PURE AND APPLIED MATHEMATICS

PA 001: Soft neutrosophic quasigroups by Oyem Anthony, T. G. Jaiyeola.

PA 002: Decision-making with fuzzy soft matrix using a revised method: a case of medical diagnosis of diseases by Taiwo Sangodapo.

PA 003: Results on quantum stochastic differential equations under the strong topology by Sheila A. Bishop and Nurudeen Kolade.

PA 004: Some results on cut set of picture fuzzy subgroups by Taiwo O. Sangodapo.

PA 005: Dynamic analysis of optimal glucose production from pretreated corn cob in batch and continuous process by Evans, Patience. O., Fadepo, Joshua T. and Johnny, Samuel E.

PA 006: On G-asymptotic quasi contraction in metric spaces with application to Solow growth model by Kanayo Stella Eke and Patrick Omoruyi Eke.

PA 007: A survey on fixed point iterative schemes for various classes of multivalued ρ-contractive-like maps in modular function spaces by H. Akewe and H. Olaoluwa.

PA 008: A Picone type identity and some properties of the principal eigenvalue of a (p,q)-biharmonic system by Abimbola Abolarinwa.

PA 009: Modified inertial subgradient extragradient method in reflexive Banach spaces by Bashir Ali, G. C. Ugwunnadi, M. S. Lawan, and A. R. Khan.

PA 010: On existence and uniqueness of solutions to inhomogeneous linear evolution equations by Iluebe Victor Odalochi.

PA 011: Bi-univalent conditions associated with Bessel and modified sigmoid function by Hamzat Jamiu Olusegun and Fagbemiro Olalekan.

PA 012: On geometric properties of certain subclasses of analytic functions associated with hypergeometric function by M. O. Oluwayemi, B. O. Moses and J. O. Okoro.

PA 013: Investment and pricing using lagrange multipliers technique to optimize a nonlinear programming problem for an optimal value in power generation by Darius P. B. Yusuf

PA 014: Metric fixed point theory applied in solving certain nonlinear problems by Godwin Amechi Okeke.

PA 015: Multivariate Opial-type inequalities on time scales by Y. O. Anthonio, A. A. Abolarinwa, and K. Rauf.

PA 016: Fixed point results of a new family of hybrid contractions in generalized metric spaces by Jamilu Abubakar Jiddah and Mohammed Shehu Shagari.

PA 017: Extension of Pachpatte result of Opial-type on times scales by Aribike E. E., Rauf K. and Aniki S. A.

PA 018: The normal structure of Banach spaces and fixed point theorems on cone metric spaces over Banach algebras by Panle, Augustine Bwan.

PA 019: On the proofs of irreducible elements for integer-valued polynomials by A. A. Olayiwola and S. A. Adebisi.

PA 020: The connections between the vertices and edges in connected neighbourhood in graph theory by Daniel, Ifeyinwa Eunice and Ogunsola, Oluwafemi Johnson.

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PA 025: Fixed points of some contractions on O-metric spaces by A. O. Ige, H. O. Olaoluwa and J. O. Olaleru.

PA 026: Transmission dynamics of reservoir – human sar-cov-2 disease with optimal control by H. O. Edogbanya and S. E. Fadugba.

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PA 059: On subgroups of a presentation group with generators of same order by Ogunfolu Olusola.

PA 060: Green functions of Caputo-fractional partial differential operator with elliptic perturbation by Sam Idiong Ubong.

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PA 070: Odd order numerical method for the solution of initial value problem of first order differential equation by Alakofa, Catherine.

COMPUTER SCIENCE AND STATISTICS

CS 001: Evaluation of autism spectrum disorder (ASD) diagnosis using machine learning models by Akinyemi M. I. and Awojide, M. O.

CS 002: A new Gompertz-Shanker distribution with applications by Badmus, N. I. and Agboola, S. O.

CS 003: A new inverse-Gompertz Frechet distribution: properties and applications to real life data by S. Adeyeye, E. Akarawak, A. Adewara, and A. Ogunsanya.

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CS 007: Estimation of different types of entropies for the Gumbel type-2 distribution by Ogunde, A. A., Oseghale, I. O., Fatoki, O., Audu, J., and Adefolarin, A. D.

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PURE AND APPLIED MATHEMATICS

PA 001: SOFT NEUTROSOPHIC QUASIGROUPS

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Abstract: This paper introduced and studied for the first time the object of neutrosophic quasigroup over a quasigroup. It was shown that the direct product of any two neutrosophic quasigroups is a neutrosophic quasigroup. Also, it was established that the holomorph of any neutrosophic quasigroup is a neutrosophic quasigroup. The Soft set theory Molodsov innovated is a potent mathematical tool used for solving mathematical problems with uncertainties and things that are not clearly defined. We broaden soft set theory by introducing soft neutrosophic quasigroup over a neutrosophic quasigroup. We introduced and established the orders of a finite soft neutrosophic quasigroup with varied mathematical inequality expressions which exist between the orders of a finite neutrosophic quasigroup and its soft neutrosophic quasigroup.

Keywords and Phrases: Soft set, Neutrosophic set, Quasigroup, Neutrosophic quasigroup, Neutrosophic subquasigroup, Soft neutrosophic quasigroup, soft neutrosophic subquasigroup.

PA 002: DECISION-MAKING WITH FUZZY SOFT MATRIX USING A REVISED METHOD: A CASE OF MEDICAL DIAGNOSIS OF DISEASES

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Abstract: In this paper, we study the matrix representation of fuzzy soft sets, complement of fuzzy soft sets, product of fuzzy soft matrices and the application of fuzzy soft matrices in medical diagnosis presented by Lavanya and Akila. Additionally, a new method (max-min average) based on reference function is introduced to extend Sanchez's technique for decision making problems in medical diagnosis. The result shows that the new method gives more information about the medical status of the patients being considered in relation to a set of diseases.

PA 003: RESULTS ON QUANTUM STOCHASTIC DIFFERENTIAL EQUATIONS UNDER THE STRONG TOPOLOGY

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Abstract: In this paper we consider some new results on quantum stochastic differential equations associated with the Hudson and Parthasarathy's formulation of quantum stochastic calculus under the strong topology. These solutions are called strong solutions in comparison with the solutions of similar equations defined on the space of operator processes where the topology is generated by the family of seminorms defined via the inner product of the range space.

PA 004: SOME RESULTS ON CUT SET OF PICTURE FUZZY SUBGROUPS

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Abstract: Here, the concept of cut set of picture fuzzy set was studied. The concept of cut set of picture fuzzy subgroup of a group was introduced, and some of its characterisations were investigated.

Keywords: Picture Fuzzy Set, Picture Fuzzy Subgroup, Cut Set of Picture Fuzzy Set, Cut Set of Picture Fuzzy Subgroup

PA 005: DYNAMIC ANALYSIS OF OPTIMAL GLUCOSE PRODUCTION FROM PRETREATED CORN COB IN BATCH AND CONTINUOUS PROCESS

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Abstract: Glucose will be a cheap alternative industrial chemical and pharmaceutical product when produced from renewable resources like Corn Cob. In this work we formulated mathematical models for the optimal production of glucose from Corn Cob. Initial value problems (IVP) were generated for pretreated Corn Cob in batch and continuous process. The particular solution was obtained and MAPLE 17 software was used to estimate the variables. The results obtained shows the kinetic parameter for optimum production of glucose are pretreatment rate (η) 0.5 and hydrolysis rate (μ) 1.0, with glucose yield of 20,000mg/ml, 50,000mg/ml and 100,000mg/ml for batch process, and 38000mg/ml 90,000mg/ml and 190,000mg/ml for continuous process. The particular solution shows that optimum production of glucose from pretreated Corn Cob can be reached at day 8 and day 4 for batch and continuous process respectively. The result concludes that glucose produced using continuous process gives better yield with less time than that of batch process.

Keywords: Glucose, IVP, Optimum, Pretreated Corn Cob, Batch and Continuous process.

PA 006: ON G-ASYMPTOTIC QUASI CONTRACTION IN METRIC SPACES WITH APPLICATION TO SOLOW GROWTH MODEL

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Abstract: The purpose of this paper is to introduce a class of G-asymptotic quasi contraction mappings. The existence and uniqueness of the fixed point for this newly introduced map is proved in the context of metric spaces equipped with a graph. Examples are provided to validate our main results. This work applies the G-asymptotic quasi contraction mappings to obtain the solution of Solow version of neoclassical growth models. The results obtained generalize and extend some related works in the literature.

Keywords: Graph map, quasi contraction, asymptotic contraction, fixed point, Solow growth model.

PA 007: A SURVEY ON FIXED POINT ITERATIVE SCHEMES FOR VARIOUS CLASSES OF MULTIVALUED ρ-CONTRACTIVE-LIKE MAPS IN MODULAR FUNCTION SPACES

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Abstract: This research presents complementary results with wider applications on convergence and rate of convergence of classical fixed point theory in Banach spaces to the world of the theory of fixed points of mappings defined in classes of spaces of measurable functions, known in the literature as modular function spaces. The study gives a comprehensive survey of various iterative fixed point results for the classes of multivalued ρ-contractive-like, ρ-quasi-contractive-like, ρ-quasi-contractive, ρ-Zamfirescu and ρ-contraction mappings in the framework of modular function spaces. Analytical and numerical examples are presented to demonstrate the applicability of the explicit Kirk-type and implicit Kirk-type iterative schemes. Our results complement the results obtained on normed and metric spaces in the literature. Also, our method of proofs serves as a guide to obtain several similar improved results for nonexpansive, pseudo-contractive and accretive type mappings.

Keywords: Explicit Kirk-type iterative schemes, implicit iterative schemes.

PA 008: A PICONE TYPE IDENTITY AND SOME PROPERTIES OF THE PRINCIPAL EIGENVALUE OF A (p,q)-BIHARMONIC SYSTEM

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Abstract: The Picone's identities are one of fundamental tools in the analysis of qualitative properties of linear and nonlinear differential equations and systems. In this paper, we prove a weak Picone type identity of integral form for p-biharmonic operator on a domain (not necessarily bounded). As a consequence of the identity derived we prove existence, positivity, simplicity, uniqueness and isolation of the principal eigenvalue of a (p,q)-biharmonic system.

PA 009: MODIFIED INERTIAL SUBGRADIENT EXTRAGRADIENT METHOD IN REFLEXIVE BANACH SPACES

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Abstract. In this paper, we study a modified inertial subgradient extragradient algorithm in reflexive Banach spaces and prove a strong convergence theorem for approximating common solutions of fixed point equation of a demi-generalized mapping and a variational inequality problem of a monotone and Lipschitz mapping. Our result extends and improves important recent results announced by many authors.

PA 010: ON EXISTENCE AND UNIQUENESS OF SOLUTIONS TO INHOMOGENEOUS LINEAR EVOLUTION EQUATIONS

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Abstract: In this paper, we apply the Banach fixed point theorem to prove the existence and uniqueness of solutions to an inhomogeneous linear differential evolution equations.

PA 011: BI-UNIVALENT CONDITIONS ASSOCIATED WITH BESSEL AND MODIFIED SIGMOID FUNCTION

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Abstract: The main object of the present work is to study the bi-univalent conditions for function f(z) belonging to the class $\sum(b,c,p,\alpha,\theta,\phi)$ associated with both Bessel and modified sigmoid function in the open unit disk.

PA 012: ON GEOMETRIC PROPERTIES OF CERTAIN SUBCLASSES OF ANALYTIC FUNCTIONS ASSOCIATED WITH HYPERGEOMETRIC FUNCTION

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Abstract: One major focus of geometric function theory (GFT) of complex analysis is the geometric properties of analytic functions. Various authors in the field have considered different forms of special functions and their applications in GFT. In this work therefore, using subordination principle, the authors considered certain subclasses of analytic functions associated with hypergeometric function. The necessary and sufficient conditions for functions belonging to the new subclasses were give. In addition, certain geometric properties of the functions belonging to the new subclasses were also discussed. The results were validated with the existing w Several related problems are also discussed.

Keywords: Analytic functions, univalent functions, subordination and hypergeometric function.

