PROCEEDINGS BOOK

FIRST INTERNATIONAL CONFERENCE ON NATURAL SCIENCES, MATHEMATICS AND TECHNOLOGY

(ICNSMT-2023)

Durrës, May 26, 2023

Organized by

Faculty of Information Technology and Faculty of Professional Studies,

"Aleksandër Moisiu" University of Durrës

in collaboration with

Durrës Port Authority, "Aleksandër Xhuvani" University of Elbasan,

Polytechnic University of Tirana, University of Tirana, Crystal System,

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International Conference on Natural Sciences, Mathematics and Technology

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ACKNOWLEDGMENTS

The first International Conference on Natural Science, Mathematics and Technology, was held on May 26th, 2023 in Durres, Albania. The purpose of the conference was to bring together all students, doctoral students, academics, engineers and scientists from different countries to discuss theoretical and practical issues in all fields of natural sciences, mathematics and technology. The main topics included areas such as Geosciences, Information and Technology, Mathematics, Medical Sciences, Natural Sciences and Navigation Sciences.

This conference was held as a hybrid conference, through which the attendees were able to follow the conference either virtually or by visiting the physical premises of "Aleksander Moisiu" Durres University.

We want to thank all the participants and especially our guests of honor. A special appreciation for all our colleagues and students who supported us in this conference. Your participation was significant and valuable to this activity. We do acknowledge the cooperation and trust of all participants and collaborators.

We express our gratitude to everyone, looking forward to seeing you at the next conference!

Thank you to everyone!

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Some hydrochemical data of groundwater in the Përmet-Delvinë region

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Abstract

The study of the chemical composition of groundwaters is very important to determine their origin, flow and quality. In this paper will be given some data on the chemical composition of groundwater in the Përmet - Delvinë region. The Përmet - Delvinë region is located in the southern part of Albania, and is one of the main groundwater basins. The region is part of the Kruja and Ionian tectonic zones. Based on the geological and hydrogeological map of the region (scale 1:200 000), the main aquifer complex belongs to the carbonate formacion. The carbonate formation are found in Sarandaporo - Melesin - Lengatic anticlinal belt (Kruja tectonic zone) and Nëmerçkë - Trebeshin, Lunxheri - Bureto, and the Mali të Gjerë anticlinal belt (Ionian tectonic zone). In the carbonate formations is very developed the phenomenon of karst which has conditioned a lower surface flow and very developed underground flow. This has conditioned the emergence of a large number of important springs throughout the region. A total of 16 water samples taken from 10 main springs were analyzed for major dissolved components. Analyzes have shown that the groundwater have lower hardness and the ion relation of the springs water generaly are HCO_3 - Ca and HCO_3-SO_4-Ca which indicate typical waters of infiltration. The thermal spring of Benja in Langarica river valley have ion relation Cl - Na type with temperature that varies from 23-30^{0}C.

Key words: Përmet – Delvine, Groundwater, thermal springs, carbonate

1. INTRODUCTION

The study of the chemical composition of groundwaters in Përmet - Delvinë region has special importance due to the presence of a large number of springs with significant flow, which are used for water supply to inhabited areas. The thermal springs that emerge in Sarandoporo and Benjë also have

particular significance in this region, as they are an important tourist attraction. The study of the chemical composition of groundwaters aims to determine the chemical interaction of the water with the lithological environment through which it circulates, as well as to assess its suitability for drinking water. The Përmet - Delvinë region is located in the southern part of Albania, bordering Greece to the south and east, and city of Sarandë to the west. To the north, it extends into the Kurvelesh massif. The region is predominantly characterized by mountainous relief, with the main mountain belts Trebeshin-Dhëmbël-Nëmerçkë, Shëndelli-Lunxheri-Bureto, and Mali i Gjerë-Kurvelesh. These mountain ranges are divided by the valleys of the Vjosa and Drinos rivers, as well as the Lengarice and Suhe canyons, forming narrow and deep gorges such as the Këlcyra Gorge, the Selca Gorge.[1]

1.1.Geological Construction

The Permet - Delvine region is located in two tectonic zones, the Kruja zone (western subzone of Tomorr) and the Ionian tectonic zone (subzones of Berati and Kurvelesh). Carbonate deposits in the Kruja tectonic zone build the Sarandaporo – Melesin - Lengatic anticlinal structures. These deposits emerge into the surface in Leskovik area and in the Langarica canyon. The flysch deposits of lower and middle Oligocene age fill the synclinal structure of Permet (Fig.1) [2].In the Ionian tectonic zone, the oldest deposits are Triassic evaporates that emerge into the surface in Dhrovian. Carbonate deposits in the Ionian tectonic zone, with age from upper Triassic to the Eocene. These deposits built the Nemercke-Trebeshin, Lunxheri-Bureto and the Mali i Gjerë anticlinal belt. During the Oligocene is done the transition from carbonate deposits to flysch deposits, which fill the synclinal structure of Drinos - Memaliaj. (Fig.1) [2].

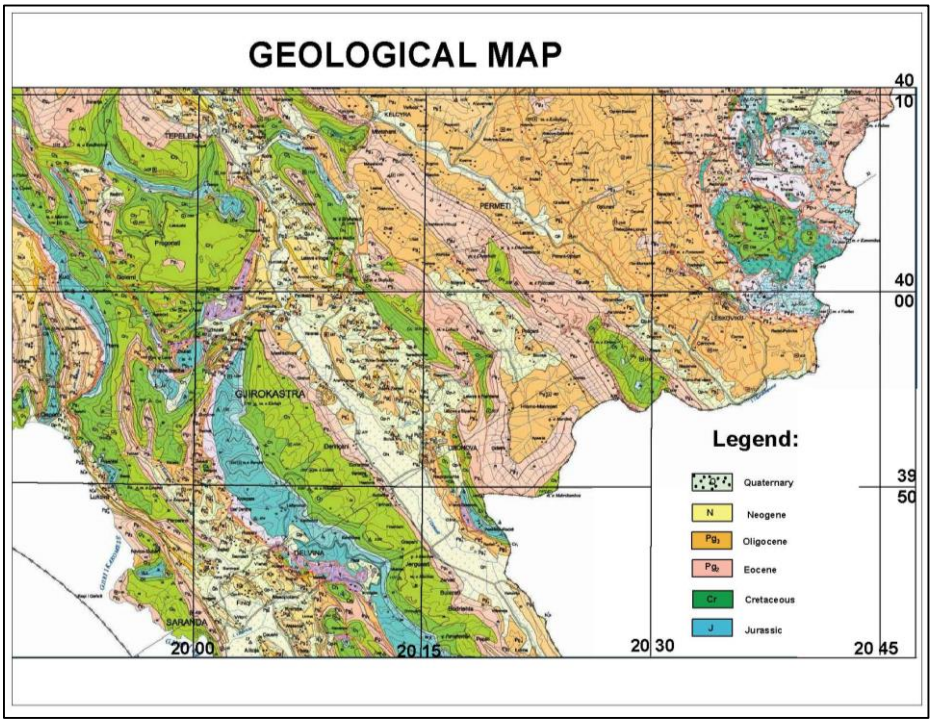


Figure 1: *The Geologic map of Përmet – Delvin region (1:200 000 Albanian Geologic Survey)*

1.2. Hydrogeological Characteristics

Based on the geological and hydrological map (Fig 1, 2), the carbonate formation are the most significant water complex in the study area. In the eastern part of the region, within the Kruja tectonic zone, the carbonate formations are covered by flysch formation. Along the Melesin-Postnam structural line, emerge the thermal springs of Sarandaporo in the south and Bënja in the Langarica river valley to the north [3]. Towards the west of this structural line, the carbonate formation built the Nëmerçkë –Trebeshin, Lunxheri-Bureto, and the Mali i Gjerë anticlinal structure that have a large groundwater reserves (Fig.2).

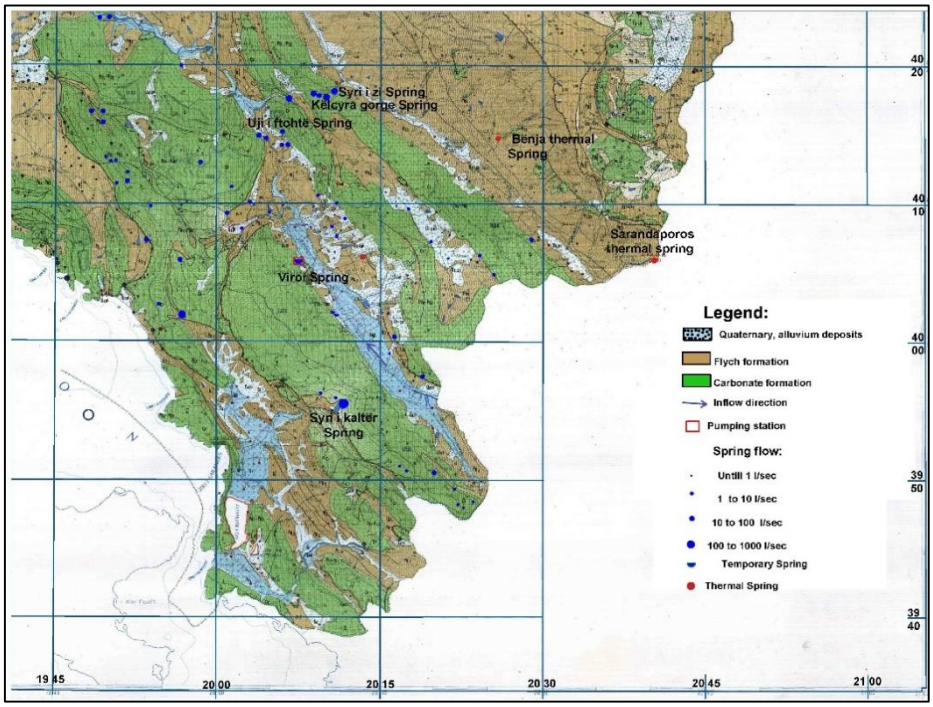


Figure 2: *The hydrogeological map of Përmet – Delvin region (1:200 000 Albanian Geologic Survey)*

The Trebeshina and Shëndëlli anticlinal structures are interrupted by the Vjosa River valley and forming the Këlcyra gorge where several springs emerge on the left side of the Vjosa River (Photo.1) and the Trebeshinë spring on the right side.

Photo 1: *The Gryka e Këlcyrws (1) and Syri i zi (2) spring (Dh. Ndreko 2023)*

The Lunxheri-Bureto anticlinal structure have large groundwater reserves due to this a large number of springs emerge from it, such as the Glina spring (flow 1.8 – 4.0 l/s) [8] and Nepravishta spring (flow 150 l/s) [3], as well as several smaller springs (Fig.2). The Mali i Gjerë massif have a total surface area of 440 km^2 and a maximum elevation of 1798 meters above sea level, is one of the most important carbonate aquifers, from which numerous springs emerge. In the eastern slope, near the city of Gjirokastër emerge the Viroi spring, characterized by variable flow. During rainfall periods the flow is 35 m^3/s [4] [5] (Photo.2), while in summer the spring dry out.

Photo 2: *Viroi spring (Dh. Ndreko 2023)*

On the western slope of the Mali i Gjerë emerge one of biggest spring of the study region the Blue Eye (Bistrices) spring (average flow of 18.3 m^3/s) (Photo 3) [3] [4].

Photo 3. *Syri i Kaltër (Bistrica) spring (Dh. Ndreko 2023)*

Quaternary deposits are also an important aquifer complex, spread mainly in the river valleys of the Vjose and Drinos rivers. The Uji i Ftohte Tepelene spring that emerge on the right side of the national road Tepelene - Gjirokastër from massif of Kurvelesh, it has a flow that varies from 70-250 l/sec [3] (Photo.4).

Photo 4. *Uji i Ftohte Tepelene spring (Dh. Ndreko 2023)*

In general, the morphology of carbonates is characterized by the presence of the phenomenon of karst, forming forms such as crèches and ribs, funnels, caves, corridors, chimneys, which serve as pathways for the movement of

groundwater. Making the carbonate massifs characterized by a weak surface hydrographic network, while the underground one is quite developed. Depending on the karst development in the carbonate formation, karst aquifers are characterized by the heterogeneity of groundwater flow [7]. Based on [6], the groundwater flow in the karst aquifers is made into channel flow or diffuse flow.

2. MATERIALS AND METHODS

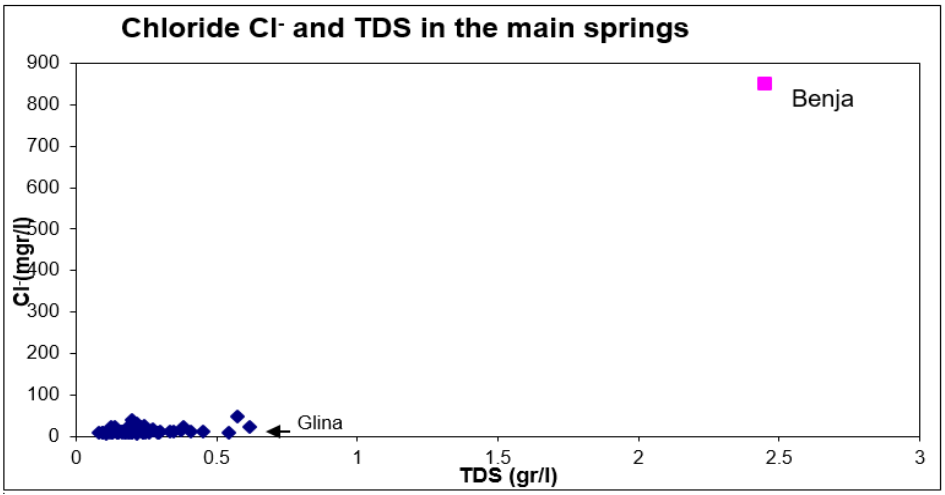
To determination of the chemical composition of groundwater in the Permet-Delvine region, field measurements of temperature and pH (Photos.5) have been conducted. The water samples collected have been analyzed for the content of the main ions Na^{+}, Ca^{+2}, Mg^{+2}, Cl^{-}, $SO4^{-2}$, HCO_3^{-}.

Photo 5. *Fied work and water samples 1.3 Benja thermal spring, 2 Syri Kaltër spring, 4 Uji ftohtë spring (Dh. Ndreko 2023)*

3. RESULTS AND DISCUSSIONS

Based on the chemical analysis of water samples from 10 main springs in the study region, it can be concluded that the groundwater in the area exhibits low total dissolved solids (TDS) concentrations, with values up to 0.25 g/liter. This characteristic is observed across the majority of the groundwater sources, including springs in the northern region of Libohova (Lunxheri zone), Uji ftohtë Tepelenë (Kurvelesh massif), and the Viroi spring on the eastern slope of Mali i Gjerë. These springs have common features such as low temperatures (11-12°C), low hardness, and low concentrations of sulfate ions (SO_4^{-2}), typically ranging from 10-11 mg/l. The pH values of the water samples vary within the neutral range, from 7 to 7.8. The prevailing hydrochemical type of the groundwater is characterized by bicarbonate and calcium ions (HCO_3-Ca), indicating the presence of typical infiltration waters. This is supported by the chloride ion concentrations and the overall low TDS values (Graph.1).

Graph 1. *Relation between Cl^- and TDS in the main spring (Dh. Ndreko 2023)*



Based on the analysis of the chemical composition of groundwater, notable variations are observed in the Glinë, Trebeshinës, and Syri i Kaltër springs compared to other springs in the study region. These particular springs exhibit higher concentrations of total dissolved solids (TDS) and sulfate ions. The Glinë spring is characterized by a chemical type of SO_4-Ca, while the Trebeshinës and Syri i Kaltër springs display a chemical type of HCO_3-SO_4-Ca. According to reference [5], the elevated levels of sulfate ions in the Syri i Kaltër spring can be attributed to the influence of water from the Drinos River, which serves as a source zone in the southeastern part of Mali i Gjerë. The thermal springs of Bënja, found on both sides of the Langarica river Valley,

are characterized by high TDS values and a hydrochemical type of Cl-Na. Furthermore, temperature measurements in the thermal springs of Bënja (Photo.5) indicate that the springs on the right side of the river valley have lower temperatures compared to the springs on the left side.

4. CONCLUSIONS

Based on the results of the chemical analysis, it can be concluded that the majority of groundwater in the study region has low total dissolved solids (TDS) concentrations, indicating that atmospheric precipitation and surface water serve as the primary sources for groundwater, also indicate a significant velocity of groundwater flow, which is influenced by the development of karst phenomena.

The presence of elevated sulfate ion concentrations in the Glinë and Trebeshinës springs suggests the possible circulation of groundwater through gypsum-bearing formations. Gypsum is a mineral that contains sulfate ions, and its dissolution can contribute to the increased sulfate content in the groundwater. The elevated levels of sulfate ions in the Syri i Kaltër spring can be attributed to the influence of water from the Drinos River, which serves as a source zone in the southeastern part of Mali i Gjerë.

The variations in temperature observed in the Bënja thermal springs, indicate different flow paths and travel times for the groundwater before reaching the surface. Specifically, the thermal springs on the right side of the river exhibit a longer flow path compared to those on the left side. This difference in flow path can is attributed to the geological characteristics and the karst processes. The thermal springs on the right side may possibly interacting with infiltration waters along the way.

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The kinematic slopes stability analysis along the segment Pus Mezini-Kanine

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Abstract

The kinematic slope stability analysis along a road segment is crucial for road design and maintenance. This paper is to analyze the kinematic stability of slopes along the segment Pus Mezini-Kanine based on on-site investigation and the identification of the joint sets and their characterization. The segment from Pus Mezin to Kanine is located on molasse deposits, with relatively weak physicomechanical properties which have shown geologic-engineering problems, especially regarding the stability of the slope. The analysis was carried out by processing the data in the stereographic projection using the equal area net known as the Schmidt net. The results of the analysis indicate that the same slopes along the road segment have varying levels of stability, with some sections showing susceptibility to slope failure. The analysis also identifies potential failure modes, including planar, flexural, and wedge failures. Based on these findings, the study recommends the implementation of mitigation measures, such as slope reinforcement and stabilization. The methodology used in this study can be applied to other road segments or slope stability analyses in different settings. In conclusion, the kinematic slope stability analysis along the segment Pus Mezini-Kanine provides valuable insights into the stability of slopes along this segment to reduce the risk of slope failure and enhance road safety.

Key words: kinematic, slope, stability, analysis.

1. INTRODUCTION

This paper relates to the fact that the road project of this segment has encountered geological engineering problems during its construction. These problems have also led to an increase in costs and delay in the time limits of its completion, and for this reason, have been monitored throughout the time

of the work's construction. During this monitoring, all the necessary data for the massive rock classification of the problem areas, in terms of slope stability are collected. The study is based on identifying the joint sets and their characterization, geological descriptions, and all the standards for identifying the joint sets. For the classification and evaluation of the massive rock across the segment, used RMR (Rock Mass Rating) classification, Beniawski (1976, 1989) [1] and the GSI classification (Geological Strength Index), Hoek-Brown (1998) [2]. The segment from Pus Mezini to Kanina passes through molasses deposits represented by flysch and flyschoidal deposits, which in the classification of rocks according to the geological-engineering map of the Albanian enter into the group of rocks are weak. This is one of the reasons that during the opening of the route, the movement of rock masses along this axis of the road was activated. After the classification of the rock massif, the kinematic analysis of the stability of the slopes was performed using the DIPS software ("Open Source" produced by Rock Science) [3].

2. MATERIALS AND METHODS

The study area is located north of the city of Vlora, in the villages of Babic e Madhe and Kanina. From the physical-geographical and geomorphological point of view, the region of the route area represents a hilly relief to the east of the city of Vlora, and the route of the road is designed mainly on the eastern side of the axis of the highest ridges of the hills in a north-south direction. (*Figure 1*).

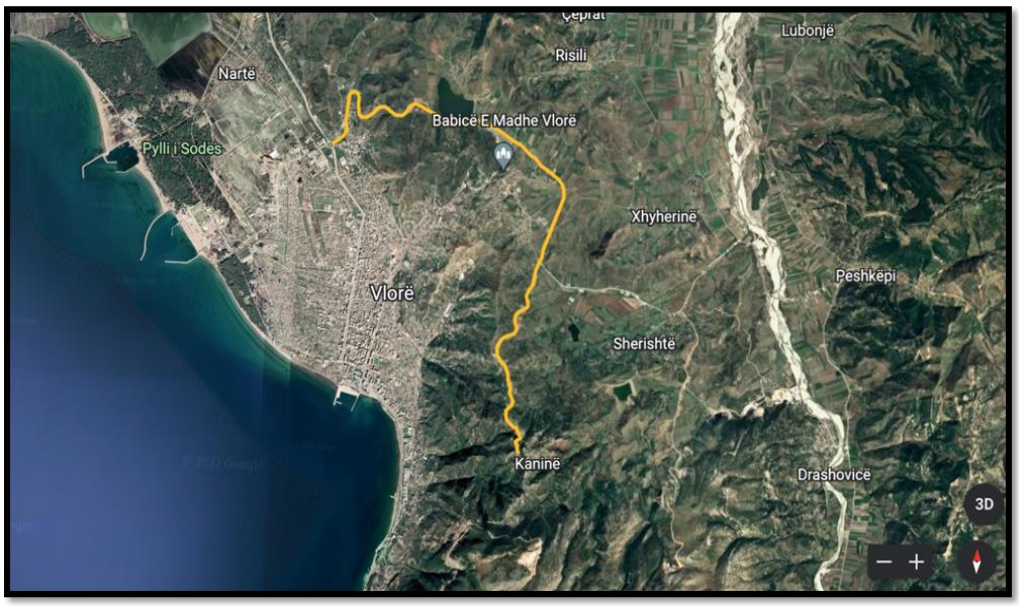

Figure 1: *The route of the segment from Pus Mezini to Kanina (google earth)*

Geologically, this segment is represented by Neogene deposits of Acutanian (N11a), Burdigalian ($N_1^1{}_b$), Messinian ($N_1^3{}_m$), Lower Pliocene ($N_2^1{}_{-h}$), Upper Pliocene ($N_2^2{}_{rr}$), and Quaternary deposits (Qp-h). (Figure 2) [4].

The route in this segment passes mainly through the molasse deposits of the Messinian and as a result of the conditions of the lagoon environment of the respective facies and the opening of the route, we have the negative effects of the geological-engineering conditions such as the presence of landslides on the right slope of the route especially in the intervals of station no. 4,5,6,7. (Figure 3.)

To determine the geological-engineering conditions in the Pus Mezini - Kanin segment, the geological-engineering survey of the road action was carried out. At each point where it was considered reasonable, an observation station was taken and the following characteristics are described: 1) The measurement of the parameters necessary for the classification of the rock mass "RMR", such as the Uniaxial compressive strength of the intact rock and the field assessment of Rock Quality Designation (RQD); 2) Structural elements of the rock layers (strike, dip direction, and dipping angle); 3)The slope direction and dipping angle of the slope;4) Rock type, description of the lithology, and morphometric characteristics of the strata. The number of investigated stations is 10. (Figure 3)

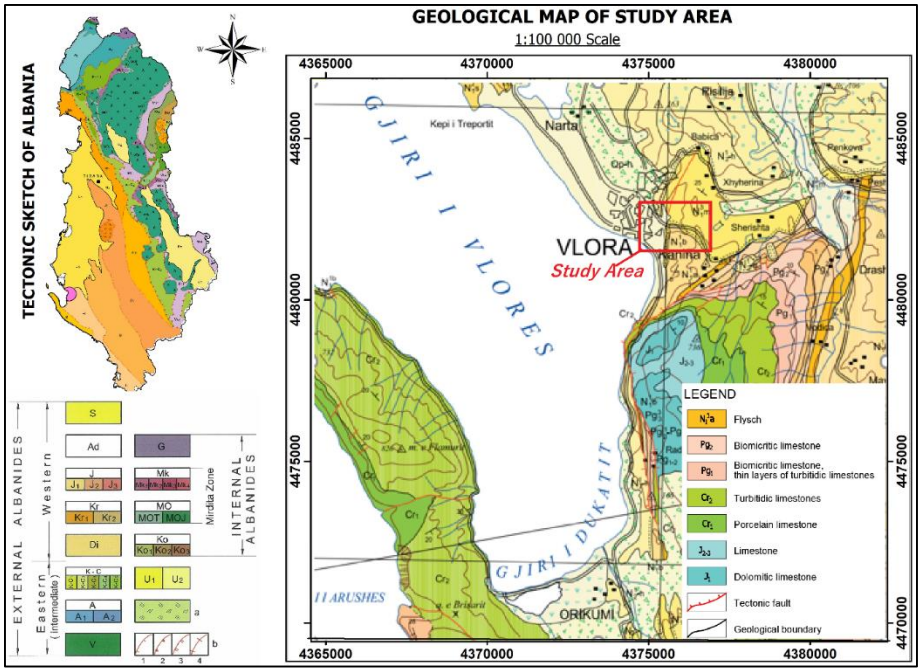

Figure 2: *Geological map of the study area*

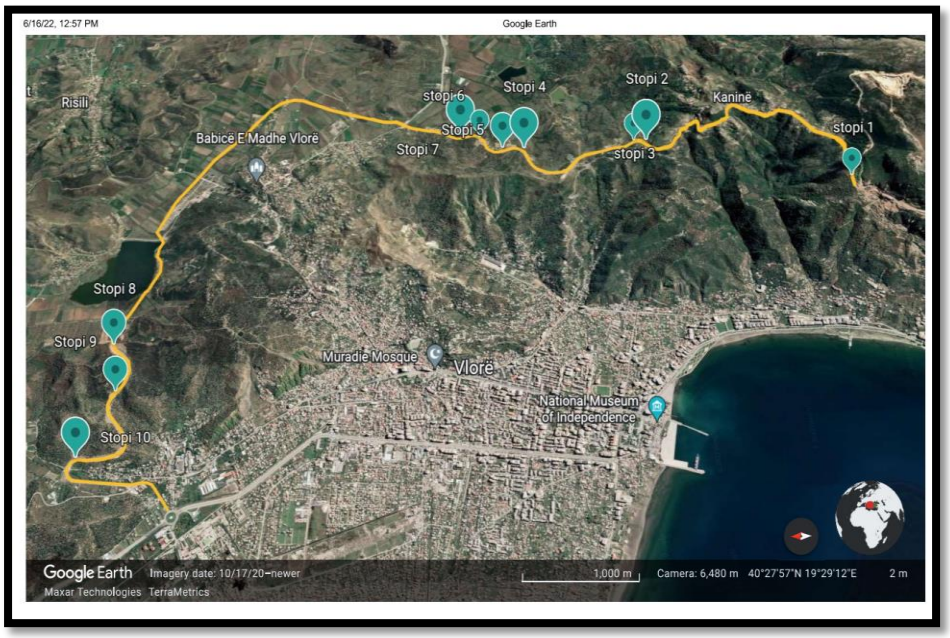

Figure 3: *Geographical position of the observation station (google earth)*

Based on the RMR (Bieniawski, 1976 1989), the rock mass is classified in Class III of the RMR system, suggesting the following shear strength parameters: cohesion 200-300 KPa and friction angle 25^0-35^0, [1]. These values are used for performing the kinematic analysis of slope stability. Based on the GSI classification (Geological Strength Index), the physical-mechanical characteristics of these formations do not depend on the characteristics of the rock, but on the fractured state of the massif and the conditions of contacts or discontinuities. The evaluation of the mass physical-mechanical characteristics of these formations was done using the Hoek-Brown Classification of rocks as follows:

The uniaxial compressive strength (UCS) of fresh rock is estimated based on the type of rock and its response to scratches and external impacts with a geologist's hammer. This assessment was made using the RocData Program developed by RockScience [3] by selecting the type of flysch rock and the respective response to scratches and external shocks with the geologist's hammer. The value used in the calculation is UCS = 30 Mpa.

Geological Strength Index (GSI). This indicator depends on the rock type (lithology), structure (deformation), and fractured state or contact conditions. The data included in the calculation is a clayey-siltstone dominated and interlayered sandstone, tectonically relatively calm and with weak contact conditions. GSI value = 20.

The modulus of elasticity of the fresh rock was calculated using the relationship between the uniaxial compressive strength and the modulus of elasticity according to the relationship Ei= MR*sigci; where MR is a coefficient that depends on the rock type. The value of MR in the case of flysch rocks is MR=200.

The Shear Resistance parameters according to the Mohr-Coulomb criterion for calculating the stability of the slope and the pressure on the protective works of the massif were calculated considering a vertical slope with a height of 30 m.

Below we present in tabular form the parameters for the Hoek-Brown classification for the massif in natural conditions (before excavation for the opening of the route) and the parameters in artificial conditions of the massif (after excavation). For the classification in artificial conditions, the coefficient of external excitation has been set for the case of digging with mechanical means (D=0.7):

Table 1: *Hoek-Brown classification*

Hoek-Brown classification	
Natural conditions	**Artificial conditions**
Hoek-Brown Criterion	
• mb 0.344596 • s 0.000137913 • a 0.543721	• mb 0.0739886 • s 9.21938e-006 • a 0.543721
Failure Envelope Range	
• Application Slopes • sig3max 0.542924 MPa • Unit Weight 0.023 MN/m3 • Slope Height 30 m	• Application Slopes • sig3max 0.503347 MPa • Unit Weight 0.023 MN/m3 • Slope Height 30 m
Mohr-Coulomb Fit	
• c 0.122116 MPa • phi 36.137 degrees	• c 0.0623175 MPa • phi 23.1735 degrees
Rock Mass Parameters	
• sigt -0.0120065 MPa • sigc 0.23886 MPa • sigcm 1.85042 MPa • Erm 274.03 Mpa	• sigt -0.00373816 MPa • sigc 0.0548687 MPa • sigcm 0.798037 MPa • Erm 159.163MPa

The shear resistance parameters are used for the kinematic analysis of the massif.

3. RESULTS AND DISCUSSIONS

To perform a kinematic slope stability analysis, we need to consider the geometry and orientation of the joint sets and stratification planes, as well as the mechanical properties of the rock mass. We will analyze three types of failures: planar failure, wedge failure, and toppling failure. The analysis will be based on the assumption of a two-dimensional problem in which gravity acts perpendicular to the plane of the slope. The analysis was carried out by processing the data in the stereographic projection using the equal area net known as the Schmidt net.

The rock mass is classified in Class III of the RMR system, suggesting the following shear strength parameters: cohesion 300 KPa and friction angle 30^0, [1] . These values are used for performing the kinematic analysis of slope stability.

By processing the stereographic projections of field measurements, it results that in the study area, the joint system consists of 3 joint sets with the following structural elements. (Table 1, Figure 4).

Table 1: *List of the major joint sets in the study area*

J ID	Description	Dip direction	Dip angle
Joint set 1	Stratification plans	N 150^0	30^0
Joint set 2	Persistent fractures	N 202^0	70^0
Joint set 3	Fractures approximately parallel to the strike of the layers	N 296^0	70^0

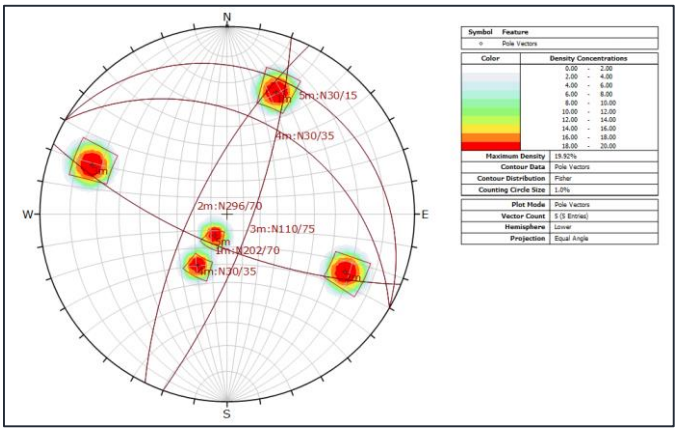

Figure 4: *Stereographic representation of the main joint sets*

The necessary structural conditions for rock failures are as follows:

For planar slides (failures):

i. the dip direction of the planar discontinuity must be within 20 degrees of the dip direction of the slope face;
ii. the dip of the planar discontinuity must be less than the dip of the slope face and thereby must "daylight" in the slope face; [5].
iii. the dip of the planar discontinuity must be greater than the angle of friction on the surface.

For wedge slides (failures):

i. trend of the intersection line between two joints must approximate the dip direction of the slope face,
ii. the plunge of the intersection line must be less than the dip of the slope face
iii. the dip of the slope face must be greater than the angle of friction on the surface.

For toppling failure:

i. the strike of the layers must be approximately parallel to the slope face (+-20 degrees),
ii. the dip of the layers must be into the slope face,
iii. the normal to the toppling plane must have a plunge less than the inclination of the slope faceless the friction angle of the surface [6]

Once we plotted the joint sets on the stereonet, we analyzed the potential failure modes of the slope. For each failure mode, we check if there is a potential failure plane that intersects with any of the joint sets. If there is, then the slope is potentially unstable in that mode.

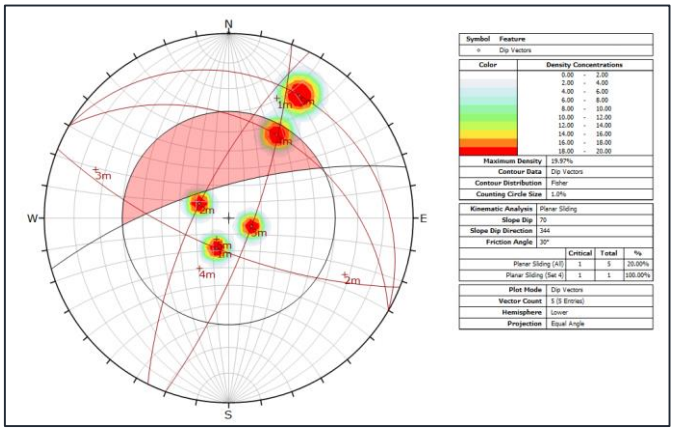

Figure 5: *Kinematic slope stability analysis for planar failure*

From the stereographic analysis for plane failures, the possibility of having a planar slide is 20% and according to joint set 4, it is 100% (Figure 5). This

suggests that the orientation and properties of the joint set 4 have a significant influence on the likelihood of a planar slide occurring.

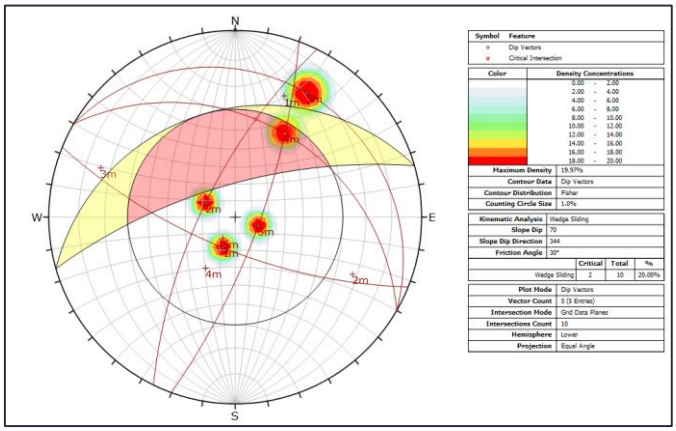

Figure 6: *Kinematic slope stability analysis for wedge failure*

From the stereographic analysis for wedge failures, the possibility of having a wedge slide is 20%. This suggests that the orientation and properties of the planes involved in the wedge play a significant role in determining the likelihood of a wedge slide occurring.

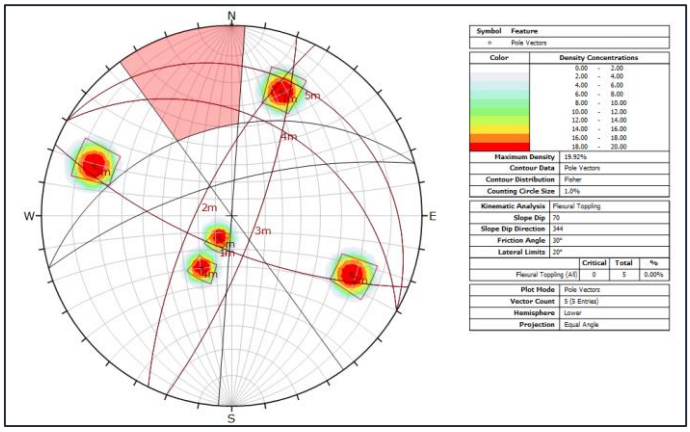

Figure 7: *Kinematic slope stability analysis for flexural toppling*

From the stereographic analysis for flexural failures, the possibility of having a flexural toppling is 0%. This indicates that the orientation and properties of the planes involved in flexural failure are not conducive to this type of failure mechanism.

4. CONCLUSIONS

The kinematic analysis of massive rock, in combination with the stereographic analysis of the planes and joints involved in different types of slope failures,

can provide important insights into the potential modes and directions of failure, as well as the critical parameters that control failure. Overall, these conclusions highlight the importance of combining different types of analyses, such as stereographic analysis and kinematic analysis, to gain a better understanding of the potential failure modes and critical parameters of massive rock slopes. This information can then be used to design appropriate stabilization or protection measures to mitigate the risks and ensure safe and sustainable use of the slope. The segment from Pusi i Mezin to Kanina is located on molasse deposits, with relatively weak physical-mechanical properties which have shown geological-engineering problems, especially in relation to the stability of the escarpments. Since we are dealing with a built work, it can be observed that along the axis of the road, there have been falls of different types and sizes which confirm the results of the kinematic analysis done.

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Analysis of the integration of polymer injection for oil production in the Patos Marinez field. An approach with regression analysis

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Abstract

The largest amount of world oil production is the result of the application of chemical injection methods. The purpose of this study is to present the injection scheme, modeling curves and regression analysis for the type of production with the polymer injection method, specifically for wells 5647, 5415, 5467 of the Patos-Marinez Field. The method used in this study is the regression method. Data from October 2014 to September 2021 was obtained from Bankers Petroleum. The results achieved by the injection of polymers are quite satisfactory because they ensure a high coefficient of oil extraction at low cost and directly affect the preservation of the subsoil. Polymer injection in the Pato-Marinza field is a very promising technique in the future for a superior and long-term economic activity for the oil company Bankers Petroleum.

Key words: Polymer solution, regression analysis, oil extraction coefficient

1. INTRODUCTION

The field of Patos-Marinëz is located in the central-southern part of Albania, east of the city of Fier. It is the largest field on land in Europe with estimated geological reserves (5.1 billion barrels) discovered in 1928 by APOV (Anglo Persian Oil Company) and started production in 1939 reaching peak production in 1950.[3] The main sources of natural energy in a hydrocarbon zone are water and gas, which move the oil from the formation to the production wells. More often than not this process contributes only a small part of the country's crude oil production. Thus, various recovery techniques have been developed and invented over the past few decades to increase oil recovery.In Albania, polymer

injection was applied for the first time by the Bankers Petroleum Company in 2013 in the Patos-Marinze well. Initially, pilot studies were carried out in 3 injection plots in the Driza and Marinza layers.[3] The results obtained were very encouraging, production increased by 4.7% compared to the quarter of the previous year. After these very good results the company expands the field of injection use by drilling new production wells and converting current production wells to polymer injection wells[3]. The oil-bearing formation where the company injects the polymer is the Driza formation, object of exploitation D^5Polymers are mainly used for increasing viscosity, flocculation, breaking emulsions and for blocking areas with high permeability in the reservoir to increase oil production. [9] The types of polymers most commonly used in the petroleum industry are partially hydrolyzed polyacrylamides. Bankers currently uses Flopam 3630 polymer because of its low cost. [3]
This study will provide an overview of polymer injection molding including advantages, screening criteria and development processes and field evaluation with regression analysis.

1.1. Schematic of injection of polymer solution

Injection schemes mainly consist of one injection well and two production wells, illustrated in the figure below: [3].

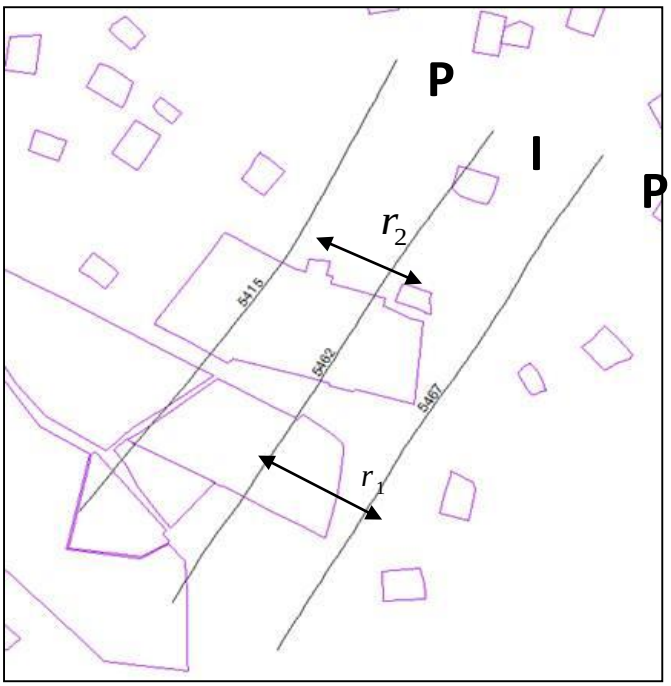


Figure 1: *Polymer injection scheme (Bankers Petroleum development plan)*

1.2. Creation of the polymer solution

The polymer solution is created in a plant that has been designed and built for this purpose. The plant serves to mix the powdered polymer with water thus forming a viscous liquid - with certain parameters based on the technical specifications for injection into the tank.The following figures show the plant for the preparation and transport of the polymer solution.[3].

Figure 2: *Polymer Preparation Plant (photo by Bankers Petroleum)*

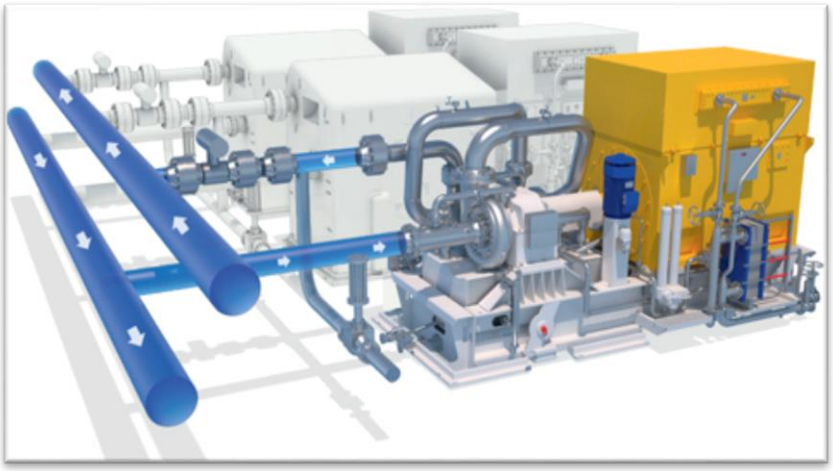


Figure 3: *Polymer transport (according to Bankers Petroleum development plan)*

A pump is installed in each injection well that serves to inject the solution into the reservoir according to Figure 3. The base solution, after being transported through the pipeline to the injection well, is diluted to meet the technical specifications of the well injection. tank. [3] The injection process uses tanks of fresh water to mix the polymer as well as a high-pressure pump to increase the pressure of the solution.The last step before the polymer is injected into the well is the dilution of the polymer solution. The device that dilutes the solution also serves to increase its pressure before the solution is injected into the well.[3]

2. MATERIALS AND METHODS

The data from October 2014 to September 2021 were obtained from the oil company Bankers Petroleum Albania Ltd. The method used in this study is the regression method which is expressed by equation 1:[10]

$$Y = \beta_1 + \beta_2 x \qquad \text{Eq.1}$$

where: Y – dependent variable, x – independent variable, β_1- coefficient cutting the y axis, β_2-slope coefficient.

To determine the polymer flow characteristics in the porous space is the Screen Factor coefficient, which can be written mathematically: [1]

$$screen\ Factor = \frac{[\Delta\ time]_{polymer\ solution}}{[\Delta\ time]_{water}} \qquad \text{Eq.2}$$

$$Screen\ Factor = \frac{q_{water} * \Delta P_{polymer}}{q_{polymer} * \Delta P_{water}} = \frac{[\Delta P/q]polymer}{[\Delta P/q]water} \qquad \text{Eq.3}$$

Assuming that oil and water flow simultaneously through a segment of the porous medium, the flow of crude oil f_o, and water, f_w, are given by both Equation 4 and Equation 5 [4]

$$f_o = \frac{1}{1+\frac{\mu_o k_{rw}}{\mu_w k_{ro}}} \qquad \text{Eq.4}$$

$$f_w = \frac{1}{1+\frac{\mu_w k_{ro}}{\mu_o k_{rw}}} \qquad \text{Eq.5}$$

$\mu_o$viscosity of oil, $\mu_w$viscosity of water, k_{rw} relative permeability of water, k_{ro}relative permeability of oil

Any change of ratio $\frac{\mu_w k_{ro}}{\mu_o k_{rw}}$ will lead to an improvement in fluid recovery. The mobility ratio of an injection is the main determinant of the flushing efficiency of the area for a given well space and pattern and is defined in Eq.6 as:[4]

$$M = \frac{\mu_o k_{rw}}{\mu_w k_{ro}} \quad \text{Eq.6}$$

M -Fluid mobility ratio

3. RESULTS AND DISCUSSIONS

Polymers, when added to water, have the ability to increase the viscosity of water (μ_w). To see how the increase in viscosity through polymer concentration affects the increase in oil production, look at figure 4.

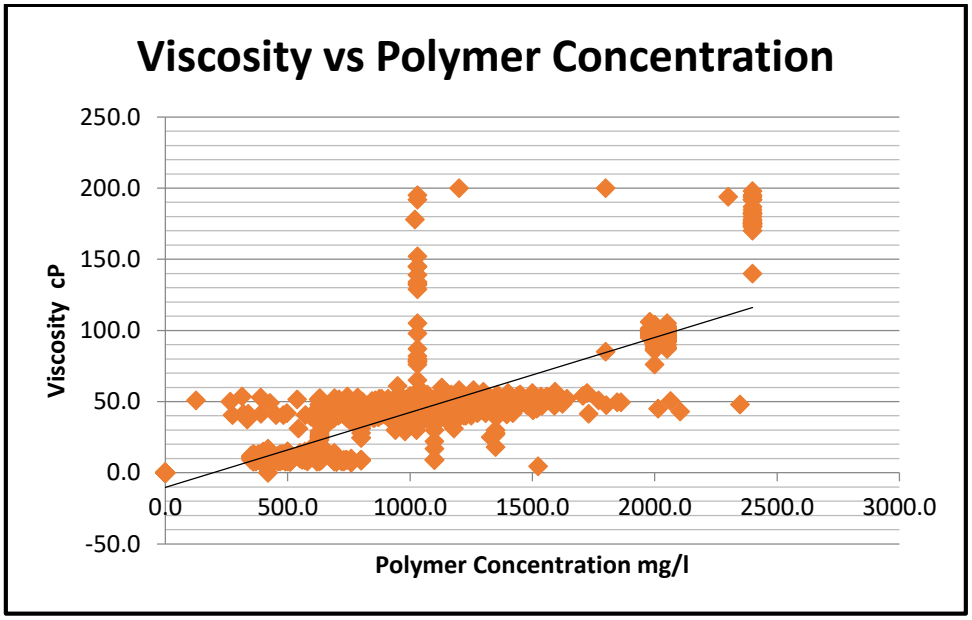


Figure 4: *Graph of Viscosity and Polymer Concentration, Source Bankers (by the author)*

It is observed that there is an increase in viscosity at each concentration as we go from lower to higher molecular weight. Since these polymers cost more or less the same, there is a tendency to use the polymers with the highest possible molecular weight. Unfortunately, the reservoir itself can limit the size of the polymer that is injected, as the higher molecular weight of the product will reduce the pore entry space. When this happens, polymer injection causes the reservoir to shrink, excluding smaller pores from injecting fluid.

Chart 1: *Analysis of oil production (by the author)*

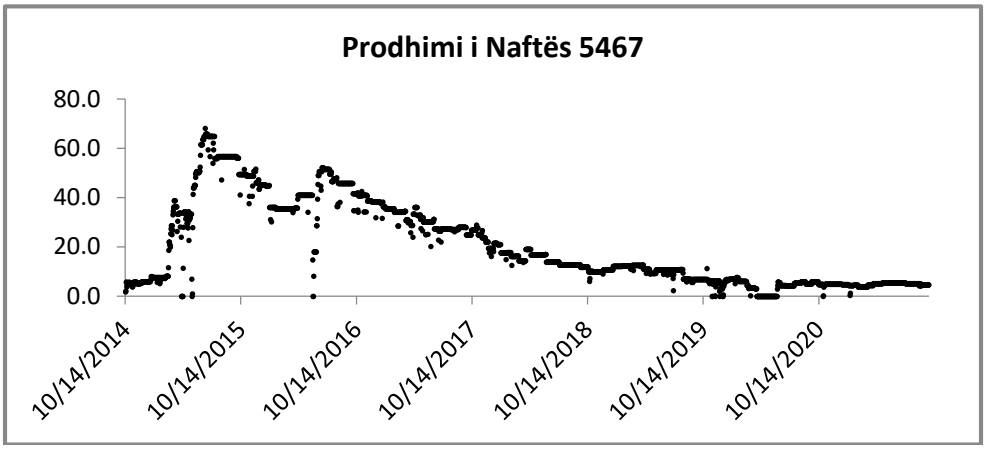
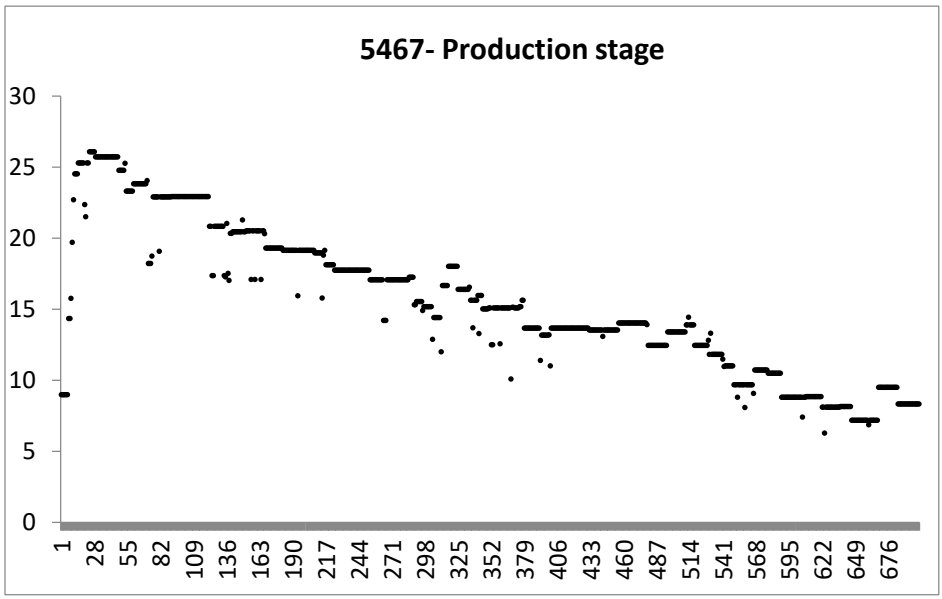


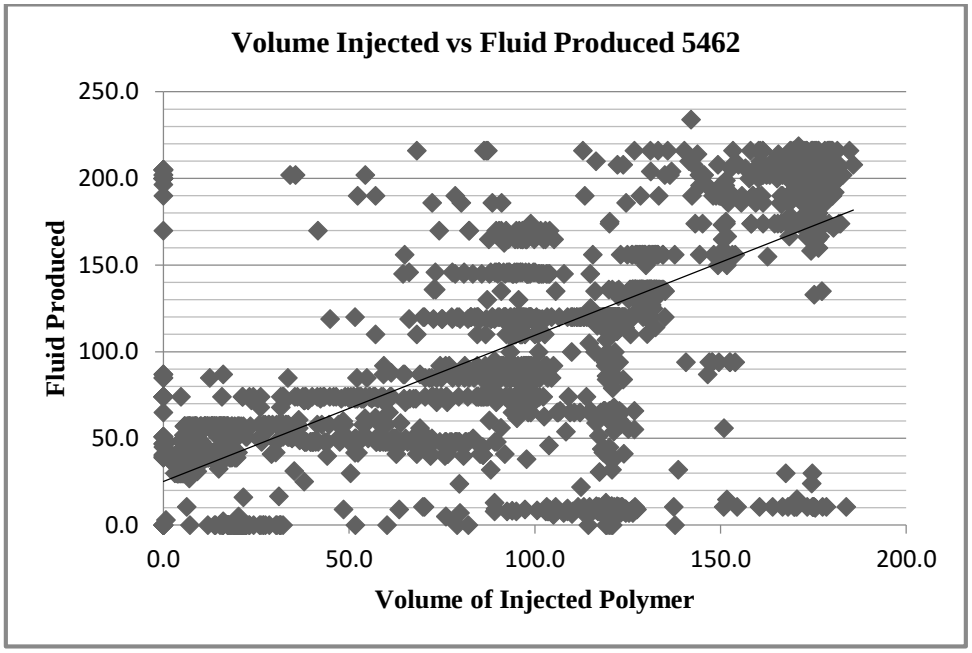
Chart 2: *Production stage for well 5467 of the Patos-Marinez well (by the author)*

0	Day to save the trend	Radius from Injector	Production decline
	day	m	
5467	694	106	3.627



Formation	Layer Pressure	Depth	Viscosityi	Injection Pressure	Polymer Concentration	Injected Volume	chlorides	FGN	Density of Oil	Oil Viscosity 30°C
	Mpa	m	cp	psi	ppm	m3/d	mg/l	m3N/m3	g/cm3	cp
D3	8	1384	50	500	2000	80	3010	17.32	0.996	4401

Graph 3: *Regression analysis of the volume injected with the fluid produced in well 5462 (by the author)*



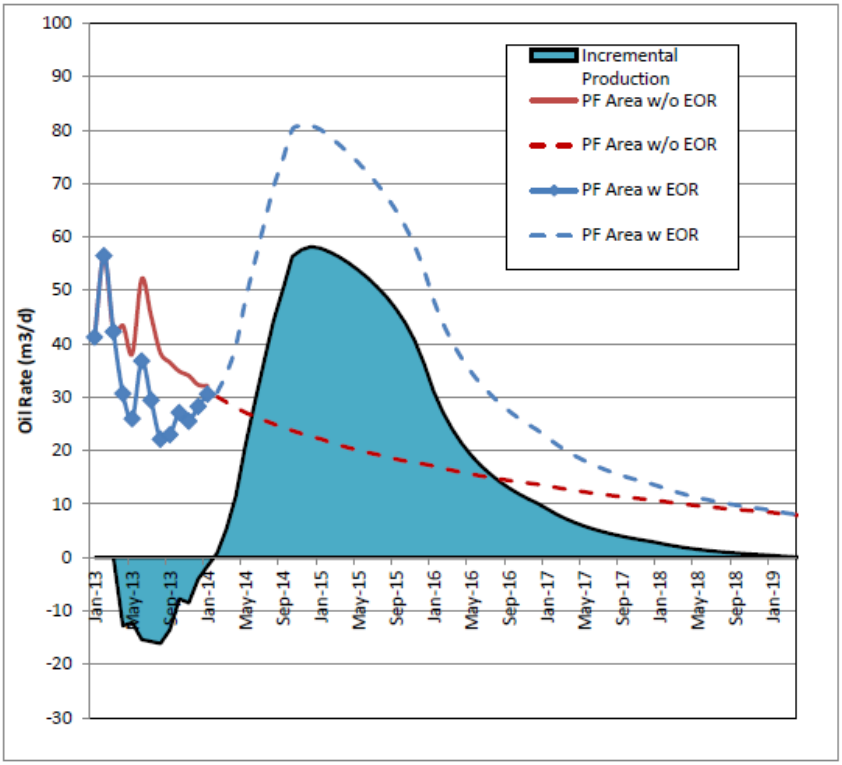
From Eq.1 we get that *Fluid Produced*=*Y* (dependent variable) [10]

$$Fluid\ Produced = 25.086 + 0.8431x \qquad \text{Eq.7}$$

$$R^2 = 0.575$$

From the regression analysis done in well 5462, namely in the period from October 2014 to September 2021, a positive relationship between the volume of polymer injected and the fluid produced (oil + water) results. From this analysis, it appears that about 58% of the changes in the amount of fluid (oil+water) produced is explained by the change in the volume of injected polymer, from which it follows that 42% are other factors that affect the fluid produced during this period.

Graph 4: *Increasing Yield of Polymer Injection in the Driza D^5 formation (according to the Bankers development plan)*



Extraction volumes and the decline in volumes before the application of polymer in the Driza formation, exploitation facility D^5 can be found in the graph above. The current model production at the exploitation facility D^5 has stabilized and the extracted oil is increasing. Both the injection and the production yield are being monitored to verify the maximum oil recovery coefficient values. We also carefully monitored: the low concentration of polymer dust according to the technological specifications, the initial response of the production wells, the duration of the maximum production, the values of the decline in production after reaching the maximum production. [3]

4. CONCLUSIONS

The use of polymer injection in the Pato-Marinza well is a successful technique in several ways for the oil company, which provides high oil recovery coefficient at low cost, ensures high oil discharge coefficient from water and directly affects subsoil conservation. Because in addition to the extraction of oil, the energy consumed by the introduction of water is also compensated. It is a very promising technique in the future for a superior and long-term economic activity for the oil company Bankers Petroleum. However, paying

more for the injected polymer and maintaining a satisfactory oil recovery rate is usually the better choice from an economic point of view.

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Comparison of soils classification based on laboratory testing and CPTU data in Quaternary deposits of Pre-Adriatic Depression

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Abstract

This paper presents the results obtained from laboratory testing and CPTU data in Quaternary deposits at Levan, Fier, as part of the Pre-Adriatic Depression. These soils are characterized by weak properties as a foundation for the construction of engineering facilities. The geotechnical investigation consisted of conventional borehole sampling, in-situ testing, and laboratory testing for the classification of these soils. In-situ testing within the soft soils, sandy soils, and silty clay consisted of piezo-cone (CPTU - Cone Penetration Test). Laboratory tests within these soils consisted of physical properties. The determined thickness of layers in both methods referred field description of soil layers during borehole drilling.
The soil layers are classified by laboratory testing according to the USCS system (Unified Soil Classification System) and by CPTU data using soil behavior classification charts proposed by Robertson (2009) [1], and updated by Mayne (2014) [2].
By comparing the results obtained in this paper from both methods, it was concluded that there is a good correlation between the Soils Behavior Type (SBT) according to CPTU results and the classification of soils in the USCS System by laboratory testing. It is noted that the silt contained in the soils from the surface to the depth is slightly greater in the CPTU results compared to the laboratory tests.

Keywords: Laboratory testing, CPTU, soils, USCS.

1. INTRODUCTION

The Later Quaternary deposits are very important to be studied, especially in cases where they are saturated present low bearing capacity and high compressibility which make them difficult foundations as they can damage the structures placed on them. The damage that can be caused challenges geological and geotechnical engineers and requires much higher costs for maintenance and repair if these soils are not identified and the geotechnical parameters are not calculated accurately in the first phase of the study.
The Quaternary deposits at the Pre-Adriatic depression are characterized by sand, clay, silt, fluvial clay, and sometimes from organic material [3].
According to seismic data, well drilling data (conducted for different purposes), and geological-lithological cross-sections designed throughout the region, the relief of the base of the Quaternary deposits has been accidental, with ridges and extended large valleys, within which hills and small pits are differentiated [4].
The identification and classification of soils are the main part of geotechnical projects. As above this paper presents the results obtained from laboratory testing and CPTU data in Quaternary deposits at the Levani site in the Fier area, as part of the Pre-Adriatic Depression.
The porpoise in this paper compares and correlates the results of the soil classification based on the classical method of laboratory testing and the In-situ CPTU test method. Accurate results for the correlation of soil classification in both methods are essential to provide cost-effective geotechnical solutions because the CPTU test provides fast results.

2. MATERIALS AND METHODS

This section describes sufficient available data and the procedure of work. The used methods in this paper are borehole drilling sampling according to ASTM, CPTU testing Fieldwork done in the study area is performed in accordance with ASTM standards [5].
The phases of the works in the study area are realized as follows:
1. Geological exploration works, drilling with disturbed and undisturbed samples.
2. Geological exploration works, in-Situ CPTU
3. Analysis of soil samples in laboratory testing;
In the site of borehole drilling, samples are taken up to a depth of 15-20 m, and laboratory testing of moisture content, bulk density, plasticity, and grain size composition, whereas these results are used for soil classification in the USCS system [6].

In the same sites where the samples were taken for laboratory testing, CPTU tests were performed for the soil classification based on the proposed SBT charts (Fig. 1).

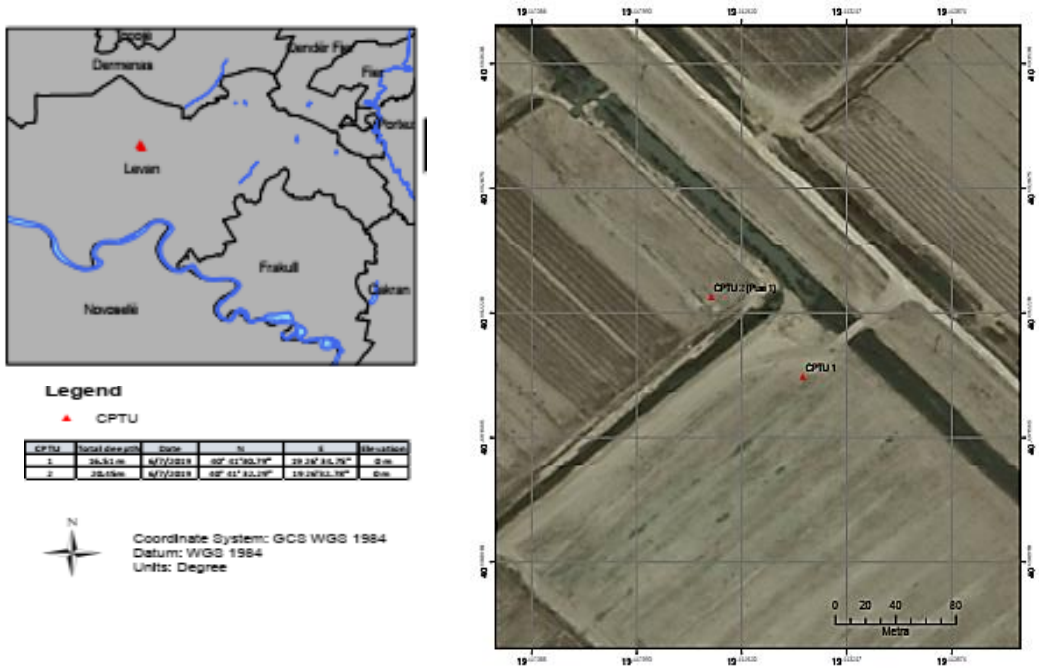

Figure 1: *The location of CPTU and borehole drilling.*

The results obtained from the laboratory testing and soil classification in the USCS System were compared with the soil types obtained from the SBT charts, to compare the correlation between the two classification methods.

3. RESULTS AND DISCUSSIONS

Identification and classification of soils are the most important. The classification of soils was done from the results of laboratory testing, as well as the classification according to the soil behavior types by CPTU data.
From the results of laboratory testing (plasticity and grain size analysis) in the site of Levan, according to the USCS classification system, the cohesive soils classified in the group CH, CL, CL-ML, MH and ML in the plasticity chart (fig. 2).

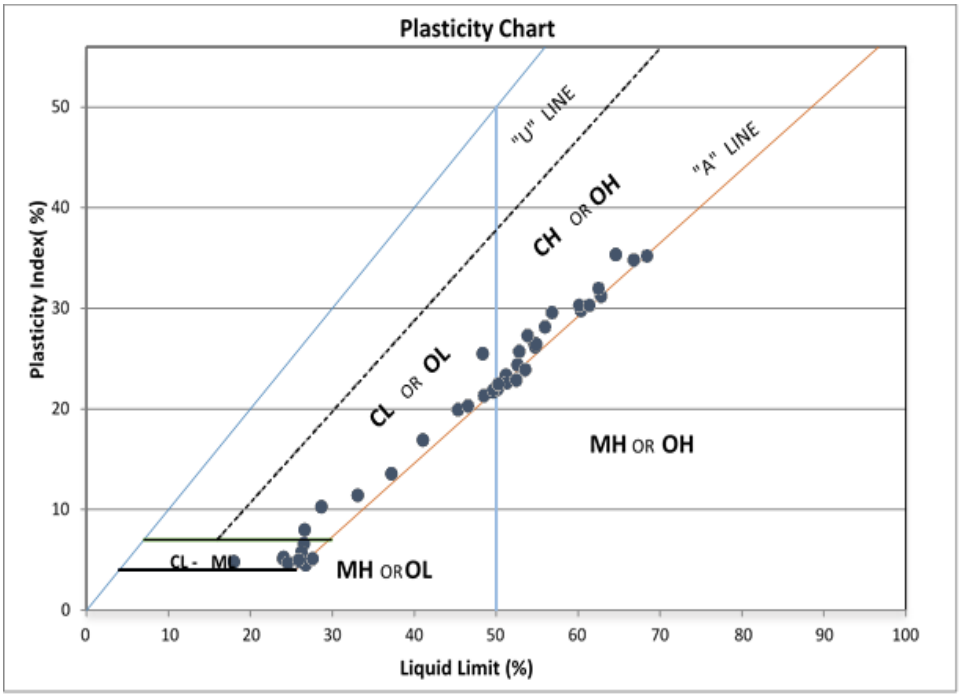

Figure 2: *Soil classification according to laboratory testing.*

The cohesive soils in the site of Levan have variability along the soil profile from the surface down to depth. The cohesive soils near-surface that overlie on the sand layer, have a thickness from 4.4-5.5 m. They are characterized by high-plasticity clay soils with transitions to low-plasticity clay soils. A layer of sandy loam clays underlain a sand layer, such soils are also found in some small intermediate layers between the sands and continued under sands in depth.
While cohesion less soils refer to the grain size composition (fig. 3), according to the USCS classification system classified in the groups' SP, SM, SP-SM, SC-SM.

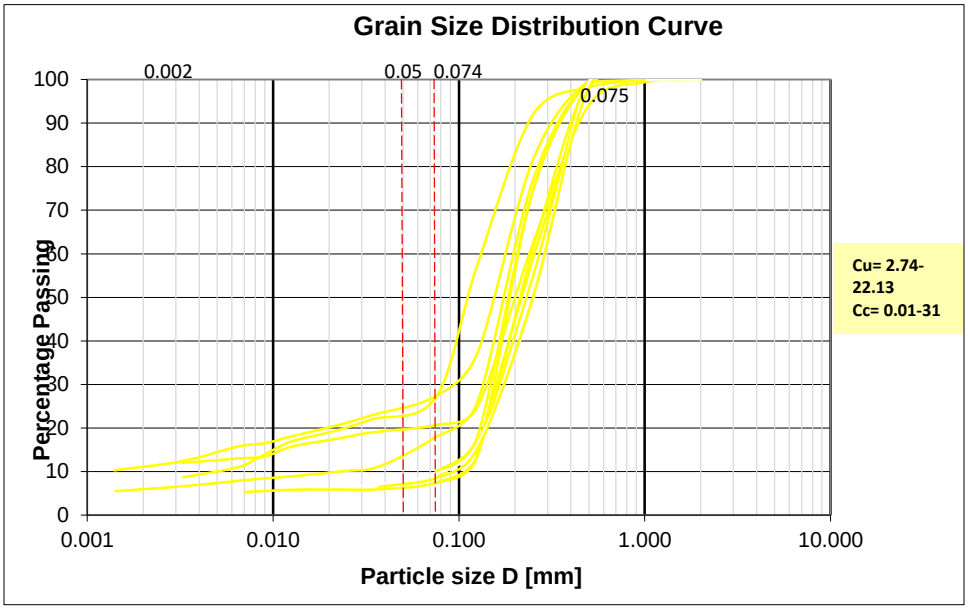

Figure 3: *Grain size distribution Curve*

In the first 5 meters, the sand layers according to the laboratory tests performed are in the SP group according to the USCS system, poorly graded sands, while deeper the sands became silty-sand. This is shown by the values of Cu the uniformity coefficient and Cc the coefficient of curvature.

From the interpretation of CPTu data according to the chart by Robertson (2010) updated by Mayne the classification of soils in the SBTn chart is shown depending on two parameters the Normalized Friction Ratio Fr and the Normalized Cone Resistance Qtn (fig. 4). According to this classification, the soils encountered along the soil profile are lean clays, fat clays, silt, silty sand mixtures, and sands. From the chart, it is noticed frequent variability in the lithology of the layers from the surface to the depth, the same results that are ascertained from the laboratory testing.

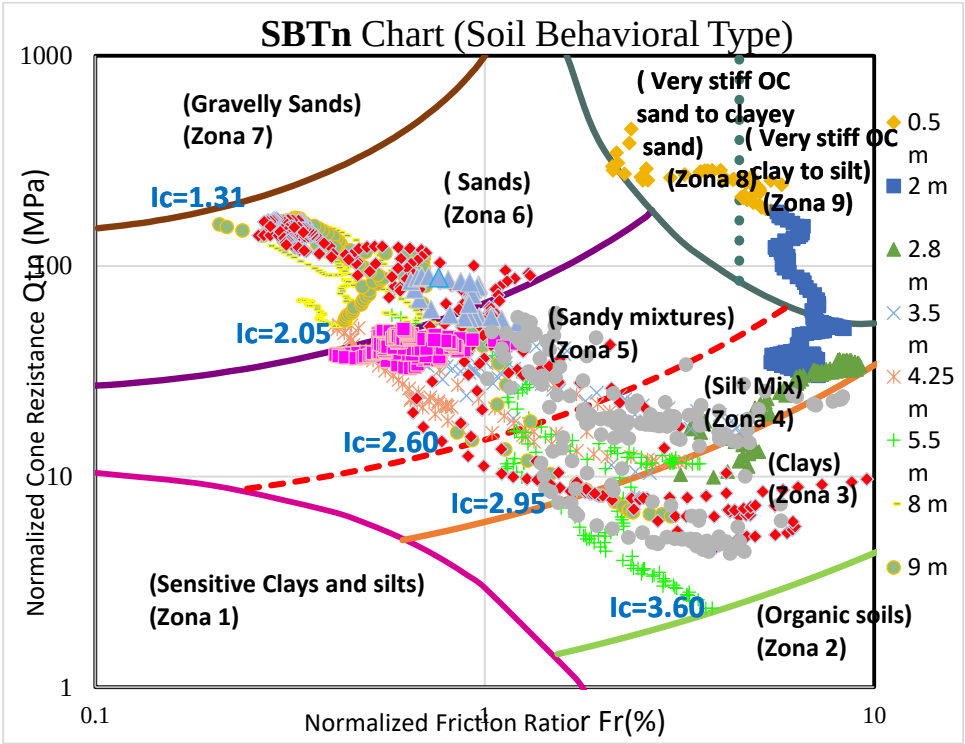

Figure 4: *Soil classification according to SBTn Chart.*

By the results above comparison and correlation of the two classification methods is done. In order to use the CPTU data for the classification of soils in the USCS system, in addition to the SBTn chart, is done the calculation of the main properties used in the classification of sands and clays according to the correlation proposed by several authors.

For the classification of sands, the coefficient of heterogeneity Cu and asymmetry Cc are calculated from CPTU data according to the proposal of Roy and Dass (2014) [7]. As the friction angle is calculated according to the proposal of Mayne (2016) [8]. For the classification of cohesive soils, the Plasticity Index PI and the Liquid Limit LL are calculated from the CPTU data according to the proposal of Cetin and Ozan (2009) [9].

By comparing the results obtained in the classification of soils according to the USCS soil classification system during the laboratory testing with the classification results from CPTU data, there is a correlation for most layers (Table 1). It is observed, that the data of the CPTu method give a greater presence of silt content in cohesive soils compared to the classification from laboratory testing.

Table 1: *Soils clasification in USCS System and Comparison of the two methods results.*

Zones	USCS Classification by laboratory analysis			USCS Classification by CPTu data	
	Depth m	**Symbols**	**Name**	**Symbols**	**Name**
LEVAN	**2**	**CH**	Fat clay	**CH -MH**	Fat silty- clay
	2.8	**CL**	Lean clay	**CL**	Lean clay
	3.5	**CH**	Fat clay	**CH -MH**	Fat silty clay
	4.25	**CL**	Lean clay		
	5.5	**CL - ML**	Sand silty clay	**CL - ML**	Sand silty clay
	8	**SP- SM**	Silty sand poor graded	**SP- SM**	Silty sand poor graded
	9	**SM**	Silty sand	**SM**	Silty sand
	13.5	**SC-SM**	Silty clayey sand	**SC-SM**	Silty clayey sand
	15.5	**CL -ML**	Sandy silty clay	**CL -ML**	Sandy silty clay
	16	**SC-SM**	Silty clayey sand	**SC-SM**	Silty clayey sand

As above, we can say on the whole of the data table there is a good correlation between the results of the two methods in soil classification by USCS System.

4. CONCLUSIONS

By the results of this paper, we reach the following conclusions:

1. Later Quaternary deposits have specific properties that it is concluded by the obtained results along the soil profiles whereas a frequent variability of the layers is noticed maybe also be related to the sedimentation conditions.

2. Along the soil profiles soil strata are encountered that may cause problems and according to the USCS classification system these soils are included in the groups CH-CL, CL-ML, MH -ML as well as SP, SM, SP-SM, and SC-SM.

3. In-situ CPTu test methods have recently found wide-range usage in the study of these soils essential to provide cost-effective geotechnical solutions because the CPTU test provides fast results, but some empirical parameters are influenced by local conditions.

4. By comparing the soil classification results from the laboratory testing and the CPTu data there is a good relation, besides the silt clay content is slightly greater in the CPTU results, so on the whole of the data table, there is a good

correlation between the results of the two methods in soil classification by USCS System.

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Assessment of the geoheritage of Prespa National Park in Albania for the development of geotourism

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Abstract

Protection and promotion of geodiversity in the protected area is a new goal of recent geosciences studies. Elements of geodiversity with scientific value are considered as geoheritage. Identified as outdoor classes, geosites could be used to develop geotourism and to geoeducation present and future generations, before and during the touristic movements. Geotourism is a new form of natural tourism based on abiotic nature.

This study is focused on geotourism assessment of Prespa National Park geoheritage, Albanian territory, which is presented by eleven geosites, like Iron Oxide object in Mali i Thatë, Quartz sand object in Zaroshka, Source of ash Stone in Gorica, Maligrad Island, Zaveri Hollow, Source of Limestone of Shuec, Treni Cave, Prespa karst field, Mumje Rocks, Small Prespa Lake, and Big Prespa Lake. Through the use of GAM and M-GAM is intended to compare the geoscientist opinions with tourist opinions about the geosites. Comparison of GAM and M-GAM numerical data helps to analyze the present geotourism potential, to identify the problems and to recommend the future sustainable use of geosites. As a result of a qualitative assessment the most valuable geosites are proposed to be used as geotourism attraction for tourists of Prespa National Park.

Key words: geosites, geotourism, geodiversity, GAM, M-GAM.

1. INTRODUCTION

Geodiversity present the abiotic nature of our planet, with vital values for the biotic nature. Humans, as part of biotic nature have dependent relationships with geodiversity. Geo-sphere is the place where humans live, feed, work, and create.

Due to the development of the geosciences, and from the human perception and description, some parts of the geo-sphere are considered with scientific, education, aesthetic, scenic, and tourism values [1] [2]. The amount of geological and geomorphological sites with scientific values is defined as geoheritage. Based on the classification of [3] geological and geomorphological sites or geosites are elements or parts of geodiversity located *in situ* and have important values for humans beings. To encourage increase of Earth knowledge, evaluation and conservation of the geosites it is necessary to develop geotourism, especially inside of Protected Areas. Geotourism is a new form of natural tourism that needs interpretative and services facilities to enable tourists to understand the Earth structures and processes in geosites, including its contribution to the development of Earth science, beyond the level of mere aesthetic appreciation [4] [5] [6].

This paper is focused in assessment of the geotourism potential in Prespa National Park, Albania territory, based on its geoheritage. Prespa National Park is located in the southeastern of Albania, in the cross border between North Macedonia and Greece. Prespa Park is near to Korça city, in the cross roads with North Macedonia and Greece. Due to its rich geodiversity, biodiversity, and cultural heritage in 1999 is declared as a National Park [7], and in 2014 is included in Ohrid-Prespa Transboundary Biosphere Reserve. The Prespa Park cover an area of 27 750 ha, including Albanian land and water space of Big and Small Prespa Lake [8]. This protected area is composed of Prespa pit and eastern slope of Mali i Thatë mountain [8]. Due to the dominance of limestone of Upper Triassic and Lower Jurassic (T_3-J_1), in Prespa National Park are present karst fields, caves, and karst springs. In spots forms are present Middle Triassic limestone's, Pliocene deposits (N_2), Middle Eocene (Pg_2^2), and Pleistocene-Holocene deposits (Q_{p}-h) (Fig.1) (Xhomo, Kodra, Xhafa, & Shallo, 2002).

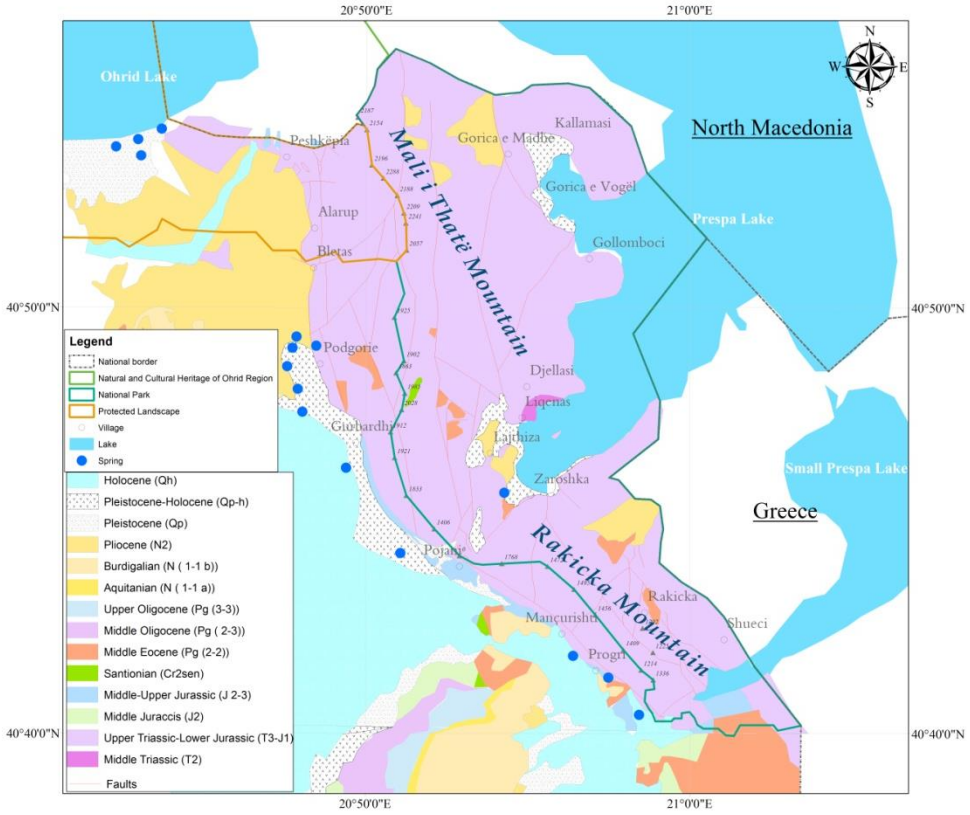

Figure1: *The geological map of Prespa National Park, Albanian part.*

Due to the presence of different geological compositions, geomorphological features, inside the Prespa National Park are identified 11 (eleven) geosites [10] geotourism potential. In the table below are described the geological and geomorphological characteristics of each of geosites.

Table1: *The general geological/geomorphological characteristic of geosites in Prespa National Park.*

Nr.	Geosite	Characteristics
GS_1	Iron Oxide object in Mali i Thatë	It is a iron oxide body, located 1800 m a. s. l., with about 400 m length and 200 m width [11].
GS_2	Quartz sand object in Zaroshka	The quartz sand of Zaroshka is created above terrigenue's deposits of Paleogene-Neogene period [11].
GS_3	Source of ash Stone in Gorica	It is a source of ash, near to Big Gorica village, covering an area of 1 km^2, thickness of 20-30 cm, created by Triassic limestone grinding during tectonic movements [11].
GS_4	Maligrad Island	Represent a part of the great subsidence of Prespa graben, composed of limestone rocks, about 900 m above sea level [12] [11] [13].
GS_5	Zaveri Hollow	It is a big karst swallow, created in the eastern slope of Mali i Thatë Mountain, whereby the water of Big Prespa Lake flow to Ohrid Lake [11].
GS_6	Source of Limestone of Shuec	It is a source of limestone created in Upper Triassic-Lower Jurassic limestone, near to Shuec village.
GS_7	Treni Cave,	It is a karst cave, located near to Woolf Throat, with five halls, some galleries and passageways [7] [14]
GS_8	Prespa karst field	It is a karst field, created on the surfice of limestone, in the western part of the Big Prespa Lake [15] [11].
GS_9	Mumje Rocks	A limestone rock, height of 2.5 m created by Aeolian erosion and karst processes [12].
GS_{10}	Small Prespa Lake	It is the south part of Prespa Lake, separated from an alluvial belt from Big Prespa. Created in limestone rocks, with 11 m depth [16] [17] [18].
GS_{11}	Big Prespa Lake	It is part of Desaret lakes, created in Oligocen, with about 50 m deepth [16]

Source: Shërbimi Gjeologjik Shqiptar

The above geosites are located in the Prespa National Park are natural resources with geotouristic value, that should be protected, conserved and promoted to develop new forms of education and tourism. In this paper is intended to evaluate geotourism potential of geosites through the use of GAM and M-GAM.

2. MATERIALS AND METHODS

Identification, evaluation, protection and sustainable use of geoheritage needs literature review, fieldwork, map analysis and uses of methodologies. To

analyses geotourism potential of geoheritage in Prespa National Park, Albanian part, are used two methodologies, GAM and M-GAM. Geosite Assessment Method (GAM) is composed of two groups of indicators: main values and additional values [19]. In the main values (MV) are included scientific/ education values (VSE), scenic/aesthetic values (VSA) and protection values (VPr), each values consisted of four sub-indicators. In additional values (AV) are included functional values (VFn) and touristic values (VTr), respectively with six and nine sub-indicators. GAM method suggests that geosite assessment should be made by geosciences researchers that have scientific knowledge about main and additional values about geosite. According to GAM, an objective numerical evaluation should be made for each of the geosites, based on scientific researches, reliable statistic data gathered in the fieldwork and from national institutions. In total, there are 27 sub-indicators that are evaluated with 0.00, 0.25, 0.50, 0.75, 1.00 point [19]. To summaries the main values and additional values for each geosites are needed equations below:

$$MV = VSE + VSA + VPr$$
$$AV = VFn + VTr$$

On the other hand, for more objective geotourism assessment of geosites is important to include in the geotourism assessment, tourist's opinions. In this way, a Modified Geosites Assessment Method (M-GAM) as a variation of GAM is developed [20] [21] [22]. Tourists have different socio-economic and cultural background and have other goals during their touristic movements. M-GAM indicate evaluation of the importance factor (*I m)* of each of the sub-indicators through the tourists opinions. Tourists have to ranches sub-indicators with 5 points mentioned up, like: O= not at all important; 0.25= not very important; 0.50= neutral; 0.75=somewhat important; 1.00 very important. The equation of the important factor (*Im)* is:

$$Im = \frac{\sum_{k=1}^{K} Ivk}{K}$$

Differently from values made with GAM, in M-GAM the *Im* can take any value from 0.00 to 1.00. To indicate numerical values of the sub-indicators in M-GAM is necessary to multiply the numerical values taken from GAM with important factors (*Im).* The results of the multiplied could express the main values and additional values of geosites in M-GAM. The results are showed in the respective matrix, where in the X axes are the main values, and in the Y axes are expressed the additional values. In this paper is intended to analyze geotourism values of geoheritage in Prespa National Park from two different viewpoints.

3. RESULTS AND DISCUSSIONS

Even though geotourism in Albania is less developed, compare with other touristic activities, is important to make a qualitative assessment of scientific abiotic features, in order to develop it in the future. In the last Albanian researches, geotouristic potentials of geosites are only evaluated through the expert's opinions (Albanian geologists, geographers) (table 2) [23] [24] [25]. GAM enables objective assessment of the geosites, but this assessment differ almost completely from general tourists opinions. M-GAM intended to include tourist's opinion in the designation of geotouristic potential of Prespa Park geoheritage (table 3). Inclusion of tourist's opinion was requested the completion of 140 questionnaires with 27 questions. The results of the questionnaires create the important factor (*Im)* for each sub indicator. In the Scientific/Educational values (VSE) the most evaluated sub-indicator from tourists is the *Rarity*, where *Im* is 0.91 point, which makes the uniqueness of the geosite so important. For tourists, the representativeness (*Im=0.84),* knowledge (*Im=0.74)* and level of interpretation (*Im= 0.*79) are also important during the touristic movements. In the Scenic/Aesthetic (VSA) values, the most evaluated sub-indicator is the Surrounding landscape and nature (*Im= 0.94)*. Tourists are less interested about surface, viewpoints or environmental fitting.

Table 2: *Evaluation of geosites in Prespa National Park by using GAM*

Geosites	Main Values VSE+VSA+VPr	Σ	Additional Values VFn+VTr	Σ	Zone
GS_1 Iron Oxide object in Mali i Thatë	1.50+2.75+2.50	6.75	1+2.25	3.25	Z21
GS_2 Quartz sand object in Zaroshka	1.50+0.50+2	4	2.25+2	4.25	Z11
GS_3 Source of ash Stone in Gorica	1.50+0.50+1.75	3.75	2.50+1.75	4.25	Z11
GS_4 Maligrad Island	2.50+3.25+2.25	8	2.25+4.75	6	
GS_5 Zaver Hollow	1.75+1.75+2.75	6.25	3.50+3.25	5.75	Z 22
GS_6 Source of Limestone of Shuec	1.25+1+1.75	4	2.75+1	3.75	Z 11
GS_7 Treni Cave,	3+2+2	7	3.25+1.50	4.75	Z 22
GS_8 Prespa karst field	1.25+3.75+2.50	7.50	3+1.50	4.50	Z21

GS_9 Mumje Rocks	1.50+1+2.50	5	3.25+1.50	4.75	Z 21
GS_{10} Small Prespa Lake	3.25+2.75+2	8	4.25+4.25	8.50	Z22
GS_{11} Big Prespa Lake	3.25+3.75+2.75	9.75	3.50+6.50	10	Z32

Table 3: *Evaluation of geosites in Prespa National Park by using M-GAM*

Geosites	Main Values	Σ	Additional Values	Σ	Zone
GS_1 Iron Oxide object in Mali i Thatë	1.16+2.36+1.43	4.95	0.38+1.44	1.82	Z 21
GS_2 Quartz sand object in Zaroshka	1.16+0.43+1.36	2.95	1.10+1.11	2.21	Z 11
GS_3 Source of ash Stone in Gorica	1.16+0.43+1.05	2.64	1.29+1.07	2.36	Z 11
GS_4Maligrd Island	2+2.72+1.43	6.15	1.03+2.28	3.31	Z 21
GS_5 Zaver Hollow	1.66+1.45+1.78	4.89	1.30+1.90	3.20	Z 21
GS_6 Source of Limestone of Shuec	0.96+0.91+0.92	2.79	1.50+0.54	2.04	Z 11
GS_7 Treni Cave,	2.41+1.66+1.39	5.46	1.48+2.50	3.98	Z 21
GS_8 Prespa karst field	1+3+1.50	5.50	1.44+0.92	2.36	Z 21
GS_9 Mumje Rocks	1.24+1.07+1.74	4.05	1.48+0.78	2.26	Z 21
GS_{10} Small Prespa Lake	2.65+2.38+1.59	6.62	2.04+2.70	4.74	Z 21
GS_{11} Big Prespa Lake	2.65+2.38+1.90	6.93	1.81+4.10	5.91	Z 22

In the Protection values (VPr) tourists evaluate the level of protection (*Im=0.95).* Tourists think that is important to protect geosites in national and international level for future generations. The Functional values (VFn) are the less evaluated subindicators of the M-GAM. When tourists choose to visit a natural destination, in this case Prespa National Park, are not interested in other facilities, like: the vicinity of important road (*Im=0.41),* additional functional

values (*Im=0.42*), or vicinity of emissive centers (*Im=0.41*). The Touristic values (Vtr) are most evaluated by tourists. The touristic infrastructure (*Im=0.81*), the tours guide service (*Im=0.78*), and the vicinity of visitor center (*Im=0.80*) are the most evaluated subindicators of tourism values (VTr).
Multiplying the numerical values of the subindicators in GAM with the impact factor (Im) have bring the above numerical values of M-GAM. The main values and additional values of M-GAM are less evaluated than the main and additional values of GAM. The numerical values of the two methodologies are put in the figure2 and figure 3.

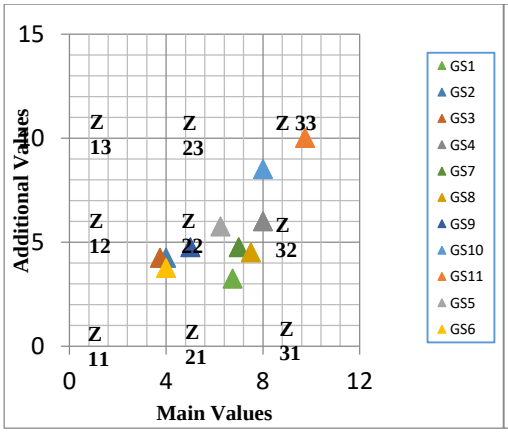

Figure 2: *The position of Prespa National Park geosites in the GAM matrix.*

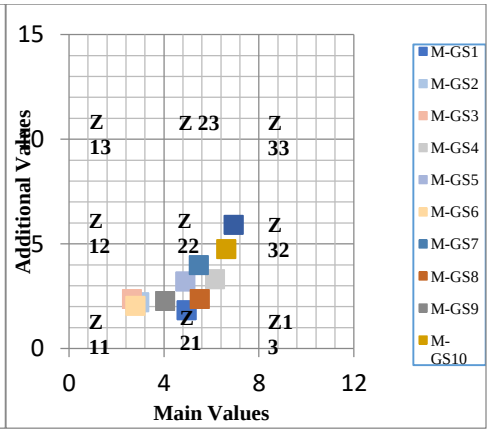

Figure 3: *The position of Prespa National Park geosites in M-GAM matrix.*

Based on GAM matrix, the geosite with high main values is Big Prespa Lake due to its surfice, aesthetic and scenic values. Treni cave, Zaveri Hollow and Small Prespa Lake average main values, the other seven geosites have low main values. According the figure 2, Quartz sand object in Zaroshka, Source of ash Stone in Gorica and Source of Limestone of Shuec have low main and additional values because have low scenic and aesthetic values and touristic values for general tourists.
According to M-GAM matrix all the geosites have lower main and additional values. In the figure 3 is seen that only Big Prespa Lake have main and additional values and the ten other geosites have low additional values.

4. CONCLUSIONS

According to the results of GAM and M-GAM, are seen changes between experts evaluation and general tourists opinions. Through the GAM is intended to evaluate the geosites based on their current natural conditions, touristic

movements and present financial supports for development of geotourism. Through GAM is seen obviously how and in which way is seen this form of natural tourism. Whereas through the use of M-GAM is intended to see the perception of geosites from tourist view, the realistic situation of the level of the development of geotourism. The differences in the GAM and M-GAM results express the importance of education of general tourists about the Earth processes and structures, in order to develop conservation and promotion of the geoheritage.

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Smart Contract Framework for Financial Data Management: The Blockchain technology

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Abstract

Data and the security of the data generated are two of the main concerns today. Every day people generate more and more data and they are committed to preserving the integrity of their confidential data from outside attacks. They are also very committed to choosing companies that can provide sufficient storage and security for their confidential data. The use of cloud computing today is very widespread and common but the security that it offers is questionable. Blockchain is a decentralized technology that utilizes peer-to-peer networks. This technology will contribute to the increase in the security of managing the finances of a business within a city. A node that is introduced to the system is permitted by using the company ID, which creates a set of public and private keys; this provides a higher level of security, confidentiality, and authenticity. The algorithm used in this work is a Smart Contract, which uses distributed nodes to provide a level of privacy and security. The performance of the algorithm is measured based on execution time, memory usage, latency in reading or writing the request, and identification of the points of failure. The analysis of the results obtained at the end confirms the efficiency of the algorithm.

Keywords: Blockchain, Cloud Computing, smart contract, security, financial data

1. INTRODUCTION

Today we see that much attention is being paid to data processing and data collection from all sides, this is because machines are trained to perform

services that up to this point were performed manually by people. However, the ever-increasing data demand burdens the computer as the available memory is used. In 2006, Amazon brought the idea of the cloud by allowing external users access to their memory storage. Thus, the term cloud computing was born; and at the same time providing a solution to the constant problem of changing the memory needs of the electronic device. Meanwhile, with the report on innovation in informatics, other problems arise, such as security. Cloud computing needed to assure its users that the data or the hardware containing the data was protected from outside attacks and was as reliable as if it was stored in the user's computer. Cryptography is a science that has evolved since its early times in the pursuit of suitable algorithms. Algorithms such as the AES algorithm, elliptic curve cryptography (ECC), hyperelliptic curve cryptography, or encryption algorithms have been used in data security for up to a period. In addition to all the above techniques, the focus has shifted to blockchain technology. This technology has achieved the aspect of confidentiality, integrity, and authenticity. This article will analyze blockchain technology along with the applications it allows us in the cloud computing environment for the security it offers. Using blockchain also helps us in terms of cost. Previously, services with good security for secure data storage came at a high cost. However, blockchain technology afforded users the option of a high-security service with a low cost by not allowing cloud service companies to monopolize access to secure data storage services. This article is as follows; in part II we will discuss the basic concepts of cloud computing. In the third part, we will discuss blockchain technology; its architecture, the block type, the security, and its costs. Section IV will show the experimental side of data encryption and the levels of security provided by the algorithm used. Culminating with the conclusions drawn from this article on the application of the algorithm on the financial data. Section V explains the benefits of integrating the cloud with blockchain technology, and the architecture proposed [4].

2. CLOUD COMPUTING

Cloud computing is a term used to define a platform and a type of usage. A computer platform changes every day adapting to the necessary configurations that should occur as needed. Cloud computing also serves for applications that can be accessed via the Internet. These programs use powerful data centers and servers that provide internet service. Are you working in Cloud Computing? Cloud computing is a user-computing worksite that stores information in the service, which can be accessed through the Internet. Cloud computing can be front-end and back-end. The front end is the first part, where a user enters data in the cloud using a web browser or a cloud software computer. However, the cloud's main informative component- the meaning of information and security

of data - is the backend. This includes the servers, computers, databases, and central servers. The central server facilitates operations by following a set of rules known as protocols[33]. It uses software, to provide connections between users/computers connected to the cloud. Cloud service providers should provide not only memory space but also security against data breaches from third parties and assurances for the integrity of the user's data. This will be the frontend and backend architecture for cloud computing:

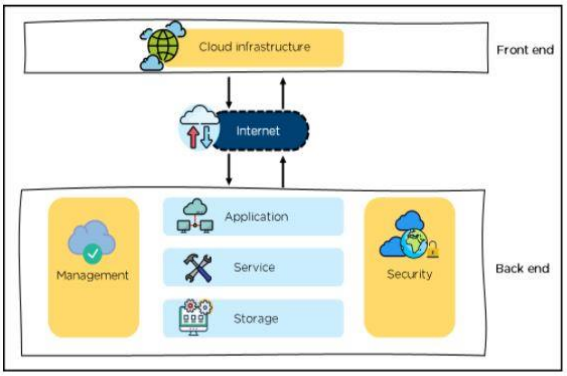

Figure 1: *Cloud computing architecture*

Type of cloud services: There are several types of cloud services such as Platform as a Service (PaaS), Infrastructure as a Service (IaaS), Data as a Service, Security as a Service, etc. Below is the end-user spending forecast for receiving cloud computing service in millions of dollars in the year 2022. It also clearly shows which type of cloud services are mostly used by users.

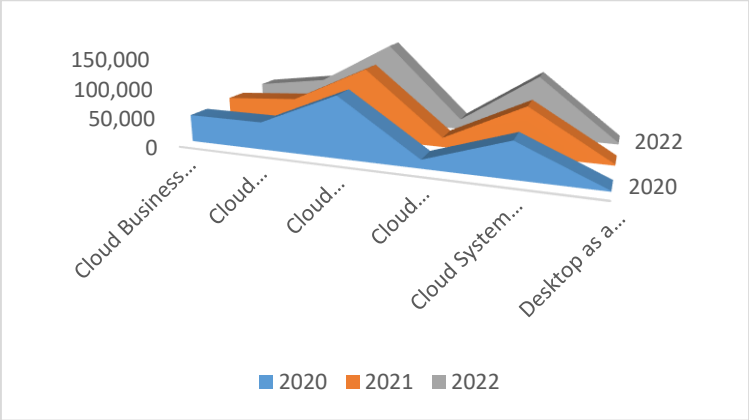

Figure 2: *Worldwide Public Cloud Services End-User Spending Forecast[32]*

3. RELATED WORK

When the whole world is driven by the digitalization of all the services it needs, the demand for information storage increases proportionally. The need for cloud storage introduces another problem, how safe is this information that we are storing externally? Thus, the use of data encryption has been an unavoidable necessity and the search to find algorithms as efficient and difficult as possible to attack is a constant struggle of programmers. In addition, the use of relatively high-cost platforms leads to the reluctance of the users to purchase this service. A challenging technology for all cloud giants such as Google, Alibaba, Amazon, etc. is the use of blockchain technology; this has received tremendous attention, especially in recent years. Blockchain, originally used as a technology in the popular Bitcoin cryptocurrency, is a more comprehensive technology than Bitcoin. Thus, blockchain will bring faster data transfer, more innovation compared to other platforms, and at the same time very quickly integrated with IoT. Healthchain is an application developed on Blockchain as an innovative idea. This application will be used on financial and banking data where high security, scalability, and efficiency must be satisfied. Tareq Ahram, Arman Sargolzaei, Saman Sargolzaei, Jeff Daniels, and Ben Amaba at *Blockchain for cloud exchange: A survey,* concluded that the use of the modular architecture of Hyperledger fabric, which enables confidentiality and security in informatic health, and its implementation of smart contracts ensure the proper authorization and set privileges on its permissioned network. HealthChain is equipped with the consensus algorithm provided by PBFT and does not bring about the reduction of complexity required by the PHI transfer rule between healthcare data and mobile devices within the network. Blockchain allows immediate contracts, engagements, and agreements with inherent, robust cyber security features. The authors Dinh C. Nguyen, Pubudu N. Pathirana, Ming Ding, And Aruna Seneviratne [10] borrow the blockchain Ethereum platform to build an e-health system. To implement the allocation according to the HER [10][24] conditions, a private Ethereum in AWS is initially selected. Data access and transactions are recorded and displayed on the website for monitoring [10]. Based on the terms of the blockchain, selected smart contracts for IPFS [10] storage, on which they created the entities for connection to the mobile phone by building an application for electronic distribution. With these settings, they operated the EHRs sharing system and evaluated the efficiency of our design through two main performance metrics: access control and network overheads. Compared to what was built up to that period this algorithm brought success in some key points such as Flexibility, Availability, Avoid Single Point Of Failure, Integrity, and Data Privacy [10]. Wang-You Tsai, Tzu-Chuan Chou, Jiann-Liang Chen, Yi-Wei Ma, and Chen-Jui Huang have come up with another proposal proposing the cloud @ blockchain model which includes Blockchain,

Smart Contract, Cloud Storage, and the person who owns the data file. Blockchain preserves the anonymity of owners while remaining open to public inspection. Although nothing is completely certain, confusion with blockchain is almost impossible. The three main performance elements such as loading, unloading, and performance analysis conclude that the average response time captures the highest figures currently proposed [16]. The authors claim that: the analysis reveals that the proposed @ blockchain cloud is feasible. Although it performs 0.88 times as the traditional database solution, the user experience is as expected. In the other article, the authors Rajashree V Biradar and Girish Kumar D studied companies' requirements and the storage of financial data in cloud computing. They have been studying the BaaS by comparing it to two other service platforms PaaS and SaaS. They suggest using PaaS for financial data because of its high flexibility and low cost.

4. BLOCKCHAIN TECHNOLOGY

4.1 What is Blockchain?

Blockchain aims to store data in blocks [1], which it connects to the user by creating a chain with successive links. If their number increases, this leads to increases in the size of the chain. Normally blockchain has an architecture on which it operates. The basic architecture helps to adapt according to the requirements of the business or the field where it operates. For example, we have seen the use of blockchain in Bitcoin, Hyperledger, and Ethereum. From the point of view of blockchain security, it is divided into private, public, and consortium [34]. Blockchain is a collection of file creation that as I said above are known as blocks that use cryptography to connect. Each block holds the cryptographic hash, action time, and block communication data over and over again. Blockchain is a reset architecture for various changes to data. This technology is reliable because it does not have a supervisor but is transparent, immutable, and not easy to decode. This is high security for data storage. Blockchain security enhancement applications use a series of mathematical calculations that help improve the security of this technology. As we have pointed out above from various fields for sensitive data [19]

4.2 How blockchain works in cloud computing

Block storage of the block takes the data of the users and divides the data into small parts. It then takes these pieces of data and encrypts them by laying an additional layer over the real data and distributing them over the network. This occurs from the specificity of blockchain as a cryptographic hash function using private or public-key encryption. The hash of the current data with the hash data that was set as we explained above with the stratification attached to

the block to distinguish external attempts. If there is an attack that wants to change this brings changes in the hash value to all blocks which indicates that there has been an attack. The data stored in the blockchain book which is split into blocks is signaled by a unique hash for each block. As hash is stored in different places, this partition is random and distributed on the network. Therefore, even if outside attacks are successful, only part of the information in the file can be obtained by third parties. A node does not know the true owner of the data which maintains anonymity. When the data owner goes to retrieve his data after it has been encrypted, he must satisfy all the security requirements, this is shown even more clearly in Figure 3 below. If the information is manipulated by unknown third parties, nodes will be altered to record the encounter; this will inform the owner of the data about the event.

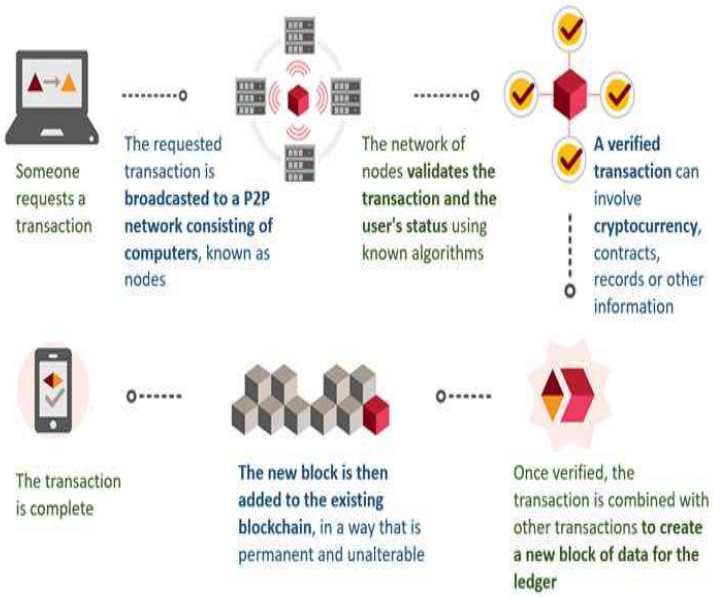

Figure 3: *Process of Blockchain*

4.3 Features of blockchain technology

Blockchain technology is a decentralized book scheme with high security to improve trust and increase the integrity of information [35]. This technology carries with it some of the following features of blockchain:

Decentralization: Blockchain decentralization manages the only point of failure which is scalability. This also reduces the delay.

Transparency: This technology transmits high transparency with the help of sharing transaction information among all users involved in the transaction. It also does not need any third-party verified information.

Immutable: Blockchain can secure any connection by creating main book immutability. In a blockchain, every block transaction cannot change. This is because expenditure blocks are permanently stored by connecting using hash values [35].
Security: Provides more security for data protection by using public key infrastructure and protecting against malicious user changes.
Efficiency: The distributed mechanism is used to increase efficiency, verifying all types of distributed environments. Blockchain is more efficient compared to a centralized system in terms of completion speed, cost, and risk [35] management.
Traceability: The blockchain time stamp feature is used to detect any use. This helps the participant to maintain the order of transactions for traceable data. The timestamp helps reduce the cost and strengthen the legitimacy of the transaction.
Anonymity: This technology is using asymmetric encryption anonymity techniques to encrypt data. Blockchain data encryption uses two methodologies such as data encryption and digital signatures [35]. Encryption to ensure the security of the data and reduce the possibility of the data being sold to third parties. Transmission of the data uses a digital signature to indicate the identity of the original data owner.

5. PROPOSED SYSTEM

This paper proposes a model of the finance hierarchy starting from the smallest business to the central offices, which control every movement, approve every payment, or at the same time perform every important and sensitive transaction for the company. By proposing the use of blockchain technology, and mainly Smart Contracts, we would have a reduction of unreal work for both employees and employers. This model is illustrated in the following figure:

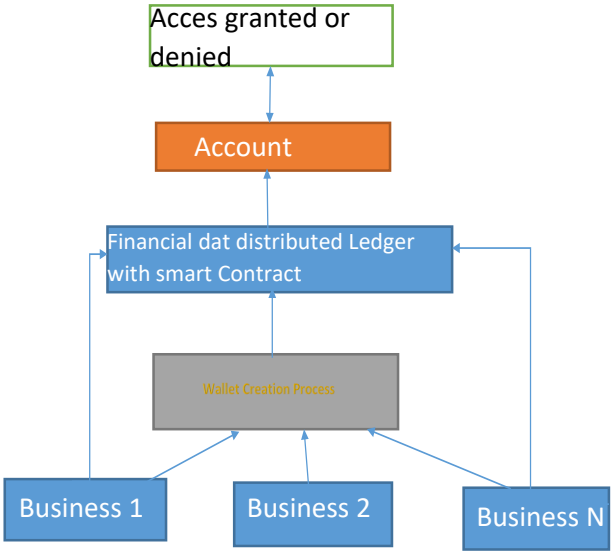

Figure 4: *Proposed blockchain-based Financial management model.*

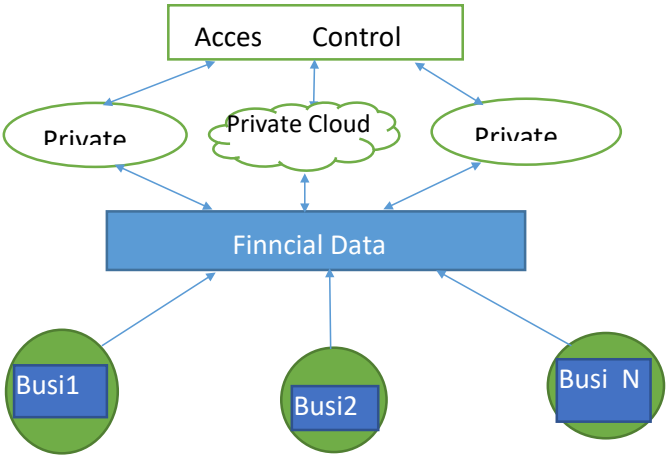

Figure 5*: Edge-cloud computing perspective in Business blockchain.*

A smart contract is an executable program that is executed to mediate contractual interactions between two or more parties [36]. In this paper we want businesses to use smart contracts for the data that they will collect. Access to the financial data of a company with several businesses is based on the level of data privacy and the terms of the smart contract that will be programmed for private data. This will help us to avoid any element that violates the transparency of sensitive data that will be transmitted to the parent business by the small businesses. (This means a leading business that operates in several business areas and these businesses transfer data directly to the company. Financial data are sensitive data for a company.) Privacy-based smart contracts

help us maintain privacy in the blockchain because the terms of each business have the same access to this data. This would work as follows:

SmartContract1()
if Bussines contains Data privacy level 1
Access grant ();
Else if the Business belongs to (Data privacy level 2 or Data privacy level 3)
Access grant (check validation);
Else
Accessdeclined(); One problem that arises is how to enable access to one of the businesses in the data after they have been encrypted. The diagram below helps with this concept:

One problem that arises is how to enable one of the businesses in the data after they have been encrypted. The following scheme would help us with this:

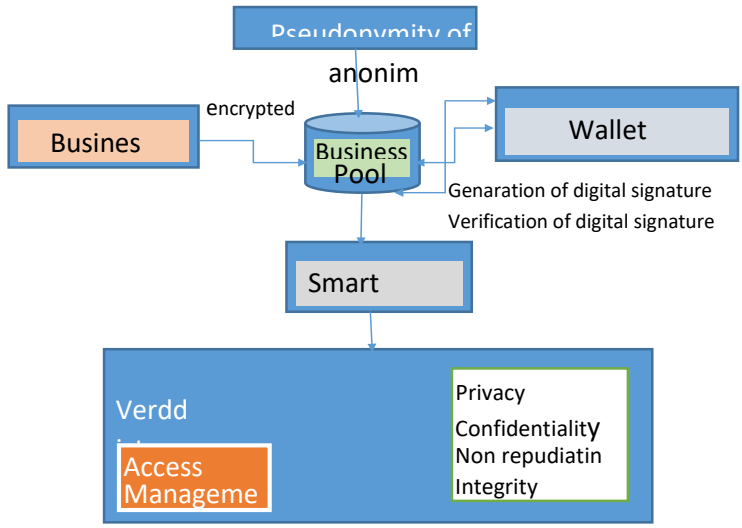

Figure 6*: Access permission process.*

Results:

Some parameters that we will measure in this study are memory consumption, processing speed, and time.

Table 1: *Implementation Metrics*

Consensus protocol	Solidity consensus (smart contract)[36]
Geographic distribution of all peers	MAN
Test tools and framework	Hyperledger Caliper
Number of nodes involved in the test transaction	4
The type of data store used	Blanc

Table 2: *Commit Time of Nodes*

Node No.	Node 1	Node 2	Node 3	Node 4
Commit time	2.20	3.20	1.27	1.39

Table 3: *Proposed Approach Performance*

Performance	10	20	30	40	50	Measured complexity
TC	13.33	25.51	34.67	45.73	57.62	O(n)
RL	3.52	5.75	7.30	8.71	9.21	O(n)
TL	23.45	31.07	43.09	54.51	68.73	O(nlogn)
T	2.51	3.03	3.54	4.76	6.31	O(Nlogm)
MC	82	157	256	325	418	O(n)

TC= Time consumption, RL= Real latency as time between the read request of business and access for a single block of business TL= Time consumption for overall access of business called Transaction latency (seconds) T= Time consumption for Smart Contract process MC= Memory consumption(KB)

Table 4: *Results for Caliper Framework*

Number of nodes	Number of Concurrent transactions capacity	Average (TPS)	Min/ transaction
10	2500	9	11.27
20	3800	14	15.31
30	15000	74	37.50
40	13000	56	29.13
50	19000	89	61.10

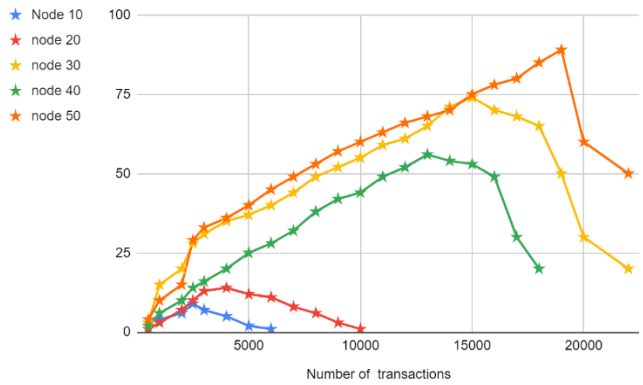

Figure 7: *Concurrent transaction capacity with a varied number of nodes.*

6. CONCLUSIONS

Blockchain is the future of the digital world by offering security, transparency, and tolerance for error. This paper evaluates all the features mentioned in the previous sections. Application occurs on a central business that has other dependent businesses. The main feature of this paper is the access that small business financiers have to financial data and the short-term verification of the variables that they need to control or change. Since the data is sensitive, the model is applied based on blockchain by using Smart Contract which is necessary for financial data for data distributed within a city. Data privacy is also maintained. The experimental results that compare the manual process against the proposed process using smart contracts show that the process of using smart contracts is more efficient than the existing process. Secondly, it

must be proven if the same algorithm has the same or better efficiency if applied on a larger network. At the same time it should be employed for a higher tolerance for the point of failure or to reduce the complexity of the algorithm. Although the results are satisfactory compared to the works of other authors, this algorithm still has room for improvement.

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Performance analysis of some metaheuristic algorithms using benchmark functions

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Abstract

The discipline of optimization can be used to maximize or minimize several problems. The use of metaheuristic algorithms is a strategy that often works well for global optimization. They are a type of stochastic algorithm that, via trial and error, finds workable solutions to difficult optimization problems in a reasonable amount of time, but they do not provide assurance that the answers are optimal. New metaheuristics, improvements, or hybrids are constantly being proposed in order to improve the effectiveness of metaheuristics. This paper aims to offer a comparative analysis of several metaheuristics in searching for the optimal solution. The selected metaheuristics are Artificial Bee Colony, Ant Lion Optimizer, Bat, Black Hole, Cuckoo Search, Cat Swarm Optimization, Dragonfly, Differential Evolution, Firefly, Genetic, Gravitational-Based Search, Grasshopper Optimization, Grey Wolf Optimizer, Harmony Search, Krill-Herd, Moth-Flame Optimizer, Particle Swarm Optimization, Sine Cosine, Shuffled Frog-Leaping, and Whale Optimization algorithms. For this evaluation, several benchmark test functions are used to examine various properties, such as accuracy, escape from the local optimum, and convergence. As an indicator of how effectively metaheuristics work, metrics like minimum, maximum, average, and standard deviation of fitness are provided. There are no optimization algorithms that are adequate for all problems, as the No Free Lunch theorem suggests, but the metaheuristics that are more effective than the others will be demonstrated. This study might be viewed as a contribution to the field of metaheuristics and could be helpful for young researchers which study them to identify the most prominent ones.

Key words: Optimization, Metaheuristic algorithm, Benchmark function, Performance metric.

1. INTRODUCTION

The objective of global optimization is to identify the optimal solution x^* from a set X on a set of objective functions $F = \{f_1, f_2, \ldots, f_n\}$. The determination of the global optimum is a crucial objective in the search process, necessitating the avoidance of regions proximate to local minima to the greatest extent feasible. Optimization algorithms are employed to assess the optimal solution. Optimization algorithms can be classified into several categories, including non-heuristic, heuristic, metaheuristic (MH), surrogate-based, hyperheuristic, and hybrids [1].

MHs refer to optimization algorithms that are not specific to a particular problem and aim to provide a solution that is seen as satisfactory [2]. MHs accomplish two primary directions, namely exploration and exploitation. The utilization of exploration in MHs results in a global search approach, whereas exploitation leads to a local search tendency. The effectiveness of the search process is conditioned upon achieving an appropriate balance between these two functions. The aim is to enhance the quality of available solutions via iterative processes, commencing with a set of feasible solutions generated randomly and subsequently exploring and exploiting the solution space. Despite the absence of a guarantee of optimality, these algorithms have been subjected to testing and have demonstrated the ability to provide a satisfactory and acceptable solution [3].

In recent years, various classifications of MHs have been proposed. MHs can be classified into two categories, namely metaphor-based and non-metaphor-based, as stated in [2]. Metaphor-based MHs refer to algorithms that replicate natural phenomena, human behavior in contemporary society, mathematical concepts, and other related phenomena. Conversely, non-metaphor-based MHs do not rely on simulation to establish their search strategy. Another classification is by their source of inspiration, which includes evolutionary, swarm intelligence, physical law-based, and miscellaneous approaches [4]. Rajwar et al. presented alternative taxonomies of MHs based on two factors: population size (namely, trajectory-based and population-based) and the number of parameters [4]. The number of MHs has been observed to keep increasing over time. The authors conducted an investigation into the proposal of MHs, resulting in a list of approximately 540 MHs that were examined up until the year 2022 [4]. As per the data obtained from Google Scholar until December 31, 2022, the MHs that have received the highest number of citations are PSO with 75000 citations, followed by GA with 70000 citations, Simulated Annealing with 50000 citations, DE with 30000 citations, and Ant Colony Optimization (ACO) with 15000 citations.

The availability of a diverse range of algorithms provides the opportunity to select an appropriate one for addressing a problem based on its characteristics. The utilization of benchmark test functions is a viable approach to assessing

the balance between exploration and exploitation in MHs. Numerous benchmark functions have been suggested in prominent CEC competition sessions pertaining to extensive global optimization across various years, CEC'05, CEC'13, CEC'14, CEC'17, CEC'20, CEC'21 [5-10]. Also, a number of engineering problems have been suggested for the purpose of testing their efficacy in real-world scenarios. Some examples include the design of a three-bar truss, cantilever beam, 52-bar truss, tension/compression spring, welded beam, and pressure vessel, among others [11], [12].

The objective of this study is to conduct a comparative analysis of 20 MHs across 18 test functions in order to determine which of these algorithms yields superior fitness values across the majority of functions. The present paper's organization is structured in the following manner: Section II provides a concise overview of the employed methodologies, including the algorithms, benchmark functions, and similar related work. The subsequent section outlines the parameters, the experiment analysis, and the outcomes. Section IV presents the conclusions, and discussion about the results. The paper also includes the mathematical formulas for the test functions in the Appendix.

2. MATERIALS AND METHODS

In this section, general information is provided about the MH algorithms, and the list of benchmark functions. Additionally, a brief review of relevant literature from comparable studies is presented.

2.1 Metaheuristic optimization algorithms

2.1.1 Artificial Bee Colony Algorithm

The Artificial Bee Colony (ABC) algorithm is developed based on the behavior of bees in terms of foraging and abandoning food sources [13] and is in the category of swarm-based MHs. In the initial stage, the ABC algorithm generates an initial population of food source positions, which are solutions randomly distributed among a group of employed bees or onlooker bees. Following the initialization phase, the population of positions, or solutions, undergoes a series of iterative cycles, during which the employed bees, onlooker bees, and scout bees engage in search processes. During all the phases each of the bees alters its memory of the location and evaluates the fitness (quantity of nectar) present at a potential source. In the event that the fitness surpasses that of its prior discovery, the bee will commit the updated location to memory while disregarding the previous one. The aforementioned process is iterated for a specified number of cycles or until a termination criterion is met.

2.1.2 Ant Lion Optimizer algorithm

The Ant Lion Optimizer (ALO) is a MH that is based on swarm intelligence and aims to replicate the hunting behavior of antlions in their natural habitat [14]. Antlions are known to prey on ants. The method comprises five primary steps, namely: (1) conducting random walks of ants; (2) constructing traps; (3) entrapping ants within the constructed traps; (4) capturing prey; and (5) reconstructing the traps. Ants employ random walks to navigate through a search area that is subject to the presence of antlion traps. Antlion traps have an impact on the random behavior of ants. The process of selecting antlions for optimization is accomplished through the utilization of a roulette wheel selection approach, which is based on the antlions' respective fitness values. The antlion that exhibits the highest level of fitness in each iteration is preserved as the elite. In addition, the updates to the positions of ants are conditioned upon the random walks of both the selected antlion and the elite. If an ant exhibits superior fitness compared to an antlion, the antlion is substituted for the corresponding ant. The antlion might replace the elite if it exhibits better fitness.

2.1.3 Bat Algorithm

Yang was the first to introduce the Bat Algorithm (BA), which takes its inspirations from the echolocation practices of bats that involve varying emission pulse rates and loudness [15]. This falls under the classification of swarm-based MHs. Each simulated bat exhibits stochastic flight patterns, characterized by a velocity vector at a given position and modulated by frequency, wavelength, and loudness parameters. The bat regulates its frequency, loudness, and pulse emission rate during the process of locating and capturing its prey. The local random walk technique enhances the intensity of the search process. The process of selecting the optimal solution continues until specific termination conditions are satisfied. The proposed approach employs a frequency-tuning methodology to regulate the dynamic behavior of a bat swarm.

2.1.4 Black Hole Optimization algorithm

Hatamlou introduced the Black Hole algorithm (BH), which belongs to the class of physics-based MHs [16]. The algorithm in question draws inspiration from the black hole phenomenon and attempts to replicate its characteristic of gravitational attraction towards other celestial bodies in the universe. The algorithm initiates by generating a population of candidate solutions, commonly referred to as "stars," in a random manner. Following initialization, the population's fitness values are assessed and the individual with the highest fitness value is designated as the black hole, while the remaining individuals constitute the normal stars. As a star approaches a black hole, it is possible for

it to encounter a region with a lower gravitational potential energy than that of the black hole. In the event of such an occurrence, the black hole goes through a change to the position of the aforementioned star, and conversely. The optimal solution is often referred to as a "black hole" and all alternative solutions are expected to converge towards it. The algorithms may terminate upon reaching a maximum number of iterations or achieving a satisfactory level of fitness.

2.1.5 Cuckoo Search Algorithm

Yang and Deb drew inspiration from the breeding practices of specific cuckoo species, particularly their brood parasitism, to develop the Cuckoo Search (CS) swarm-based algorithm [17]. Several assumptions are made in relation to this algorithm. 1) the reproductive behavior of cuckoos involves the deposition of a single egg into a randomly selected host nest. 2) the best nests with high-quality eggs will carry over to the next generation. 3) the probability of a host bird discovering a cuckoo egg depends on a range of factors, with values ranging from 0 to 1, and 4) the number of available host nests remains constant. A cuckoo is stochastically generated through a Levy flight mechanism and subsequently subjected to a fitness assessment. In a nest, each individual egg can be viewed as a representation of a solution, while the presence of a cuckoo egg can be interpreted as a new solution. The objective is to employ new and potentially superior alternatives (cuckoos) for the purpose of substituting suboptimal solutions within the nests. Once the optimal nest has been identified, the solutions are ranked, and the most favorable one is preserved.

2.1.6 Cat Swarm Optimization algorithm

Shu-An Chu et al. introduced the Cat Swarm Optimization (CSO) swarm-based MH [18]. This approach employs cats and their behavioral patterns to address optimization problems and represent solution sets. The CSO algorithm is comprised of two distinct modes, specifically tracing and seeking modes. Each feline entity embodies a distinct set of solutions, characterized by its unique position, fitness value, and flag. The position consists of M dimensions within the search space, with individual velocities assigned to each dimension. The fitness value represents the efficacy of the solution set (cat), while the flag serves to categorize the cats as either being in seeking or tracing mode. Therefore, it is necessary to establish the number of felines to be involved in the iteration and subject them to the algorithmic process. The optimal cat from each cycle is stored in the memory, and the cat found at the ultimate cycle will serve as the final solution.

2.1.7 Dragonfly optimization algorithm

Mirjalili proposed the Dragonfly Algorithm (DA), which draws inspiration from the hunting and migration strategies of dragonflies [19]. The hunting strategy commonly referred to as static swarming" (feeding) involves the coordinated flight of all members of a swarm in small clusters within a restricted region to locate sources of food. Dragonflies employ a migratory technique known as a dynamic swarm. During this phase, dragonflies exhibit a tendency to fly in larger groups, which can facilitate their migration as a swarm. The exploration and exploitation phases of dragonflies are guided by five distinct factors: separation, alignment, cohesion, food factor, and enemy factor. The objective is to guarantee the survival of the swarm by drawing it towards sources of nourishment and diverting its attention from potential threats. The optimal outcome identified during an iterative process is designated as the food source, while the worst outcome identified is designated as the enemy. The artificial dragonflies' neighbors are determined by defining a radius around each individual specimen. In the final phase of optimization, the dragonflies will integrate into a dynamic swarm that will ultimately converge toward the optimal global solution. The iterative process involves updating the step vector and position vectors of each dragonfly until the specified termination condition is satisfied.

2.1.8 Differential Evolution Algorithm

Storn and Price introduced the Differential Evolution (DE) algorithm [20]. DE is a MH search algorithm that employs an evolutionary approach to optimize a given problem. The algorithm iteratively enhances a candidate solution to achieve the optimal solution. The algorithm explores the design space through the utilization of a population of potential solutions, also known as individuals. These individuals are subjected to a particular process that involves the combination of existing solutions to generate novel solutions. The utilization of mutation and crossover operators is a common practice in generating novel solutions. In each iteration of the algorithm, individuals with superior objective values are selected to be retained in the population, while those with inferior objective values are eliminated. This process ensures that only individuals with improved objective values are included in subsequent iterations. The aforementioned procedure iterates until a specified termination condition is met.

2.1.9 Firefly Algorithm

Yang initially proposed the Firefly algorithm (FFA), a MH algorithm based on swarm intelligence [21]. The algorithm emulates the behavioral patterns of fireflies through the utilization of their flashing lights. The level of attraction exhibited by a firefly is directly correlated to its brightness, which is dependent

upon its objective function. The algorithm involves the assignment of light intensity to fireflies, which are randomly generated feasible solutions, based on their performance in the objective function. The aforementioned intensity shall be utilized for the purpose of calculating the luminosity of the firefly, which exhibits a direct correlation with its light intensity. In the context of minimization problems, the solution that yields the smallest functional value will be attributed with the greatest intensity of light. After assigning the intensity or brightness of the solutions, each firefly will subsequently pursue other fireflies that exhibit superior light intensity. The most luminous firefly will execute a localized exploration by undertaking stochastic movements within its immediate vicinity.

2.1.10 Genetic Algorithm

Darwin's theories of biological evolution serve as the foundation for the genetic algorithm (GA), which Holland modified for optimization purposes [22]. Subsequently, Mitchell provided a more comprehensive exposition of GA [23]. The GA algorithm is designed to imitate the natural phenomena of chromosomes and genes. In the context of optimization problems, it can be observed that every solution can be represented as a chromosome, with each gene within the chromosome corresponding to a variable of the problem. The GA employs a combination of primary operators, namely selection, crossover, and mutation, to enhance the chromosomes in every succeeding generation. The process of evolution typically commences with a population of arbitrarily generated individuals and proceeds iteratively, with each iteration's population referred to as a generation. The evaluation of the fitness of each member of a given population is a recurring process across generations. The process of selection is employed to choose the fittest individuals from the existing population, and subsequently, their genomes undergo modification through crossover and random mutation to generate a new generation. The algorithm terminates when either a maximum number of generations has been produced or a satisfactory fitness level has been reached for the population.

2.1.11 Gravitational Based Search Algorithm

Rashedi et al. introduced a physics-based optimization algorithm that draws inspiration from the laws of gravity and mass interactions, named Gravitational Based Search algorithm (GSA) [24]. The algorithm under consideration regards agents as objects and evaluates their efficacy based on their respective masses. The phenomenon of gravitational attraction results in the mutual attraction of objects, leading to a collective motion of all objects towards those with greater mass. The algorithm ensures the exploitation step by causing the heavier masses, which represent optimal solutions, to move at a slower rate than the lighter ones. GSA assigns four distinct specifications to each agent,

namely: position, inertial mass, active gravitational mass, and passive gravitational mass. Stated differently, every mass offers a solution, and the procedure is guided by appropriately modifying the gravitational and inertia masses. Over time, it is anticipated that objects will be drawn towards the most massive object due to gravitational attraction. This mass is expected to offer an optimal solution within the given search space. It can be inferred that agents exhibiting superior performance possess a larger gravitational mass. Consequently, the agents exhibit a tendency to gravitate towards the most optimal agent.

2.1.12 Grasshopper Optimization Algorithm

Saremi et al. have developed the Grasshopper Optimization Algorithm (GOA) which emulates the collective behavior of grasshopper swarms through mathematical modeling [11]. Each individual grasshopper within the population is representative of a solution, and its calculation is determined by three distinct forces: social interaction with other grasshoppers, wind advection, and the force of gravity acting upon the solution. The process starts with a given population of grasshoppers, followed by an assessment of each solution through the computation of its value utilizing the fitness function. Upon assessing each solution within the population, we allocate the optimal solution based on its respective value. Subsequently, the coefficient parameter c is updated to reduce the sizes of the attraction, repulsion, and comfort zones. Afterward, the solutions within the population are revised by taking into account the distance between the grasshopper, which represents the solution, and the other grasshopper, which represents another solution. The normalization process ensures that the distance is scaled to a range between 1 and 4. Following that, the optimal location of the superior grasshopper is determined by applying the diminishing coefficient factor c which facilitates the alignment of swarm convergence towards the designated objective.

2.1.13 Grey Wolf Optimizer

Mirjalili et al. proposed the Grey Wolf Optimization (GWO) algorithm, which emulates the hierarchical leadership structure and hunting behavior of gray wolves found in the natural world [12]. It falls into the category of swarm-based MHs. The leadership hierarchy is simulated through the utilization of four distinct categories of gray wolves, namely alpha, beta, delta, and omega. The top three performers are denoted as alpha, beta, and delta, while the remaining individuals are classified as omega. The GWO employs a hunting strategy that is directed by the three key individuals. Wolves often exhibit leadership behavior by guiding their pack members towards the most optimal areas when searching for resources. The process of iterative searching involves the evaluation of potential prey locations by the group of alpha, beta, and delta.

The omega undergoes a relocation process based on the positioning of three other wolves. Furthermore, the three primary stages of hunting, namely locating prey, surrounding prey, and engaging in an attack on prey, are executed. The outcome generated by the first search agent will be retrieved.

2.1.14 Harmony Search algorithm

Geem et al. first introduced the Harmony Search (HS) algorithm, which drew its inspiration from the fundamentals of musical harmony improvisation [25]. It is a physics-based algorithm. During an improvisation, a musician is presented with three potential options: firstly, to perform a renowned musical piece, consisting of a sequence of harmonious pitches, from memory with precision; secondly, to play identically to a familiar composition while making slight adjustments to the pitch; or thirdly, to create original or arbitrary notes. The names of this phases are harmony memory, pitch adjustment, and randomization. The algorithm commences by initializing harmonics and subsequently generates new solutions by employing one of the aforementioned procedures. The first approach involves the selection of a limited number of optimal harmonies, while the subsequent approach introduces alterations to the solutions comparable to a genetic mutation. Additionally, the incorporation of randomization serves to enhance the variety of available solutions. Ultimately, the optimal solution has been chosen.

2.1.15 Krill-Herd Algorithm

The Krill-Herd (KH) algorithm is based on a simulation of the collective herding behavior that krill organisms exhibit when searching for food. This swarm-based MH was proposed by Gandomi and Alavi in their work [26]. The minimum distances of each individual krill from food and from the highest density of the herd are considered the objective functions of the krill's movement. The position of individual krill is affected by three aspects: krill movement due to other individuals; foraging behavior; and random diffusion. In order to enhance the efficacy of the algorithm, genetic reproduction mechanisms, namely crossover and mutation, have been integrated into the algorithm, drawing inspiration from the classical DE algorithm. Then the krill positions are updated until the end criterion is reached.

2.1.16 Moth-Flame Optimizer algorithm

Mirjalili developed the Moth-Flame Optimizer (MFO), a widely used swarm-based algorithm that emulates the transverse navigation mechanism of moths during night flights [27]. The MFO algorithm under consideration operates under the assumption that the candidate solutions can be represented as moths, while the variables of the problem are indicative of the moths' respective positions within the space. The fitness value corresponds to the output of the

fitness (objective) function for every individual in a given population. The algorithm incorporates the presence of flames. Both moths and flames can be considered potential solutions. Flames serve as the moths' most advantageous position thus far as they move through the search space as search agents. Thus, every moth conducts a search in close proximity to a flame and modifies its position upon discovering an improved solution. Through this mechanism, the moth is able to retain its optimal solution without any loss. During the optimization process, it is observed that every moth in the present iteration navigates around its respective flame by means of a logarithmic spiral. Each moth is assigned a specific flame.

2.1.17 Particle Swarm Optimization

Kennedy and Eberhart [28] introduced the initial swarm-based MH of particle swarm optimization (PSO). A group of particles navigates through a search space of D dimensions in pursuit of an optimal solution. Every individual particle is characterized by its current position and velocity vector. The conventional PSO procedure commences with the random initialization of the position and velocity vectors. During each iteration, the optimal position discovered by an individual particle as well as the optimal position discovered by the entire swarm, are utilized to update the velocity and position of the particles.

2.1.18 Sine Cosine Algorithm

The sine cosine algorithm (SCA) is a meta-heuristic algorithm that was developed by Mirjalili inspired by a mathematical approach [29]. The utilization of trigonometric sine and cosine functions for updating the positions of individuals towards the optimal solution characterizes a population-based MH approach to address optimization problems. The utilization of four parameters, namely r1, r2, r3, and r4, serves the purpose of preventing the occurrence of local optima and maintaining a balance between exploratory and exploitative search patterns. The parameter r1 plays a crucial role in determining the direction of a solution's position update. The parameter r2 governs the magnitude of a solution's movement towards or away from its destination. A further stochastic variable, denoted as r3, allocates a probabilistic weight to the target location. The final random parameter, denoted as r4 functions as a binary switch, determining whether the trigonometric function utilized will be the sine or cosine.

2.1.19 Shuffled frog-leaping algorithm

In 2006, Eusuff et al. introduced a memetic MH algorithm known as the shuffled frog-leaping algorithm (SFLA) [30]. It falls in the category of swarm-based algorithms. According to research, frogs are regarded as carriers of

memes that facilitate the exchange of information with other frogs, thereby influencing the relocation of their habitats to areas within the swamp that are abundant in food resources. Initially, a cohort of frogs is randomly produced and subsequently partitioned into various memeplexes within the swamp. Subsequently, the selection of frogs within each memeplex is carried out through triangular probability distributions, thereby facilitating the formation of novel sub-memeplexes. In the context of memeplex optimization, the host exhibiting the lowest performance within each sub-memeplex engages in meme optimization and repositions its stone by means of information exchange with either the most high-performing host in the entire population or the most high-performing host within the sub-memeplex. Upon completion of memetic evolution, the sub-memeplexes are ultimately reorganized and aggregated into a novel population, which then undergoes a continuous iterative process of searching for the most nutritionally abundant regions within the swamp.

2.1.20 Whale Optimization Algorithm

Mirjalili and Lewis developed the Whale Optimization Algorithm (WOA) to simulate the social behavior of humpback whales [31]. It falls in the category of swarm-based MHs. The method employed by the subject for hunting is commonly referred to as the bubble-net feeding method. The process comprises three primary stages, namely, prey encirclement, bubble-net assault, and prey exploration. Whales possess the ability to locate their prey and subsequently surround it in a circular manner. The bubble net attack is a technique that involves identifying the target's location and subsequently attempting to encircle the area surrounding the optimal solution through a process referred to as "shrinking encircling". The calculation of the distance between the present location and the newly encircled points is utilized to update the location. The phenomenon under discussion is commonly referred to as the "spiral updating position". In the interim, individual whales engage in foraging behavior by utilizing the indications provided by other species. The whale with the highest fitness value is identified, and this process is repeated until the desired outcomes are attained or the iteration limit is surpassed.

2.2 Benchmark test functions

Test functions are crucial for evaluating and comparing the effectiveness of optimization techniques. Numerous functions with a variety of properties have been proposed over the years for evaluating the global optimum. In the work of Jamil and Yang, 175 unconstrained optimization test problems are summarized and can be used to assess how well optimization methods perform [32]. Each function's description and classification are given in depth. Modality, basins, valleys, separability, and dimensionality are a few of these characteristics [32]. We considered a list of 18 test functions divided into

benchmark unimodal, multimodal, and fixed-dimension multimodal functions. The unimodal functions (F1–F7), which have just one global optimum, are appropriate for measuring the exploitation and convergence of the algorithms. Each of the multimodal functions (F8–F12) in the second category has a huge number of local optimum points and a global optimum. They are quite useful in examining how algorithms explore and avoid local optima. Meanwhile, the capability to explore in low dimensions is demonstrated using the fixed-dimension multimodal functions (F13–F18). The mathematical formula, the size, the range of variables, and the minimal ideal value are all provided for each function in accordance with the recommendations made in [33]'s work and are shown in the Appendix.

2.3 Related work

A comprehensive review of relevant literature has been carried out to examine comparable publications that assess the efficacy of distinct MHs across various benchmark functions. On May 10th, 2023, a search was conducted on Google Scholar using the keywords "review," "metaheuristic algorithms," and "benchmark functions." The selection criteria for papers require the inclusion of at least one of the twenty specified MHs. The selection process for papers is limited to those that exclusively compare MHs through the use of benchmark functions. Furthermore, research papers that aimed to contrast a novel or enhanced MH with other pre-existing MHs were excluded from consideration as their primary objective was not to compare these methodologies but rather to evaluate their relative performance against other MHs. The subsequent paragraph showcases a few of the chosen articles.

Demirhan et al. conducted a comparative analysis of PSO and FA on five distinct functions. The utilization of the PSO was observed to produce comparatively superior outcomes in contrast to the primary firefly algorithm [34]. Another study has successfully addressed the FA in a total of 11 benchmark functions. The obtained results have been subjected to a comparative analysis with those obtained through the implementation of other MH algorithms such as BA, Bacteria Foraging Algorithm (BFA), and CS. The comparative analysis indicates that FA exhibited superior performance compared to BA and BFA while demonstrating comparable outcomes to CS [35]. Ab Wahab et al. conducted a comparative analysis of various swarm-intelligence algorithms across 30 benchmark functions [36]. The algorithms encompassed in this set are GA, ACO, PSO, DE, ABC, Glowworm Swarm Optimization, and CS algorithms. DE seems to be the best overall performing approach, outperforming other methods in 24 out of 30 functions followed by PSO with the best performance in 19 out of 30. The third best is GA with 14 out 30 best performances and closely followed by ACO with 13 out of 30 best performances. On 10 benchmark functions, including unimodal and multimodal ones, Joshi et al. examined the performance of GA, Simulated

Annealing, and PSO [37]. According to the results, PSO outperformed GA and SA for most of the benchmark functions that were used. An experimental examination of the most recent 10 swarm-based MH algorithms was conducted on 12 well-known benchmark test functions with various characteristics for additional performance analysis. The FA, GWO, and Animal Migration Optimization (AMO) are very promising MH algorithms that can be utilized to resolve challenging unimodal and multimodal optimization issues, according to the simulation results [38].

3. EXPERIMENT ANALYSIS AND RESULTS

This section will present the results of applying the 20 MHs to each benchmark function. Forty search agents are taken into consideration for each method throughout 100 iterations in order to solve the unimodal and multimodal benchmark functions. Each algorithm is applied 30 times in order to conduct a fair comparison. For each MH, the fitness value is displayed. The final fitness corresponds to the optimal value generated from the objective function of each benchmark function. The average, standard deviation, and best and worst fitness values from the 30 runs are finally presented. Moreover, the complexity of each algorithm is shown based on the execution time. All the codes for MH are provided from the metaheuristicOpt R package [39], where the parameters of MH are the same as in the package.

3.1 Results from the experiment

Tables 1 and 2 display the mean (Avg) and standard deviation (SD) of the fitness values of the initial 10 metaheuristic (MH) algorithms and the final 10 MH algorithms, respectively. The selected functions are unimodal functions. The minimum average and SD are highlighted for each table.

Table 1: *Performance metric results on the unimodal test functions (10 first MHs)*

	Statistic	PSO	ABC	ALO	BA	BHO	CS	CSO	DA	DE	FFA
F1	Avg	4.58	17933.07	2764.80	**8.67E-185**	1496.72	48445.87	8.33E-08	2999.99	6446.02	62519.56
	SD	2.15	3083.76	1125.17	**0**	692.25	4132.50	2.37E-07	1732.65	1399.97	7692.35
F2	Avg	1.39	50.90	80.55	**3.89E-85**	10.2	607005301	0.0011	22.02	40.89	1.33E+1
	SD	0.29	6.22	34.10	**2.13E-84**	2.73	45773882	0.0022	8.93	7.30	34.27E+13
F3	Avg	109.73	250866	40927.44	**4.84E-191**	35847.86	663735.1	1.1E-06	37578.74	72654.8	875225
	SD	50.97	63242.06	19034.59	**0**	14783.29	70391.67	4.95E-06	22529.17	14097.11	123419.5
F4	Avg	0.88	75.38	24.57	**2.17E-103**	14.58	76.91	2.28E-06	40.91	64.26	80.05
	SD	0.19	2.78	5.79	**9.09E-103**	2.62	2.65	2.94E-06	11.99	4.80	3.96
F5	Avg	117.99	30628529	797176.6	28.99	1548025	136934963	28.99	1039747	7587554	1378579
	SD	61.56	9121657	734992.4	**0.01**	1067404	22428131	0.03	1257752	3286001	96 2203101 6
F6	Avg	4.78	18083.21	2889.01	7.4	1832.22	47046.72	2.04	3465.51	6584.32	62055.01

	SD	1.74	3806.66	1217.92	**0.18**	909.87	4130.3	0.77	2699.13	1655.01	7997.47
F7	Avg	6.16	15.82	1.99	0.59	0.78	59.99	0.52	1.81	4.28	3.84
	SD	6.31	5.64	0.73	0.263	0.29	12.19	0.262	1.06	1.75	1.46

The findings derived from the simulation outcomes presented in Tables 1 and 2 indicate that BA has effectively delivered the optimal solution for F1, F2, F3, and F4, among the seven unimodal functions considered in this study. Subsequently, it can be observed that GWO yields superior outcomes in terms of the mean fitness for F5 and F6. However, the standard deviation of BA indicates that the fitness values are more closely clustered around the mean compared to GWO. The optimal mean value for F7 is produced through the utilization of SFL, while the most favorable standard deviation is attained via GOA.

Tables 3 and 4 display the mean and standard deviation of fitness in relation to the multimodal functions. BA has attained the optimal global value for F9 and F11, as well as the most optimal metrics for F10.

Table 2: *Performance metric results on the unimodal test functions (10 second MHs)*

	Statistic	GA	GBS	GOA	GWO	HS	KH	MFO	SCA	SFL	WOA
F1	Avg	5480.63	44.64	351.53	6.9E-12	616.97	18583.08	6060.14	3468.54	159.05	1.5E-23
	SD	1255.78	42.53	208.30	6.6E-12	118.14	14866.78	5085.11	2518.66	59.64	4.9E-23
F2	Avg	20.70	7.59	20.6	2.75E-07	5.45	1.30E+12	50.82	6.33	4.22	3.03E-14
	SD	3.34	2.56	17.91	1.9E-07	0.88	5.82E+12	16.49	3.55	1.26	4.17E-14
F3	Avg	66840.55	1625.64	4719.41	9.66E-11	7964.71	219272.7	87717.43	41139.43	1889.79	4.09E-22
	SD	20043.37	1909.94	4251.99	1.39E-10	2702.32	197110	53200.13	34082.72	933.04	1.14E-21
F4	Avg	51.28	9.71	13.83	0.009	31.7	60.08	69.10	67	20.91	66.58
	SD	6.08	2.66	4.07	0.004	3.42	16.68	8.10	9.3	4.27	19.75
F5	Avg	2894991	2666.84	24355.74	**27.37**	93781.63	23474242	6805662	11727249	6238.6	28.47
	SD	1298344	3318.17	21006.95	0.6	40761.76	26196728	15260678	14790659	4537.96	0.34
F6	Avg	4894.70	67.7	272.74	**0.68**	632.41	18929.72	5603.51	3011.13	149.00	0.78
	SD	1226.10	78.27	158.42	0.35	173.47	15071.85	4089.70	1977.88	124.25	0.28
F7	Avg	2.15	1.17	0.77	0.61	0.71	7.34	4.7	4.92	**0.48**	0.46
	SD	0.66	0.43	**0.261**	0.27	0.27	3.11	3.42	3.5	0.31	0.30

According to the available data, GWO appears to yield the best results for F12. The minimum average for F8 has been provided by HS, while ALO has exhibited the lowest standard deviation.

Table 3: *Performance metric results on the multimodal test functions (10 first MHs)*

	Statistic	PSO	ABC	ALO	BA	BHO	CS	CSO	DA	DE	FFA
F8	Avg	-1009.98	-1198.97	-1632.06	-790.29	-844.36	-646.06	-787.49	-1153.47	-1589.26	-554.87
	SD	135.52	64.14	**0**	104.90	87.87	47.72	191.81	107.19	109.54	98.10
F9	Avg	75.61	376.76	159.39	**0**	174.70	764.78	1.55E-06	253.1	336.32	824.18
	Sd	14.73	38.94	30.03	**0**	33.91	40.02	3.05E-06	65.03	26.51	91.66
F10	Avg	20.56	20.34	8.62	**4.44E-16**	20.26	21.16	2.97E-06	20.31	20.32	21.01
	Sd	0.50	0.06	5.94	**0**	0.07	0.06	4.92E-06	0.16	0.10	0.19
F11	Avg	0.17	5.56	1.78	**0**	0.86	13.24	1.61E-09	1.88	2.653	16.35
	Sd	0.05	0.81	0.23	**0**	0.15	1.21	3.7E-09	0.58	0.32	1.66
F12	Avg	0.17	38.07	11.56	1.32	11.05	129.67	0.19	11.5	50.02	59.21
	Sd	0.35	5.39	5.92	0.29	4.46	11.65	0.10	5.58	9.65	11.07

Table 4: *Performance metric results on the multimodal test functions (10 second MHs)*

	Statistic	GA	GBS	GOA	GWO	HS	KH	MFO	SCA	SFL	WOA
F8	Avg	-1613.64	-674.10	-1355.28	-1146.45	**-1868.55**	54.75	-1662.94	-819.61	-961.70	-1721.9
	Sd	48.18	140.04	118.40	122.55	9.31	646.15	69.89	76.62	74.99	127.89
F9	Avg	214.23	45.03	174.13	18.29	54.4	398.92	302.68	210.75	61.91	8.34E-14
	Sd	28.67	11.44	26.70	10.93	8.76	73.55	61.87	59.94	17.71	8.92E-14
F10	Avg	20.18	13.406	20.48	20.92	20.03	20.44	20.004	20.39	7.12	1.49E-12
	Sd	0.04	2.64	0.22	0.06	0.005	0.13	0.008	0.08	4.01	3.60E-12
F11	Avg	2.32	0.63	1.08	0.01	1.17	4.26	2.55	1.74	1.01	0.02
	Sd	0.28	0.31	0.06	0.02	0.04	1.89	1.28	0.49	0.10	0.09
F12	Avg	11.87	0.87	8.82	**0.048**	1.89	36.32	39.98	20.31	1.20	0.052
	Sd	2.46	0.58	5.87	**0.02**	0.6	23.44	9.3	11.27	0.61	0.04

Both Table 5 and Table 6 display the mean and standard deviation of fitness findings for the fixed-dimension multimodal. Regarding the benchmark functions, only for the F17 function, PSO, ALO, DA, DE, and MFO yielded the optimal value (3) for the F17 function. For the other functions, the optimums are not the same, as shown in Table 9 of the Appendix. Concerning the remaining functions, it has been observed that in certain instances, the minimum average is attained by a multitude of metaheuristic algorithms (12 in total), such as in the case of F13. The algorithms in question are PSO, ABC, ALO, BA, BHO, CSO, DE, GWO, MFO, SCA, SFL, and WOA. A further case relates to F16, wherein the optimal mean is attained by nine meta-heuristic algorithms, namely PSO, ABC, ALO, DA, DE, GWO, MFO, SCA, and WOA. Out of the 20 metaheuristic algorithms considered (namely PSO, ABC, ALO, CSO, DA, DE, FA, GBS, GOA, GWO, KH, MFO, SCA, and WOA), 14 of them demonstrate an average of -0.3 and a standard deviation of 0 for F18. This suggests that a majority of these algorithms are well-suited for this particular optimization task. The most reliable statistical data for F14 is produced by the CSO, whereas for F15, it is the MFO that generates the most accurate statistics.

Table 5: *Performance metrics results on the fixed-dimension multimodal test functions (10 first MHs)*

	Statistic	PSO	ABC	ALO	BA	BHO	CS	CSO	DA	DE	FFA
F13	Avg Sd	**2.181038 1125** 0.03	**21810381 125** 0.0003	**21810381 125** 0.003	**21810381 125** 2.0E-06	**21810381 125** 2.37E-05	22306364 392 4.61E+08	**2181038 1125** 0.15	2181038 1126 5.67	**2181038 1125** **4.37E-07**	277475 92099 1.344E +10
F14	Avg Sd	0.002 0.005	0.002 0.0008	0.006 0.007	0.001 0.0009	0.001 0.003	0.01 0.008	**0.0006** **0.0001**	0.004 0.007	0.005 0.008	2.10 9.48
F15	Avg Sd	4.6525E-08 3.22E-11	4.95E-08 3.93E-09	4.65107E -08 7.00E-13	0.0004 0.0004	4.65105E -08 4.33E-13	0.04 0.03	0.004 0.004	5.13E-08 2.55E-08	4.65101 3E-08 1.87E-14	0.49 0.60
F16	Avg Sd	**16.960** 1.7E-13	**16.960** 5.97E-15	**16.960** 8.05E-15	16.961 0.001	17.38 0.26	17.36 0.33	16.97 0.02	**16.960** 1.47E-13	**16.960 0**	18.43 1.48
F17	Avg Sd	**3** 5.03E-10	3.007 0.01	**3** 3.53E-12	3.017 0.02	3.000001 3.56E-06	3.66 0.7	5.87 15.4	**3** 1.72E-09	**3** 2.86E-12	46.37 42.76
F18	Avg Sd	**-0.30 0** **0**	**-0.30 0** **0**	**-0.3 0** **0**	-0.28 0.03	-0.19 0.03	-0.15 0.05	**-0.3 0** **0**	**-0.3 0** **0**	**-0.3 0** **0**	**-0.3 0** **0**

Table 6: *Performance metric results on the fixed-dimension multimodal test functions (10 second MHs)*

	Statistic	GA	GBS	GOA	GWO	HS	KH	MFO	SCA	SFL	WOA
F13	Avg Sd	2183717 4687 2901182 5	2181041 1144 35157.05	2181038 1126 0.86	**2181038 1125** 1.00E-06	2181567 3278 1213947 0	2181528 9372 6254273	**2181038 1125** 1.87E-06	**2181038 1125** 2.92E-06	**2181038 1125** 0.032	**2181038 1125** 3.88E-06
F14	Avg Sd	0.009 0.01	0.009 0.02	0.01 0.01	0.009 0.01	0.005 0.007	0.28 0.80	0.001 0.0004	0.002 0.004	0.002 0.007	0.002 0.004
F15	Avg Sd	0.012 0.015	5.91E-06 6.95E-06	4.687E-08 2.9E-10	1.56E-07 1.18E-07	1.27E-05 2.93E-05	0.001 0.001	**4.651012E-08** **4.05E-17**	0.00027 0.0005	4.65396 E-08 1.61E-10	4.32E-07 1.67E-06
F16	Avg Sd	17.08 0.11	279.16 25.91	16.97 2.76E-11	**16.960** 7.82E-10	16.97 0.006	137.62 16.96	**16.960 0**	**16.960** 2.92E-06	19.06 2.14	**16.960** 5.99E-14
F17	Avg Sd	11.74 12.87	4.54 5.56	5.7 14.79	3.0004 0.0007	3.93 4.93	3.008 0.007	**3** **3.02E-15**	3.0012 0.002	3.90 4.93	3.0002 0.0008
F18	Avg Sd	-0.27 0.02	**-0.3 0** **0**	**-0.3 0** **0**	**-0.3 0** **0**	-0.3 0.0003	**-0.3 0** **0**	**-0.3 0** **0**	**-0.3 0** **0**	-0.06 0.04	**-0.3 0** **0**

3.2 The results of the best and worst fitness solution

Another approach to our analysis will be to evaluate how each MH has behaved in finding the minimum (best) and maximum (worst) fitness for each benchmark function. Figure 1 displays the lowest possible fitness for each function across all MHs. Figures 2 and 3 display the best fitness for the remaining 12 functions in the same way. According to the findings of Figs. 1, 2, and 3, BA algorithms find the best fitness in 9 out of 18 functions (F1, F2, F3, F4, F9, F10, F11, F13, and F18), WOA 6 times (F7, F8, F9, F11, F13, and F18), PSO 5 times (F12, F13, F14, F17, and F18), and GWO 4 times (F5, F6, F13, and F18). For F13, 14 MH locate optimal fitness; for F18, 15 MH achieve this; for F17, 9 MH; for F15, 4 MH; and for F9 and F11, just 3 MH.

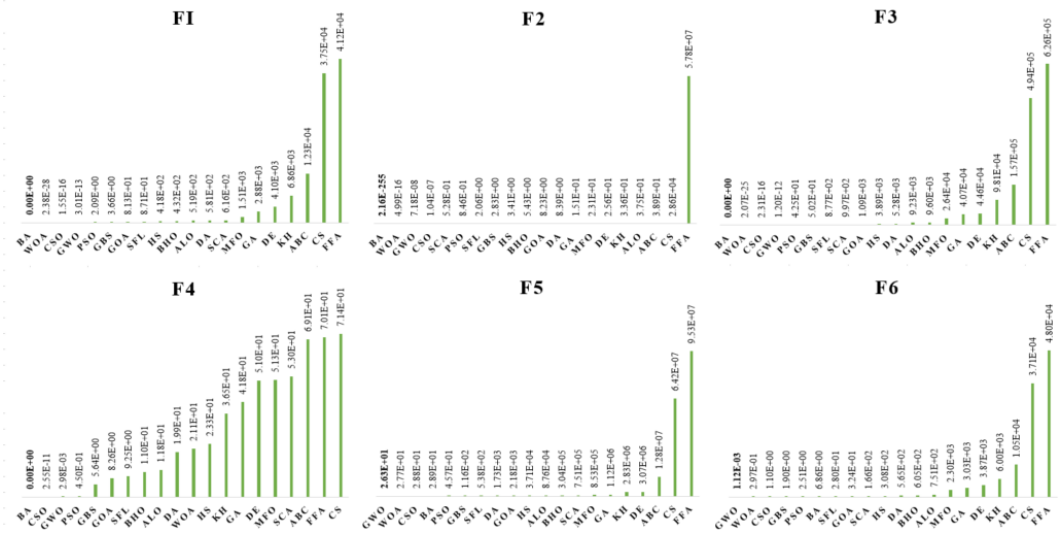

Figure 1: *Best fitness for the F1-F6 test functions*

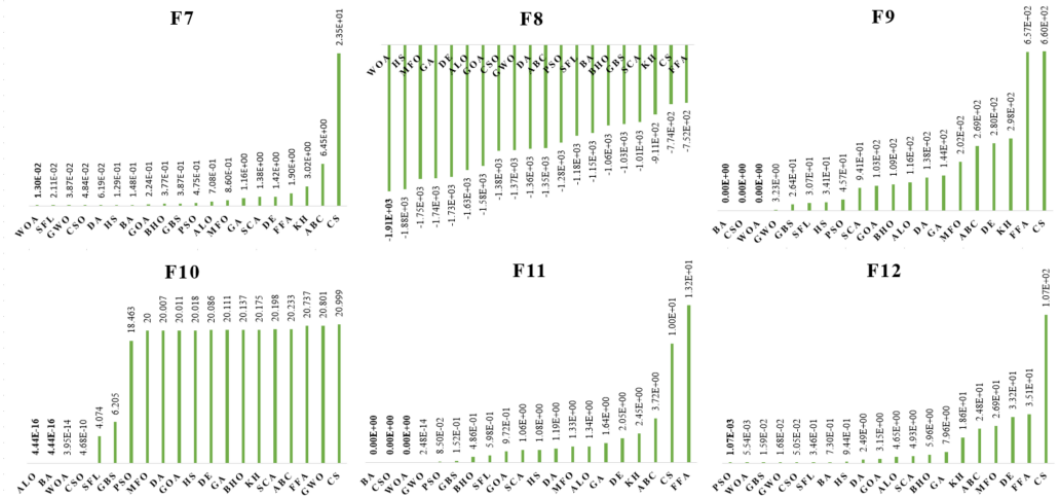

Figure 2: *Best fitness for the F7-F12 test functions*

Figures 4 through 6 illustrate the worst fitness offered by each benchmark function in connection with the 20 MH. The findings indicate that out of the 20 functions examined, the FFA metaheuristic approach yielded the highest level of fitness in 12 of them. However, it is notable that FFA may not be capable of achieving optimal fitness in the 12 functions, which are F1, F2, F3, F5, F6, F9, F10, F11, F13, F14, F15, and F17. The next MH is KH, which yields the worst fitness for the functions F4, F8, and F16. With respect to the F7, and F12 function, CS yields the highest fitness result (2 times), while for F18, SFL shows the highest fitness.

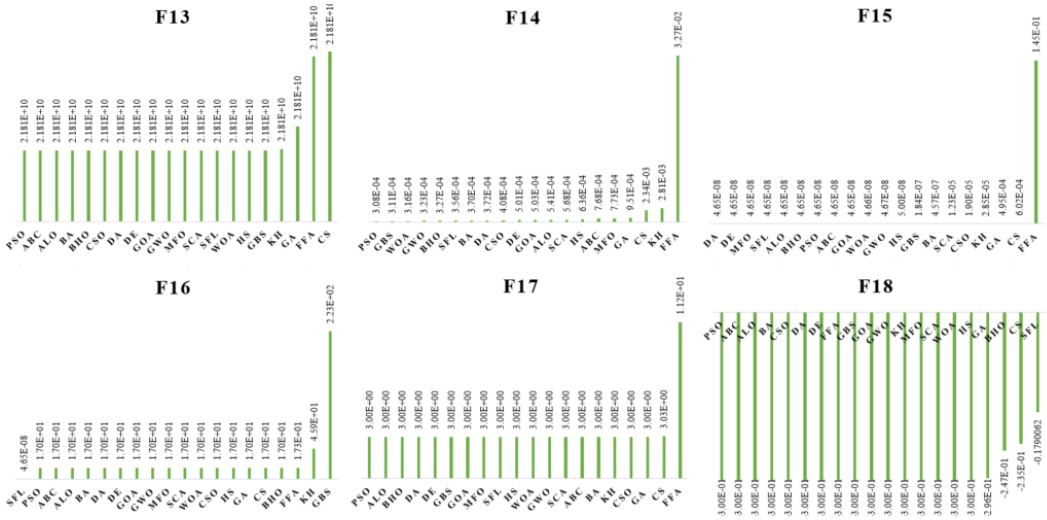

Figure 3: *Best fitness for the F13-F18 test functions*

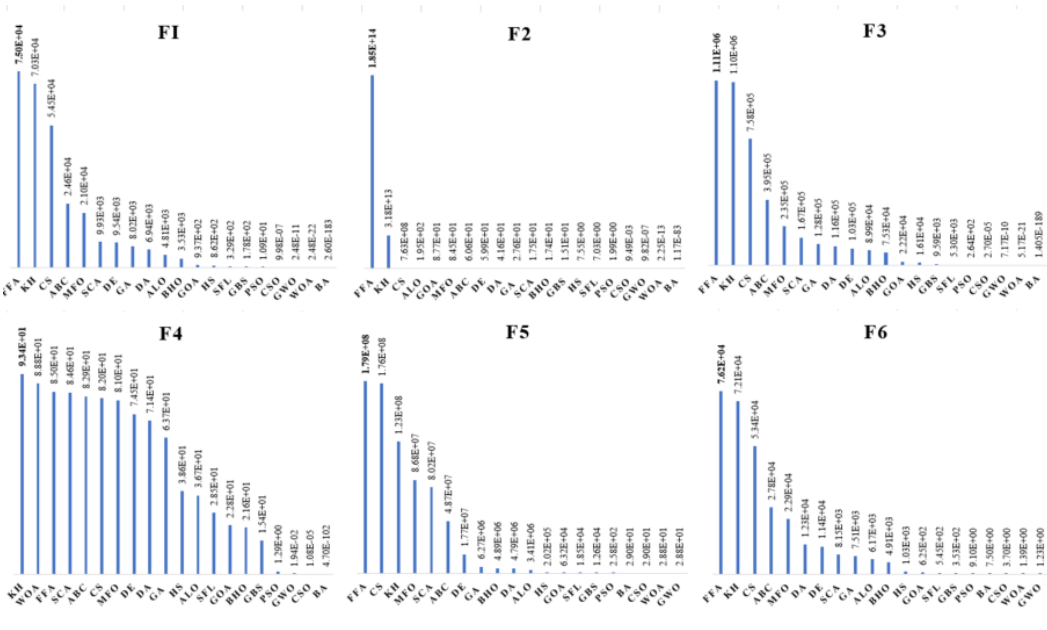

Figure 4: *Worst fitness for the F1-F6 test functions*

3.3 Execution time

Another significant metric refers to the amount of time of execution required by each MH. The experiments were conducted utilizing a personal computer equipped with an Intel(R) Core(TM) i5-3337U CPU 1.80 GHz and 8GB RAM,

running on the Windows 10 operating system. The RStudio environment is utilized for all executions [40]. The data presented in Figure 7 displays the average execution time of each MH algorithm, computed across all benchmark functions.