PA 013: INVESTMENT AND PRICING USING LAGRANGE MULTIPLIERS TECHNIQUE TO OPTIMIZE A NONLINEAR PROGRAMMING PROBLEM FOR AN OPTIMAL VALUE IN POWER GENERATION

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Abstract: The proposed investment and pricing using Lagrange multipliers technique to optimize a nonlinear programming problem for optimal value in power generation is considered in this research. The method of Lagrange multipliers is a powerful tool used in multivariable calculus, in this article interpretation of Lagrange multipliers is presented by indicating their positive values. Optimization models are presented with detailed mathematical derivations. An attempt has been made to optimize on investment and pricing subject to a budget constraint, using the method of Lagrange multipliers, as well as, validating using necessary and sufficient conditions for optimal value.

Keywords: Optimization, Lagrange Mutipliers, Necessary and Sufficient Conditions and Optimal Value

PA 014: METRIC FIXED POINT THEORY APPLIED IN SOLVING CERTAIN NONLINEAR PROBLEMS

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Abstract: Three major divisions of fixed point theory, viz: topological fixed point theory, metric fixed point theory and discrete fixed point theory will be highlighted. Moreover, recent developments and results in metric fixed point theory and its applications in solving certain nonlinear problems in science and engineering will be examined.

PA 015: MULTIVARIATE OPIAL-TYPE INEQUALITIES ON TIME SCALES

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Abstract: A refined Jensen inequality for multivariate functions is employed to obtain a generalized Opial-type inequality for convex functions of several variables on time scale.

Keywords: Opial-type Inequalities; convex functions; Refined Jensen inequality.

PA 016: FIXED POINT RESULTS OF A NEW FAMILY OF HYBRID CONTRACTIONS IN GENERALIZED METRIC SPACES

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Abstract: In this discussion, a novel general family of contraction, called hybrid interpolative Reich-Istratescu-type (G-α-μ)-contraction will be introduced and some fixed point results that cannot be deduced from their corresponding ones in metric spaces will be discussed. The preeminence of this class of contraction is that its contractive inequality can be extended in several ways, depending on the given parameters. Consequently, a number of corollaries that reduce our result to other well-known results in the literature will be highlighted and analyzed. Substantial examples will be constructed to validate the assumptions of our obtained theorems and to show their distinction from corresponding results.

PA 017: EXTENSION OF PACHPATTE RESULT OF OPIAL-TYPE ON TIMES SCALES

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Abstract: The aim of this paper is to use the modified Jensen's Inequality to obtain an extension and refinement of Pachpatte result of Opial-type inequality on times scales.

Keywords: Pachpatte, Opial-type Inequality, Jensen's Inequality, Time Scales.

PA 018: THE NORMAL STRUCTURE OF BANACH SPACES AND FIXED POINT THEOREMS ON CONE METRIC SPACES OVER BANACH ALGEBRAS

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Abstract: This paper deals with the achievement of introducing the notion of normal structures of Banach spaces and studying some fixed point results of mapping with certain contractive conditions on partially ordered cone metric spaces over Banach algebras. Subsequently as an application of our results, we provide some examples. Our results generalize, extend and unify some well-known results in the literature.

Keywords: Normal structure of Banach spaces, cone metric spaces over Banach algebra, partially ordered set, generalized Lipschitz mapping, contractive mapping, fixed points.

PA 019: ON THE PROOFS OF IRREDUCIBLE ELEMENTS FOR INTEGER-VALUED POLYNOMIALS

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Abstract: Let p is a prime such that $p > 2$ and for a natural number $n > 1$. Given that $h(x) = x$

$pn-1(p-1) -q$ for $q \equiv 1 \mod pn+1$ and $q > pn-1(p-1)+n$. Then, h is irreducible in $Q[x]$.

PA 020: THE CONNECTIONS BETWEEN THE VERTICES AND EDGES IN CONNECTED NEIGHBOURHOOD IN GRAPH THEORY

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Abstract: We use graphs to model networks in computers, airlines, phones, social networks and other corridors. They can also be used to model such diverse things as connections between data in a database or in molecular structures. Graph theory studies various connection principles in local and wider connections. Many theorems have been established within nodes or vertices, edges and region, also many theorems have been established among the important components of connections. In this paper we study the connections among the components and how the number of nodes and edges optimally affect the connectivity, since graphs and topological sorting are for automating optimization.

Keywords: Graph theory, Edge, Vertex, Connectivity

PA 021: ON PERTURBED EVOLUTION INTEGRAL EQUATIONS

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Abstract: This paper is concerned with the existence and the stability of solutions of a nonlocal evolution equation perturbed by some random processes. The desired results are obtained by relaxing certain restrictions placed on the evolution operator. Lastly, for the purpose of illustration a problem is solved.

Keywords: Evolution equation; Ulam-Hyers-Rassias Stability; Stochastic perturbed term; Contraction mapping theorem.

PA 022: MATHEMATICAL MODELING OF BLOOD FLOW AND HEAT TRANSFER IN THE HUMAN CARDIOVASCULAR SYSTEM

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Abstract: This research work focus on the mathematical modeling of blood flow and heat transfer impacts in the human cardiovascular system with pulsation and time dependent thermal conductivity. The effects of blood flow and heat transfer with time dependent thermal conductivity in the human cardiovascular system under a closed watch of an external magnetic field is mathematically analyzed. The governing equations subject to the boundary conditions is solved using parameter expanding method and eigenfunction expansion technique. We examine the properties of the fluid dynamical factors of the model equations and provide graphical summaries of the system responses. It is observed that the influence of hematocrit, magnetic field and the shape of artery have important impact on the velocity profile, pressure gradient and wall shear stress. Moreover, the effect of primary stenosis on the secondary one has been significantly observed.

Keywords: Blood flow, Hematocrit, Magnetic Field, Eigenfunction, Velocity Profile, Blood Flow, Heat Transfer.

PA 023: EFFECT OF ENTROPY GENERATION ON HEAT AND MASS FLOW OF A STEADY MAGNETOHYDRODYNAMIC POISEUILLE FLOW IN A VERTICAL CHANNEL: AN EXACT SOLUTION

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Abstract: The steady MHD Poiseuille flow in a vertical porous plate is examined taking into consideration the effect of an inclined magnetic field and constant pressure gradient. The lower plate is assumed to be porous while the upper plate is not porous. An electrically conducting fluid moving with velocity is passed through these vertical channels, at an inclined angle to this flow, the magnetic field is applied. The effect of various flow and heat emerging parameters such as Hartmann number which dampens the velocity of the fluid, and Prandtl number which increases the temperature of the fluid, Granshof number, dimensionless heat generation, and absorption and fluid velocity are examined and their significant effect on the flow of the liquid and movement of the model (momentum and energy). The resulting equations are solved exactly and the effect of each emerging parameter is explained graphically.

PA 024: FIXED POINT THEOREMS ON A NEW GENERALIZED METRIC-TYPE SPACE AND APPLICATIONS

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Abstract: A novel class of metric-types named 'O-metric' which is found out to be a broad unifier of existing metric types and significantly a generalization of not only existing metric types but also almost all possible metric types, is introduced. This metric-type is further classified into upward and downward O-metrics, and the topology of the space generated by the metric is explored. Fixed point theorems on contractive-like maps, contractions, and generalized contractions are proved on this novel space in relation to other popular fixed point results, and extensions consistent to the literature on metric-type spaces are mentioned.

Keywords: O-metric, upward and downward O-metric, O-metric topology, fixed point theorems.

PA 025: FIXED POINTS OF SOME CONTRACTIONS ON O-METRIC SPACES

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Abstract: The class of O-metric spaces was recently introduced as a robust unification of existing metric-type spaces. It also generalizes these metric-type spaces and many other possible metric-types yet to be established in literature. The properties of O-metric spaces and the proof of the famous Banach Contraction Principle on this robust space as presented by Olaoluwa, Ige and Olaleru in 2021 are recalled; fixed point theorems on three new contraction types are proved as extensions of the result on Banach contraction in O-metric spaces. These results generalize some known results in literature. Polygon O-inequalities which are a natural generalization of the triangle inequality play a key role in the proof of the theorems.

Keywords: O-metric, Banach contraction principle, Polygon O-inequalities, contraction types.

PA 026: TRANSMISSION DYNAMICS OF RESERVOIR – HUMAN SAR-COV-2 DISEASE WITH OPTIMAL CONTROL

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Abstract: In this paper, we developed a Reservoir-Human SAR-COV-2 model with four control interventions namely; vaccination, lockdown, nose mask and social distance. Optimal control strategies are proposed to minimize both the disease burden and the intervention cost. Moreover, we proved the existence and uniqueness of optimal control paths and also obtained these optimal paths analytically with the help of Pontryagin's Maximum Principle. Furthermore, we analyzed our results numerically to compare various strategies of proposed controls. Hence, the results obtained through optimal control suggest that control interventions are useful for minimizing infected individuals and improving population health.

Keywords: Sar-cov-2, Stability, Optimal control, Optimal path, Vaccination.

PA 027: SEMI-ANALYTICAL APPROACH FOR SOLVING NON-LINEAR ORDINARY DIFFERENTIAL EQUATIONS: APPLICATIONS TO RICCATI-TYPE EQUATIONS

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Abstract: An effective semi-analytical approach of Differential Transform Method (DTM) for getting the solution of non-linear differential equations with applications to Riccati-type equations is presented in this study. DTM and its fundamental properties were presented. Moreover, DTM has been implemented on four illustrative examples. In addition, comparison has been made between numerical and exact results to obtain convergence to a good degree of accuracy. Furthermore, DTM provides the solutions of RDEs in the form of a convergent power series with easily computable components without any restrictive assumptions and also reduces the numerical computations to a great extent. Hence, the results obtained suggest that DTM can be treated as effective semi-analytical and alternative approach for solving initial value problems of non-linear RDEs.

Keywords: Accuracy, differential transform method, effectiveness, Riccati-type, suitability.

PA 028: HEAT TRANSFER ANALYSIS OF RYTHMICALLY CONTRACTING WALLS WITH SLIPPAGE

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Abstract: The analysis of heat and mass fluxes on the peristaltic motion of an asymmetric channel was explored in this study. The governing equation of fluid flow is altered when an external magnetic field is considered, lubrication theory, and lengthy governing equations are abridged. Reduced coupled non-linear partial differential equations are transformed into non-linear ordinary differential equations, which are then solved analytically. The findings of the velocity profile and temperature are visualized using the computational mathematics software Maple, as well as the trapping phenomenon's streamlines. The graphs produced effectively illustrate all of the findings.

PA 029: NUMERICAL ALGORITHM AS MULTI-ORDER DIFFERENTIAL EQUATIONS SOLVER

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Abstract: Numerical Algorithm as Multi-Order Differential Equations Solver Abstract This research focuses on an innovative procedure of integrating higher-order systems of equations with initial values. The proposed 4-point implicit method constructed by collocation and interpolation procedures was used to integrate system of third, and fourth-order differential equations directly with a substantial enhancement in efficiency. The method derived in a block mode to simultaneously estimate three kind of differential equations has improved accuracy and rate of convergence in problem evaluations. The analysis of the scheme was established via order, consistency, zero-stability, and convergence. The proposed method was used to solve some systems of equations for third and fourth-order as numerical experiments to check the favorable performance of the method in comparison to some existing methods.

Keywords: Accuracy; Block Integrator; Efficiency; Higher-order ODEs; Initial Value Problems (IVPs).

PA 030: STABILITY ANALYSIS OF MATHEMATICAL MODEL ON CONTROL OF COVID-19 PANDEMIC TRANSMISSION DYNAMICS THROUGH VACCINATION AND TREATMENT

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Abstract: Stability analysis of a Mathematical Model on control of COVID-19 Transmission Dynamics through Vaccination and Treatment of humans was established for the model developed which considers vaccinations and drugs in used for treatment of the disease globally. On nine compartment differential equations describing control of COVID-19 transmission using: vaccination, isolation, enlightenment and treatment -of the disease to reduce the resulting human casualty figures. The invariant region of the model was defined and the positivity of the solution established. The model stability analyses for the disease-free equilibrium (DFE) and Endemic Equilibrium points obtained shows interesting result that supports medical literature.

Keywords: Stability, Mathematical Model, COVID-19.