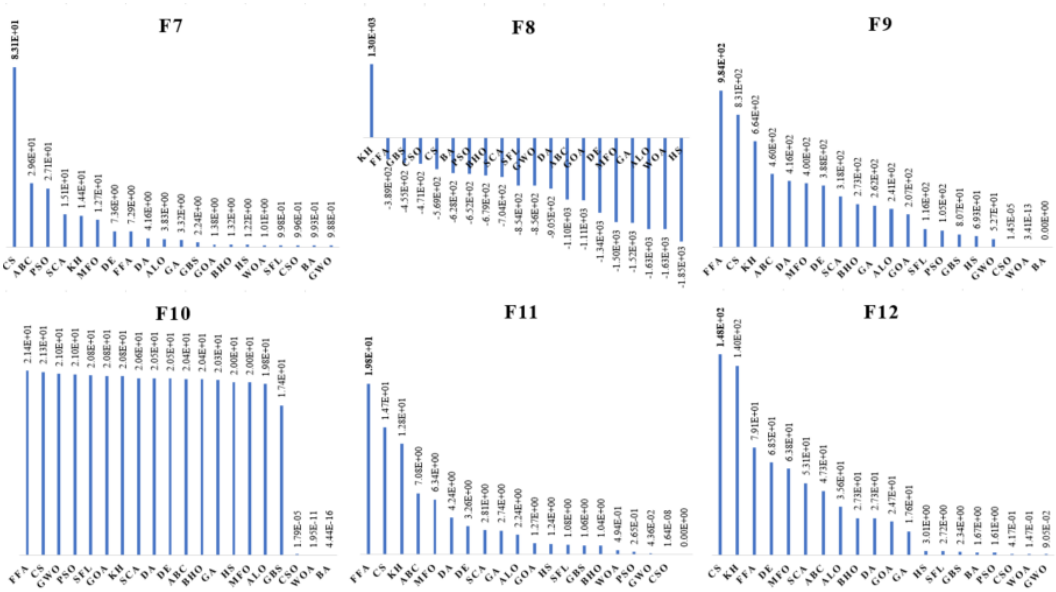

Figure 5: *Worst fitness for the F7-F12 test functions*

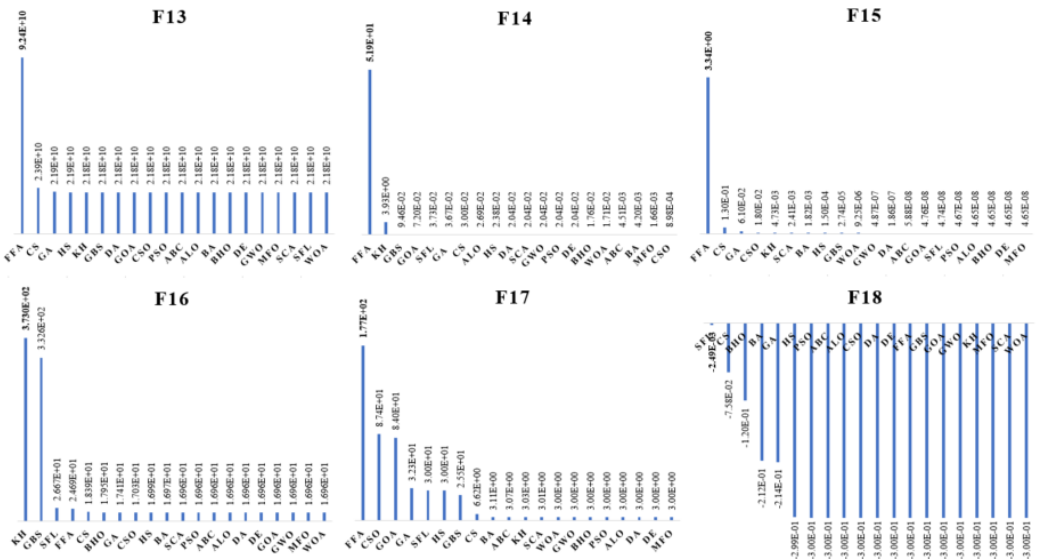

Figure 6: *Worst fitness for the F13-F18 test functions*

Fig. 7 indicates that the CSO algorithm exhibits a comparatively longer execution time, averaging 26.132 minutes across the 18 test functions. Subsequently, GOA shows a duration of 23.481 minutes, followed by KH with a duration of 13.04 minutes. The graphical comparison of MHs reveals that CS demonstrates the quickest execution time of 0.428 minutes, followed by BHO with 0.551 minutes and WOA with 0.563 minutes. DE, GA, ABC, BA, and MFO illustrate execution times of 0.602, 0.652, 0.699, 0.771, and 0.839 minutes, respectively. On average, the 18 functions can be processed in less than one minute by all of the algorithms mentioned above.

Figure 7: *The execution time of each MH*

4. CONCLUSIONS

This paper presents a comparative analysis of metaheuristic optimization algorithms and their capacity to attain the global optimum. In the present comparison, a total of 18 benchmark test functions have been employed, classified based on their respective characteristics as either unimodal, multimodal, or fixed-dimension multimodal functions. In the context of metaheuristics, a total of 20 algorithms have been utilized, with 14 of them being swarm-based (namely, CSO, GOA, KH, DA, SFL, ALO, GWO, PSO, FFA, MFO, BA, ABC, WOA, and CS), 2 being evolutionary-based (GA and DE), 3 appearing physical-based (GBS, HS, and BHO), and 1 remaining mathematical-based (SCA). A fitness value is generated for each metaheuristic,

representing the objective function's value from each benchmark function. The evaluation of metaheuristics is conducted based on various metrics such as average, standard deviation, minimum, and maximum fitness. Furthermore, an analysis of the velocity of each metaheuristic was conducted by calculating the average execution time across the total of 18 functions.

The BA algorithm has demonstrated superior performance in optimizing eight benchmark functions, as demonstrated by its evaluation of the average fitness. Notably, this algorithm appears to be particularly well-suited for identifying optimal solutions for both unimodal functions and multimodal functions, as it achieved success in the latter category on seven different occasions. At the same time, GWO has provided an optimal mean fitness for two unimodal functions and one multimodal function. In the context of fixed-dimension multimodal functions, it has been observed that the optimal objective function is exclusively attained by PSO, ALO, DA, and DE for the F17 function. In contrast to the other two categories of functions, a significant number of metaheuristics generate the majority of fixed-dimension average fitness values, which distinguishes them from the aforementioned categories. It can be deduced that a majority of metaheuristics are highly suitable for identifying the optimal solution for the final category.

With respect to the worst fitness achieved for each benchmark function, the results indicate that the FFA metaheuristic optimization algorithm yields notably higher fitness values in twelve benchmark functions, followed by KH for three functions, CS for two functions, and SFL for one function. There is a dissimilarity in the outcomes obtained while determining the minimum level of fitness. Benchmark functions, such as F18, involve the utilization of a significant number of metaheuristics, specifically 15, to determine the minimum value. The optimization algorithm known as BA has demonstrated superior performance in approximately 50% of fitness evaluations, followed by WOA, PSO, and GWO.

In terms of computational efficiency, it has been observed that CSO, GOA, and KH algorithms require a relatively longer time for their execution, whereas CS, BHO, and WOA algorithms show faster computational performance.

In future studies, alternative benchmark functions may be employed to attain the global maximum of the MH algorithms. Alternative values of MH parameters may have an impact on or enhance the overall optimal performance of the MH. Different dimensions and ranges of benchmark functions can have an impact on the optimal solution. As previously stated in the introduction, research in the field of MH is continuously developing, and alternative MH may be examined for similar functions.

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APPENDIX

Table 7: *Unimodal benchmark functions*

Function	Dim	Range	f_{min}	Name
$f_1(x) = \sum_{1=1}^{n} x_i^2$	30	[-100, 100]	0	Sphere
$f_2(x) = \sum_{1=1}^{n} \lvert x_i \rvert + \prod_{i=1}^{n} \lvert x_i \rvert$	30	[-10,10]	0	Schwefel 2.22
$f_3(x) = \sum_{i=1}^{n} \left(\sum_{j=1}^{i} x_j \right)^2$	30	[-100,100]	0	Schwefel 1.2
$f_4(x) = max_i\{\lvert x_i \rvert, 1 \le i \le n\}$	30	[-100,100]	0	Schwefel 2.21
$f_5(x) = \sum_{i=1}^{n-1} [100(x_{i+1} - x_i^2)^2 + (x_i - 1)^2]$	30	[-30,30]	0	Rosenbrock 1
$f_6(x) = \sum_{i=1}^{n} ([x_i + 0.5])^2$	30	[-100,100]	0	Step 2
$f_7(x) = \sum_{i=1}^{n} i x_i^4 + random[0,1)$	30	[-1.28,1.28]	0	Quartic

Table 8: *Multimodal benchmark functions*

Function	Dim	Range	f_{min}	Name
$f_8(x) = \sum_{1=1}^{n} -x_i \sin \sqrt{\lvert x_i \rvert}$	30	[-100, 100]	0	Schwefel 2.26
$f_9(x) = \sum_{1=1}^{n} [x_i^2 - 10\, cos(2\pi x_i) + 10]$	30	[-10,10]	0	Rastrigin

$f_{10}(x) = -20\exp\left(-0.2\sqrt{\frac{1}{n}\sum_{1=1}^{n}x_i^2}\right) - \exp\left(\frac{1}{n}\sum_{i-1}^{n}\cos(2\pi x_i)\right) + 20 + e$	30	[-100,100]	0	Ackley
$f_{11}(x) = \frac{1}{4000}\sum_{1=1}^{n}x_i^2 - \prod_{i=1}^{n}\cos\left(\frac{x_i}{\sqrt{i}}\right) + 1$	30	[-100,100]	0	Griewank
$f_{12}(x) = \frac{\pi}{n}\{\sin(\pi y_1) + \sum_{i=1}^{n-1}(y_i - 1)^2[1 + sin^2(\pi y_{i+1})] + (y_n - 1)^2\} + \sum_{i=1}^{n}u(x_i, 10, 100, 4)\ \ y_1 = 1 + \frac{x_i+1}{4}$ $u(x_i, a, k, m) = \begin{cases} k(x_i - a)^m & x_i > a \\ 0 & -a < x_i < a \\ k(-x_i - a)^m & x_i < -a \end{cases}$	30	[-30,30]	0	Generalized Penalized function no.1

Table 9: *Fixed-dimension multimodal benchmark functions*

Function	**Dim**	**Range**	**f_{min}**	**Name**
$f_{13}(x) = \left(\frac{1}{500} + \sum_{j=1}^{25}\frac{1}{j + \sum_{i=1}^{2}(x_i - a_{ij})^6}\right)^{-1}$	2	[-65, 65]	1	De Jong 5
$f_{14}(x) = \sum_{1=1}^{11}\left[a_i - \frac{x_1(b_i^2 + b_i x_2)}{b_i^2 + b_i x_3 + x_4}\right]^2$	4	[-5,5]	0.00030	-
$f_{15}(x) = 4x_1^2 - 2.1x_1^4 + \frac{1}{3}x_1^6 + x_1x_2 - 4x_2^2 + 4x_2^4$	2	[-5,5]	-1.0316	Six-Hump camel
$f_{16}(x) = \left(x_2 - \frac{5.1}{4\pi^2}x_1^2 + \frac{5}{\pi}x_1 - 6\right)^2 + 10\left(1 - \frac{1}{8\pi}\right)\cos(x_1) + 10$	2	[-5,5]	0.398	-

$f_{17}(x) = [1 + (x_1 + x_2 + 1)^2(19 - 14x_1 + 3x_1^2 - 14x_2 + 6x_1x_2 + 3x_2^2)] . [30 + (2x_1 - 3x_2)^2 . (18 - 32x_1 + 12x_1^2 + 48x_2 - 36x_1x_2 + 27x_2^2)]$	2	[-2,2]	3	Goldstein Price
$f_{18}(x) = -\sum_{i=1}^{4} C_i exp\left(-\sum_{j=1}^{3} a_{ij}(x_j - p_{ij})^2\right)$	3	[1,3]	-3.86	Hartman 3

The Impact of Artificial Intelligence on the Transformation of Our World

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Abstract

Artificial intelligence (AI) has become an increasingly prevalent topic in recent years, with the potential to revo- lutionize many aspects of our lives. While there are many potential benefits, there are also concerns about the impact that AI will have on job displacement and inequality. This paper will explore both the positive and negative effects of AI on our world. One of the positive impacts of AI is its potential to revolutionize many industries. AI has the ability to increase efficiency and productivity, reducing costs and improving decision-making processes. For example, in manufacturing, AI can help streamline the production process, leading to faster and more consistent output. In the financial sector, AI can be used to analyze large amounts of data, leading to more accurate financial predictions and risk assessments. However, there is also concern that AI will lead to significant job displacement. Automation can replace jobs previously done by humans, leading to a skills gap and income inequality. For example, self-driving cars may lead to the displacement of millions of truck drivers. Additionally, the skills required for many of the jobs that will be created by AI may be beyond the reach of many people, leading to a growing divide between the rich and poor. Despite these concerns, there are also arguments that AI can create new job opportunities. AI can create new industries, leading to the development of new skills and the creation of new jobs in areas such as data analysis and engineering. For example, as AI becomes more prevalent in healthcare, there will be a growing need for healthcare workers who have the necessary skills to work with these technologies. Another potential positive impact of AI is its ability to improve quality of life. AI can improve healthcare by enabling more accurate diagnoses and personalized treatment plans. It can also improve public safety by helping to prevent accidents and crime. Finally, AI can help protect the environment by enabling more efficient use of resources and reducing waste. AI has the potential to revolutionize many industries, leading to increased efficiency and productivity. However, there are also concerns about the impact that AI will

have on job displacement and in- equality. While there are arguments that AI can create new job opportunities and improve quality of life, there is still much work to be done to ensure that AI is developed in a way that benefits everyone.

Keywords: Collaboration, Governments, Education, Legislation, Intelligence.

JEL: classification: O10, O31, O19, F20.

1. INTRUDCTION

1.1. Definition of Artificial Intelligence. What is Artificial Intelligence?

Defining the exact nature of Artificial Intelligence (AI) is not an easy task. AI encompasses properties that are generally not found in non-artifacts, it is a result of human creativity and ingenuity, rather than a product of nature.2 AI has become increasingly popular in different fields, such as business, science, education, and medicine. It is also used in marketing to influence all aspects of the marketing mix, in- cluding consumer value delivery and the management of the marketing organization AI applications in marketing even reach the operational level3. The paper proposes a formal definition of AI, which is different from Turing's definition as it does not consider knowledge as an aspect of intelligence. Accord- ing to the definition, a newly born baby is also considered an intellect. AI is a property that arises from a certain process, which makes it distinct from other non-artifacts4.

1.2.What are the different types of Artificial Intelligence?

AI is composed of various subfields, with the four main ones being machine learning, artificial neural networks, natural language processing, and computer vision. Machine learning provides the ability to predict outcomes from data, and artificial neural networks are inspired by biological nerve systems, but have been simplified and divergent from natural mechanisms. AI algorithms inspired by nature, such as the grey wolf algorithm, ant colony optimization, particle swarm, and genetic algorithm, are also used in AI.

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What is Artificial Intelligence?.https://link.springer.com/chapter/10.1007/978-94-009-1900-6_1

CEEOL - Article Detail.https://www.ceeol.com/search/article-detail?id=775030

Computer Science > Artificial Intelligence.https://arxiv.org/abs/1210.1568

Additionally, there are two major branches of AI computer vision and natural language process- ing. Computer vision systems enable computers to identify objects and analyze images, while natural language processing systems help machines comprehend and generate human language5. Furthermore, AI has core subfields which have been reviewed in this piece, each of these subfields provides potential solutions to clinical problems. AI is also being used in other industries such as autonomous cars, social networks, and deep learning computers. Furthermore, there are two major types of AI approaches: learn- ing-based approaches and engineered autonomous systems6. Learning-based approaches involve online updates, which is known as life-long learning, these approaches may or may not enable autonomous learning abilities. On the other hand, engineered autonomous systems typically have fixed functional- ity sets that cannot be expanded. In addition to these two types, there are also generic AI systems that require autonomous learning AGI involves humans interacting with AI systems as omnipotent helpers, while ANI systems have a limited range of well defined intelligence related functionalities. The devel- opment of AI is divided into three stages: ANI, AGI, and ASI. ANI applications do not require globally optimal solutions and heuristic approaches have been widely studied as time feasible alternatives. ASI is considered a singularity in the development of AI, it may be able to create better AI systems than humans and may be considered a novel form of life. Additionally, there are alternative effective tech- nical routes for AI design, such as positive examples, ability migration, critical thinking, imitation, and creativity.7

1.3.Objectives, research and questions

In simple terms, this research examines the great impact that the use of AI has on the development of the economy, especially in new branches of industry. The rise of supercomputing power and Big Data technologies have empowered AI in recent years, the new generation of AI is again an attractive topic for research. This paper will explore both the positive and negative effects of AI on our world.

The main questions asked in this research:

- What is Artificial Intelligence?
- How is Artificial Intelligence different from Machine Learning and Deep Learning?
- What are the benefits of using Artificial Intelligence in business?
- How has Artificial Intelligence impacted the field of science?
- What are the potential benefits and drawbacks of using Artificial Intelligence in education?

- Determining who is at fault in case of an accident involving an autonomous vehicle?
- Managing a global autonomous arms race?

1.4.Research methodology

Analysis issues: There are several levels of analysis where challenges can arise due to various factors. AI is a result of human creativity and ingenuity, rather than a product of nature. Defining the exact nature of Artificial Intelligence (AI) is not an easy task.
Research methodology: A qualitative methodology is the most appropriate and effective tool to address the objectives of this study with the aim of answering the main questions that have been raised.
Data collection method: This study refers to AI has the ability to increase efficiency and productivity, reducing costs and improving decision-making processes. Considering the theoretical framework, the methodology was built to answer the main issues raised and the materials that supported the research argument were used.
Looking into the future: The findings of this study can renew the applicability of research in the future, what are the opportunities that developing countries have in the use of AI.

1.5.How is Artificial Intelligence different from Machine Learning and Deep Learning?

Artificial intelligence (AI) is a broad field, encompassing many different sub-categories. Machine learn- ing (ML), is a sub-discipline of AI, which focuses on allowing a machine to learn by itself. Deep learning (DL), is a more specific category of ML, which relies on various artificial neural network architectures to analyses data. ML and DL are often used interchangeably in literature, which can lead to confusion8. This is further compounded by the lack of consistency in how these terms are used. The paper does not provide a direct comparison of these three AI fields, but instead aims to analyses the current state of the art of their use in logistics.

Surgery.https://journals.lww.com/annalsofsurgery/FullText/2018/07000/Artificial_Intelligence_in_Surgery Promis- es_and.13.aspx

Artificial Intelligence and Law: An Overview.https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3411869

Quo vadis artificial intelligence?.https://link.springer.com/article/10.1007/s44163-022-00022-8

All three of these AI fields are used in logistics, with AI being used for the conceptual boundaries of the research subject, and ML and DL for the specific technical approaches 9. ML approaches include decision tree methods and DL techniques such as deep multi-layer and recurrent neural networks. AI is able to accurately predict clinical outcomes from high dimensional, multimodal data, is part of the same dynamic and rapidly evolving arena as ML and DL. AI methods can be thought of as functions that learn outcomes from input data, with ML and DL being specific types of AI methods. In summary, AI is a broad concept that encompasses both ML and DL, with DL being a sub-category within ML, which relies on neural network architectures with more than one hidden layer of interconnected nodes.

2. IMPACT OF ARTIFICIAL INTELLIGENCE ON BUSINESS. HOW HAS ARTIFICIAL INTELLIGENCE TRANSFORMED THE BUSINESS LANDSCAPES?

Artificial Intelligence (AI) has had a transformative effect on the business landscape across the globe. It is being used to search for efficiencies, to improve customer experience, and to create new business models, while also improving productivity and contributing to the global economy. AI is also trans- forming the way people communicate, which is aiding companies in creating new business structures. Furthermore, AI is being used to digitize products and services, making it the main driver of the current digital transformation. AI has also revolutionised business models in the insurance sector, with its ap- plications impacting the entire insurance value chain, from claims management, fraud detection, and underwriting accuracy, to personalization of customer experiences and improved customer satisfaction10. AI is also aiding companies to enter new revenue streams and acquire new customers, resulting in rev- enue growth. This is evidenced by the growing attention and interest from practitioners worldwide, as reflected in the rapidly growing and generously funded insurtech sector. Despite all these benefits, AI is still in its early stages of adoption, further research is needed to answer important research questions and help practitioners to take full advantage of the benefits of AI.

8 Sustainability | Free Full-Text | A Review of Further Directions for Artificial Intelligence, Machine Learning, and Deep Learning in Smart Logistics.https://www.mdpi.com/708784

9. Artificial intelligence, machine learning, and deep learning for clinical outcome prediction | Emerging Topics in Life Sciences | Portland Press.https://portlandpress.com/emergtoplifesci/article-abstract/5/6/729/230519

10 Laws | Free Full-Text | Digital Transformation and Artificial Intelligence Applied to Business: Legal Regulations, Eco- nomic Impact and Perspective.https://www.mdpi.com/2075-471X/10/3/70

11. The impact of artificial intelligence along the insurance value chain and on the insurability of risks.https://link.springer. com/article/10.1057/s41288-020-00201-7

AI has been used in cases related to fraud management, risk modeling, operation of services, customer service analytics, customer segmentation, marketing and sales, has the potential to raise profitability rates and contribute to economic growth11. However, it has also brought legal challenges for global authorities, as traditional methods of regulation are insufficient to regulate AI in the business landscape. AI has had a profound effect on people's daily lives, the economy, has the highest potential impact in sectors above USD 300B.

2.1.What are the benefits of using Artificial Intelligence in business?

The potential applications of AI in businesses are many, such as in enhancing customer intelligence, enabling faster informed decisions, leading to the innovation of products and services, and saving mon- ey and improving efficiency12. Furthermore, AI-powered personalized recommendations can increase the likelihood of customers choosing something they genuinely will like, while AI-driven customer segmentation can enable precise targeting13. AI also offers competitive advantages to adopters, with all the Big four firms employing the technology to save time, increase accuracy, gain insight into processes and improve client service 14. AI-driven marketing is also becoming increasingly popular, with organi- zations capitalizing on the technology to adapt their strategies, as well as introducing new products and services. As well as these benefits, AI-empowered strategic planning on the scale of the entire economy can build a model of extended reproduction and implement a model of sustainable, crisis free growth, while AI promises to transform businesses, allowing them to restructure their innovation activities. While it is clear that AI has the potential to bring unlimited benefits to businesses, it is still not clear how financial performance can be improved through AI adoption, especially in terms of long term financial returns, with firms needing to consider the equilibrium between investing in AI resources and the expected financial returns15.

2.2.What challenges arise from the use of Artificial Intelligence in business?

The use of Artificial Intelligence (AI) in business is rife with challenges, ranging from job displacement and the need for reskilling or upskilling of employees, to legal and regulatory issues such as intellectual property and liability, to ethical concerns around potential biases and lack of transparency. Moreover, a substantial investment is required to implement AI, involving not only the data infrastructure but also the acquisition of the necessary talent16. With such a plethora of issues, managers must determine which ones to address, to do this, it is essential to quantify the potential for value destruction associated with each component of AI. Currently, fewer than half of large

organizations have meaningful AI initiatives underway, although the percentage is increasing. On the other hand, AI is still in a relatively early state in large enterprises and absent from smaller ones, other than technology startups. In this regard, it is essential to overcome the challenges related to AI in organizations to realize the potential of this emerging technology17. For example, traditional manufacturing companies find it difficult to integrate AI into their business models, the need for AI business model innovation to be aligned with ecosystem innovation has been established. For short term incumbents, a strategy of ecosystem reconfiguration can be employed, whereas long term strategies should focus on ecosystem revitalization and resilience. AI also presents potential and risk, as indicated by case studies in universities, corporations, and govern- ments, is still a fuzzy concept with many open questions remaining. To address this, organizations need to consider the internal and external implications of AI, and AI needs to be seen in a more nuanced way. Additionally, few studies have examined customers' behavioral switch from human mediated services to technology mediated ones with regard to AI applications in frontline services. Low empathy and low adaptability are push effects that can affect consumers' behavioral switch from using human agents to using AI-based conversational agents. The frequency of service use positively moderates the relation- ship between pull effects, such as anytime or anywhere connectivity, association, visibility, and person- alization, and switching behavior. These issues and more must be taken into consideration, as customers' service experiences have shifted from interactions with service personnel to those with technology due to the application of AI technology in organizational frontlines. Finally, the rise of supercomputing power and Big Data technologies have empowered AI in recent years, the new generation of AI is again an attractive topic for research.

12 Artificial intelligence and machine learning as business tools: A framework for diagnosing value destruction potential. https://www.sciencedirect.com/science/article/pii/S0007681319301570

13 Artificial intelligence and sustainable development.https://www.sciencedirect.com/science/article/pii/ S1472811719300138

14 The rising tide of artificial intelligence and business automation: Developing an ethical framework.https://www.science- direct.com/science/article/pii/S0007681318301046

15 The Ethical Implications of Using Artificial Intelligence in Auditing.https://link.springer.com/article/10.1007/s10551- 019-04407-1

16 Artificial Intelligence in Organizations: Current State and Future Opportunities.https://papers.ssrn.com/sol3/papers. cfm?abstract_id=3741983

17 The Impact of Artificial Intelligence on Innovation - An Exploratory Analysis.https://papers.ssrn.com/sol3/papers. cfm?abstract_id=3821173

3. IMPACT OF ARTIFICIAL INTELLIGENCE ON SOCIETY. HOW HAS ARTIFICIAL INTELLIGENCE IMPACTED SOCIETY?

Artificial Intelligence is a revolutionary technology that has had a profound effect on society. It has im- proved various sectors such as healthcare, finance, and manufacturing and made life simpler18, safer and more efficient. AI also has the potential to bring many benefits such as increased efficiency, productivity, and economic growth. However, AI poses numerous ethical concerns such as privacy, algorithmic bias, and accountability, it has caused job displacement in some industries. AI also poses dangerous privacy risks, exacerbates racism by standardizing people, and costs workers their jobs19. AI has raised many im- portant questions for society, its impact is being discussed globally. Additionally, AI has altered society and has the potential to worsen our lives. It has also challenged the need for new AI bioethics principles and has had a tremendous impact on how we do things and the ways we relate to one another20. AI has impacted industrial, social, economic changes in the 21st century, it is expected to make most people better off over the next decade. Determining who is at fault in case of an accident involving an autono- mous vehicle and managing a global autonomous arms race are two of the challenges to be faced due to the impact of AI on society.

3.1. What are the positive and negative implications of Artificial Intelligence on society?

AI is both an opportunity and a risk for society, with implications for both positive and negative out- comes. Organizations must apply AI principles to remain competitive and to increase profitability. There are several positive implications of AI on society, such as increased efficiency and cost savings, im- proved decision-making, more accurate predictions. AI can also improve lives by providing medical services, reducing environmental damage, and creating new jobs. At the same time, AI can have neg- ative implications, such as job displacement, privacy concerns, and potential misuse of technology21. This could lead to unfair outcomes for certain people. Additionally, machine learning carries the risk of perpetuating data bias, use cases such as facial recognition and predictive analytics can result in racial bias and unfair loan rejections. AI literacy and upskilling are necessary to allow people to prosper in the new age of technology. The global AI market is projected to grow 54 percent each year, AI impacts our everyday lives in various ways. While the potential of AI is enormous, it must be monitored to pre- vent it from getting out of hand. Individuals in the scientific community must be informed about AI to anticipate and navigate its impact on society, to recognize the potential

risks and advantages. AI has the potential to create a better world, but it is also important to consider the potential negative implications22.

3.2.What are the ethical implications of using Artificial Intelligence in society?

The ethical implications of AI in society are complex and far-reaching. These implications include pri- vacy, surveillance, bias, discrimination, and the role of human judgment. Mistakes in healthcare pro- cedures or protocols can have devastating consequences for vulnerable patients, making it essential to address the legal and ethical issues related to AI. Currently, there are no well-defined regulations in place to address these legal and ethical issues, AI can become a source of inaccuracy and data breaches, leading to concerns about its use. Cybersecurity of associated vulnerabilities is another concern related to the ethical implications of using AI in society, and AI has the potential to increase efficiency and pro- ductivity, leading to economic benefits23. However, the ethical implications of AI usage can also impact meaningful work, the ethical implications of AI are often assumed to be negative, though AI can also have numerous benefits. The discussion of the moral status of AI depends on the definition of ethics, the discussion of the ethical implications of AI extends beyond immediate issues arising from machine learning to broader societal concerns. Additionally, metaphysical issues are linked to fundamental as- pects of reality and the nature of being, these issues are the most open and unexplored when considering the ethical implications of AI. To address these ethical implications, several companies have created guidelines, policies or a code of ethics, such as the Google Artificial Intelligence Principles, Microsoft Responsible AI Principles, and the EU's High-Level Expert Group on AI. Furthermore, a Delphi Study on AI and ethics gathered responses from 250 experts across various stakeholders, and found that ethical and human rights issues are raised by AI and big data. Ultimately, AI is a powerful tool that can be used for good, with the right ethical framework, AI can change the world for the better24.

18 What's The Impact Of Artificial Intelligence And Technology On Society.https://www.forbes.com/sites/bernard- marr/2020/03/09/whats-the-impact-of-artificial-intelligence-and-technology-on-society/

19 What is the impact of artificial intelligence (AI) on society?.https://www.britannica.com/question/What-is-the-im- pact-of-artificial-intelligence-AI-on-society

20 The impact of artificial intelligence on human society and bioethics.https://www.ncbi.nlm.nih.gov/pmc/articles/ PMC7605294/

21 Advantages and Disadvantages of Artificial Intelligence.https://www.simplilearn.com/advantages-and-disadvantag- es-of-artificial-intelligence-article

22 14 Ways AI Could Become A Detriment To Society.https://www.forbes.com/sites/forbestechcouncil/2021/06/14/14- ways-ai-could-become-a-detriment-to-society/

4. IMPACT OF ARTIFICIAL INTELLIGENCE ON SCIENCE. HOW HAS ARTIFICIAL INTELLIGENCE IMPACTED THE FIELD OF SCIENCE?

Artificial Intelligence (AI) has had a huge impact on the field of science. AI technologies like deep learning, computer vision and robotics have been used to improve industries' performance and quality. AI also has the potential to reduce the workload of medical professionals and improve patient care AI is being used to diagnose, monitor and predict medical conditions. In addition, it has been used in agricul- tural and food sustainability to solve multiple problems and save energy resources. Interest and research in AI has increased significantly over the last decade, billions of dollars are projected to be spent on deep learning in particular. AI has also been applied to medical image analysis. Predictions have been made about the future of radiology, ranging from algorithms outperforming radiologists to calls to "stop training radiologists now".25 Although the exact role AI will play in future radiology practice remains undefined, it will be integrated into the education of future radiologists. Radiology residents and fellows will need to learn how to interact with AI tools and understand how to evaluate their outputs. AI has also had an impact on materials, processes and structures engineering (MPSE), with AI and ML technologies being used for materials characterization, model development and materials discovery. ML is likely to be one of the most transformative technologies of the 21st century and can be used to improve MPSE results. AI advancements have also opened up a research frontier in computer sciences for understanding how technologies work and their relationships to physical science26. Furthermore, modeling frameworks can provide virtual test beds for materials and processes, which can be used in ML/DL/AI tools. Final- ly, a survey was conducted to evaluate perceptions towards radiology and other medical specialties in relation to AI.

4.1.What are the potential applications of Artificial Intelligence in science?

AI has a broad range of potential applications in various domains of science. It has the potential to mimic the cognitive functions of humans and to complete tasks based on algorithms in an intelligent manner. AI has been used in medicine since the 1990s, with expert systems being replaced by Machine Learning.

23 Ethical Issues of AI.https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7968615/

24 AI Ethics Are a Concern. Learn How You Can Stay Ethical.https://learn.g2.com/ai-ethics

25 Medical Student Perspectives on the Impact of Artificial Intelligence on the Practice of Medicine.https://www.sciencedi- rect.com/science/article/pii/S0363018820301249

26 Perspectives on the Impact of Machine Learning, Deep Learning, and Artificial Intelligence on Materials, Processes, and Structures

AI-based systems can analyze large amounts of data and make predictions about a patient's health. AI can also help clinicians with differential diagnosis by considering multiple confounding, interdependent outcomes. AI is a general- purpose technology that can be used in different contexts to perform a wide variety of tasks. It can help physicians to predict illnesses such as cancer risk, heart attacks and develop long-term plans of patient care AI can also be used for prediction in language translation, chat bots and other areas27. AI can assist in surgery when used with augmented reality programs. The healthcare market for AI is increasing rapidly and is expected to reach $6.6 billion by 2021. AI has the potential to transform healthcare by enhancing the efficiency and effectiveness of care delivery, by providing radiol- ogists with tools to improve accuracy and efficiency. AI can also be leveraged to manage large amounts of data and handle repetitive work processes. AI is expected to play an increasingly prominent role in medicine and healthcare due to advances in computing power, learning algorithms and the availability of large datasets. AI has the potential to substantially reconfigure health care, even to be a partner in medicine28.

4.2.How can Artificial Intelligence be used to enhance scientific research and development?

AI can be applied to various scientific fields to enhance research and development. For instance, in the field of shoulder surgery, AI can be used to improve accuracy, reduce costs, and reduce the duration of operations. Research on AI applications in shoulder surgery has proliferated in recent years. AI is a branch of computer science that aims to simulate human intelligence using automated computer algo- rithms. It can be used to analyze vast amounts of data in a short amount of time, uncovering patterns and insights that may otherwise go unnoticed. AI can also be used to automate repetitive tasks, such as data entry and analysis, freeing up scientists' time for more complex tasks. AI can also be used to improve the efficiency and speed of drug discovery by screening large databases of compounds and predicting their efficacy. Additionally, AI can help develop more accurate models and simulations to test scientific hypotheses. Finally, AI can be used to discover new materials and chemicals by predicting their proper- ties and optimizing their production29. As AI technology continues to evolve, it will become increasingly important for scientists and researchers to take advantage of its potential.

5. IMPACT OF ARTIFICIAL INTELLIGENCE ON EDUCATION. HOW HAS ARTIFICIAL INTELLIGENCE CHANGED THE EDUCATION SECTOR?

Artificial Intelligence (AI) has become a game-changer in the education sector, enabling the develop- ment of new methods of teaching and learning. AI applications, such as tutoring systems, social robots, smart learning and various other technologies have had a profound impact on education. AI has opened up new avenues of opportunities for the education sector, provides a solution to the various difficulties faced in education30. AI has been divided into three parts by Holmes, Bialik, and Fadel, and can be implemented by educational organizations according to their requirements and objectives. AI is also changing the education world and can be used to assist in risky tasks. AI technologies are not limited to smart learning and tutoring systems rather, AI technologies include virtual facilitator, online learning environments, learning management systems, learning analytics. AI has made it possible for students to access learning from any location, regardless of their location. AI has addressed and resolved many issues related to learning, such as content accessibility and teacher deficiency. However, inappropriate use of AI techniques, changing roles of teachers and students, and social and ethical issues are proposed as challenges in education caused by AI. AI technology must be capable of communication and under- standing the language used by the user side in the education sector. AI has the potential for supervision, process control, and optimization in education, is becoming a key engine of revolutionary change in the field of education31.

5.1. What are the potential benefits and drawbacks of using Artificial Intelligence in education?

AI has the potential to provide numerous benefits to education, such as the automation of monotonous operational tasks, the generation of assessments and feedback, the personalization of learning experi- ences, and the recommendation of educational resources.

27 Journal of Medical Internet Research - Artificial Intelligence and the Implementation Challenge.https://www.jmir. org/2019/7/e13659/

28 The impact of artificial intelligence in medicine on the future role of the physician.https://peerj.com/articles/7702/

29 Exploring the impact of artificial intelligence on teaching and learning in higher education.https://telrp.springeropen. com/articles/10.1186/s41039-017-0062-8?trk=public_post_comment-text

30 Sustainability | Free Full-Text | Artificial Intelligence and Its Role in Education.https://www.mdpi.com/1369450

AI also has the potential to impact relation- ships between different stakeholders in education, track learners' progress, and identify learning gaps. Furthermore, AI can identify effective teaching methods based on a student's context and past learn- ing experiences. Moreover, AI can help teachers make more informed decisions, rather than replacing them32. Despite its potential for educational applications, there are some drawbacks that must be taken into consideration, such as automation bias and issues of accountability, the risk of recommending the wrong learning materials, and the potential to perpetuate systemic bias and discrimination. As such, it is important to weigh the risks and potential benefits of using AI in education, particularly as it relates to the future of humanity. It is also important to consider ethical and societal drawbacks, as well as develop AI and ethics-based curriculum and professional development opportunities for teachers and students. The text provides an overview of five applications of AI in education, outlining their potential benefits for educators and students, as well as acknowledging that ethical issues surrounding AI may vary in prominence in different parts of the world. Additionally, the main promise of machine-learning models in education is increased accuracy and objectivity. Ultimately, teachers and students need to understand the potential risks and ethical drawbacks of AI applications in education in order to reap the benefits of AI while minimizing the costs33. AI can be a time-saving and cognitive aide for teachers, but it cannot be a substitute for human interaction, it is just one tool in the teachers' toolkit.

5.2.What role does Artificial Intelligence play in creating a more equitable education system?

Artificial intelligence (AI) has the potential to bring about a more equitable education system. AI tech- nology can help education systems use data to improve educational equity and quality in the developing world AI can also be used to improve learning outcomes by promoting personalized learning, as well as better learning outcomes34.

31 Sustainability | Free Full-Text | Analysis of Worldwide Research Trends on the Impact of Artificial Intelligence in Edu- cation.https://www.mdpi.com/1190674

32 Artificial Intelligence in Education (AIEd): a high-level academic and industry note 2021.https://link.springer.com/arti- cle/10.1007/s43681-021-00074-z

33 Artificial intelligence in education: Addressing ethical challenges in K-12 settings.https://link.springer.com/arti- cle/10.1007/s43681-021-00096-7

34 Artificial intelligence in education : challenges and opportunities for sustainable development.http://repositorio.minedu. gob.pe/handle/20.500.12799/6533

35 A vulnerability analysis: Theorising the impact of artificial intelligence decision-making processes on individuals, soci- ety and human diversity from a social justice

36 Artificial intelligence in educational leadership: a symbiotic role of human-artificial intelligence decision-making.https:// www.emerald.com/insight/content/doi/10.1108/JEA-10-2020-0216/full/html

However, the effects of AI decision-making processes on education systems should be analyzed using a social justice lens AI decision-making processes can disadvantage groups who have historically experienced discrimination. It is important to note that the use of AI technologies in the university admissions process can have significant impacts on individuals and society. Depending on their design, AI decision-making processes can either produce solidarity or segregation between groups in society. Additionally, AI decision-making processes may fail to reflect the lived experiences of individuals and undermine the protection of human diversity35. To ensure that equity is maintained in educational systems, AI technology should be used in conjunction with human judgment guided by moral values. AI can act as an extended brain in making data-driven, evidence-informed decisions that are bal- anced with value-based moral decision-making. To ensure that AI-assisted data -driven decision-making does not run against value-based moral decision-making, human judgment should be used alongside AI technology 36. In conclusion, AI technology can be used to create a more equitable education system, but it must be used in conjunction with human judgment and moral values.

6. CONCLUSIONS

Artificial Intelligence is a rapidly advancing field that has the potential to revolutionize the way we live and work. AI has already proven to be an invaluable tool in many areas, including healthcare, finance, and transportation. While AI has the potential to bring great benefits, it also poses some risks and chal- lenges. One of the main concerns is the potential for AI to take over jobs currently performed by hu- mans, leading to widespread unemployment. There are also concerns about the ethics and accountability of AI systems, as well as the potential for these systems to be hacked or manipulated. To ensure that AI is developed and used in a responsible and ethical manner, it is important for researchers, policymakers, and the public to work together. This includes developing clear guidelines and regulations for the de- velopment and use of AI, as well as investing in education and training programs to prepare individuals for the changing job market. In conclusion, AI has the potential to bring significant benefits to society, but it must be developed and used responsibly to avoid unintended consequences. Artificial Intelligence is a rapidly advancing field with the potential to revolutionize numerous aspects of our lives. Despite its potential benefits, AI also poses risks and challenges that must be addressed. Ethical and regulatory frameworks must be put in place to ensure that AI is developed and used in a responsible and transparent manner. Additionally, there is a need for increased education and training programs to prepare individu- als for the changing job market. As AI continues to evolve, it is important for researchers, policymakers, and the

public to work together to ensure that it is used to promote human welfare and benefit society as a whole.

7. RECOMMENDATIONS

AI development in developing countries, there are both opportunities and challenges:

1. Potential benefits of AI in developing countries: AI has the potential to bring significant benefits to developing countries, including improved healthcare, education, and infrastructure. For example, AI could be used to develop more efficient and effective healthcare systems, predict and prevent natural disasters, and improve access to education.
2. Barriers to AI development in developing countries: Despite the potential benefits, there are several barriers to AI development in developing countries. These include lack of infrastructure, limited access to funding and resources, and shortage of skilled professionals in the field.
3. Addressing the challenges: To overcome these challenges, there needs to be a concerted effort by governments, non-profit organizations, and the private sector to invest in AI development in de- veloping countries. This includes investing in infrastructure, providing training and education pro- grams, and creating policies and regulations that support the development of AI technologies.
4. Ethical considerations: As AI is developed and implemented in developing countries, it is important to consider the ethical implications. This includes issues such as privacy, security, and bias in AI algorithms. It is important to ensure that AI is developed and used in a responsible and transparent manner to avoid unintended consequences.
5. Collaboration and knowledge sharing: Finally, collaboration and knowledge-sharing are crucial for AI development in developing countries. By sharing expertise and resources, and working together to overcome common challenges, the global community can help ensure that AI is used to promote human welfare and benefit society as a whole in developing countries.

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RT ALBANIA – Rural Tourism Albania

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Abstract

RT Albania (Rural Tourism Albania) offers a platform for rural tourism. The platform is an important source of information for those interested in exploring rural areas and different cultures in Albania. Users can find detailed information about villages and tourist attractions, as well as browse galleries of beautiful places on the platform. The platform may also include maps of village locations, information about hotels and restaurants in the village, and important information for tourists.
Rural tourism is an important field of tourism that can help promote the development of village economies and promote their cultural heritage. The platform for rural tourism can help create links between tourists and local communities, making rural tourism an activity built on respect and tolerance for different cultures and traditions. With the updated and accurate data provided by the rural tourism platform, tourists can plan their visits to villages and rural areas in a suitable manner and prepare for an authentic experience.
This website is a valuable source of information and ideas for a fulfilling trip. This can help increase awareness about rural tourism and promote a culture of sustainable travel, which is respectful of nature and focused on protecting the environment and local communities. The platform for rural tourism is an important solution for those who want to explore the villages and rural areas and be in contact with the nature and culture of Albania.

Keywords: Rural Tourism, platform, information, explore.

1. INTRODUCTION *(Rural Tourism)*

Rural tourism is a form of tourism that focuses on utilizing the natural and cultural resources of rural areas for tourism purposes. This type of tourism offers an opportunity to explore undeveloped settlements and experience local culture and food traditions.[1]

Rural tourism offers many advantages for tourists. In this type of tourism, tourists have the opportunity to relax and feel away from the hustle and bustle of the city. They can enjoy nature and take a breath of fresh air during their leisure time. Additionally, they have the chance to try traditional food and learn about the culture and way of life of people in rural areas.

From an economic standpoint, rural tourism has many benefits for local communities. It creates job opportunities for people in the area and helps to boost the economy of those countries. Rural tourism also helps to preserve and conserve the cultural and natural heritage of a region.

Rural tourism is growing in popularity in many countries around the world, and this is due to the unique experience it offers to tourists. With many opportunities for adventure and exploration of nature and culture, rural tourism provides another form of escape from daily stress.

4.1. Rural Tourism in Albania

Rural tourism in Albania is one of the most important sectors for the economic development of rural areas in the country. Many areas in Albania have significant tourism potential due to their rich natural and cultural heritage.

Rural tourism in Albania offers a variety of activities for tourists, such as hiking, horseback riding, fishing, rafting, and more. Tourists can also enjoy traditional food and get to know the culture and way of life of people in rural areas.

2. WEBSITE

A website (also written as a web site) is a collection of web pages and related content that is identified by a common domain name and published on at least one web server.

A website for promoting rural tourism plays a very important role in the development and promotion of this sector in Albania. This page can be used as an information source for tourists who are seeking information about rural areas in Albania and the activities they can do there.

3. RT ALBANIA – Rural Tourism Albania

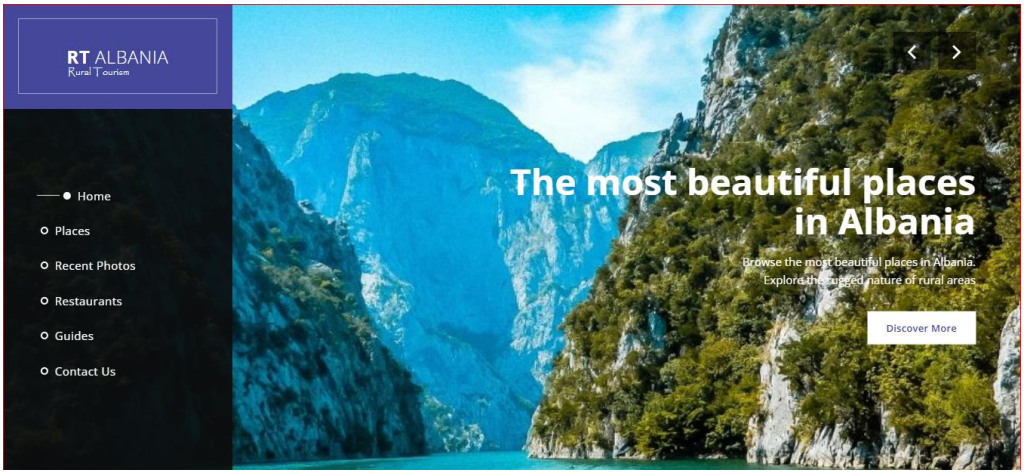

Figure 1: *RT ALBANIA main page*

RT ALBANIA aims to help promote rural tourism and provide information about beautiful villages, their culture, and traditions.
On this platform, users can find detailed information about villages and tourist attractions in them, as well as browse galleries of beautiful places. The platform may also include maps of the village location, information about hotels and restaurants in the village, and important information for tourists.
This website is a valuable source of information for those interested in exploring rural areas and different cultures around the world. The rural tourism platform can be an important resource for those who want to discover new places and be in touch with the nature and culture of a country.
Next, I will give you some concrete examples of the role that this website plays in promoting rural tourism:

3.1.Informing tourists

A website for rural tourism can provide detailed information about location, climate, activities, tourist attractions, as well as public transportation and main roads to reach rural tourism destinations. This information helps tourists plan their trip and make better decisions about their travel.

3.2. Promoting rural tourism

A website for rural tourism can help promote different rural areas and the activities offered there. This can help increase awareness of these areas and improve their reputation as tourist destinations.

3.3.Creating a communication channel

A website for rural tourism can help create a communication channel between tourists and local communities. This can help stimulate revenue and share ideas to improve tourists' experiences in rural areas.

3.4.Assisting in raising awareness for sustainable tourism

A website for rural tourism can help promote a culture of sustainable tourism and activities that impact the preservation of nature and cultural heritage in rural areas.

3.5.Creating a data source

A website for rural tourism can become an important source of statistical and analytical data for rural tourism in Albania. This can help make important decisions for the development of rural tourism in the future.

4. PAGE

4.1.Home

This Home men is the first presentation menu of the RT Albania page. Here, three slides will appear for three different pieces of information that you will be able to find on the page. A slide where in the background there will be a photo of a place from the rural tourist area presents the service of promoting tourist places and through the "Discover More" button, the site users will automatically see the tourist places that RT Albania promotes. The second slide will contain in the background a photo of a landscape of a restaurant and will enable direct connection with the group of restaurants located in these tourist areas. The third slide is designed to provide the site's tourists with a service to promote the guides that different agencies organize to visit these places. Each slide contains a button that automatically takes you to the corresponding menu of each service.

4.2.Places

Our Places menu is a comprehensive catalog of amazing places to visit, with detailed information on the most frequented destinations around the globe.
This menu offers you a virtual walk through iconic cities, beautiful beaches, impressive mountains, and historical sites. You can browse the different categories.

Each menu item contains a detailed description of the destination and amazing photos. Through the "Places Menu", you can create a list of favorite walks and gather important information to plan your dream trip.
Prepare for an extraordinary travel experience, feel like a virtual explorer, and get inspiration from our "Places" menu to start your new adventure in the world of tourism. Through a pop-up, tourists will be able to get more information specifically for that rural tourist village.

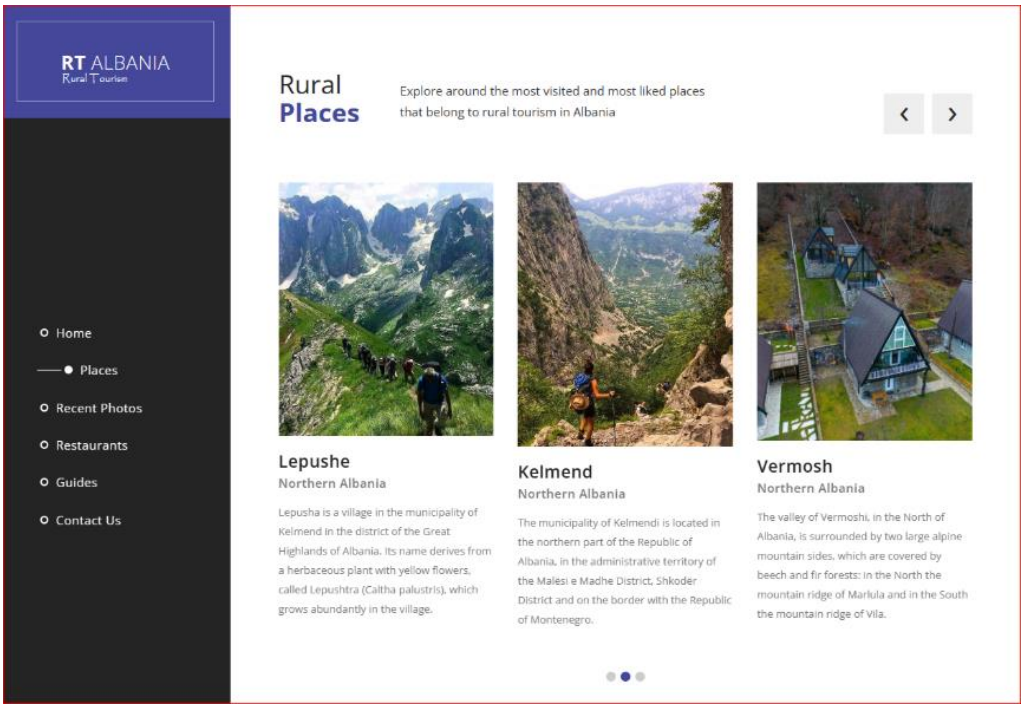

Figure 2: *Places Menu*

4.3.Recent Photos

In this section, site browsers can see some photos that visitors have taken in the places they have visited.

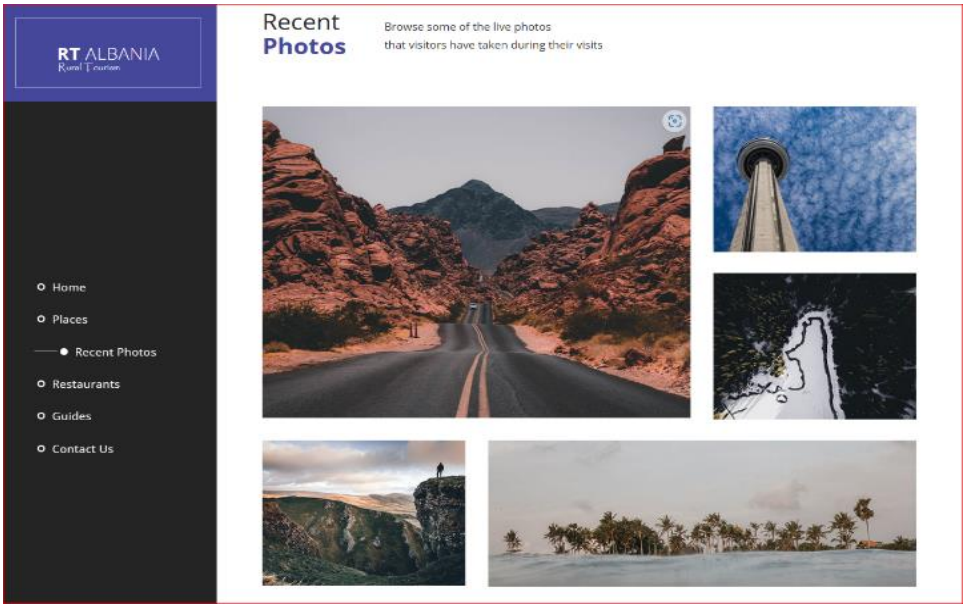

Figure 3: *Recent Photos Menu*

4.4.Restaurants

This menu will provide information about the restaurants located in each tourist area. When the user will click the "Continue" button, a pop-up will appear, which will contain detailed information about that restaurant. There will also be a GPS map showing the location of the restaurant. Each restaurant will have displayed the menu for which it stands out the most and the reviews that the tourists have left.

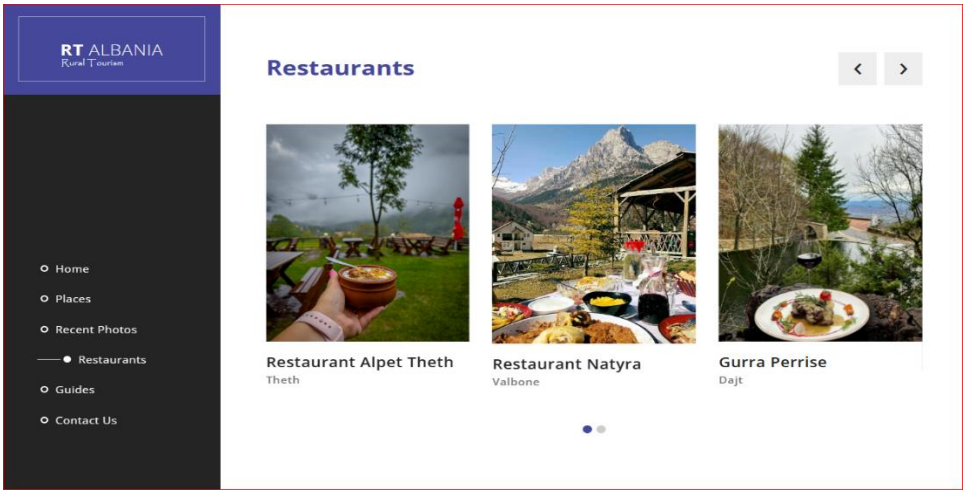

Figure 4: *Restaurants Menu*

4.5.Guides

In a table, all the guides that different agencies organize to travel to these countries will be displayed for each month. Each line will contain a photo of the tourist site with a brief description of the guide. If the tourist wants more information, he can click on the "Continue" button and more information will automatically appear through a pop-up. Through our RT Albania page, in this menu, each individual or group can make a reservation for a specific guide that they want to follow.

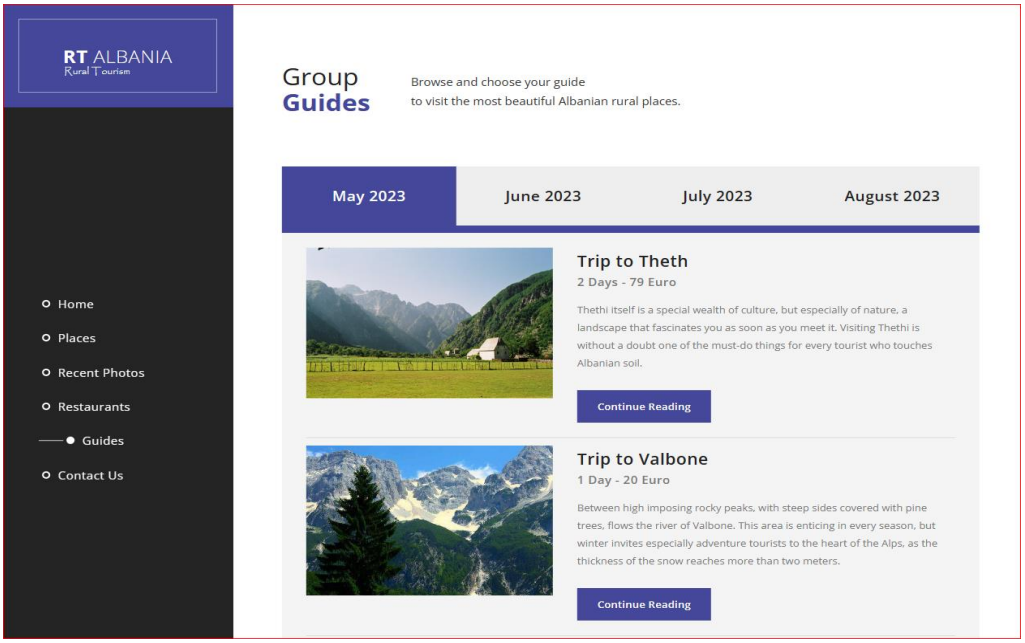

Figure 5: *Guides Menu*

4.6.Contact Us

A form gives the possibility to receive a message from the user of the site, via email.

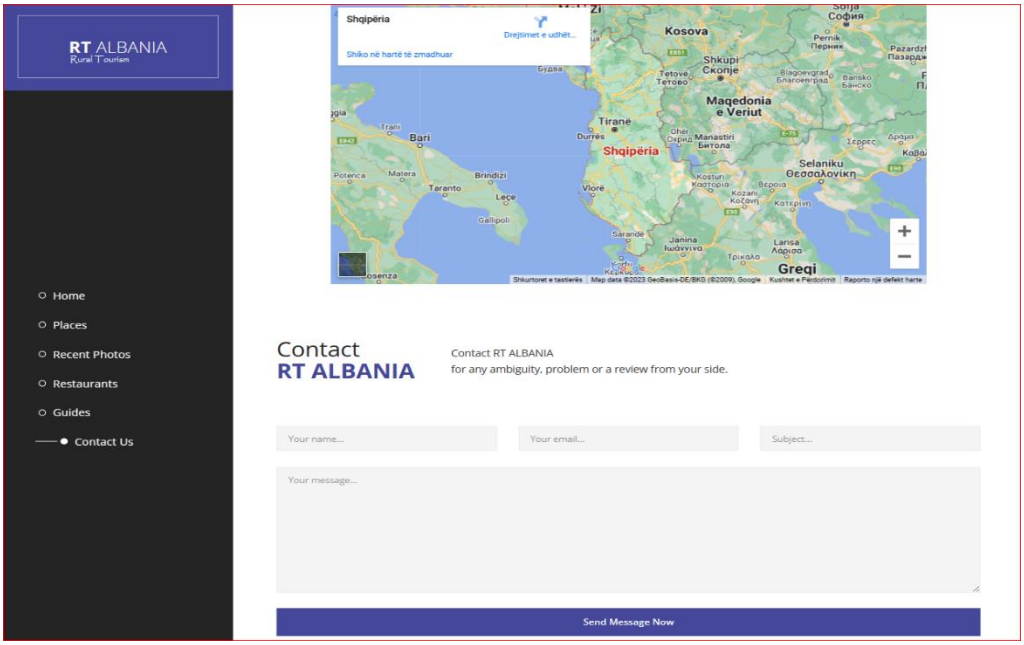

Figure 4: *Contact form*

WEB DOMAIN

You can visit Rural Tourism Albania by typing in the browser domain: https://rt-albania.netlify.app/ , or by scanning the code.

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Designing and developing a software system for a client in the automotive industry

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Abstract

Designing and developing a software system for a client in the automobile business is a difficult process that needs to be approached methodically. The software program may be applied to a number of automotive operations, including manufacturing, supply chain management, sales, and customer support. The software development team should adopt a structured methodology that includes requirements collecting, system design, software development, system testing and validation, deployment, and maintenance in order to guarantee the project's success. This team can create a high-quality software system that fulfills the needs and expectations of the customer and helps to increase the efficiency and effectiveness of their operations by cooperating closely with the client and using a systematic approach. It takes a systematic process that includes requirements gathering, system design, software development, system testing and validation, deployment, and maintenance to design and construct a software system for a client in the automobile industry. In the software engineering process the software development team can create a high-quality software system that fulfills the needs and expectations of the customer and helps to increase the efficiency and effectiveness of their operations by using a systematic approach and close communication with the client. Requirements management is essential in order to ensure that the software system meets the needs and expectations of the customer, is of high quality, compliant with regulations, cost-effective, and promotes effective communication and collaboration between the development team, customers, and stakeholders.

This case study emphasizes the significance of efficient requirements management in the development of software as well as the difficulties brought on by requirements volatility. Software development teams can lessen the effects of requirements volatility and create high-quality software systems that meet the needs by implementing an agile process that prioritizes flexibility and adaptability to changing requirements. Software systems are a critical

component of the automotive industry, which help companies to improve their productivity, security, safety, customer satisfaction, and innovation. The importance of software systems in the automotive industry is expected to continue growing as technology continues to advance and vehicles become increasingly connected and intelligent.

Keywords: software development, automotive industry, efficient management, requirements.

1. INTRODUCTION

Software systems play a critical role in the automotive industry in today's highly digital and connected world. Software systems are used throughout the entire lifecycle of an automotive product, from research and development to production, distribution, sales, and customer service. Software systems can automate many tasks, such as production line monitoring, inventory management, and supply chain optimization, thereby improving the overall efficiency and productivity of the automotive operations. These systems can help improve vehicle safety by incorporating features such as collision detection, driver assistance, and automated emergency braking systems. They can also enhance the security of the vehicle by implementing advanced cyber security measures to protect against cyber threats and attacks. Software systems can improve the customer experience by providing personalized services, such as online vehicle configuration, mobile app integration, and remote diagnostics[1]. They can also enable real-time communication with customers, leading to improved customer satisfaction. Software systems can enable the automotive industry to innovate and research new products and technologies by providing advanced simulation and modeling tools, as well as data analytics and machine learning capabilities. Designing and developing a software system for a client in the automotive industry can be a complex and challenging task due to several factors:

Integration with hardware: Software systems in the automotive industry (figure 1) often have to integrate with various hardware components such as sensors, cameras, and control units. Developers of these systems are required to have a thorough understanding of the hardware and the complicated interactions it has with software.

[1] Remote diagnostics is the act of diagnosing a given symptom, issue or problem from a distance. Instead of the subject being co-located with the person or system done diagnostics, with remote diagnostics the subjects can be separated by physical distance (e.g., Earth-Moon). Important information is exchanged either through wire or wireless.

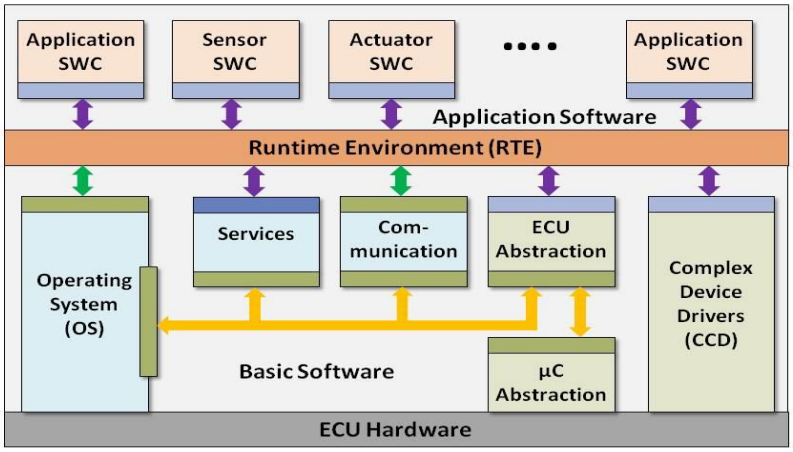

***Figure 1**: Software systems in the automotive industry*

Compliance with safety and regulatory standards: The automotive industry is highly regulated, and software systems must comply with safety and regulatory standards such as ISO 26262, which requires a rigorous process for safety analysis and validation.
Complex supply chain: The automotive industry has a complex supply chain with multiple stakeholders involved, which can lead to challenges in coordinating software development efforts between different vendors and suppliers.
Large and complex systems: Automotive software systems can be large and complex, comprising several components and subsystems, which can make it challenging to efficiently manage the development process.
Evolving technology: The automotive industry is constantly evolving, and software systems must keep pace with the most recent technical developments, including connectivity, autonomous driving, and electrification.
Data privacy and cyber security: With the increasing use of data and connectivity, automotive software systems must be designed with strong data privacy and cyber security measures to protect against cyber threats and attacks.

2. LITERATURE REVIEW

2.1. Requirements Gathering

Requirements gathering in the automotive industry are a critical part of the software development process, as it involves identifying and documenting the specific needs and requirements of the client. These are essential to ensure that the software system meets the needs of the stakeholders, and that the

development process is efficient and cost-effective. Effective requirements gathering in the automotive industry requires a deep understanding of the industry and its specific requirements, as well as a strong focus on communication, collaboration, and project management skills. It is also important to continuously. To gather requirements effectively for a client in the automotive industry, software developers should:

Engage with the client stakeholders: it requires identifying and engaging with the various stakeholders in the project, such as automotive manufacturers, suppliers, and end-users. Effective communication and collaboration with these stakeholders are essential to ensure that the requirements gathering process is effective and that the software system meets their needs.

Identify and document requirements: it is based on identifying the specific needs and requirements of the stakeholders and documenting them in a clear and concise manner. This may involve using techniques such as interviews, surveys, and workshops to gather information from stakeholders. Prioritize requirements: it involves prioritizing the requirements based on their importance and relevance to the project, requires using techniques such as stakeholder analysis and risk management to identify the most critical requirements. Validate requirements: is validating the requirements with the stakeholders to ensure that they are accurate, complete, and feasible. It requires using techniques such as prototyping, simulation, and user testing to validate the requirements.

2.2. System Design

System design is the process of defining the architecture (figure 2), components, modules, interfaces, and data for a software system to satisfy specified requirements. It involves the creation of a high-level description of the system's structure, behavior, and interactions. The purpose of system design is to translate the requirements gathered in the earlier phases of the software development process into a detailed specification that can be used to guide the implementation phase as architectural design, component design, interface design, database design, user interface design, system testing and evaluation. System design in the automotive industry involves creating a detailed plan for how the software system will meet the specific needs and requirements of the client.

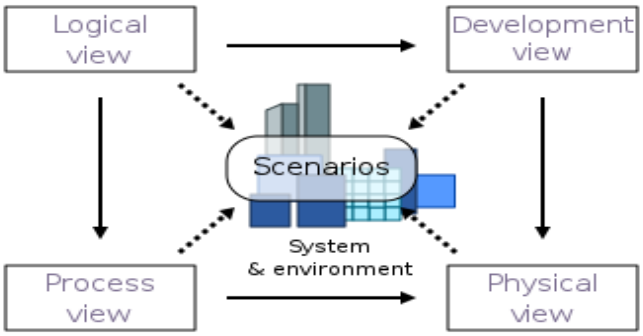

Figure 2: *4+1model used for "describing the architecture of software-intensive systems*

Effective system design is essential to ensure that the software system is efficient, reliable, and scalable. To design a software system effectively for a client in the automotive industry, software developers should: follow the steps below:

- Analyze requirements: is based on analyzing the requirements gathered from the client stakeholders to determine the specific features and functionalities the software system will need to have. This needs using tools such as use case diagrams and data flow diagrams to visualize how the software system will work.
- Define system architecture requires defining the overall structure of the software system, including how different components will interact with one another. This is reached using tools such as UML diagrams[2] (figure 3) to map out the system architecture.
- Choose development tools and technologies require selecting the appropriate tools and technologies for developing the software system. This needs considering factors such as performance, scalability[3], and maintainability.

[2] A UML diagram is a diagram based on the UML (Unified Modeling Language) with the purpose of visually representing a system along with its main actors, roles, actions, artifacts or classes, in order to better understand, alter, maintain, or document information about the system.

[3] In the context of scale-out data storage, scalability is defined as the maximum storage cluster size which guarantees full data consistency, meaning there is only ever one valid version of stored data in the whole cluster, independently from the number of redundant physical data copies.

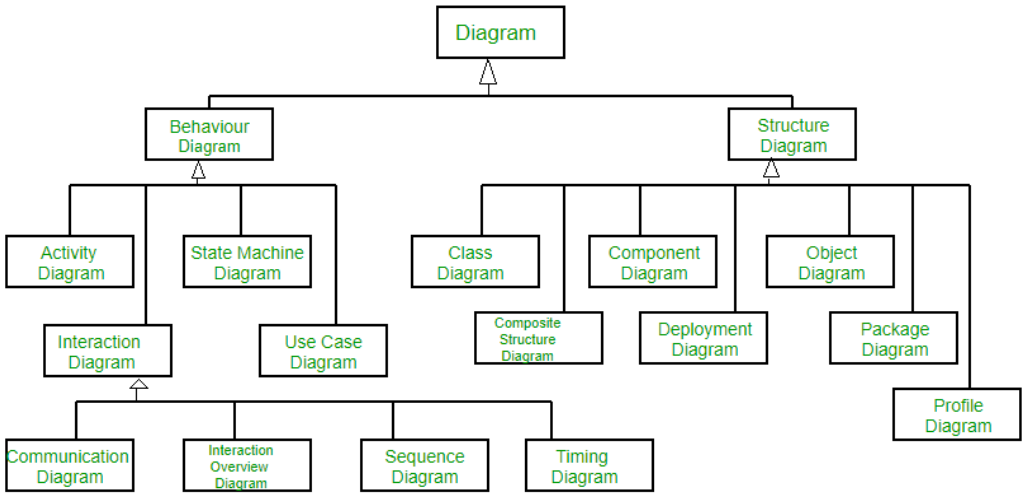

***Figure 3**: The hierarchy of diagrams according to UML 2.2*

- Create a detailed design specification based on creating a detailed plan for how the software system will be developed, including how different components will be integrated and how the system will be tested and validated. The best way is using tools such as flowcharts, sequence diagrams, and state machine diagrams to document the system design (figure 4).

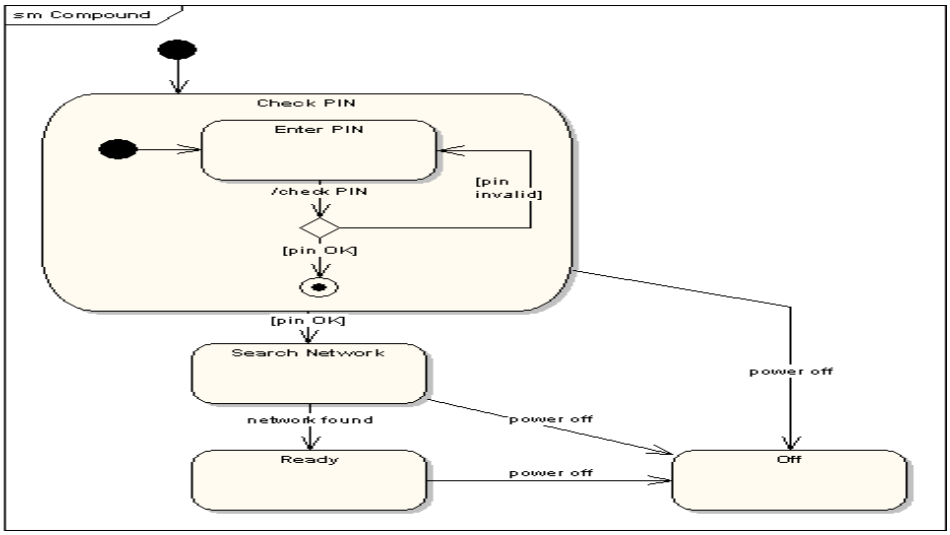

***Figure 4**: A state machine diagram including sub-machine diagrams.*

- Consider safety and reliability involves designing the software system with safety and reliability in mind, to ensure that it meets the high

standards required in the automotive industry. For this have to consider factors such as fault tolerance, redundancy[4], and error handling. Effective system design in the automotive industry requires a deep understanding of the industry and its specific requirements, as well as a strong focus on communication, collaboration.

3. METHODOLOGY

The purpose of this study is to show the steps that must be followed to design a software system effectively for a client in the automotive industry. Case diagrams and data flow diagrams are important to visualize how the software system works. Defining the system architecture requires defining the overall structure of the software system, including how the various components will need to interact with each other. Effective system design in the automotive industry is accomplished by using tools such as flowcharts, sequence diagrams, and state machine diagrams to document system design, understanding specific requirements, and a strong focus on communication and cooperation. Also, a detailed plan must be drawn up for how the software system will fulfill the specific needs and requirements of the client so that the software system is efficient and reliable (figure 5).

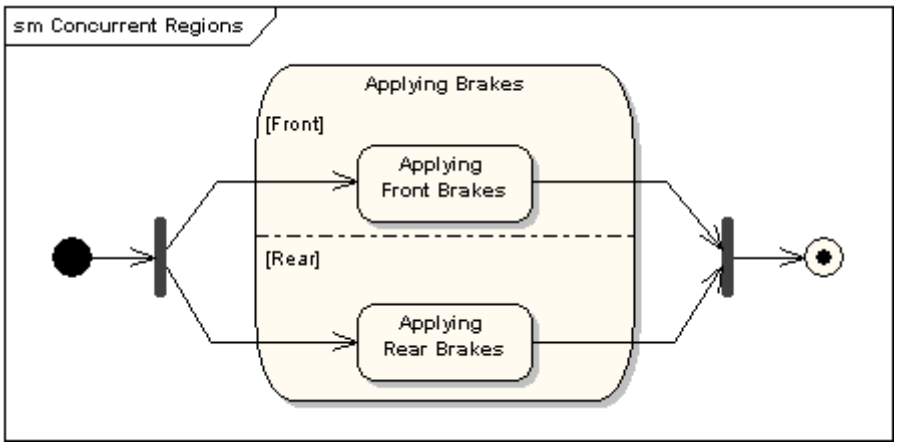

Figure 5: *The state "Applying Brakes" for the front and rear brakes to be operating simultaneously and independently*

[4] "Data redundancy" means keeping the same computer data in more than one place as a safety measure, and a backup system in an airplane may provide redundancy, again for the sake of safety.

4. RESULTS AND DISCUSSIONS

4.1 Deployment and Maintenance

Deployment is the process of installing the software system in the production environment, configuring it for use, and training users. This process can be based on several steps, such as packaging the software system, creating installation scripts, testing the installation process, and training users on how to use the software system. Maintenance is the process of maintaining and updating the software system over time to ensure that it continues to meet the needs of the stakeholders. Deployment and maintenance are crucial stages in the software development lifecycle in the automotive industry. Once the software system has been thoroughly tested and validated, it must be deployed and maintained to ensure it continues to function as intended. Some key considerations for deploying and maintaining software for a client in the automotive must be taken into account factors as.

a. Deployment plan is a comprehensive deployment plan should be created to ensure a smooth transition from the testing and validation phase to the production phase. The plan should include steps for installing the software, configuring it to meet the client's specific needs, and testing it in a production environment.
b. Backup and recovery plan is critical to develop a backup and recovery plan to ensure the software system can be restored quickly in case of any unexpected issues or failures.
c. Monitoring and maintenance plan should be in place to ensure the software system continues to function as intended. This plan should include regular software updates and patches, monitoring for any system errors or bugs, and providing technical support to address any issues that arise.
d. Compliance with industry standards such as ISO 26262 is essential for maintaining the safety and reliability of the software system. Therefore, the system should be tested and validated against these standards during the development phase, and compliance should be maintained during the deployment and maintenance phases.
e. Collaboration with stakeholders is effective including the client and end-users, and is essential for identifying any issues or concerns that arise after deployment. Continuous feedback and communication can help to identify areas for improvement and ensure that the software system continues to meet the needs of the client and the industry.

4.2. Software Development

Software development is the process of designing, creating, and maintaining software products. It encompasses a wide range of activities, including requirements gathering, design, coding, testing, and maintenance. The ultimate goal of software development is to create high-quality software products that meet the needs and expectations of the stakeholders. Effective software development requires a combination of technical skills, such as programming languages and development tools, as well as communication, collaboration, and project management skills (figure 6). The software development process should be guided by a clear set of requirements and design documents, and should be continuously reviewed and updated throughout the software development lifecycle. The figure below shows, a four Layer Security architecture. Here each layer provides a layer of security contributing to overall defense of the system.

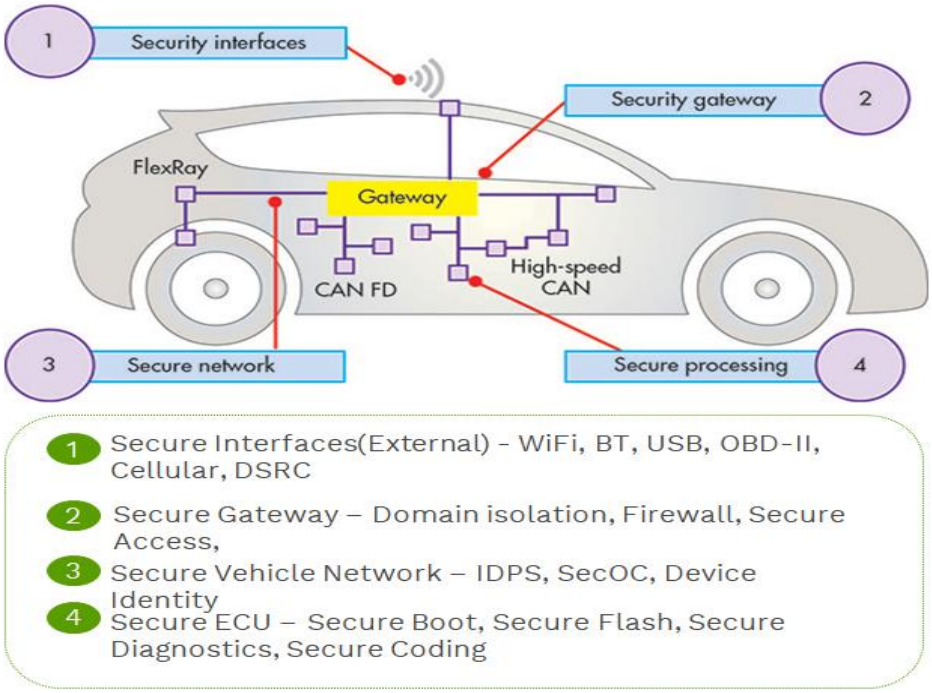

Figure 6: Secure Platform

Software development in the automotive industry requires designing and developing software systems that meet the specific needs and requirements of the automotive industry. This can include developing software for automotive manufacturing, design, testing, and maintenance, as well as software for vehicle connectivity, infotainment systems, and autonomous driving. One of the key challenges in software development for the automotive industry is the

complexity and diversity of the systems involved. Automotive software systems often require integration with a wide range of hardware and software components, including sensors, actuators, electronic control units (ECUs), and communication protocols[5]. Another challenge is ensuring that the software systems meet the high standards of safety and reliability required in the automotive industry.

Automotive software systems must be designed to operate in harsh environments, such as extreme temperatures, vibrations, and electromagnetic interference, and must be able to detect and respond to safety-critical events in real-time. To overcome these challenges, software development for the automotive industry typically involves a rigorous software development process that includes requirements gathering, design, coding, testing, and validation (figure 7) This process may also involve the use of specialized software development tools and techniques, such as model-based development and simulation. Effective software development for the automotive industry requires a deep understanding of the industry and its specific requirements, as well as a strong focus on quality, safety, and reliability. It also requires effective communication, collaboration, and project management skills, as automotive software development typically involves multiple stakeholders, including automotive manufacturers, suppliers, and regulatory agencies. The following figure shows the major uses of software in vehicles.