PA 031: TIME DEPENDENT PRESSURE DRIVEN FLOW IN A HORIZONTAL CYLINDER FILLED WITH A BIDISPERSE POROUS MATERIAL

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Abstract: Some properties of time dependent modify Brinkman equations for fluid flow in a cylindrical tube filled with Bidisperse porous material are discussed in this article. The fluid velocities through the fracture and porous phases of the Bidisperse Porous Medium resulting from the application of pressure gradient are described by two coupled second order partial differential equations. Laplace transform technique, D'Alembert and Riemann Sum Approximation methods are used to obtain a semi-analytical solution for the model. The choice of the D'Alembert is to systematically decouple the coupled governing equations without altering their initial orders. The role of the coupling parameter: the coefficient of momentum transfer (η) in the flow formation is considered. Accordingly, three cases are analyzed: (a) weak coupling $(\eta = 0)$ which described the fluid flow in the absent of the coupling parameter, (b) the strong coupling resulting from large value of the coupling parameter $(\eta \to \infty)$ and (c) fluid momentum for any arbitrary value of η. It is observed that the fluid stability is attained when Da_f and Da_p are decreased; a finding that agrees with the findings of Nield and Kuznetsov (2013) and Magyari (2013). Also, the maximum velocity in the fracture phase of the BDPM is attained when the coefficient of momentum transfer is neglected $(\eta = 0)$.

Keywords: Transient State Velocity; Bidisperse Porous Medium; Coefficient of Momentum Transfer; Laplace Transform Techniques; D'Alembert method.

PA 032: HORIZONTAL METHOD FOR COUPLING RIVER AND FLOOD FLOWS

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Abstract: A method to simulate the problem of coupled flow of rivers and flood is presented. Two-dimensional shallow water model and one-dimensional Saint Venant model are adopted for the flood and River flows respectively. Then a 1D coupling source term is derived in closed form, while a sub-2D model is proposed for the first time to capture multi-dimensional flow features within the river. Godunov-type finite volume schemes are adopted for both flood and River models. The discrete 1D coupling term is derived in closed form and a new subcell hydrostatic reconstruction algorithm is proposed. The properties of the resulting method are proved theoretically. The numerical results show the accuracy and efficiency of the proposed method over existing methods.

PA 033: DUAL PASSAGE MHD HEAT TRANSFER IN A VERTICAL PARALLEL WALL CHANNEL WITH WALL SLIP AND POROUS MATRIX

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Abstract: The current study investigates the flow of a mixed convection thermally radiating flow and heat transfer under the influence of a magnetic field in a vertical channel partially filled with a Darcy Forchheimer porous matrix of finite thickness attached to one of the walls. While taking the slip condition at the boundary wall into account, this flow model considered the effects of Lorentz force, Roseland radiation, permeability, viscous dissipation, as well as Ohmic dissipation. The resulting governing equations which is non-linear together with the corresponding coupled boundary conditions are dimensionalized and solved using the Homotopy Perturbation Method (HPM), a semi analytical technique. The velocity and temperature profiles are deduced and discussed by means of graphs for various values of the pertinent emerging parameters. The analytic expression for the effect of the, Magnetic field, Grashof number, Stark number, permeability of the porous substrate, Prandtl, and Brinkman parameter on the flow transport and temperature fields are analysed and discussed. From the graphical presentations these parameters have significant influence on the fluid flow. It is of note that the presence of a transverse magnetic field in this present model impedes flow and subsequently reduces heat dissipation.

PA 034: DYNAMIC EPIDEMIC MODEL OF COVID-19 WITH DISEASE INDUCED DEATH RATE

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Abstract: Novel Coronavirus is a highly contagious disease with more than one million laboratory confirmed cases and recorded number of death cases. The disease has affected almost all nation of the world and has cost untold hardship on the world economy. The rate of transmission by dead bodies of COVID-19 induced death rate and are not properly buried has been identified as one the factor that can trigger the highly infectious disease globally. In justifying this claim quantitatively, we propose and analyse a nonlinear mathematical model to investigate the effect of improper burial of the disease induced dead bodies in the transmission of Coronavirus disease (COVID-19) prevalence. Rigorous stability analysis of the model equilibrium was performed to ascertain the basic reproduction number. Numerical simulation was carried out by using real life data to further support our analytical claims. We therefore, conclude that the model analytical result shows that diseases free equilibrium is locally and globally asymptotically stable.

Keyword: COVID-19, induced death, stability, reproduction number, exploratory data analysis.

PA 035: QUADRATIC MIXED CONVECTION TANGENT HYPERBOLIC FLUID STRATIFIED FLOW PAST A VERTICAL ELONGATED SHEET WITH NONLINEAR THERMAL RADIATION: SPECTRAL LOCAL LINEARIZATION METHOD

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Abstract: In the present study, the flow of tangent hyperbolic fluid over a vertically elongated sheet with double stratification and nonlinear thermal radiation effects is investigated. The model is developed with nonlinear mixed convection of second-order via Boussinesq approximation, a transverse magnetic field of uniform strength, viscous dissipation effects and temperature-dependent thermal conductivity. The model equations are transformed from nonlinear partial differential equations into ordinary differential equations through appropriate similarity transformation quantities while the translated equations are solved with an iterative technique known as the Spectral Local Linearization Method (SLLM). A comparison of the obtained results in the current study with related existing studies in literature shows perfect agreement under some limiting constraints. The physical parameters' effects on the dimensionless velocity, temperature, skin friction coefficient and Nusselt number are clearly illustrated by various graphs. In the analysis, it is found that an increase in the fluid material parameter decelerates the fluid motion while the velocity appreciates with the mixed convection term. Similarly, the surface heat transfer improves by raising the value of the temperature ratio parameter (nonlinear thermal radiation) whereas there is a reduction in the heat transfer in the presence of the thermal stratification parameter.

Keywords: Mixed convection; Tangent hyperbolic fluid; Nonlinear thermal radiation; Stratified flow; Spectral Local Linearization Method.

PA 036: ON FORMULATION OF HETEROGENIC VEHICLE ROUTING PROBLEMS (HVRP) OBJECTIVE FUNCTION WITH PRIORITIES AND FORCED SPLIT DELIVERY

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Abstract: As businesses expand with numerous customers entering the supply chain daily, different cases and issues ranging from different customers with different conditions of services, different vehicles with variant conditions, and the problems facing the routes are not left out. This paper is aimed at developing a model for Heterogenic Vehicle Routing Problems (HVRP) with time windows, quantities, and Forced Split Delivery resulting from: Customers' Vehicular Preference, Road Time Restriction, Vehicle Weight Restriction, and Vehicle Height Restriction. It puts into consideration the service choices and recent research updates on fleet sizes, mixed vehicles as well as looks into the differences in customers' demand over the quantity the vehicle can carry. The formulation of the HVRP objective function emphasizes robustness and demonstrates a simplified architecture that minimizes the total travel cost (as it relates to the travel schedules, the travel cost, or the interspace), minimizes the running cost (relating to the fixed cost as well as the variable cost of several channels used), maximizes the clienteles' priorities and carter for the marginal difference in vehicle capacity, is extensively and explicitly discussed.

Keywords: Vehicle Weight Restriction, Forced Split Delivery, Heterogenic Fleet, Vehicle Height Restriction, Road Restrictions, and Priorities.

PA 037: A PAIR OF THREE-POINTS SIXTH DERIVATIVE MULTISTEP TECHNIQUE FOR SOLVING SECOND-ORDER PROBLEMS IN APPLIED MATHEMATICS AND ENGINEERING

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Abstract: This article presents a pair of three-points sixth derivative multistep technique (TSDMT) for numerical approximation of second-order problems arising from applied mathematics and engineering. The derivation of the TSDMT is grounded on collocation of the sixth derivative function at equidistant points while the interpolation is done at the appropriate points which coincides with the order of the differential equations to be solved. The TSDMT is a continuous scheme and applied to get simultaneous approximations to the solution and its derivative at every point in the interval of integration. The convergence analysis and order of accuracy of the TSDMT is discussed. The TSDMT is compared with the exact solution to show that they are in good agreement. Lastly, to determine the uniqueness of the method and its application, the comparison of the Efficiency and error curves of the TSDMT with other existing methods were also presented to illustrate the advantages of the TSDMT over other existing methods.

Keywords: A pair of three-point Method; Sixth derivative multistep techniques, Collocation approach; Convergence analysis, second-order models, applied mathematics & engineering problems.

PA 038: A MULTISTEP METHOD FOR A SPECIAL CLASS OF SECOND-ORDER DIFFERENTIAL EQUATIONS

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Abstract: A multi–step numerical method for the solution of second order ordinary differential equation was developed by interpolating in a finite range with a basis function. The basis function consists of a combination of exponential and trigonometric functions to ensure that such problems possess unique and continuously differentiable solutions. The method tested and found to be reliable, efficient and less tedious than other multistep methods which require reduction of higher order equations into several first-order equations, as it was applied to some special second order equations arising from mechanics and engineering problems. The requisite numerical properties were obtained.

Keywords: order equations, numerical method, basis function, linear multistep method.

PA 039: IMAGING OF ORGANIC AND INORGANIC MATERIALS IN A CYLINDRICAL PIPE

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Abstract: In this study, magnetic resonance imaging (MRI) has further been applied to image organic and inorganic materials that may be causing blockage in a cylindrical pipe. The T1 and T2 relaxation rates of Brines as well as Gas crystals and fat were used in the Imaging Equation mathematically to probe and picture blockage in the cylindrical pipe. The gradient pulse is designed such that it undergoes trigonometrical and exponential rise and fall. The results show that the graphical pattern changed when the fluid undergoes free flow as compared to when there is blockage. This indicates the presence of obstruction to the fluid flow. One discovery from the plaques imaged is that when the time is varied, there is a drop in the magnetization which shows the effectiveness of the method of magnetic resonance imaging (MRI) as the signal is registered in microseconds!

Keywords: Magnetic field, Radio frequency, Gradient and Field of view.

PA 040: SOLVING SECOND-ORDER ELLIPTIC PDES NUMERICALLY USING BLOCK UNIFICATION MULTISTEP TECHNIQUES AND THE METHOD OF LINES

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Abstract: In this article, a block unification technique (BUMT) for the numerical solution of second-order elliptic partial differential equations (PDEs) is developed, analyzed, and implemented. The method was derived through Collocation and Interpolation techniques using Hermite polynomial as the basis function. The Hermite polynomial is interpolated at the first two successive points while the collocation was done at all the suitably chosen points. The main scheme and its complementary scheme were combined together to form the BUMT. The convergence analysis of the BUMT confirms that the BUMT satisfied the condition for convergence. In other to determine the exceptionality, accuracy, and efficiency of the BUMT, the method of lines approach was applied to discretize the second-order elliptic partial differential equation PDES into a system of second-order ODEs and subsequently use the derived BUMT to compute the approximate solutions for the PDEs. The computed solution produced by using the BUMT is compared to the exact solutions of the problems and other existing methods. The BUMT gives better accuracy which is validated through the test problems whose solutions are presented in tabular form and curves.
Keywords: Second-order elliptic PDEs; Block unification multistep techniques, Hermite polynomial approach; Convergence analysis, Initial & boundary value problems, Method of lines.

PA 041: STABILITY ANALYSIS OF EPIDEMIC MODEL ON LEPTOSPIROSIS WITH NONLINEAR INCIDENCE RATES

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Abstract: This paper explores the non- linear epidemic models of Leptosirosis, an infectious disease caused by bacteria belonging to genus Leptospira. The organism penetrates abraided skin or intact mucous membranes after which they enter the circulation and flow speedily to various tissues. The disease is mostly common in tropical and Subtropical climate regions. A Susceptible-Exposed-Infected- Removed (SEIR) model is used to study the stability analysis, analytical solution and global behaviour of the spreading of the disease. The model was analyzed using the techniques of nonlinear dynamical modeling method. Two equilibrium points are found and the stability and uniqueness conditions for these equilibrium points are established. Numerical solutions are shown to support and further confirm our analytical result.

Keywords: Leptospirosis, mathematical models, global behavior, numerical solutions.

PA 042: ENTROPY GENERATION ANALYSIS FOR A VARIABLE VISCOSITY REACTIVE MHD FLUID FLOW IN AN ANNULUS UNDER EXPONENTIALLY APPLIED MAGNETIC FIELD

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Abstract: This article examines the entropy generation of magnetohydrodynamics (MHD) flow of chemically reactive and radiating third grade Magnetohydrodynamics fluid flow through a cylindrical annulus with variable viscosity and exponentially applied magnetic field. The nonlinear governing equations along with the boundary conditions are first non-dimensionalized and are solved analytically using Adomian Decomposition Method. The effects of various physical parameters such as magnetic parameter, Hall parameter, Biot number, Bejan number are discussed and graphically presented.

Keywords: Magnetohydrodynamics, Third grade fluid, Entropy generation, Bejan number.