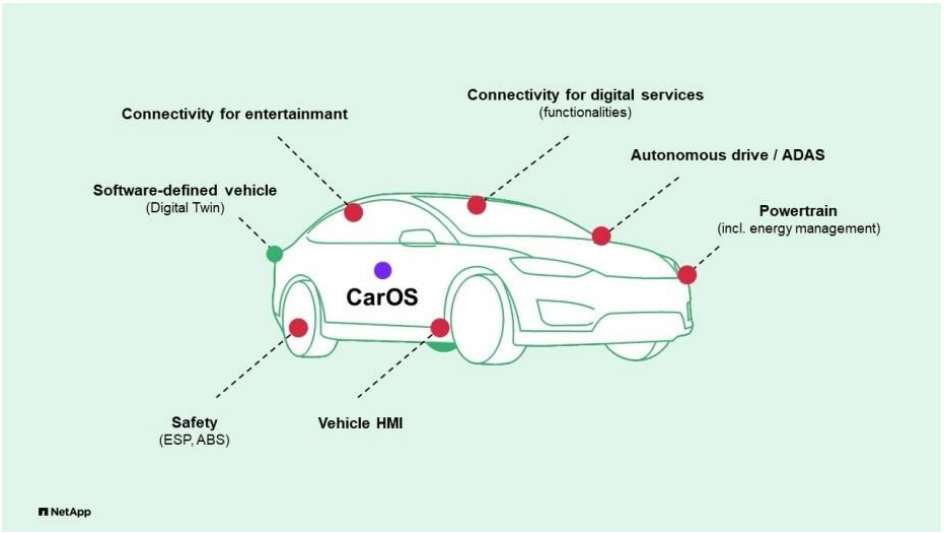

Figure 7: *The major uses of software in vehicles*

[5] A communications protocol is a set of formal rules describing how to transmit or exchange data, especially across a network. A standardized communications protocol is one that has been codified as a standard. Examples of these include Wi Fi, the Internet Protocol, and the Hypertext Transfer Protocol (HTTP).

4.3. System Testing and Validation

System testing and validation are critical parts of the software development process, as they ensure that the software system meets the requirements and is free of defects and errors. These processes typically involve a series of tests and evaluations to ensure that the software system is working as intended and meets the needs of the stakeholders. Effective system testing and validation require a combination of technical skills, such as testing tools and techniques, as well as communication, collaboration, and project management skills. These processes should be integrated into the software development lifecycle, with testing and validation occurring throughout the process, rather than as an afterthought. This system testing includes the following types of tests: functional testing, performance testing, security testing, usability testing and system validation includes: verification, validation and acceptance testing.
System testing and validation in the automotive industry is a critical part of the software development process, because it entails making sure the software system is reliable, efficient, and meets the specific needs and requirements of the client. Effective system testing and validation are essential to minimize the risk of software failures and ensure that the system is safe for use. To test and validate a software system effectively for a client in the automotive industry, software developers should:

- Develop a comprehensive test plan developing a detailed plan for how the software system will be tested and validated. The test plan should include a list of test cases, test scripts, and test data, as well as a schedule for testing and a plan for how to handle any issues that arise during testing.
- Conduct unit testing of individual components of the software system to ensure if they are working correctly. Unit testing may involve using tools such as automated testing frameworks to test code functionality and identify any defects or errors.
- Conduct integration testing to show how different components of the software system work together to ensure that they are integrated and functioning correctly. Integration testing may involve using tools such as testing frameworks and automated testing tools to test the interaction between different components.
- Conduct system testing on the entire software system to ensure that it meets the requirements of the client and is functioning correctly. System testing may involve using tools such as manual testing, automated testing, and performance testing to identify any issues or defects.

5. CONCLUSIONS

Designing and developing a software system for a client in the automotive industry requires careful planning, execution, and monitoring. The importance of requirements gathering, system design, software development, testing and validation, deployment, and maintenance cannot be overstated. To meet the specific needs of the automotive industry, compliance with industry standards such as ISO 26262 is critical, and effective collaboration with stakeholders is essential.

By following a well-structured software development lifecycle, software engineers can design and develop software systems that are reliable, safe, and efficient for clients in the automotive industry. With the increased use of technology in the automotive industry, software systems have become critical components of modern vehicles, and it is essential to design and develop them with a focus on quality, reliability, and safety. Through careful planning, execution, and monitoring, software engineers can create software systems that meet the needs of the automotive industry and contribute to the development of safer, more efficient vehicles.

A structured approach to designing and developing a software system for a client in the automotive industry is essential for ensuring that the system meets the specific needs of the industry, complies with industry standards, and is reliable, safe, and efficient. By following a well-structured software development lifecycle, software engineers can create software systems that contribute to the development of safer, more efficient vehicles and help the automotive industry to thrive.

The continued growth of autonomous and electric vehicles will require the development of software systems that can support these technologies. The increasing use of data in the automotive industry will require the development of software systems that can effectively manage and analyze large volumes of data. The integration of software systems with physical components of vehicles will require the development of software systems that can function seamlessly with these components.

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The impact of technology on education and its role in shaping the future of learning

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Abstract

Technology has revolutionized education in numerous ways, changing the traditional classroom and pedagogical practices. This paper aims to provide an in-depth analysis of the impact of technology on education, examining its benefits, challenges, and potential for shaping the future of learning. First, the paper explores how technology has transformed the classroom environment by enabling students to access vast amounts of information, interact with peers and teachers from different locations, and personalize their learning experiences. In addition, technology has enabled new ways of learning, such as e-learning, blended learning and flipped classrooms offer ring flexibility and accessibility. The integration of technology into education also brings challenges, such as the digital divide, equity and access issues, concerns about privacy and security, and potential for technology addiction.

The paper highlights the need to address these challenges and ensure that all students can benefit from the opportunities provided by technology. Furthermore, the paper examines emerging technologies, such as artificial intelligence, virtual reality, and block chain, and their potential to further transform education. These technologies offer new opportunities for personalized learning, adaptive assessment, immersive learning experiences, and credentialing. Finally, the paper concludes by discussing the role of technology in shaping the future of learning, emphasizing the importance of designing technology-enabled learning environments that foster collaboration, creativity, critical thinking, and innovation. The paper argues that technology is a powerful tool for enhancing learning outcomes and preparing students for the demands of the 21st-century workforce. Its potential can only be fully realized if it is integrated thoughtfully and purpose fully into education, with a focus on student-centered learning and equitable access for all learners.

*Key words***:** technology on education, modes of learning, essential component, modern society.

1. INTRODUCTION

Technology in education refers to the use of various technological tools and resources to enhance teaching, learning, and educational outcomes. It encompasses a wide range of hardware, software, and digital media, including computers, tablets, smart phones, educational software, multimedia tools, interactive whiteboards, online learning management systems, and digital libraries among others. The integration of technology in education is aimed at providing students with new ways of learning, facilitating access to information, promoting collaboration and communication, personalizing learning, and preparing students for the 21st-century job market. Technology in education is a dynamic field that continues to evolve and transform the educational landscape. Technology has become an essential part of education in the modern world. It provides a wide range of benefits, including improved access to educational resources, personalized learning experiences, and increased student engagement. Technology has become increasingly important in education in recent years. Here are some of the reasons why:

Access to information - Technology has made it easier than ever for students and teachers to access information. The internet is a vast resource of information that can be used to supplement traditional classroom learning. This information can be accessed from anywhere at any time, making it more convenient for students and teachers.

Engaging learning experience - Technology has made learning more interactive and engaging. Educational software, multimedia tools, and interactive whiteboards can make learning more exciting, fun, and effective.

Personalized learning - Technology has made it possible for students to learn at their own pace and according to their own learning style. Adaptive learning software[6] can adjust the difficulty level of lessons based on a student's progress, while online quizzes and assessments can provide immediate feedback to students (figure 1).

6 There are 2 main types of technologies where adaptive learning is being deployed: designed adaptivity and algorithmic adaptivity.

Figure 1: *Personalized learning program*

Collaboration and communication - Technology has made it easier for students and teachers to collaborate and communicate with each other. Online discussion forums, video conferencing, and social media platforms can be used to facilitate communication and collaboration between students and teachers.
Preparation for the future - Technology is an essential component of modern society, and students who are proficient in technology are better prepared for the future job market. Students who are comfortable with technology are more likely to be successful in a wide range of careers. In conclusion, technology has become an essential tool in education, providing access to information, engaging learning experiences, personalized learning, collaboration and communication, and preparing students for the future. As technology continues to evolve, it will undoubtedly continue to play a significant role in education, transforming the way we learn and teach. This paper aims to analyze the impact of technology on education and its role in shaping the future of learning. It will explore the advantages and disadvantages of technology in education, the role of technology in shaping the future of learning, and the challenges and opportunities of integrating technology in education. We will conclude with recommendations for integrating technology in education and a future outlook for technology in education.

2. LITERATURE REVIEW

2.1 The Impact of Technology on Education

a. Access to educational resources
Technology has significantly improved access to educational resources for students and teachers alike. Online libraries, digital textbooks, and educational apps have made it easier for students to access information from anywhere and at any time. Teachers can also use technology to access a wide range of teaching materials and resources to enhance their lessons.

b. Personalized learning
Technology has enabled personalized learning, where students can learn at their own pace and according to their individual needs. Adaptive learning software, for instance, can identify the strengths and weaknesses of each student and provide customized learning pathways to help them achieve their learning goals.

c. Blended learning
Blended learning combines face-to-face classroom instruction with online learning (figure 2). Technology has made it possible for students to access online resources and collaborate with other learners outside the classroom. Blended learning provides a flexible and customized learning experience for students while allowing teachers to monitor student progress and provide support. Flexible learning is a method of learning where students are given freedom in how, what, when and where they learn (figure 2).

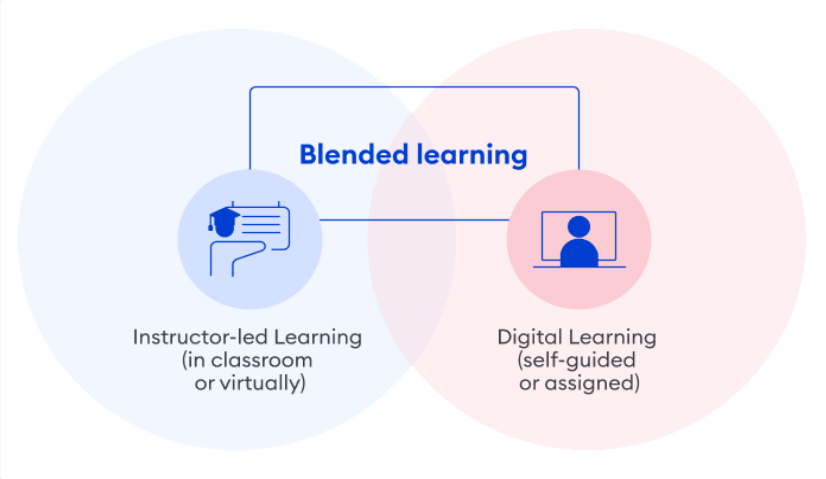

***Figure 2**: Blended learning*

d. Distance learning
Distance learning refers to a mode of education where students learn remotely, often through online platforms. Technology has made distance learning more accessible and effective, enabling students to learn from anywhere and at any time. This approach to education has become increasingly popular, especially during the COVID-19 pandemic.

e. Gamification
Gamification is the use of game-like elements in educational activities to enhance student engagement and motivation. Technology has made it possible to create educational games and simulations that can help students understand complex concepts and skills in an enjoyable and interactive way. Technology has had a significant impact on education, providing new and innovative ways to learn and teach. It has opened up new opportunities for students and teachers and has transformed the traditional classroom into a more engaging and dynamic learning environment.

3. METHODOLOGY

The purpose of this paper is to examine how technology is affecting education and how it will affect how people will learn in the future. Firstly we give the reasons why technology has become increasingly important in education in recent years. The paper explores the benefits and drawbacks of technology in education, how technology is influencing how people will learn in the future, and the potential opportunities and challenges associated with incorporating technology into the classroom. We'll wrap off with suggestions for utilizing technology in education and a look at what the future holds for this field.

4. RESULTS AND DISCUSSIONS

4.1. The Role of Technology in Shaping the Future of Learning

Technology is constantly evolving, and its impact on education is likely to become even more significant in the future.

- Artificial Intelligence in Education

Artificial intelligence (AI) has the potential to revolutionize education by providing personalized learning experiences and automating certain tasks, such as grading and assessment. AI-powered educational tools can also adapt to the learning pace of individual students and provide real-time feedback, making the learning process more efficient and effective (figure 3).

Figure 3: *Artificial intelligence in education*

- Virtual and Augmented Reality in Education

Virtual and augmented reality technologies have the potential to transform the way students learn by providing immersive, interactive experiences that can enhance engagement and understanding of complex concepts. For example, virtual reality simulations[7] can enable students to explore historical sites, experience scientific phenomena, or even visit different countries and cultures without leaving the classroom (figure 4).

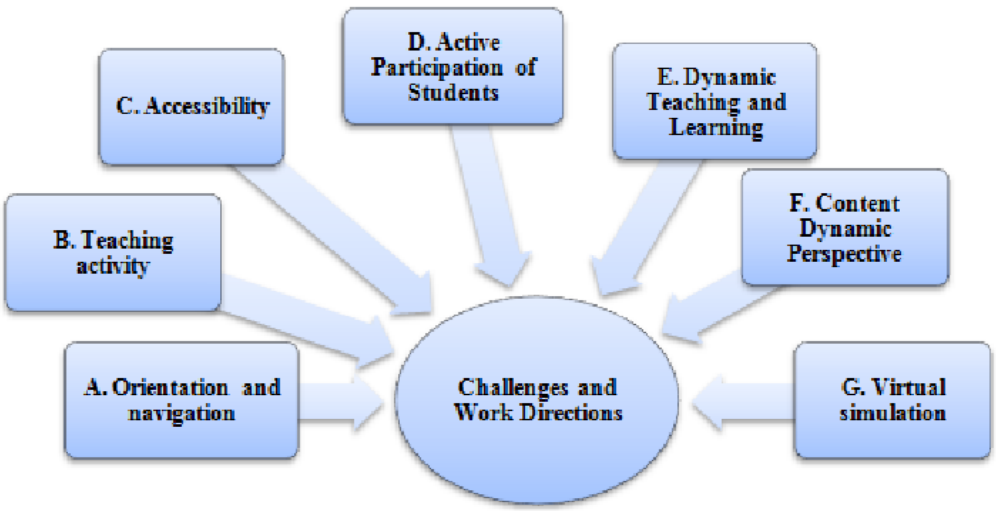

Figure 4*: Challenges and work directions*

- Personalized Learning Technologies

Technology has made it possible to tailor learning experiences to the individual needs and preferences of each student. Personalized learning technologies can

[7] virtual reality (VR), the use of computer modeling and simulation that enables a person to interact with an artificial three-dimensional (3-D) visual or other sensory environment.

assess a student's learning style and pace and provide adaptive content and learning activities that match their individual needs.

- Gamification and Game-based Learning

Gamification involves the use of game-like elements, such as points, badges, and leader boards, to motivate and engage students in the learning process. Game-based learning goes a step further by using actual games to teach specific concepts and skills. These approaches can help make learning more enjoyable and increase student motivation and engagement.

- The Impact of Technology on the Teaching Profession

Technology is also changing the role of teachers in education. With the availability of digital learning resources and tools, teachers are becoming facilitators of learning rather than just information providers. Teachers must also learn to use technology effectively and stay up-to-date with the latest developments in educational technology. The future of education is likely to be shaped by the continued evolution of technology, with the potential to make learning more personalized, engaging, and effective for all students. It is important to ensure that technology is used in an ethical and equitable manner to avoid exacerbating existing inequities and to maximize its benefits for all learners (figure 5).

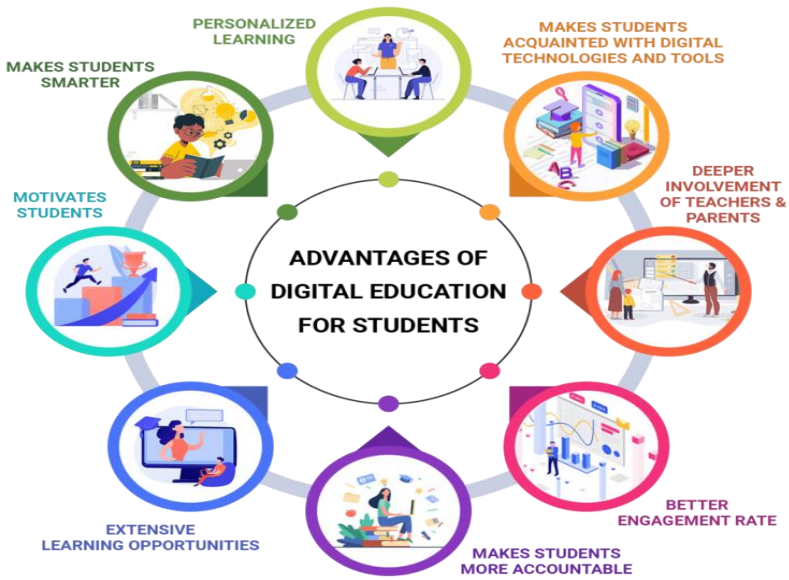

Figure 5: *Advantages of digital education*

4.2. Advantages and Disadvantages of Technology in Education

While technology has brought about many benefits to education, there are also some disadvantages that need to be considered.

a. Advantages

Improved student engagement - Technology has made learning more interactive and engaging for students, which can lead to improved retention and understanding of concepts (figure 5).

Increased access to information - With technology, students have access to a wide range of educational resources from anywhere and at any time.

Personalized learning - Technology has made it possible to tailor learning experiences to meet the individual needs of each student.

Cost-effective - Technology can help reduce the cost of education, especially in terms of textbooks and other learning materials.

Enhanced collaboration - Technology enables students to collaborate with each other and teachers in real-time, even when they are not physically in the same location (figure 6).

Figure 6: *Benefits of teacher collaboration*

b. Disadvantages

Distraction - Technology can be a source of distraction[8], leading to a loss of focus on the learning task at hand.

Dependence - Over-reliance on technology may hinder critical thinking and problem-solving skills.

Inequity - Not all students have equal access to technology, leading to an inequitable distribution of learning resources.

Technical issues - Technical issues with hardware or software can disrupt learning and cause frustration for students and teachers.

[8] A situation where one is distracted by a technology device (e.g., smartphone, laptop, tablet) while engaging in another activity.

Security and privacy - The use of technology in education can raise concerns about the security and privacy of student data. While technology has brought about many benefits to education, it is important to consider the potential disadvantages and address them proactively. Effective integration of technology in education requires careful planning, consideration of the needs of all stakeholders, and ongoing evaluation and adaptation (figure 7).

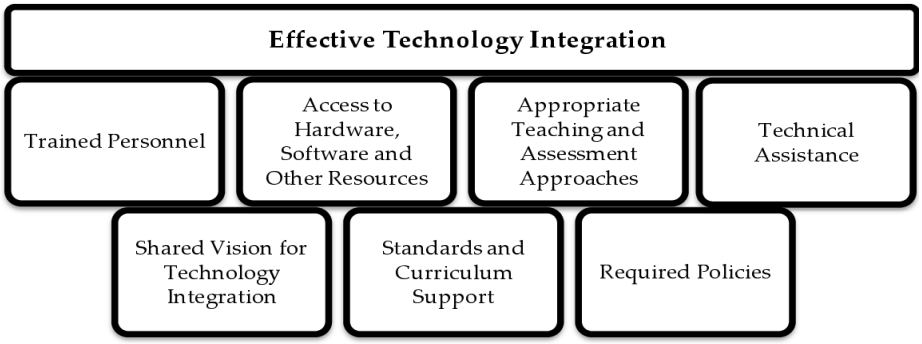

Figure 7: *Integrating technology into teaching and learning*

4.3. Challenges and Opportunities

4.3.1. Challenges in Integrating Technology in Education

While technology has the potential to revolutionize education (figure.5), there are also several challenges associated with its integration as below:
Infrastructure - Many schools, particularly those in rural or low-income areas, lack the necessary infrastructure to support technology-based learning. This includes access to high-speed internet, appropriate devices, and adequate technical support.
Cost - The cost of implementing and maintaining technology-based learning can be high, and many schools and districts may not have the necessary resources to invest in these tools.
Teacher Training - Teachers need to be trained to use technology effectively in the classroom, and ongoing professional development is necessary to keep up with new tools and approaches.
Equity - There is a risk that technology-based learning could exacerbate existing inequities in education. Students from low-income or marginalized communities may have less access to technology outside of the classroom, which could put them at a disadvantage (figure 5).

4.3.2. Opportunities

Despite these challenges, there are also many opportunities associated with the integration of technology in education (figure 8).

Increased Access - Technology can provide access to educational resources[9] and tools that might not otherwise be available, particularly for students in remote or under-resourced areas.
Personalized Learning - Technology can help tailor learning experiences to the individual needs and preferences of each student, making learning more engaging and effective.
Efficiency - Technology can automate certain tasks[10], such as grading and assessment, freeing up teachers to focus on more meaningful interactions with students.
Innovation - Technology is driving innovation in education, providing new tools and approaches that have the potential to transform the learning experience.
In order to realize the full potential of technology in education, it is important to address the challenges associated with its integration and ensure that it is used in an equitable and effective manner. This will require collaboration between educators, policymakers, and technology providers to identify and address these challenges, and to maximize the opportunities presented by technology-based learning.

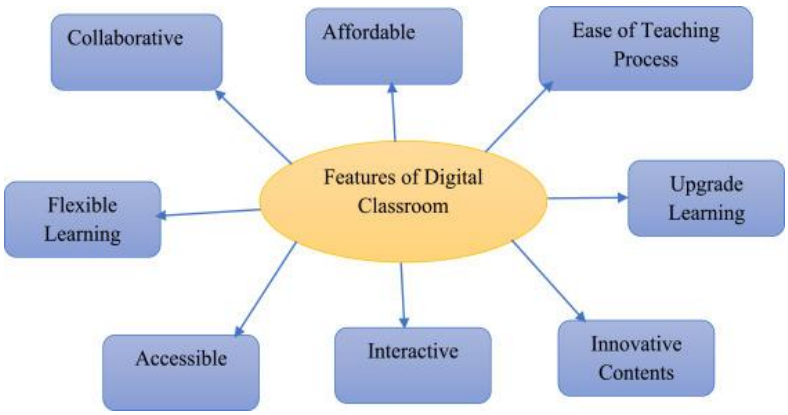

***Figure 8**: Digital technologies in education*

5. CONCLUSIONS

In summary, technology has had a significant impact on education, providing new tools and approaches that have the potential to transform the learning

[9] The use of educational technology enables learners to use tools and online programs to develop their knowledge and acquire new skills, all of which will be useful for future study, career paths and life.
[10] Task automation is the use of software to reduce the manual handling of simple tasks or a series of more complex tasks with the goal of making processes more efficient and employees more productive.

experience. Some of the benefits of technology in education include increased access to educational resources, personalized learning experiences, and more efficient use of time and resources. There are also challenges associated with the integration of technology, including infrastructure, cost, teacher training, and equity concerns.

To ensure that all students have access to technology-based learning, it is important to invest in the necessary infrastructure, including high-speed internet and appropriate devices.

Teachers need ongoing training to effectively use technology in the classroom and keep up with new tools and approaches.

To ensure that technology-based learning is equitable, it is important to consider the needs of students from marginalized communities and invest in programs and resources to support them.

Collaboration between educators, policymakers, and technology providers is necessary to identify and address the challenges associated with technology integration and to maximize the benefits of technology-based learning.

The future of technology in education is promising, with new tools and approaches being developed that have the potential to revolutionize the learning experience. It is important to ensure that technology is used in an equitable and effective manner, and that educators are prepared to effectively integrate technology into their teaching practices. With the right investments and strategies, technology has the potential to play a transformative role in education, providing new opportunities for students and educators alike.

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Revolutionizing the Stadium Experience: The Importance of Multimedia Systems in Enhancing Albanian Stadiums according to UEFA criteria

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Abstract

Multimedia systems have become an essential part of the stadium experience for sports fans around the world. The integration of audio, video, and digital technologies into stadium design has revolutionized the way people engage with sports events. The use of high-definition screens, high-fidelity sound systems, and interactive displays creates an immersive and engaging environment for fans. UEFA, the governing body for football in Europe, has set out strict criteria for stadiums hosting major football events. The introduction of UEFA's criteria has driven stadium owners to invest in cutting-edge multimedia technologies to meet the standards required for hosting major football events. This has led to a significant transformation in stadium design and has revolutionized the way that sports events are experienced by fans. This paper will examine how UEFA's criteria have influenced the adoption of multimedia systems in Albanian stadiums, the benefits and challenges associated with their implementation, and the future of sports entertainment in a world where multimedia systems play an increasingly important role.

Key words: Multimedia Systems, Albanian Stadiums, UEFA, interactive solutions.

Tourism&innovation by drone delivery. Case study: Durres, Albania

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Abstract

E-commerce is now one of the most successful and successful ways to do business and marketing through the Internet, in sectors such as tourism, communications, services, finance, retail trade, but not only. As such, the combination of the program, which will bring together a wide range of local businesses and service providers, would commercialize it even more and give an impetus to local businesses with a focus on tourism, staying as close as possible to tourists with ease of use, speed of transport and flexibility in navigating from one store to another.

There is no doubt now that tourism is becoming the keyword of our country's national, social and economic development to turn Albania into a destination of the most recognized Albanian value, hospitality building instruments to increase the added value especially for households, develop new tourism products, and significantly improve service, so that all together we can promote an Albania of healthy values for a better future for us.

Drone-Delivery is the solution to many problems and delays that businesses today encounter during delivery. Drone-Delivery can be defined as an ideal solution or a necessity that facilitates the work of businesses but also takes society and technology to a completely different level.

The potential of this idea is mainly seen in highly populated and touristic areas where traffic and the distances covered are very large. In this research paper we will explain in detail how through e-commerce can raise this solution to very high and successful levels.

Key words: Drone Delivery, E-commerce, tourism, e-service.

A novel of the applications of photovoltaic systems in Albania

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Abstract

Albania has good potential for solar energy due to its geographical location and favourable climate conditions.
The country receives abundant sunshine throughout the year, with an average 240-260 days with sun in a year, which makes it suitable for the installation of photovoltaic (PV) panels. 1)
The study is focused on estimating the implementation and importance of photovoltaic panels.
In recent years, there has been a noticeable increase in the installation of PV panels in Albania, mainly for residential and commercial purposes as is proven from the figures taken by Institute of Statistics in Albania.
Hereby is important to highlight the issue that the potential for photovoltaic panels in Albania is promising, and the government has taken significant steps to promote the use of solar power at homes and companies and at the same time to educate the community with the terms of renewable technology and energy efficiency which are factors that construct a cleaner, cost and energy efficient future. With these developments Albania is in the right direction supporting the developments of clean energy and green transformation.

Key words: photovoltaic 1, energy efficiency 2, renewable energy 3.

Understanding the Importance of Cybersecurity at Albanian Ports: Risk Assessment and Threat Mitigation

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Abstract

The aim of this research is to assess the importance of cybersecurity in Albanian ports and to identify the risks and threats that exist in this sector. With the increasing digitization of ports, cybersecurity has become an essential factor in the protection of critical infrastructure. The research employs a mixed-methods approach which extends to about 65 participants, including a literature review, interviews with experts, and a survey of employees in Albanian ports. The study identifies the specific cybersecurity needs of four Albanian ports, and the potential threats and vulnerabilities that exist. The research findings demonstrate the importance of cybersecurity in Albanian ports and provide recommendations for mitigating potential risks and threats. The study's outcomes will contribute to the development of effective cybersecurity strategies in Albanian ports and enhance their overall security posture.

Key words: CyberSecurity, Albania Ports, Risk Assessment, Maritime Security.

The use of photovoltaic technology in Albania, a good opportunity to face the energy crisis

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Abstract

Albania is a country with a great potential for solar energy due to its geographical location and favorable climate conditions. Albania's high levels of sunlight offer a chance for the nation to use PV technology to harness solar energy. Currently, the total installed capacity of solar energy in Albania is around 70 MW, which represents only a small fraction of the country's potential. Most of the existing solar power plants in Albania are small-scale installations, with a capacity of less than 5 MW. This paper will focus on the use of photovoltaic (PV) technology in Albania as a potential solution to the energy crisis that the country currently faces. Albania, like many other countries, relies heavily on imported fossil fuels for its energy needs. Due to this dependence, the country's economic growth and development are severely damaged by the oil crisis. In addition to lowering Albania's reliance on fossil fuels, the deployment of PV technology can help the country develop a sustainable and ecologically friendly energy system. The adoption of PV technology can also foster economic expansion and generate new job possibilities. The future of PV technology in Albania looks promising, as the country continues to implement policies and incentives to encourage investment in renewable energy sources.

However, there are a number of obstacles to the adoption of PV technology in Albania, including poor infrastructure, a lack of funding, and low technical know-how. Participation from both, the public and business sectors as well as international organizations will be necessary to address these difficulties. The use of PV technology in Albania presents a good opportunity to address the country's energy crisis and transition towards a sustainable energy system. With proper investment and support, Albania can become a leader in solar energy in the region, creating a positive impact on the environment and the economy.

Key words: photovoltaic (PV) technology**,** energy crisis, favorable conditions, sustainable energy.

Analysis of the 7.47kWp photovoltaic system, installed on the terrace of the G1-building, UAMD Campus

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Abstract

In general, the demand for electricity is constantly increasing. This growing demand must be met by an increase in energy sources, preferably using renewable sources. Would be better if it is possible for the consumer to produce this energy itself. The analysis of this work consists in calculating the amount of energy produced by the photovoltaic system on the terrace of the G1-building and at what percentage of the total consumption it covers; if the available space on terrace would be completely filled up at what % of the total consumption it would cover; the saving benefits from the extension of the photovoltaic plant as: earnings in Lek, CO2 emission saved, wood saved, etc. The analysis is based on the data obtained from the Fronius inverter database which has collected data every day on the amount of energy produced by the plant in real time and the energy received from the OSHEE grid. Since the plant is installed recently and the data we have are for approximately 3 months. The amount produced in % of the amount consumed would be looked at more precisely, after the summer period has passed because there are more sunny-hours in a day. Other factors that can be added to this analysis in the future are: plant life-time, maintenance, return on investment, etc.

Key words: photovoltaic, CO2 saved, plant life-time.

Challenges and applications of Fog-health systems

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Abstract

Fog computing is one of the modern technological innovations, which addresses various limitations associated with the cloud platform. The healthcare sector is highly influenced by technological innovations like IoT, fog computing and cloud computing. This research aims to explore the hidden designs of the fog-health domain by reviewing related studies on the topic.
In this regard, this study investigates different aspects of the domain, such as open challenges, real-time applications of fog-health systems, the device layer, the fog layer, and the cloud layer of the fog-health system. Moreover, it also discovers data manipulation strategies of the fog-health architectures. This study provides future guidelines to work on the fog-health domain. It has demonstrated what has been done and discovered in the field and what has to be done in the future, the challenges and recommendations related to the implementation of fog-health systems.

Key words: fog computing, healthcare, edge computing, Internet of Things (IoT), Security.

Evaluation of Student Performance Using Data Visualization Tools

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Abstract

Data visualization tools are software used to analyze large amounts of data and render the information in the visual form. Through these tools, we analyze and explore the data interactively, by identifying patterns, correlations and sense-making activities on them.
In this paper we will focus on the analysis and evaluation of the performance of the students of the Faculty of Information Technology (FTI) of "Aleksandër Moisiu" University of Durrës (UAMD), applying various data visualization methods. We will use Microsoft Power BI Data Visualization platform and for data visualization we will apply graphs and maps techniques. To create the dataset we will extract the data from the Pitagora_UAMD system for various subjects for the academic year 2021-2022. Through the results of this paper, we aim to improve decision-making regarding the quality of teaching and syllabus course improvement in study programs covered by FTI. This study makes a noble contribution in the field of data visualization and especially at FTI and not only.

Key words: Data Visualization, Higher Education, Decision-making.

Network Monitoring Process at ISP using Nagios

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Abstract

An information system is an integrated set of components for collecting, storing and processing data and for securing information, knowledge and digital products. One such system that best meets these requirements is an ISP network monitoring system. Monitoring in a distributed and heterogeneous network like that of ISPs is essential for the health of the network. Some monitoring systems are free to use open source software tools for continuous monitoring. Assists in monitoring systems, applications, services, network and infrastructure. They allow us to detect all kinds of network or server issues, enable the sharing of network services or devices into specific groups, generate alerts by simplifying the monitoring process but also save logs for drafting certain reports. In this paper we will focus on the description and implementation of a system such as Nagios for network monitoring in an ISP. Nagios is an open-source system that provides real-time monitoring and notifies the network administrator of any anomalies that occur. We will also present the advantages that Nagios offers to an Internet Service Provider (ISP) for monitoring network equipment and services. We focus on using Nagios as a tool for automatic detection of anomalies occurring in the network topology as well as notification to the Network Monitoring Center (NMC) via email or web interface access.

Key words: Information system, Internet Service Provider (ISP), Monitoring System, Network, Nagios.

Implementation of a Blockchain System for Car Theft Detection

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Abstract

Vehicle theft is a significant problem that affects many individuals, resulting in various impacts, such as a breach of privacy, economic loss, and personal insecurity. Although there are theft detection systems in place, many stolen cars can still be resold to unsuspecting victims due to the lack of a comprehensive and reliable database or service. Moreover, existing solutions are often incomplete and vulnerable to security breaches, such as DDoS attacks, data leaks, and database tampering, or are not easily accessible to buyers. Our proposal relies on blockchain technology, which offers a decentralized system for storing data, making it tamper-proof and easily accessible. This technology drastically reduces the possibilities of cyber-attacks, including DDoS attacks, through the use of cutting-edge tools such as EVM and Smart Contracts deployed on blockchain network. These principles enable a singular logic to be spread seamlessly and synchronously to a large scale of computing units, making it one of the most challenging tools to attack. In addition to securing the information, our proposal can automatically process agreements between vehicle owners and national theft agencies. The information stored on the blockchain will be undecipherable from unauthorized parties, addressing one of the least addressed issues of blockchain technology. Communication between the blockchain network and the end-user is also accessible through everyday devices, ensuring seamless and convenient user experience.

Key words: blockchain, Security, smart con.

Bayes algorithm for portfolio optimization with biased data from the Albanian forex market

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Abstract

The foreign exchange market in Albania exhibits lower levels of volatility to its counterparts in the region, as shown by the charts of forex data. Existing research in Albania has fewer promising results because of the lack of financial transparency. This analysis shows an approach to portfolio theory with biased data in the context of an informal economy. The objective of this study is to propose a Bayesian-based approach implemented in Python for optimizing a portfolio with nine different assets for the analysis. These assets are the main nodes of trade exchanges in the Albanian economy. Historical returns of these assets are used as inputs into the optimization algorithm. The methodology used in this research involves Bayesian statistics, which nowadays are a cornerstone in empirical finance and not only facilitate the selection of stocks but also determine the optimal sequential portfolio weights.

Key words: albanian financial data, python, portfolio optimization, Bayes algorithm.

Text Editor App

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Abstract

A Java-built web page includes a text editor, a specialized program that enables users to write and edit text files with advanced features such as syntax highlighting and auto-complete. A text editor is a software tool designed to facilitate the process of writing and editing text files. Its features, such as syntax highlighting and auto-complete, help users to work more efficiently and reduce errors in the process. Syntax highlighting is a programming technique that helps programmers distinguish and present different elements of code in a clear and easily understandable manner. This feature enables users to write code with ease and speed, assisting in reducing errors that may occur in the process. Auto-complete is a technology used in programming that assists users in writing code more easily by suggesting complete words or phrases to automatically complete the code. This feature offers a better experience for users and increases their productivity.
The content of the text editor can be varied and tailored to the users' needs, providing them with the ability to write and edit the text in a simple and efficient way. Therefore, users can work with text more quickly and efficiently, achieving their tasks successfully.

Key words: Java, text editor, syntax, app, automatically.

Optimizing the produced energy by the photovoltaic system at the University of Durres

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Abstract

Based on the follow-up of the European Union's objectives and the Strategic Development Plan 2030, Albania takes continuous measures to ensure a green economy through the construction and use of renewable energy systems. The rapid development and implementation of renewable technologies encourage the need to collect and analyze data as a necessary tool for studying of the working systems and determining their performance. Their analysis helps students, academic staff and all interested parties for optimizing the generated energy, gain experience in working with renewable energy systems, reducing costs, returning of the University of Durres toward a Green University, making the right decisions, advancing scientific research, and increasing the public interest. The produced energy by the photovoltaic system installed in the energy efficiency laboratory in the premises of one of the University of Durres'

buildings are being monitored and evaluated by the photovoltaic system's software. The information should be collected and analyzed by students and lecturers of the Professional Studies Faculty and Information Technology Faculty during the development of lessons related to the study of renewable

energy sources and their technologies for determining of the its performance.

This study ensures a guideline for the learning process and research in the future as well as helps in the optimization of the product energy from the photovoltaic system. The obtained results may not only be valuable for improving the work of the system installed at the University of Durres, but they can be generalized and serve all concerned. The data collection and analysis provide missing information on the performance of the system, financial and ecological impact, the creation history of the photovoltaic system, as well as decisions related to the improvement and expansion of the system in the future.

Key words: optimization, renewable energy, photovoltaic system, performance, university.

A proposed approach University app in the domain of education

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Abstract

The current era is the era of digitization and coding. Nowadays, the rapid expansion of technology has led to the digitization of various systems, improving the quality of services in various sectors such as education, health, economy, etc. Moreover, to facilitate students in finding information in the right place as well as to improve digitization standards, this research proposes the creation of an application that transforms the entire University into an app. Therefore, this study aims to investigate state-of-the-art approaches that other researchers have done in that field. Furthermore, the study will address the challenges related to the implementation and development of such applications in the domain of education. Thus, as a result of the study, the application will be proposed with the functions that must be fulfilled to facilitate the students with any information. At the same time, appropriate recommendations will be given for the implementation and security of such systems in education.

Key words: University app, education, system digitalization, security.

B – Spline Curves and their applications for hand recognition and handwritten signature recognition

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Abstract

One of the main tasks of geometrical modeling is to find ways of designing and representing freeform curves and surfaces. One of the well-known geometric modeling tools in computer-aided geometric design are B-spline curves and surfaces which provide an accurate tool to record object shape. We present a biometric identification system through hand geometry measurements by using B-Spline curves. We use 4 B – Spline curves to fit with fingers (except thumb) from a single – hand image / handwritten signature image for a single person. Then we store these 4 curves as well as other geometry measurements of the hand and handwritten signature as the "signature" of that person in the database. By computing the differences between the curves from database hand images / handwritten signature image and the curves from the query hand image using the point projection method, we are able to verify/identify the person by locating the closest database hand image / handwritten signature image to the query hand image / handwritten signature image.

Key words: B – spline model, knot vector, control polygon, multiple knot, hand recognition, handwritten signature recognition.

Technological materials for increasing energy efficiency in buildings

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Abstract

Technological materials have become an increasingly important area of research in the pursuit of energy efficiency in buildings. This paper aims to provide an overview of the technological materials that are being developed and used to increase energy efficiency in buildings, and to examine the potential impact of these materials on building design and performance. The importance of energy efficiency in buildings is discussed, both in terms of reducing greenhouse gas emissions and improving building performance and occupant comfort. It then goes on to discuss the role of technological materials in achieving these goals, including insulation materials, glazing systems, and facade materials.

The paper examines the different types of insulation materials that are available, including traditional materials such as fiberglass and cellulose, as well as newer materials such as spray foam and rigid foam board. Also discusses the role of glass systems in energy efficiency, including double and triple glazing, low-level coatings and dynamic glazing that can adapt to changing environmental conditions. Facade materials are also a key area of research in the pursuit of energy efficiency, with materials such as photovoltaic panels, green roofs, and exterior shading systems all showing promise in reducing energy consumption and improving building performance. The potential benefits and challenges of these materials, as well as the need for careful consideration of their environmental impact and long-term durability are reviewed. The potential impact of these technological materials on building design and performance includes the need for integrated design approaches that take into account the interaction between different materials and systems. It is necessary to consider the importance of continuous monitoring and maintenance to ensure the long-term effectiveness of these materials in reducing energy consumption and improving building performance. This paper demonstrates the potential of technological materials to significantly increase energy efficiency in buildings, and highlights the need for ongoing

research and development in this area to continue to improve building performance and reduce greenhouse gas emissions.

Key words: energy efficiency in buildings; different types of materials; building performance.

The efficiency of electrical mobility use

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Abstract

In the development of the PELMOB project for the Promotion and Popularization of Electrical Mobility[11] through the Transformation and Modernization of WB HEIs study programs, this paper aims to analyze the current situation of the use of EM, sensitize the opinion on the positive sides of EM, as well as help through the change of curricula helping the education of the new generation. One of the main advantages of electric mobility is that it improves people's quality of life by not emitting toxic gases. We used the questionnaire methodology to achieve the results; over 400 answers resulted. Questionnaires were distributed to universities, businesses, and decision-makers through all social networks. On the obtained data, through graphs and analyses, we tried to achieve conclusions to reach the aim of the study. These conclusions are combined with the results of the eight partner universities to create a database for the use of EM in the Western Balkans. The study's outcomes will contribute to developing effective electrical mobility strategies in Albania and enhance their overall popularization.

Key words: Electrical mobility, popullarization, survey test, transformation curricula.

PELMOB

[11]Electrical Mobility- EM

Technological tools, policies and challenges of education after the pandemic

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Abstract

Education is a common good for the community. The education system has developed over time. Its development has been influenced by national and international policies and strategies, technological development, etc. But even the pandemic period has had an influence to the change and development of teaching and learning techniques and processes, adapting to the evolving requests. Everywhere in the world, continuous efforts have been made to integrate technological achievements in every field of life. Even the education system is part of this effort. Today, it is necessary for the school/university environment to be equipped with technological infrastructure. The use of technological tools and information systems is becoming increasingly important.

Nowadays, the ability to manage and create knowledge through technology is critical to the future of students. Many platforms have been created that help and emphasize the importance of using technological tools during the teaching and learning process to increase its efficiency. Improving the quality of the education system is achieved by increasing the teaching capacity for students, which means more qualified staff, updating didactic materials in line with technological developments and transforming auditoriums/schools into resource centers for promoting the professional development of lecturers/teachers. In this paper we will study, technological development and its inclusion in the educational system, as a support to the teaching-learning process, and the challenges encountered in everyday life. In addition to technological development, an important element for the further development of the educational process and the updating of curricula, is the national and international strategy policy.

Key words: education system, technological tools, curriculum, learning-teaching process.

The connection between production and price of electricity in Albania

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Abstract

Electricity is a necessary element in a society. The whole world needs more energy as a result of the increase in its population as well as the increase in living standards as. In this article it has been carried out an analysis of electricity production, the factors affecting it, the change in the price of energy and the impact of the price of energy on the population or businesses.
In addition, this article presents a link between the import/export electricity market and the impact this market has on the economic growth. The main generation of electricity in Albania is precisely the hydropower power, electricity prices also depend on factors that reflect the cost of construction, maintenance and operation of hydropower plants, the distribution system and weather conditions.
It has been carried out a comparison between the statistical models ARIMA and IA in order to forecast the production and price growth for the next 5 years. These methods are used to examine the degree of stability of the series and its behavior for the subsequent years. Furthermore, in this article are presented some suggestions which can have a positive effect on energy production in our country.

Key words: Electricity, Price, ARIMA, IA, Forecast.

Applications to the Henstock-Kurzweil integral

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Abstract

In this paper aims to apply the concepts covered in the previous articles in relation to various issues of contemporary mathematics.
First, by introducing exhaustive functions by means of ideals, we have devised a new Bohner integral (by means of admissible ideals), which generalizes at least the Bohner integral (by statistical convergence).We have introduced the exhaustive functions on the Henstock-Kurzweil integral.

Key words: Bohner integral, Henstock-Kurzweil integral, HK-equi-integrable, exhaustive sequence, normed spaces

1. INTRODUCTION

The concept of exhaustiveness which is given for families and sequence of functions. This new concept is given for the first time from Gregoriades and Papanastassiou [6], and has been followed by many other papers.
This concept is applied to measure theory and Henstock-Kurzweil integration. In addition to the relativization of equi-integrable functions Schwabik S, Guoju. Y.[1], new ones on Bohner-type ideal-integrals Komisarski [3], Kostyrko, P., Sal´at T. and Wilczy´nski [4], in the theory of measure and continuous functions, continuing the results of Boccuto, A., Das P., Dimitriou, X., Papanastassiou, [5].
In this first part of the paper, several applications to various problems of measure theory and integration are presented, using the concept of exhausting series and local convergences.

Definition 1.1. [5]
(a) Let Y be an non empty set, $Y\neq\emptyset$. A family $\mathfrak{J}\subset\Pi(Y)$ is called an *ideal of the set Y* if and only if, for $A, B\in\mathfrak{J}$ it follows that, $A\cup B\in\mathfrak{J}$ and for every $A\in\mathfrak{J}$ and $B\subset A$ we will have that $B\in\mathfrak{J}$.

(b) An ideal $\Im$ is said to be *nontrivial* if and only if, $\Im \neq \varnothing$ and y$\notin \Im$. A non-trivial ideal is called *admissible* when it contains one points sets.
Let (T, Σ, μ) be a space with probabilistic measure, where T is an arbitrary set on the line, Σ-the Borel algebra and μ a bounded measure.

Definition 1.2. [5]
The function $f: T \to X$, where X is a vector space is called *a simple function according to* μ, if for every family of measurable sets $\{E_i\}$ not cutting, that is $E_i \subset T$ and $E_i \cap E_j = \emptyset$, for $i \neq j$, where $T = \bigcup_{i=1}^{n} E_i$ and $f(t) = x_i$, for $t \in E_i$, i=1, 2,…, n.
As is known, the simple function is presented in the form $f(t) = \sum_{i=1}^{n} x_i \chi_{E_i}$, where χ_{E_i} is the characteristic function of E_i.

Definition 1.3. [5]
The function is called $f: T \to X$ is called $\Im$ *-measurable in T* if for every t$\in$ T, $\varepsilon > 0$ and $A \subset \Im$ there exists a sequence of simple functions $f_n: T \to X$ for which $|f_n(t) - f(t)| < \varepsilon$ for $n \in \mathbb{N}\backslash A$.

Proposition 1.4. The linear combination of $\Im$-measurable functions (measurable ideal) is a $\Im$-measurable function.

Proof: Let f and g be two $\Im$-measurable function. For the function f we will find a sequence of simple functions $f_n(t)$ that $\Im$-converge to the function f.
This means that for every $\varepsilon > 0$, and for $\frac{\varepsilon}{|\alpha|} > 0$ and a set $A_1 \in \Im$ such that, $|f_n(t) - f(t)| < \frac{\varepsilon}{2|\alpha|}$ for $n \in \mathbb{N}\backslash A_1$ and t$\in$T. Similarly, for the $\Im$- measurable function $g(x)$, there is the sequence of simple functions $g_n(t)$ that $\Im$-converges to g(x), i.e.for every $\varepsilon > 0$ also for $\frac{\varepsilon}{2|\beta|} > 0$ we find $A_2 \in \Im$ so that for $n \in \mathbb{N}\backslash A_2$ we have $|g_n(t) - g(t)| < \frac{\varepsilon}{2|\alpha|}$. Since $\mathbb{N}\backslash A_1 \cup \mathbb{N}\backslash A_2 \subset \mathbb{N}\backslash(A_1 \cup A_2)$,
for $n \in \mathbb{N}\backslash(A_1 \cup A_2)$ and t $\in$T we will have:

$$\left|\left(\alpha f_n(x) + \beta g_n(x)\right) - (\alpha f + \beta g)\right| \leq |\alpha||f_n(x) - f(x)| + |\beta||g_n(x) - g(x)| < \frac{\varepsilon}{2} + \frac{\varepsilon}{2} = \varepsilon$$

Definition 1.5. The subsequence $\left(f_{n_k}\right)_{k\in\mathbb{N}}$ of the sequence $(f_n)_{n\in\mathbb{N}} \overset{\Im}{\to} f$ is called *fundamental* if, for $A' = \{n_1 < n_2 < \cdots < n_k < \cdots\}$ $f_{n_k} \overset{\Im}{\to} f$ for $n \in \mathbb{N}\backslash A'$ where
$A' \subset A$.

Definition 1.6. Let (I, Σ, μ) be a measurable space with nonnegative integer space. The series of measurable functions $(f_n)_n$ on I is $\Im$-*convergent by measure* μ on the function f, if for every $\varepsilon > 0$ and $\sigma > 0$ and there exists a fundamental subseries $\left(f_{n_k}\right)_k$ of the series $(f_n)_n$ such that: $\mu\{t: |f_{n_k}(t) - f(t)| \geq \sigma\} < \varepsilon$ for $n_k \in \mathbb{N}\backslash A'$ and t $\in$I. We denote $f_n(t) \overset{\Im-\mu}{\longrightarrow} f(t)$.

Definition 1.7. The sequence of measurable functions $(f_n)_n$ with values in $\mathbb{R}$ is called $\Im$-*fundamental by measure in* $S \subset \Im$, if there exists a natural number $N(\sigma, S) \subset \mathbb{N}\backslash A$
and a fundamental subsequence $\forall \varepsilon > 0$ and $\sigma > 0$, $\mu\{t: |f_{n_k}(t) - f(t)| \geq \sigma\} < \varepsilon$.

Proposition 1.8. If the sequence$(f_n)_n$is $\Im$-convergent to f in $\Im$ then it $\Im$-fundamental.

Proof: Is $\left(f_{n_k}(t)\right)_k$ a fundamental subsequence of the sequence $\left(f_n(t)\right)$?

We choose a number $N \in \mathbb{N}$, $N \in \mathbb{N}\backslash A$ and consider the inequality:
$|f_{n_k}(t) - f_N(t)| \leq |f_{n_k}(t) - f(t)| + |f(t) - f_N(t)|$; from here we can write:

$$\{t: |f_{n_k}(t) - f_N(t)| \geq \sigma\} \subset \left\{t: |f_{n_k}(t) - f(t)| \geq \frac{\sigma}{2}\right\} \cup \left\{t: |f(t) - f_N(t)| \geq \frac{\sigma}{2}\right\}$$

Since we get that for $n_k \in \mathbb{N}\backslash A'$, $A' \subset A$.

$$\mu\{t: |f_{n_k}(t) - f_N(t)| \geq \sigma\} \leq \left\{t: |f_{n_k}(t) - f(t)| \geq \frac{\sigma}{2}\right\} + \mu\left\{t: |f(t) - f_N(t)| \geq \frac{\sigma}{2}\right\}$$

Proposition 1.9. The $\Im$-limit of the sequence $\left(f_n(t)\right)_n$ by measure μ is unique with equivalence proximity.

Proof: Let us assume that the statement is not true. This means that the series $(f_n)_n$ $\Im$ -converges in two different limits $f_1(t)$ dhe $f_2(t)$ .For every ε>0 and σ>0 there exists a basic subsequence such that,

$\mu\left\{t: \left|f_{n_k}(t) - f_1(t)\right| \geq \frac{\sigma}{2}\right\} < \frac{\varepsilon}{2}$ for $n_k \in \mathbb{N}\backslash A_1'$, when $A_1' \subset A$ and $\mu\left\{t: \left|f_{n_k}(t) - f_2(t)\right| \geq \frac{\sigma}{2}\right\} < \frac{\varepsilon}{2}$ for $n_k \in \mathbb{N}\backslash A_2'$ when $A_2' \subset A$ and t ∈ T, where there is the inclusion $\{t: |f_1(t) - f_2(t)| \geq \sigma\} \subset \left\{t: \left|f_{n_k}(t) - f_1(t)\right| \geq \frac{\sigma}{2}\right\} \cup \left\{t: \left|f_{n_k}(t) - f_2(t)\right| \geq \frac{\sigma}{2}\right\}$, for $n_k \in \mathbb{N}\backslash(A_1' \cup A_2')$ when $A_1' \cup A_2' \subset A$, or taking the measures of both sides;

$$\mu\{t: |f_1(t) - f_2(t)| \geq \sigma\} \leq \mu\left\{t: \left|f_1(t) - f_{n_k}(t)\right| \geq \frac{\sigma}{2}\right\} + \mu\left\{t: \left|f_{n_k}(t) - f_2(t)\right| \geq \frac{\sigma}{2}\right\} < \varepsilon$$

The above inequality shows that, $f_1(t)$ and $f_2(t)$) can be different only in a set of zero measure.

Proposition 1.10. If the sequence $(f_n)_n$ is an $\Im$ fundamental sequence in T⊂R then there exists $\Im - \lim_k \int_T f_k(t)d\mu$.

Proof: Since $(f_n)_n$ is a $\Im$-fundamental sequence for every ε>0, there exists $k \in \mathbb{N}\backslash A$ and fixed natural N
such that $|f_k(t) - f_N(t)| < \frac{\varepsilon}{\mu(T)}$ for almost all $k \in \mathbb{N}\backslash A$.
We will have: $\left|\int_T f_k(t)d\mu - \int_T f_N(t)d\mu\right| \leq \int_T |f_k(t) - f_N(t)|d\mu \leq |f_k(t) - f_N(t)|\mu(T) < \varepsilon$
This shows that the sequence $(\int f_n(t)d\mu)_n$ is a fundamental sequence in $\mathbb{R}$ and as such is convergent.

Definition 1.11. The function $f: T \to X$ is called $\Im$- *integrable Bohner,* if there is an underlying series of simple functions $(f_k)_k$ such that,
$a)$ $(f_k)_k$ to be $\Im$-integrable on f.
$b)$ $\Im - \lim_k \int |f_k(t) - f_N(t)|d\mu = 0$
almost everywhere this limit is denoted $\Im - B - \int f(t)d\mu$
and is called *Bohner′s* $\Im$*-integral.*

The sequence of simple functions f_n is called *the defining sequence of the function f.*
The statement is easily proved:

If (f_n) and (g_n) are defining and fundamental sequences on the same function, then

$$\Im - \lim f_n(t)\, d\mu = \Im - \lim g_n(t)\, d\mu$$

This shows that the above statement is correct.

2. APPLICATION OF EXHAUSTIVE FUNCTIONS ON HENSTOCK-KURZWEIL INTEGRAL

The definition given on the metric space we can reconstruct and in the case of the normed space or Banach space.

Definition 2.1.[2]

a) Let $f_n : S \to X$, where S and X are normed space the sequence (f_n) is called *exhaustive sequence* at $s \in S$ if for every $\varepsilon>0$ there is a $\delta>0$ and $n_0 \in N$ such that for every $y \in B(s,\delta)$ we get $\| f_n(y) - f_n(y) \| < \varepsilon$.

b) Sequence $(f_n(s))$ has the δ-limit the function f(s) for every $s \in S$ if and only if for every $\varepsilon>0$ there is a $\delta>0$ and $n_0 \in N$ such that for every $y \in B(s,\delta)$ we have $\| f_n(y) - f(y) \| < \varepsilon$

Let $S \subset R^m$ be a compact interval and $m \geq 1$.

Recall that for the definition of the Henstock-Kurzweil integral we need the concepts of K-partition [1].The pair (r, S) where $r \in R^m$ and S is a compact interval by R^m is called a tagged interval such that r is a tag of S.

K-system $\{(r_j, I_j) : j = 1,2,..p\}$ is a collection of finite tagged non-overlapping intervals where $r_j \in I_j$ and

$$S = \bigcup_{j=1}^{p} I_j$$

K-system is called K-partition of the interval S if is true the previous equality.

Let $\delta: S \to]0, +\infty[$ be the function, that is called gauge in S. The tagged interval (τ, S) is called δ −refined if we have

$$S \subset B(\tau, \delta(\tau))$$

where $B(\tau, \delta(\tau))$ is a ball in R^m with the center in τ and radius $\delta(\tau)$.

K-system or the K-partition are δ −refined if all the tagged intervals (τ_j, I_j), j=1,2,…,p are δ −refined in connection with the gauge δ.

Now, let S be a measurable set with algebra Σ and probability measure μ, we write {S, Σ, μ}.

Definition 2.2:*[2]*

The function f: S → X is Henstock-Kurzweil integrable and $I \in X$ is Henstock-Kurzweil integral, if for every $\varepsilon > 0$, there is the gauge $\delta: S \to]0, +\infty[$ such that, for every δ −refined, K-partition (t_i, I_i), i=1, 2, …, p of S takes place the inequality :

$$\left\| \sum_{i=1}^{p} f(t_i)\mu(I_i) - I \right\| < \varepsilon$$

The Henstock-Kurzweil integral we denote by the symbol $I = (HK) \int f_s$.

Definition 2.3*: [2]*

The function f: S → X has the property S^*HK if for every $\varepsilon > 0$ there is the gauge δ in S such that we take (1)

$$\sum_{i=1}^{k} \sum_{j=1}^{l} \|f(t_i) - f(s_i)\|_X \mu(I_{i_n}, l_i) < \varepsilon$$

For every δ −refined K-partitions $\{(t_i, I_i), i = 1,2, \dots, k\}$ and $\{(s_j, l_j), j = 1,2, \dots, l\}$ in S.

Proposition 2.4: *[2]*

If we have $\Phi = \{f: S \to X\}$ a set of exhaustive functions then those are S^*HK integrated.

Proof. By choosing the value of δ that both partitions can be δ −refined, for every $\frac{\varepsilon}{\mu(s)} > 0$, there exists $\delta_1 < \delta$, that for $t_i \in S(s_i, \delta_1)$ we will have i=1,2,…,p.

$$\|f(t_i) - f(s_i)\| < \frac{\varepsilon}{\mu(s)}$$

From which we prove the inequality (1).

Definition 2.5*: [2]*

A collection $\mathcal{M}$ of the functions f: S → X, S is a compact interval on ℝ is called *HK-equi-integrable* if every $f \in \mathcal{M}$ is Henstock-Kurzweil integrable and for any $\varepsilon > 0$ there is a gauge Δ such that for any $f \in \mathcal{M}$ the inequality

$$\| \sum_{i=1}^{p} f(t_i)\mu(I_i) - (HK)\int_S f \| < \varepsilon$$

holds provided $\{(t_i, I_i), i = 1,2, \dots, p\}$ is a Δ-refined K-partitions of S.

Proposition 2.6*:*[2]

Let $\mathcal{M} = \{f_k : S \to X, k \in \mathbb{N}\}$ be a collection of exhaustive functions H-K integrable and that :

$$\delta - \lim_{k\to\infty} f_k(t) = f(t), t \in S$$

Then the function $f: S \to X$ is H-K integrable and it is allowed passing in limit

$$\lim_{k\to\infty} (HK) \int f_s = (HK) \int f_I$$

Proof.We can choose a Δ-gauge of S such that for every $t \in S$ and a partition Δ-refined

$$t_i : [U_i, U_i]$$

$\|f_k(t) - f(t)\| < \varepsilon$ for $t \in B(t_i, D_x)$

For a given choice of Δ ,according to the equi-integrability of the sequence (f_k),for every $\varepsilon > 0$ and $k \in \mathbb{N}$,we have

$$\left\| \sum_{i=1}^{p} f_k(t_i)\mu(I_i) - (HK) \int_S f_k \right\|_X < \varepsilon$$

Proposition 2.7*: *[2]

Let the functions f_n be of the collection Φ of function $f_n : S \to X$, HK-integrable δ −convergent to f and exhaustive. Then they are HK-equi-integrable.

Proof: Let $\{(t_i, I_i), i = 1,2, \dots, p\}$ is Δ-refined partitions of S for any $n \in \mathbb{N}$,we write

$$\left\| \sum_{i=1}^{p} f_n(t_i)\mu(I_i) - \int_S f \right\|_X < \frac{\varepsilon}{2}$$

From the exhaustivity of the sequence f_n,for t_i and $s_i \in I_i$ we have:

$$\|f_n(t_i) - f_n(s_i)\| < \frac{\varepsilon}{2\mu(I)}$$

or

$$\left\|\sum_{i=1}^{p}[f_n(t_i) - f_n(s_i)]\mu(I_i)\right\| < \frac{\varepsilon}{2}$$

Therefore

$$\left\|\sum_{i=1}^{p} f_m(t_i)\mu(I_i) - \int_S f\right\|_X$$
$$\leq \left\|\sum_{i=1}^{p}[f_m(t_i) - f_n(t_i)]\mu(I_i)\right\| + \left\|\sum_{i=1}^{p} f_n(t_i)\mu(I_i) - \int_S f\right\|$$
$$\leq \frac{\varepsilon}{2} + \frac{\varepsilon}{2} = \varepsilon$$

If the partition $\{(t_i, I_i); I_i = [u_i, v]; i = 1,2, \dots, p\}$ is fixed then from the δ −convergence of the (f_k)-sequence yields ;

$$\delta - \lim_{k\to\infty} f_k(t_i)\mu(I_i) = \sum_{i=1}^{p} f(t_i)\mu(I_i)$$

Choose $k_0 \in \mathbb{N}$ such that for $k > k_0$,the inequality

$$\left\|\sum_{i=1}^{p} f_k(t_i)\mu(I_i) - \sum_{i=1}^{p} f(t_i)\mu(I_i)\right\|_X < \varepsilon$$

holds .Then we have

$$\left\|\sum_{i=1}^{p} f_k(t_i)\mu(I_i) - (HK)\int_S f_k\right\|_X < \varepsilon$$

$$\leq \left\|\sum_{i=1}^{p}[f(t_i) - f_k(t_i)]\mu(I_i)\right\|_X + \left\|\sum_{i=1}^{p} f_k(t_i)\mu(I_i) - (HK)\int_S f_k\right\|_X \leq 2\varepsilon$$

For k> k_0.

This given for k, l > k_0 the inequality

$$\left\| (HK)\int_S f_k - (HK)\int_S f_l \right\|_X \leq 4\varepsilon$$

which shows that the sequence $(HK)\int_S f_k$, k ∈ ℕ of elements of X in Cauchy and therefore $\lim_{k\to\infty}(HK)\int_S f_k = J \in X$ exists .

Let $\varepsilon > 0$. By the gauge Δ that is choose above, we can take a $n_0 \in \mathbb{N}$,such that

$$\left\| (HK)\int_S f_k - J \right\|_X < \varepsilon$$

For all k≥ n_0. By the δ −convergence of the sequence (f_k) to f,there exists $k_1 \geq n_0$, such that

$$\left\| \sum_{i=1}^{p} f_{k_1}(t_i)\mu(I_i) - \sum_{i=1}^{p} f(t_i)\mu(I_i) \right\|_X < \varepsilon$$

Therefore

$$\begin{aligned} &\left\| \sum_{i=1}^{p} f(t_i)\mu(I_i) - J \right\|_X \\ &\leq \left\| \sum_{i=1}^{p} f(t_i)\mu(I_i) - \sum_{i=1}^{p} f_{k_1}(t_i)\mu(I_i) \right\|_X \\ &+ \left\| \sum_{i=1}^{p} f_{k_1}(t_i)\mu(I_i) - (HK)\int_S f_{k_1} \right\|_X + \left\| (HK)\int_S f_{k_1} - J \right\|_X \\ &\leq 3\varepsilon \end{aligned}$$

And it follows that f is Henstock-Kurzweil integrable on S and it follows that f is Henstock-Kurzweil integrable on I and

$\lim_{k\to\infty} (HK)\int_S f_k = J = (HK)\int_S f$ ■

3. CONCLUSIONS

This paper is concluded by introducing the applications of the concepts treated in the preceding papers in relation to various issues of contemporary mathematics. First, by introducing exhaustive functions by means of ideals, we have devised a new Bohner integral (by means of admissible ideals), which generalizes at least the Bohner integral (by statistical convergence). Prompted by an article by Boccuto et al., we have used it not only for measures but also for functions that reflect a given community; bringing an important theoretical development and deriving as special cases the usual propositions, such as the case of the monotone string of sets.
The paper concludes with an application of exhaustive series and local uniform convergence to the Henstock-Kurzweil integral, both regular and strong.

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From Euclid geometry to fractal geometry

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Abstract

When we think geometry as a science we associated that with the name of mathematician of the ancient Greek, Euclid (around 300 B.C). Geometry, one of the oldest branch of math so named at least since Plato's time. The concept came from practice then follow its development into a rigorous abstract science by the Greek philosophers, until the rich period with more and more sophisticated problems and methods in the later Greek and Arab period. Euclid is referred to as the "**Father of Geometry**", and he wrote s the most important and successful mathematical textbook of all time, the "**Stoicheion**" or "**Elements**", which represents the culmination of the mathematical revolution which had taken place in Greece up to that time. Bolyai, came to the radical conclusion that it was in fact possible to have consistent geometries that were independent of the parallel postulate. In the early 1820s, Bolyai explored what he called "imaginary geometry" (now known as hyperbolic geometry). Mathematicians recognized during their 1875-1925 crisis that a proper understanding of irregularity or fragmentation (as of regularity and connectedness) cannot be satisfied with defining dimension as a number of coordinates. The first step of a rigorous analysis is taken by Cantor in his June 20, 1877, letter to Dedekind, the next step by Peano in 1890, and the final steps in the 1920's. Benoit B. Mandlebrot felt that Euclidean geometry was not satisfactory as a model for natural objects. Here we give some elements of story to development of geometry.

Key words: Geometry, fractals, Cantor set, connected, fractals and medicine.

1. GEOMETRY FROM BABILONASIT ANCIENT EGYPT TO EUCLID

The first geometric pictures date from 25000 BC. Babylonian geometry, was closely connected to practical needs and geometric problems were treated with immediate and explicit reference to the corresponding arithmetic-algebraic problems ("In Mesopotamia the role of geometry was insignificant. Geometry was not an autonomous mathematical discipline" M. Kline [13]). One perplexing tablet that has been discovered is the Yale tablet YBC8 7289. Although the exact time this tablet was written is unknown, it is generally dated between 1800 and 1650 B.C. On this tablet, there is evidence that the Babylonians may have had an understanding of irrational numbers—particularly, that of $\sqrt{2}$ (O'Connor & Robertson, 2000). Engraved in the tablet is the figure of a square, with one side marked with the number 30 (see Figure 1). In addition, the diagonal has two sexagesimal numbers marked—one of which is

and the other of which is

Regarding the former of these two numbers, scholars agree on transliterating it as 1; 24, 51, 10, which is approximately (1; 24, 51, 10 is equal to $1 + \frac{24}{60^1} + \frac{51}{60^2} + \frac{10}{60^3}$, the sum of which is 1.41421), accurate to five decimal places (Hodgkin, 2005).

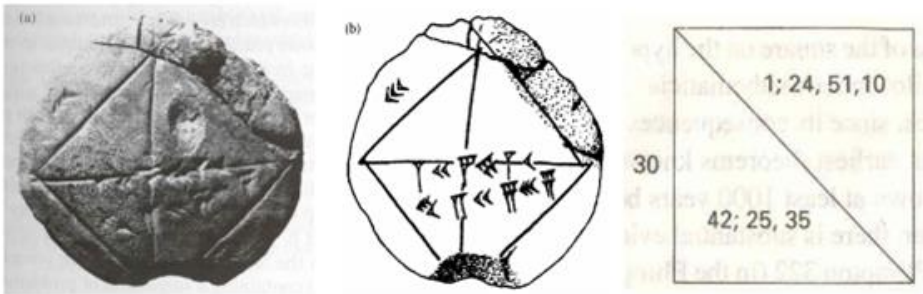


Figure 1: *(a) YBC 7298 tablet* *1 (b) Drawing* *1(c) Dimension*

One of the tablets contains a list of geometrical constants[1]. A tablet gives the approximate areas of the first seven regular polygons. As far as the circle is concerned, it is claimed that the perimeter of the regular hexagon inscribed in a circle (= six times the radius) is equal to 24/25 of the circumference, figure 2. In modern notation

$$6R = \frac{24}{25} \cdot 2 \cdot \pi \cdot R$$

which yields the value

$$\pi = \frac{25}{8} = 3{,}125$$

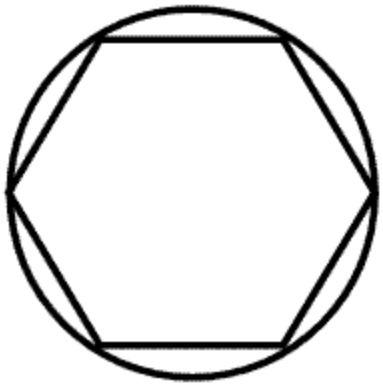


Figure 2

The Babylonians also knew that Theorem[2]. An angle inscribed in a half circle is necessarily a right angle. The first geometric ideas which arose in various civilizations before the influence of the systematic work of the Greek geometers. They already indicate some mastering of the notions of symmetry and congruence of figures.

The Moscow Papyrus that dates to 1850 BC contains a method on how to calculate the volume of a truncated pyramid and the surface area of half a sphere; it also shows that the Egyptians used the value of Pi at 3.16 which is very close to our modern number of 3.14. it shows their standard of measurement was the cubit around 52.3 cm, these techniques were used in constructing the pyramids and other monuments all over Egypt[3]. Geometry, one of the oldest branch of math so named at least since Plato's time.

For example, Problem 51 of the Ahmes papyrus shows that The area of an isosceles triangle is equal to the height multiplied by half of the base

Figure 3

Problem 56 of the Ahmes papyrus also investigates the “similarity” of triangles.

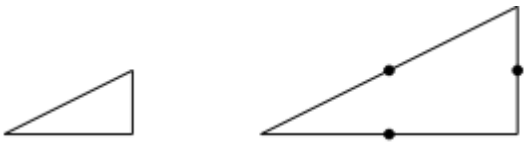


Figure 4

Two right angled triangles having their respective sides proportional have their corresponding angles equal.

The concept came from practice then follow its development into a rigorous abstract science by the Greek philosophers, until the rich period with more and more sophisticated problems and methods in the later Greek and Arab period, and its name is derived from the Greek words meaning "measurement of the earth". We see in the chronology below that Euclid, figure 5 who lived around 300 B.C., was not the first great geometer, despite the fact that his famous Elements “with all its definitions, postulates, axioms & preliminary principles, which seem to promise nothing but arid reading” (see the above quotation from Clairaut) usually serve as a model for the beginning of a course on geometry.

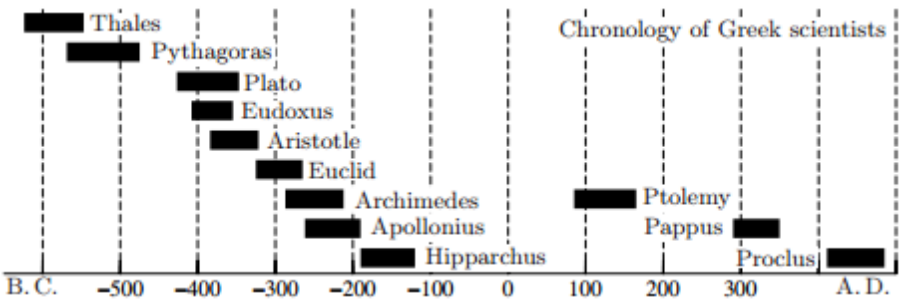


Figure 5

But mathematical results had already been obtained in the preceding centuries, in order to measure land to survey fields after the regular floods of the Nile, to compute the quantity of corn in a cylindrical container, and to construct spectacular temples and pyramids[4]. Euclid is referred to as the “Father of

Geometry", and he wrote s the most important and successful mathematical textbook of all time, the "Stoicheion" or "Elements", (around 300 BC) constitute the classical reference for the study of Greek geometry and represents the culmination of the mathematical revolution which had taken place in Greece up to that time. Euclid (c. 325-265 BCE): Wrote 'The Elements of Geometry' consisting of 13 books: rigorous proofs; axiomatic development of geometry; foundations of number theory. Also wrote other works on geometry. 'There is no Royal Road to geometry.' – Euclid to King Ptolemy. Of all the works of antiquity which have been transmitted to the present times, none are more universally and deservedly esteemed than the Elements of Geometry which go under the name of Euclid[8]. In many other branches of science the moderns have far surpassed their masters; but, after a lapse of more than two thousand years, this performance still maintains its original preeminence, and has even acquired additonal celebrity from the fruitless attempts which have been made to establish a different system.(from the preface to Bonnycastle's Euclid London (1798)) [5]
The Elements is founded on simple objects such as points, lines, and circles, the associated quantities of length and angle, and certain axioms about them (which are traditionally called postulates). These axioms are, in the classic translation of Heath (1925):

P1. To draw a straight line from any point to any point.
P2. To produce a finite straight line continuously in a straight line.
P3. To describe a circle with any center and distance.
P4. That all right angles are equal to one another.
P5. That, if a straight line falling on two straight lines make the interior angles on the same side less than two right angles, the two straight lines, if produced indefinitely, meet on that side on which are the angles less than the two right angles.[8]

1.2. Analytic geometry

La Géométrie (Geometry), is the one in which Descartes made his great and lasting contribution to pure mathematics. In the Géométrie, he combined the methods of algebra and geometry to produce the new fild of analytic geometry[2].
Although one does not need algebra to study geometry, algebra can be a great help. The concepts and techniques used in the study of algebra sometimes make otherwise difficult geometry problems easy. The discovery of analytic geometry, the branch of geometry whose problems and solutions are expressed algebraically, accelerated the pace of mathematical and scientific progress, because it allowed scientists and mathematicians the opportunity to use insights from both geometry and algebra to understand both better Most of our modern mathematics is possible due to the use of functions and curves that can

be visualized in a coordinate plane. The concept of a function and of curves as described by a relationship between two or more variables, is a relatively recent invention in mathematical history. In 1637, René Descartes (1596-1650), a French mercenary, mathematician and philosopher, published a book called La Géométrie as an appendix to his great Discours de la Methode pour bien conduire la raison, et chercher la verité dans les sciences. In La Géométrie, he set out to create a new, all-encompassing field of mathematics, where the then separate fields of ”true mathematics”, geometry and algebra, were linked together and used in symbiosis1 . It was groundbreaking in the sense that it provided the entire mathematical community with a new set of tools: a way of solving algebraic equations using geometry; and a way of describing geometrical problems in algebraic terms, thus making it possible to manipulate and solve them2 . First presented in 1637, these tools were developed and scrutinized throughout the century until the new discoveries eventually led to the creation of the calculus in 1666 and 16843. Furthermore, one of the important events in the history of mathematics is the foundational crisis of mathematics. Following the discovery of Russell's paradox, mathematicians searched for a new consistent foundation for mathematics. During this period, three different schools of thought emerged with the leading school opting for a formalist approach. Geometry played a significant role for this leading school. Indeed, it was led by Hilbert who began his work on formalism with geometry which culminated with "Grundlagen der Geometrie" . During this crisis, mathematicians started to differentiate theorems from metatheorems to highlight that the latter correspond to theorems about mathematics itself. As well as for mathematics, geometry has had a substantial place in the history of metamathematics. First, the earliest milestone in the history of metamathematics is probably the discovery of non-Euclidean geometry . Incidentally, the impact of this discovery was very important in the history of mathematics. Second, aside from Hilbert, another prominent figure in metamathematics, namely Tarski, dedicated a notable part of his research to an axiomatization of geometry . that he proposed with a special emphasis on its metamathematical properties. Finally, geometry has influenced other areas of mathematics. When Descartes invented analytic geometry [12], he started to consider squares of numbers not only as areas but also as lengths. This led him to analyze algebraic equations of degree higher than three which, until then, corresponded to three-dimensional objects and were regarded as the highest dimension of the universe. Thus, the invention of analytic geometry proved to be crucial in the development of modern algebra, yet, it contributed to the discovery of calculus too.[thesis].

2. NON-EUCLIDEAN GEOMETRY

The 19th century saw the birth of so-called non-Euclidean geometries. Bolyai, came to the radical conclusion that it was in fact possible to have consistent geometries that were independent of the parallel postulate. In the early 1820s, Bolyai explored what he called “imaginary geometry” (now known as hyperbolic geometry). In Lobachevsky’s geometry, for example, the sum of the interior angles of a triangle is always less than 180°, whereas in Euclidean geometry the sum of the interior angles of a triangle is always precisely 180°. We emphasize that Lobachevsky’s geometry is not mathematically wrong[7].

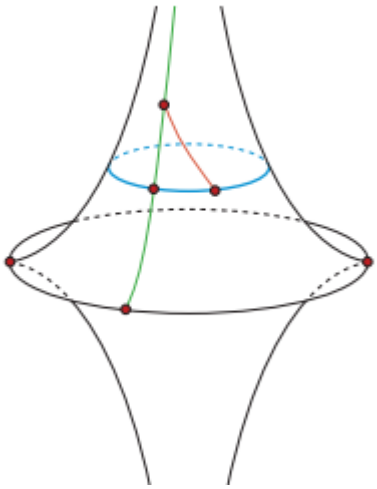


Figure 6: *Pseudosphere*

Lobachevsky’s geometric ideas can be realized by doing geometry on the surface of this object, called a pseudosphere figure 6. Notice the size and shape of the triangle determined by the three points on the pseudosphere’s surface. The sum of the interior angles of this triangle are less than 180 degrees. George F.B. Riemann (1826-1866), always denying Euclid's fifth postulate, constructed another geometry, called elliptical, based on the assumption than for an external point to a straight line you can't" lead no parallel. A model of geometry elliptical is built by means of a sphere, in which we call the Riemann plan the surface of the sphere, point each pair of points diametrically opposite, every circle straight maximum of the sphere.

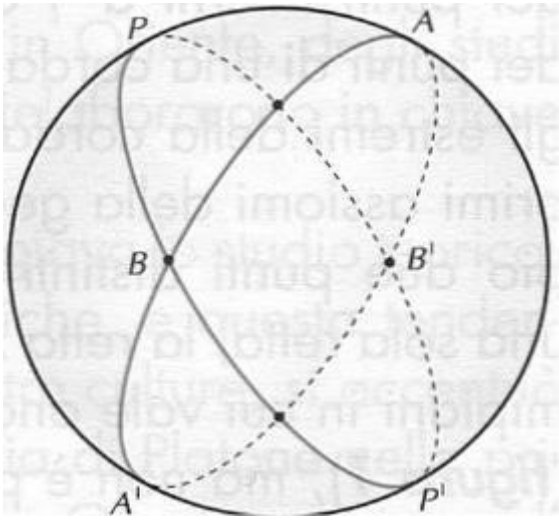


Figure 7

With reference to figure 7, are for example point the pairs . (A A'), (B, B'), (P, P'); the line r passing through the points (A A') and (B, B') is the greatest circumference passing through A A', B, B'. Also in this case they are still valid many axioms of Euclidean geometry, but straight lines parallels no longer exist: taken a point (P, PI) in the plane thus defined, it is not possible to find a straight line for such a point that does not intersect the straight line r. To search to understand the reason you can make the comparison with an orange: if you cut the peel into slates a lot.

As a basis for the analysis of our intuition of space, Professor Hilbert commences his discussion by considering three systems of things which he calls points, straight lines, and planes, and sets up a system of axioms connecting these elements in their mutual relations. The purpose of his investigations is to discuss systematically the relations of these axioms to one another and also the bearing of each upon the logical development of euclidean geometry. Among the important results obtained, the following are worthy of special mention:

1. The mutual independence and also the compatibility of the given system of axioms is fully discussed by the aid of various new systems of geometry which are introduced.

2. The most important propositions of euclidean geometry are demonstrated in such a manner as to show precisely what axioms underlie and make possible the demonstration.

3. The axioms of congruence are introduced and made the basis of the definition of geometric displacement

We think of these points, straight lines, and planes as having certain mutual relations, which we indicate by means of such words as “are situated,” “between,” “parallel,” “congruent,” “continuous,” etc. The complete and exact description of these relations follows as a consequence of the axioms of geometry. . These axioms may be arranged in five groups. Each of these groups expresses, by itself, certain related fundamental facts of our intuition. We will name these groups as follows:

I, 1–7. Axioms of connection.

II, 1–5. Axioms of order.

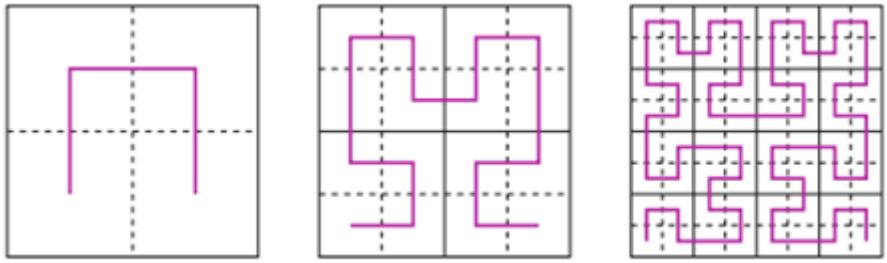
III. Axiom of parallels (Euclid’s axiom).

IV, 1–6. Axioms of congruence.