PA 043: IMPROVED EULER'S METHOD NUMERICAL SIMULATION FOR THE SOLUTION OF TIME VARIANT OPTIMAL CONTROL PROBLEMS

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Abstract: This paper discussed the extension of an improved Euler method to the solution of optimal control problems with the state constrained by differential equations. The method combined the classical method with the numerical algorithm of Euler by embedding the boundary conditions from the Hamiltonial into the algorithm of Euler. A suitable formula for updating the control variable u(t) at each one dimensional search was developed. The Numerical results generated by this process demonstrated the stability and robustness of the method as it triumph over reasonable number of problems.

Keywords: Euler method, Optimal Control Problems, Hamiltonian, Algorithmic process, Control variables.

PA 044: COMPARATIVE ANALYSIS OF TRANSMISSIBILITY AND CASE FATALITY RATIO OF SARS, MERS AND COVID-19 VIA A MATHEMATICAL MODELING APPROACH

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Abstract: Coronavirus epidemics emerged in the 1960s and the world has witnessed seven coronavirus outbreaks since then. Four of the coronaviruses instigate human influenza while the rest: Severe Acute Respiratory Syndrome Coronavirus (SARS-CoV), the Middle East Respiratory Syndrome Coronavirus (MERS-CoV) and Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-CoV2) trigger severe respiratory disorders (SARS, MERS and COVID-19 respectively). The etiology of SARS, MERS and COVID-19 are similar but their epidemiology, in terms of incubation period, infectivity, case fatality ratio and the serial interval differ. In an attempt to compare the infectivity and case fatality ratio of the diseases, a mathematical model was considered for each disease. The key epidemiological quantity, the basic reproduction number, was derived for each model to examine the transmission potential of each disease. The mortality rates for the diseases were also investigated by considering the global report of COVID-19 as of October 1 2020 together with the history of SARS and MERS. Results from the computations showed that COVID-19 had the highest transmission potential and at the same time the lowest case fatality ratio. It was also revealed that COVID-19 would have wrecked more havocs had its case fatality ratio was as high as that of MERS.
Keywords: Coronavirus; incubation period; infectivity; case fatality ratio; reproduction number.

PA 045: HYBRID BLOCK NUMERICAL ALGORITHM FOR DIRECTLY SOLVING THIRD AND FOURTH ORDER ORDINARY DIFFERENTIAL EQUATIONS

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Abstract: This paper investigates a single and efficient hybrid block numerical technique for solving third and fourth order initial value issues. The novel method was developed using an interpolation and collocation methodology, with a power series approximate solution as the interpolating polynomial. The numerical integrators that formed the block were derived by evaluating the non-interpolating points within the selected interval of integration. The efficiency of the block was tested on some third and fourth orders ordinary differential equations and the results produced performed better when compared with existing methods in terms of accuracy.

Keywords: Block Method; Collocation; Hybrid; Interpolation; Power series; third order; fourth order.

PA 046: ON THE NUMERICAL SOLUTION OF NONLINEAR EMDEN EQUATIONS

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Abstract: This paper discusses numerical solution of nonlinear Emden Fowler's equations. The problem is transformed into system of nonlinear algebraic equations by collocation of the approximate solution using the standard collocation points. The efficiency of the method is tested using some numerical examples solved in literature. The results are accurate and the implementation is simple.

Keywords: integro-differential equation, Emden Fowler's equations, collocation method, Lebnitz multiple integral formula.

PA 047: SARS-COV-2 AND SELF-MEDICATION IN CAMEROON: A MATHEMATICAL MODEL

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Abstract: Self-medication is an important initial response to illness in Africa. This mode of medication is often done with the help of African traditional medicines. Because of the mis-conception that African traditional medicines can cure/prevent all diseases, some Africans may opt for COVID-19 prevention and management by self-medicating. Thus to efficiently predict the dynamics of COVID-19 in Africa, the role of the self-medicated population needs to be taken into account. In this paper, we formulate and analyse a mathematical model for the dynamics of COVID-19 in Cameroon. The model is represented by a system of compartmental age-structured ODEs that takes into account the self-medicated population and subdivides the human population into two age classes relative to their current immune system strength. We use our model to propose policy measures that could be implemented in the course of an epidemic in order to better handle cases of self-medication.
Keywords: COVID-19; unconcerned infectious individuals; testing; stability analyses; stochastic sensitivity analysis.

PA 048: MODELLING THE IMPACT OF UNCONCERNED COVID-19 CASES IN NIGERIA: A DETERMINISTIC AND STOCHASTIC APPROACH

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Abstract: COVID-19 is caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). Many measures have been made by World Health Organization (WHO), but these may be threatened by unconcerned infectious individuals (some infectious individuals who do not take the disease serious, by ignoring non-pharmaceutical intervention). A system of nonlinear ordinary differential equations that absorbs a class of unconcerned infectious individuals and its corresponding stochastic differential equation model to capture the randomness in the system were developed. An invasion threshold parameter, Rc, is derived using the next generation matrix approach. This is used to establish the global stability of COVID-19-free equilibrium points. The global asymptotic stability of COVID-19 persistence equilibrium solution is studied through the use of suitable LaSalle's Invariance Principle with a Lyapunov function of Goh-Volterra type. The intervention of the model key parameters is assessed through sensitivity analysis. Analyses of the stochastic model was also carried out and the results of the stochastic model were compared with the ODE model using numerical simulations. Our results indicate that increase in the rate of hospitalization of the asymptomatic infectious and unconcerned infectious individuals after a compulsory national testing, could bring Rc below one. Our results suggest that there should be compulsory national testing and continuous enhancement, the awareness through effective risk communication concerning COVID-19 to the general public. Numerical simulations are carried out to validate the analytical results.
Keywords: COVID-19; unconcerned infectious individuals; testing; stability analyses; stochastic sensitivity analysis.

PA 049: CONVERGENCE OF FINITE DIFFERENCE METHOD FOR PARABOLIC PARTIAL DIFFERENTIAL EQUATIONS: A MODIFIED CRANK-NICOLSON METHOD

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Abstract: This paper presents the convergence of finite difference method for parabolic partial differential equation using modified Crank-Nicolson scheme. Considering the fact that for a finite difference approximation to be convergence, consistency and stability are necessary, we have therefore, derive the local truncation error, consistency and stability of the modified scheme and show that the scheme converges to the analytical solution using numerical examples.

Keyword: Finite difference method, convergence, local truncation error, consistency, mesh size, heat equation.

PA 050: NUMERICAL MODEL FOR MAGNETOHYDRODYNAMIC MICROPOLAR NANOFLUID FLOW AND HEAT TRANSFER OVER A STRETCHY SHEET CONTAINING GYROTACTIC ORGANISM WITH CONCENTRATION BASED HEAT SOURCE

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Abstract: Bioconvection flow and heat transfer analysis of hydromagnetic non-Newtonian fluid of non-symmetric stress tensor which is made up of rigid randomly oriented particles suspended in a viscous medium is investigated in this study. The fluid contains tiny particles of nanomaterial with swimming microorganism flowing along a two-dimensional stretchy sheet with concentration based heat source. With the use of a suitable similarity transformation quantities, the developed partial differential equations are remodeled into ordinary differential equations and subsequently solved numerically using the Runge-Kutta-Gill method coupled with shooting technique. The outcomes of the investigation are presented through graphs and tables with appropriated analysis and discussions of results for specific applications. It is revealed that growth in the material parameter improves the hydrodynamic boundary layer but reduces the surface drag force whereas the magnetic field term behaves in an opposite manner. The temperature distribution improves significantly with a rise in the haphazard motion of the tiny particles, thermophoresis, and concentration based heat source.
Keywords: Magnetohydrodynamic; Micropolar nanofluid; Concentration based heat source; Gyrotactic microorganism.

PA 051: MODELLING INTEGRATED RIVER AND FLOOD FLOWS: THE SUBCELL COUPLING METHOD.

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Abstract: This study proposes a technique to simulate the coupled flow of rivers and floods. River flows are unidirectional provided no flooding but become multidimensional once flooding sets in. The problem of appropriately combining an efficient 1D channel model and an accurate 2D flood model is tackled. The 1D model which is built with coupling terms that link channel flow to the flood flow, and 2d model which includes surface fluxes that link flood flow to channel flow, are both adopted. To recover the lateral discharges within the channel, an adhoc 2d model is proposed and a new subcell hydrostatic reconstruction algorithm is proposed for the first time to approximate the lateral discharges model. The resulting scheme is proved to be well balanced and Mass conservative. The numerical results verify the efficiency and accuracy of the approach over existing method in the literature.

PA 052: EVALUATION OF MELTING HEAT TRANSFER MECHANISM IN MHD HYBRID NANOFLUID FLOW OVER A SLENDERING ELONGATED SHEET IN A POROUS MEDIUM

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Abstract: Melting heat transfer phenomenon finds useful application in magma solidification, the melting of permafrost, the thawing of frozen grounds, and the preparation of semi-conductor materials. Hence, the present study evaluates the mechanism of melting heat transfer in a magnetohydrodynamic (MHD) hybrid nanofluid over a slendering stretching sheet characterized by a variable thickness in a porous medium. The considered heat equation in the model features the effects of thermal radiation via Roseland approximation, viscous dissipation and Joulean heating. The transport partial differential equations modelling the physical situation are re-structured into ordinary differential equations using similarity variables while numerical technique via shooting technique together with Runge-Kutta-Fehlberg (RKF) method is employed to provide solution to the equations. The outcomes of the analysis are presented in tables and various graphs. It is found that the thermal boundary layer thickness enlarges with a rise in the magnitude of nanoparticle volume fraction, melting heat transfer and magnetic field parameters whereas the momentum boundary layer decelerates with magnetic field and nanoparticle volume fraction terms. Furthermore, the Nusselt numbers corresponding to heat transfer improves with an increase in the thermal radiation, Darcy and Eckert numbers. Under limiting conditions, the obtained results are found to be perfectly correlated with related existing studies in the open literature.
Keywords: Hybrid nanofluid, Melting heat transfer, Slendering sheet, Porous medium, Thermal radiation.

PA 053: A NUMERICAL METHOD FOR SOLVING VOLTERRA INTEGRO-DIFFERENTIAL EQUATION

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Abstract: A third derivative trigonometrically fitted method is developed to approximate the solution of Volterra Integro-differential equations via the multistep collocation method. The VIDEs are first reduced to initial value problems (IVPs) by the Leibnitz rule of differentiating integral. A continuous third derivative trigonometrically fitted method is derived with the trigonometric basis function from which the main method is generated. The complementary methods are generated from the third derivative of the continuous version and are then applied with the main method as simultaneous integrators in a block-by-block form. The numerical properties such as zero-stability, and region of stability of the proposed method are investigated while its accuracy is demonstrated through well-known examples.

PA 054: A CLASS OF POWER SERIES LEGENDRE COLLOCATION MULTISTEP METHODS FOR THE INTEGRATION OF INITIAL VALUE PROBLEM USING PYTHON

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Abstract: In this paper, we present a new approach for the derivation of a class of collocation linear multistep methods for the integration of some initial value problems of ordinary differential equation. The derivation of the discrete methods of orders p=2,3,4, and 5 for the un-economized collocation method for solving Initial Value Problems. By introducing the Legendre polynomial terms, the economized invariants of the methods are derived. The methods are all consistent and zero stable, thus they are convergent. For implementation as predictor-corrector pairs, the class of explicit methods of the Adams Bashforth methods are used as predictors while the new methods which are implicit are used as correctors. Python programming language and MATLab were used for the numerical computations. The methods compete favourably with other methods known in literature.

Keywords: Linear Multistep Methods, Legendre polynomials, integration, Python codes, Collocation methods and absolute stability

PA 055: ANALYTICAL SOLUTIONS FOR THE UNSTEADY MAGNETOHYDRODYNAMICS (MHD) FLOW OF A FOURTH-GRADE FLUID EMBEDDED IN A POROUS MEDIUM WITH DARCY RESISTANCE EFFECTS.

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Abstract: This study focuses on obtaining a new class of analytical solutions for a nonlinear partial differential equation capturing the unsteady magnetohydrodynamics (MHD) flow of a fourth-grade fluid with Darcy resistance effects. The governing nonlinear problem is analysed via the Lie symmetry approach. Travelling wave solutions of the forward and backward, and conditional symmetric solutions, form the basis of our analytical analysis. The essential characteristics of the embedded fluid parameters are graphically discussed in details. In particular, the physical significant of the suction/injection, porosity and magnetic field is studied

Keywords: Conditional symmetric approach, Darcy Resistance, Fourth grade fluid, Lie symmetry approach, magnetohydrodynamic flow.