V. Axiom of continuity (Archimedes’s axiom).

3. SPACE-FILLING CURVES

One of the best achievements in human research is the better understanding of natural phenomena that can be represented by mathematical models. The history of describing natural objects using geometry is as old as the advent of science itself. Traditionally lines, squares, rectangles, circles, spheres, etc., have been the basis of our intuitive understanding of the geometry[6]. However, nature is not restricted to such Euclidean objects which are only characterized typically by integer dimensions. Mathematicians recognized during their 1875-1925 crisis that a proper understanding of irregularity or fragmentation (as of regularity and connectedness) cannot be satisfied with defining dimension as a number of coordinates. The first step of a rigorous analysis is taken by Cantor in his June 20, 1877, letter to Dedekind, the next step by Peano in 1890, and the final steps in the 1920’s. Benoit B. Mandlebrot felt that Euclidean geometry was not satisfactory as a model for natural objects. In 1878, George Cantor demonstrated that any two finite-dimensional smooth manifolds, have the same cardinality, and Mathematics has never been the same since. Cantor's finding implies, in particular, that the interval [0,1] can be mapped bijectively onto the square [0,1] x [0,1]. In 1890 Peano showed that there is indeed a continuous curve that continuously maps all points of a line onto all points of a square, though the curve exists only as a limit of very convoluted curves. Although it was G. Peano who discovered the first space-filling curve, it was Hilbert who-to paraphrase E.H. Moore (Moore p. 73)-made this phenomenon of surface-filling curves luminous to the geometric imagination. He was the first to recognize a general geometrical generating procedure that allowed the construction of an entire class of space-filling curves.



The first three iterations of the Hilbert curve

4. FRACTAL GEOMETRY

In the 1920's. Benoit B. Mandlebrot felt that Euclidean geometry was not satisfactory as a model for natural objects. *"Clouds are not spheres, mountains are not cones, coastlines are not circles, and bark is not smooth, nor does lightning travel in a straight line.*" Benoit Mandelbrot". These shapes have something in common - something intuitive, accessible and aesthetic[10]. Geometry developed as a collection of tools for understanding the shapes of nature. For millenia, symmetry has been recognized as a powerful principle in geometry, and in art. Fractals are common in nature and are found nearly everywhere. Casey Donoven, one of Montana State University's newest recipients of the prestigious Goldwater Scholarship for excellence in science and math, uses fractals in his research to understand variations in heartbeats. Fractal mathematics has many practical uses, too - for example, in producing stunning and realistic computer graphics, in computer file compression systems, in the architecture of the networks that make up the internet and even in diagnosing some diseases. What is a fractal? A fractal is a geometric shape containing detailed structure at arbitrarily small scales, usually having a fractal dimension strictly exceeding the topological dimension. Many fractals appear similar at various scales, as illustrated in successive magnifications of the Mandelbrot set.

Figure 8

Biological structures isolated fractals that are linked to a higher-order fractal structure. Our human body is the best example of fractal geometry[11]. Our lung, brain and vascular systems are all fractal. The bronchial tree and its branching is fractal. The Purkinje cell forms space-filling dendrites that extensively ramify non-overlapping branchlets in a single parasagittal plane. The non-overlapping dendrites of a Purkinje cell enable it to make hundreds of thousands of non-redundant synapses with parallel fibers , which pass perpendicularly through the planes formed by Purkinje cell dendrites. Considerable efforts have been made to define anatomical characteristics of Purkinje cell dendrite and underlying molecular mechanisms .The dendrites of Purkinje cells are paths cross by nerve fibers and they intercept the signals. These dendrites are typical fractal structures because the main branches are divided into prolongations gradually tiny and scalar relationships, consistent with each other.

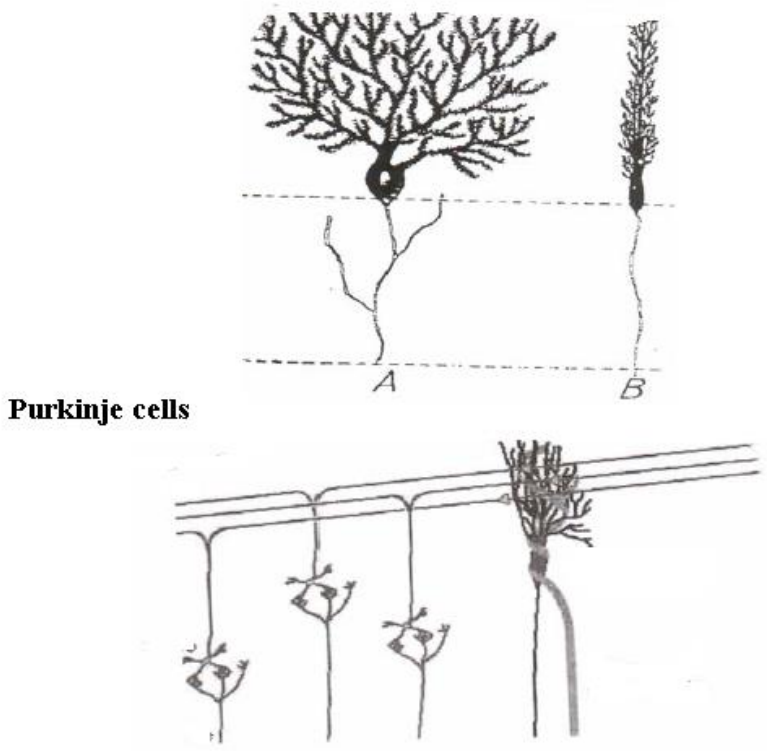


Figure 9: *Purkinje Cells*

Attempts have been made to reconstitute dendrite growth processes using mathematical models. Among these are growth models aimed at finding elementary rules of dendrite development that inform branch pattern variation. Stochastic growth models assume that dendrites growth is an outcome of serial stochastic process.

5. CONCLUSIONS

Mathematics is an important tool to understand what property of life and nature are the result of regularity describable mathematically for us. Means to move closer to a holistic approach in medicine , on behalf of an analytical and reductionist strategy under which all phenomena , symptoms , diseases are dissected and traced to molecular mechanisms character , losing an essential unified vision. The Mandelbrot studies to fractal geometry give a special contribution to medical research and biological helping to introducing a new highly unifying vision of the phenomenon of life and a unified approach to the treatment of disease and the sick person . Selected examples will contribute to depict complex biological shapes and structures as fractal entities, and also

show why the application of the fractal principle is valuable for measuring the dimensional, geometrical, and functional parameters of cells, tissues, and organs occurring within the vegetal and animal realms. If the criteria for a strict description of natural fractals are met, then it follows that a "Fractal Geometry of Life" may be envisaged, and all natural objects and biological systems exhibiting self-similar pattern and scaling properties may be considered as belonging to the ne sub discipline of fractalomics.

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Linear regression analysis in R

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Abstract

Regression analysis has become one of the most widely used statistical tools for analyzing multifactor data. In this paper we present the steps to follow for linear regression analysis in R, which are: Load the data into R, the main assumptions for linear regression such as independence of observations, normality, linearity and homoscedasticity, perform the linear regression analysis, check for homoscedasticity, visualize the results with a graph, reporting the results of linear regression.
In this paper we include some examples from medicine field that are applied through R scripts. The data are taken from a medicine center for 19 individuals where the variables are: Glycemia, Cholesterolemia, HDL cholesterol, LDL cholesterol, Triglyceride.

Key words: linear regression, normality, homoscedasticity, packages, hypothesis test.

1. INTRODUCTION

Regression analysis has numerous areas of applications. A list would include economics, finance, business, law, meteorology, medicine, biology, chemistry, engineering, physics, education, sports, history, sociology, and psychology [1]. Regression analysis is one of the most widely used statistical tools because it provides simple methods for establishing a functional relationship among variables. The techniques presented in this paper address problems whose objective is to analyze the relationship between variables which data types are quantitative. One of the reasons for the importance of regression is that it can be used to forecast variables. The variable to be forecast is called the dependent variable and is denoted Y , while the related variables are called the independent variables and are denoted $X_i, i = 1, 2, ..., p$. When uses only one independent variable, the regression called simple linear regression, while when uses two

or more independent variables, the regression called multiple linear regression. The properties of least squares estimators and the statistical analysis are based on the linearity, normality, independence and heteroscedasticity assumptions. These assumptions are stated in Section 2.2. The examples were applied through R scripts in Section 3.3. Regression models with heteroscedastic errors can be fitted by a method called the weighted least squares (WLS) [2].

2. THE MODEL OF LINEAR REGRESSION

2.1.Model specification

The model of simple linear regression is:

$$Y = \beta_0 + \beta_1 X + \varepsilon \quad (1)$$

where Y is the dependent variable, X is the independent variable, β_0 is the intercept, β_1 is the slope of the line, ε is the random error term.

The model of multiple regressions is:

$$Y = \beta_0 + \beta_1 X_1 + \cdots + \beta_p X_p + \varepsilon \quad (2)$$

where Y is the dependent variable, $X_1, X_2, \cdots, X_p$ are the independent variables, $\beta_0, \beta_1, \cdots, \beta_p$ are the regression coefficient, and ε is the random error variable.

2.2.The standard regression assumptions

Our goal is to develop ways to judge the adequacy of the simple linear model under of its assumptions [1].

1. **The linearity assumption**:
   The model that relates the response Y to the predictors $X_1, X_2, \cdots, X_p$ is assumed to be linear in the regression coefficients $\beta_0, \beta_1, \cdots, \beta_p$. The assumption of linearity in simple regression can be determined by examining the scatterplot of Y versus X. When the linearity assumption does not hold, transformation of the data can sometimes lead to linearity.

2. **Assumptions about the error variable must be satisfied:**

   - The probability distribution of ε is normal.
     The validity of the normality assumption can be assessed by examination of appropriate graphs of the residuals and he Shapiro-Wilk test of normality [3]

   - The mean of the distribution of ε is zero.

- The constant variance assumption.
  The variance of ε is σ^2 (which is a constant; no matter what the value of x is). If the variability comes only from variability of errors and variance of the errors term does not depend from the values of the explanatory variable X, thus have equal variance. This property is called homoscedasticity [2]. When this assumption does not hold, the problem is called the heteroscedasticity problem. A test that controls the dispersion of errors in a regression is called "**Breusch-Pagan test**" by Breusch, and Pagan, 1979, which control the hypothesis if the variance of errors is constant versus the alternative the error variance changes with the level of response (fitted values), or with a linear combination of predictors [4], [5].

- The independent-errors assumption.
  The errors are independent of each other. As a result, the value of the error variable at one point does not affect the value of the error variable at another point. When this assumption does not hold, we have the autocorrelation problem.

3. **Assumptions about the predictors:**
   - The predictor variables are nonrandom.
   - Values $x_{1j}, x_{2,j}, \cdots, x_{nj},\ j = 1, 2, \cdots, p$ are measured without error.

2.3.Coefficients estimation

Our initial goal is to determine the value of the coefficients $\beta_0, \beta_1, \cdots, \beta_p$. We estimate their values from a random sample by using the least squares method [6], [7]. That is, we calculate the estimates of the coefficients by minimizing:

$$S(\beta_0, \beta_1, \cdots, \beta_p) = \sum_{i=1}^{n} \left(y_i - \beta_0 - \beta_1 x_{i1} - \cdots - \beta_p x_{ip} \right)^2 \tag{3}$$

where y_i represents the observed value of Y.

The values of $\hat{\beta}_0$ and $\hat{\beta}_1$ that minimize $S(\beta_0, \beta_1)$ by using the least squares method (in the case of simple linear regression) are given by

$$\hat{\beta}_1 = \frac{S_{XY}}{S_X^2},\ \hat{\beta}_0 = \bar{Y} - \hat{\beta}_1 \bar{X} \tag{4}$$

were $S_{XY} = \dfrac{\sum_{i=1}^{n} \left(X_i - \bar{X} \right)\left(Y_i - \bar{Y} \right)}{n-1}$, $S_X^2 = \dfrac{\sum_{i=1}^{n} \left(X_i - \bar{X} \right)^2}{n-1}$, $\bar{X} = \dfrac{1}{n} \sum_{i=1}^{n} X_i$,

$\bar{Y} = \dfrac{1}{n} \sum_{i=1}^{n} Y_i$.

The estimates $\hat{\beta}_0$ and $\hat{\beta}_1$ are the least squares estimates of the parameters β_0 and β_1.

The least squares regression line is given by:

$$\hat{Y} = \hat{\beta}_0 + \hat{\beta}_1 X . \quad (5)$$

For each observation in our data we can compute:

$$\hat{y}_i = \hat{\beta}_0 + \hat{\beta}_1 x_i, i = 1, 2, \cdots, n . \quad (6)$$

These are called predicted values or fitted values. The differences:

$$e_i = y_i - \hat{y}_i, \quad i = 1, 2, \cdots, n \quad (7)$$

are called residuals.

2.4.The model goodness of fit

Our next task is to decide how well the model describes the data. Goodness of fit refers to a significance test that compares the linear relationship between the dependent and independent variable to no relationship at all. After we compute the least squares estimates of the parameters of a linear model, let us compute the following quantities:

$$SSR = \sum_{i=1}^{n} \left(\hat{Y}_i - \bar{Y} \right)^2,$$

$$SSE = \sum_{i=1}^{n} \left(Y_i - \hat{Y} \right)^2, \quad (8)$$

$$SST = \sum_{i=1}^{n} \left(Y_i - \bar{Y} \right)^2 = SSR + SSE,$$

were SSR is the sum of squares due to regression, which measures the amount of variation in Y that is explained by the variation in X, SSE is the sum of squares residuals (error), which represents the unexplained variation, and SST is the total sum of squares.

The ratio:

$$R^2 = \frac{SSR}{SST} = 1 - \frac{SSE}{SST} \quad (9)$$

is called the coefficient of determination.

In simple linear regression, R^2 is equal to the square of the correlation coefficient between the response variable Y and the predictor X.

The high value of R^2 indicates a strong linear relationship between them.

The standard error of estimate is:

$$s_{\varepsilon} = \sqrt{\frac{SSE}{n-p}} \tag{10}$$

2.5. The F test

With MS denoting mean square (is the sum of squares divided by the degrees of freedom), we define:

$$MSR = \frac{SSR}{p-1}, \quad MSE = \frac{SSE}{n-p}, \tag{11}$$

where $p-1$ is the number of covariates in the regression, n is the sample size.

In simple linear regression, $p=2$ and $n-p=n-2$. Therefore $MSR = SSR$,

$$MSE = \frac{SSE}{n-2}.$$

If the assumptions remain and the null hypothesis $H_0 : \beta_1 = 0$ is true, the ratio:

$$F = \frac{MSR}{MSE} \sim F_{1,n-2} \tag{12}$$

so there is a Fisher distribution with 1 and $n-2$ degrees of freedom. With confidence level α, if $F_{1,n-2} > F_{1,n-2,\alpha}$ (when $F_{1,n-2,\alpha}$ denotes the critical value), then we reject the null hypothesis in favor of the alternative hypothesis. Instead of comparing F values, we can obtain the p-value directly, where

$$p\text{-value} = F_{1,n-2}^{-1}\left(\frac{MSR}{MSE}\right) = 1 - \text{pf(F,1,n-2)} \tag{13}$$

If the p-value $< \alpha$, we reject the null hypothesis. We usually report results of the F-test with the so-called analysis of variance (ANOVA) table [8]. The calculation of the test statistic is summarized in an analysis of variance table, which in general appears as follows:

Table 1*: Typical ANOVA table*

Source of variation	Degree of Freedom (df)	Sum of squares	Mean squares	F -ratio	p-value
Regression	k	SSR	MSR	$F = MSR / MSE$	$1-\text{pf(F,1,n-2)}$
Residual	$n-p$	SSE	MSE	-	-
Total	$n-(p-k)$	SST		-	-

Although each of the assessment measurements offers a different perspective, they agree in their assessment of how well the model fits the data. This is because they are all based on the sum of squares for error SSE [9].

Table 2: *The relationship among standard deviation,* R^2 *and F-ratio*

SSE	Standard deviation	Coefficient of determination	F-ratio	Assessment of Model
0	0	1	∞	Perfect
Small	Small	Close to1	Large	Good
Large	Large	Close to 0	Small	Poor
SST	$\approx \sqrt{\frac{SST}{n-p}}$	0	0	Useless

3. THE STEPS TO FOLLOW FOR LINEAR REGRESSION ANALYSIS IN R

3.1.Data collection

The data are taken from a medicine center for 19 individuals where the variables are: Glycemia, Cholesterolemia, HDL Cholesterol, LDL Cholesterol, Triglyceride, and Age.

Table 3: *Data from the responses of the "Check-Up", Basic Medical Control, Pogradec, Albania*

GLI	CHO	HDL	LDL	TRI	AGE
109.34	280	34.07	194.83	195	52
91.52	227	38.95	135.26	275	64
88.77	195	41.26	137.75	109	55
70.66	164	24.06	95.68	263	49
90.36	254	57.81	174.6	98	63
114.83	228	57.18	155.45	134	56
191.48	174	46.11	99.11	208	64
97.93	239	46.63	180.1	102	57
91.79	200	72.05	109.46	58	56
178.49	247	44.64	178.09	172	70
83.35	206	34.03	143.21	137	46
89.88	119	36.09	62.81	133	53
73.76	199	51.86	123.39	71	47
82.93	218	58.22	142.61	77	41
89.41	207	52.48	129.77	111	65
117	160	48.33	94.13	95	40
70.85	271	57.46	176.31	172	36
70.06	212	69.04	128	102	44
96.11	219	50.07	145.62	120	35

GLI – Glycemia (blood sugar levels).
CHO - Cholesterolemia is the presence of cholesterol in your blood.
HDL - High-Density Lipoprotein.
LDL - Low-Density Lipoprotein (bad cholesterol).
TRI - Triglycerides are a type of fat, called lipid.
AGE - Age.

3.2.Getting started in R and installing packages

Download R and RStudio from the website http://r-project.org. Then we open RStudio and click on File > New File > R Script. We write the codes in the script and to execute them, we highlight the lines that want to be executed and click on the Run button on the top right of the text editor. For our analysis we need to install the following packages:

```
install.packages("ggplot2")
install.packages(car)
install.packages(MASS)
install.packages(nlme)
install.packages(alr4)
install.packages(splines)
install.packages(Rcmdr)
```

rm(list=ls()) # remove (almost) everything in the working environment.

3.3.Using R software

Simple linear regression: Low-Density Lipoprotein and Cholesterolemia

TM<-read.csv(file.choose(), header = T)
Reads a file in table format and creates a data frame from it.

TMdf<-data.frame(TM)
The function data.frame() creates data frames, tightly coupled collections of variables which share many of the properties of matrices and of lists.

summary(TMdf)

```
      GLI              CHO              HDL              LDL        
 Min.   : 70.06   Min.   :119.0   Min.   :24.06   Min.   : 62.81  
 1st Qu.: 83.14   1st Qu.:197.0   1st Qu.:40.10   1st Qu.:116.42  
 Median : 90.36   Median :212.0   Median :48.33   Median :137.75  
 Mean   : 99.92   Mean   :211.5   Mean   :48.44   Mean   :137.17  
 3rd Qu.:103.64   3rd Qu.:233.5   3rd Qu.:57.32   3rd Qu.:165.03  
 Max.   :191.48   Max.   :280.0   Max.   :72.05   Max.   :194.83  
      TRI              AGE        
 Min.   : 58.0   Min.   :35.00  
 1st Qu.:100.0   1st Qu.:45.00  
 Median :120.0   Median :53.00  
 Mean   :138.5   Mean   :52.26  
 3rd Qu.:172.0   3rd Qu.:60.00  
 Max.   :275.0   Max.   :70.00  
```

The relationship between the independent and dependent variable must be line ar. We can test this visually with a scatter plot to see if the distribution of data points could be described with a straight line. The code for this is:

```
plot(TMdf$LDL,TMdf$CHO,main = "Scaterplot between LDL and CHO",
+      xlab = "Low-Density Lipoprotein",ylab = " Cholesterolemia")
```

To perform a simple linear regression analysis and check the results, we need to run these lines of code. The first line of code makes the linear model, the second line is a function adds regression line through the current plot, and the third line prints out the summary of the model.

```
reg_CHO<-lm(TMdf$CHO~TMdf$LDL)
abline(reg_CHO, lwd=2,col="red")
summary(reg_CHO)
```

The output is:

```
Call:
lm(formula = TMdf$CHO ~ TMdf$LDL)

Residuals:
     Min       1Q   Median       3Q      Max
-19.2700  -6.8751   0.5479   4.8009  18.6406

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) 62.18288   10.83598   5.739 2.41e-05 ***
TMdf$LDL     1.08877    0.07668  14.198 7.38e-11 ***

Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
Residual standard error: 11.35 on 17 degrees of freedom
Multiple R-squared:  0.9222,   Adjusted R-squared:  0.9177
F-statistic: 201.6 on 1 and 17 DF, p-value: 7.38e-11
```

The estimates for the model coefficients are $\beta_0 = 62.18$ and $\beta_1 = 1.08$. The p-value is 7.38e-11, which indicate the model fits the data is well. The value of the coefficient of determination tell us that 92.22% of the variability in Cholesterolemia values is explained by the variability in Low-Density Lipoprotein.

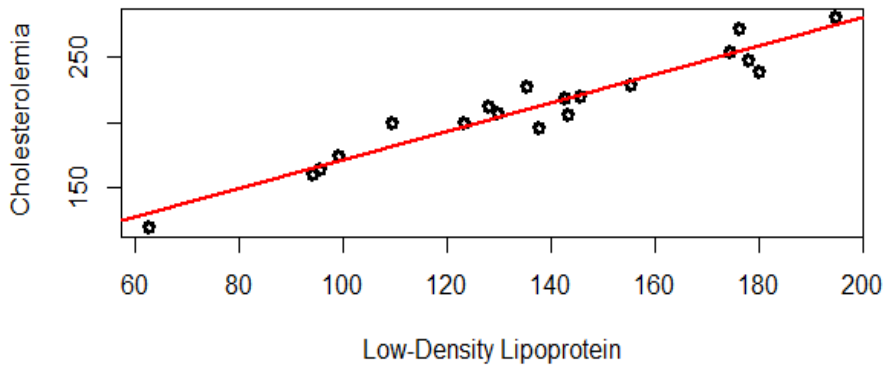

Figure 1*: Scatter plot between Low-Density Lipoprotein and Cholesterolemia, and regression line.*

```
par(mfrow=c(1,3))
hist(TMdf$CHO)
qqnorm(resid(reg_CHO)); qqline(resid(reg_CHO),lwd=3)
plot(reg_CHO$residuals, lwd=3)
```

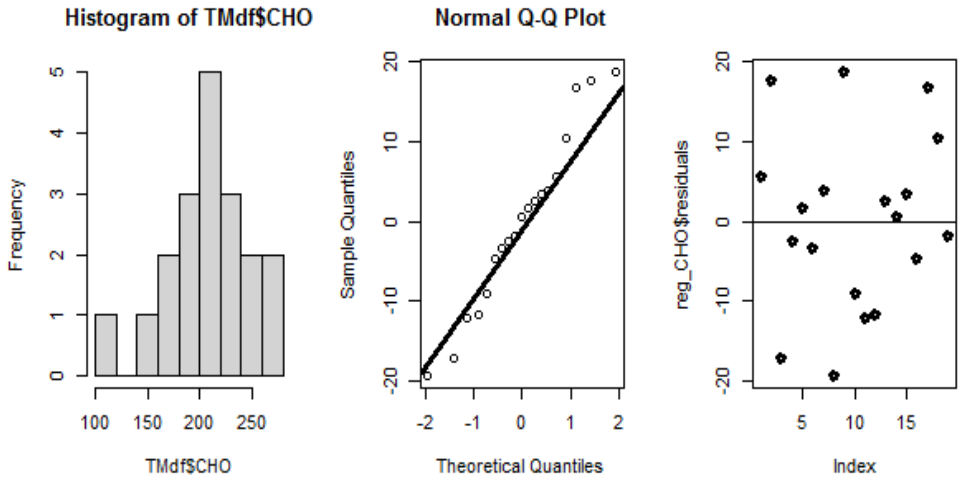

***Figure 2**: Histogram of Cholesterolemia, normal Q-Q plot and plot of residuals.*

shapiro.test(reg_CHO$residuals) # Performs the Shapiro-Wilk test of normal ity [3].

Shapiro-Wilk normality test
data: reg_CHO$residuals
W = 0.96474, p-value = 0.6685

With command ncvTest computes a score test of the hypothesis of constant error variance against the alternative that the error variance changes with the level of the response.

ncvTest(reg_CHO) # The test for Non-Constant Error Variance (homoscedas ticity).

Non-constant Variance Score Test
Variance formula: ~ fitted.values
Chisquare = 0.1940812, Df = 1, p = 0.65954.

anova(reg_CHO)# Analysis of Variance Table

```
Response: TMdf$CHO
           Df  Sum Sq Mean Sq F value    Pr(>F)
TMdf$LDL    1 25959.5 25959.5  201.58 7.38e-11 ***
Residuals 17  2189.2   128.8
```

Multiple linear regressions: Cholesterolemia, LDL Cholesterol, HDL Cholesterol and Age.

To test the relationship, we first fit a linear model with CHO as the dependent variable and LDL, HDL and AGE as the independent variables. In R, to add another coefficient, add the symbol "+" for every additional variable you want to add to the mode. We run these two lines of code:

```
reg_CHO_M<-lm(TMdf$CHO~TMdf$LDL+TMdf$HDL+TMdf$AGE)
summary(reg_CHO_M)
```

The output is

```
Residuals:
    Min      1Q  Median      3Q     Max
-17.708  -6.246  -1.510   5.831  21.694
Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) 44.49230   18.86872   2.358   0.0324 *
TMdf$LDL     1.07159    0.07300  14.680 2.63e-10 ***
TMdf$HDL     0.42608    0.20928   2.036   0.0598 .
TMdf$AGE    -0.01132    0.24710  -0.046   0.9641
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
Residual standard error: 10.67 on 15 degrees of freedom
Multiple R-squared:  0.9394,   Adjusted R-squared:  0.9273
F-statistic: 77.48 on 3 and 15 DF,  p-value: 2.336e-09
```

```
par(mfrow=c(1,2))
qqnorm(resid(reg_CHO_M)); qqline(resid(reg_CHO_M),lwd=3)
plot(reg_CHO_M$residuals, lwd=3)
abline(h=0)
```

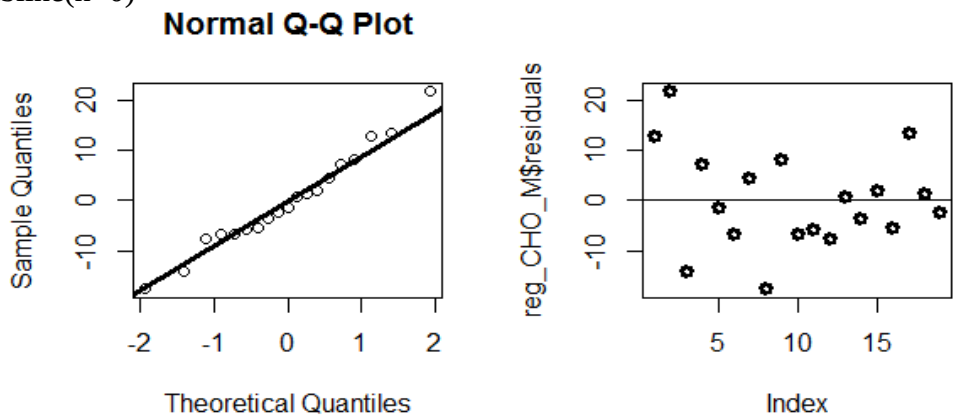

Figure 3*: Normal Q-Q plot and plot of residuals for this multiple regression.*

Based on these residuals, we can say that our model doesn't meet the assumpt ion of homoscedasticity.

```
shapiro.test(reg_CHO_M$residuals) # The Shapiro-Wilk test of normality
```

```
        data:  reg_CHO_M$residuals
        W = 0.97653, p-value = 0.8949
```

```
anova(reg_CHO_M) # Analysis of Variance Table
```

```
Response: TMdf$CHO
            Df  Sum Sq Mean Sq  F value    Pr(>F)
TMdf$LDL     1 25959.5 25959.5 228.1971 1.757e-10 ***
TMdf$HDL     1   482.6   482.6   4.2422   0.05723 .
TMdf$AGE     1     0.2     0.2   0.0021   0.96405
Residuals 15  1706.4   113.8
```

4. CONCLUSIONS

For linear regression with normal random errors having constant variance, the least squares method of the coefficients estimators and standard deviation are accurate. Thus, the usual linear regression model, assumes that all the random error components are identically and independently distributed with constant variance. When this assumption is violated, then ordinary least squares estimator of regression coefficient loses its property of minimum variance in the class of linear and unbiased estimators

The test procedures are not valid if the assumptions on which the tests are based do not hold.

It is to be emphasized, that before starting on any testing procedure, the adequacy of the model assumptions should always be examined.

If a new model is chosen on the basis of a statistical test, residuals from the new model should be examined before terminating the analysis.

Residual plots provide a very convenient graphical way of accomplishing this task. To find the linear regression and to control if the assumptions are valid we can use R software.

If these assumptions are not valid then we can use other methods such as weighted least squares [11], ridge regression [12], robust regression [13].

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2-Normed Strictly Convex And 2-Strictly Convex

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Abstract

In this paper we give the well-known concepts of 2-normed strictly convex and 2-strictly convex. By concretizing them with examples from the different 2-normed spaces views such as:$R^3, \mathcal{L}^p$, $\mathcal{L}^\infty$, $\mathbb{C}_{[0,1]}$the difference between these two different types which have similar names but not in axiomatics.

Key words: 2-normed strictly convex linear space, 2-normed 2-strictly convex linear space.

1. INTRODUCTION

The concepts of 2-metric spaces, 2-norm linear spaces, 2-semi-norm spaces and inner product spaces, introduced by S Gahler in 1963, paved the way for a number of authors such as: A White, YJ Cho, R Freese, CR Diminnie who worked on the possible applications of metric geometry, functional analysis and topology as a new tool.

Definition 1.1. [4] Let X be a real vector space of dimension *d*, where $2 \leq d < \infty$. A 2-norm on X is a function $\|\cdot,\cdot\| : X \times X \to R$ which satisfies the following four conditions:

i. $\|x, y\| = 0$ if and only if *x* and *y* are linearly dependent;
ii. $\|x, y\| = \|y, x\|$;
iii. $\|\alpha x, y\| = |\alpha|\|x, y\|$, $\alpha \in R$;
iv. $\|x, y + z\| \leq \|x, y\| + \|x, z\|$ për çdo $x, y, z \in X$ dhe $\alpha \in R$.

The pair $(X, \|\cdot,\cdot\|)$,is then called a 2-normed space.

2. STRICTLY CONVEX 2-NORMED SPACE

Strictly convex 2-normed space are very important in the study of some geometric structures of normed linear spaces and 2-normed linear spaces, respectively. These concepts are given by different authors in [1-3], [4-5], [7-8], [12].

Let z be a nonzero fixed element of $L, V(z)$ be a the subspace of L generated by z and L_z be a factor space $L/V(z)$. Let x_z be an equivalence class of x with respect to $V(z)$. It is clear that L_z is a vector space in which the operations vector addition and scalar multiplication are defined as following $x_z + y_z = (x + y)_z$ and $\alpha x_z = (\alpha x)_z$

Definition 2.1 Let $x, y \in L$ be non-null elements and let $V(x, y)$ be the subspace of L e generated by the vectors x an y. The vector 2-normed space $(L, \|\cdot,\cdot\|)$ is called a strictly convex if $\|x, z\| = \|y, z\| = \left\|\frac{x+y}{2}, z\right\| = 1$ and $z \notin V(x, y)$ for $x, y, z \in L$ implies $x = y$.

Some characteristics of strictly convex 2-normed linear singularities are given in [1-3], [5], [12].

Theorem 2.1. [7-8] Let$(L, \|\cdot,\cdot\|)$ be a 2-normed linear space. The following statements are equivalent:

1. $(L, \|\cdot,\cdot\|)$ is strictly convex.
2. For any nonzero element $z \in L$, the space L_z is strictly convex.
3. If $\|x + y, z\| = \|x, z\| + \|y, z\|$ dhe $z \notin V(x, y)$, for $x, y, z \in L$ than $y = \alpha x$ for $\alpha > 0$.
4. If $\|x - u, z\| = \alpha\|x - y, z\|$, $\|y - u, z\| = (1 - \alpha)\|x - y, z\|$, $\alpha \in (0,1)$ and $z \notin V(x - u, y - u)$, than $u = (1 - \alpha)x + \alpha y$.
5. A 2-normed linear space $(X, \|\cdot,\cdot\|)$ is strictly convex if and only if $\|x, z\| = \|y, z\| = 1$, $x \neq y$ and $z \in X \backslash V(x, y) \Longrightarrow \left\|\frac{x+y}{2}, z\right\| < 1$.

Example 2.1. Let $X = R^3$ be a 2- norm where $x = (x_1, x_2, x_3)$ $y = (y_1, y_2, y_3)$ and $z = (z_1, z_2, z_3)$ on R^3defined as follows:

$$\|x, y\| = max\{|x_1y_2 - x_2y_1| + |x_1y_3 - x_3y_1|, |x_1y_2 - x_2y_1| + |x_2y_3 - x_3y_2|\}$$

Than the linear space $(R^3, \|\cdot,\cdot\|)$ is strictly convex.

Than $R^3, \|\cdot,\cdot\|)$ is a 2-normed linear space is easily proved. Let's try to prove that it is strictly convex. We take the three unit vectors of this space and prove that it is strictly convex with respect to these vectors.

$e_1 = (1,0,0)$, $e_2 = (0,1,0)$ and $e_3 = (0,0,1)$,

$$\|x,z\| = max\{|x_1y_2 - x_2y_1| + |x_1y_3 - x_3y_1|, |x_1y_2 - x_2y_1| + |x_2y_3 - x_3y_2|\} = 1$$

$\|y,z\| = max\{|x_1z_2 - x_2z_1| + |x_1z_3 - x_3z_1|, |x_1z_2 - x_2z_1| + |x_2z_3 - x_3z_2|\} = 1$, $e_1 \neq e_2$ and $e_3 \in R^3 \backslash V(x,y) \Longrightarrow \left\|\frac{x+y}{2}, z\right\| = max\left\{\left|\frac{x_1+y_1}{2} z_2 - \frac{x_2+y_2}{2} z_1\right| + \left|\frac{x_1+y_1}{2} z_3 - \frac{x_3+y_3}{2} y_1\right|, \left|\frac{x_1+y_1}{2} z_2 - \frac{x_2+y_2}{2} z_1\right| + \left|\frac{x_2+y_2}{2} z_3 - \frac{x_3+y_3}{2} z_2\right|\right\} = \frac{1}{2} < 1$ So is strictly convex.

Example 2.2. In the set of series of real numbers l^∞ we define the 2-norm

$$\|x,y\| = \sup_{\substack{i,j \in N \\ i<j}} \begin{Vmatrix} x_i & x_j \\ y_i & y_j \end{Vmatrix}, x = (x_i)_{i=1}^{\infty}, \qquad y = (y_i)_{i=1}^{\infty} \in l^\infty.$$

That the function $\|x,y\|$ is a 2-norm in l^∞ is easily proven. To show if our space is strictly convex we take the vectors

$$x = \left(1 - \frac{1}{2}, 1 - \frac{1}{2^2}, \dots, 1 - \frac{1}{2^n}, \dots\right), y = \left(0, 1 - \frac{1}{2}, 1 - \frac{1}{2^2}, \dots, 1 - \frac{1}{2^{n-1}}, \dots\right),$$

$z = (1,0,0, \dots, 0, \dots)$

which satisfy $\|x,z\| = \|y,z\| = \left\|\frac{x+y}{2}, z\right\| = 1$, and $z \notin V(x,y)$, but $x \neq y$. Since the fifth statement of the theorem is not fulfilled, we conclude that l^∞ is not a 2-normed strictly convex linear space. ■

3. STRICTLY 2-CONVEX 2-NORMED SPACE

Definition 3.1. [13] A linear 2-normed space $(X, \|.,.\|)$ is said to be strictly 2-convex if $\|x,y\| = \|y,z\| = \|x,z\| = \frac{1}{3}\|x+z, y+z\| = 1$ implies that $z = x + y$.

Theorem 3.1. [5] A linear space $(X, \|.,.\|)$ is strictly 2-convex if and only if $\|x+z, y+z\| = \|x,y\| + \|y,z\| + \|x,z\|$ and $\|x,y\|\|y,z\|\|x,z\| \neq 0$ implies that $z = \alpha x + \beta y$ for $\alpha, \beta > 0$.

Theorem 3.2. A linear space $(X, \|.,.\|)$ is strictly 2-convex if and only if $p \in (1, \infty)$,

$z \notin V(x,y)$ dhe $\|x,y\|\|y,z\|\|x,z\| \neq 0$ implies that

$$\left\|\frac{x+z}{\sqrt{3}}, \frac{y+z}{\sqrt{3}}\right\|^p < \frac{\|x,z\|^p + \|y,z\|^p + \|x,y\|^p}{3}.$$

Example 3.1. Let $X = R^2$ being equipped with the 2-norm $\|x,y\|$ the area of parallelogram spanned by the vector $x = (x_1, x_2)$ and $y = (y_1, y_2) \in R^2$ which may be given clearly by the formula $\|x,y\| = |b_1c_2 - b_2y_1|$

That the space $X = R^2$ is 2-normed is easily proven. Let's prove that it is 2-nomed strictly convex and 2-nomed strictly 2-convex.

Let us take the three unit vectors of this set R^2: $e_1 = (1,0,0)$, $e_2 = (0,1,0)$ dhe $e_3 = (0,0,1)$
$\|x,z\| = 1$, $\|y,z\| = 1, e_1 \neq e_2$ and $e_3 \in R^3 \backslash V(x,y) \Longrightarrow \left\|\frac{x+y}{2}, z\right\| = 0 < 1$ so it is strictly convex.
Now let prove that is strictly 2-convex with respect to these unit vectors
$\|x+z, y+z\| = 3$, $\|x,y\| = 1, \|y,z\| = 1, \|x,z\| = 1,$ $\|x,y\|\|y,z\|\|x,z\| \neq$. So $\|x+z, y+z\| = \|x,y\| + \|y,z\| + \|x,z\|$ than $z = \alpha x + \beta y$ for $\alpha, \beta > 0$.
Finally R^2 is a 2-normed strictly convex space and 2-normed strictly 2-convex space to.
We find that the liear 2-normed space of dimension 2 are both strictly convex and strictly 2-convex.

Example 3.2. Let $X = R^3$ where $x = (x_1, x_2, x_3)$, $y = (y_1, y_2, y_3)$ and $z = (z_1, z_2, z_3)$ in R^3 be a 2-norm defined as follows:

$$\|x,y\| = (x_1y_2 - y_1x_2)^2 + (x_2y_3 - y_2x_3)^2 + (x_1y_3 - y_1x_3)^2$$

Let us take the three unit vectors of this set and prove that is strictly convex with respect to these vectors $e_1 = (1,0,0)$, $e_2 = (0,1,0)$ dhe $e_3 = (0,0,1)$, $\|x,z\| = 1$, $\|y,z\| = 1, e_1 \neq e_2$ and $e_3 \in R^3 \backslash V(x,y) \Longrightarrow \left\|\frac{x+y}{2}, z\right\| = \frac{\sqrt{3}}{2} <$ 1 so it is strictly convex.
Show that it is also a 2-normed 2-strictly convex linear space.
We take the unit vector : $e_1 = (1,0,0)$, $e_2 = (0,1,0)$ and $e_3 = (0,0,1)$
$\|x+z, y+z\| = 3$ $\|x,y\| = 1, \|y,z\| = 1, \|x,z\| = 1,$
$\|x,y\|\|y,z\|\|x,z\| \neq 0$
So $\|x+z, y+z\| = \|x,y\| + \|y,z\| + \|x,z\|$ Implies that $z = \alpha x + \beta y$ for $\alpha, \beta > 0$.

4. CONCLUSIONS

Every linear 2-normed space of dimension 2 is both strictly convex and strictly 2-convex (as examle 3.1)
If a 2-normed linear space $(X, \|.,.\|)$ is strictly convex, then it is strictly 2-convex (as example 3.2). But the converse is not necessarily true.
There are 2-normed linear spaces which are not strictly convex and strictly 2-convex.

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Factor Analysis and Cluster Analysis approaches for Web-based Learning System

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Abstract

The rapid development of the Internet is influencing the dynamics of teaching paradigm from traditional classroom learning to web based learning system. The aim of this research is to investigate the constructs influencing the use of web based learning system. In this study is done the classification of 8 constructs related to behavioral intention to use web based learning system. The questionnaire was developed in different universities in Albania. Is presented an approach that uses factor analysis (FA) for the constructs taken into consideration and incorporated with cluster analysis technique to realize a division of the data in groups based on the behavioral intention to use web based learning system. According to the FA results it was found out that from all of the constructs integrated in study, social inclusion has the strongest connection with behavioral intention. The findings have methodological and practical implications.

*Key words***:** Constructs, Web Based Learning System, Factor Analysis, Cluster Analysis.

1. INTRODUCTION

The expansion of information and communication technologies (ICT) has influenced universities by adopting web based systems to ensure ubiquitous communication with students. A Web-based learning system permits users who may be instructors or students to share instructional information, submit and return course assignments, interact with each other online [1]. It mentions Learning Management Systems (LMS) as well as web-based learning systems. LMS incorporation into teaching and learning has been increased in higher

education [2]. LMS is promoted by a number of benefits such as flexibility, accessibility and management of course delivery and educational materials.
Several framework have been employed to address the issues of use and acceptance of new technology enabled learning and to identify the cause and effect of different variables. For instance, Performance Expectancy (PE), Effort Expectancy [2], Satisfaction and Academic Achievements [3], Social Influence (SI), Facilitating Conditions, Hedonic Motivation (HM), Habit (HT), Behavioral Intention (BI) all of them have been connected with web based learning for educational purposes [4-5].
Performance Expectancy (PE) is concerned with students' beliefs that a system use will enhance their learning productivity. Effort Expectancy (EE) is the students' perception that the system will be easy to use [6]. Social Influence (SI) relates to whether important people (friends), impact a students' intention to use the system. Hedonic Motivation (HM) defines the satisfaction of using system. Habit (HT) is related to automatic behaviors of a student using a system.
The purpose of this study is to determine the constructs that influence the acceptance and use of web-based learning system. The integration of the cluster method will group data with close factors scores into the same cluster.

2. MATERIALS AND METHODS

The target sample for this study was taken from students in Albania higher education. All variables were measured on a 1–5 likert scale, from "Strongly Disagree" to "Strongly Agree".
Factor analysis (FA) is a multivariate statistical technique useful to identify the factors underlying the variables by means of set related variables in the same factor [7]. It reduces the number of variables by using a smaller number which are called constructs [8]. To obtain factor solutions, Principal Components Analysis (PCA) has been applied and will use the principal component expression for behavioral intention to use LMS.
The variables: Performance Expectancy (PE), Effort Expectancy (EE), Social Influence (SI), Hedonic Motivation (HM), Habit (HT), are called constructs of the behavioral intention to use LMS. As part of the FA plan is the definition of the number of factors to be extracted. The relations between components and data are evaluated by using the factors scores technique. The latter are used as inputs in the cluster analysis method. In the study, the K-means procedure was developed and a three-cluster solution analysis was introduced.

3. RESULTS AND DISCUSSIONS

Table 1 shows factor loading regarding the component. All constructs that have a load greater than 0.3 are taken into consideration. All constructs are important in explaining the first component. The latter is interpreted as the component of the behavioral intention to use web based learning system.
Table 2 shows how the variance is separated between the 15 factors. As it's shown the 4 factors have eigenvalues greater than 1 and the variance explained by them is shown. The first factor can be explained 37.034% of the variance.
Table 3 shows the results of the K-means method with three solutions. Values greater than zero for a factor score, exhibits that the characteristic described by the component (in our case the level of behavioral intention to use web based learning system) is above the average and if a factor score is below zero, then show that the characteristic is below average [9]. The clusters based on the above explanations are named as follows: The first cluster: the level of behavioral intention to use web based learning system is low, the second cluster: the level of behavioral intention to use web based learning system is average, the third cluster: the level of behavioral intention to use web based learning system is high. This separation is made based on the values of factor scores.

Table 1: *Rotated Component Matrix*

Items	Component
PE2	.707
PE1	.725
PE3	.316
PE4	.416
EE1	.321
EE2	.790
EE3	.809
EE4	.726
SI1	.747
SI2	.737
HM1	.472
HM3	.597
HT1	.505
HT2	.490
HT3	.360

***Table 2**: Total Variance Explained*

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.925	37.034	37.034	5.925	37.034	37.034
2	2.040	12.747	49.781	2.040	12.747	49.781
3	1.679	10.495	60.276	1.679	10.495	60.276
4	1.083	6.767	67.043	1.083	6.767	67.043
5	.918	5.736	72.779			
6	.895	5.592	78.371			
7	.744	4.649	83.020			
8	.717	4.482	87.502			
9	.518	3.239	90.741			
10	.413	2.579	93.321			
11	.309	1.930	95.250			
12	.271	1.692	96.942			
13	.182	1.136	98.078			
14	.173	1.083	99.161			
15	.134	.839	100.000			

***Table 3:** K-means method results*

	Cluster		
	3	1	2
REGR factor score for analysis	2.19355	-2.35929	-.09133

4. CONCLUSIONS

In the proposed approach, the factor analysis method simplifies the data construction by reducing the dimension of data and cluster analysis develops the grouping in clusters. Constructs; Performance Expectancy, Effort Expectancy, Social Influence, Hedonic Motivation (HM), Habit (HT) are important in determining the behavioral intention to use web based learning. Similar factors scores of the FA method were grouped into the same clusters which were named: low level of behavioral intention to use web based system learning, medium level of behavioral intention to use web based system learning, high level of behavioral intention to use web based learning system.

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On some applications of derivatives and differential equations in real life

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Abstract

The derivative of a function represents the infinitesimal changes that the function causes in one of its variables. Derivatives and differential equations are used in everyday life to tell us "how much" something is changing. Knowing their extensive use helps us learn to solve problems accurately. The purpose of this paper is to demonstrate with concrete examples the use of derivatives and differential equations in real life, for example: car timers, speed radars, business, bridge construction, as well as their wide use in approximating solutions as correct. The methodology used, extensive literature on the use of derivatives and differential equations are studied to expand with practical examples their use in everyday life. To fulfill the purpose of this paper, examples are illustrated with steps, photos and block diagrams.

Key words: derivatives, equation, application, problem solving.
Feature including work: Applied Mathematics
Science Field: Mathematics

1. INTRODUCTION

Differential equations have a remarkable ability to predict the world around us. They are used in a wide variety of disciplines, from biology, economics, physics, chemistry and engineering. They can describe exponential growth and decay, the population growth of species or the change in investment return over time. A differential equation is one which is written in the form $dy/dx = f(x) = y'$.

In the automotive industry.
First in this list, we will discuss how the automotive industry uses derivatives in cars and vehicles. An automobile usually comes with an odometer and a speedometer. These gauges are known to help the driver determine the speed at which he is traveling. In addition, they can also find out the distance they have traveled so far. Electronic versions of these gauges often employ the use of derivatives to convert the data from the tires into miles per hour, in addition to the distance sent to the motherboard in kilometers.

In the Police Force
You may have seen police officers speeding a car in some movies before. But have you ever wondered how these weapons use derivatives in real life? It's very easy. Police officers using radar guns often use the power of derivatives to target and detect if a driver is speeding. Whenever it is pointed at a vehicle, the radar gun can easily estimate the time and distance at which the radar hits a part of the vehicle.
The derivative defines the rate at which one variable changes with respect to another. So it is an important concept that comes in extremely useful in many applications: in everyday life. In this article, you will discover different applications of derivatives.

2. METHODOLOGY

Derivatives answer questions like “How fast?” “How steep?” and “How sensitive?” These are all questions about rates of change in one form or another. One of the most familiar applications of derivatives that we can find around us. Every time you get in your car, you witness differentiation. [12] In everyday life, we often use speed and velocity interchangeably if we are describing the rate of change of a moving object. Speed is always positive, whereas velocity introduces a notion of direction and, hence, can exhibit both positive and negative values. Hence, in the ensuing explanation, we shall consider velocity as the more technical concept, defined as:

$$velocity = \delta y / \delta t$$

This means that velocity gives the change in the car’s position, δy, within an interval of time, δt. In other words, velocity is the first derivative of position with respect to time.
The car’s velocity can remain constant, such as if the car keeps on travelling at 100 kilometers an hour consistently, or it can also change as a function of time. In case of the latter, this means that the velocity function itself is changing as a function of time, or in simpler terms, the car can be said to be accelerating.

[12]Willey, J. (2016), Calculus for Dummies, 2nd Edition, Learning made easy

Acceleration is defined as the first derivative of velocity, v, and the second derivative of position, y, with respect to time:

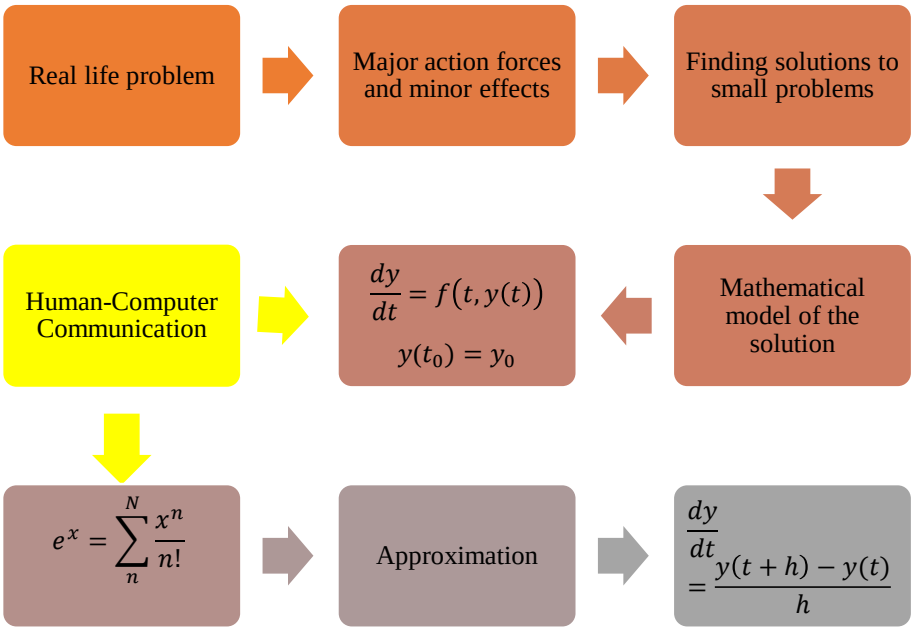
$$\text{acceleration} = \delta v / \delta t = \delta^2 y / \delta t^2$$

But there is a plethora of real-life phenomena that change with time (or variables other than time), which can be studied by applying the concept of derivatives as we have just done for this particular example. To name a few:

- Growth rate of a population (be it a collection of humans, or a colony of bacteria) over time, which can be used to predict changes in population size in the near future.
- Changes in temperature as a function of location, which can be used for weather forecasting, ect.

2.1 Building a mathematical model for solving real problems using differential equations

A real world problem is like building a bridge over a river, we always try to find the "correct answer" to problems. For this, we need to build an accurate mathematical model of the problem. But it is not possible to include every aspect of the problem in the construction of the model. The simple reason can be easily elaborated by considering the problem of bridge construction. The various forces acting on the bridge are: the Earth's gravity, the density of traffic crossing the bridge, the number of people crossing the bridge at any time, the gravity of the Moon, etc. For mathematical modeling it is necessary to include all such effects. Some of the forces have major effects and others produce minor effects. These types of complications are also observed in many types of problems in physics, chemistry, biology, economics, engineering, etc. The most important mathematical tool used in modeling the solution to such and many other problems in the physical sciences is the differential equation. The differential equation or ordinary differential equation is in many cases too complicated to be solved analytically. The numerical solution is thus the only way to obtain information about the system. The diagram below shows the construction of a human-computer communication model for solving a real-life problem.



The use of elementary difference methods to obtain the approximate solution of differential equations or initial value problems was first reported in 1768 by Leonhard Euler [13]. Thus, the method is ideally suited for using computers to obtain numerical solutions since it dictates the independent variable, computers only understand discrete variables. Euler gave the idea of programming long before the introduction of the concept of programming in 1842 by Ada Lovelace, daughter of Lord Byron [14]. Numerical methods are no longer laborious as computers will perform the solution. Effectively, Euler's idea transforms a differential equation into an algebraic equation. Thus solving an initial value problem is simply a procedure that produces approximate solutions at particular points using only the operations of addition, subtraction, multiplication, division, and functional evaluations. Euler's method removes the discrepancy between two worlds: the analog world in which we humans live and the discrete/digital world in which computers survive.

[13] BISWAS, B. N. CHATTERJEE, S. MUKHERJEE S. P. (2013) Differential equations, stability, existence, Euler method. Vol. 1, July 2013, ISSN: 2090-792X (online)
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2.*2 Speedometer*

An odometer or odometer is an instrument used for measuring the distance traveled by a vehicle, such as a bicycle or car. The device may be electronic, mechanical, or a combination of the two (electromechanical). [15]

How to measure speed? If you've know speed it's the distance you travel divided by the time you take. So if you go 100 kilometers and it takes you two hours to do it, your average speed is 50 kilometers in hour. To find your average speed from A to B, you could divide the distance between them by the time it took you. But that doesn't tell you anything about your speed on the way, because you might have traveled by different routes or paused your journey. Only a speedometer can tell you your actual speed at any given moment.

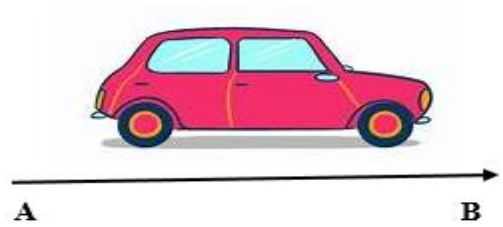

Figure 1: *Moving the car from A to B*

What we really need is a way of figuring out how fast the car's wheels are turning. But how do you measure a wheel's rate of rotation?
Acceleration is defined as the first derivative of velocity, *v*, and the second derivative of position, *y*, with respect to time:

$$acceleration = \delta v / \delta t = \delta^2 y / \delta t^2$$

We can graph the position, velocity and acceleration curves to visualize them better. Suppose that the car's position, as a function of time, is given by $y(t) = t^3 - 8t^2 + 40t$:

[15] S, André Wegener (October 1981). "Odometer". *Scientific American*. **245** (4): 188-200. Bibcode:1981SciAm.245d.188S. doi:10.1038/scientificamerican1081-188. ISSN 0036-8733.

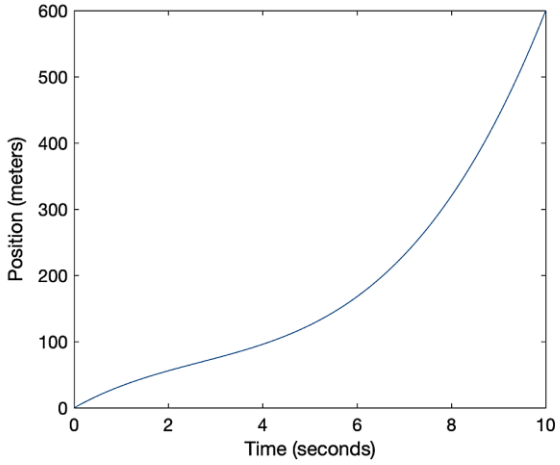

Figure 2: *Line plot of the car's positions against time*

The graph indicates that the car's position changes slowly at the beginning of the journey, slowing down slightly until around t = 2.8s, at which point its rate of change picks up and continues increasing until the end of the journey. This is depicted by the graph of the car's velocity:

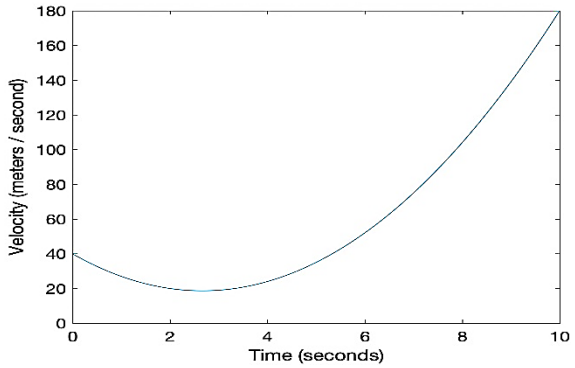

Figure 3: *Line Plot of the Car's Velocity Against Time*

Notice that the car retains a positive velocity throughout the journey, and this is because it never changes direction. If we had to apply the power rule to y(t) to find its derivative, then we would find that the velocity is defined by the following function:

$$v(t) = y'(t) = 3t^2 - 16t + 40$$

Acceleration is the derivative of velocity. If we had to, again, apply the power rule to v(t) to find its derivative, then we would find that the acceleration is defined by the following function:

$$a(t) = v'(t) = 6t - 16$$

Putting all functions together, we have the following:

$$y(t) = t^3 - 8t^2 + 40t$$
$$v(t) = y'(t) = 3t^2 - 16t + 40$$
$$a(t) = v'(t) = 6t - 16$$

- If we substitute for t = 8s, we can use these three functions to find that by the end of the journey, the car has travelled 100m, its velocity is 104 m/s, and it is accelerating at 32 m/s^2.
- If we substitute for t = 10s, we can use these three functions to find that by the end of the journey, the car has travelled 600m, its velocity is 180 m/s, and it is accelerating at 44 m/s^2.

2.3 Police Radar

RADAR speed detectors bounce microwave radiation off of moving vehicles and detect the reflected waves. These waves are shifted in frequency by the Doppler effect, and the beat frequency between the directed and reflected waves provides a measure of the vehicle speed.

To measure speed, radar relies on a principle called the "doppler shift." If you've ever heard an emergency vehicle with sirens drive past you and the sound changes as they pass you (it's higher pitched initially and then the pitch drops after they pass you), you've experienced the doppler effect. The sound waves are compressed when the vehicle is driving towards you and then get stretched as they drive past you. Police radar relies on the same principle. It shoots radar forward, and the radar waves get compressed (if the target vehicle is getting closer) or stretched out (if the target is moving away), and the radar gun measures this change in frequency and converts it to a speed.

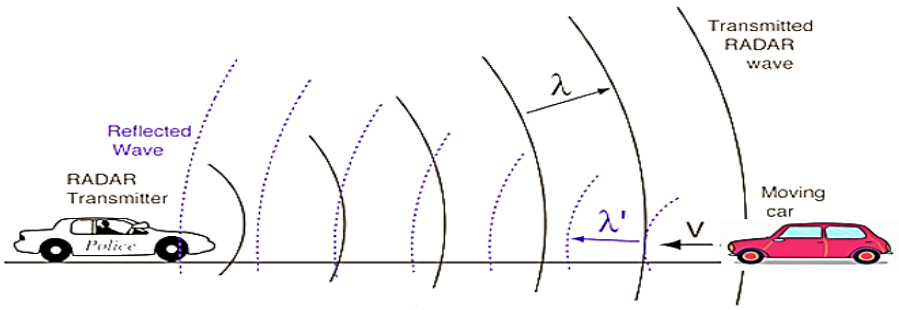

Figure 4: *Police Radar*

Police radar guns use the Doppler principle to measure the speed of a vehicle. The radar gun emits a radio wave that bounces off the vehicle and returns to

the radar gun like figure 4. The frequency of the returning wave is different from the frequency of the emitted wave due to the Doppler effect. The radar gun uses this difference in frequency to calculate the speed of the vehicle. The Doppler shift for relatively low velocity sources such as those encountered by police RADAR is given by:

$$\Delta f = \frac{2 f_0 v}{c}$$

where Δf is the Doppler shift, f_0 is the frequency of the emitted wave, v is the velocity of the vehicle relative to the radar gun, and c is the speed of light.

3. CONCLUSIONS

- Derivatives answer questions like "How fast?" "How steep?" and "How sensitive?" These are all questions about rates of change in one form or another.
- The differential equation or ordinary differential equation is in many cases too complicated to be solved analytically. The numerical solution is thus the only way to obtain information about the system.
- The Euler approximation method is ideally suited for using computers to obtain numerical solutions since it dictates the independent variable, computers only understand discrete variables.
- Euler gave the idea of programming long before the introduction of the concept of programming in 1842 by Ada Lovelace, daughter of Lord Byron.
- The Euler method of approximation is applied in solving different problems from real life, as well as it can be implemented in different computer programs to be solved (Microsoft Excel, MATLAB, AP Monitor, etc.
- The speedometer has been improved so much that it accurately determines the acceleration of the movement of a vehicle using derivatives.
- By means of derivatives we calculate the speed and acceleration of the movement of cars.
- Police radar guns use the Doppler principle to measure the speed of a vehicle. The radar gun emits a radio wave that bounces off the vehicle and returns to the radar gun.

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Study of the Stability and Asymptotic Behavior of a Nonlinear Dynamic System Having a Hopf Bifurcation

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Abstract

In this paper we will analyze non-linear dynamic systems. We aim to determine the equilibrium points, examine their characteristics and determine the existence of a bifurcation for the value of the corresponding parameter. A detailed local stability analysis was performed for the parameter values. The existence of the Hopf bifurcation of systems of differential equations is proved and the existence of a limit cycle which is always stable is proved.

Key words: Non -linear dynamic systems, equilibrium, local stability, Hopf bifurcation.

1. INTRODUCTION

Different processes in biology, physics, economics, etc. are interested in being modeled by means of dynamic systems that include non-linear differential equations. Solving the equations, if possible, provides information on the progress of the process in time, which depends on the initial conditions. Bifurcation theory and system stability analysis are useful tools for the quantitative and qualitative study of complex phenomena without the need to select the system for each initial value. The ideal would be to calculate the solution of the system for each initial value, but in general this cannot be done except in the case of a linear dynamic system with constant coefficients or in some simple cases for linear dynamic systems. Although the solutions are unique depending on the initial values, again it is difficult to determine by means of a law the change in time and in a specific space. In many cases, very small changes in the initial values lead to disturbances in the development of the system. Consequently, it is necessary to study the dynamic system

qualitatively and quantitatively, especially in the surrounding area of the equilibrium points or for some variables.

Definition 1.1 ([1]). Dynamic system is called the triple (E, R, φ) where E is the system space, R is the parameter space and φ: E×R→R is the law of motion starting from an initial position.

$\varphi(t,x)$ defined for each t ϵ R and E ⊂ R^nsuch that:

i. $\varphi_0(x) = x$ for each x ϵ E.
ii. $\varphi_s(\varphi_t(x)) = \varphi_{t+s}(x)$ for all s, t and x ϵ E
iii. $\varphi_{-t}(\varphi_t(x)) = \varphi_t(\varphi_{-t}(x))$ for all t ϵ E

Definition 1.2 ([1]). In linear dynamic systems that develop in time $\{\varphi(t,x)\}_{t\,\epsilon\,E}$ is called flow.

Definition (1.3) ([5]).

i. If E is a subset of R^n and $f: E \to R^n$ then $\dot{x} = f(x)$ is called a linear dynamic system where:

$f(x) = (f_1(x), f_2(x), \ldots, f_n(x))^T$ and x= $(x_1, x_2, \ldots, x_n)^T$

ii. The solution of the dynamical system is called the parametric function

x(t)= $(x_1(t) \quad x_2(t) \quad \ldots \quad x_n(t))^T$ such that $\dot{x}(t) = f(x(t), x_0)$; $x_0 = x(0)$.

iii. Equilibrium point of the dynamic system $\dot{x} = f(x)$ is every point

x = $(x_1 \quad x_2 \quad \ldots \quad x_n)^T$ in R^n such that $\dot{x} = f(x) = 0$.

iv. If x(t) is the solution to the initial state problem

$\dot{x} = f(x)$ and x (0) = x_0.

v. Then x_0 is called the initial state and x(t) is called the solution of the system for the initial state x_0.

Definition 1.4 ([4]). Let A be a square matrix. The solution of the dynamic system $\dot{x}$ = A x for initial state x (0) = x_0 is given by

$$x\,(0) = x_0 \text{ given by } \varphi(t, x_0) = e^{At}x_0.$$

Theorem 1.1 ([1]). Let δ = det A and τ = trace A and consider the linear system:

$$\dot{x} = A\,x$$

a. If $\delta < 0$ then $\dot{x} = A\,x$ has a saddle at the origin.
b. If $\delta > 0$ and $\tau^2 - 4\delta \geq 0$ then $\dot{x} = A\,x$ has a node at the origin; it is stable if $\tau < 0$ and unstable if $\tau > 0$.
c. If $\delta > 0$ and $\tau^2 - 4\delta < 0$ and $\tau \neq 0$ then $\dot{x} = A\,x$ has a focus at the origin; it is stable if $\tau < 0$ and unstable if $\tau > 0$.
d. If $\delta > 0$ and $\tau = 0$ then $\dot{x} = A\,x$ has a center at the origin.

2. LIMIT SET

Consdider the autonomus system
$\dot{x} = f(x)$
for $f \epsilon C^1(E)$, where $E \subset R^n$, E is an open subset. For $x \epsilon E$, the function $\varphi(t, x_0) \rightarrow E$ defines a solution trajectory or orbit. We will use the symbol $\Gamma(x_0) = \{\varphi(t, x_0)\ \epsilon\ R^n\ ku\ t \epsilon R\}$as the trajectory of the dynamical system that passes through the point x_0 at the instant of time t = 0.

Definition 2.1 ([6]).

i. A point $b \epsilon E$ is called ω-limit point of the trajectory φ (t, x) if there is a sequence $t_n \rightarrow +\infty$ such that:

$$\lim_{n\to\infty} \varphi(t_n, x) = b.$$

The set of all ω-limit points is denoted ω(Γ)

ii. A point $b \epsilon E$ is called α -limit point of the trajectory φ (t, x) if there is a sequence $t_n \rightarrow -\infty$ such that:

$$\lim_{n\to\infty} \varphi(t_n, x) = b.$$

The set of all α-limit points is denoted α(Γ).

Definition 2.2 ([2]). If P is a point of ω(Γ) or α(Γ) then the trajectories that passing through P are called limit orbits for Γ and ω(Γ), α(Γ) contain equilibrium points and limit orbits.

Definition 2.3 ([2]). An orbit is called periodic if $\varphi(t, x_0)$ has the property that

$$\varphi(3.t + T, x_0) = \varphi(t, x_0)$$

for any T and for all t.

Definition 2.4 ([1]). A closed set A ⊂ E is called attractive for the dynamic system if there is a neighborhood of U such that for all φ (t, x) ϵ U and $\lim_{n\to\infty} \varphi(t,x) = A$ for all t≥0. An attractor of $\dot{x}$ = f (x) is an attracting set which contains a dense orbit.

Theorem 2.1 ([3]). If Ω is a nonempty, closed and bounded limit set of a planar system of differential equations that contains no equilibrium point. Then Ω is a closed orbit.

3. BIFURCATION

Definition 3.1 ([1]). Saddle-node bifurcation. Consider $\dot{x}(t) = f(x(t), \mu)$, $x\epsilon\, R^n, \mu\epsilon R$ a dynamic system with continuous time that depends on the parameter μ. The μ_0 value of the μ parameter is called the bifurcation value.

Theorem 3.1 ([2]). Suppose that the vector field C^k, k ≥ 2 in a neighborhood of the point (0,0) satisfies.

$$\frac{\partial f}{\partial \mu}(0,0) =: a \neq 0, \frac{\partial^2 f}{\partial x^2}(0,0) =: 2b \neq 0.$$

The following properties hold for sufficiently small μ, in a neighborhood of (0,0).

i. If ab < 0 (ab > 0) the differential equation has no equilibrium point for μ < 0 (for $\mu > 0$).
ii. If ab < 0 (ab > 0) the differential equation has two equilibrium points of opposite stability.

$$x = \sqrt{|\mu|},\ x = -\sqrt{|\mu|} \text{ for } \mu > 0 \text{ (for } \mu < 0).$$

For $\dot{x} = f(x, \mu)$ we have a saddle-node bifurcation for $\mu = 0$.

([2]). The illustration below shows an example of a saddle - node bifurcation.

$$\frac{dx}{dt} = \mu - x^2.$$

Where x is the bifurcation variable, μ is the bifurcation parameter.

For $\mu < 0$ there is no balance point (μ = - 0.5). For μ = 0 (bifurcation value) there is an equilibrium point at the origin which is semi stable. For μ > 0 there are two equilibrium points which are $x^* = \sqrt{\mu}$ stable and $x^* = -\sqrt{\mu}$ unstable ($\mu = 0{,}5$).

Pitchfork bifurcation. ([1]) There are two types of pitchfork. They are the supercritical fork bifurcation and the subcritical fork bifurcation. First let's look

at the supercritical fork bifurcation. The illustration below shows an example of a supercritical fork bifurcation.

$$\frac{dx}{dt} = x(\mu - x^2).$$

i. $\mu < 0$ there is only one equilibrium point, it is the origin and it is stable ($\mu = -0.5$).
ii. $\mu = 0$ (bifurcation value) the origin is still stable but weaker.
iii. $\mu > 0$ there are three equilibrium points which are the origin which is unstable, $x^* = \sqrt{\mu}$ stable and $x^* = -\sqrt{\mu}$ unstable ($\mu = 0{,}5$).

Hopf bifurcation ([6]) The bifurcation associated with the birth of its own value $\lambda_1 = 0$ is called a fold bifurcation. Consider $\dot{x} = f(x, \mu)$ a continuous-time system depending on the parameter μ. Where f is smooth with respect to x and μ. Let x= x_0 be the hyperbolic equilibrium point for $\mu = \mu_0$. We know that under a small change of the parameter, the parameter moves but still remains hyperbolic. We monitor the stability of the equilibrium by changing the parameter values. The condition of being a hyperbolic point is violated in two cases, either some real value approaches 0 and we have $\lambda_1 = 0$ or when the pair of conjugate complex eigenvalues reach the imaginary axis and we have $\lambda_{1,2} = \pm i\omega_0,\ \omega_0 > 0$ for any parameter value.

Definition 3.2 ([1]). The bifurcation corresponding to the presence of $\lambda_{1,2} = \pm i\omega_0,\ \omega_0 > 0$, is called a Hopf (or Andronov - Hopf) bifurcation.

Definition 3.3 ([3]). A Hopf bifurcation is called supercritical if a stable limit cycle surrounds an unstable equilibrium point.

Definition 3.4 ([3]). A Hopf bifurcation is called subcritical if an unstable limit cycle surrounds a stable equilibrium point.

The Briggs – Rauscher reaction [4].

A special quality that characterizes dynamical systems is the change of parameter values in a periodic orbit. This is observed in biology, in chemical reactions and in many other phenomena. Such a property of the dynamical system is called a Hopf bifurcation. In 1972 came the reaction of Thomas Briggs and Warren Rauscher. They brought about the Briggs – Rauscher reaction by replacing potassium bromate with potassium iodide in the BZ (Belousov - Zhabotinsky) reaction and adding hydrogen peroxide and starch. So the Briggs-Rauscher reaction contains a mixture of potassium iodine, sulfuric acid, malonic acid, manganese sulfate, starch and hydrogen peroxide. This mixture changes from a colorless mixture to yellow and then to blue which repeats. A simple case of a periodic chemical reaction is obtained from the

reaction between hydrogen peroxide $H_2O_2$and iodine IO_3^-. The system that represents this reaction is:

$$\begin{cases} x' = 1 - (b+1)x + ax^2y \\ y' = bx - ax^2y \end{cases}$$

Where x, y are the chemical concentrations H_2O_2 and IO_3^-, a ,b > 0 are parameters.

First, find the equilibrium point by solving the system:

$$\begin{cases} 1 - (b+1)x + ax^2y = 0 \\ bx - ax^2y = 0 \end{cases}$$

From

$$bx - ax^2y = 0$$

we get

$$x(b - axy) = 0.$$

From here we have

$$x\ y = \frac{b}{a}$$

$$1 - (b+1)x + ax^2y = 0 \text{ or}$$

$$1 - (b+1)x + ax(xy) = 0$$

$$1 - (b+1)x + bx = 0$$

$$1\text{-}x = 0$$

$$x = 1 \text{ and } y = \frac{b}{a}$$

Then $x_0 = (1, \frac{b}{a})$ is the equilibrium point.

We calculate the Jacobian matrix at the equilibrium point.

$$Jf(X) = \begin{pmatrix} -b - 1 + 2axy & ax^2 \\ b - 2axy & -ax^2 \end{pmatrix}$$

$$Jf(1, \frac{b}{a}) = \begin{pmatrix} b - 1 & a \\ -b & -a \end{pmatrix}$$

The eigenvalues of the Jacobian matrix are given by the equation:

$$\lambda^2 - (trJ)\lambda + \det J = 0$$

where

$$\lambda_{1,2} = \frac{\mathrm{trJ} \pm \sqrt{(\mathrm{trJ})^2 - 4\mathrm{detJ}}}{2}$$

$$\lambda_1 + \lambda_2 = \mathrm{trJ} \text{ and } \lambda_1\lambda_2 = \det \mathrm{J}$$

$$\det \mathrm{J}(1, \tfrac{b}{a}) = -ab + a + ab = a, \text{ tr J } (1, \tfrac{b}{a}) = b-1-a$$

$$D = \det \mathrm{J}(1, \tfrac{b}{a}) > 0, \; T = \text{tr J } (1, \tfrac{b}{a}) = b-1-a = 0.$$

We have a Hopf bifurcation at b = a+1.

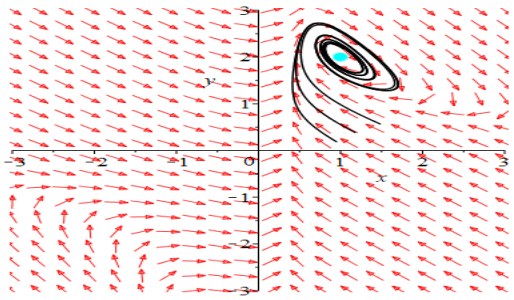

Figure 1: *Hopf Bifurcation for parameter values a=1. Taken with Maple.*

Hopf Bifurcation Theorem ([1]). Conisider the planar system

$$\dot{x} = f_\mu(x, y),$$

$$\dot{y} = g_\mu(x, y),$$

where μ is a parameter. Suppose it has equilibrium point $(x, y) = (x_0, y_0)$, which may depend on μ. Let the eigenvalues of the linearized system about this equilibrium point be given by $\lambda(\mu), \bar{\lambda}(\mu) = \alpha(\mu) \pm i\beta(\mu)$. Suppose further that for a certain value of μ, say $\mu = \mu_0$, the following conditions are satisfied:

1. $\alpha(\mu_0) = 0$, $\beta(\mu_0) = \omega \neq 0$ where $sgn(\omega) = sgn[\partial g_\mu / \partial x|_{\mu=\mu_0}(x_0, y_0)]$

(non-hyperbolicity condition: conjugate pair of imaginary eigenvalues)

2. $\left.\frac{d\alpha(\mu)}{d\mu}\right|_{\mu=\mu_0} = d \neq 0$

(transversality condition: the eigenvalues cross the imaginary axis with non-zero speed)

3. $b \neq 0$ where

$$b=\frac{1}{16}\left(f_{xxx}+f_{xyy}+g_{xxy}+g_{yyy}\right)+\frac{1}{16\omega}\left(f_{xy}\left(f_{xx}+f_{yy}\right)-g_{xy}\left(g_{xx}+g_{yy}\right)-f_{xx}g_{xx}+f_{yy}g_{yy}\right)$$

$$\text{with } f_{xy} = \left.(\partial^2 f_\mu/\partial x\,\partial y)\right|_{\mu=\mu_0}(x_0,y_0), etc.$$

(genericity condition)

Then a unique curve of periodic solutions bifurcates from the equilibrium point into the region $\mu > \mu_0$ if $bd < 0$ or $\mu < \mu_0$ if $bd > 0$. The equilibrium point is stable for $\mu > \mu_0$ (resp. $\mu < \mu_0$) and unstable for $\mu < \mu_0$ (resp. $\mu > \mu_0$) if $d < 0$ (resp. $d > 0$) whilst the periodic solutions are stable (resp. unstable)
if the equilibrium point is unstable (resp. stable) on the side of $\mu = \mu_0$ where the periodic solutions exist. The amplitude of the periodic orbits grows like $\sqrt{|\mu|}$ whilst their periods tend to $2\pi/|\omega|$ as $|\mu|$ tends to zero.

Consider the dynamic two-dimensional system:

$$\begin{cases} x' = -x + by + x^2y \\ y' = a - by - x^2y \end{cases}$$

Where $a, b > 0$. First, find the equilibrium point by solving the system:

$$\begin{cases} -x + by + x^2y = 0 \\ a - by - x^2y = 0 \end{cases}$$

The equilibrium point for this system is

$$x^* = a \quad y^* = \frac{a}{a^2+b}$$

If we change the coordinates by leaving $\tilde{x} = x - a \; and \; \tilde{y} = y - \frac{a}{a^2+b}$ then

$x = \tilde{x} + a, y = \tilde{y} + \frac{a}{a^2+b}$, $\dot{\tilde{x}} = \dot{x}$ and $\dot{\tilde{y}} = \dot{y}$. If we then $\tilde{x} = x \; and \; \tilde{y} = y$, the system becomes

$$\dot{x} = -(x+a) + b\left(y + \frac{a}{a^2+b}\right) + (x+a)^2\left(y + \frac{a}{a^2+b}\right)$$

$$\dot{y} = a - b\left(y + \frac{a}{a^2 + b}\right) - (x + a)^2\left(y + \frac{a}{a^2 + b}\right)$$

Where the equilibrium now is (0,0).

The Jacobian matrix for this system at the equilibrium is

$$\begin{pmatrix} -1 + \frac{2a^2}{a^2 + b} & a^2 + b \\ \frac{-2a^2}{a^2 + b} & -a^2 - b \end{pmatrix}$$

The eigenvalues of the Jacobian matrix are given by the equation:

$$\lambda^2 - (trJ)\lambda + \det J = 0$$

where

$$\lambda_{1,2} = \frac{trJ \pm \sqrt{(trJ)^2 - 4detJ}}{2}$$

$$\lambda_{\pm(a,b)} = \frac{b + b^2 - a^2 + 2a^2b + a^4 \pm i\sqrt{4(a^2 + b)^3 - (b(1 + b) + (-1 + 2b)a^2 + a^4)^2}}{-2(a^2 + b)}.$$

Let

$$\alpha(a, b) = Re(\lambda_{\pm(a,b)}) = \frac{b + b^2 - a^2 + 2a^2b + a^4}{-2(a^2 + b)}$$

and

$$\beta(a, b) = Im(\lambda_{\pm(a,b)}) = \frac{\sqrt{4(a^2 + b)^3 - (b(1 + b) + (-1 + 2b)a^2 + a^4)^2}}{-2(a^2 + b)}.$$

In order for condition 1 of the Hopf Bifurcation Theorem to be satisfied, we need

$$a = a_1(b) = \sqrt{(1 - 2b - \sqrt{1 - 8b})/2}$$

or

$$a = a_2(b) = \sqrt{(1 - 2b + \sqrt{1 - 8b})/2}$$

The derivative of the real part of the eigenvalues with respect to the parameter a in each of their values is

$$\frac{\mathrm{d}\alpha(\mathrm{a},\mathrm{b})}{\mathrm{da}}\Big|_{\mathrm{a}=\mathrm{a}_1(\mathrm{b})} = \frac{\sqrt{2-16\mathrm{b}}\sqrt{1-2\mathrm{b}-\sqrt{1-8\mathrm{b}}}}{1-\sqrt{1-8\mathrm{b}}},$$

and

$$\frac{\mathrm{d}\alpha(\mathrm{a},\mathrm{b})}{\mathrm{da}}\Big|_{\mathrm{a}=\mathrm{a}_2(\mathrm{b})} = \frac{\sqrt{2-16\mathrm{b}}\sqrt{1-2\mathrm{b}+\sqrt{1-8\mathrm{b}}}}{-1-\sqrt{1-8\mathrm{b}}}$$

Condition 3 of the Hopf Bifurcation Theorem is

$$\left(-\frac{1}{8} - \frac{(a+b)^2\left(y+\frac{a}{a^2+b}\right)^2}{2\sqrt{4(a^2+b)^3-(b(1+b)+(-1+2b)a^2+a^4)^2}}\right)\Bigg|_{a=a_1,a_2(0,0)}$$

Let us now fix the parameter value b = 0,1. Then $a_1(b) = a_1(0,1) \approx 0{,}4199$ and $a_2(b) = a_2(0,1) \approx 0{,}7897$. Also $\omega_1 = \beta(a_1(0,1),0,1) \approx -0{,}5257$, $\omega_2 = \beta(a_2(0,1),0,1) \approx -0{,}8507$. $d_1 = \frac{d\alpha(\mathrm{a},0,1)}{da}\Big|_{a=a_1(b)} \approx 0{,}6796$ and $d_2 = \frac{d\alpha(\mathrm{a},0,1)}{da}\Big|_{a=a_2(b)} \approx -0{,}4750$.

Lastly, the values for the expression on condition 3 of the theorem are $b_1 \approx -1{,}223$ and $b_2 \approx -0{,}4750$.