PA 056: STABILITY OF SOLUTIONS FOR A CLASS OF SECOND ORDER NONLINEAR INTEGRO-DIFFERENTIAL EQUATIONS WITH DELAY

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Abstract: In this paper, we investigate the stability of solutions for a class of second order nonlinear delay integro-differential equations by using a suitable Lyapunov-Krasovskii functional with sufficient conditions to establish our new results. An example is given to show the validity of the results obtained.

PA 057: A COMPARATIVE ANALYSIS OF SHARE PRICES BEHAVIOUR OF SOME SELECTED COMPANIES, PRE, DURING AND POST COVID-19 LOCKDOWN PERIOD IN NIGERIA

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Abstract: Investigating the impact of COVID-19 Lockdown on Stocks Share Prices afford government or its agencies on timely evidence guided policy response. We therefore examined the share prices of stocks from three sectors of the economy, which comprises of the Manufacturing sector (Nestle, Dangote Cement, Dangote Sugar, PZ and Nigeria Breweries (NB)), Banking and finance sector (GT Bank, First bank, Zenith Bank, UBA and Wema Bank.) and Oil and gas sector (MRS filling station, Total filling station, Mobil filling station, Oando filling station and Conoil filling station.) And comparison of the stock prices pre COVID-19 lockdown, during lock down and post COVID-19 lockdown was analyzed using Analysis of Variance (ANOVA) at five percent level of significance. The result of the analysis of the banking and finance sector reveals that share prices means for the pre, during and post COVID lockdown are the same. This implies that the lockdown period does not have any significant different on prices of share in Banking and Finance Sector, and there is different between share prices means of the companies in that sector. Also the analysis of the oil and gas sector reveals that, share prices means for the pre, during and post COVID lockdown are the same, which implies that the lockdown period does not affect the prices of share in Oil and Gas Sector but there is also difference between share prices means of the companies in that sector. The analysis of the manufacturing sector also reveals that share prices means for the pre, during and post COVID lockdown are the same. which implies that the lockdown period does not have any significant different on prices of share in Manufacturing Sector.

Keywords: COVID 19, Lockdown, ANOVA, Stock Share Prices.

PA 058: POINT RESULTS FOR ASYMPTOTIC QUASI CONTRACTION MAPPINGS IN UNIFORM SPACES

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Abstract: The best proximity point theorem is investigated in a new class of asymptotic quasi contraction of Meir-Keeler type. The existence and uniqueness of best proximity point of a pair of this contraction satisfying weakly comparable condition will be proved in the context of uniform spaces. This is a generalisation of previously known results in metric spaces. Example will be given to validate the results obtained. The examples which illustrate the main result and the comparison of this result with the ones existing in literature will be given.

PA 059: ON SUBGROUPS OF A PRESENTATION GROUP WITH GENERATORS OF SAME ORDER.

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Abstract: We shall determine the number of subgroups of a presentation group G. We identify the form and the order of elements of the finite group G. The lattice of subgroups will be presented.

PA 060: GREEN FUNCTIONS OF CAPUTO-FRACTIONAL PARTIAL DIFFERENTIAL OPERATOR WITH ELLIPTIC PERTURBATION

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Abstract: In this paper, the Green function in terms of a symmetric function of Caputo-fractional operator with elliptic perturbation is obtained. The Fourier transform approach is adopted.

PA 061: STOCK OPTION PRICE FORECAST UNDER ECONOMIC RECESSION-INDUCED STOCHASTIC VOLATILITY HESTON MODEL

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Abstract: We present a model for an option pricing with economic recession-induced stochastic volatility in a univariate Heston setting. The recession-induced volatility concept of Bankole and Ugbebor is extended to the Heston model to account for uncertainty effect of recession on option returns on an underlying stock asset in a recessed economy. The model formulated is subject to two economic states which allows regime switching based on the economic state under consideration. The characteristic function for the model is derived and subjected to Fast Fourier Transform method of Carr and Madan for option price computation. The numerical integration approximations based on Trapezoidal rule and Simpson's rule is applied and simulation of the model is carried out to obtain European-type call option prices. The option prices obtained with our approach shows significant improvement on the existing Heston model especially with the economic recession parameters inclusion.

PA 062: REVIEW ON FLOW SHOP PROBLEMS AND INFORMATION DELAY

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Abstract: Abstract Scheduling is simply the timetable for carrying out activities, with many applications. It is a widely studied and complex combinatorial optimization problem. Among the different tasks in production logistics, job scheduling is one of the most vital applications, because operational decisions enable organizations to achieve competence in real-life situations. One important application of scheduling is the flow shop problem, which involves scheduling a sequence of jobs on a series of machines to optimize a certain criterion. Possible criteria include minimizing total time to complete all jobs, number of late jobs, total tardiness etc. In a traditional flow shop problem, the job processing times are known (deterministic) however, in realistic situations the processing times may vary due to unforeseen circumstances (uncertainties). Additionally, jobs may require information from management to be completed, and this information may not be immediately available. This paper provides a general overview of the flow shop scheduling problem under uncertainties and information delays. Previous papers about flow shop problems were analyzed and classified. Trends in the reviewed literature are presented and finally, some research opportunities in this field are proposed.

PA 063: AN SEIRS DETERMINISTIC EPIDEMIC MODEL WITH VITAL DYNAMICS FOR A REVIVAL AND ITS SUSTAINABILITY

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Abstract: Revival in the Christendom refers to a mystical new start from a state of dormancy or stagnation in the lives of Christians called believers. It involves the reemerging of a love for God, a passion for His Word and His church, a convicting awareness of personal and corporate sin, a spirit of humility, and a desire for repentance and growth in righteousness. The evidence of revival, a great outpouring of the Holy Spirit upon believers, is changed lives. Great movements toward righteousness, evangelism, and social justice occur. Believers are once again spending time in prayer and reading and obeying God's Word. Revival spreads from person to person, it happens with and through others, but it always begins with a believer and through contacts with unbelievers, it spreads like an infection. The author in this paper proposes a new deterministic model with vital dynamics from the SEIRS epidemic model to study the dynamic of a Christian religious revival and its sustainability involving the relationship between the susceptible S (Unbelievers), exposed E (those that had contact with the believers but are yet unbelievers), infected I (Believers), and recovered R (Backsliders) individuals for understanding the proliferation of a religious revival. The model proposed is a system of four ODEs where discipleship was introduced as a means of keeping believers permanently or near permanently in the infected state; hence sustaining revival for a long period of time (in years) and reducing backsliding to its barest minimum. The model shall be solved, analyzed using both empirical and hypothetical data and the results presented.

Keywords: SEIRS Model, Epidemic, Revival, Dynamic and Sustainability.

PA 064: STABILITY AND BOUNDEDNESS RESULTS OF SOLUTIONS OF CERTAIN SYSTEM OF THIRD ORDER NON-LINEAR DIFFERENTIAL EQUATIONS

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Abstract: This paper provides certain conditions for the global asymptotic stability of the trivial solution and boundedness of all solutions for a certain class of third order non-linear differential equation. By employing the direct method of Lyapunov as a basic tool, we establish the results of this paper. Examples are given together with the simulations of the numerical solutions of the examples constructed to illustrate the correctness of results. The results in this paper compliment and improve on some existing results in literature.

PA 065: MATHEMATICAL MODEL FOR VECTOR-TRANSMITTED AND TRANSFUSION TRANSMITTED MALARIA DISEASE

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Abstract: In this paper, we study the transmission dynamics of malaria infection under the administration of treatment, where the disease is transmitted through mosquitoes and transfusion of blood components. The basic properties of the model are studied, while the basic reproduction number RO, is computed using the epidemiological approach. Stability of the disease-free state is investigated. The result shows that the dynamics of the malaria model is determined by the basic reproduction number RO. Such that, if RO < 1, the disease-free equilibrium is both locally and globally stable and the disease dies out. If RO > 1, the disease-free equilibrium is unstable and the disease persist in the population.

PA 066: OPTIMAL CONTROL ANALYSIS FOR A TUBERCULOSIS-LYMPHATIC FILARIASIS CO-INFECTION MODEL

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Abstract: The co-infection model of Iyare and Akhaze (2021) was extended to assess the impact of three control measures (prevention of lymphatic filariasis, killing of mosquitoes and treating those with active tuberculosis) on the transmission dynamics of the two diseases. Using analytic method, we proved the existence of the optimal control. From our numerical simulation, we found out that when the three controls, that is, prevention of lymphatic filariasis, killing of mosquitoes and treating those with active tuberculosis are combined, the two diseases can be effectively controlled in the community. But if the resources are limited, our results shows that efforts should be geared towards killing of mosquitoes and treating those with active tuberculosis cases.

PA 067: A SOLITARY WAVE SOLUTION TO THE GENERALIZED BURGERS-FISHER'S EQUATION USING AN IMPROVED DIFFERENTIAL TRANSFORM METHOD: A HYBRID SCHEME APPROACH

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Abstract: In this research, an unrivalled hybrid scheme which involves the coupling of the new Elzaki integral transform (an improved version of Laplace transform) and a modified differential transform called the projected differential transform (PDTM) have been implemented to solve the generalized Burgers-Fisher's equation; which springs up due to the fusion of the Burgers' and the Fisher's equation; describing convective effects, diffusion transport or interaction between reaction mechanisms, traffic flows; and turbulence; consequently finding meaningful applicability in the applied sciences viz: gas dynamics, fluid dynamics, turbulence theory, reaction-diffusion theory, shock-wave formation, traffic flows, financial mathematics, and so on. Using the proposed Elzaki projected differential transform method (EPDTM), a generalized exact solution (Solitary solution) in form of a Taylor multivariate series have been obtained; of which the highly nonlinear terms and derivatives handled by PDTM have been decomposed without expansion, computation of Adomian or He's polynomials, discretization, restriction of parameters, and with less computational work whilst achieving a highly convergent results when compared to other existing analytical/exact methods in the literature, via comparison tables, 3D plots, convergence plots and fluid-like plots. Thus showing the distinction, novelty and huge advantage of the proposed method as an asymptotic alternative, in providing generalized or solitary wave solutions to a wider class of differential equations.

PA 068: INTRODUCTION TO SWITCHED SYSTEMS

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Abstract. In this talk, we shall introduce the notion of switched differential systems, state Filipov existence theorem, and raise their stability problems.

PA 069: APPLICATIONS OF SPECTRAL GRAPH THEORY TO NETWORK ANALYSIS

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Abstract: Spectral graph theory is the study and exploration of graphs through the properties of the eigenvalues and eigenvectors of the matrices associated with those graphs such as the adjacency matrix and the Laplacian matrix. In this talk we shall present some applications of spectral graph theory to the analysis of networks such as wireless mesh network.

PA 070: ODD ORDER NUMERICAL METHOD FOR THE SOLUTION OF INITIAL VALUE PROBLEM OF FIRST ORDER DIFFERENTIAL EQUATION

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Abstract: In this paper, a new numerical scheme for solving first order differential equations is developed. The sum of trigonometric and even order polynomial function is used as assumed solution in this work. The scheme is designed to solve IVP with points of singularity by the introduction of two control complex functions. The complex functions represent the nature of singularity (N) and the location of singularity (A). The absolute error is computed to show the efficiency and accuracy of the proposed method. The resulting numerical results are compared with those previously published in the literature.

COMPUTER SCIENCE AND STATISTICS

CS 001: EVALUATION OF AUTISM SPECTRUM DISORDER (ASD) DIAGNOSIS USING MACHINE LEARNING MODELS

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Abstract: The study of Autism Spectrum Disorder (ASD) has witnessed several developments since its first study in 1908 by Eugen Bleuler. However, since the diagnosis of ASD does not follow the traditional medical protocol, diagnosis is difficulty and often delayed. This paper conducts predictive analysis by applying Machine Learning models to data across four age groups viz: Toddlers, Children, Adolescents and Adults. The machine learning models implemented were derived from 4 categories: Linear Models, Tree Models, Non-Linear Models and Ensemble Models. It was observed based on the AUC Score, Precision, Recall and F1 score of the models that the Logistic Regression, Naïve Bayes and AdaBoost classifier models had the best predictive ability. Chi-Square test of independence was conducted to explore the relationship between ASD and some socio-demographic variables, Neonatal Jaundice and Genetics. The results established a significant relationship genetics and ASD, Jaundice and ASD, indicating that a known family history of autism increases the likelihood of a positive autism diagnosis. In addition, the results recorded a statistically significant relationship between Gender and ASD diagnosis in toddlers, but not in children, adolescents and adults.

Keywords: Predictive analysis, Machine Learning, Autism Spectrum Disorder, Neonatal Jaundice, Ensemble Models.

CS 002: A NEW GOMPERTZ-SHANKER DISTRIBUTION WITH APPLICATIONS

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Abstract: This work proposed a new probability distribution called Gompertz-Shanker distribution derived from Gompertz-G family of distributions. Some basic Statistical properties of the distribution were presented include: moment and its related measures like the expected value, variance, coefficient of variation, skewness, moment generating function, survival function, hazard function, reversed hazard function and order statistics. The method of maximum likelihood estimation is used to estimate the model parameters. Then, we apply the model to two real data sets in order to showcase its flexibility and usefulness in real life situations over other competing distributions considered in this research.

Keywords: Gompertz-G, Moments, Order Statistics, Reversed Hazard, Shanker Distribution.

CS 003: A NEW INVERSE-GOMPERTZ FRECHET DISTRIBUTION: PROPERTIES AND APPLICATIONS TO REAL LIFE DATA

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Abstract: Distribution theory is very important in modelling real life events. In fact, it's relevance in almost every discipline, be it finances, biology, medicine, engineering, actuarial sciences just to mention but a few cannot be over – emphasized. In this paper, a new four – parameter continuous distribution called Inverse – Gompertz Frechet (IGF) distribution is developed. The proposed model is very suitable for modelling heavy right- tailed data. IGF distribution is the reciprocal of the random variable which follows Gompertz-Frechet distribution and it does not involve addition of extra parameter, thereby removing the cumbersomeness in the estimation process posed by other methods involving additional extra parameters, especially where more than three parameters are involved. The statistical properties of the new distribution such as survival function, hazard function, cumulative hazard function, reversed hazard function, quantile function, order statistics, moments, skewness, and kurtosis were derived. Also, method of maximum likelihood was used in estimating the model's parameters. The simulation results revealed that as the sample sizes increased, the root mean squared errors decreased which showed that the parameters of IGF distribution are stable. The proposed distribution was applied to two real life data sets. The results showed that it performs better than the competing models.

CS 004: STATISTICAL ANALYSIS OF CRIME RATE AND PRISON POPULATION IN NIGERIA

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Abstract: Human beings and the society are susceptible to criminality and so criminality can be likening to an oil that is capable of staining a very white garment when it comes in contact with the white garment. That is why it is impossible for any society to claim to be completely free from crime. The types of criminal behavior depends on the social and economic development of a given society. It is therefore not unexpected that a society at a low level of development tends to experience an upsurge in the rate of violent crimes such as armed robber, politically motivated killings, the use of illegal weapons, ethnic and religious clashes and the like. To examine the relationship between the crime rate and the number of prison inmates in Nigeria. Secondary data was used in this study. The data were on various crimes committed within the period of one year and the data were collected from the National Bureau of Statistic. Multiple linear regressions model was used to carry out the analysis. From the result it shows that the top five states with the highest number of criminals and prison populations are Lagos, Rivers, Delta, Abuja and Kano States.

CS 005: HALF LAPLACE FAMILY OF DISTRIBUTIONS: THEORY AND APPLICATION

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Abstract: This research work introduces a new T - Half-Lapalace{Exponential}family with specific three-parameter lifetime model called the Weibull-Half-Lapalace{Exponential}(W-HLa{E}) distribution. The W-HLa{E} model is capable of modeling various shapes of aging and failure criteria. The W-HLa{E} distriution is derived by combining Half-Laplace and Weibull distribution together using quartile function of Exponential distribution. Some of its statistical properties such as the mean, mode, quantile function, median, variance, standard deviation, skewness and kurtosis are derived. Other statistical properties such as survival function, hazard rate, moments, asymptotic limit, order statisitcs and entropy which is the measure of uncertainty of a random variable are derived and studied. The parameter estimation method adopted is maximum likelihood method. The graphs of W-HLa{E} at different valves of shape and scale parameters show that the distribution is unimodal hence the mode is given as $mode = \theta + (\frac{k-1}{k})^{\frac{1}{k}}$ and positively skewed with steep peak. The survival curves and hazard curve for different samples sizes with different values of shape parameters do not change (i.e. change in sample size n does not affect the survival curves and the hazard curves of W-HLa{E}) Cumulative hazard function is the probability of failure at time x given survival until time x is also described in the work. Simulation study is carried on the new distribution using maximum likelihood estimation. We demonstrated the importance and the flexibility of the new model in modeling some data sets.

Keywords: Laplace distribution; Half-Laplace distribution; Weibull Half-Laplace distribution; Censored data; Lifetime data; Maximum likelihood estimation.

CS 006: ON THE STOCHASTIC AND ENTROPY ORDERING OF THE WEIBULL-RAYLEIGH DISTRIBUTION WITH APPLICATIONS

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Abstract: In Akarawak et al. (2013), a new generalized distribution was developed which possesses flexible properties. The authors studied several properties of the new distribution including the cumulative distribution function, probability density function, moment generating function, skewness, kurtosis, and Shannon entropy. A simulation study was further conducted to numerically validate these properties. However in their paper, the stochastic and entropy ordering of the distribution was not carried out. In this paper, a study on the stochastic and entropy ordering of the distribution is performed. The paper is concluded with an application.

CS 007: ESTIMATION OF DIFFERENT TYPES OF ENTROPIES FOR THE GUMBEL TYPE-2 DISTRIBUTION

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Abstract: The estimation of the entropy of a random system is relevant in many scientific applications. This article is aimed at the analysis of the entropy of the Gumbel type-2 distribution, an aspect of the statistical analysis which has not been employed. On this basis, six different entropy measures are considered and expressed analytically. A numerical study is performed to discuss the behavior of these measures. In addition we considered the method of maximum likelihood estimation approach to obtain the parameter estimates of the Gumbel type-2 distribution. Maximum likelihood estimates for the considered entropy measures are thus derived. The convergence properties of these estimates are proved through a simulated data, showing their numerical efficiency. Concrete applications to two real data sets are provided.

Keywords: Entropy, maximum likelihood estimation, Gumbel type-2 distribution, Random system.

CS 008: ON PERFORMANCE OF GENERALIZED GAMMA TUKEY'S CONTROL CHART

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Abstract: Tukey's control chart takes care of the effect of outliers generated from the data which makes the data to be non-normal and does not assume any pre-specified distribution for the data. In this study, Tukey's control chart assuming the data follow Generalized gamma distribution which has Weibull, gamma and exponential distribution as its sub-model is proposed. MonteCarlo simulation from Weibull, gamma and generalized gamma was used to examine the performance of the proposed chart in comparison with the conventional Tukey's control chart. The results of the AARLs for different shifts show that Tukey's control chart based on generalized gamma distribution would detect out-of-control faster and more sensitive to both small and large shift when the process is not normal than the conventional Tukey's control chart.

Keywords: Average run length, Generalized gamma, Non-normality, Tukey's chart.

CS 009: NORMAL-POWER GENERALIZED LINEAR MODEL: THEORY AND APPLICATION

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Abstract: Normal distribution applications in literature are verse, the new normal power distribution is a new distribution which is adequate for modelling bimodal data. There are many data that would have been modelled by normal distribution, but because of their bimodality, they are not, since normal distribution is unimodal. In this paper, a new extension of the normal linear model called the normal-Power generalized linear model, derived from the T-Power framework is presented. The statistical properties of the distribution and the proposed model were derived such as quantiles, median, mode, robust skewness, robust kurtosis and moment. The Likelihood Ratio Test (LRT) was used to test the performance of the proposed model with linear model. The maximum likelihood estimation method was considered to obtain the unknown model parameters. The proposed normal power model was applied to estimate spill volume of crude oil to demonstrate its flexibility and usefulness. The LRT showed that the proposed normal-power model outperformed the normal linear model. The new model would be very useful as alternative in regression modelling, where the response variable is skewed or bimodal, or when the normal regression model is not a good fit.

Keywords: Bimodal, Exponential Family, Generalized Linear Model, Normal-Power, Quantile Function.

CS 010: STRUCTURAL MODELLING OF EXCHANGE RATES OF NIGERIA CURRENCY TO SOME FOREIGN CURRENCIES

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Abstract: This paper modeled and forcasted the exchange rates of naira to three of the major foreign currencies (Pound Sterling, Euro and US Dollar). The purpose of this work was to determine the pattern of causalities that exist among these three exchanges to Nigerian Naira using Multivariate Time Series Modelling Techniques. The forecast was done using a structural ARIMA while Granger causality tests were conducted, to test the impact of some structural variables on the exchange rates. he data employed for this study were extracted from the daily exchange rates of Naira to US Dollar, Pounds Sterling, and Euro beginning from 1st of January 1999 to 31st December, 2019 as gazetted by Central Bank of Nigeria, Statistical Bulletin. The results showed that seasonality, holidays and elections significantly determined the exchanges.
Keywords: Causality, Exchange Rates, Structural ARIMA, Time Series.

CS 011: SPATIAL PATTERN AND DETERMINANTS OF RISK FACTORS OF MALARIA AMONG CHILDREN UNDER FIVE IN NIGERIA

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Abstract: Malaria remains one of the leading public health problems in developing countries, especially Nigerian. Evidence-based knowledge of interventions are needed to combat the menace of the disease. Pregnant women and under five children have been found to be the most vulnerable groups. Therefore, in this study, we explore the spatial pattern and risk factors of malaria among under five children in Nigeria using datasets from the 2010 and 2015 Nigeria Malaria Indicator Survey. A total of 9360 children aged 6-59 months were included in the analysis. A structured geo-additive model, an approach that simultaneously estimates nonlinear, spatial, fixed and random effects within a Bayesian context in one step was adopted for all estimation. The results reveal a reduction in the proportion of children who had malaria in 2015 compared with those in 2010. Socio-economic status, mother educational level and place of residence have marginal effect on child health. Malaria risk increased with increasing age of child and age of household head. Further, malaria risk was found to be higher in Kebbi, Kwara, Niger and Zamfara states. Findings from this paper are meant to guide policy makers and donor agencies in appropriate identification of the drivers of the disease with the aim of designing and funding of effective intervention strategies to reduce the pattern of the disease endemicity so as to improve child survival-hood.

Keywords: Bayesian inference, geo-additive model, malaria, Nigeria, nonlinear, spatial analysis.

CS 012: PORTFOLIO OPTIMIZATION OF CRYPTO COINS AND THE STOCK MARKET: A CAPM-MARKOWITZ APPROACH

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Abstract: In this paper, we seek to investigate the portfolio optimization of an investor who invested part of his assets in some selected crypto coins. The aim is to use the Capital Asset Pricing Model (CAPM) and the Markowitz Portfolio Theory (MPT) to get the optimal asset allocation. The result will then be compared with another investment in the standard market (some selected SP 500 stocks). The result will be used as a guide for investors or would be investors in the crypto currency and stock market.

CS 013: APPLICATION OF QUANTUM COMPUTING IN DISCRETE PORTFOLIO OPTIMIZATION

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Abstract: This article proposes a new, more efficient quantum algorithm for portfolio optimization and uses quantum combinatorial optimization (QCO) techniques. The recent construction developed in 2021 has sparked the field of financial portfolio optimization through the Quantum Walk Optimization Algorithm (QWOA). We study the complexity and efficiency of quantum optimization algorithms with a special interest in QWOA. The objective is to minimize the risk of investing by having a good combination of assets in the portfolio. We also focus on reducing the number of iterations yet attaining a high-quality resolution through contraction of the solution space that eases computations. We extend QWOA's idea by constructing a newly outperforming scheme known as 'Quantum Mix Optimization Algorithm (QMOA)'. QMOA algorithm codes are provided for the implementation and simulation of numerical results. In addition, QMOA's efficiency (better than the existing QCO algorithms) is discussed. For instance, the least QWOA number of computations required to execute the initial state equation is $p > 2$ while this value is $p \geq 2$ in the proposed QMOA.
Keywords: Combinatorial optimization, qubits, induced tadpole graph, and search subspace.