Thus, for both values of the parameter a, the Hopf Bifurcation Theorem applies. In each of the

two cases, $\mathrm{a} = \mathrm{a}_1 \approx 0{,}4199$ and $\mathrm{a} = \mathrm{a}_2 \approx 0{,}7897$ there is a Hopf Bifurcation. We have $\mathrm{d}_1 > 0$ and $\mathrm{b}_1\mathrm{d}_1 < 0$. Hence, the origin is stable for $\mathrm{a} < \mathrm{a}_1$, and there is a stable limit cycle for $\mathrm{a} > \mathrm{a}_1$, provided a is sufficiently small. In addition, $\mathrm{d}_2 < 0$ and $\mathrm{b}_2\mathrm{d}_2 > 0$. Thus, the origin is stable in the region $\mathrm{a} > \mathrm{a}_2$, and there is a stable limit cycle in the region $\mathrm{a} < \mathrm{a}_2$. Therefore, the origin is unstable in the region $\mathrm{a}_1 < \mathrm{a} < \mathrm{a}_2$, where there exists a unique and stable limit cycle. (see Figures 2, 3, 4).

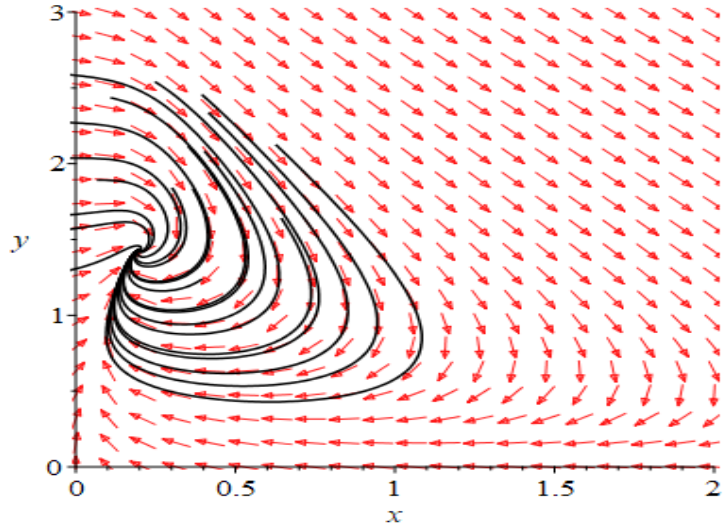

Figure 2: *Phase Portrait with a = 0,2. The origin is a stable focus. Taken with Maple.*

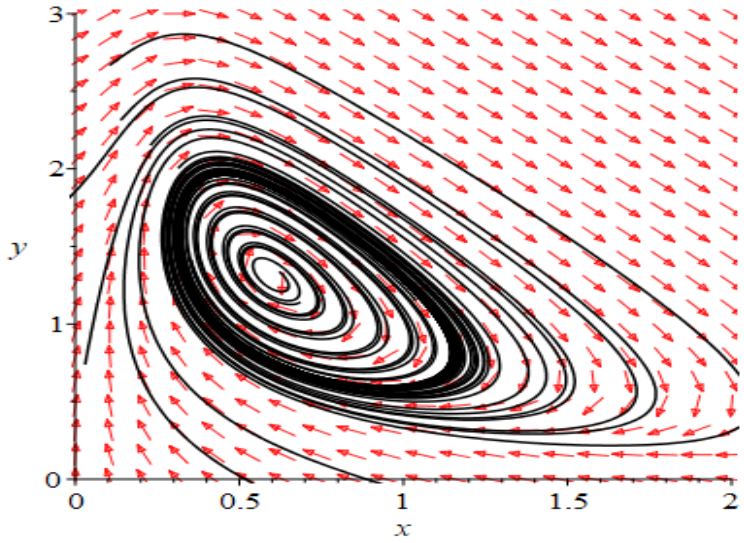

Figure 3: *Phase Portrait with a = 0,6. The origin is an unstable focus and there is a stable periodic orbit. Taken with Maple.*

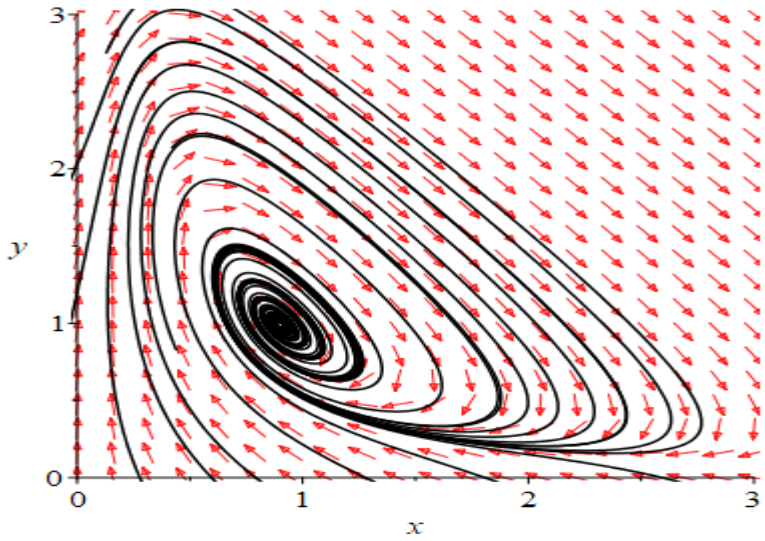

Figure 4: *Phase Portrait with a = 0,9. The origin is a stable focus. Taken with Maple.*

4. CONCLUSIONS

Bifurcation theory is a broad and active field of research. We have explored, through some simple examples, some of the different types of bifurcations in systems of one-dimensional ordinary differential equations. We have analyzed bifurcation examples through phase portraits. In order to further understand bifurcations, it is recommended to understand the normal form of systems of differential equations, stability, chaos and even numerical analysis of these systems.

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Remittances to Albania During the Post COVID Period

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Abstract

Our study consists in discovering the trend of remittances in recent years in Albania as well as the reasons that led to this trend. In order to discover these reasons, a survey, through questionnaires, was conducted with Albanian immigrants in Italy, Greece and Germany.
From the analysis of the questionnaires, it was found that the main factors affecting the income from remittances are:

- The post COVID crisis or in other words the state of the economy in the host country.
- Job insecurity and wages.
- Increase in the cost of living, especially children's education.
- Family reunification.
- Weaker ties between the emigrant and his relatives in Albania.

In this paper, we have tried to make a ranking of these factors that affect the income from remittances according to their strength with simple models. To analyze the main factors, there are many methods, but due to the fact that the data obtained from the questionnaires are subjective data and not many in number, they have forced us to use one of the simplest methods: namely the method of tables of contingency. Since data on remittance income are scarce and unstabilized, almost all forecasts with all methods give the same results. We underline that the important thing is that remittances continue to decrease every year, and the models show that the probability is small for these series to change their trend (increase). The economic crisis and family reunification are the main factors in remittance income.

Key words: Remittance, income, family reunification, economic crisis.

1. INTRODUCTION

In this post-COVID period, checking the data from INSAT, we see that the amount of remittances received in Albania is in a big decline. It is known that after some time the trend of remittances will be decreasing, but the question raised in this study is: Is this downward trend in remittances the result of family reunification alone or does it depend on other elements as well?
In this study, our objective is to investigate the factors contributing to the decline in remittance inflows to Albania among immigrants. We aim to determine the reasons behind this decrease and explore the potential connection or interdependence between these factors and the declining remittance amounts.

1.1. Methodology

To identify these underlying factors, we employed a survey-based methodology utilizing questionnaires administered to Albanian immigrants residing in Italy, Greece, England, and Germany. A total of 900 questionnaires were gathered, employing a combination of online collection through Google Forms and direct data collection at various locations, including ports in Durrës and Vlorë, bus stations in Tirana, Durrës, Shkodër, and Vlorë, as well as the Rinas-Tirana airport. The questionnaire encompassed numerous elements, which will be subjected to analysis and utilized in other ongoing research studies.
This paper focuses exclusively on gathering and analyzing the perspectives of immigrants regarding the factors influencing the remittance amounts they have sent to Albania, particularly in relation to the pre-COVID period. We have specifically collected and processed data pertaining to the immigrants' perceptions of the reasons behind reduced or nonexistent remittances during this time frame. Based on the analysis of the questionnaires, several primary factors have been identified as influential in shaping the income derived from remittances. These factors include:

- The post-COVID crisis or the overall economic condition of the host country.
- Escalation in prices within the host country.
- Job insecurity and wage levels.
- Rising living costs, particularly concerning children's education.
- Family reunification dynamics.
- Weakening connections between emigrants and their relatives in Albania.

To assess the relative impact of these factors on remittance income, we will employ simple models to create a ranking based on their strength. Given that

the data obtained from the questionnaires are subjective and relatively limited in quantity, we have opted for one of the simplest methods available: the contingency table method along with the Pearson test (using the χ^2 criterion). This approach enables us to determine whether there is a dependence or independence between these factors and remittance income, facilitating an analysis of the primary factors influencing remittance amounts.
Due to the scarcity and instability of data regarding remittance income, various forecasting methods consistently yield similar results. It is noteworthy that the crucial observation is the consistent decline in remittance amounts each year. The models utilized indicate a low probability for these trends to reverse and for the series to exhibit an upward trajectory (increase). Therefore, it becomes increasingly crucial to address the ongoing decrease in remittances rather than expecting a significant change in the foreseeable future.

2. CONTINGENCY TABLES AND THEIR DISTRIBUTIONS

Definition 2.1. A two-entry contingency table is a statistical table that presents the observed densities or frequencies of classified data elements from two variables. The rows in the table represent one variable, while the columns represent the other variable.

However, according to Karl Pearson's definition in 1904, contingency tables are described as follows:

Definition 2.2. A contingency table is a tabular representation where the cells contain densities or frequencies derived from the observed outcomes for a particular choice. Another name for them is the cross-classification table.

2.1. 2×2 Contingency Tables

A 2×2 contingency table illustrates the association between two binary variables based on their densities.

Definition 2.3. Let X and Y represent binary variables within the variable space A. The contingency table A is constructed as follows for a finite set:

Table 2.1

	$\mathbf{X_1}$	$\mathbf{X_2}$	**TOTAL**
$\mathbf{Y_1}$	x_{11}	x_{12}	$x_{1.}$
$\mathbf{Y_2}$	x_{21}	x_{22}	$x_{2.}$
TOTAL	$x_{.1}$	$x_{.2}$	$x_{..}$

Typically, independent variables are represented in columns, while dependent variables are represented in rows in a contingency table. Once the table is populated with the densities for each case, three additional tables are completed to assess the relationship between the variables and draw conclusions for extreme cases.

The first table contains relative densities expressed as percentages. These percentages are obtained by dividing the absolute densities of each cell by the total number of observations. By analyzing the data in this table, one can identify the extreme percentages and interpret their significance.

The second table displays relative densities in percentage based on the columns. To calculate these percentages, the absolute densities of each cell are divided by the total of the column to which the cell belongs. Examining the data in this table allows us to identify the extreme percentages in each column and interpret their implications.

The third table presents relative densities in percentage based on the rows. The absolute densities of each cell are divided by the total of the row to which the cell belongs to determine these percentages. Analyzing the data in this table helps identify the extreme percentages in each row and provides insights into their interpretation.

2.2. r×c Contingency Tables

The concept of a two-entry contingency table can be expanded to include multi-entry contingency tables for multinomial variables. In such cases, a contingency table with r rows and c columns is referred to as an r × c table. Let's consider two categorical variables, X and Y, where X has r categories and Y has c categories. The classification of both variables results in r × c possible combinations. When variables (X, Y) are randomly selected from a population, they exhibit a probability distribution.

Consider the data for two qualitative variables, X and Y, represented as (x_1, y_1), (x_2, y_2), ..., (x_n, y_n). Let p_1, p_2, ..., p_c denote the modes of variable X, and q_1, q2, ..., q_r represent the modes of variable Y. A matrix M of size r x c is constructed, where the elements x_{ij} represent the count of individuals who possess the respective values p_i and q_j, with i ranging from 1 to c and j ranging from 1 to r. This matrix M is commonly referred to as the contingency table for variables X and Y. These tables are predominantly utilized when studying qualitative variables.

According to Tsumoto (2006), the contingency table, denoted as T, has a size of r × c and is structured as follows:

Table 2.2

	X_1	X_2	X_3	…..	X_c	**TOTAL**
Y_1	x_{11}	x_{12}	x_{13}	…..	x_{1c}	$x_{1.}$
Y_2	x_{21}	x_{22}	x_{23}	…..	x_{2c}	$x_{2.}$
Y_3	x_{31}	x_{32}	x_{33}	…..	x_{3c}	$x_{3.}$
…..	…..	…..	…..	…..	…..	……
Y_r	x_{r1}	x_{r2}	x_{r3}	…..	x_{rc}	$x_{r.}$
TOTAL	$x_{.1}$	$x_{.2}$	$x_{.3}$	…..	$x_{..c}$	$x_{..}$

In a manner similar to 2×2 contingency tables, it is customary to represent independent variables in the columns and dependent variables in the rows. Once such a table is completed, containing the densities for each case, three additional tables are constructed to assess the relationship between the variables and draw conclusions for extreme cases.

The first table involves calculating the relative densities in percentage. This is achieved by dividing the absolute densities of each cell by the total number of observations. Analyzing the data in this table allows us to identify the extreme percentages and interpret their significance.

The second table is completed with the relative densities in percentage, calculated within each column. The absolute densities of each cell are divided by the total of the column to which the cell belongs. From the data in this table, we can identify the extreme percentages within each column and interpret their implications.

The third table is completed with the relative densities in percentage, calculated within each row. The absolute densities of each cell are divided by the total of the row to which the cell belongs. By analyzing the data in this table, we can determine the extreme percentages within each row and interpret their meaning.

3. STATISTICAL INDEPENDENCE OF CONTINGENCY TABLES

The analysis utilizing contingency tables is widely employed to explore the relationship between variables. This approach is particularly applicable to categorical data involving multiple variables and involves the use of contingency tables. These tables serve to condense the necessary information for conducting statistical inference and testing of the association between variables, based on observed data. The primary focus of this analysis is to assess the hypothesis of independence between two qualitative variables. However, the results obtained can also be utilized for quantitative variables.

Consider two qualitative variables, X and Y. Let p_1, p_2…, p_c represent the modes of variable X, and q_1, q_2, …, q_r denote the modes of variable Y. According to the definition, X and Y are independent if:

$$P(X = c,\ Y = r) = P(X = c) \cdot P(Y = r) \quad \text{Eq. 3.1}$$

for every combination of values c and r for variables X and Y, respectively, as indicated in Equation 3.1.

To evaluate the hypothesis, we will employ the chi-square test, a statistical method used to assess the association between row and column variables in a two-entry table. The null hypothesis (H_0) assumes that there is no relationship between the variables, implying that changes in one variable are not accompanied by changes in the other variable. On the other hand, the alternative hypothesis (H_a) takes into consideration the possibility of a relationship between the two variables, without specifying the exact nature of that relationship. The nature of the relationship is determined by analyzing the data. Therefore, the hypotheses can be formulated as follows:

- H_0 – X and Y are independent.
- H_a – X and Y are not independent.

The Chi-square test utilizes a statistic that quantifies the deviation between the observed data (O) and the expected values (E) under the assumption of no relationship between the variables. For two-entry tables, the expected value (E) for each cell is calculated as follows:

$$E = \frac{\sum_{j=1}^{c} x_{ij} \times \sum_{i=1}^{r} x_{ij}}{N} \qquad \text{Eq. 3.2}$$

Once the expected values have been determined, the chi-square statistic is computed by summing the squared differences between the observed and expected values for each cell. This sum is then divided by the corresponding expected value. Thus, the calculation of the chi-square statistic can be expressed using the following formula:

$$\chi^2 = \sum \frac{(observedValue - \exp ectedValue)^2}{\exp ectedValue} = \sum \frac{(O-E)^2}{E} \qquad \text{Eq. 3.3}$$

The Chi-square statistic follows a χ^2 (Chi-square) distribution with degrees of freedom equal to (r-1)(c-1), where r represents the number of rows and c represents the number of columns in the two-entry table. The distribution of the Chi-square statistic is limited to positive values only. The p-value for the Chi-square test represents the probability of observing a value as extreme or more extreme than the calculated test statistic under the assumption of a Chi-

square distribution with (r-1)(c-1) degrees of freedom P($\chi^2 \geq X_2$). The null hypothesis H_0 is rejected if the calculated Chi-square statistic (χ^2) is greater than the critical value (CV) obtained from the Chi-square table at a confidence level α, with (r-1)(c-1) degrees of freedom.

Chi-square tests have certain requirements that need to be fulfilled for the test to be valid. Adequate sample size is one such condition. In the case of 2 x 2 tables, the sample size should be greater than 40 for the Chi-square test to be applicable. However, if the sample size falls between 20 and 40 observations, an additional condition is necessary. The smallest expected value (frequency) in the table must be at least 5 for the test to be valid. These criteria ensure that the test results are reliable and accurate. In the case of tables other than 2 x 2, the Chi-square test can be utilized if the expected frequencies in no more than 20 percent of the cells are below 5, and none of the expected frequencies are less than 1. These criteria ensure the validity of the Chi-square test and help maintain the accuracy and reliability of the test results.

One limitation of the data obtained in the database is the nominal nature of the variables. While this poses some constraints on conducting quantitative regression analysis, it does not completely hinder the analysis of qualitative variables in the model. It is crucial to discern the relationships between these variables to extrapolate this relationship to the entire population. By carefully examining these relationships, valuable insights can still be derived from the data, despite the nominal nature of the variables.

4. CONTINGENCY TABLES IN OUR STUDY

In this survey, we aim to investigate the potential relationship or dependency between the amount of remittances sent to Albania in recent years and various factors such as the post-covid global crisis, family reunification, unemployment, and rising prices in the host country. The data collected for this study are presented in a two-entry table, which categorizes the qualitative variables as follows:

a) Amount of remittances sent in recent years (categorized as "less" or "none")
b) Reasons provided by immigrants in the questionnaire regarding the quantity of remittances sent (also categorized qualitatively)

The two-entry table below depicts the classification based on the two variables: Causes of remittance amounts in recent years and the corresponding amounts.

Table 4.1 *The reasons for the decrease i*

Cause / Amount of remittances	Post covid crises	Family reunion	Unemployment	Price increase	**TOTAL**
Less	172	93	54	34	**353**
None	299	94	42	112	**547**
TOTAL	**471**	**187**	**96**	**146**	**900**

Source: Data from the 2023 questionnaire

After constructing the initial table with the densities of each case, we proceed to complete three additional tables that provide insights into the potential relationship between the variables. These tables offer a glimpse into extreme cases and allow us to draw conclusions regarding the connection between the variables. The first table is populated with the relative densities in percentage, which are obtained by dividing the absolute densities of each cell by the total number of observations.

Table 4.2 *Specific percentages*

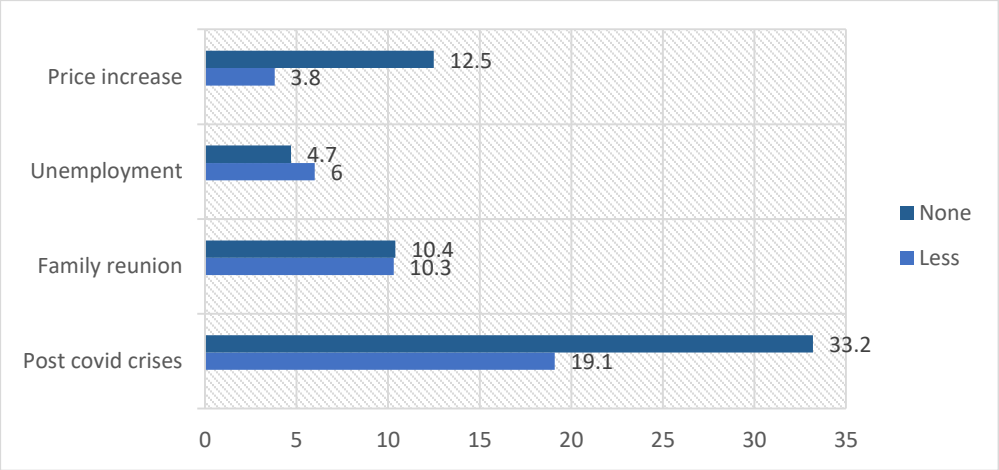
Cause / Amount of remittances	Post covid crises	Family reunion	Unemployment	Price increase	**TOTAL**
Less	19.1	10.3	6	3.8	**39.20%**
None	33.2	10.4	4.7	12.5	**60.80%**
TOTAL	**52.3%**	**20.7%**	**10.7%**	**16.3%**	**100%**

We observe that the lowest percentage is achieved by immigrants who did not send any remittances during this period due to unemployment. This is because most of them, being family members, will find alternative employment opportunities to support their families, even if temporarily unemployed. Therefore, among all the respondents, these individuals are more likely to have secured jobs or have a spouse who is employed.

On the other hand, the highest percentage is obtained by immigrants who did not send any remittances during this period due to the post-covid crisis. Even when comparing the row totals, the largest percentage is achieved by immigrants who did not send any remittances at all. Similarly, when considering the column totals, the highest percentage is reached by immigrants who sent few or no remittances during this period, primarily attributed to the post-covid crisis.

These findings suggest a correlation between the decline in remittance amounts and the post-covid crisis, with the crisis being the primary contributing factor. This conclusion is further reinforced by the graphical representation provided below.

Graph 4.1



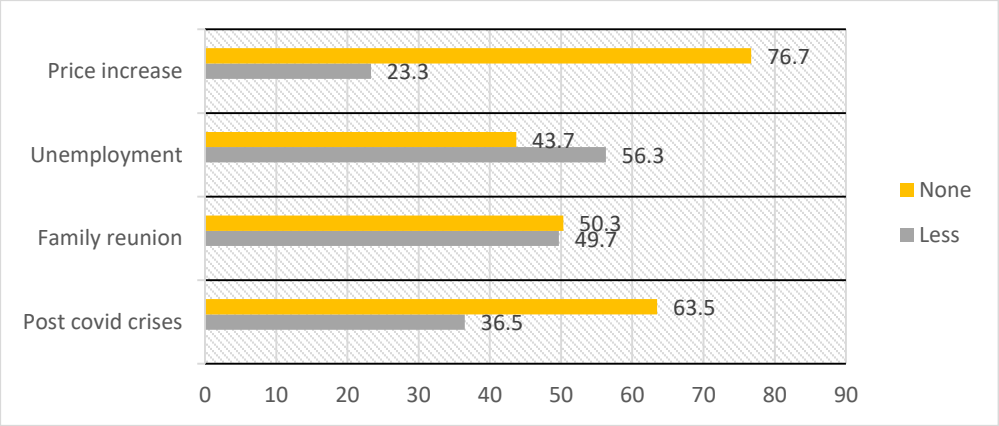
The second table is constructed by calculating the relative densities in percentage based on the columns. This is achieved by dividing the absolute densities of each cell by the total of the column in which the cell is located. The resulting percentages for the data in the aforementioned table are presented in the following table.

Table 4.3 *Percentages by columns*

Cause / Amount of remittances	Post covid crises	Family reunion	Unemployment	Price increase
Less	36.5	49.7	56.3	23.3
None	63.5	50.3	43.7	76.7
TOTAL	**100%**	**100%**	**100%**	**100%**

By examining the percentages based on the pillars, it is evident that the highest percentages in each pillar correspond to immigrants who have not sent any remittances during this period, with the exception of the unemployment pillar. This observation aligns with the reasons we previously mentioned. Therefore, the percentages based on the pillars further reinforce the conclusions drawn from the first table. Furthermore, these conclusions are visually depicted in the following graph, which provides a clearer representation of the findings.

Graph 4.2



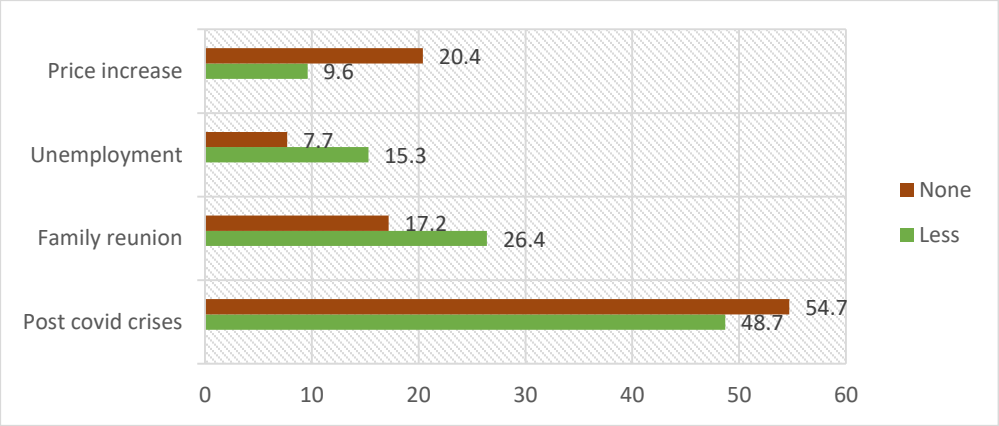
The third table is constructed by calculating the relative densities in percentage according to the rows. This is achieved by dividing the absolute densities of each cell by the total of the respective row.

Table 4.4 *Percentages by rows*

Cause / Amount of remittances	Post covid crises	Family reunion	Unemployment	Price increase	**TOTAL**
Less	48.7	26.4	15.3	9.6	**100%**
None	54.7	17.2	7.7	20.4	**100%**

By examining the percentages according to the rows, it becomes evident that the highest percentages within each row correspond to immigrants who have brought minimal or no remittances during this period, primarily due to the post-covid crisis. These findings reinforce the conclusions derived from the first table, indicating a strong association between the decrease in remittance amounts and the impact of the post-covid crisis. The crisis emerges as the main contributing factor behind the decline in remittances. These conclusions are visually depicted with greater clarity in the following graph:

Graph 4.3



5. INVESTIGATING THE INTERDEPENDENCE OF VARIABLES USING SURVEY DATA

To verify the relationship between the decreasing amount of remittances in the recent period and the reasons provided by the interviewed immigrants, we will conduct the chi-square ($\chi 2$) test as discussed in section 2. This test will be performed four times.

Firstly, we will examine the dependency of the remittance amount variable (less or none) with respect to two causes: the post-covid crisis and family reunification. These two causes were prominently mentioned in the questionnaire and were revealed in the conclusions of the contingency tables in part 3.

Secondly, we will analyze the dependency of the remittance amount variable (less or none) with respect to family reunification and two additional causes: unemployment and price increases. These two factors are associated with the post-covid crisis.

Thirdly, we will investigate the dependence of the remittance amount variable (less or none) on all the reasons individually mentioned by the immigrants in the completed questionnaires. This analysis aims to explore whether the relationship between these two variables changes when considering all the modes of the second variable in the study.

The fourth analysis will explore the relationship between the remittance amount variable (less or none) and all the causes mentioned by the immigrants in the completed questionnaires, excluding the modality of Family Reunification. This examination aims to assess whether the dependence between these two variables changes when this specific modality, which was anticipated to have a significant impact on the decrease in remittances, is not considered. If no dependency is found in this analysis, it indicates that the

entire dependence observed in the previous tests was primarily driven by the Family Reunification modality.
By conducting these tests, we aim to assess the significance and authenticity of the relationship between the amount of remittances and the identified causes.

5.1. The Impact of Post-COVID Crisis and Family Reunification on Remittance Amounts

Let's examine the 2-entry contingency table representing the observed values (O) for the relationship between the amount of remittances and the post-covid crisis. Based on Table 4.1, we isolate the crisis factor, resulting in the following table:

Table 5.1 *Observed Values (O)*

	X_1 (Crisis)	X_2 (Fam. Reunion)	**TOTAL**
Y_1 (Less)	172	299	**471**
Y_2 (None)	93	94	**187**
TOTAL	**265**	**393**	**658 (= N)**

Source: Data from the 2023 questionnaire

To properly apply the chi-square test, two key requirements should be met:

1. The data should be organized into frequency groups.
2. The sample size must be sufficiently large for the validity of the chi-square distribution. Otherwise, the test statistic may be overestimated, leading to the rejection of the null hypothesis incorrectly.

In practice, a commonly followed guideline is that if there is a frequency value below 5 in the grouped data, it should not be used as an individual category. If multiple frequencies fall below 5, they need to be combined to create a single category with a frequency value greater than 5. This consolidation ensures reliable statistical analysis.

Table 5.2 *Expected Values (E)*

	X_1 (Crisis)	X_2 (Fam. Reunion)
Y_1 (Less)	189.7	281.3
Y_2 (None)	75.3	111.7

Based on our analysis, the expected values of these variables meet both conditions, indicating that we can utilize the chi-square test to determine the presence or absence of a relationship between these variables. Please find the completed table below:

Table 5.3

	X_1 (Crisis)	X_2 (Fam. Reunion)
Y_1 (Less)	172 (189.7)	299 (281.3)
Y_2 (None)	93 (75.3)	94 (111.7)

We calculate:

$$\chi^2 = \sum \frac{(O-E)^2}{E} = \frac{(172-189.7)^2}{189.7} + \frac{(93-75.3)^2}{75.3} + \frac{(299-281.3)^2}{281.3} + \frac{(94-111.7)^2}{111.7} \quad \text{Eq.5.1}$$

$$\chi^2 = 9.73 \quad \text{Eq. 5.2}$$

The degrees of freedom are:

$$(r-1)\cdot(c-1) = (2-1)\cdot(2-1) = 1 \quad \text{Eq. 5.3}$$

At a confidence level of $\alpha = 0.05$, the critical value for the chi-square test with the degrees of freedom determined by the table is CV = 3.81. Since the calculated chi-square statistic (9.73) is greater than the critical value (3.81) at a confidence level of $\alpha = 0.05$, we reject the null hypothesis (H_0) and accept the alternative hypothesis (H_a). This indicates that there is a dependence or relationship between variables X and Y.

5.2. The Impact of Post-COVID Crisis, Unemployment, and Price Increases on the Dependency between the Variables

To further strengthen this conclusion, we re-evaluate the hypotheses by incorporating responses that attribute the decrease in remittances to low wages or unemployment, as these factors are also linked to the post-crisis conditions in the respective countries. To do so, we refer to the contingency table consisting of two entries for the observed values (O):

Table 5.4 *Observed Values (O)*

	X_1 (Crisis, Unemployment, Price Increase)	X_2 (Family Reunification)	**TOTAL**
Y_1 (Less)	260	453	**713**
Y_2 (None)	93	94	**187**
TOTAL	**353**	**547**	**900 (= N)**

Source: Data from the 2023 questionnaire

We find the expected values (E) and complete the table below:

Table 5.5 *Expected Values (E)*

	X_1 (Crisis, Unemployment, Price Increase)	X_2 (Family Reunification)
Y_1 (Less)	280	433
Y_2 (None)	73	114

Based on our analysis, we can conclude that the expected values of these variables meet the necessary conditions, allowing us to apply the chi-square criterion to determine the dependence or independence between these variables. Let us now complete the following table:

Table 5.6

	X_1 (Crisis, Unemployment, Price Increase)	X_2 (Family Reunification)
Y_1 (Less)	260 (280)	453 (433)
Y_2 (None)	93 (73)	94 (114)

We calculate:

$$\chi^2 = \sum \frac{(O-E)^2}{E} = \frac{(260-280)^2}{280} + \frac{(93-73)^2}{73} + \frac{(453-433)^2}{433} + \frac{(94-114)^2}{114} \quad \text{Eq. 5.4}$$

$$\chi^2 = 11.34 \quad \text{Eq. 5.5}$$

The degrees of freedom are:

$$(r – 1) \cdot (c – 1) = (2 – 1) \cdot (2 – 1) = 1 \quad \text{Eq. 5.6}$$

Given a confidence level of $\alpha = 0.05$, the critical value CV is determined to be 3.81. As the calculated value of 11.34 exceeds the critical value of 3.81, we reject the null hypothesis (H_0). Consequently, we accept the alternative hypothesis (H_a), indicating that variables X and Y are dependent on each other.

5.3. The Statistical Dependence Between Two Variables in a 2 x 4 Contingency Table

In this section, we will examine the relationship between the global crisis, family reunification, unemployment, low salary, and the amount of remittances brought in recent years. To analyze this relationship, we will utilize a 4x2 contingency table. Specifically, we will construct a 2x4 contingency table by considering each stated cause individually.

Table 5.7 *2x4 contingency table. Observed Values (O)*

	X_1 (Crisis)	X_2 (Family Reunion)	X_2 (Unempl.)	X_2 (Prices Increase)	**TOTAL**
Y_1 (Less)	172	93	54	34	**353**
Y_2 (None)	299	94	42	112	**547**
TOTAL	**471**	**187**	**96**	**146**	**900**

Source: Data from the 2023 questionnaire

Let's now calculate the expected values and fill in the following table with them:

Table 5.8 *2x4 contingency table. Expected Values (E)*

	X_1 (Crisis)	X_2 (Family Reunion)	X_2 (Unempl.)	X_2 (Prices Increase)
Y_1 (Less)	184.7	73.3	37.7	57.3
Y_2 (None)	286.3	113.7	58.3	88.7

Based on the calculations, we can conclude that the expected values of these variables fulfill the required conditions. As a result, we can proceed to utilize the chi-square criterion to determine the presence of dependence or

independence between these variables. The table below presents the filled-in values:

Table 5.9 *2x4 contingency table. Expected Values (E)*

	X_1 (Crisis)	X_2 (Family Reunion)	X_2 (Unempl.)	X_2 (Prices Increase)
Y_1 (Less)	172 (184.7)	93 (73.3)	54 (37.7)	34 (57.3)
Y_2 (None)	299 (286.3)	94 (113.79	42 (58.3)	112 (88.7)

We calculate:

$$\chi^2 = \sum \frac{(O-E)^2}{E} = \frac{(172-184.7)^2}{184.7} + \frac{(93-73.3)^2}{73.3} + \frac{(54-37.7)^2}{37.7} + \frac{(34-57.3)^2}{57.3} + + \frac{(299-286.3)^2}{286.3} + \frac{(94-113.7)^2}{113.7} + \frac{(42-58.3)^2}{58.3} + \frac{(112-88.7)^2}{88.7} \quad \text{Eq. 5.7}$$

$$\chi^2 = 28.23 \quad \text{Eq. 5.8}$$

The degrees of freedom are:

$$(r-1)\cdot(c-1) = (2-1)\cdot(4-1) = 3 \quad \text{Eq. 5.9}$$

With a confidence level of $\alpha = 0.05$, the critical value CV is determined to be 7.815. Given that the calculated chi-square value of 28.23 is greater than the critical value of 7.815, we reject the null hypothesis (H_0) and accept the alternative hypothesis (H_a). Therefore, we conclude that there is a statistically significant dependence between variables X and Y.

5.4. The Statistical Dependence between 2 Variables in a 2 x 3 Contingency Table

In general, we anticipate a relationship between the decreasing amount of remittances and family reunification. However, our aim is to demonstrate that this decline is not solely attributed to family reunification but primarily to the global crisis and other factors that are, in turn, consequences of this crisis. To further investigate this, we conduct another hypothesis test using the variable "causes" with three modes: crisis and two modes related to the crisis. To begin, we refer to the table of observed values:

Table 5.10 *2x3 contingency table. Observed Values (O)*

	X_1 (Crisis)	X_2 (Unempl.)	X_2 (Prices Increase)	**TOTAL**
Y_1 (Less)	172	54	34	**260**
Y_2 (None)	299	42	112	**453**
TOTAL	**471**	**96**	**146**	**713**

Source: Data from the 2023 questionnaire

Let's now calculate the expected values and fill in the following:

Table 5.11 *2x3 contingency table. Expected Values (E)*

	X_1 (Crisis)	X_2 (Unempl.)	X_2 (Prices Increase)
Y_1 (Less)	171.8	35	53.2
Y_2 (None)	299.3	61	92.8

Based on the verification conducted, we conclude that the expected values of these variables fulfill both conditions, allowing us to utilize the chi-square criterion to determine the presence of dependence or independence between these variables. We fill in the following table:

Table 5.12 *2x3 contingency table*

	X_1 (Crisis)	X_2 (Unempl.)	X_2 (Prices Increase)
Y_1 (Less)	172 (171.8)	54 (35)	34 (53.2)
Y_2 (None)	299 (299.3)	42 (61)	112 (92.8)

We calculate:

$$\chi^2 = \sum \frac{(O-E)^2}{E} = \frac{(172-171.8)^2}{171.8} + \frac{(54-35)^2}{35} + \frac{(34-53.2)^2}{53.2} + + \frac{(299-299.3)^2}{299.3} + \frac{(42-61)^2}{61} + \frac{(112-92.5)^2}{92.5} \quad \text{Eq. 5.10}$$

$$\chi^2 = 27.14 \quad \text{Eq. 5.11}$$

The degrees of freedom are:

$$(r – 1) \cdot (c – 1) = (2 – 1) \cdot (3 – 1) = 2 \quad \text{Eq. 5.12}$$

At a confidence level of $\alpha = 0.05$, the critical value is CV = 5.991. Since the calculated value 27.14 is greater than the critical value, we reject the null hypothesis (H0) and accept the alternative hypothesis (Ha). This indicates that there is a significant dependence between the amount of remittances brought in recent years and the global crisis, even when excluding the "Family Reunification" modality.

6. CONCLUSIONS

Given the limited and volatile nature of data on remittance income, most forecasting methods yield consistent results. It is crucial to emphasize that remittances consistently decline annually, and various models indicate a low probability of a reversal in this trend (i.e., an increase). The factors contributing to the decrease in remittances include:

1. The post-COVID economic crisis: The economic downturn following the COVID-19 pandemic has had a significant impact on the income of Albanian immigrants. The crisis has led to job insecurity and reduced wages, making it more challenging for immigrants to send remittances.
2. Increased costs for education: The host countries' rising costs of education, specifically for the children of Albanian immigrants, have put additional financial strain on families. This, in turn, reduces the amount of money available for remittances.
3. Family reunification: The reunification of families in host countries often results in no family members remaining in Albania. As a consequence, there is no longer anyone in Albania who can receive remittances, leading to a cessation of remittance transfers.
4. Weakened family ties: The distance and time spent apart from family members in Albania can lead to weakened connections between immigrants and their remaining family members. This may result in a decrease in the frequency or amount of remittances being sent.
5. Return migration and investment: Some immigrants, facing difficulties due to the post-COVID economic crisis, contemplate or have already decided to return to Albania. In such cases, the remittance flow is replaced by the savings accumulated during their time abroad. These savings are then transformed into a form of self-directed investment, often used to establish independent ventures in Albania. This represents a unique type of Foreign Direct Investment, as it involves utilizing personal savings to become self-employed in the home country.

It can be concluded that the post-COVID economic crisis and family reunification are the key determinants of remittance income, with other factors operating within the framework of these primary factors. While other factors, such as price increases and job insecurity, do have an impact on remittance income, their effects are closely tied to the economic crisis. As the crisis intensifies, the influence of these factors becomes more pronounced. On the other hand, the increase in family expenses consistently affects remittance income, regardless of the economic conditions.

7. RECOMMENDATIONS

We propose the following recommendations:

1. Diversify the sources of income to compensate for the decline in remittances. Relying solely on remittances is not sustainable for the Albanian economy.
2. Avoid increasing sovereign debt through commercial loans to cover the remittance drop. This approach could lead to further financial burdens in the long run.
3. Instead of reducing consumption as a means to offset the decline, explore alternative strategies. Drastically reducing consumption can have negative consequences, such as job losses and social problems. Seek sustainable solutions that promote economic growth.
4. Focus on attracting tourists, particularly from EU countries and emerging European markets. Encourage partnerships with neighboring countries' tourism operators to facilitate the influx of tourists through various means such as cruises or land travel.
5. Develop high-quality tourism services and facilities to cater to elite tourists. This requires investment in infrastructure and the employment of skilled labor. Utilize the skills and experience of Greek or Italian immigrants who have returned to Albania.
6. Embrace an export-oriented economic model to increase and diversify exports. Reduce dependence on neighboring countries for material goods and shift towards exporting Albanian products. Prioritize the export of organic agricultural products to generate income and foreign currency.

By implementing these measures, the Albanian economy can mitigate the impact of declining remittances and foster sustainable economic development.

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Study of Bifurcation and Stability of a Dynamical Linear System Depending on Parameters

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Abstract

In this paper we will study stability and bifurcation depending on the parameters of a dynamical homogeneous three-dimensional linear system. Depending on the parameters we will determine the general solution, the phase portrait and the exponential of the matrix. Interest has its multiple eigenvalues and its complex eigenvalues of the matrix A.

Key words: dynamical systems, bifurcation, phase portrait, eigenvalues, exponential of the matrix.

1. INTRODUCTION

Many dynamical systems depend on parameters and changing their values brings qualitative changes in the behavior of system solutions. Otherwise we say that the dynamic system x' = f (x,μ) has a bifurcation at the value of the parameter μ_0 if there is a change in the structure of the solution trajectories when the parameter passes through the value μ_0. So, there is a change in the number and stability of the fixed points of the system when passing through the bifurcation value. The theory of bifurcations has its beginnings in the works of Euler, but it was developed with the works of Poincare and nowadays this theory has received a great development. The object of study is dynamical systems in the form of differential equations or difference equations. In this paper we will focus on homogeneous linear dynamical systems.

Bifurcations that depend on 3 parameters will be called with 3-codimension. These bifurcations have interesting dynamics, and have numerous applications in physics, biology.

2. MATERIALS AND METHODS

In this article we will work with the most important concepts and rules in the theory of dynamical systems and in particular in the field of bifurcations.
We will use Mapple software for geometric illustration of bifurcations by presenting the phase portrait for different parameter values.
The phase portrait is called the set of trajectories for the initial values giving a qualitative representation of the dynamic system.
Bifurcation theory deals with the study of qualitative changes in the phase portrait e.g. emergence and disappearance of equilibrium points, periodic orbits, stability of the system, etc.
Flow. For an initial value x_0 the dynamic system has a single solution $x(t, x_0)$ belonging to a line in R^n with parameter t which is the trajectory that has an initial value x_0. This trajectory of the system is called flow with initial value $x_0 = x(0)$.
The exponential of the matrix. [1] (L. Perko) For every square matrix A with n×n dimensions, there is the matrix
$e^A = I + \frac{A}{1!} + \frac{A^2}{2!} + \frac{A^3}{3!} + \cdots \frac{A^k}{k!} + \cdots$ which is called the exponential of the matrix A.

Theorem; [3] Coddington and Levinson (Jordan form of the matrix). If matrix A with n×n dimensions has k eigenvalues and n – k eigenvalues complex, then a basis $\{v_k : k = 1, 2, \ldots n\}$ } of generalized eigenvectors is found that returns the matrix to the Jordan form:

$$J = \begin{pmatrix} B_1 & \cdots & 0 \\ \vdots & \ddots & \vdots \\ 0 & \cdots & B_r \end{pmatrix} = P^{-1}AP$$

Where $B_i = \begin{pmatrix} \lambda_i & 1 & 0 & & \\ 0 & \lambda_i & 1 & \cdots & 0 \\ 0 & 0 & \lambda_i & & \\ & \vdots & & \ddots & \vdots \\ & 0 & & \cdots & \lambda_i \end{pmatrix}$ for real λ_i and

$$B_i = \begin{pmatrix} D_i & I_2 & 0 & & \\ 0 & D_i & I_2 & \cdots & 0 \\ & \vdots & & \ddots & \vdots \\ & 0 & & \cdots & D_i \end{pmatrix}$$

for complex eigenvalues $\lambda_i = a_i + b_i$, where $D_1 = \begin{pmatrix} a_i & b_i \\ -b_i & a_i \end{pmatrix}$ and $I_2 = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$, $0 = \begin{pmatrix} 0 & 0 \\ 0 & 0 \end{pmatrix}$.

Defective matrices [2] Hirsch and Smale [H/S], p. 124: If a multiple value of λ has a geometric multiplicity $\delta = \dim Ker(A - \lambda I)$ smaller than the algebraic multiplicity m, then $m - \delta$ is called the defect index.

The derivative of the exponential matrix. [4] Rudin, p. 149. If matrix A is with $n \times n$ dimensions then $(e^{At})' = Ae^{At}$ for each t in R .

Theorem (Fundamental Theorem of Linear Dynamical systems). [1] (L. Perko). If A is a matrix with $n \times n$ size then for each initial value $x_0 \in R^n$ the dynamical system x' = A x has unique solutions $x(t, x_0) = e^{At}x_0$ of its beginning value.

Fixed point or stationary point, or equilibrium [5] is otherwise called a stationary point in relation to the flow of system in R^n if $x' = f(x) = 0$, and the flow may have no stationary point, a finite number, or an infinity.

The equilibrium point x_0 is the hyperbolic of the dynamical system $x' = f(x)$ if eigenvalues of the Jacobian matrix $Df(x_0)$ has their eigen values such as $Re(\lambda) \neq 0$

Otherwise they are called non-hyperbolic fixed points. Hyperbolic points are stable in small changes while non-hyperbolic points flows change greatly in small perturbations. Non-hyperbolic points are weak for the system, while hyperbolic points are stable.

The Hartman-Grobman theorem gives a clear idea of this idea. A generalization of this theorem has been proved by Shoshitaishvilli that deals with the case of non-hyperbolic points.

Harman-Grobman Theorem [6] If x = 0 is the hyperbolic point of the system $x' = f(x)$ and $x(t, x_0)$ is a flow of the linearized system $x' = Df(0)x$ then a homeomorphism is found

$\psi: R^n \dashrightarrow R^n$

And a neighborhood of the point x = 0 where $x(t) = \psi^{-1} \circ \varphi(t) \circ \psi(x)$, such that for every $x \in U$ we get $x(t) \in U$.

3. Study of Bifurcation in a 3-dimensional linear dynamic system with codimension-3 bifurcation.

We will study stability, bifurcations and construct the phase portrait of the linear dynamical system x' = A x depending on the parameters where A is a 3×3 matrix with three parameters:

$$A = \begin{pmatrix} a & 0 & c \\ 0 & b & 0 \\ -4 & 0 & a \end{pmatrix}$$

The general solution and stability depend on the eigenvalues and the corresponding eigenvectors of the matrix A.

First we find the eigenvalues by finding the roots of the characteristic polynomial:

$$|\mathrm{A} - \lambda \mathrm{I}| = \begin{vmatrix} a-\lambda & 0 & c \\ b & b-\lambda & 0 \\ -4 & 0 & a-\lambda \end{vmatrix} = 0$$

By calculating we have that

$(a-\lambda)^2(b-\lambda) + (b-\lambda)\cdot 4c = 0$ or: $(b-\lambda)\cdot[(a-\lambda)^2 + 4c] = 0$ and we will get $\lambda_1 = \mathrm{b}\,, \lambda_{2,3} = a \pm \sqrt{-4c}$

We discuss the nature of eigenvalues, whether they are single, multiple or complex depending on the parameters. This affects the nature of the phase portrait and the stability of the parameter-independent homogeneous linear dynamic system. Then we distinguish these cases:

1.For $c \leq 0$ the eigenvalues are real $\lambda_2 = \lambda_3 = a\ dhe\ a \neq b$ is a double eigenvalue, in the case when a = b we have that $\lambda = a$ is a triple eigenvalue.

2.For $c > 0$ there are two conjugate complex eigenvalues $\lambda_{2,3} = a \pm \sqrt{-4c}$ and one real eigenvalue $\lambda_1 = b$.

We study stability and bifurcations in the case when c = 0 and a = b so the real value itself $\lambda = a$ is triple ,matrix A has the form:

$$\mathrm{A} = \begin{pmatrix} a & 0 & 0 \\ 0 & a & 0 \\ -4 & 0 & a \end{pmatrix}$$

We find the eigenvectors by solving the matrix equation:

$$(A - a\,l)\begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix} \text{ or } \begin{pmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ -4 & 0 & 0 \end{pmatrix}\begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix}$$

$Dim\ ker(A - a\,l) = 2$ which is the geometric multiple of the triple value itself $\lambda = \mathrm{a}$ smaller than the algebraic multiplicity which is 3, consequently we will have a chain of generalized self vectors. It seems clear that $(A - a\,l)e_2 = (A - a\,l)e_3 = \begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix}$ so e_2, e_3 are two eigenvalue vectors

$\lambda = \mathrm{a}$ consequently the oxy plane is invariant with respect to the given dynamical system.

We also have that $(A - a\ l)e_1 = -4e_3 3$ this defines the generalized eigenvector e_1 and consequently the chain of generalized eigenvectors $\{-4e_{3,}e_1\}$.

Then the eigenvectors of the triple eigenvalue λ = a are $\{e_2, \{e_1, -4e_3\}\}$.

In this case, the general solution has the form:

x(t)=$c_1 e^{at} e_2$ + $c_2 e^{at}$(-4 e_3) + $c_3 e^{at}$(e_1 −4t e_3) or in vector form $\boldsymbol{x}(t) = e^{at}\begin{pmatrix} c_3 \\ c_1 \\ -4c_2 - 4tc_3 \end{pmatrix}$.

To express the general solution depending on the initial value we need to calculate the exponential of the matrix in this case:

$\boldsymbol{x}(0) = e^{a\cdot 0}\begin{pmatrix} c_3 \\ c_1 \\ -4c_2 \end{pmatrix} = \begin{pmatrix} x_0 \\ y_0 \\ z_0 \end{pmatrix}$ from here we get that: $c_1 = y_0, c_2 = -\frac{z_0}{4}$, c_3=x_0

And the general solution takes shape

$$\mathbf{x}(t)=e^{at}\begin{pmatrix} x_0 \\ y_0 \\ z_0 - 4x_0 t \end{pmatrix} = e^{at}\begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ -4t & 0 & 1 \end{pmatrix}\begin{pmatrix} x_0 \\ y_0 \\ z_0 \end{pmatrix} = \begin{pmatrix} e^{at} & 0 & 0 \\ 0 & e^{at} & 0 \\ -4te^{at} & 0 & e^{at} \end{pmatrix}\begin{pmatrix} x_0 \\ y_0 \\ z_0 \end{pmatrix} = e^{At}\begin{pmatrix} x_0 \\ y_0 \\ z_0 \end{pmatrix}$$

In this case the exponential of the matrix is:

$$e^{At} = \begin{pmatrix} e^{at} & 0 & 0 \\ 0 & e^{at} & 0 \\ -4te^{at} & 0 & e^{at} \end{pmatrix}.$$

Depending on the parameter a we study stability and bifurcations. If a≠0 the system has only one equilibrium point which is 0.

$$\mathbf{x}(t)=e^{at}\begin{pmatrix} x_0 \\ y_0 \\ z_0 - 4x_0 t \end{pmatrix} \xrightarrow[t\to\infty]{} \begin{cases} \begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix} \ for\ a < 0 \\ \begin{pmatrix} \infty \\ \infty \\ \infty \end{pmatrix} \ for\ a > 0 \end{cases}$$

Then for values of the parameter a < 0 the system is stable and the trajectories tend towards the origin parallel to the oz axis which belongs to the eigenvector of the longest chain of generalized eigenvectors as in the figure:

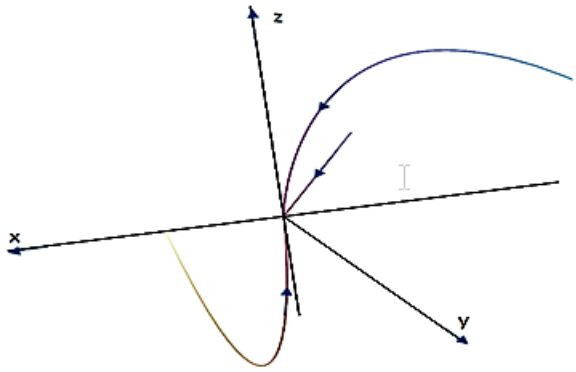

Figure 1: *Phase portrait in the case c = 0, a = b < 0. Taken from Maple*

For a = 0 bifurcation occurs, The set of equilibrium points of the dynamical system where x' = 0 is the oyz plane and is obtained from the solution of the system

$$x' = A\,x = \begin{pmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ -4 & 0 & 0 \end{pmatrix}\begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \\ -4x \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix} \Leftrightarrow \text{ x = 0 or plane oyz}$$

$\{(x, y, z); x = 0\}$= OYZ

For a = 0 the general solution takes the form:

$$\boldsymbol{x}(t) = \begin{pmatrix} x_0 \\ y_0 \\ z_0 - 4tx_0 \end{pmatrix} \xrightarrow[t\to+\infty]{} \begin{pmatrix} x_0 \\ y_0 \\ \pm\infty \end{pmatrix}$$

We specify that for $x_0 > 0$ we have:

$$\begin{pmatrix} x(t) \\ y(t) \\ z(t) \end{pmatrix} = \begin{pmatrix} x_0 \\ y_0 \\ z_0 - 4tx_0 \end{pmatrix} \xrightarrow[t\to+\infty]{} \begin{pmatrix} x_0 \\ y_0 \\ -\infty \end{pmatrix}$$

And for $x_0 < 0$

$$\begin{pmatrix} x(t) \\ y(t) \\ z(t) \end{pmatrix} = \begin{pmatrix} x_0 \\ y_0 \\ z_0 - 4tx_0 \end{pmatrix} \xrightarrow[t\to+\infty]{} \begin{pmatrix} x_0 \\ y_0 \\ \infty \end{pmatrix}$$

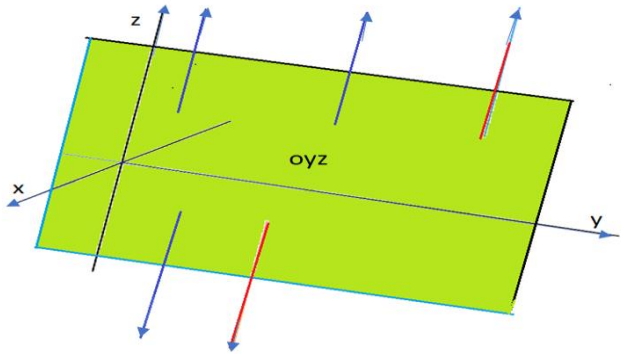

Figure 2: *Phase portrait in the case c = 0, a = b = 0*

We will continue the study with the case when $c > 0$ and the matrix has its complex conjugate values $\lambda_1 = b, \lambda_{2,3} = a \pm \sqrt{-4c}$

And we stop at the typical case for c = 1 and get

λ_1=b, $\lambda_{2,3} = a \pm 2i$ and the matrix A will be $A = \begin{pmatrix} a & 0 & 1 \\ 0 & b & 0 \\ -4 & 0 & a \end{pmatrix}$

We find the eigenvectors for the corresponding eigenvalues and for λ_1= b by solving the vector equation:

$$(A - b\,I)\begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} a-b & 0 & 1 \\ 0 & 0 & 0 \\ -4 & 0 & a-b \end{pmatrix}\begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix}$$

It seems clear that $(A - b\,I)e_2 = \begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix}$ *or* $\mathrm{A}e_2 = \mathrm{b}e_2$

Then the eigenvector for the eigenvalue $\lambda_1 = b$ is e_2. We calculate the eigenvectors for $\lambda_2 = a + 2i$ by solving:

$$(A - (a + 2\mathrm{i})I)\begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} -2i & 0 & 1 \\ 0 & b-a-2i & 0 \\ -4 & 0 & -2i \end{pmatrix}\begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix}$$

Or :

$$\begin{pmatrix} -2i & 0 & 1 \\ 0 & b-a-2i & 0 \\ -4 & 0 & -2i \end{pmatrix}\begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} -2ix + \mathrm{z} \\ (b-a-2i)y \\ -4x - 2iz \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix}$$

$\begin{cases} -2ix + \mathrm{z} = 0 \\ (b-a-2i)y = 0 \\ -4x - 2iz = 0 \end{cases}$ brings that $\begin{cases} y = 0 \\ z = 2i \\ x = 1 \end{cases} = \begin{pmatrix} 1 \\ 0 \\ 2i \end{pmatrix} = e_1 + \mathrm{i}\begin{pmatrix} 0 \\ 0 \\ 2 \end{pmatrix} = e_1 + 2e_3 i$

The eigenvector of the complex eigenvalue is $w = e_1 + 2e_3 i$ so so $u = e_1$ and $v = 2e_3$ then the general solution has the form:

$\boldsymbol{x}(t) = c_1 e_2 e^{bt} + c_2 e^{at}(\cos 2t\, e_1 - \sin 2t\, 2e_3) + c_3 e^{at}(\sin 2t\, e_1 + \cos 2t\, 2e_3) =$

$$\begin{pmatrix} c_2 e^{at} cos2t + c_3 e^{at} sin2t \\ c_1 e^{at} \\ c_2 e^{at}(-2) sin2t + c_3 e^{at} 2cos2t \end{pmatrix} = \begin{pmatrix} e^{at}(c_2 cos2t + c_3 sin2t) \\ c_1 e^{at} \\ e^{at}(-2c_2 sin2t + 2c_3 cos2t \end{pmatrix}$$

To express the general solution depending on the initial value we calculate the exponential of the matrix, obtaining:

$$\mathrm{x}(0) = \begin{pmatrix} c_2 \\ c_1 \\ 2c_3 \end{pmatrix} = \begin{pmatrix} x_0 \\ y_0 \\ z_0 \end{pmatrix} \rightarrow \begin{cases} c_1 = y_0 \\ c_2 = x_0 \\ c_3 = \frac{z_0}{2} \end{cases}$$

Exponential calculation of the matrix e^{At}

$$\mathbf{x}(\mathrm{t}) = \begin{pmatrix} e^{at}(x_0 cos2t + \frac{z_0}{2} sin2t) \\ y_0 e^{bt} \\ e^{at}(-2x_0 sin2t + z_0 cos2t \end{pmatrix}$$

$$= \begin{pmatrix} e^{at} cos2t & 0 & e^{at} \frac{sin2t}{2} \\ 0 & e^{bt} & o \\ -2e^{at} sin2t & 0 & e^{at} cos2t \end{pmatrix} \begin{pmatrix} x_0 \\ y_0 \\ z_0 \end{pmatrix} = e^{At} \begin{pmatrix} x_0 \\ y_0 \\ z_0 \end{pmatrix}$$

Evaluate :

$$4x^2(t) + z^2(\mathrm{t}) =$$
$$e^{2at}(4x_0 cos^2 2t + y_0 z_0 \sin 2t \cos 2t + {z^2}_0 sin^2 2t) +$$
$$e^{2at}(4x_0 sin^2 2t - 4x_0 z_0 \sin 2t \cos 2t + {z^2}_0 cos^2 2t) =$$
$$e^{2at}(4{x^2}_0 + {z^2}_0)$$

Finally we get that

$$4x(t)^2 + z(t)^2 = e^{2at}(4{x_0}^2 + {z^2}_0)$$

After we pass the limit we have

$$4x(t)^2 + z(t)^2 = e^{2at}(4{x_0}^2 + {z^2}_0) \xrightarrow[t \to +\infty]{} \begin{cases} 0 & p\ddot{e}r\ a < 0 \\ 4{x_0}^2 + {z^2}_0 & p\ddot{e}r\ a = 0 \\ \infty & p\ddot{e}r\ a > 0 \end{cases}$$

We distinguish cases depending on parameters a and b:

Case 1. a < 0 and b < 0 we have that $4x(t)^2 + z(t)^2 = e^{2at}(4{x_0}^2 + {z^2}_0) \xrightarrow[t \to +\infty]{} 0$ and $y(t) = y_0 e^{bt} \xrightarrow[t \to +\infty]{} 0$ the system is stable trajectories for any initial value $\begin{pmatrix} x_0 \\ y_0 \\ z_0 \end{pmatrix}$ are spirals:

x(t)=$\begin{pmatrix} e^{at}(x_0 cos2t + \frac{z_0}{2} sin2t) \\ y_0 e^{bt} \\ e^{at}(-2x_0 sin2t + z_0 cos2t \end{pmatrix} \xrightarrow[t\to+\infty]{} \begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix}$ so the balance point is stable spiral knot.

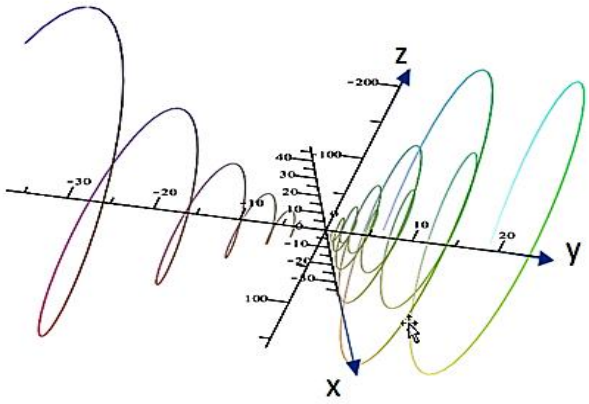

Figure 3: *Phase portrait in the case c = 1, a < 0, b < 0. Taken with Maple*

Case 2. a < 0 and b = 0 we have that the dynamical system has equilibrium set where x ' = 0 the oy axis, also $4x(t)^2 + z(t)^2 = e^{2at}(4{x_0}^2 + {z^2}_0) \xrightarrow[t\to+\infty]{} 0$ and $y(t) = y_0 e^{0\,t} = y_0$ trajectories are spirals in the plane $y = y_0$ such that:

x(t)=$\begin{pmatrix} e^{at}(x_0 cos2t + \frac{z_0}{2} sin2t) \\ y_0 \\ e^{at}(-2x_0 sin2t + z_0 cos2t \end{pmatrix} \xrightarrow[t\to+\infty]{} \begin{pmatrix} 0 \\ y_0 \\ 0 \end{pmatrix}$

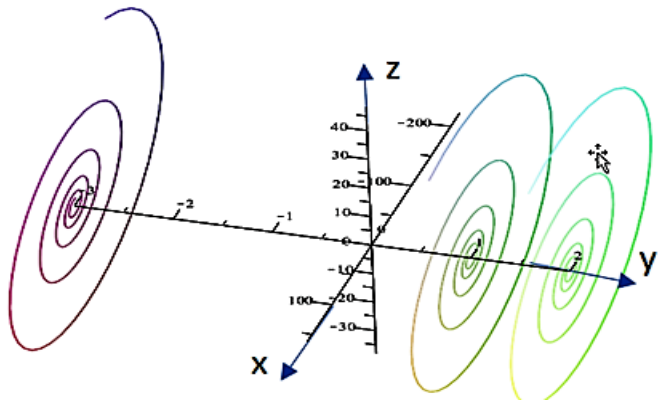

Figure 4: *Phase portrait in the case c = 1, a < 0, b = 0. Taken with Maple*

Case 3. a < 0 and b > 0 we have a bifurcation, the dynamical system is the saddle, the stable space is the oxy plane and the unstable space is the oy axis, the trajectories are spirals narrowing around the oy axis:

$$\mathbf{x}(t)=\begin{pmatrix} e^{at}(x_0 cos2t + \frac{z_0}{2} sin2t) \\ y_0 e^{bt} \\ e^{at}(-2x_0 sin2t + z_0 cos2t \end{pmatrix} \xrightarrow[t\to+\infty]{} \begin{pmatrix} 0 \\ \infty \\ 0 \end{pmatrix}$$

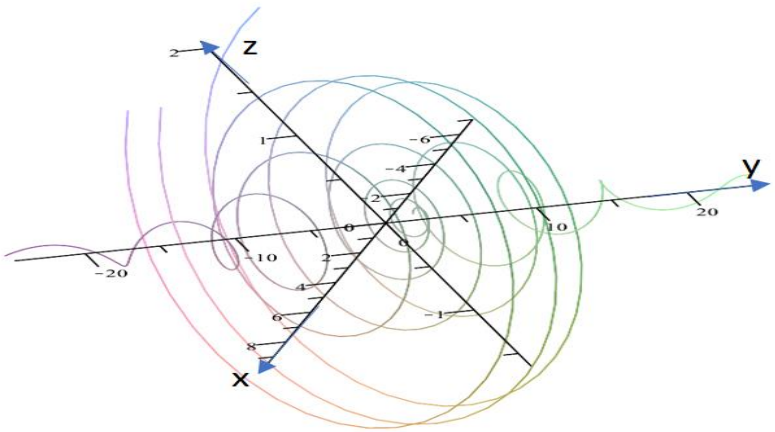

Figure 5: *Phase portrait in the case c = 1, a < 0, b > 0.Taken with Maple*

4. RESULTS AND DISCUSSIONS

In this paper, studying the stability of the system depending on 3 parameters, we notice that in general the value 0 is the value of bifurcations.
If the value c of the parameter goes from negative values to positive values, it leads to the birth of its complex eigenvalues and the equilibrium point turns from a simple node to a spiral node.
For c=0 there is the generation of generalized eigenvectors.
For the parameter b, the transition from b< 0 to b > 0 brings the stability of the eigen space of λ=b which is the oy axis. For b < 0, the oy-axis is a stable eigenspace, for b > 0 it is an unstable eigenspace. for λ=0 the oy axis is the equilibrium axis.
Changing the parameter a< 0 the eigen space of the oxz plane is stable, for a≥0 it is switched to unstable space.

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Art of Problem Solving in Mathematics

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Abstract

This paper deals with the importance and influence of mathematical problems in individual development, specifically in the improvement of logical analytical cognitive skills, improving memory, gaining skills and speed in solving problems in mathematics and in other areas where it is applied. Strategies, methods, and the most important techniques for neatly solving problems are dealt with. Secondary and high school Olympiad and non-standard problems are included. Furthermore, through a study with high school students is pointed out their formation with acquired skills in terms of problem solving.

Key words: students, problem solving, Olympiads, non-standard, development.

1. INTRODUCTION

Problems are definitely a fundamental tool in the development of students' thinking. It can be said that everyone experiences this pleasure of cognitive development. Problems are considered not only as an integrative element of different aspects of the curriculum, but help to establish a true relationship between mathematics and reality.

1.1.Mathematical Problems

Benefits of solving mathematical problems:

- They give the true meaning to mathematical concepts, techniques, habits.
- Help develop the desire to understand.
- Encourage the creative spirit and independence of thinking, enable students to be structured, organized, formalized and mathematized.

But it is also known that problems constitute a critical part of learning, in which students often encounter insurmountable difficulties for them. On the other hand, their successful solution brings satisfaction to every student, makes them feel successful, increases self-confidence and promotes further progress. Therefore, problem solving should occupy a significant place in the mathematics curriculum and should be part of every student's experience in mathematics.

The problem has to do with a situation during which the student is somehow caught by surprise and the knowledge acquired up to that moment is not enough for him to respond immediately. Solving the problem does not mean repeating a ready answer pork no answer must be found. The knowledge and techniques that the student possesses are necessary but not sufficient for him. His brain is facing a challenge that has intuition and reasoning as its basic ingredients. The key is for the learner to meet the appropriate level of challenge because a problem that is too difficult can lead to long-term strain.

So, a problem can be considered as a task that does not have an immediate solution, while exercises as tasks that are solved immediately and with the use of ready-made formulas and serve more to practice.

1.2.Problem Solving

Problem solving can be defined as the process by which an individual tries to find a solution to a non-routine mathematical question. Solving the problem is a 4-step process (George Polya 1945):

1. Understanding the problem.
2. Creating a plan for finding a solution.
3. Implementation of the plan, i.e. the solution.
4. Going back to the answer to make sure it makes sense and to determine if another plan would be more effective (i.e. if there is another solution).

Problem solving is part of the thinking process. Problem solving can be considered as the highest stage of the cognitive process that requires certain basic skills as well as the use of certain knowledge and methods to reach the right conclusions or to find the result. The seemingly difficult problem is easily solved when the right strategy is used. Depending on the level of the students, some problem-solving strategies can be applied, such as:

- Interpretation of the problem.
- Making a figure or a diagram.
- Building a physical model.
- Reformulating the problem in other words.
- Conversion to a simpler case.

- Listing of all possibilities.
- Work backwards: guess, check and review.
- Elimination.
- Making a table, list or outline.

The benefits of problem solving:

- Students gain skills to reflect critically on learning experiences and processes and to make effective decisions.
- As they solve problems, they also acquire other skills, such as creativity and cooperation.
- Critical thinking allows facts to be distinguished from opinions and helps to consider all possible alternatives for solving a problem.

1.3.Research Questions and Methodology

Taking into account all the elements that I mentioned above about the importance of problems in mathematics as well as in the process of thinking and reasoning of students, we have tried to do a study on the fact that the problems occupy a place in the new curriculum as well as the effectiveness of a lesson through problem solving

- Hypothesis 1: Problems in the new curriculum occupy a smaller place than in the previous curriculum.
- Hypothesis 2: The lack of problems has reduced students' ability to reason and reason critically.

The methodology followed in this research involves 2 steps:

1. The research in the new mathematics texts and the discovery of the problem based also on the difficulties that the high school graduates encounter in the mathematics exam in the Matura.
2. Development of a questionnaire about how much students like mathematics and the difficulties they encounter during the development of this subject.

2. PROBLEMS IN NEW MATHEMATICS TEXTBOOKS

2.1.Designing Mathematics Textbooks for Grades 10, 11, 12

In mathematics books 10, 11 and 12, mathematics topics are divided into: Skills (A) and Application (Z).

Training (A) begins with giving the simple concept: either with visual illustrations or with definitions or formulas where it is not specified that this sentence is the definition of the mathematical concept. This is where the problem of the student not distinguishing between definition and mathematical properties appears. Then it continues by giving two or three solved examples and then continues with exercises where almost the first 4 exercises are the same as the examples but with different numbers. In these topics, there are almost never problems, only threats. Here are some of the positives and problems encountered by treating it this way.

Positive sides:

1. Starting with solved exercises, the student finds it easier to succeed in solving similar situations and is more satisfied and motivated.
2. Encourages students' independent work.
3. Reinforces the formulas if they were given at the beginning of the lesson.

Negative sides:

1. The student learns the ready solution of the exercise and not the logic of the solution, which will cause difficulties as soon as the situation changes a little
2. Creates problems in problem-solving reasoning.
3. It requires a very committed preparation on the part of mathematics teachers to draw out from the students the purpose of the given examples as well as the problems during their solution.
4. The mathematics teacher must complete the theoretical framework if he wants the students not to encounter difficulties in solving even slightly more difficult exercises.

Application (Z) starts with new formulas or definitions and continues with problem situations from everyday life or from other sciences that use these definitions or formulas. Again, the way they are presented is through two or three solved problems in the book. Then it continues with problems to be solved by the students where only the first 2 or 3 problems are the same as the solved examples but with different numbers or approximate words. All the following problems are new situations where the student must reason and understand that the solutions are with the same formulas as more difficult problems.
In this part, the defects of the lack of theoretical basis in both part (A) and part (Z) stand out, which would help the student both in reasoning and in reaching the solution of these problems. Here too, the student only has the solved model and tries to memorize the model, not the logic of the solution. We can add here

the fact that some teachers are too lazy to get the essence of the problem with one of the methods we said above and solve it themselves, or they give homework and the students can copy it or not solve it at all. Some of the problems are more difficult than they should be in relation to the concepts taken which lowers the confidence of the students.
At the end of a chapter are a review topic which has only exercises up to the intermediate level as well as a self-assessment topic which has exercises and problems of a higher level of difficulty.

2.2.Mathematics Textbooks Design Flaws

At first glance, it seems as if the text has an equal number of exercises and problems, but this is not the case. As we defined above, a problem is not a task that is solved immediately or that uses a routine procedure, but a task that will go through its stages to be solved. If even in topics (Z) the number of problems is the same as the solved examples, then they are no longer called problems but exercises. We have emphasized that the same task can be an exercise for some students but a problem for others, depending on the level and stage they are at. As we can see, real problems occupy a small place in these texts, and it decreases even more if we take into account the fact that some teachers focus more on exercises than on problems (which they usually give homework).
These flaws, both the small number of practical problems in the text and the mathematics teachers who neglect these few problems in the textbooks are clearly manifested:

1. In Matura exams that have a certain degree of difficulty.
2. At the level of reasoning of first-year students in scientific faculties, both in Albania and abroad.

Let's study the matriculation exam of 2021 in the subject of mathematics. This year the test was of an above average level of difficulty for the graduates who complained and protested. If we analyze the exercises that they complained about, they were mainly: The problems that were solved with the formulas given in the book, so a part of them were in the port book drawn up in other words. For example, we have a look at following problem:
Cindy places chocolates in a crate. The ark has the shape of a cuboid measuring 2.5 m; 2 m and 1.2 m. Each chocolate is in the form of a cube with 50 cm sides. Cindy performs these calculations:

$$V_{crate} = 2.5 \cdot 2 \cdot 1.2 = 6\,m^3$$

$$V_{chocolate} = 0.5 \cdot 0.5 \cdot 0.5 = 0.125\,m^3$$

$$\#chocolates = 6 \div 0.125 = 48$$

V – volume, # – number of

She says: "I can put 48 chocolates in the crate." Is Cindy, right? Justify your answer.

A large part of the graduates solved this problem incorrectly and after seeing the correct solution of the problem they came to the conclusion that this problem was difficult and there were hints that it was outside the program. In fact, this problem was not only within the program but was formulated essentially almost the same as in the book, only with different words. In the book, the problem was as follows (Class 11, Topic 3.2 Z Exercise 8 page 51): How many CDs with dimensions 12.5 cm, 14.2 cm, 0.5 cm can fit in a box with dimensions 75 cm, 60 cm and 30 cm?
As you can see, the problem is the same as that of the exam, only that the word CD has become a box and the word box has become a box, as well as the dimensions have changed, not to mention the fact that in the Matura test both the reasoning and the actions are given, that is, the students have easier to reason when they see them. And again, most of them failed in the solution. What does this show? What could have been the causes of this result?

1. In the solved problems of this lesson, there was no solved problem like this model and the students (together with the math teacher) have not solved this exercise at all, and therefore they did not know how to solve it at all.
2. The students in this lesson may have solved this problem but the same mistake and the solution was not checked or discussed. Consequently, they knew the wrong answer for the correct solution.
3. The lack of providing logic in the reasoning of the problem from the side of the lesson text due to the small amount of problems as well as the failure to fill this gap from the side of the mathematics teacher by adding more problems to draw out the difference between the fluid that takes the shape of the container and occupies every space of the body where they are inserted without leaving empty spaces and of the solid body that does not take the shape of the container and if the dimensions are not sub-double of the body where they are inserted, they will leave empty spaces. etc.

In this Matura exam, the graduates rated the following problem as difficult and solved it incorrectly: Determine whether the statement is always true, sometimes true, or never true. Give an example to support your answer. A number P, rounded to the nearest whole number, is 5. Another number Q, given to exactly one decimal place, is 5.0. Then $P \neq Q$.

The statement is _____ true.
Example: _____.

Here, too, the solution method was to eliminate from the 3 different answers the other 2 cases using the counterexample, but in the text, there are almost no problems of this type, so again the lack of problems.
Even the probability or calculation of ship/vehicle courses problems caused many difficulties for students making them give the wrong answers. Again, the main reasons behind these wrong answers are: Small number of problems and more emphasis put on memorizing the description and solution of exercises rather than learning through reasoning (which is only reinforced by solving problems). With respect to geometry, we have a discrepancy of almost 70% between the level of problems given in the textbook and those given in the Matura exam. This inconsistency also comes from the very small number of textbook problems about 2D and 3D Euclidean geometry. As a result, high school graduates encounter many difficulties in solving these problems in the Matura exam.

3. SURVEY CONDUCTED WITH GRADUATES

700 graduates participated in this questionnaire. The questionnaires were mostly filled out online using google form, but also a part in public and non-public Durrës schools. In these schools, a trial test with problems of different levels was developed, but the statistics for the results of these tests are the subject of another study. The results of the questionnaire with the students are as follows:

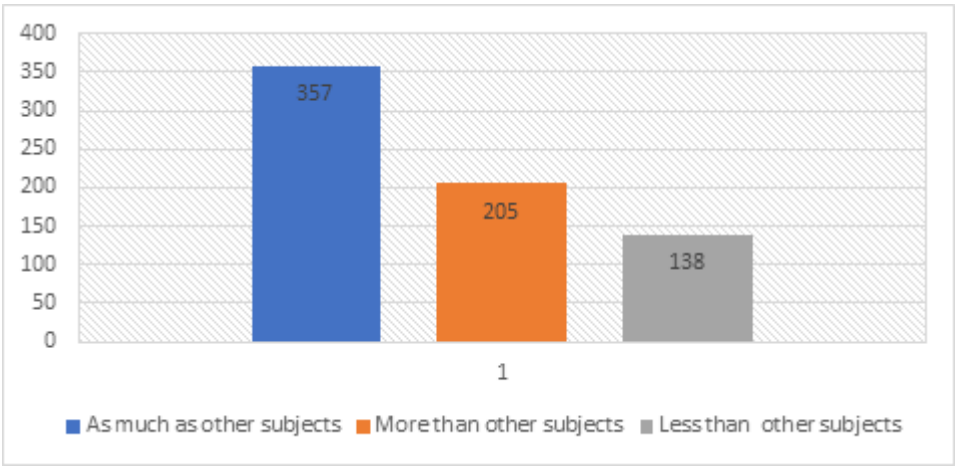

Figure 3.1 *I love mathematics*

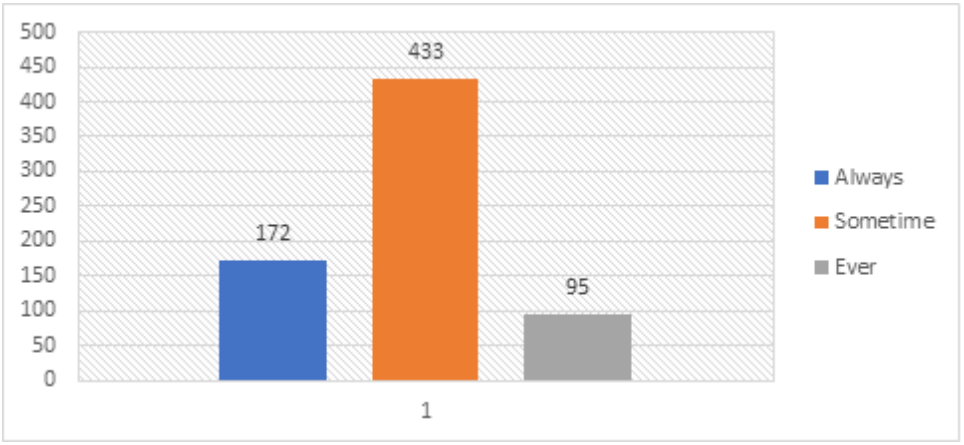

Figure 3.2 *Mathematics is difficult for you*

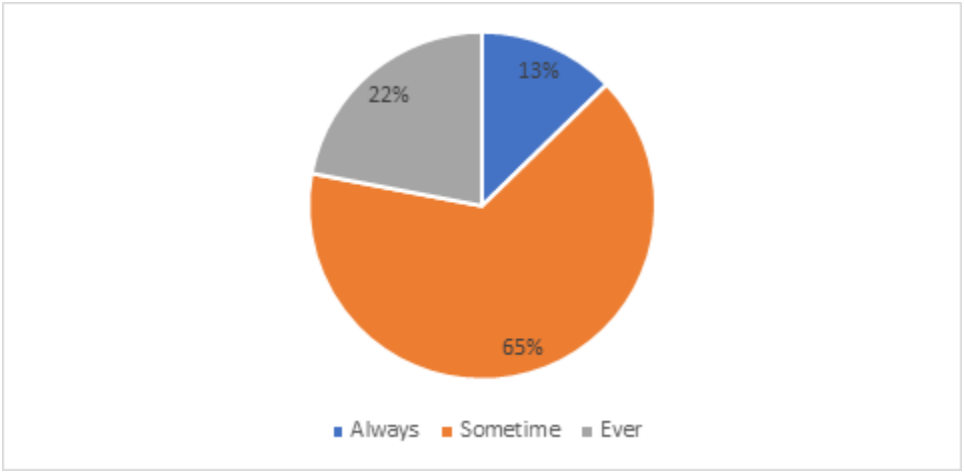

Figure 3.3 *I complete the math problems completely by myself*

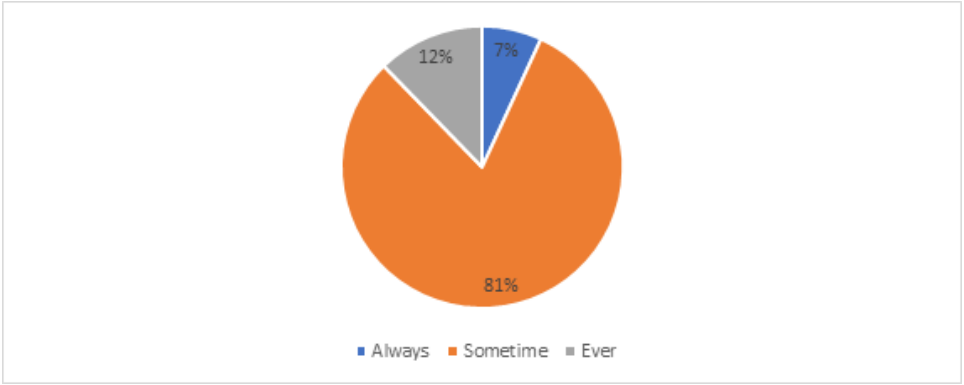

Figure 3.4 *I understand math problems*

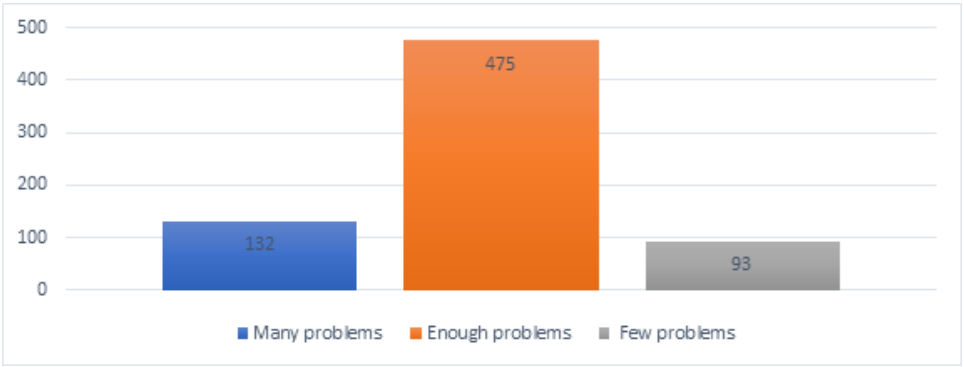

Figure 3.5 *I think that in the text there are*

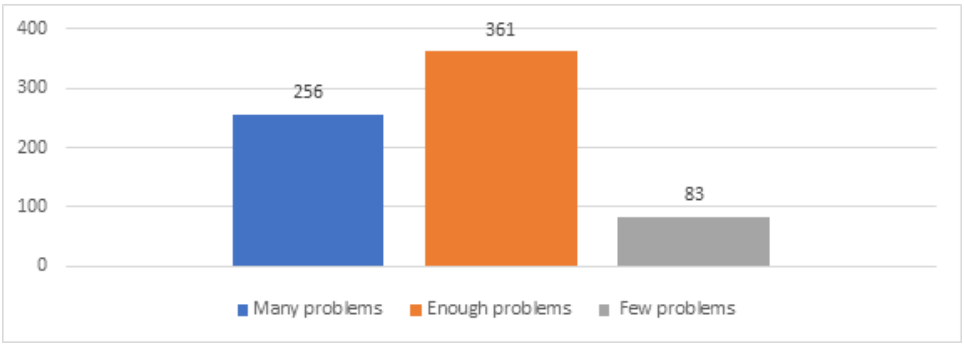

Figure 3.6 *Your math teacher illustrates/solves*

In Figure 3.7 the graph bars represent:
a) He solves all the problems himself.
b) I get some problems out of question and answer with the students, some others I solve by myself.
c) He solves some problems himself, others he gives homework.
d) He chooses a little on his own and gives most of the homework.