CS 014: OPTIMIZING IN-BAND NETWORK TELEMETRY

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Abstract: Network monitoring is an essential key in providing high network-wide visibility in several sectors. The process consists of monitoring the network usage and performance, detecting failures and reporting it in real-time as much as possible. The Network monitoring mechanism started with putting taps in the network for collecting packets to monitor, then evolved to recording the internal states of the switches into the data packet itself as it traverses through the network. The last mechanism is called the IN-Band Network Telemetry (INT) and has recently emerged as a promising monitoring alternative to the traditional means of network monitoring. The INT is a framework designed to monitor, collect, and report flows and network states, by the data plane, without requiring intervention or work by the control plane.
In this work, we propose an automated approach for routing network flows in the INT. This approach optimally assigns network flows to telemetry items and provides higher network-wide visibility to the INT.

CS 015: STATISTICAL ANALYSIS OF REPORTED CASES OF MALARIA ACROSS THE SIX GEOPOLITICAL ZONES IN NIGERIA

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Abstract: Malaria prevalence in Nigerian is a major public health problem both at the regional and all geopolitical zone geographic scale. An estimated 3.2 billion confirmed cases and 627,000 cases were reported in health facilities and each geopolitical zone respectively, with about 1 million deaths annually as a result of malaria infection. Several studies have estimated malaria prevalence in Nigeria using the analytical techniques at the regional scale. We aimed at identifying malaria cases and the Demographic and Health Survey (DHS) data for geopolitical zone between 2003 and 2017 using SPSS and Two way ANOVA intervention programs. To identify malaria case and analyze the pattern of distribution, we used the SPSS version 20.0 and Two way ANOVA as the statistical tool. The results show that there is no significant difference among the cases of malaria reported at the six geopolitical zones. The f-calculated value is 6.276 with p-value 0.001. The ANOVA table showed that p-value is less than 0.05, hence the null hypothesis "there is no significant difference among the cases of malaria reported at the six geopolitical zones" was rejected at 95% confidence level and then conclude that there is significant difference among the means of malaria cases reported at the six geopolitical zones. That is the rate of malaria cases reported is not the same in the six geopolitical zones in Nigeria. We also used Post-hoc test analysis to compare the six geopolitical zone The spatial distribution of malaria showed statistically Northwest geopolitical zone, malaria case is very high than other geopolitical zone from the year 2003 to 2017. We recommend that more attention should be given to the Northwest geopolitical zone malaria case which has very high prevalence when compared with other geopolitical zones.

Keywords: Two way ANOVA, Malaria, Demographic and Health Survey (DHS), data.

CS 016: STOCHASTIC EPIDEMIC MODEL FOR THE TRANSMISSION DYNAMICS OF INFECTIOUS DISEASE IN A MIXED POPULATION

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Abstract: We formulate and analyse a Stochastic Susceptible-Exposed-Infected-Recovered model for the transmission dynamics of an infectious disease in heterogenous population using a Continuous Time Markov Chain approach. This model is based on existing deterministic model. The disease dynamics of the two models (deterministic and stochastic) are compared in order to determine the effect of randomness in the disease dynamics. The probability and time of extinction are computed for a major outbreak using the multitype Galton-Watson branching process. The results of the analytical and numerical show some significance difference in the model.

CS 017: AUTOREGRESSIVE DISTRIBUTED LAG (ARDL) MODEL OF SOME SELECTED ECONOMIC VARIABLES

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Abstract: This study examines the effect influence of crude oil trend on the Nigerian economy for the period of 2009 – 2019. After employing ARDL method to analyse the data, the study confirm that Nigerian economy is influenced by crude oil trend and is significantly positive to inflation rate in the long run. The unit root test shows that only inflation rate was stationary at I(0), whereas crude oil price, crude oil production and export were stationary at I(1). This satisfy the condition of selecting ARDL model that data should have stationary either I(0) or I(1) or both. The production of crude oil and price was used to examine the relationship it has with inflation in the economy. It was discovered that if crude oil price is decreased by 1%, inflation rate will be increased by 0.05%, likewise, inflation rate will increase by 3.99% if production is increased by 1% and equally, crude oil export, if decreased by 1% will negatively affect inflation rate by decreasing it by 3.17%, hence, addressing the objective to confirm whether oil price instability has significant impact on the inflation rate. .From the ARDL results, it was observed that Inflation rate was used as the dependent variable, while others are independent. Number of models evaluated (that is, the number of different lags which have been evaluated before selected optimum lag) are 500 from which ADRL(3,0,0,0) is the selected model. The top 20 models as displayed, hence, the least criteria becomes the selected ARDL model (3, 0, 0, 0). The CUSUM test statistics lie within the critical bounds, implying that all the coefficients in the estimated model are stable for the long run relationship and error correction model. But the CUSUM of squares test resulted that the co-efficient in the estimated ECM model and long run relationship is suffering from a bit of structural breaks. This happens when an occasion has affected the trend of a particular series of when there is a visible movement in the past and future movements in a particular series.

Keywords: Autoregressive Distributed Lag (ARDL), Model, Economic Variables

CS 018: DEA AND BOOTSTRAP APPROACHES FOR EVALUATING EFFICIENCY IN HIGHER EDUCATION SECTOR: EVIDENCE FROM ABOMEY-CALAVI UNIVERSITY, BENIN

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Abstract: In this talk, we use the DEA-BCC method and the bootstrap approach to evaluate the efficiency of the University of Abomey-Calavi (UAC) in Benin (West Africa) for the year 2020. The main objective is to use three groups Decision Making-Units and seven models to evaluate the efficiency of the faculties (G1), normal schools and institutes (G2), the faculties, normal schools and institutes (G3). For this we use two inputs (Number of Teachers and the Total Budget) and two outputs (Number of Students Registered and Number of students graduating). The G3 is considered as the reference group Decision Making-Unit. The model M7 is used to evaluate efficiency in relation to both the budget and the number of teachers for all students (Bachelor and Master) and is considered as the reference model. The results showed that, the M7 model of the group (G3) obtained an average score of 0.821 and an average corrected bias of 0.898 with an average confidence interval of [0.218; 1.185]. We can say that the UAC has a decision support about the number of students to be taken and trained per year.

CS 019: OPTIONS VALUATION WITH STOCHASTIC INTEREST RATE AND RECESSION-INDUCED STOCHASTIC VOLATILITY

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Abstract: This study seeks to formulate mathematical model for options valuation with stochastic interest rate and Recession-induced Stochastic Volatility. We simulated the derived model and used it to forecast future returns of stock asset in a recessed economy. The figures obtained and the model parameter estimated for the model showed the effectiveness of volatility control function c(t) which is dependent on the state of the economy.

CS 020: OPTIMIZATION MODEL FOR OIL SUPPLY AND DISTRIBUTION IN NIGER

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Abstract: Like other African countries, Niger's territory is full of various natural resources, in particular energy resources such as oil, minerals and gas are highly strategic and non-renewable resources. On November 28, 2011, the first refinery in Niger was inaugurated in Zinder. Thisn refinery is operated by Zinder Refining Company (SORAZ), which is a joint venture between the China National Petroleum Company (CNPC), for 60% of the capital; and the State of Niger for 40% of the shares. This refinery will proceed the crude extracted from certain deposits of the Agadem field, the exploitation of which has been entrusted by the Nigerien State to CNPC and where it has been proven the existence of reserves amounting to 483.3 million barrels. Despite the advantages of the multi-product pipeline, factors appear that weaken its effectiveness by affecting the availability of products in storage and distribution centers, and then automatically customer satisfaction. Among these constraints, the formation of the mixture in the contact zone of two fuels during their transport, which is stored in two tanks on arrival at a designated station at the final end of the pipeline., the need for a very specific fuel, preceded by a batch of fuels in orderly transport sequences, can thus alter the distribution and create shortages of the fuel object of the request, because its reception comes only after ejecting the quantity of fuels preceding it. Therefore, in this work we propose a model of supply and distribution of oil in Niger which makes it possible to optimize transport by multi-product pipeline, aiming to improve it by taking into account the aforementioned constraints and others. We use the MILP approach and the Cplex solver as a simulation tool.

CS 021: PERTURBATION ANALYSIS OF WALLS IN GENE REGULATORY NETWORKS OF GLASS TYPE

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Abstract: This paper presents a study of walls in gene regulatory networks (GRN) using the method of perturbation. GRN of Glass type is known to possess singularities at threshold hyperplanes where the state of the network is not known. As a result most studies deny threshold sets from possessing solution(s) of the system. However within the context of plausibility of the network describing biological activities, it is known that threshold hyperplanes represent one form of biological function or the other. Owing to this, the primary target is to seek asymptotic series that can approximate the limit solution in the vicinity of threshold boundaries. In addition we shall investigate the possibility of matching the both the inner and outer solution before finally seeking a manifold for the system.

CS 022: MODELING PREVALENCE OF ENVIRONMENTAL HEALTH DISEASE AMONG UNDERGRADUATE STUDENTS OF THE UNIVERSITY OF IBADAN, NIGERIA: A ML APPROACH

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Abstract: Environment has various effects on human health depending on the environmental factors (biological, chemical, physical, social, psychosocial) that occur in that location at a particular period. Consequently, leads to different diseases known as Environmental Health Diseases (EHDs). Respiratory Tract Infections (RTIs) is one of such and common among people generally. Therefore, this work focusses on the determinants of upper RTI (URTI) prevalence among the undergraduate students in University of Ibadan, Nigeria. Binary logistic regression under the Machine Learning (ML) method was adopted, with the halls of residence considered as the environmental classification. The result shows that the students who stay off campus (0.60) as well as those who stay in Idia Hall (0.76) has higher probability value to be diagnosed with the infection when compared with the students in other halls of residence. It is also noted that URTI is spread within the age limit of 20 – 24 years.

Keywords: Respiratory Tract Infections, Machine Learning, Binary Logistic Regression, Environmental Health Disease, Halls of residence

CS 023: CHI – SQUARE – NORMAL {LOG – LOGISTIC} DISTRIBUTION: PROPERTIES AND APPLICATION TO SURVIVAL DATA

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Abstract: This research is aimed at developing the probability density function and the cumulative density function of Chi- Square Normal distribution using the TR{Y} approach developed by Alzaatreh et al. (2014). The chi-square distribution is used in for goodness of fit test of an observed distribution to a theoretical one, the independence of two criteria of classification of qualitative data, and in confidence interval estimation for a population standard deviation of a normal distribution from a sample standard deviation. Alzaatreh et al. (2014) generated Weibull-Normal with exponential quantile function, Exponential-Normal with log-logistic quantile function, Logistic-Normal with logistic quantile function (bimodal distribution) and Logistic-Normal with extreme value quantile function. Famoye et al. (2018) also generated Weibull-Normal with log-logistic quantile function, which also happened to be a bimodal distribution. The developed pdf and CDF can be applied to bimodal, longitudinal, survival data.

Keywords: Chi- Square Normal distribution, log-logistic quantile function, bimodal data.

CS 024: STRATEGIC ASSET AND LIABILITY MANAGEMENT AND FINANCIAL STABILITY OF BANKS IN NIGERIA: A STATISTICAL COST ACCOUNTING APPROACH

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Abstract: Essentially, Asset and Liability Management (ALM) is practiced by banks and other financial institutions to mitigate financial risks resulting from a mismatch of assets and liabilities. Effective management of financial risk is what guarantees financial stability for banks. A composite quantitative measure of financial stability (bank stability index) which is a weighted average of sub-indicators of banking sector soundness is adopted to proxy for financial stability under the Statistical Cost Accounting (SCA) model. The different categories of banks in Nigeria as contained in the Central Bank of Nigeria (CBN) banking policy and regulatory framework; (regional, national and international) are also adopted in this study. The central hypothesis of the SCA model is tested under each scenario generated and findings reveal some important contributions to the ALM literature.

Keywords: Asset and Liability Management; financial risk, financial stability, statistical cost accounting; bank stability index.

CS 025: INFLATION AND ECONOMIC GROWTH NEXUS IN SELECTED AFRICAN ECONOMIES: A SIMULATION APPRAISAL

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Abstract: This study tests the proposition that inflation may be favorable agent of economic growth using simulation approach in Nigeria, South Africa and Egypt. Nominally, the rate of growth of money income should be consistent with rate of growth in economic activities, however, perhaps the persistent rise in the former may have been the most consistent problem affecting economic agents on the supply-side of the economy, and thus adverse to the economy's growth rate. Theoretically, economic growth is linked to inflation through savings, capital formation, investments, and productivity. Data is obtained from the world development indicators, and macroeconomic modeling methodology is applied. It is envisaged that the co-integrating impact of inflation may be adverse to growth rate in the economies, thus worsen their welfare status.