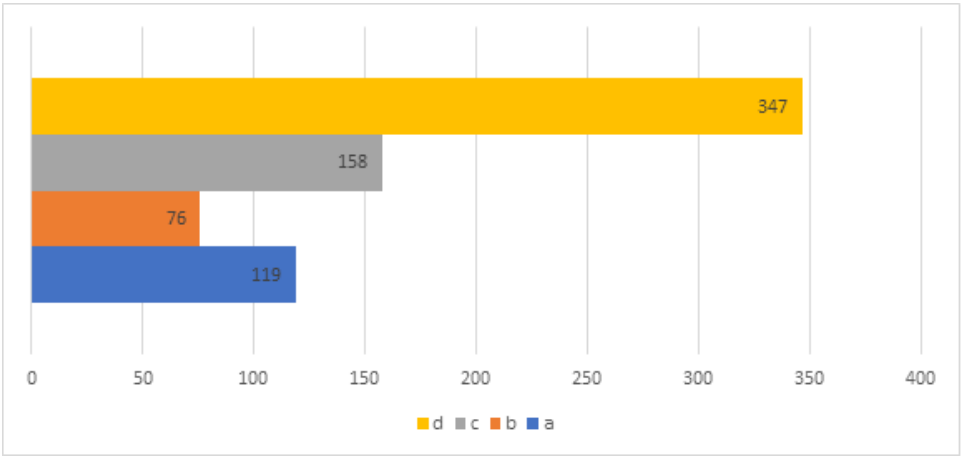

Figure 3.7 *Your math teacher*

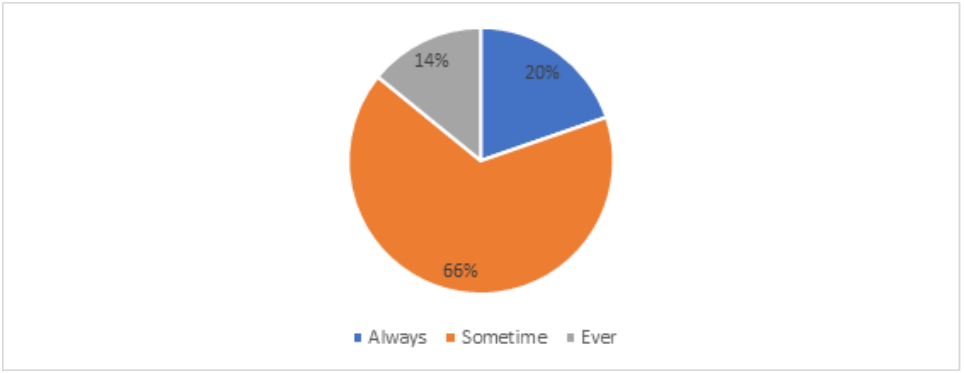

Figure 3.8 *In math homework, you solve the problems*

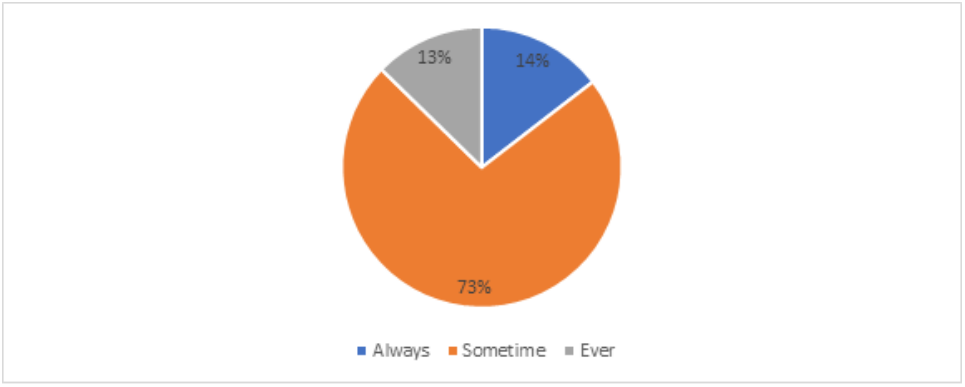

Figure 3.9 *In the written mathematics tests, you solve the problems*

In Figure 3.10 we ask the open question: What types of problems do you consider difficult? Give 1 or more reasons. You can also list more than one problem type from the types listed below and you can also add other types mentioned below.

a) Plane geometry problems.
b) Problems with the course of ships or planes, etc.
c) Probability problems.
d) Problems with bodies.
e) Problems with geometric transformations.
f) Other.

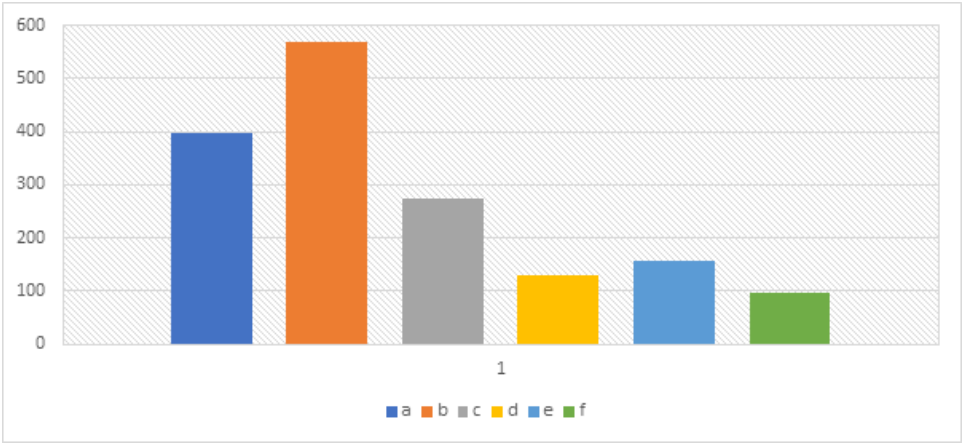

Figure 3.10 *Open question*

Most of the reasons for the difficulties in solving these problems were: The lack of problems in the text so that they can be understood better, as well as having few hours in the program for explaining and developing them. There were also students who cited the incompetence of the math teacher or the fact that they solved very few problems.

4. CONCLUSIONS

The following conclusions emerged from the processing of the questionnaire results:

1. Students have many difficulties in solving problems in mathematics, mainly problems that use knowledge from geometry.
2. The main reasons for the difficulties they have in solving problems are both their small amount in the text and the lack of theoretical logic in the text for solving them or in other words giving them as a solved example.

3. Another reason for these difficulties in solving problems was the greater focus of mathematics teachers on solving exercises and their neglect of problems.

5. RECOMMENDATIONS

Seeing all these difficulties that students have in solving problems, we recommend that:

1. Mathematics teachers should pay more attention to solving problems and use different techniques to solve them so that students are enriched with a variety of reasoning and methods that will lead to strengthening critical thinking.
2. To be prepared by mathematics teachers, additional problems, to complete the right amount, so that the students become skilled in the way of reasoning for their solution.
3. Teachers should pay attention to the use of as many problems from everyday life as possible to make them as understandable and assimilable as possible for students, and to avoid, as far as possible, ready-made solutions from the teacher.
4. Teachers should be attentive in choosing the problem-solving strategy depending on the stage in which the student is as well as his level in order not to create passivity and fear of students for their solution.

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A review on Particle Swarm Optimization and Bayesian Optimization

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Abstract

The Particle Swarm Optimization (PSO) computational method has recently become popular. This paper is a review on the concept of Particle Swarm Optimization (PSO), its application to different systems including electric power systems, modifications of the basic PSO to improve its premature convergence, and its combination with Bayesian Optimization (BO) to improve search capacity and reduce the time spent to come out of local optimums. To resolve many optimization problems on different fields production system, a Bayesian network learnig algorithm based on relationship prediction Particle Swarm Optimization (PSO) has been used recently. Here we present some conclusions of these two methods and it is shown that using the capability of both PSO and BO algorithms to make efficient use of parallel computing resources is very useful.

Key words: Particle Swarm Optimization (PSO), Bayesian Optimization (BO), Algorithm.

1. INTRODUCTION

Particle Swarm Optimization (PSO), is one of the more promising examples of an evolutionary algorithm and can be used to solve nonlinear and convex optimizations problems for global optimal solutions. PSO it is now one of the most commonly used optimization techniques. There have been attempts to formulate the method in formal probabilistic or stochastic terms, bare bones particle swarms. J. Kenned [1], with the aim to achieve more generality and explain the practical behavior of the method. One of them is the Bayesian interpretation of the particle swarm optimization. Bayesian Optimization is an

elegant solution to the hyperparameter optimization problem in machine learning (ML). On the other hand, as an important artificial intelligence model, Bayesian Networks (BN) have been broadly applied in many fields, such as risk analysis [2], bioinformatics [3] and data fusion [4]. Special interest has emerged in using these two methods to compare hyperparameters to various optimization problems.

2. CLASSICAL PSO

The theory of particle swarm optimization (PSO) has been growing rapidly. PSO has been used by many applications of several problems.

Figure 1: *A flock of birds and a flock of fish PSO*

The algorithm of PSO emulates from behavior of animal's societies that don't have any leader in their group or swarm, such as bird flocking and fish schooling fig. 1. The technique was originally designed and developed by Eberhart and Kennedy [5]. The flocks achieve their best condition simultaneously through communication among members who already have a better situation. Animal which has a better condition will inform it to its flocks and the others will move simultaneously to that place. This would happen repeatedly until the best conditions or a food source discovered. The process of PSO algorithm in finding optimal values follows the work of this animal society.

2.1. The standard PSO

The PSO approach exploits the behavior of *Np*-independent virtual particles, which "fly" through the search domain, have a memory and are able to communicate with other members of their "swarm." Each particle has a single purpose to better its fitness and thereby identify the optimum (minimum or maximum) of a function.

Let in a physical *d*-dimensional search space, the position and velocity of the *i*-th particle (*i*-th individual in the population of particles) be represented as the vectors $X_i = (x_{i1}, x_{i2}, \dots, x_{id})$ and $V_i = (v_{i1}, v_{i2}, \dots, v_{id})$ respectively [6]. The previous best position of the *i*-th particle is recorded and represented as

$Pbest_i = (Pbest_{i1}, Pbest_{i2}, \dots, Pbest_{id})$. The index of best particle among all the particles in the group is represented by the $Gbest_d$. The modified velocity and position of each particle can be calculated using the current velocity and the distance from $Pbest_{id}$ to $Gbest_d$ as shown below:

$$V_{id}^{k+1} = w \times V_{id}^{k} + C_1 \times rand( ) \times \left(Pbest_{id} - X_{id}^{k}\right) + C_2 \times rand( ) \times \left(Gbest_d - X_{id}^{k}\right)$$

$$i = 1,2, \dots, N_p \qquad d = 1,2, \dots, Ng. \tag{2.1}$$

Where N_p is the number of particles in a swarm or group, N_g is the number of members or elements in a particle, V_{id}^{k} is the velocity of individual *i* at iteration *k*, *w* is the weight parameter or swarm inertia, C_1 and C_2 are the acceleration constants and *rand ( )* is uniform random number in the range [0 1]. The constants C_1 and C_2 represent the weighting of the stochastic acceleration terms that pull each particle toward the *Pbest* and *Gbest* positions. The updated velocity can be used to change the position of each particle in the swarm as depicted in Eq. (2.2) as:

$$X_{id}^{k+1} = X_{id}^{k} + V_{id}^{k+1} \tag{2.2}$$

Suitable selection of inertia weight *w* provides a balance between global and local explorations, thus requiring less iteration on average to find a sufficiently optimal solution. In general, the inertia weight *w* is set according to the following equation:

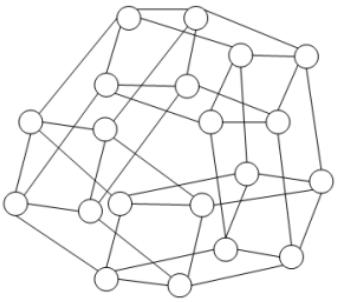
$$w = w_{max} - \frac{w_{max} - w_{min}}{iter_{max}} \times iter \tag{2.3}$$

where $iter_{max}$ is the maximum number of the iterations and $iter$ is the current number of iterations, w_{max} is the maximum value of weight and w_{min} is the minimum value of weight The results of algorithm PSO depend from inertia weight *w*, the acceleration constants C_1 and C_2 and from the experience of local and global particle.

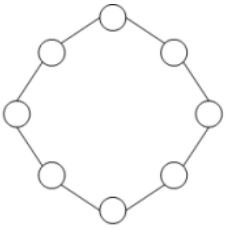
2.2. Related works of PSO variants

Recently, there are several modifications from original PSO. Inertia weight plays a key role in the process of providing balance between exploration and exploitation process. The inertia weight determines the contribution rate of a particle's previous velocity to its velocity at the current time step. In PSO, the inertia weight is used to balance the global and local search ability. A large inertia weight facilities a global search while a small inertia weight facilities a local search [7]. Based on the basic idea of decreasing inertia weight, in [8] are proposed two natural exponential inertia weight strategies. The results of the experiments show that these two new strategies converge faster than linear one

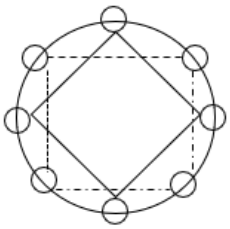
[9], during the early stage of the search process. For most continuous optimization problems, these two strategies perform better than the linear one. Conditions $C_1 + C_2 \geq 4$ and $k\epsilon[0,1]$ of the swarm guarantee the convergence, in other words it guarantees the stability of PSO [10]. The neighborhood affects the transmission speed and influences the PSO convergence. Since the neighborhood topology changes the flying pattern of the swarm, convergence and diversity differ from topology to topology. In [11], is introduced a new neighborhood structure for PSO, called Singly-Linked Ring. The proposal is easy to implement, and its results and its convergence performance are better than other structures. A statistical test was performed for every experiment to compare the mean values of the 3 structures, singly-linked ring, the ring and Von Neumann structures, with the same PSO parameters. In most functions, the singly-linked ring is statistically better than the ring and Von Neumann structures, fig. 2.



a) Von Neuman neighborhood structure



b) Ring neighborhood structure



c) Singly-Linked Ring neighborhood structure

Figure 2: *Neighborhood structures for PSO*

The modification in PSO consists of three categories: extension of field searching space, adjustment the parameters, and hybrid with another technique. If the swarm size is small, a larger inertia weight has been employed to improve the global search capability for finding the global optimum, presented by Chen et al [12]. A significant improvement in terms of the optimum solution was observed with the introduction of mutation along with time-varying acceleration coefficients MPSO-TVAC for all the benchmarks in comparison

with the PSO with time-varying inertia weight PSO-TVIW. The performance of the MPSO-TVAC method on the Rastrigrin function in all dimensions showed significant improvement compared with both the PSO-TVIW and the PSO-RANDIW methods [13]. Study on the development of PSO is necessary to do to know how far its development, its advantages and disadvantages and how much use this method to settle a problem. The basic variants as mentioned above have supported controlling the velocity and the stable convergence. At the other hands, modified variant PSO help the PSO to process other conditions that cannot be solved by the basic PSO [14].

2.3.Advantages and disadvantages of PSO

In analysis, PSO has advantages and disadvantages. PSO is based on the intelligence. It can be applied into both scientific research and engineering use. Then PSO have no overlapping and mutation calculation. The search can be carried out by the speed of the particle. During the development of several generations, only the most optimist particle can transmit information onto the other particles, and the speed of the researching is very fast. After that the calculation in PSO is very simple. Compared with the other developing calculations, it occupies the bigger optimization ability and it can be completed easily. The last one is PSO adopts the real number code, and it is decided directly by the solution. The number of the dimension is equal to the constant of the solution. On the other hands, disadvantages of particle swarm optimization (PSO) algorithm are that it is easy to fall into local optimum in high-dimensional space and has a low convergence rate in the iterative process.

3. BAYESIAN OPTIMIZATION

Bayesian Optimization is an approach to optimizing objective functions that take a long time (minutes or hours) to evaluate. It is best suited for optimization over continuous domains of less than 20 dimensions, and tolerates stochastic noise in function evaluations. It builds a surrogate for the objective and quantifies the uncertainty in that surrogate using a Bayesian machine learning technique, Gaussian process regression, and then uses an acquisition function defined from this surrogate to decide where to sample. The model used for approximating the objective function is called **surrogate** model [15].

1.1.A review of BO

Bayesian Optimization (BO) is a class of machine learning based optimization methods focused on solving the problem

$$\max_{x \in A} f(x) \tag{3.1}$$

where the feasible set and objective function typically have the following properties:

- The input x is in $\mathbb{R}^d$ for a value of d that is not too large. Typically, $d \leq 20$ in most successful applications of BO.
- The feasible set A is a simple set, in which it is easy to assess membership. Typically, A is a hyper-rectangle $\{x \in \mathbb{R}^d : a_i \leq x_i \leq b_i\}$ or the d-dimensional simplex $\{x \in \mathbb{R}^d : a_i \leq x_i \leq b_i\}$.
- The objective function f is continuous. This will typically be required to model f using Gaussian process regression.
- The objective function f is "expensive to evaluate" in the sense that the number of evaluations that may be performed is limited, typically to a few hundred. This limitation typically arises because each evaluation takes a substantial amount of time (typically hours) but may also occur because each evaluation bears a monetary cost (from purchasing cloud computing power, or buying laboratory materials) or an opportunity cost (if evaluating f requires asking a human-subject questions when the subject will tolerate only a limited number).
- The objective function f lacks known special structure like concavity or linearity that would make it easy to optimize using techniques that leverage such structure to improve efficiency. We summarize this by saying f is a "black box" (when there is a function that we cannot access but we can only observe its outputs based on some given inputs, it is called a black-box function) [16].
- When we evaluate f, we observe only $f(x)$ and no first or second order derivatives. This prevents the application of first and second order methods such as gradient descent, Newton's method, or quasi-Newton methods. We refer to problems with this property as "derivative free."
- We assume $f(x)$ is observed without noise. We will allow $f(x)$ to be obscured by stochastic noise. In almost all work on Bayesian Optimization, noise is assumed independent across evaluations and Gaussian with constant variance.
- The focus is on finding a global rather than local optimum.

The ability to optimize expensive black-box derivative-free functions makes BO extremely versatile. Recently, it has become extremely popular for tuning hyperparameters in machine learning algorithms (ML), especially deep neutral networks [17].

There are other techniques outside of BO that can be used to optimize expensive derivative free black-box functions. Bayesian Optimization distinguishes itself from other surrogate methods by using surrogates developed using Bayesian statistics, and in deciding where to evaluate the objective using a Bayesian interpretation of these surrogates [18].

1.2.Advantages and disadvantages of BO

Bayesian Optimization is a powerful tool for machine learning, where the problem is often not acquiring data, but acquiring labels. It proves us with an efficient way to learn the solutions to problems, and to collect data, all within a Bayesian framework. BO is particularly advantages for problems where $f(x)$ is difficult to evaluate due to its computational cost. The objective function $f(x)$, is continuous and takes the form of some unknown structure, referred to as a "black box". Performing evaluations in parallel using multiple computing resources allow obtaining multiple function evaluations in the time that would ordinarily be required to obtain just one with sequential evaluations. There are also disadvantages to using Bayesian analysis. It does not tell you how to select a prior. There is no correct way to choose a prior. Bayesian inferences require skills to translate subjective prior beliefs into a mathematically formulated prior. If you do not proceed with caution, you can generate misleading results. Developing Bayesian Optimization methods that work well in high dimensions is of great practical and theoretical interest. Directions for research include developing statistical methods that identify and leverage structure present in high dimensional objectives arising in practice, which has been pursued by recent work [19, 20, 21].

2. CONCLUSIONS

Bayesian Optimization, which acts as a very effective global optimization algorithm, has been widely applied in designing problems. By structuring the probabilistic surrogate model and the acquisition function appropriately, BO framework can guarantee to obtain the optimal solution under a few numbers of function evaluations, thus it is very suitable to solve the extremely complex optimization problems in which their objective functions could not be expressed, or the functions are non-convex, multimodal and computational expensive. The Bayesian interpretation of PSO algorithms paves the way for many future developments in PSO research. By providing solid theoretical foundations for the analysis of PSO algorithms and their performance factors it is expected to stimulate the work on variants of PSO and hybrids of PSO with other computational methods.

One class of optimization models based on Bayesian influence networks is presented in [22], Bayesian Optimization Models (BOMs). In a BOM, the optimization problem is framed as inference in a Dynamic Bayesian Network (DBN) where information relationships are characterized as conditional probability distributions. BOMs are useful tools for specifying motion algorithms, but they represent just one possible class of models. Perhaps even more interesting than the presented BOM is the accompanying process that was used to generate useful particle swarm motion, the model is the starting point, the solution methodology creates a real algorithm, and the final approximation

makes that algorithm tractable. Together these ideas represent a unified framework for function optimization that provides insights into how to tune the new algorithm and why it behaves the way that it does. All of the behavior of the algorithm may be traced back to one or more of the choices made during this process, all of which are explicit, allowing any desired change to be affected by revisiting those choices. The introduction of a BOM and its success in creating a competitive PSO algorithm highlights the utility of the associated algorithm design framework. The framework is not only valuable as a tool for the synthesis of PSO algorithms, but also for their analysis. This work has presented the framework and model-based approach as a way of thinking about optimization and this perspective suggests new ways of approaching the problem.

A formal framework is presented in [23], a Bayesian interpretation of the PSO using kernel functions. To evaluate the performance of Bayesian PSO were compared the standard PSO, the bare bones PSO, two kinds of Gaussian PSO representing the dependence and independence assumption versions of Gaussian PSO and a kernel extension of the standard PSO. To compare the performance of these methods were chosen 10 dimensional functions. The results show that the bare bones PSO is statistically significantly better than the standard PSO for all functions with the exception of the Rosenbrock and modulus sum functions. They also show that the Gaussian PSOs are statistically very significantly better than the bare bones PSO for seven out nine functions, the exceptions being the Schwefel and step functions. The results show that the kernel standard PSO is significantly better than the bare bones PSO for all functions except the Rastrigin function. The Bayesian interpretation of PSO allows formal analysis of the mechanisms and performance factors of PSO algorithms and this can lead to a better understanding of the reasons why certain PSO algorithms may work better in certain circumstances than other similar algorithms.

An effective hybrid evolutionary algorithm (HEA) is proposed in [24] to solve the Flexible Job shop Scheduling Problem (fJSP) in which is based on Particle Swarm Optimization (PSO) with real number encoding as the basic algorithm to increase the search space and avoid getting into local optimum solutions. Then, it is used Bayesian Network (BN) structure to find out the relationship between the variables and according to the relationship to regroup, at the same time, using parameter adaptive mechanism to dynamic adjust parameters of PSO, minimize the makespan of fJSP within a reasonable amount of calculating time. The proposed algorithm can get better solutions and increase the robustness.

In [25], the basic PSO can converge fast, but susceptible to fall into local minima easily. To solve this problem, this research attempt has been made with the following improvements. The hybrid PSO algorithm is employed as a search strategy in order to identify an optimal weighting for attributes

probabilities from NB classifier and to solve the optimization problems. The inertia weight (w) is the most important parameter that moves the particle toward the optimal position. Thus, to increase the search ability the particles flight should be controlled by the objective functions. The particle which is closer to the optimal point should move slowly as compared to the other particle. This movement of the particle can be controlled using different w values according to their rank between w_{min} and w_{max} as given in this work. This proposed NB with hybrid PSO method is used to improve the performance of accuracy. The architecture NB classifier combined with hybrid PSO feature selection method proves to be the best feature selection capability without reducing the classification accuracy. This method also proves to be the best suited for method for mining large structural data in much less computational time. The experimental results prove that this hybrid PSO with NB classifier is very efficient, fast, and successful.

In [26], it is shown how to scale safe BO to larger dimensions by using an adaptive discretization. The main challenges to applying PSO to optimize the acquisition function of safe BO are designing a sparse approximation for the safe set as initial points for the particles, defining suitable objective functions for the maximizer and expanders subject to the safety constraints, and selecting the tuning parameters of the PSO to be generally applicable. The resulting algorithm was applied to tuning an $\mathcal{L}_1$ adaptive controller on a quadrotor, which confirmed that this approach is flexible, practical, and can safely optimize controller parameters with low computational cost.

It is shown that using the capability of both PSO and BO algorithms to make efficient use of parallel computing resources is good [27]. In this paper is compared the performance of two autonomous algorithms for the optimization of hyperparameters, Bayesian Optimization (BO) and Particle Swarm Optimization (PSO), on two benchmark tasks typical for ML applications in the field of high energy physics: the task of finding the minimum of the Rosenbrock function and the ATLAS Higgs boson machine learning challenge. The parameter settings used for the BO and PSO algorithm are the same as for the task of finding the minimum of the Rosenbrock function. It was found that the BO algorithm performs better than the PSO algorithm when the total number of evaluations of the Rosenbrock function is in the order of a few hundred to a few thousand. In case the number of evaluations (ML trainings) is large, the PSO algorithm outperforms the BO algorithm. The capability of both algorithms to make efficient use of parallel computing resources is good. In particular, the "multi-points expected improvement" of the BO algorithm provides similar performance when running on parallel computing resources compared to executing the BO algorithm sequentially on a single machine. In case the PSO algorithm, the best performance is achieved when setting the number of particles in the swarm to 2% times the total number of function evaluations (ML trainings) and using a fixed number of 50 iterations. The BO

algorithm may add a significant computational overhead to the task of finding the optimal hyperparameter values, while for the PSO algorithm the overhead is insignificant.

This review provides some potential research directions that can help researchers further enhance the performance of Particle Swarm Optimization using Bayesian Optimization. In a nutshell, there are still rooms for improvement in PSO development to provide better performance when applied to complex high-dimensional real-world optimization problems.

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A critical review of artificial intelligence and fuzzy cognitive maps: issues, challenges, and opportunities

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Keynote paper

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Abstract

Humankind today is confronted with several challenges, threats, risks, and problems that never had faced before. Furthermore, they are global and require cross-institutional solutions. Complex dynamical systems (CDS) comprise of collections of many heterogeneous entities which interact with other entities and their environment which usually are having a lot of uncertainties, fuzziness, ambiguities, and structural complexities. The last few decades, the study of CDS represents a challenging new approach to science that investigates how relationships between parts give rise to the collective behaviors of a system and how the system interacts and forms relationships with its environment. Two different approaches are considered for addressing the above challenging problems: Artificial Intelligence (AI) and Fuzzy Cognitive Map (FCM). Artificial Intelligence (AI) has been considered a revolutionary and world-changing science. FCMs are a computational method that can examine situations in which human thinking processes involve fuzzy or uncertain descriptions. To ensure the operation of the system, FCMs embody the accumulated knowledge and experience from experts and especially from the history of the dynamic system. This enables the experts to understand how the system behaves in different circumstances. The issue of creating new knowledge is addressed by both AI and FCMs. This knowledge is extracted using linguistic variables, which are then transformed into numeric values using a defuzzification method. The importance of taking into consideration past knowledge is properly defined. A new algorithm is describing this process.

Key words: Artificial Intelligence, complex dynamic systems, fuzzy logic, fuzzy cognitive maps.

1. INTRODUCTION

Today's most physical and human-made systems are complex in nature. In addition, all of them are dynamic in their behavior. The science of complex dynamical systems (CDS) is a multidisciplinary field aiming at understanding the complex real world that surrounds us [1-4]. Examples of these systems are energy and environment, engineering, health and medical, geology, economics, business, agriculture, human brain and cognitive sciences, communications, physics, psychology, biology, transportation, sociology, philosophy, international affairs, Information and Communication Technologies (ICT) just to mention a few. Such systems are often concurrent and distributed because they must react to various kinds of events, signals, and conditions. They may be characterized by a system with uncertainties, time delay, stochastic perturbation, hybrid dynamics, distributed dynamics, and chaotic dynamics. Unlike those systems which are characterized by linear processes that can be effectively isolated from environmental influence, the external structures or boundary conditions of complex systems form an important part of the internal structure [1-2]. Two different approaches are considered for addressing the above challenging problems: Artificial Intelligence (AI) and Fuzzy Cognitive Map (FCM). Artificial Intelligence (AI), although it is still a young scientific field, has been considered a revolutionary and world-changing science. Most people have been hoping that all problems of the world will be solved by AI. The truth is that since the 1950s, different scientific fields have emerged to address all the challenges and problems of society. However, there is little interdisciplinary synergy between these different scientific approaches even within AI. It is amazing and somehow threatening that AI is behaving as the only player that can confront and solve the problems of the whole world, without taking seriously all other scientific fields. However, the problems of society cannot and have not been carefully analyzed till today. It is a common belief that not a single scientific field can provide valuable solutions. We must wisely and carefully study all problems from a holistic approach, considering all available theories, methods, and techniques. The road is long and full of obstacles. Other approaches must be considered such as fuzzy cognitive maps (FCMs).

A Fuzzy Cognitive Map (FCM) draws a causal picture to represent the model and the behavior of the system. The concepts of an FCM interact according to imprecise rules and the operations of complex systems are simulated. FCMs are symbolic representations for the description and modeling of a CDS. FCMs are a computational method that can examine situations in which human thinking processes involve fuzzy or uncertain descriptions. An FCM presents a graphical representation that describes the cause-and-effect relations between

nodes, enabling the behavior of a system to be described in a simple and symbolic way. To ensure the operation of the system, FCMs embody the accumulated knowledge and experience of experts who understand how the system behaves in different circumstances [5-6].

In this keynote paper for the first time, both AI and FCMs are considered together, and their basics are discussed. Furthermore, also for the first time, the issue of creating new knowledge is addressed by both AI and FCMs. This knowledge is extracted using linguistic variables, which are then transformed into numeric values using a defuzzification method. The importance of taking into consideration past knowledge must properly be analyzed and defined. An algorithm creating new knowledge based on FCM is presented.

This paper is structured as follows. Section 2 presents the basics of artificial intelligence (AI) while section 3 covers in more detail the basics of fuzzy cognitive maps (FCM). A short list of references is given for FCM application in a number of societal problems. Section 4 is addressing a very challenging and interesting question. How is known and truth knowledge generated? How AI and FCMs can be used for meeting the goal of creating new knowledge. Finally, section 5 provides the conclusions of the paper.

2. BASICS OF ARTIFICIAL INTELLIGENCE (AI)

2.1 Introductory remarks

Contrary to popular belief, Artificial Intelligence (AI) was not born just recently. As a matter of fact, Greek mythology is full of myths and stories that refer to the roots of AI [7]. In ancient times master craftsmen were developing intelligent beings according to myths and rumors. Aristotle (384–322 B.C.) is considered the father of AI by many people. He was the first to formulate a precise set of laws governing the rational part of the mind. "Logic is new and necessary reasoning".

The first humanoid robot in history was the ancient Greek robot, with the name, Talos [7]. Even today, the myth of the bronze giant, Talos, that was also the protector of Minoan Crete is relevant. The bronze hero symbolizes the technological advancements in metallurgy during the prehistoric Minoan period. The scientists of that period had reached a high level of technological development and created a bronze superhero to protect them. Talos was not born but was made, either by Zeus himself or Hephaestus, the god of metallurgy and iron, on Zeus's order, according to the myth [7]. In a coin found in the Minoan palace of Phaistos, Talos is portrayed as a young, naked man with wings. Talos' body was made of bronze, and he had a single vein that gave him life, starting from his neck and ending in his ankles. Instead of blood, molten metal flowed in his veins, and his ankle had a bronze nail that acted like a stopper to retain this life-giving liquid. Talos' primary job was to protect Crete from outside attacks by not allowing ships to approach the island and

hurling giant rocks at potential invaders. Talos not only protected Crete from outside enemies but also its citizens from all kinds of injustice. Taking power from the wings, Talos would tour Cretan villages four (4) times a year, carrying on his back bronze plates inscribed with divinely inspired laws to ensure their observance in the province. Another important aspect of Talos was that he was serving faithfully justice. These Talos' characteristics clearly demonstrate the importance ancient Cretans devoted to justice [7].

People keep asking: What do we mean by Artificial Intelligence (AI)? The term has never had clear boundaries [8]. Despite that AI has changed over time, the central idea remains the same. One of the main objectives, of AI, has always been to build intelligent machines capable of thinking and performing like humans. When it was introduced at a seminal 1956 workshop at Dartmouth College, it was broadly understood to mean making a machine behave in ways that would be considered intelligent like a human being. Human beings have demonstrated a unique ability to interpret the physical world around us and use the information we perceive and apprehend to influence changes [8]. Therefore, if we want to develop "intelligent machines" that can help humans to perform their everyday actions in a better and more efficient way, it makes sense to use humans as a blueprint [9-10].

The progress of AI has been impressive. Efforts to advance AI concepts over the past 50-65 years have resulted in several incredible innovations and developments. To comprehend better the several challenging issues of AI, we need to understand well the four basic AI concepts: 1) Machine Learning (ML) 2) Neural Networks (NNs) 3) Deep Learning (DL), and 4) Edge Intelligence (EI).

It is not an exaggeration to say that some believe that Deep Learning (DL) has revolutionized the world. In other words, AI people think that AI and its methods have been a revolutionary and world-changing science and will provide the world with solutions for all problems. The irony is that DL, a surrogate for neural networks (NNs), is an age-old branch of AI that has been resurrected due to several factors such as new and advanced algorithms, fast computing power, and the big data world. Nevertheless, if you want to understand better AI, this DL subfield of AI will help you do so.

DL is one of the most highly sought-after skills in AI technology [9-10]. The basic idea of DL is simple: the machine learns the features and is usually very good at decision-making (classification) versus a human manually designing the system. DL software attempts to mimic the activity in layers of neurons in the neocortex of the brain where 80% of thinking occurs [13]. Today, computer scientists can model many more layers of virtual neurons than ever before thanks to improvements in mathematical algorithms, intelligent theories, and increasing computer power [13-14]. Theories and methods of AI are provided on many books and papers are abandoned. Here are given only a few references [13-31].

2.2 Threats of Artificial Intelligence.

Despite the fantastic and remarkable AI gains so far, there is still the anguish of what AI could do in the wrong hands [32-35]. One of the biggest concerns with AI is its potential to replace human jobs. As AI systems become more sophisticated, they can perform tasks that were previously thought to require human intelligence, such as analyzing data, making predictions, and even driving vehicles. This could lead to job displacement and unemployment, particularly for workers in low-skilled jobs [33]. The interaction between machines and humans may evolve into a new paradigm that human beings are transforming into data beings. However, AI also raises concerns with regard to risks for society—from fundamental ethical considerations, through impacts on democracy, to the labor market. These risks and opportunities call for scientific policy advice based on interdisciplinary technology assessment (TA) activities [34].

In recent years Artificial Intelligence (AI) has gained much popularity, with the scientific community as well as with the public. Often, AI is ascribed many positive impacts on different social domains such as medicine, energy, and the economy. Indeed, AI has revolutionized industries such as healthcare, finance, manufacturing, and transportation, with its ability to automate and optimize processes and make predictions and decisions with speed and accuracy. On the other side, there is also growing concern about its precarious impact on society and individuals, respectively. Several opinion polls frequently query the public fear of autonomous robots and artificial intelligence, a phenomenon coming also into scholarly focus [34-35].

3. BASICS OF FUZZY COGNITIVE MAPS (FCMs)

The most interesting and challenging question of this research study is: why are Fuzzy Cognitive Maps (FCMs) useful in creating new knowledge from the big data-driven world (BDDW) and cyber-physical systems? FCMs possess valuable characteristics that can create new data and knowledge by addressing the cause-and-effect principle, which is the driving force behind most complex dynamic systems. This raises a further question: can FCMs be useful for Artificial Intelligence (AI)? Fuzzy Cognitive Maps are a combination of fuzzy logic and neural networks and were first introduced by Kosko [36] just 35 years ago. It is a relatively new scientific method for modeling complex dynamic systems (CDS) and possesses all the characteristics of such systems. A more detailed presentation of FCM is provided in [37]. FCMs are a computational method that can examine situations in which human thinking processes involve fuzzy or uncertain descriptions. An FCM presents a graphical representation that describes the cause-and-effect relations between nodes, enabling the

behavior of a system to be described in a simple and symbolic way. To ensure the operation of the system, FCMs embody the accumulated knowledge and experience of experts who understand how the system behaves in different circumstances. This knowledge is extracted using linguistic variables, which are then transformed into numeric values using a defuzzification method. In other words, FCMs recommend a modeling process consisting of an array of interconnected and interdependent nodes (variables) Ci, as well as the relationships between them (weights) W. Concepts take values in the interval [0, 1], and weights belong in the interval [-1, 1]. Figure 2 shows a representative diagram of an FCM. FCMs are effective in dealing with complex dynamic systems and can examine situations in which human thinking processes involve fuzzy or uncertain environments, using a reasoning process that can handle uncertainty and ambiguity descriptions.

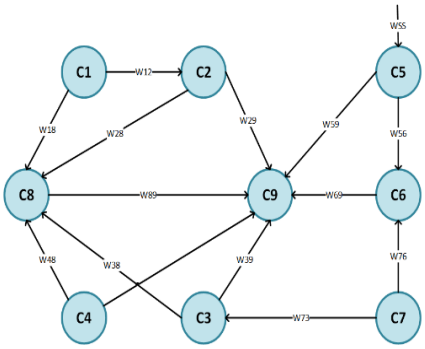

Figure 1: *A simple Fuzzy Cognitive Map (FCM)*

The full procedure of the development of a FCM follows the four steps:
Step 1: Experts select the number and the kind of concepts Ci that constitute the Fuzzy Cognitive Map
Step 2: Each expert defines the relationship between the concepts
Step 3: The experts determine the kind and the value of the relationship between the two nodes (causality)
Step 4: Experts describe the existing relationship firstly as “negative” or “positive” and
secondly, as a degree of influence using a linguistic variable, such as “low”, “medium”, “high” etc.
The sign of each weight represents the type of influence (causality and not correlation) between concepts. There are three types of interconnections between two concepts Ci and Cj:
• wij>0, an increase or decrease in Ci causes the same result in concept Cj.
• wij<0, an increase or decrease in Ci causes the opposite result in Cj.
• wij=0, there is no interaction between concepts Ci and Cj.

The degree of influence between the two concepts is indicated by the absolute value of Wij. During the simulation, the value of each concept is calculated using the following rule, equation (1):

$$A_i(k+1) = f(k_2 A_i(k) + k_1 \sum_{j=1, j\neq i}^{N} A_j(k) W_{ji}) \quad (1)$$

where N is the number of concepts, Ai(k + 1) is the value of the concept Ci at the iteration step k+1, Aj(k) is the value of the concept Cj at the iteration step k, Wji is the weight of interconnection from concept Cj to concept Ci and f is the sigmoid function. "k1" expresses the influence of the interconnected concepts on the configuration of the new value of the concept Ai and "k2" represents the proportion of the contribution of the previous value of the concept in computing the new value. The sigmoid function f is defined as equation (2):

$$f(x) = \frac{1}{1 + e^{-\lambda x}} \quad (2)$$

Where $\lambda > 0$ determines the steepness of function f. The FCM's concepts are given some initial values which are then changed depending on the weights; the way the concepts affect each other. The calculations stop when a steady state is achieved, the concepts' values become stable. A more comprehensive mathematical presentation of FCMs with application to real problems with very useful results is provided in [37-40].

The above methodology and using learning algorithms have been used to create new knowledge, [41]. This is the only mathematical model that can describe the dynamic behavior of any system, using recursive equations (eq.1) and the experience of experts with deep knowledge of the system. The experts use methods of cognitive science and fuzzy logic. This approach has been used to address difficult problems with very useful results: in energy [42-44], in health [45-49], in business and economics [50-51], in international affairs [53-55], on COVID-19 [56-59], in agriculture [60-62] and other ones. New knowledge is generated not based on statistical analysis and correlation but on causality and the past knowledge of the system been acquired by the experts. Neuroscience studies are part of causality and AI methods [80]. Results obtained in several applications using FCM theories and methods with real data and comparing with other methods of AI, DL and ML, were better by 20-25%.

Therefore, FCM theories can be used in a complimentary with AI and merge methods and algorithms to address all problems of the society and thus viable and realistic solutions can be found.

4. CREATING NEW TRUE KNOWLEDGE (NTKN) WITH AI or FCMs?

This is a very challenging and interesting question. Creating new knowledge has been part of the human evolution process since the dawn of civilization [63-65]. There are several methods for creating and discovering new knowledge. Self-created knowledge can often occur when one first discovers knowledge through personal experimentation and analysis, and later augments this understanding with existing knowledge. This understanding does not have to be completely original but can also be personally created knowledge that is broadly available. The pursuit of knowledge and discovery has always been an intrinsic human characteristic, but when new knowledge is curated and put in the right hands it has the power to bring about high-value change to society.

Before we get deeper into these issues, we need to address the terms knowledge and true knowledge. Knowledge is a form of awareness or familiarity. It is often understood as an awareness of facts, information, and skills acquired through experience or education: the theoretical or practical understanding of a subject. It may also mean familiarity with objects or situations. True knowledge is knowledge of the truth. Unlike false knowledge, which is intellectual knowledge, made up of information/concepts, linking the subject mind with the object of knowledge, the knowledge of the truth is not made up of anything. The truth is known by being, not by thinking, by processing information, because there is nothing to process, no subject-object duality in the truth. Knowledge of facts, also called propositional knowledge, is often defined as the true belief that is distinct from opinion or guesswork by virtue of justification. While there is wide agreement among philosophers that propositional knowledge is a form of true belief, many controversies in philosophy focus on justification: whether it is needed at all, how to understand it, and whether something else besides it is needed. Actually, anything related to the broad aspect of "knowledge" is directly linked to the question: what is the Theory of Knowledge (TOK)? Many believe that Theory of knowledge (TOK) is an area of philosophical speculation that plays a crucial role in all aspects and activities of our everyday life. It concentrates on the nature of knowledge and how genuine knowledge is achieved.

Till a few years ago, knowledge can be produced in many different ways. The most important source of empirical knowledge is perception, which is the usage of the senses. Many theorists also include introspection as a source of knowledge, not of external physical objects, but of one's own mental states. According to foundationalism, some of these sources are basic in the sense that they can justify beliefs without depending on other mental states. This claim is rejected by coherentists, who contend that a sufficient degree of coherence among all the mental states of the believer is necessary for knowledge. According to infinitism, an infinite chain of beliefs and data is needed.

However, lately, all these have been changed. With the arrival of artificial intelligence (AI), the TOK and creating new and/or true knowledge are having a new scientific approach. But why?

Based on a large scale of technology application scenarios, artificial intelligence (AI) is expected to have a disruptive impact on economies and societies. In recent years, breakthroughs have been made in basic research on the fundamental technologies of artificial intelligence. AI is showing greater potential to become a general-purpose technology. In the domain of technology assessment (TA), the research on AI and its potential impacts has been considered important already early.

It's becoming clearer that the next big wave of changes to how and where many of us work will be sparked by new applications of artificial intelligence. The latest wave of AI tools generally doesn't require technical skills and includes image generators, video editors, podcast audio editors, email-reply generators, word processors, computer coding assistants, research-paper summarizers, marketing copywriters, and much more. Open AI's Dall-E and ChatGPT services give you a quick sense of the power behind these tools. What makes these generative AI applications both concerning and exciting is that they can generate seemingly original content based on simple prompts from users. In other words, without speculating any further AI is capable of creating new knowledge.

It must be emphasized that all AI methods and their application to solving societal problems require an enormous amount of data. New knowledge, created by AI, will be changed when new data are added to the process. This creates a fundamental scientific question as to if and when we can trust and rely on this newly generated knowledge. In addition, all theoretical methods of AI are based on the assumption that the systems are linear and the associated correlation coefficient is sufficient to reach the desired or expected result.

In this paper for the first time, the FCM method is proposed as a scientific approach that can be trusted better than AI in creating new and true knowledge. Figure 2 is the proposed method.

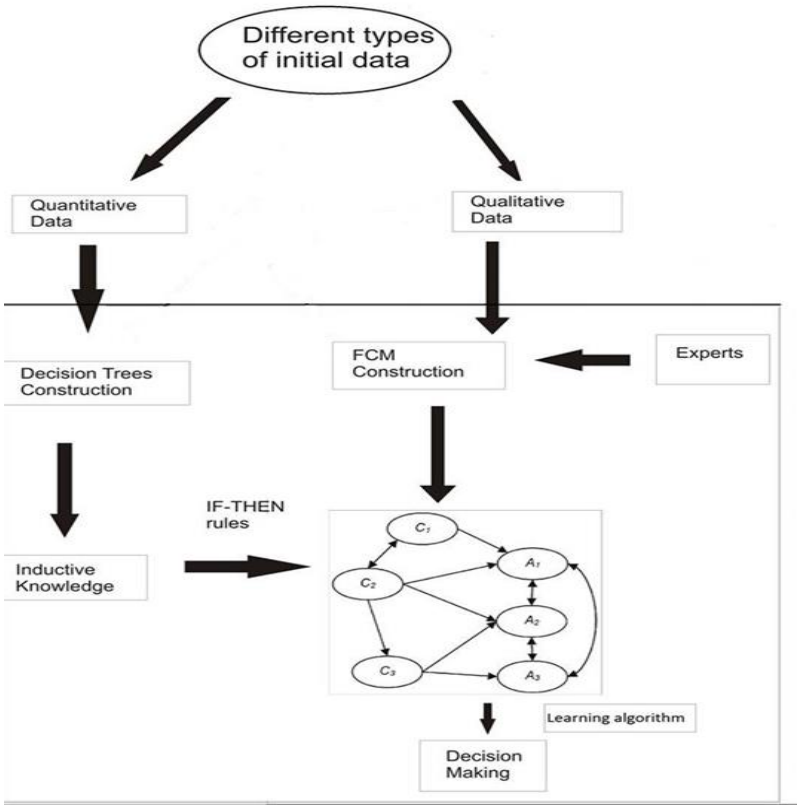

Figure 2: *A generic approach to Decision-Making system creating new knowledge*

In Figure 2 a generic approach of the Decision-Making system is provided for creating new knowledge. This is accomplished by combining Decision Trees and Fuzzy Cognitive Maps. Quantitative data: are used to induce a Decision Tree. Qualitative data (through experts' knowledge) are used to construct the FCM model. FCM's flexibility is enriched by the fuzzification of the strict decision tests. The derived FCM model (new weight setting and structure) is trained by the unsupervised NHL algorithm to achieve a decision. Finally reaching a decision provides the opportunity for creating new knowledge.

What are the advantages of this new method in generating new knowledge? Association rules derived from the decision trees have a simple and direct interpretation and are introduced in the initial FCM model to update its operation and structure. A procedure that introduces the Decision Tree rules into an FCM also specifies the weight assignment through the new cause-effect relationships among the FCM concepts. The proposed method using experts and based on causality and not in correlation utilizes much better and more efficient past data. This is not the case with AI which uses a correlation coefficient and depends heavily on the availability of large amounts of data.

This technique fares better than the best Decision Tree inductive learning technique used on any AI method. All these are several opportunities for using FCM in various everyday challenging problems. By solving them according to the proposed algorithms and Figure 2, new and true knowledge is created [66-69].

5. CONCLUSIONS

This keynote paper for the first time provides, on the same paper, a critical overview of two new and exciting scientific fields of AI and FCMs. The world today is confronted with several challenges, threats, risks, and problems that never had faced before. Furthermore, they are global and require cross-institutional solutions. Complex dynamical systems (CDS) comprise collections of many heterogeneous entities which interact with other entities and their environment which usually are having a lot of uncertainties, fuzziness, ambiguities, and structural complexities. In the last few decades, the study of CDS represents a challenge to science to investigate how relationships between parts give rise to the collective behaviors of a system and how the system interacts and forms relationships with its environment. Two different approaches are considered for addressing the above challenging problems: Artificial Intelligence (AI) and Fuzzy Cognitive Map (FCM). A short presentation of the field of Artificial Intelligence (AI) and several of its methods and applications is a good start for young researchers to pursue research in CDS. FCMs are a computational method that can examine situations in which human thinking processes involve fuzzy or uncertain descriptions. The mathematical model of an FCM is very useful for further studies. An algorithm is provided which can be used for creating new knowledge.

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A review of several famous math conjectures using Python language

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Abstract

Mathematical conjectures have been created since the beginning. It is human nature to seek beyond what has been achieved, beyond what is simple, obvious, and proven. Especially in science and more so in mathematics. There are hundreds of mathematical conjectures from ancient times to the present, covering almost all areas of mathematics. Some have been proven true, becoming theorems; some have been proven wrong, being replaced by other hypotheses or conjectures; and some others that seemed so obvious and easy have turned out to be extremely difficult to prove right or wrong, keeping the challenge alive until today. However, they are an important part of beautiful minds and a strong attraction not only for professional mathematicians, but also for amateurs and math enthusiasts, thus contributing to the enrichment of mathematics. A mathematical conjecture is a statement that has not yet been proven true or false. Mathematical conjectures arise when a pattern is observed many times, so it has a high probability of being always true. They were createdand continue to be created, often based on simple propositions, and today, it is easier with the help of computer programming. The use of programming languages, among them the Python language, has proven its usefulness by verifying old and new conjectures for larger numbers, finding and verifying new patterns and formulas, searching for counterexamples and thus rejecting the corresponding conjectures, updating and improving the present conjectures, or even creating new ones. The purpose of this article is to review some of the most popular conjectures in mathematics, especially in number theory, and, with the use of the Python programming language, to verify them for large numbers or other properties and features. Some famous conjectures to mention are Euclid's perfect number conjecture, Fermat's

number conjecture, Collatz's conjecture, Landau’s conjecture, Mersenne's prime conjecture, etc.

Key words: conjecture, mathematics, python, coding, programming.

MCDA application to evaluate urban resilience: Building frameworks and criteria on available data

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Abstract

Urban resilience has become an important guiding principle in urban development planning, replacing 'sustainability'. As an indicator of importance, scientific research is leading studies and politics about the importance and benefits of urban resilience in the economic and social development of our cities, urban centers and communities. Publications and academic research have experienced a noticeable increase, especially in recent years, thus demonstratingand analyzing the problem and proposing methods of coping with them. Today's new governance management model requires policies that mitigate risk and respond to evolving challenges. Due to rapid and rather chaotic urban transformations, especially in developing countries, as well as climate change, cities and communities will experience more frequent and more intense challenges in the coming years; therefore, disaster preparedness and management will be a serious challenge. Urban resilience is defined as the ability of communities, cities and regions to withstand natural disasters and return to a normal state as quickly as possible with minimal damage. Albania has experienced natural disasters in the recent past, causing great material and economic damage, in addition to human losses, for which there is a need to collect, read and understand the available data to analyze, conclude and prepare for the challenge of next. This article aims to provide an overview of the research carried out in relation to urban resilience in Albania, particularly in relation to floods and the use of MCDA and other assessment and ranking methods. The paper also suggests methods to use available data to build reliable frameworks and criteria to assess whether and how communities are able and prepared to withstand and survive natural disasters.

Key words: MCDA, floods, disaster, framework, criteria.

A Semigroup-based Approach to Machine Learning

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Abstract

Application of semigroup theory can be found in various areas of mathematics, and in machine learning. Some types of machine learning algorithms, such as decision trees and neural networks, can be modeled and analyzed using semigroups.In this paper we propose a new approach to collaborative filtering, using the semigroups. Collaborative filtering is a technique used in recommender systems to predict a user's interests by analyzing the preferences and behavior of other users with similar characteristics. More specifically, the paper discusses how the semigroups can be used to measure the similarity between users or items in a recommendation system. We propose two approaches of using semigroup algebraic properties to collaborative filtering: (1) representing users or items as vectors of features and combines them using the semigroup operation to calculate a similarity score, and (2) combining recommendations from multiple sources using semigroups. For the proposed approaches, we introduce a new semigroup- based collaborative filtering algorithm in terms of accuracy and efficiency of recommendations. The paper concludes that the proposed algorithm is a promising technique, offering a flexible and powerful way to analyze data in collaborative filtering systems, leading to more accurate and personalized recommendations.

Key words: machine learning algorithm, recommender system, collaborative filtering, semigroups.

Homomorphisms in weaklyΓ-rings

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Abstract

Many algebraic structures have been defined so far. One of them, is that of *Γ*-ring which was defined by Barnes, as cited in literature. Weakening some of the conditions of the definition of *Γ*-ring, Sema and Petro defined weakly *Γ*-rings. An important concept for every algebraic structure is homomorphism.In this paper, the concept of homomorphism in weakly*Γ*-ringsis introduced. Further, some simple results analogous to the theory of rings, related to this concept are extended.

Key words: Γ-semigroup, Γ-ring, weaklyΓ-ring, homomorphism.

Fuzzy Z-AHP decision support approach to detect the factors that impact the online learning

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Abstract

During the last decade the evolution of the online technologies has influenced many fields, including that of the education. The acceptance of a new technology is evaluated according the unified theory of acceptance and use of technology 2 (UTAUT2).This study aims to estimate the impact that has each of the constructs of the model UTAUT2 toward the behavioural intention of using an online learning platform.The decision making methodology proposed in this studyis fuzzy analytical hierarchic process with Z-numbers (Fuzzy Z-AHP). Fuzzy Z-AHP gives more complete, flexible and realistic results compared to other decision making methods. The data were collected through a survey of 350 samples from students of the University "AleksanderMoisiu" of Durres during 2020-2022. The study research found out that the most important construct of UTAUT2 that impacts the behavioural intention of using the online learning platform is Habit. The findings help higher education policymakers to better understand the factors that influence most the online learning.

Key words: Fuzzy Z-AHP, online learning, constructs, UTAUT2.

Comparison of block bootstrap procedures in estimating the seasonal means in a real data time series

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Abstract

Nowadays estimating parameters in periodic data has become an important issue and several methods have been studied with intention estimating different parameters or constructing confidence intervals for the parameters.
In this study we conducted a comparison of the performance of three block bootstrap procedures designed for dependent data in the case of a real data time series with periodic structure such as the series of rainfall in a region in Albania that contains data collected for a period of 40 years. We used R programming language to perform the bootstrap and to obtain the results.
From the results obtained we notice a good performance of our proposed bootstrap procedure compared with other procedures considered.

Key words: block bootstrap, periodicity, time series, parameter estimation.

An application of MCDA procedures to the location of radioactive waste deposit according to Legislative Decree

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Abstract

The procedure followed by Sogin (a company appointed by the Ministry for the location of the deposit of radioactive waste in Italy) regarding the suitability of the possible sites, has followed analytical procedures that do not find any confirmation in the scientific field of MCDA. The decisional process drawn up is clearly in contradiction with the provisions of Art.27 of Legislative Decree no.31/2010, by which the technical and socio-environmental characteristics of the areas and the potential direct benefits to involved stakeholders could be simultaneously quantified. Moreover, the structure of a decisional tree is missing and there is a remarkable mixture of factors and criteria, summarized in the irrational and schematic dichotomy of favorable and unfavorable, with a remarkable absence of weighting them. This paper, taking into account the ministerial directives of the Legislative Decree, aims to highlight how the decision could be carried out according to the procedures of the MCDA, with the quantification of the criteria in their physical, environmental, and social-economic values, in particular, regarding the seismic aspect through the introduction of specific veto thresholds, spreading the areas in more or less high eligibility bands. Especially the stakeholders, who were completely ignored in the Sogin proposal, are also taken into account, as well as the specific economic and sustainability conditions of the area, completely disregarded by Sogin. Taking into account a set of areas, as already considered eligible by Sogin, an application of MCDA procedure aims to enlighten how to point out a rational and coherent decisional process, also by an analysis of the robustness of the results as required by the directives imposed by the Legislative Decree.

Key words: Legal provisions, stakeholders, decision tree, thresholds, robustness.

New Paths Opened by $\bar{g}$ − Function in Pseudo-Analysis And Other Fields Through Several Applications

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Abstract

The extension problem for the axiomatic concepts of pseudo-arithmetic operations $\{\overline{\oplus},\overline{\odot},\overline{\ominus},\overline{\oslash}\}$ supported by $\bar{g} - Functions$ are treated in the field of Pseudo-Analysis by many authors, opening new paths for development and investigation of their role as well as for the modifying and modified functions. The $\bar{g} - Negation$ of the negation N is presented in this paper transformed by the $\bar{g} - Function$ as a general or normed generator $\bar{g} = \bar{g}_{a,r}$ in Pseudo-Analysis, where the role of the extended pseudo-arithmetic operations sistem $\{\overline{\oplus}_{\bar{g}},\overline{\odot}_{\bar{g}},\overline{\ominus}_{\bar{g}},\overline{\oslash}_{\bar{g}}\}$ is very specific and important for development of $\bar{g} - Calculus$. Further more, developing the theory of action of these special functions $(\bar{g}, f_{\bar{g}}, t_{\bar{g}}, N_{\bar{g}})$ by generalizations and modifications, we arrive at some connections of Pseudo-Analysis with other fields such as Information Theory, Geometry, Trigonometry, Elementary Algebra and other areas of pure mathematics connected with combinatorial problems. In these fields, the paper addresses several composition of some real continuous parameterized functions with other special functions, above all showing the interesting forms of their generalization and transformation created by modification thought $\bar{g} - Transform$. Some important formula and classical problems are generalized and transformed, leading us to new connections between different problems and fields.

Key words: Pseudo-Analysis, pseudo-operations, transform, $\bar{g}$ − Function, $\bar{g}$ − Negation.

Fuzzy Semigroups via Semigroups

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Abstract

The theory of fuzzy semigroups is a branch of mathematics that arose in early 90's as an effort to characterize properties of semigroups by the properties of their fuzzy subsystems which include, fuzzy subsemigroups and their alike, fuzzy one (resp. two) sided ideals, fuzzy quasi-ideals, fuzzy bi-ideals etc. To be more precise, a fuzzy subsemigroup of a given semigroup $(S, \cdot)$ is just a $\wedge$-prehomomorphism f of $(S, \cdot)$ to $([0, 1], \wedge)$. Variations of this, which correspond to the other before mentioned fuzzy subsystems, can be obtained by imposing certain properties to f. It turns out from the work of Kuroki, Mordeson, Malik and that of many of their descendants, that fuzzy subsystems play a similar role to the structure theory of semigroups that play their non fuzzy analogues.
The aim of the present paper is to show that this similarity is not coincidental. As a first step to this, we prove that there is a 1-1 correspondence between fuzzy subsemigroups of S and subsemigroups of a certain type of $S \times I$. Restricted to fuzzy one sided ideals, this correspondence identifies the above fuzzy subsystems to their analogues of $S \times I$.
Using these identifications, we prove that the characterization of the regularity of semigroups in terms of fuzzy one sided ideals and fuzzy quasi-ideals can be obtained as an implication of the corresponding non fuzzy analogue.
These results show that, although fuzzy systems are perceived as blurred versions of their standard counterparts, they are in fact as standard as everything else in the classical theory of semigroups and that at least some of the fuzzy results which we have visited in this paper, are equivalent to their non fuzzy analogues.

Key words: Fuzzy subsemigroup, fuzzy one sided ideal, fuzzy quasiideal, regular semigroup.

Some propositions about semigroups

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Abstract

Inversive semigroups constitute an important subclass of the class of semigroups. An important role in the properties of semigroups in general and in particular, is played by the set of their idempotents, which we denote by **E**. In this paper we will show some propositions related to an important subclass of the class of inverse semigroups, such as that of their normal semigroups. We will also see some properties of the maximal idempotent-separative congruence in an invertible semigroup **S** and its connection with **Clifford** semigroups.

Key words: inversive, normal, idempotent, congruence.

Intrahospital infections

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Key words: intrahospital infections, chain of infection, identification, prevention, patients, nurses.

Nosocomial infections occur all over the world and affect both developed and developing countries. Infections acquired in health care settings are among the greatest causes of death. They are an important problem for both patients and public health. A prevalence study conducted in 55 hospitals in 14 countries by the WHO has shown that 8.7% of hospitalized patients had nosocomial infections. At any given time, over 1.4 million people worldwide suffer from hospital-acquired infectious complications. The highest frequencies of nosocomial infections were reported by hospitals in the Mediterranean area - Eastern Europe and the South-Eastern Asia region (11.8 and 10%), in the European region 7.7% and in the Pacific region 9%.

The most frequent nosocomial infections are those of surgical wounds, urinary and lower respiratory tract infections. WHO studies have also shown that nosocomial infections also occur in intensive care and surgical wards. These infections are more prevalent in elderly patients as well as those with chronic diseases or those who have undergone chemotherapy.

Nosocomial infections add functional disability and emotional stress to patients and in some cases lead to reduced quality of life. Nosocomial infections are one of the main causes of death. The economic costs are considerable. Increased days of hospital stay for affected patients is the largest contributor to costs. One study showed that the overall increase in length of hospitalization for patients with infected surgical wounds was 8.2 days, ranging from 3 days for gynecological problems to 9.9 for general surgery and 19.8 for orthopedic surgery.

Prolonged stay not only increases the direct costs of patients and payers, but indirectly often leads to loss of work, increased use of medications, increases the need for isolation, and increases the cost related to the need to perform laboratory tests or diagnostic tests.

Hospital-acquired infections add to the loss of balance between the allocation of funds for primary and secondary health care by diverting funds from health promotion and prevention.

The advanced age of the hospitalized patient, the increase in the length of stay of chronic diseases among hospitalized patients, and the increased use of diagnostic and therapeutic procedures that affect the value of costs will continue to put pressure on nosocomial infections in the future. Organisms that cause nosocomial infections can be transmitted to the community by patients discharged from hospitals, health care staff and various visitors. Because microorganisms are multiresistant, they can cause significant disease in the community

Epidemiology of nosocomial infections

Studies worldwide have documented that IN are a significant cause of morbidity and mortality. A high frequency of IN is evidence of a low quality of health care delivery and leads to the elimination of unnecessary costs. There are many factors that contribute to the frequency of IN.

Depending on the region where the infection appears, these infections have special definitions (urinary, pulmonary, etc.). They are based on clinical and biological criteria and summarize 50 body parts.

IN can be considered endemic or epidemic. Endemic IN are more frequent. Epidemic infections occur during epidemics and are defined as an unusual increase above the level of a specific infection or infectious organism.

Changes in the health system have resulted in lower length of stay and increased patient care.

It has been suggested that the term IN should encompass infections that occur in patients being treated in any healthcare facility. Infections acquired by staff or visitors in hospitals or other institutions are also called IN.

Types of nosocomial infections

Urinary tract infections (UTIs)

SUTI Symptomatic urinary tract infection

ASB Asymptomatic bacteriuria

OUTI Other urinary tract infections

Surgical site infections (SSI)

SKIN Superficial area

SKNC Superficial chest area

ST Deep surgical site

STC Deep thoracic surgical site

STL Deep area in extremities or organs such as: bone, heart, ears, endometritis, etc.

Pneumonia (PNEU)

PNEU Pneumonia

Bloodstream Infection (BSI)

LCBI Laboratory confirmed bloodstream infection

CSEP Clinical sepsis

The role of hospital management

The administration and/or medical management of the hospital should lead by supporting the program towards IN. They are responsible for:

- Determination of the committee for infection control.
- Identifying the appropriate resources for the program and monitoring of infections and the application of methods to prevent IN.
- Provide education and training of all staff through support programs in infection prevention, disinfection and sterilization techniques.
- To refer the technical aspects of hospital hygiene to care staff such as nurses, hygienists, maintenance workers, clinical - microbiological laboratories.
- To periodically review the status of nosocomial infections and the effectiveness of interventions to limit them.
- Review, approve and implement rules approved in the relevant commissions.
- Ensure that the infection control team has the appropriate authority to facilitate the operation of appropriate programs.
- Participate in the investigation of epidemics.

CASE STUDY

Methodology:

Purpose:

Assessment of nursing knowledge and practices on the prevention of nosocomial infections in order to identify wrong practices and provide the necessary recommendations.

Objectives:

1. Evidence of the knowledge of the nurses of the Kruje hospital on the prevention of hospital infections based on the ward where they work

2. Evidence of the knowledge of the nurses of the Kruje hospital on the prevention of hospital infections based on work experience

3. Evidence of the knowledge of the nurses of the Kruje hospital on the prevention of hospital infections based on the educational level

4. Evidence of the practices of the nurses of the Kruje hospital on the prevention of hospital infections based on the ward where they work

5. Evidence of practices of Kruje hospital nurses on the prevention of hospital infections based on work experience

6. Evidence of the practices of the nurses of the Kruje hospital on the prevention of hospital infections based on the educational level

Hypotheses:

1. The nurses of the Kruje hospital have good knowledge on the prevention of hospital infections

2. The nurses of the Kruje hospital have good practices on the prevention of hospital infections

3. Demographic factors influence the prevention of hospital infections

Study, time and population

This was a cross-sectional study, carried out in the Kruje hospital during the period April-May 2022. In the study, 114 nurses were randomly selected from several wards (Pathology, Surgery, Emergency, Pediatrics, Infectious, Maternity). Permission was obtained from the hospital directorate.

Questionnaire and analysis:

I distributed a self-administered questionnaire to the nurses which had 28 questions. The questionnaire was selected after a careful literature review. In the beginning, the questionnaire had 39 questions, but after it was tested on 10 nurses, 11 questions were removed which were unclear to be answered by the nurses. The questionnaire had three parts.

The first part had three questions about demographic data such as ward (Pathology, Surgery, Emergency, Pediatrics, Infectious, Maternity), education (university and post-university) and work experience (Under 5 years; 5-10 years; 11-15 years; Over 15 years).

The second part had questions that would assess nursing knowledge on nosocomial infections and had 20 questions with different answers such as yes and no, multiple choices, etc.

The third part had 9 questions and assessed nursing practices. The questions had yes and no answers, multiple answers, etc.

Nurses' answers were put into tables and graphs in the SPSS program version 22, and were expressed in %.

Limitations of the study:

This study was conducted in a relatively short time and not all nurses of the hospital participated. Also, to make the study more comprehensive, nurses in other hospitals in the surrounding areas could have been included.

RESULTS

Are you aware of healthcare-associated infections in your hospital?

Table 1: *Awareness of infections*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	108	94.7	94.7	94.7
	no	6	5.3	5.3	100.0
	Total	114	100.0	100.0	

Graffic 1: *Awareness of infections*

As expected, from the information obtained from the table and graph, we see that the majority of nurses 94.7% of them are aware of healthcare-associated infections. Only 5.3% answered no.

The fact that some nurses have answered that they are not aware of these types of infections makes us curious to see how many years of experience they have at work and which ward they belong to.

Awareness of infections in relation to nurses' experience at work.

Count

	the sector where you work						
	Pathology	Surgery	Emergencies	Pediatric	Infection	Maternity	Total
Are you aware of healthcare-associated infections in your hospital? yes	14	23	21	11	27		108
no	1	0	3	2	0	12	6
Total	15	23	24	13	27	0 12	114

Which of the following hospital-acquired infections are commonly seen in your hospital?

In the following table, the nurses selected in this study were asked to identify the nosocomial infections that they think are most often observed in the hospital where they work.

They were able to choose several types of infections.

What we get information is that all infections are selected by nurses but specifically those infections that are considered more frequent for them are:

➢ Urinary tract infections (22.5%)

➢ Surgical wound infections (26.5%)

➢ Skin infections (17.7%)

Table results

Table 3: *Infections Frequencies*

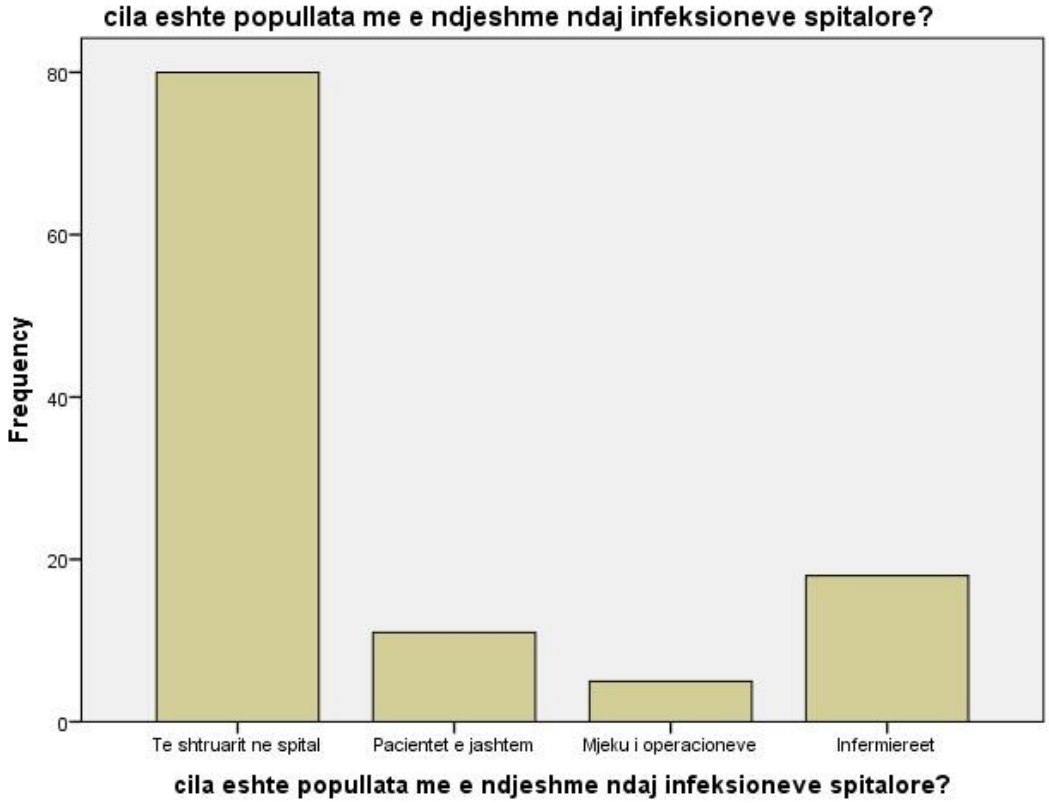
	Responses		Percent of Cases
	N	Percent	
urinary tract infections	84	22.5%	74.3%
surgical wound infections	99	26.5%	87.6%
respiratory tract infections	58	15.5%	51.3%
blood infections	43	11.5%	38.1%
gastrointestinal tract infections	23	6.2%	20.4%
skin infections	66	17.7%	58.4%
Total	373	100.0%	330.1%

Which population is most susceptible to hospital-acquired infections?

Table 4: *The most vulnerable population*

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Hospitalized	80	70.2	70.2	70.2
Outpatients	11	9.6	9.6	79.8
Surgeon	5	4.4	4.4	84.2
The nurses	18	15.8	15.8	100.0
Total	114	100.0	100.0	

Graffic 2: *The most vulnerable population*



CONCLUSIONS

Looking at the data of the study, and our hypotheses both hypotheses are accepted as follows:

➢ Nurses who have stated that they have not worked for many years are those who have expressed that they are not very aware of these infections.

➢ Infections that are considered more frequent for nurses are: Urinary tract, surgical wound and skin infections

➢ Escherichia coli for them was one of the most common pathogens that cause infections

➢ Nurses think that the population most susceptible to hospital infections are the hospitalized themselves and then the staff.

➢ Nurses in the infectious disease ward have differences in their knowledge about groups susceptible to infections

➢ Nurses do not have very good practices to protect themselves from nosocomial infections

➢ Not all of them know all the steps for hand washing even though they know that this is important for the prevention of nosocomial infections and they do not use gloves.

➢ There are deficiencies in the perception of patients as carriers of infections

➢ Nurses with fewer years of work are not aware that there are control programs on nosocomial infections

➢ The nurses do not take proper measures to protect themselves, they are splashed with blood and pierced with needles.

➢ The group of nurses of the infectious disease ward, most affirm that the hospital has management and control of infections. Nurses who claim that there is no infection control belong to the emergency ward.

RECOMMENDATIONS

➢ Nurses should participate in training to improve knowledge on nosocomial infections

➢ The steps of hand washing, the types of disinfectants and how they should be used should be reflected in the hospital premises.

➢ Nurses with more work experience should train younger nurses about the rules of prevention of nosocomial infections

➢ If there are nosocomial infection control protocols, they should be made known to new employees

➢ More detailed studies should be done in this field to better understand the factors that influence the knowledge of the nurses of the Vlora regional hospital about nosocomial infections.

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Antibiotic use in pregnancy and lactation

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Abstract

Over ten million women are either pregnant or lactating at any time. The risks of medication use for these women are unique. In addition to normal physiologic changes that alter the pharmacokinetics of drugs, there is the concern of possible teratogenic and toxic effects on the developing fetus and newborn. This article reviews the risks and pharmacokinetic considerations for 11 broad-spectrum antibiotics that can be used to treat routine and life-threatening infections during pregnancy and lactation.The purpose of this study is to highlight the latest recommendations regarding the toxic side effects of antibiotics during pregnancy and lactation.Health care professionals should consider the teratogenic and toxic risk profiles of antibiotics to assist in making prescribing decisions for pregnant and lactating women. These may become especially important if anti-infective countermeasures are required to protect the health, safety, and survival of individuals exposed to pathogenic bacteriologic.

*Key words***:** antibiotic,teratogenic,toxic effects, pharmacokinetics.

Establishment of an automatic radiation monitoring station in Durrës

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Abstract

An automatic radiation monitoring station assesses in real time the level of ambient radioactivity and provides an immediate warning if there is a significant increase of ambient radiation above its natural background values. This information is relevant for official authorities for early intervention in the case of a radiological or nuclear emergency.
The National Automatic Radiation Monitoring Network (NARMN) was established for the first time in 2005 and in 2021 it was updated completely with new equipment and the number of monitoring stations distributed across the country was increased from five to eight. The operation centre of NARMN is at Institute of Applied Nuclear Physics in Tirana. In the frame of updating the NARMN, for the first time in Durrës was installed an automatic radiation monitoring station placed on the roof of Durrës University 'A. Moisiu'. In this work the establishment of Durrës automatic radiation monitoring station, including design, installation and its operation integrated in NARMN, is reported. The result of this work shows that in Durrës region, for the first time, an automatic, sensitive and reliable radiation monitoring station is successfully established. This monitoring station measures the level of ambient radioactivity under normal circumstances. In the case of abnormal values detected, the station provides an automatic early warning to NARMN and can provide data during all stages of radiological emergency, thus contributing both in the region and in national radiation protection.

Key words: ambient radioactivity, monitoring station, radiation protection, radiological emergencies.

1. INTRODUCTION

People and environment have been continually exposed to natural ionizing radiation due to cosmic and terrestrial sources. As a result of development of nuclear applications in wide human activities, the artificial (man-made) sources of ionizing radiation are added to the natural radioactivity, defining the ambient radioactivity. Mismanagement of man-made sources of ionizing radiation may lead to incidents and disasters with persistent consequences on the human and environment locally as well as internationally and the victims may be also from future generations. The severe Chernobyl nuclear accident of 1986 have given rise globally to the need of automatic radiation monitoring networks in order to monitor in real time the ambient radiation and to provide an immediate warning if there is a significant increase of ambient radiation above its natural background values. This information is relevant for official authorities for early intervention to minimize the effect of radiation emergencies on people and in environment. Based on the classification of the International Atomic Energy Agency (IAEA), a radiation emergency is due to a radiologic accident within a country or abroad (e.g accidents with radioactive source in medical or industrial applications, in radioactive sources transportation), from a nuclear accident in a power plant (e.g nuclear accident of Fukushima on 2011) or from a terrorist attack (‘dirty bomb’) [1].

The National Automatic Radiation Monitoring Network (NARMN) was established for the first time in 2005 consisting of five stations distributed in the cities of: Kukës, Shkodër, Tiranë, Korçë and Vlorë. During 2017 - 2021, it has been upgraded by a National Project of the Institute of Applied Nuclear Physics with support of the IAEA. Through this project all the equipment of NARMN is renewed and there are added three more stations completely new in the cities of: Durrës, Elbasan and Gjirokastër. NARMN is object of the Regulation 'On the Preparation and Response in Case of Radiological Emergency for the Protection of Employees and the Public' and the data from this network are reported to the state authorities as well as IAEA [2].

The main aim of this paper is to describe the establishment of Durrës automatic radiation monitoring station including the design, installation, measurements, data analysis and its operation integrated in NARMN. Moreover, this study determined the baseline data based on the dose rate values of gamma radiation that have begun to be measured by the station of Durrës. Finally, a conservative estimate for the annual dose of ambient radiation received by the population of Durrës Region was made and it was compared with the national and international legal safety norm of for the public [3].

2. MATERIALS AND METHODS

2.1. The National Automatic Radiation Monitoring Network

NARM consist of eight monitoring stations distributed throughout the country and the central radioactivity monitoring station is in the Department of Radiation Protection and Monitoring Networks at Institute of Applied Nuclear Physics (IANP). All monitoring stations are equipped with new detectors that automatically measure ambient radioactivity. The number and distribution of radioactivity monitoring stations in our country was planned considering the geographical position of the nuclear power plants closest to the borders of Albania, population distribution, land use, ports and industrial centres as places with the greater potential for radiological accidents [4]. All monitoring stations collect locally the data from the measurements and transmit them via Internet to the server computer of the central station of NARM at Institute of Applied Nuclear Physics. The Network Monitoring Centre (NMC) ENVINET GmbH program, installed on the server, manages all the measurement data sent by all monitoring stations. In case the measured dose rate exceeds the set limit values, NMC automatically activates a written alarm. Moreover, this program performs some other basic functions such as station administration and graphical or tabular presentation of data. The NMC program has manual and automatic monitoring data export options including option to export data to the radiological monitoring data exchange network EURDEP of European Commission and data transmission to The International Radiation Monitoring Information System (IRMIS) of IAEA.

2.2. Radiation monitoring station installed in Durrës Region

The radiation monitoring station in the Region of Durrës was chosen as part of the NARM by taking mostly in consideration Durrës port as the most important in the country, the high number of populations of Durrës Region, industrial development, the risk of radioactive contamination from the nearest nuclear power plants, the risk of radioactive contamination in agriculture and livestock [4].

The dose rate of ambient gamma radiation is the physical quantity that NARM detectors measures. The detector of the Durrës radiation monitoring station (as well as all the detector of NARM), is MIRA type produced by ENVINET GmbH (Germany). In the MIRA detector two GM (Geiger-Muller) counters that measure respectively the rate of low doses (LD) and high doses (HD), are mounted. Both GM counters can measure automatically the radiation dose rate in the range from 10nSv/hour to 10Sv/hour. The stations are supplied with mains electricity and have an integrated battery as part of the MIRA ENVINET GmbH detector. This detector, as other NARM detectors, has an integrated data recording device which enables data storage and communication with the

central unit. The detector has an internal memory in case of sudden interruption of the measurement data transfer to the central station at NARM. In the event of a power cut-off, the detector is powered by its integrated battery. The MIRA detector architecture installed in Durrës station is represented in Figure 1.

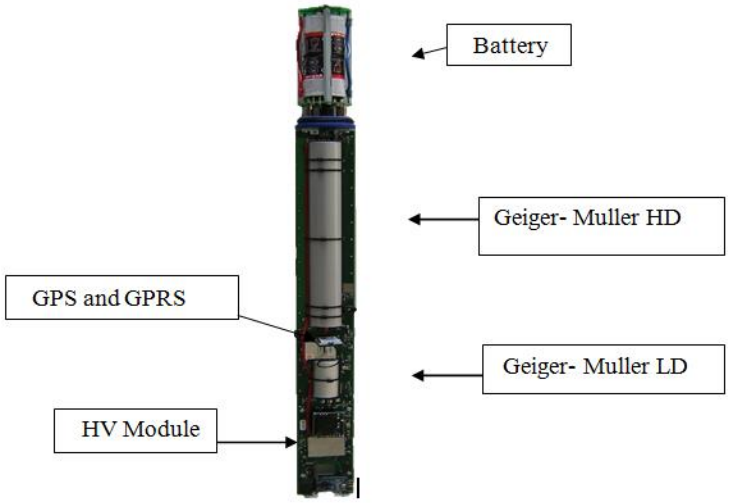

Figure 1: *The MIRA detector architecture installed in Durrës Region*

The radiation monitoring station for the Durrës Region, was installed on the roof of the University 'A. Moisiu' on January 17, 2020, by the group of IANP and ENVINET specialists in cooperation with the University 'A. Moisiu' specialists.

A view of the monitoring station with its main parts, installed on the roof of the University 'A. Moisiu' in Durrës in Figure 2 is reported. Since the detector is installed in the open environment, it operates in the temperature range -40^0 C to $+60^0$ C.

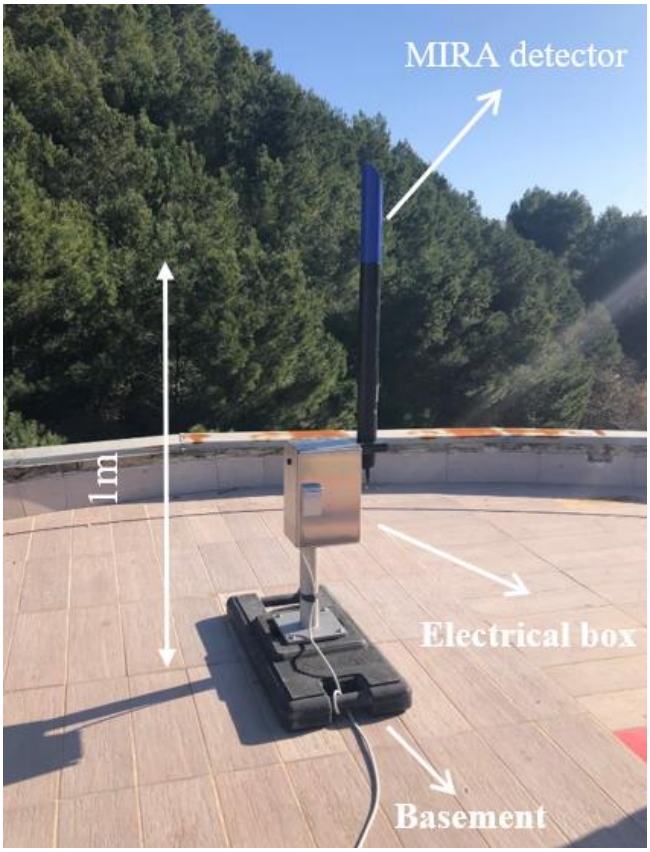

Figure 2: *A view of the monitoring station installed on the University 'A. Moisiu', Durrës*

2.3. Data analysis

The measurement values of gamma dose rate sent automatically from the radiation monitoring station of Durrës station to the central station of the NARM can be presented in graphical and tabular forms through the NMC program. The Normal Mode is set for monitoring the normal ambient radioactivity, where the measurement interval of detector is 1 hour. The option Intensive Mode with the measurement interval of 10 min is set automatically from NMC in case of triple the mean of normal value of dose rate, typical for a radiological or nuclear emergency [5]. For the study of a particular situation the interval of measurement time can be set even 1 min. For further processing and analysis, the dose rate values measured from the Durrës station were manually exported from NMC program in Excel format in the form of tables. The quality of data before calculations is checked for any artefact. The baseline data for ambient gamma radiation dose rates in Durrës are calculated based on the dose rate values of gamma radiation that have begun to be measured by the

station of Durrës the first year after this station is installed. The conservative estimation for the annual dose of ambient radiation received by the population of Durrës is based on dose rate values of gamma radiation measured by this station and was compared with the national and international legal safety norm of 1mSv per year for the public [2]. The data from radiation monitoring of Durrës station are also compared to natural background values at the national scale.

3. RESULTS AND DISCUSSIONS

A typical example of ambient gamma radiation dose rate value on Normal Mode measured by the Durrës station, presented graphically by the NMC program, in Figure 3 is reported. During all the time of ambient radiation monitoring in Durrës Region there were not detected any radiological anomaly, thus the Intensive Mode were not activated. The variability of gamma dose rate values observed in Durrës Region is normal and is due to several factors such as: statistical nature of radioactivity, Radon concentration in air, precipitation, snow coverage [6].

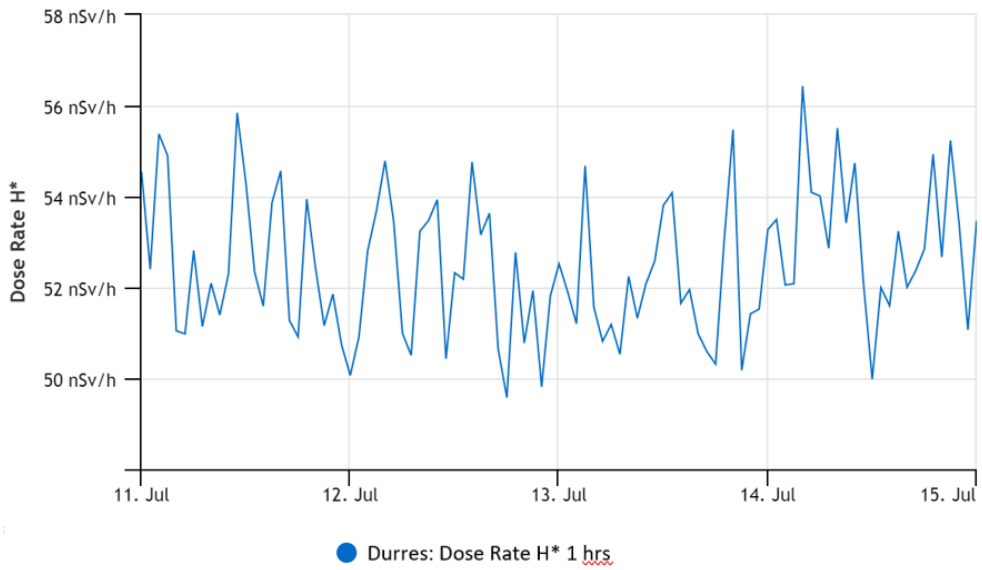

Figure 3: *Example of environmental gamma radiation dose rate values on Normal Mode measured by the Durrës station. The measurement period is one hour.*

Based on the values of gamma dose rate received from Durrës station during the first year after its installation, monthly average gamma radiation dose rates and their standard deviation were calculated for the first year after station installations and are reported in Table 1. The results of Table 1 can be used as baseline data for future ambient radiation monitoring in Durres Region.

The annual maxima gamma dose is used as practical conservative estimation to assess the risk to public and environment to external ionizing radiation [7]. In the case of Durrës Region annual maxima gamma dose rate is lower than the value of the dose rate limit for the general population of 1 mSv/year. This is evidence that the annual dose received from the population of Durrës Region is within the safety regulations and it is due to natural radioactivity.
Comparing the gamma dose rate levels measured by the Durrës station with the natural background values at other stations of NARM it results that they are of the same order of magnitude at national level [8,9].

Table 1: *Monthly ambient average gamma radiation dose rates for 2020*

	January	February	March	April	May	June	July	August	September	October	November	December
Dose rate (nSv/h)	63.86	65.80	66.46	66.68	66.01	65.97	66.65	66.85	67.29	66.60	66.42	67.68
Standard Deviation (nSv/h)	1.23	2.96	2.67	2.80	4.12	2.55	2.17	2.21	2.77	4.66	1.90	3.90

4. CONCLUSIONS

This paper shows that for the first time in Durrës Region, an ambient radiation monitoring station is installed in Durrës Region, in the frame of the National Project for upgrading the NARMN in Albania. The aim of this ambient radiation monitoring station, installed at the University 'A. Moisiu' roof, is to protect the public and the environment of Durrës Region from ionizing radiation. This station supervises in real time the ambient radiation situation inside the Durrës Region in Normal Mode. In case of a significant increase of ambient radiation level the station automatically will operate in Intensive Mode. The gamma dose rate measurements of Durrës station are automatically transferred to the national centre of NARM at IFBZ in Tirana. Particularly, in case of any radiological or nuclear emergencies an early notification goes to national authorities.
This study demonstrates that the Durrës Region is characterized by a normal ambient radiation that corresponds to the normal national values. This study ensures that the annual dose received from the population of Durrës Region is within the safety regulations and it is due to natural radioactivity. Moreover the present study provides essential baseline data for future studies on ambient radiation monitoring in Durrës Region.
This station, as part of NARMN, is providing data for radiation protection at the Region level as well as the national and international level.

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The air quality and some of the polluting components in Durrës, Albania

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Abstract

The air contains nitrogen, oxygen, argon, carbon dioxide and small quantities of other gases. The air can never be totally pure because of pollutants like particulate matter (PM), ozone (O_3), nitrogen dioxide (NO_2) and sulphur dioxide (SO_2).
Particulate matter are fraction of particles with an aerodynamic diameter smaller than 10 μm (PM10) and 2.5 μm (PM2.5), that originates from natural sources and anthropogenic emissions. Nitrogen dioxide (NO2) is a ubiquitous atmospheric pollutant due to the widespread prevalence of both natural and anthropogenic sources, and it can be a respiratory irritant when inhaled at elevated concentrations. CO_2 is primarily a by-product of human metabolism and is constantly being emitted into the indoor environment by building occupants. CO_2 may come from combustion sources as well. CO is produced by incomplete combustion of carbonaceous fuels such as wood, petrol, coal, natural gas and kerosene.

Keywords: air pollution, particulate matter, NO_2, CO_2, CO.

1. INTRODUCTION

Air pollution is a major cause of death and disease globally. The health effects range from increased hospital admissions and emergency room visits, to increased risk of premature death. An estimated 4.2 million premature deaths globally are linked to ambient air pollution, mainly from heart disease, stroke, chronic obstructive pulmonary disease, lung cancer, and acute respiratory infections in children.[6] Air pollution directly affects the quality of life and public health in our cities. The issue of urban air quality, in particular particulate matter (PM) concentration is receiving more attention as an increasing share of the world's population lives in urban centers.[7] Fine PM

carries unexpectedly high numbers of microorganisms, some of which might be pathogens or opportunistic pathogens that cause respiratory diseases[1]. Growing evidence suggests that environmentally relevant elevations in CO_2 may pose direct risks for human health. Increasing atmospheric CO_2 concentrations could make adverse exposures more frequent and prolonged through increases in indoor air concentrations and increased time spent indoors.[5] NO_2 is mainly emitted (as NO_x) from combustion in vehicles and power plants. It is a marker for traffic emissions and has high within-urban variability.[2] Evidence suggested that NO_2 affect people's health, including respiratory function, hospital admission, and premature death.[3] Motor vehicles and industries are recognized as main sources for atmospheric CO pollution in urban areas[8]. Acute effects are due to the formation of carboxyhemoglobin in the blood, which inhibits oxygen intake. It cause fatigue in healthy people and chest pain in people with heart disease, impaired vision and coordination; headaches; dizziness; confusion; nausea. It can also cause flu-like symptoms that clear up after leaving home. At very high concentrations, CO exposure can be fatal[4].

2. MATERIALS AND METHODS

The monitoring of the polluting elements has been done in 12 areas of Durres and in each area they were measured at 10-14 different points. The monitoring was made during dry climate conditions, with wind speeds less than 5 m / s. The monitoring was made at least 75% of the set time during the day (06.00 to 22.00) and night (22.00 to 06.00). Monitoring is performed from 5 to 7 hours, in a certain time of day and night. A sensor-based device called "aeroqual" was used to measure the level of these elements in the air. This device can collect real-time information about the surrounding air. It is a flexible air quality monitoring solution that can be configured with 27 different gas sensors and particle sensors for a variety of uses in environmental monitoring. It was held carefully, at a height of 1.5m above the ground level. The equipment is properly calibrated, both before and after measuring the level of CO_2 and NO_2 in the air, according to national standards.

3. RESULTS

The standard of PM2.5 in the EU is 0.025 mg / m3, while in Albania it is 0.06 mg / m3. Only 3 out of the 12 areas we have studied have points where PM2.5 values are higher than the Albanian standards. But, if we refer the average values of PM2.5 measured in each area, it has resulted that in all areas taken in the study the average of PM2.5 values taken were within the Albanian standards, but in 10 out of the 12 areas it resulted that PM2.5 values in the air is above the EU standards. The study shows that in Durres the values of PM2.5

in the air is at an average value within the Albanian standard, which is 0.06 mg / m3, but higher in comparison to the EU standard, which is 0.025 mg / m3. The standard of CO_2 is 0-350 ppm. If the value of CO_2 is 350-1000 ppm the city is considered with high traffic, but it is not considered a big problem. If the CO_2 value is more than 1000 ppm it is considered as a problem for the air pollution. All of the 12 areas we have studied had CO_2 values between 350 to 1000 ppm. So we can say that the level of CO_2 in Durres is high, but it is normal for cities with high circulation. So it is not considered a big problem for the air pollution. The study shows that in Durres the values of CO_2 in the air is between 350 to 1000 ppm. So we can say that the level of CO_2 in Durres is high, but it is normal for cities with high circulation. So it is not considered a big problem for the air pollution. The EU standard of NO_2 is 0.04 mg / m3, while in Albania it is 0.06 mg / m3. All the 12 areas we have studied have points where NO_2 values are higher than the Albanian standards. If we refer the average values of NO_2 measured in each area, it has resulted that only in 3 areas taken in the study the average of NO_2values taken were within the Albanian standards. If we refer to EU standards we see that all the 12 areas we have studied have points where NO_2 values are higher than the EU standards and only one area has the NO_2 average value which is within the EU standard. The standard of CO in the EU is 10 mg / m3, while in Albania it is 2 mg / m3. All of the 12 areas we have studied had CO values within the EU standards, but in all areas we have taken values of CO higher than the Albanian standards. If we refer to the average values of CO in all of the 12 areas we can say that this value is within the Albanian and EU standards. The study shows that in Durres the values of CO in the air is at an average value within the Albanian standard, which is 2mg / m3, and also within the EU standard, which is 10 mg / m3.

4. RECOMMENDATION

The priority remains the fulfillment of the legal requirements of the EU, including the standart values of the determining components of the air quality.
Monitoring air pollution from various sources as stationary sources, vehicles etc
Taking measures to eliminate the causes of exceeding the permitted rates for various pollution agents, for the protection of human health and the environment
Prohibition in certain areas for vehicles for a certain period of time
Prohibition of vehicle movement one day a week for a certain area of the city
Improvement of public transport, since the bus fleet has relatively old vehicles.

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The percentange depth dose curves of 6 MV radiation beam

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Abstract

One of the methods of treating tumors is also through radiotherapy. In the treatment of tumors through radiotherapy are used accelerators which provide radiation beams with different energies. In the treatment of tumors with radiotherapy, electronic beam can be used for tumors that are located on the surface of the human body up to a depth of 7 cm or photonic beam for tumors that are located in different organs. The treatment of tumors using the radiotherapy provided by accelerators, it is also known as external beam radiotherapy. It is very important to have a homogeneous distribution of radiation dose, so we done some measurements in water phantom for different depth. Our purpose is to present the results of measurements for radiation dose distribution in different depth of water phantom and these result will use to create the treatment plan. In our case we have used 6 MV energy beam to provide some curves for radiation dose distribution and we will estimate these results in different depth. The percentage depth dose curves gave us an information about dose distribution in every mm according to a plan for a fixed depth. So basing on these curves we estimated the dose distribution and studied how curves changed with the depth.

Key words: Dose, plan, depth, radiation, curve.

1. INTRODUCTION

The cell proliferation is a process that takes place through the cell cycle. Normally there is a balance between cell proliferation and death, when mutations that occur in DNA interrupt this process resulting in the birth of tumors. The spread of tumor diseases has led to the need to develop different methods for treating tumors. One of the methods of treating tumors is also through radiotherapy. In the treatment of tumors through radiotherapy are used

accelerators which provide radiation beams with different energies. In the treatment of tumors with radiotherapy, electronic beam can be used for tumors that are located on the surface of the human body up to a depth of 7 cm or photonic beam for tumors that are located in different organs. The treatment of tumors using the radiotherapy provided by accelerators, it is also known as external beam radiotherapy, where the patient is placed at a certain distance from the accelerator head or radiation source as it is otherwise called. In external beam radiotherapy, it is very important to know the characteristics of the beam of radiation that will be used in the treatment of a certain tumor or tumor mass. The human body has nearly 10^{13} cells. Each somatic cell contains 23 pairs of chromosomes. Each cell contains a nucleus that houses these chromosomes. The total chromosomal content of a cell involves approximately 10^5 genes in a specialized macromolecule of deoxyribonucleic acid (DNA). A number of direct and indirect radiation interaction pathways can produce damage to the DNA of irradiated cells [1].

1.1.Phantom and ionization chamber

Percent dose depth (PDD) profile was generated using the water phantom. At this point, 30 film pieces were set aside in three groups of ten segments each. Each film group was positioned, affixed in depth on the ten horizontal brackets inside the water phantom. A rectangular radiation field of 10x10 cm was standardized [2]. The water phantom is a device which filled with water in 1 m^3 volume, on it are set some accessories such as detector, ionization chamber and moving system of detector.

Figure 1: *Water phantom*

Ionization chambers are used in radiotherapy and in diagnostic radiology for the determination of radiation dose. Cylindrical chambers are produced by various manufacturers, with active volumes between 0.1 and 1 cm3 . They typically have an internal length no greater than 25 mm and an internal diameter no greater than 7 mm. The wall material is of low atomic number Z, with the thickness less than 0.1 g/cm2 [3]. The figure 2 below show cylindric ionization chamber, which used in dosimetry.

Figure 2: *Cylindric ionization chamber*

In parallel plate chambers, the electrode separation is of the order of 1 cm and the electrodes are parallel to each other and to the entrance window. In cylindrical and spherical shape chambers, the central electrode stands at the geometrical centre of the cavity, while the wall of the chamber is coated by a conductive material which is often at ground potential (ground electrode).

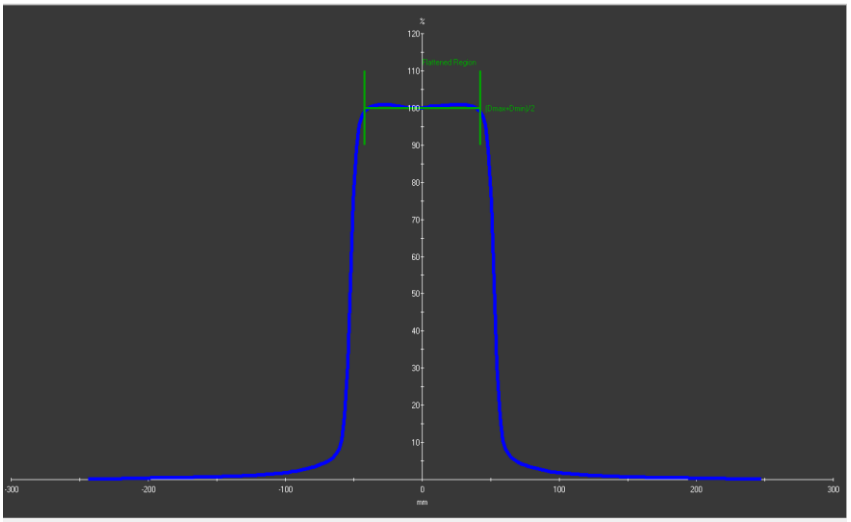
2. MATERIALS AND METHODS

The radiotherapy is very important in treatment of tumors in different parts of human body. The treatment of a tumour requires accuracy and full infomation about radiation dose that have to gives the tumoral mass. In our case we have used a radiation beam with 6 MV energy which provided by head of accelerator. In 100 cm distance by head of accelerator we have put the water phantom which is filled with water until in a certain level. The accelerator is Elekta synergy platform type which work with external radiation beam. So we put the accelerator in work state and select to use the radiation beam with 6 MVenergy and fill the water phantom with water, after that we put the water phantom on holder of accelerator in 100 cm distance by accelerator head. We have used two ionazition chambers, reference ionization chamber and another which is connected with an electrometer so sent the data in a computer soft. The detector measures the dose distribution according a plan in different depths producing the dose curves. The values of radiation dose are taken for every mm dictance and the field size of radiation beam is 10 cm x 10 cm.

3. RESULTS AND DISCUSSIONS

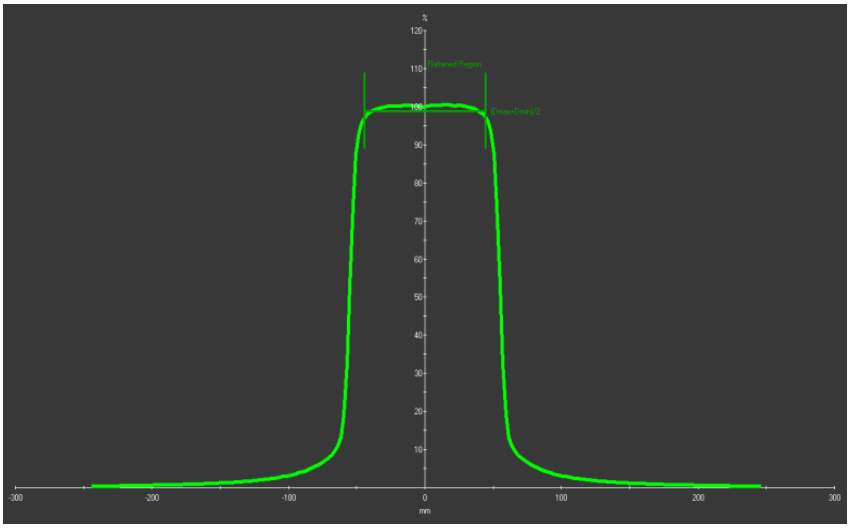
In below graphs are presented the percentange depth dose curves for three different depth respectively 5 cm, 10 cm and 20 cm. The results shown dose distribution in a certain depth for 6 MV energy beam.

Graph 1: *The dose curve in 5cm depth*

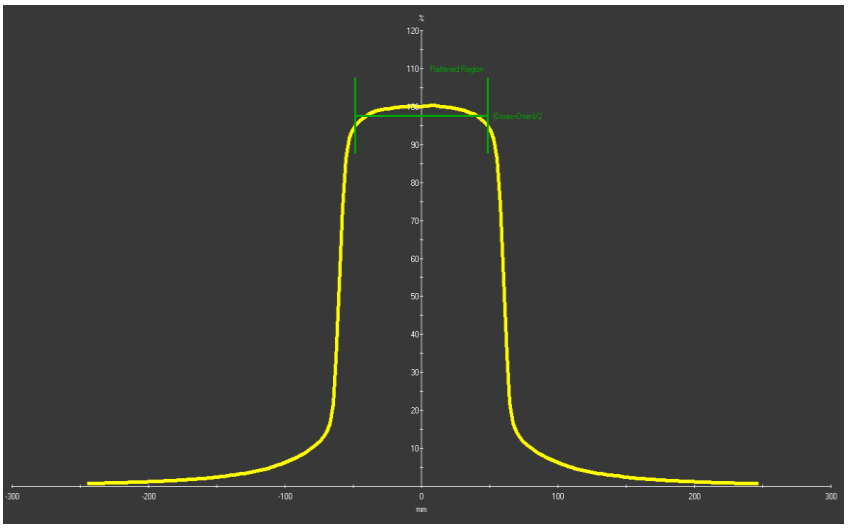


In future we have plans to study the percentange depth dose curves for several different energy beams to provide a comprehensive information about distribution dose, which will help us to create treatment plans.

Graph 2: *The dose curve in 10 cm depth*



Graph 3: *The dose curve in 20 cm depth*



4. CONCLUSIONS

The values of percentange depth dose curves shown in our case for 6 MV energy beam that, if we increase values of depth the dose distribution change. The dose distribution varies with depth so we can to determine the optimal dose distribution referring to curves and used it in treatment plan for a tumour that is in the same depth. The dose values on the edges of field size are low and increase fast inside of size field. We noticed that for low energy beam we have high values of dose distribution in a shallow depth of water phantom.

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Community Perception Towards, Economic and Social Development of Devoll Municipality

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Abstract

The interest and the perception of the community in social-economic development have great importance. Their perceptions are related to the information they provide about employment, economic income, physical infrastructure, migration, investment, and social services offered in the area. The situation identified by people who live in local areas, especially the problems they face encourages the local authorities to undertake better policies in favor of increasing their well-being. Devoll Municipality is located in the Southeastern part of Albania, on the border with Greece, it is at the intersection of important commercial and cultural routes. The municipal territory includes both urban and rural areas rich in natural and cultural resources.
This paper investigates the perception of the community towards the current social-economic situation in the municipality area, analyzing some problems and providing some opportunities for development in the future. The research methodology combines explored academic literature and quantitative and qualitative data provided by the survey. A number of 150 questionnaire surveys were distributed to the affected urban and rural people. The findings show many problems identified that require further improvement through the implementation of the local government policies for better development of the municipality in the future.

Key words: Local area, community perception, social-economic development, natural and cultural resources.

1. INTRODUCTION

Recently, a number of studies are focused in the social-economic development in local areas. The meaning of development is to increase people's ability to live the lives they choose. Economic development is not just economic growth, however important that is. It is an important means by which people try to increase their well-being. To be developmental, it must be inclusive, providing support and opportunities to those who are typically marginalized, especially women, youth, indigenous people, ethnic minorities, and people with disabilities [1]. Meanwhile, all activities of human society are closely related to each other. Policymakers and researchers have long recognized that economic development cannot happen without social change [2]. Social development in a certain country depends on the level of its economic development. According to the researchers, socio-economic elements play a vital role in enhancing community development. The community is considered the key and fundamental unit of economic and social development [3]. Community perception is decision making is often emphasizes and considered as a precondition for the acquisition of benefits particularly in West context [4].

The perception of the community on social and economic developments has an important role in the identification of various problems, but also in the design of development policies. This study uses several terms such as "local community", which means the people living in the Devolli Municipality. "Perception" is described as knowledge and awareness of the local residents to interpret socio-economic conditions and problems". “Attitudes" can be described as choices of the local community on the side, which can be supportive, neutral, and conflicting depending on the situation and the problem, participation" is described as the ability and behavior of the local community towards involvement in a management activity directly or indirectly [5].

The aim of this paper is to identify the perceptions of a local community (Devoll Municipality) about social-economic development in their living area. The strategy of the development of Devoll municipality points to the fact that the level of social-economic development of the municipality is improved [6]. However, there are not many research studies to measure the real indicators of development and their impact on the life of the community.

2. MATERIALS AND METHODS

The research is based on both quantitative and qualitative methodologies to investigate the community’s perceptions through the literature review, fieldwork, and survey questionnaires. The major method used to collect data and information was the survey. Surveys are particularly useful to study the perceptions of communities in local development. To achieve the aim of the

study a structured questionnaire with 22 questions was created in Google Forms and was completed by 150 residents of different administrative units of this municipality during March-April 2023. The questionnaire designed for the article was organized in three section, where the first section were 5 questions about the general information of the population (Age, gender, education, family size, employment),the second section were questions about the personal socio-economic situation (6 questions) and in the third section focused in socio-economic situation of Devoll Municipality (11 questions).The collection and processing of data have highlighted the features, commonalities, and problems faced by residents.

Devoll municipality is a part of the Korca region. It is located in the southeastern part of Albania and has an area of 453 43 km^2 [6]. The municipality of Devoll in the Northeast, East, Southeast, and South has international borders with the Republic of Greece, while in national borders by the municipality of Kolonja (SW), Korça Municipality (W), Maliq Municipality (W) and the municipality of Pustec (NW, N). The very favorable geographical position has influenced the movement of people, products, and capital. Important trade routes have passed through the territory of Devoll, such as the roads to Castoria, Florina, and Thessaloniki and up to Constantinople [7].

According to the administrative division of 2015, a new reorganization of the administrative division was made, according to which Devoll Municipality is part of the Korça District, which includes 6 municipalities. The city of Bilishti is the administrative center of this municipality and the only urban area.

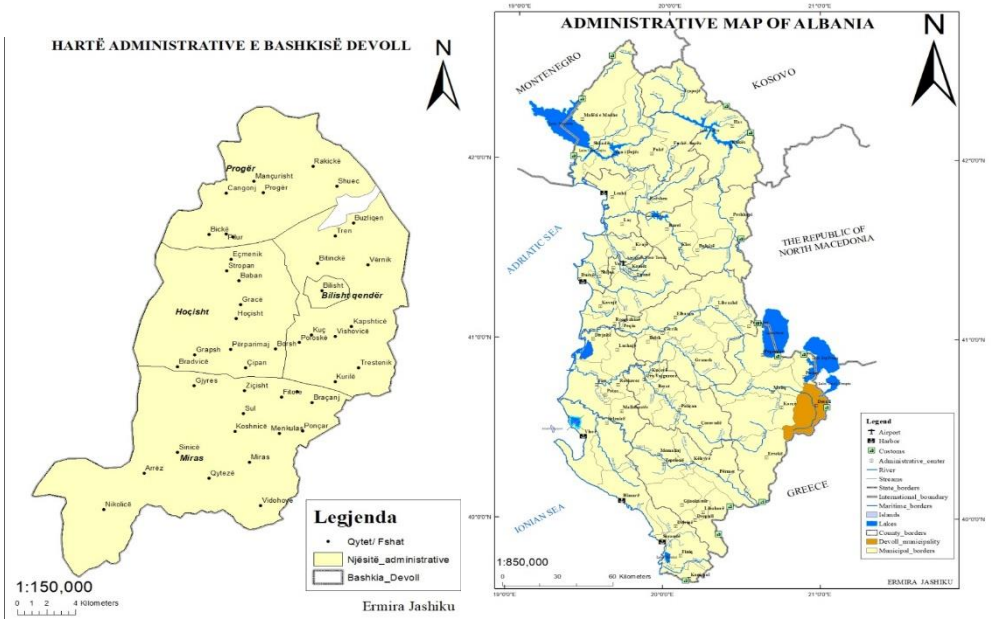


Figure 1: *The geographical position of Devolli Municipality, in Albania country.*

It is surrounded by five rural administrative units with 44 villages; Bilisht Center (with 10 settlements); Hoçishti (with 10 settlements); Progër (with 8 settlements) and Miras (with 16 settlements) (Figure 1). Settlements are generally built around hills, which has best preserved the fund of arable land. The territory of the municipality is composed in 5 administrative units and villages as it is shown below in tab.1.

Table 1: *Administrative Units, Devoll Municipality*

Bilisht Centre Administrative Unit	**Villages:** Bitinckë, Tren, Buzliqen, Vërnik, Vishocicë, Kuç, Poloskë, Kapshticë, Trestenik, Kurilë.
Progër	**Villages:** Progër, Mançurisht, Cangonj, Pilur, Vranisht, Bickë, Rakickë, Shyec
Hoçisht	**Villages:** Hoçisht, Gracë, Baban, Stropan, Eçmenik, Përparimaj, Grapsh, Çipan, Borsh, Bradvicë.
Miras	**Villages:** Miras, Vidohovë, Arrzë, Çetë, Qytezë, Sinicë, Nikolicë, Merkulas, Ponçarë, Braçanj, Koshnicë, Dobranj, Fitore, Ziçisht, Gjyres, Sul.

Based on the geographical regionalization of Albania, the territory of this municipality lies in the South unit of the Central Mountain Province, exactly in the SE pits of Albania (Figure 2) [8], [9]. Some of the physical-geographical units of this area are: the pit of Devolli, the pit of Small Prespa, the Upper Devolli Valley, the Morava Mountains, and Llapisht Mountains etc [10]. Water resources in this municipality include the river Devolli and its tributaries; there are fecundated and other water objects such as the lake of Small Prespa, The water sources of Progër, the water sources of Mancurisht and Progri [8], [11]. The climate of the territory of the municipality of Devolli is sub-mountainous SE Mediterranean. January is the coldest month with an average temperature of around 4^0 C, while the warmest is July with 21.6^0 C. During the year, rainfall prevails, while in winter snowfall is common. The average annual temperature is 10.6°C. [8], [9]. Fertile lands, water resources and dense forests have made Devolli populated since early times. The main evidence is Train Cave, one of the Middle Neolithic settlements. [12]; [13]. Devolli has a various number of objects of natural and cultural heritage. Some of the protected areas in this municipality are: The southern part of the Prespa National Park, Managed Nature Reserve, Cangonji, Nikolica Protected Landscape; [14]; [15] [16] and other protected area of the city of Bilishti. Natural monuments such as: Train Cave, Gurët Mumje, Guri i Cjapit, Burimet e Progri, 5 biomonuments such as: Ahishtja of Saint Konstantin, Ahishtja of Shën Thanasi. [6], [14], [15], [16]. In the territory of Devolli, there are also 13 archaeological and architectural monuments that belong to the first category of protected areas. [6], [9], [14]. All these natural, archaeological and cultural assets offer many opportunities for the development of different types of tourism. Despite these conditions; the tourism sector is one of the most underdeveloped sectors. The population of the municipality number 42 388 people in the civil status register and according to the Census 2011 the population is 26 716 persons [17], [18]. As a result of most suitable territories and natural conditions the population is mostly located in the rural area along the river of Devolli and in the city of Bilisht.

According to the CENSUS 2011, the age structure, of the population is divided; 24% is aged 0-14; 65.5% aged 15-64; and 9.5% of the population is over 65 years old. Meanwhile, the labor force that is included in the age group 15-64% at the national level is about 64%[19].

In recent years, the municipality of Devolli has had low rates of population growth, as a result of emigration and the decrease in the number of births. In these territory in 2022 had a negative natural increase of -183 inhabitants second in the region after Korça municipality [17]. As a result of these problems of the population, some villages are almost abandoned, such mention; Qyteza, Sinica, Nikolica, Gjyres, Rakicka, Bickë, while the population in most villages of this municipality has dropped significantly and the third age group predominates [20], [21], [22]. The basic sector of the economy in Devoll Municipality is agriculture, where the area of agricultural

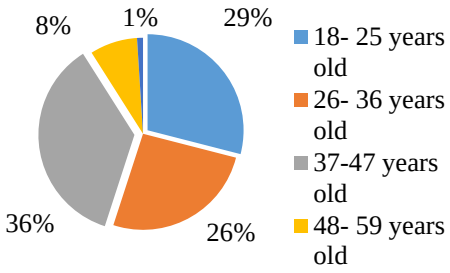
land is 12,642 ha, which 1,920.5 ha of them is uncultivated. [19]. In this municipality are active about 8300 agricultural farms with an average land area of about 1 ha. As a result of the characteristics of soil types and climatic conditions, the main crops that are cultivated are fruit trees, dry onions, beans, potatoes, wheat etc.

The economic development of the municipality of Devoll is based on the first sector of the economy and in general on agriculture; employments by sectors of the economy are: Agriculture 56.2%; services 28.5% and industry15.3% [18], [19]. The industry is represented by clothing factories that exceed the number of 700 employees, where the female gender dominates. According to the 2011 Census data; 62% of the population lives in the conditions of employment and self-employment, 6.1% with economic assistance and about 31.9% of income is covered by pensions. The level of unemployment for men is 14.9%, for women 17.1% and for young people it is 33.7%; this is one of the reasons for the increase in the number of young people who leave from year to year. Almost 90% of immigrants send remittances to their families, which exceed the figure of 2400 euro per year [19]. They are mainly used for basic needs. During the last years in the territory of the municipality, several projects have drafting and some of they have been realized or are under development, including projects in infrastructure, roads and urban areas, however the situation is still difficult, where according to field observations there is a lack of road infrastructure, water drainage black in some rural settlements, there are still problems with the supply of drinking water and the irrigation of agricultural crops.

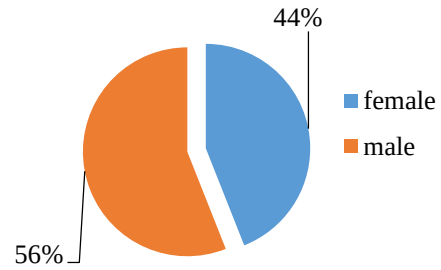
3. RESULTS AND DISCUSSIONS

The study examined community perceptions toward social-economic development in the local area of Devoll municipality. According to the data collected by 150 residents of Devoll Municipality, 44% of them were female and 56 % were male. The age of the respondents is generally young, 65% of them are up to the age up to 47 years old and 23% of them are over 47 years old.

Graphic 1: *The age of the respondents*

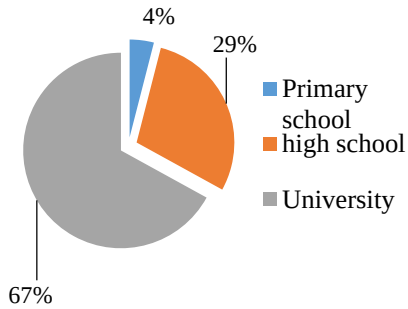


Graphic 2: *The gender of the respondents*

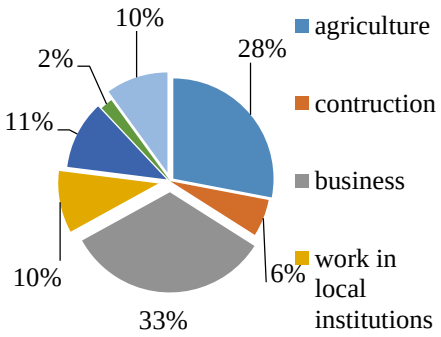


Regarding, their education the majority of the respondents (67%) have graduated from university, 29% of them have a high school diploma and 4% have a primary school. According to the graph, even though the Municipality of Devoll is an agricultural area, the majority of employees of the surveyed persons (33%) worked in businesses, followed by agriculture with 28%, 11 % of them work in different services, 10 % of them work in local institutions and other, 6 % work in construction and 2 % are unemployment.

Graphic 3: *The level of education of the respodents.*



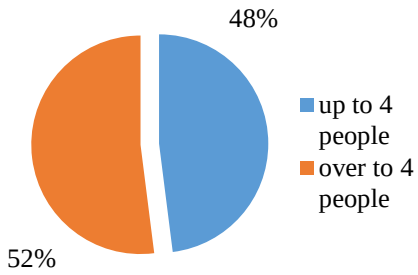
Graphic 4: *The profile of the employments.*



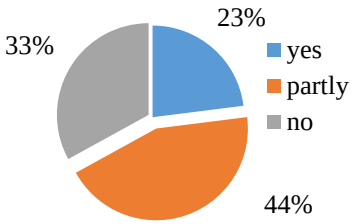
According to the family size the majority of respondents (52%) have a family of more than 4 persons, and 48% of them have a family of up to 4 people (graf.5). This is as a result of the concentration of the population in a large part in the rural areas, where the families generally have a large number of persons. Generally, the large families increase the cost of expenses. Asked if they can cover their family expenses based on their income, the majority of respondents 44% claimed that they can partially cover the expenses while 33% of them answer that they cannot and only 23% of them answered positively (graf.6). The majority of the respondents ‘stated that they are not able to cover expenses

due to unemployment and lower income. Seasonal work in Greece is seen as a solution for generating income in the rural areas of municipality. This result shows that the economic situation of the population in this municipality is generally difficult.

Graphic 5: *The family size of respodents*

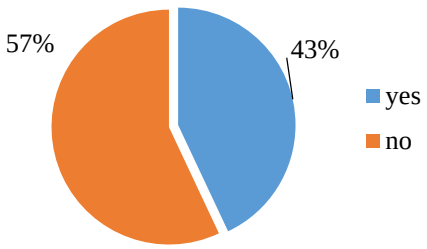


Graphic 6: *Can you cover your expenses based on your income?*

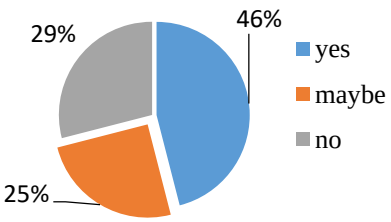


Asked if they have been in emigration or not, the majority of them (57%) say that they have not been and 43% of them have been in emigration. Of those who have emigrated, the majority 46% think they will emigrate again, 25% of them may return to emigration and 29% will not return to emigration. The higher number of respondents who consider returning to emigration comes as a result of several factors that are listed below by the respondents themselves.

Graphic 7*.Have you been in emigration?*



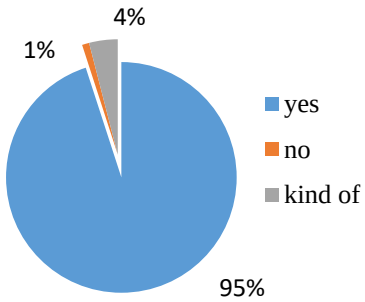
Graphic 8. *Will you return to emigration?*



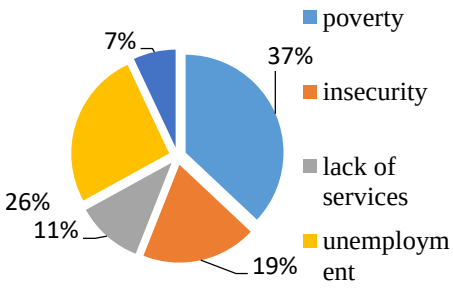
Asked about if young people want to emigrate, 95% of the respondents answered that there are young people who leave for emigration, only 1% answered no and 4%said that there is an emigration of young people to some extent. The departure of young people in emigration is a reality for the Albanian territory, especially in rural areas. The reasons for emigration are many, the main ones being poverty and unemployment, and this is clearly seen in Graph. 10. According to the respondents, the biggest problems in their place

of residence are; emigration, lack of services, lack of market for selling agricultural products, waste management, etc.

Graphic 9*: Do young people emigrate?*

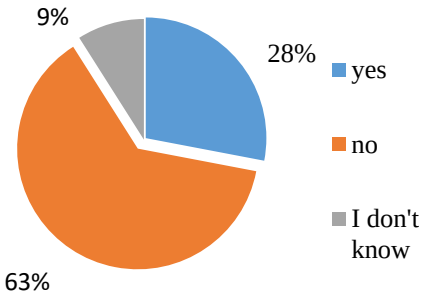


Graphic 10: *Reasons for emigration*

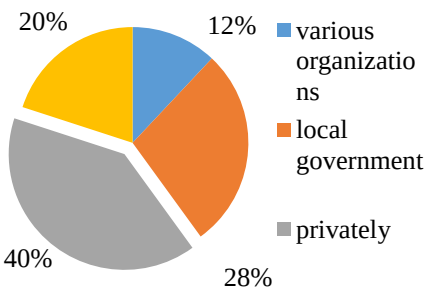


Asked if there have been madeinvestments in Devoll Municipality, 63% of the respondents answered no, 28% of them answered yes, and 9% of them do not know if there are any investments in the area where they live.40% of those who answered that there are made investments in this municipality, think that they were made by private individuals or different businesses, 28% by the local government, 20% others and only 12% by different organizations. Investments are missing or are very few, which will become an obstacle for the socio-economics of the area. According to the question, in which sectors investments should be made, the respondents listed some of them such as: businesses, health, agriculture, education, services, tourism, waste management, etc. Through field surveys, it was found that these are the areas where intervention is necessary as there are many deficiencies.

Graphic 11*: Have been made investments in Devoll Municipality?*

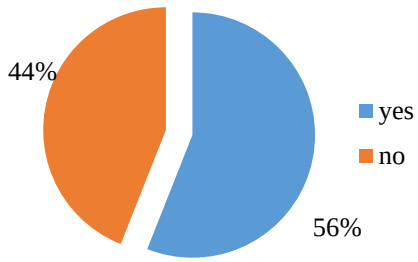


Graphic 12*: Who made the investments?*

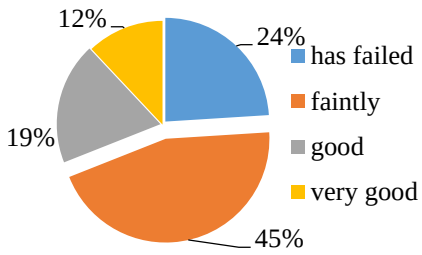


According to the question of whether they have opened a business, the majority of respondents 56% answered yes and 44% answered no. This shows that there have been initiatives in opening businesses. Asked what was the progress of the business? Most of them (45%) responded faintly, 24% answered has failed and 29% responded good and very well. This shows that opening a business in this municipality is considered an economic risk.

Graphic 13: *Have you opened a business?*

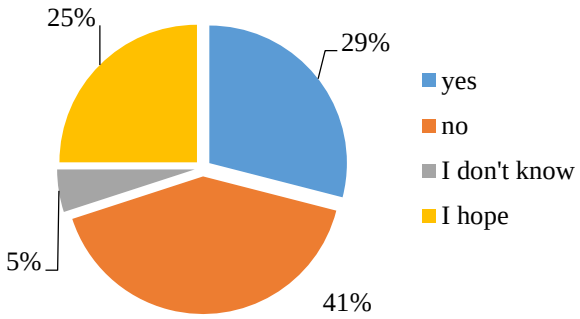


Graphic 14: *How has the business going ?*



Asked of if the community consider positively the situation of economic and social development of the municipality in the future, the majority answered (41%) no being pessimistic, , 29% of them answered yes, 25% hope that they can have a better development in their living area, and only 5% of the respondents were answered that they do not know if they can hope for a better future in their territory.

Graphic 15*: Do you consider positively the future of socio- economic development in Devoll Municipallity?*



The people surveyed think that the economic and social situation, especially during the COVID-19 Pandemic, became even more difficult, particulary for the residents of rural areas, where the prices of essential products increased. Another problem identified was the lack of market for rural products. This directly affects those who generate most of their income from agricultural activity.

4. CONCLUSIONS

Community perceptions regarding the economic and social development was based on their opinions about the real situation of the development, especially on their incomes provided, services offered by the local government and the way how they percept the local future development. The online questionnaire realized with the inhabitants of Devoll municipality showed that are evident different levels of problems, from local to regional. According to the results of the questionnaires, most of the inhabitants see the problems in infrastructure and services, and not in the natural and cultural resources. The municipality of Devolli is seen as a rich area, in geological resources, geomorphological features, hydrological bodies, soils and cultural heritage, but with luck of sustainable use. It seems that the low level of management of the municipality has created a gap between local people and responsible institutions in communication and solving problems. Through this study, it is understood that the communities see major management problems at the local level, (not only), and seek quick solutions, just like migration. This study has made an attempt to identify the community's perceptions of socio-economic development in Devoll municipality. A special focus is given to the data on their socio-economic situation and their perception on the problems of the community where they live. Results of the survey showed that Devolli is a municipality with a favorable geographical position. It has many natural resources and a rich archaeological, historical and cultural heritage which, if used, will affect the increase in the well-being of the population. Despite the numerous opportunities for the social and economic development of the area, it has various problems. Residents appreciate the natural and cultural potential of their municipality; but they emphasize that there is a lack of sustainable development policies, especially in the tourism sector. According to the survey, the strongest perceptions were found to be related to the lack of policies for the development o the area and the abandonment of rural areas as a result of emigration. As shown by the survey, majority of the respondents see immigration as the only solution. Majority of the respondents' state that they are not able to cover expenses according to the income they have or can partially cover them. Seasonal work in Greece is seen as a solution for securing income in the rural areas of Devolli Municipality. Investments are missing or are very few, which will become an obstacle for the socio-economics of the

area. Generally, the family size is above 4 people, which increases the cost of expenses. Most of the respondents answered that in general, efforts to open new businesses have failed. Drafting policies for the use of potentials through sustainable development; Needed policies for the improvement of infrastructure and services; Supporting the new businesses; Drafting of policies for the promotion of the area's values and investments for the development of tourism; Investment absorption and projects for the development of agriculture and livestock; Support for farmers and market insurance; Drafting of policies for the support of returned migrants; Opportunity to create farms and promote local products are some of the solutions for socio-economic development and to increase the well-being of the population of this municipality.

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Monitoring of urban greening in Durres city

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Abstract

The monitoring of urban greening in Durres city was carried out in four areas: the commercial, industrial, residential and beach area, during the period of 2019-2021. Field measurements of urban greening were carried out in the context of identifying the type of trees, measuring their diameter, height, presence or absence of hollows, etc. Through the data, using *"the true age calculator"* and *"the true benefit calculator",* the age of tree has been identified and the ecosystem services provided by the tree have been calculated, such as: i) the amount of oxygen it releases ii) the amount of CO_2 it sequesters iii) the energy it saves iv) water carrying capacity.
In the four monitored areas of Durres city have been identified 23.53 hectares of existing green spaces and 8.71 hectares lost as well as 6780 trees were identified. From the monitoring and calculations of each urban tree, 79.62 tons/year of O_2 were released and an amount of 55.83 tons/year of CO_2 was sequestered. In monetary value, the release of oxygen was 25,335,165 ALL and the sequestration of CO_2 through trees saves 535,302 ALL. In the monitored urban area, an amount of 127.8 MWh is conserved, which in monetary value amounts to 1,217,814 ALL.
The construction of a green belt in the hills of the city of Durres, the rehabilitation of existing parks, the construction of green corridors within the city, the creation of a new park in the city, as well as a host of other suggestions are the recommendations given for the improvement of greenery in city.

Key words: oxygen release, carbon sequestration, ecosystem services, urban greening.

Extraction of bioactive components from Helichrysim Arenarium

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Abstract

The raw material Helichrysum is used for the treatment of various pathological conditions in folk and modern medicine, for the treatment of tropical infections, respiratory diseases and as a detoxifying herbal medicine. Extraction is the most appropriate method for separating the active ingredients from plant materials. Separated bioactive components are mostly used in the food, pharmaceutical and chemical industries. The purpose of this paper is to study the influence of working parameters on the extraction process of working natural material (Helichrysum arenarium). The following separation procedures are applied for the extraction of the working raw material: solid-liquid conventional Soxhlet extraction and unconventional ultrasonic extraction. The plant extracts from this plant have various benefits, like skin care, antioxidant and antimicrobial activities.
For this purpose, ethanol with different initial alcohol concentration was used as a working solvent: 55%, 70% and 96%, petroleum ether, methanol and methylene chloride. The ethanol solution is prepared from 96% ethanol and deionized water. Calculations were made of the total extract obtained with Soxhlet and ultrasonic extraction.

Key words: ethanol, bioactive components, ultrasonic extraction, Soxhlet extraction.

Indoor radon concentration in the district of Durrës (Albania)

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Abstract

The study of the indoor radon concentration in dwellings is an important information for assessing the public exposure due to natural radioactivity. This work is part of the national radon action plan for the realisation of the indoor radon concentration map in dwellings in the Republic of Albania. The aim of this work is to present the first findings based on 45 measurements regarding the concentraion of radon in dwelling in the district of Durrës. The measurement are performed using passive detectors which are generally placed in the living/bed room in the first floors of dwellings and exposed for about three months. The preliminary results on indoor radon concentration are found to range from 32 to 233 Bq m^{-3}, which are below the reference levels for indoor radon concentration of 300 Bq m^{-3}. The arithmetic mean is found to be 93±85 Bq m^{-3}, while about 50% of the measurements are found to be above 100 Bq m^{-3}. As reported to the recent European basic safety standards, epidemiological studies have shown an increase of lung cancer from prolonged exposure to indoor radon at these levels. Therefore, these results show the necessity of a systematic survey in order to accurately evaluate assessing the public exposure due to natural radioactivity. Moreover, in future studies particular attention should be addressed to asses the public exposure in workplaces and expecially underground workplaces.

Key words: natural radioactivity, radon gas, passive methods, public exposure, district of Durrës.

A study of the dynamics inside the exoplanetary system Kepler-22

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Abstract

Digital computer technology brought great innovations not only in the field of theoretical calculations, but also in the field of advanced engineering of astronomical observations that has given celestial mechanics a substantial development. In this work we use the *Circular Restricted Three-Body Problem* (CRTBP). If it is further assumed that the third body travels in the same plane as the two larger bodies ($m_1 \geq m_2 \gg m_3$), then we have the *Planar Circular Restricted Three-Body Problem* (PCRTBP). In this paper we derive the five equilibrium points (named Lagrange points) and calculate the integral of motion (Jacobi integral) in an exoplanetary system named Kepler-22 system. This system consists of a sun-like star, Kepler-22 or KOI-087.01 and a terrestrial exoplanet, Kepler-22b. This exoplanet is situated in the habitable zone of its star. We also perform several numerical tests to discover different possible orbits. Some of these orbits are found in the habitable zone and the others outside. We have also examined the possibility of the existence of an exomoon around the terrestrial exoplanet Kepler-22b.

Key words: Lagrange points, terrestrial exoplanet, Kepler-22b, habitable zone.

The impact of α-amylase on dough rheology of some wheat cultivars

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Abstract

The purpose of this study is to study the state of rheology features of douhg with different content of α-amylases which affect in determination of baking products quality. Dough that are very strong, from experiments conducted, do not allow the development of pores and have high density,. The rheological characteristics of flour vary between varieties.
The influence of α-amylase is significant in dough viscosity for converts starch into sugar and maltose. Only the amount of sugar formed in the 25-40 °C affects the fermentation process, while the quality of the dough depends on the activity that enzymes perform at 55-80 °C (respectively freezing temperatures of starch and temperature deactivating own enzymes). β-amylase, which loses its activity at relatively low temperatures, has a minimal impact on the quality of bread during baking. The amount of sugar formed during fermentation depends on the quality of starch damaged during milling. α-amylase is very important in determining the quality in terms of hydrolyzing starch into dextrins, in the temperature 55-80 °C. pH optimum of starch activity in cereals is 5.2 - 5.4.
From the survey data is concluded that the use of α-amylase is necessary in flour production by grain without spruge, with a decrease amylasic activity. Their harmonization based on the content of α-amylase and quantified for each cultivar, and the specified radius show that improve quality of bakery products without additional α-amylase.

Key words: Wheat cultivars; quality of flour; dough; α-amylase; rheology.

The environmental impact of ship transport and the measures being taken to mitigate it

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Abstract

The environmental impact of ship transport is a growing concern, with the industry responsible for significant emissions of greenhouse gases and air pollutants, as well as the risk of oil spills and other forms of marine pollution. This paper aims to examine the environmental impact of ship transport and the measures being taken to mitigate it.

First an overview of the environmental impact of ship transport, including the emissions of carbon dioxide, nitrogen oxides, and sulfur oxides, and the impact of these emissions on climate change and air quality. We then discuss the impact of shipping on marine ecosystems, including the risk of oil spills, the release of other pollutants, and the disruption of marine life from ship traffic and noise pollution.

This paper explores the measures being taken to mitigate the environmental impact of ship transport. These include the use of low-sulfur fuels, improved engine design, and energy-efficient technologies to reduce emissions, as well as the development of spill prevention and response measures, the establishment of protected marine areas, and the use of quieter ship designs to minimize the impact on marine ecosystems. We also discuss the role of international organizations such as the International Maritime Organization in setting standards and regulations for environmental protection in the shipping industry.

The paper demonstrates that while ship transport has a significant environmental impact, there are measures being taken to mitigate this impact, including the development of new technologies and the adoption of more sustainable business practices. More needs to be done to address the environmental challenges facing the industry, particularly in the areas of emissions reduction and marine pollution prevention.

Key words: ship transport; marine pollution; environmental impact mitigation; sustainable practices.

1. INTRODUCTION

1.1 Background information on ship transport and its significance

Ship transport, also known as maritime transport, plays a vital role in global trade and commerce. It is the most widely used mode of transportation for international cargo, carrying approximately 90% of the world's trade volume. Ships provide a cost-effective and efficient means of transporting goods, raw materials, and energy resources across long distances, connecting countries and continents. The significance of ship transport can be attributed to several key factors:

Global Trade Facilitation - Ships enable the movement of goods on a large scale, facilitating international trade and economic growth.

Access to Remote Areas - Ships have the capability to reach remote and landlocked regions, providing access to essential goods and supplies that may otherwise be difficult to obtain.

Energy Efficiency - Ships are among the most energy-efficient modes of transportation, particularly for transporting large quantities of goods over long distances.

Versatility and Capacity: Ships come in various sizes and types, allowing them to transport diverse types of cargo, including bulk goods, liquid cargo, and containerized goods.

1.2 Overview of the environmental impact of ship transport

Ship transport has several environmental impacts that need to be considered due to its scale and widespread use. The key environmental impacts of ship transport include:

Air Pollution- Ships are a significant source of air pollution, primarily through emissions of sulfur oxides (SOx), nitrogen oxides (NOx), particulate matter (PM), and greenhouse gases (GHGs) such as carbon dioxide CO_2 (figure 1).

Water Pollution- Ship transport can lead to water pollution through various means. Ballast water, and accidental oil spills during fuel transfer or maritime accidents pose a significant threat to marine habitats[16] and wildlife.

Greenhouse Gas Emissions- Ships contribute to global greenhouse gas emissions, primarily through CO_2 emissions. The shipping sector accounts for around 2-3% of global CO_2 emissions. These emissions contribute to climate change and its associated impacts, including rising sea levels and altered weather patterns.

[16] These four critical marine habitats—sea grass, sand, sargassum, mangroves—nurture ocean life as we know it. Their fate hangs in the balance, imperiled largely by humans.

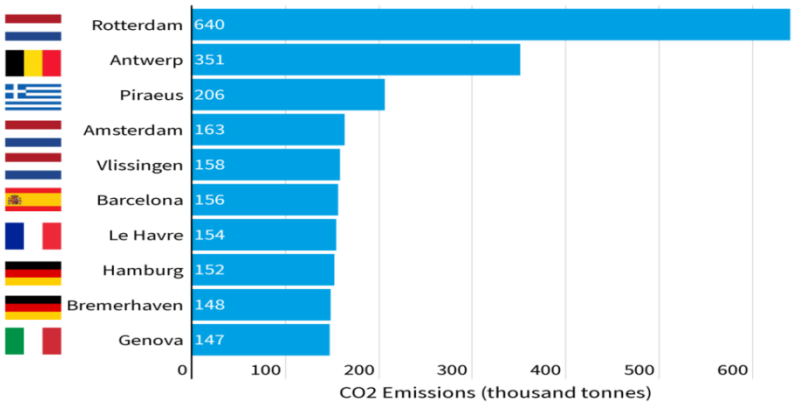

Figure 1: *Data from ship emissions at port*

Noise Pollution- Ship engines, propellers, and machinery generate significant noise underwater[17], affecting marine life such as whales, dolphins, and other marine mammals that rely on sound for communication and navigation.
Habitat Destruction- Ship anchoring and dredging activities can cause physical damage to coastal and marine habitats such as coral reefs, seagrass beds, and mangrove forests.
Waste Disposal- Ships generate various types of waste, including solid waste, sewage, and oily bilge water.

1.3 Rationale for studying measures to mitigate the environmental impact

The rationale for studying measures to mitigate the environmental impact of ship transport is rooted in the urgent need for sustainable and environmentally responsible practices in the maritime sector. Several key reasons justify the importance of this research:
Climate Change - Ship transport is a significant contributor to greenhouse gas emissions, particularly carbon dioxide (CO_2). Given the urgency of addressing climate change, it is crucial to find ways to reduce these emissions and limit the impact of ship transport on global warming (figure 2).

[17] Ocean noise refers to sounds made by human activities that can interfere with or obscure the ability of marine animals to hear natural sounds in the ocean. Many marine organisms rely on their ability to hear for their survival.

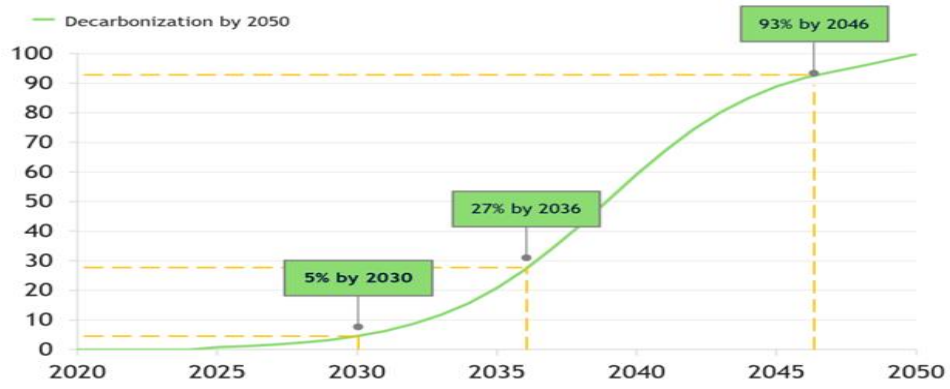

Figure 2: *Zero emission fuel adoption rate (Source: COP 26 Climate Champions, UMAS*

Air Pollution - Ships also emit other pollutants that have adverse effects on air quality and human health. These pollutants include sulfur oxides (SOx), nitrogen oxides (NOx), particulate matter (PM), and volatile organic compounds (VOCs). They can contribute to respiratory problems, cardiovascular diseases, and other health issues. Implementing measures to reduce these emissions is important for protecting human health and improving air quality in coastal areas and port cities.

Marine Environment - Ship transport can have detrimental effects on the marine environment. Discharge of oil and hazardous substances, improper waste disposal, and ballast water discharge containing invasive species are some of the environmental concerns associated with shipping activities. These pollutants can harm marine ecosystems, damage coral reefs, contaminate water bodies, and threaten marine biodiversity. Studying mitigation measures helps prevent and minimize these negative impacts, ensuring the preservation of fragile marine ecosystems.

Ecological Balance - Ships can disrupt the ecological balance in coastal and marine areas through noise pollution, habitat destruction due to dredging and port infrastructure development, and disturbance to marine mammals and other marine life.

Sustainable Development - Sustainable development calls for balancing economic growth with environmental protection. Shipping is a vital component of global trade and plays a significant role in economic development. By studying measures to mitigate the environmental impact of ship transport, we can foster sustainable practices that ensure the long-term viability of the shipping industry while minimizing its negative ecological footprint.

Regulatory Framework - The shipping industry operates globally, and international regulations play a vital role in setting standards and guiding practices. Studying measures to mitigate the environmental impact of ship

transport helps inform the development of robust and effective regulations. These regulations can promote cleaner and more sustainable shipping practices, driving innovation and technology adoption within the industry.

2. LITERATURE REVIEW

Previous studies on the environmental impact of ship transport have provided valuable insights into various aspects of this topic. Some key findings from previous research include:

Air Pollution - Studies have focused on quantifying the emissions from ships, assessing their impact on air quality, and evaluating the health effects on local populations exposed to ship emissions.

Greenhouse Gas Emissions - Numerous studies have explored strategies to reduce CO_2 emissions from ships, including the use of alternative fuels, energy-efficient ship designs[18], and operational measures such as slow steaming.

Water Pollution - Studies have highlighted the need for effective ballast water treatment systems to prevent biological invasions. The impact of oil spills and other forms of marine pollution from ship accidents or operational practices has been extensively studied.

Noise Pollution - Studies have investigated how noise pollution disrupts communication, feeding, and reproductive behaviors of marine species and suggested mitigation measures.

Environmental Regulations and Policies - Previous research has analyzed the effectiveness of international regulations and policies, such as the International Convention for the Prevention of Pollution from Ships (MARPOL) and the Energy Efficiency Design Index (EEDI), in reducing the environmental impact of ship transport.

Technological Innovations and Best Practices - Research has explored technological advancements and best practices to mitigate the environmental impact of ship transport. This includes the development and adoption of clean propulsion systems, emission control technologies, waste management systems, and improved operational practices.

Studies in this field are based on data collection and analysis on emissions, fuel consumption, and other relevant parameters from ships. This includes data on different types of vessels, their engine specifications, operating conditions, cargo, and routes. This data is then analyzed to quantify the environmental impact and identify trends.

[18] Technical measures that reduce fuel consumption include highly efficient marine engines and power trains, optimized flow profiles around hull, rudder, and propeller, and innovations such as the bulbous bow.

Life Cycle Assessment[19] is a methodology used to evaluate the environmental impact of a product or activity throughout its entire life cycle. In the context of ship transport, LCA can assess the environmental impact of the vessel's construction, operation, maintenance, and disposal. It helps in understanding the overall sustainability of the shipping process.

3. METHODOLOGY

This paper aims to examine the environmental impact of shipping and the measures being taken to mitigate it. The analysis integrates information from previous studies that assess the environmental impact of shipping, including emissions of carbon dioxide, nitrogen oxides and sulfur oxides, and the impact of these emissions on climate change and air quality. We also analyze the role of international organizations such as the International Maritime Organization in establishing standards and regulations for environmental protection in the maritime transport industry. This document explores the measures that should be taken to mitigate the environmental impact of shipping including the development of new technologies and the adoption of more sustainable business practices. Data collection sources of the study are taken by reports and publications on the environmental impact of ship transport by International Maritime Organization (IMO), United Nations Environment Program (UNEP), and International Transport Forum (ITF). ITF databases are the only source of international transport statistics that include all modes of transport. Also we are based on guidelines and studies related to environmental impact and mitigation measures in shipping by the International Chamber of Shipping (ICS) and the World Shipping Council (WSC), Global Maritime Hub, journals such as Marine Pollution Bulletin, Transportation Research Part D: Transport and Environment, and Environmental Science & Technology etc.

4. RESULTS AND DISCUSSIONS

4.1 Regulatory Measures

Measures being taken to mitigate the environmental impact of ship transport aim to reduce air and water pollution, minimize greenhouse gas emissions, and promote sustainable practices within the maritime industry. The International Maritime Organization (IMO) has implemented various regulations to address environmental concerns. The most notable is the IMO's MARPOL Convention,

[19] The goal of LCA is to compare the full range of environmental effects assignable to products and services by quantifying all inputs and outputs of material flows and assessing how these material flows affect the environment

which sets limits on air and water pollution from ships. MARPOL Annex VI regulates air emissions, including sulfur oxide (SOx) and nitrogen oxide (NOx) limits, while MARPOL Annex I addresses oil pollution prevention. Emission Control Areas are designated regions where stricter emission standards apply. These areas typically encompass coastal areas and sensitive ecosystems.
Vessels operating within ECAs must comply with more stringent limits for sulfur oxide and nitrogen oxide emissions. The IMO has introduced the EEDI, which sets energy efficiency standards for new ships. The index establishes minimum energy efficiency requirements for various ship types, promoting the use of more fuel-efficient technologies and designs. Ship Energy Efficiency Management Plan (SEEMP): SEEMP is a mandatory measure under the IMO's regulations. It requires ships to develop and implement energy efficiency plans, emphasizing operational practices that reduce fuel consumption and emissions. SEEMP encourages measures such as optimized voyage planning, regular maintenance, and improved onboard energy management.

4.2 Technology and Operational Improvements

Shipping is responsible for over 3% of global anthropogenic carbon dioxide emissions and is growing. The two main pollutants from the ship's emission are Nitrogen oxides (NOx) and Sulphur oxides (SOx) (figure 3).

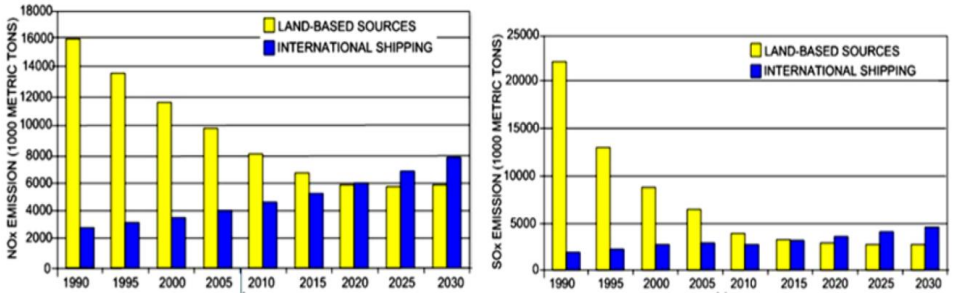

Figure 3: *Emissions NOx (a) and SOx (b) from land-based sources and international shipping*

These gases have adverse effects on the ozone layer in the troposphere area of the earth's atmosphere which results in the green house effect and global warming. It has been estimated that international shipping was responsible for approximately 13% of global sulfur dioxide emissions before the implementation of the IMO 2020 sulfur cap. Marine heavy fuel oil is approximately 86% carbon, which implies about 3.15 tonnes of CO_2 per tonne of fuel consumed. Burning 1 L of gasoline produces approximately 2.3 kg of CO_2.

More and more ships, including container ships and cruise ships, are being built to run on liquefied natural gas (LNG), which emits approximately 25% less carbon dioxide (CO_2) than conventional marine fuels in providing the same amount of propulsion power. Energy-efficient ship designs, improved hull designs, optimized propulsion systems, low-sulfur fuels, and waste heat recovery systems help reduce fuel consumption and emissions. Low-sulfur fuels[20] have a sulfur content below the limits set by regulations, typically defined as fuels with a sulfur content of 0.50% m/m (mass by mass) or lower. The International Maritime Organization (IMO) has implemented regulations to limit sulfur oxide emissions from ships. The IMO's MARPOL Annex VI (table 1) requires ships to use fuels with a sulfur content not exceeding 0.50% m/m (mass by mass) globally, with even stricter limits in designated Emission Control Areas (ECAs). IMO 2023 is a new global shipping regulation that aims to reduce carbon emissions and promote greater energy efficiency in the sea freight industry. IMO 2023 regulation is part of the International Maritime Organization's (IMO) Greenhouse Gas Strategy (GHG), which aims to reduce carbon emissions from international shipping by 40% by 2030 and 70% by 2050 versus the 2008 levels. To achieve a continuous reduction in carbon intensity, the IMO plans to lower the CII scores needed to achieve each rating progressively. The 2023 thresholds are set to achieve a 5% cut from the 2019 levels of carbon intensity, followed by a 7% cut in 2024, 9% in 2025, and 11% in 2026.

4.3. The establishment of protected marine areas

The establishment of protected marine areas, also known as marine protected areas (MPAs), is a crucial measure for conserving marine ecosystems and mitigating the environmental impact of ship transport. MPAs are designated zones where human activities, including shipping, are regulated to preserve biodiversity, protect habitats, and sustainably manage marine resources. MPAs serve as refuges and sanctuaries for marine biodiversity. By designating specific areas as protected, the diverse range of species, including fish, coral reefs, sea grass beds, and other marine organisms, can thrive and reproduce without excessive disturbance from shipping activities. MPAs offer opportunities for scientific research, monitoring, and data collection. These areas serve as living laboratories for studying marine biodiversity, ecosystem processes, and the impacts of human activities. The knowledge gained from

[20] The marine gas oil is also considered as low sulfur fuel oil or LSFO because it has sulphur content between approx. 0.10 and 1.50 m/m %. Types of clean fuel oil for the maritime industry available in the market: Residual marine or RM fuel oil is a type of diesel oil which needs heating for usage.

research within MPAs helps inform conservation strategies, shipping regulations, and sustainable management practices.

4.4. The use of quieter ship designs to minimize the impact on marine ecosystems

The use of quieter ship designs is an important approach to mitigate the impact of ship transport on marine ecosystems, particularly in reducing underwater noise pollution. Quieter ship designs help minimize these disruptions and provide a more hospitable marine environment for these species. Some regions, such as marine protected areas (MPAs) and designated sensitive habitats have regulations or guidelines in place to limit underwater noise emissions from ships. Quieter ship designs facilitate compliance with these regulations, ensuring that ships operating in these areas meet the required noise standards and do not disturb marine ecosystems beyond acceptable levels. Researchers study the impacts of ship noise[21] on marine life and provide insights to ship designers to develop quieter propulsion systems, hull designs, and engineering solutions. The shipping industry has recognized the importance of minimizing underwater noise pollution and has developed best practices and industry initiatives. These initiatives promote the use of quieter ship designs and operational practices to reduce noise emissions.

4.5. Sustainable practices in the shipping industry

The adoption of more sustainable business practices in the shipping industry is crucial for reducing the environmental impact and promoting long-term sustainability. These practices encompass a wide range of strategies and initiatives aimed at minimizing resource consumption, reducing emissions, and improving operational efficiency. Shipping companies strive to improve fuel efficiency by implementing various measures, such as optimizing vessel speed, hull cleaning and maintenance, and route optimization. By reducing fuel consumption, companies can lower greenhouse gas emissions and operating costs. Some shipping companies are exploring the use of renewable energy sources to power their operations.

Shipping companies are partnering with suppliers, customers, and logistics providers to foster sustainability throughout the supply chain. This collaboration aims to promote sustainable practices, share best practices, and develop innovative solutions for reducing environmental impact. While some

[21] IMO is currently designing a new project, the GloNoise Partnership project, which aims to address the issue of underwater noise from shipping. The project is currently in a preparatory phase and is expected to launch in mid-2023, subject to approval and funding by the United Nations Development Programme (UNDP) and the Global Environment Facility (GEF).

sustainable practices are voluntary, shipping companies also prioritize compliance with environmental regulations imposed by international bodies like the International Maritime Organization (IMO) and regional authorities.

5. CONCLUSIONS

Recognizing and minimizing ship transport's environmental impact is critical for protecting marine ecosystems, decreasing pollution, and addressing climate change. The shipping sector can aim for more sustainable practices and reduce its environmental imprint through regulatory measures, technology breakthroughs, and collaborative efforts.

Addressing the environmental impact of ship transport requires a multi-faceted approach, combining regulations, technological advancements, industry collaboration, and sustainable business practices. These efforts aim to minimize pollution, protect marine ecosystems, and promote a more sustainable future for ship transport.

The International Maritime Organization (IMO) sets international standards and regulations to reduce air and water pollution, as well as greenhouse gas emissions from ships. These regulations include limits on sulfur and nitrogen oxide emissions, ballast water management requirements, and the adoption of energy efficiency measures. Emission Control Areas (ECAs) designate specific regions with stricter emission standards, leading to the use of low-sulfur fuels and the installation of emissions abatement technologies.

Ship transport has significant environmental impacts, including air and water pollution, habitat destruction, and disturbance to marine ecosystems. Prioritizing sustainable practices, we can mitigate these impacts, protect biodiversity, and preserve fragile marine environments for future generations.

The shipping industry is a major contributor to greenhouse gas emissions, which contribute to climate change. Sustainable practices, such as the use of cleaner fuels, improved energy efficiency, and the adoption of low-carbon technologies, are essential for reducing the industry's carbon footprint and achieving global climate goals.

Governments and international bodies are increasingly implementing regulations to address the environmental impact of ship transport. Adopting sustainable practices, shipping companies can ensure compliance with regulations, avoid penalties, and maintain a positive reputation in the industry.

The continued focus on sustainable practices is vital for the future of ship transport and environmental conservation. Prioritizing environmental preservation, mitigating climate change, complying with regulations, driving innovation, meeting stakeholder expectations, and managing risks, the shipping industry can contribute to a more sustainable and resilient future while ensuring the long-term viability of the sector.

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Cyber security in the maritime transport

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Abstract

Maritime transport is an essential element for the economic sustainability of many regions around the world, including Albania. Especially for the countries that have access to the sea, maritime transport is the backbone of domestic and international trade.
One of the challenges faced by this sector is protection from threats and cyber-attacks. Cyber-attacks can lead to major environmental or economic disaster, even being able to cause loss of human life. Also, technological changes are being implemented by shipping companies more slowly compared to other manufacturing sectors. Therefore, this sector is easily attacked in this direction. The purpose of this study is to present the consequences of cyber-attacks on maritime transport through a map of current cyber security provisions on ships and in ports. Regarding this, the purpose of the research in this study is related to the conference topics regarding technology and information and navigation sciences.
The methodology used in this scientific research is based on published literature that enables a mapping of modern methods and analysis, interpretation and implications of cyber security within the maritime industry. Major results and implications of the study regards suggestions on raising cyber security capacities against cyber threats for the realization of safe and modern port activities.

Key words: cyber security, maritime transport**,** legislation, logistic.

Implementation of the MLC Convention in Albania and its role in Seafarer's Standards

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Abstract

The Maritime Labor Convention (MLC) is an international labor standard adopted by the International Labor Organization (ILO) in 2006. The MLC was designed to ensure that seafarers receive decent working conditions on board ships, without any difference regardless their nationality. The convention sets out minimum requirements to be met by authorities, shipping companies, for seafarer's employment rights, working conditions, and social protection.
Convention, 2006, as amended (MLC 2006) on 28 October 2016, and the convention entered into force in Albania on 28 October 2017. The amendments of the Code of the Convention approved by the International Labor Conference (ILC) in 2018 entered into force in Albania on 26 December 2020.
The aim of this paper is to examine the implementation of MLC requirements and its impact in Albanian maritime industry, and to identify the needed steps to be undertaken by Albanian maritime authorities to fully comply with MLC requirements.

Key words: MLC-maritime labor convention, Albanian ship's, seafarer, working conditions.

Marine protection through Marine Strategy and EU Water Framework Directives implementation in Albania

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Abstract

Having the "candidate" status for the EU assession, Albania has the obligation to transpose and implement the EU water related framework Directives and make efforts to achieve or maintain good environmental status in the marine environment according to EU *acquis*.
The Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 (amended) is a framework directive and, as such, aims at ensuring the coherence, consistency and integration of measures taken pursuant to various other EU legal instruments in order to meet the key objective of the Directive: to achieve or maintain good environmental status in the marine environment by the year 2020 at the latest. On the other hand, EU Water Framework Directive, being applied to the coastal waters, assesses the chemical and ecological status of each individual coastal water body, aiming the good status of water quality.
This paper presents the main requirements from both MSFD and EU Water Framework Directive and provides an overview on marine protection level in Albania.

Key words: Marine protection, EU Water Framework Directive, ecological status, EU Marine Strategy Framework Directive, EU acquis.

Improving the quality of urban air in Durrës to promote the development of tourism

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Abstract

In recent years the city of Durrës has been experiencing significant growth in the tourism sector. One major challenge faced by the city is the poor air quality, which has negative impacts on both the health of residents and the attractiveness of the city to tourists. This paper explores strategies for improving the urban air quality in Durrës to boost tourism development.
The study first examines the sources of air pollution in Durrës, including energy production, industry, and transportation. The study then examines global best practices and regulations for lowering air pollution in urban areas. Based on this analysis, the study recommends a set of measures to improve air quality in Durrës, including: encouraging the use of electric vehicles and promoting sustainable transportation options; promoting energy-efficient practices in industry and buildings; increasing the use of renewable energy sources in energy production and enforcing stricter laws and monitoring of air pollution sources.
It is important to keep in mind that Durrës air pollution levels might change based on things like weather conditions, traffic volume, and industrial activity. It is crucial to periodically monitor and manage causes of air pollution to improve air quality and safeguard human health. According to the World Air Quality Report, which provides annual data on air quality levels in cities around the world Durrës had an average PM2.5 concentration of 23.4 $\mu g/m^3$. PM2.5 refers to particulate matter with a diameter of 2.5 micrometers or less, which is considered to be particularly harmful to human health when present in high concentrations. The annual average concentration of PM2.5 should not exceed 10 $\mu g/m^3$.The paper concludes that improving air quality in Durrës is critical for the development of tourism and the health of residents. By implementing the recommended measures, the city can reduce air pollution levels and create a more attractive and sustainable environment for visitors and residents alike.

Key words: urban air; air pollution; measures to improve; tourism development; health of residents.

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