CS 026: PENALIZED COX REGRESSION AND ITS APPLICATION TO MICROARRAY SURVIVAL DATA

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Abstract: The relationship between the time-to-event variable and the independent variables is shown through survival analysis. Cox proportional hazard method is the most popular method for establishing these relationships but breaks down when the number of predictors p becomes too large and highly correlated. This research was aimed at applying the penalized Cox methods to micro-array survival data. The results obtained were compared to standard cox proportional hazard model. The Least Absolute Shrinkage and Selection Operator (LASSO), Ridge, Elastic net and the Cox Proportional Hazard (Cox PH) methods were applied in this study. The LASSO method performed better than the other three models when p=30 and p=262 but the Elastic net performed better when p=100 and p=263. The ridge model performed better when p=30000 and p=54682 on the train set and the Cox PH fail when the number of predictors exceeded 262. The Cox PH model outperformed the penalized methods when $p\leq$262 on the test set. The ridge model performed better than LASSO and Elastic net when p=30000 and p=54682. The penalized regression models are therefore recommended for cases when the number of predictors p is greater that 262, since the Cox PH did not perform well when p>262.

Keywords: Cox Regression, Elastic net Regression, LASSO Regression, Penalized Cox Regression and Ridge Regression.

CS 027: BAYESIAN ESTIMATION OF ASYMMETRIC GARCH MIXTURE MODELS WITH APLLICATION TO STOCK INDEX FOR TRADED VALUE

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Abstract: In statistics especially financial time series analysis and econometrics models, various models have been used to capture the volatility of stock indices. In this article, the asymmetric GARCH mixtures with normal innovation were employed to capture the volatility of NSE 30 stock indices for traded value from January, 2014 to April, 2022. Three asymmetric GARCH mixtures were considered: The EGARCH-GJRGARCH mixture, the TGARCH-EGARCH mixture and the TGARCH-GJRGARCH mixture. The parameters of the GARCH mixtures were estimated using the Monte Carlo Markov chain (MCMC) which the Bayesian method utilizes and the Metropolis-Hasting sampler was used to generate the prior distribution of the Bayesian model. R programming language was used to execute the MCMC algorithm to generate the estimated result. The result shows that the standard errors for the estimated parameters were close to zero. Also, the deviance information criteria was used to choose which of the asymmetric GARCH mixtures best capture the volatility of the NSE 30 stock indices and it was seen from our result that the EGARCH-GJRGARCH was a better fit based on the deviance information criteria (DIC).

Keywords: GARCH mixtures, MCMC, Metropolis-Hasting sampler, Stationarity.

CS 028: ROBUST KIBRIA-LUKMAN AND PRINCIPAL COMPONENT ESTIMATORS FOR LINEAR REGRESSION MODEL WITH MULTICOLLINEARITY AND OUTLIERS.

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Abstract: Professionals usually apply the method of least squared to model the relationship between a response variable and one or more regressor variables. However, the least squares estimator's performance is good when there is no multicollinearity and outlier in the model. It has been recently proven that both problems can jointly exist in a model and the least squares estimator suffers setback when there is either multicollinearity or outlier. We developed a new estimator that can handle both multicollinearity and outliers' problems in a multiple linear regression model by combining the principal components, Kibria-Lukman estimator (KL) and the M-estimator to form the Robust KL-PC estimator. Robust KL-PC estimator inherits the advantage of the following estimators: M-estimator, KL estimator and PC estimator. Robust KL-PC estimator can handle the estimation of multiple linear regression models when there is multicollinearity and outlier individually and jointly. We compared Robust KL-PC estimator's performance with existing ones. Robust KL-PC estimator outperformed other estimators considered in this study under the following conditions: theoretical comparison, the simulation design and real-life investigation.

Keywords: Ridge estimator, Kibria-Lukman estimator, M-estimator, Principal Component, Multicollinearity, Outliers.

CS 029: THE STOCHASTIC GIBBS OPTIMIZER

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Abstract: Metaheuristics search algorithms have recently been used to solve complex optimization problems that are not easily solved by traditional algorithms that use gradients and solve linear problems. In the search process, some of the good solutions of these metaheuristics search algorithms are been destroyed, this can be seen in choosing the highest or lowest result of the fitness solution. In this paper, the Stochastic Gibbs Optimizer (SGO) is introduced. SGO dimensionally samples the problem space systematically and deterministically to build convex solutions that provide an understanding of the problem space. The posteriori data that is extracted from understanding the problem space is used to make informed decisions that guide the search toward the optimum. To evaluate performance, the proposed Stochastic Gibbs Optimizer is tested on some global optimization test functions. The solutions obtained suggest that the Stochastic Gibbs Optimizer is effectively applicable for solving complex optimization problems.

Keywords: Derivative-Free Optimization, Metaheuristics, Optimization, Exploration and Exploitation

CS 030: CREDIT: A DECISION TREE INDUCTION ALGORITHM WITH CROSS-ENTROPY ATTRIBUTE SELECTION

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Abstract: Despite their simplicity decision trees are one of the most intuitive and powerful tools used in data mining for classification and regression. They split the input space recursive and hierarchically until they reach a subspace that can be associated to a class label. The main attraction of decision trees is that they are non-parametric, easy to deploy, and human-readable knowledge can easily be extracted from them. Although decision trees are robust to missing values and irrelevant attributes and can learn incrementally, they do have some shortcomings; they are insensitive to the relative spacing of numerical values in regression tasks, may be biased to selecting attribute with many values during classification, and induction time is sensitive to data diversity. It has been shown that for entropy-based attribute selection algorithms that distance-based attribute selection inducts superior decision trees. A limitation with distance-based attribute selection induction schemes is their complexity. This work explores the use of cross-entropy as a distance measure for attribute selection and finds that they preserve all the advantages of distance-based measures with less complexity and may induct trees that interestingly may be interpreted differently from algorithms such as ID3, C4.5 and CART.

Keywords: Decision-tree, Cross-Entropy, Classification, Regression, Attribute Selection, ID3, C4.5, CART, Human-readable Knowledge.

CS 031: SPATIAL ANALYSIS OF SOIL RADON GAS CONCENTRATION IN SOUTHWESTERN-NIGERIA: A BAYESIAN APPROACH

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Abstract: Radon gas is a leading cause of lung cancer after smoking. About 20,000 lung cancer deaths each year is caused by radon gas according to Environmental Protection Agency (EPA) and surgeon General. Radon is readily available in all types of soil and moves freely into homes via cracks on the floor and hence can contaminate our drinking water. Previous studies have explored the danger of soil radon gas using various classical methods such as ordinary kriging to capture spatial attributes of the data sets to make useful predictions. Therefore, this study considers a Bayesian Geo-statistical model with an additional spatial dependency parameter to quantify the relationships of the Radon gas (R_n) concentration and the covariate structures. The effects of the environmental variables were estimated and the radon potential map of the study sites was produced using 4 picocuries (200 Bqm^{-3}) as the threshold. The radon potential map indicated that 22 locations already have radon concentration above the 4 picocuries threshold. The two approaches produced similar posterior means and standard deviations. However, the WAIC and DIC values indicated that Bayesian geo-statistical model provided a better fit for the data, hence justifying the inclusion of the spatial parameter.

Keywords: Bayesian geo-statistical model, Spatial parameter, Deviance Information Criteria, Radon gas concentration, Geogenic Radon Potential.

CS 032: SALT TWIN: A FRAMEWORK FOR RAPID DIGITAL TWIN DEVELOPMENT

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Abstract: The United States Industrial Internet of Things (IIoT) and Europe' Industry 4.0 roadmaps outline innovative new technologies for optimizing industrial processes and the design and manufacture of products with creative integration of new and emerging technologies and tools from Artificial Intelligence (AI), broadband and ubiquitous connectivity, smart embedded sensors, cloud computing and vastly improved data processing of descriptive high dimensional data. A key and critical technology for the successful implementation of these roadmaps is the Digital Twin (DT). Although not new, a similar technology was used to get the crew of Apollo 13 back to earth alive, DT, or virtual and simulated models of Physical Things (PT) promises to deliver massive opportunities for new product design, optimized manufacturing processes, production control, advanced data analytics of product design, reduced time-to-market for new products, integration of consumer feedback to product design, and considerable profits. However, the difficult of creating DT and the diversity of its application makes the development of a common architecture, template or framework challenging. This problem limits the application of DT to physically large projects, mechanically complex engines and crafts, large power equipment, power grids and manufacturing systems. The work proposed a framework that can be quickly intertwined with the development of small products and large systems design. SALT Twin extends the SALT simulation framework by integrating a simple graph model with deep-learning nodes. DT models realized with SALT Twin are hosted on the cloud and connect with its PT counterpart via a suitable IoT middleware. Implementation of a remotely controlled Dojo Drone DT using SALT Twin hosted on the Microsoft Azure Cloud and connected to its PT using Microsoft's Signal R showed very encouraging results.

Keywords: Digital Twin, Simulator of All Things (SALT), Physical Twin, Industrial Internet of Things, Industry 4.0, Artificial Intelligence.

CS 033: A COMPARATIVE STUDY OF SOME REGRESSION TECHNIQUES WITH APPLICATIONS TO LINEAR AND NON LINEAR DATA

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Abstract: Regression is a statistical tools for data analysis but study has found out that some of the techniques are either misused or inadequate for some dataset due to inherent characteristics of available data, which might not comply with assumptions of using the techniques. Ordinary least square (OLS) is one of the most used regression techniques and many researchers and practitioners; especially outside the field of Statistics are more conversant with only the OLS. Although OLS estimates are generally unbiased, they can have large variances and perform poorly in both prediction and interpretation when model assumptions, such as non-linearity, non-normality, heteroscedasticity, multicolinearity and outliers, are violated. Therefore, the aim of this paper is to study and compare non-linear, OLS and Multivariate Adaptive Regression Spline (MARS) techniques. It is also aimed to compare OLS with Ridge, LASSO, Elastic net and MARS regression estimators using linear datasets. Using the non-linear data, results show that non-linear regression, with Akaike Information Criteria (AIC) = 48.1945 performed better than MARS with AIC =49.1996 and the best model fit was obtained when predictor variable X was transformed to second order polynomial $X_1 = X^2$. Due to highly correlated predictors, estimates of coefficients from the OLS were accompanied with unreasonably high standard errors. Ridge regression estimator was therefore introduced, successfully penalized the coefficients of the OLS and resulted in a better model fit to the data. Output of simulated data confirms the above results. Simulation study also revealed that when there is no multicollinearity result of ridge regression analysis coincides with that of OLS. Using machine learning approach on the academic data of 117 students of the University of Ilorin, Kwara State, Nigeria, the root mean square error was used to test for predictive performance of each model. Results show that MARS model outperformed LASSO, Elastic net, Ridge and OLS method with RMSE value of 18.19721. The study suggests that MARS method has more power and flexibility to model relationships that involves interactions in at most a few variables, and therefore is a useful and fairly accurate tool for predicting both linear and non-linear data. In particular, the MARS is recommended for predicting CGPA of students and maybe adopted by exam regulatory agencies in Nigeria.

Keywords: Ordinary least squares, Non-linear regression, MARS, Penalized Regression, Multicollinearity.

CS 034: PASSWORD PROTECTION BY ANALYZED KEYSTROKES: USING ARTIFICIAL INTELLIGENCE TO FIND THE IMPOSTOR

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Abstract: The world has become more and more connected and the amount of people who store personal information online or on their phones has steadily increased. In this thesis, a solution is proposed and evaluated to make authentication safer and less intrusive. Less intrusive in this case means that it does not require cooperation from the user, it just needs to capture data from the user in the background. As authentication methods such as fingerprint scanning and facial recognition are becoming more popular this work is investigating if there are any other biometric features for user authentication. Employing Artificial Intelligence, extra sensor metrics and Machine Learning models with the user's typing characteristics could be used to uniquely identify users. In this context the Neural Network and Support Vector Machine algorithms have been examined, alongside the gyroscope and the touchscreen sensors. To test the proposed method, an application has been built to capture typing characteristics for the models to train on. In this thesis, 10 test subjects were chosen to type a password multiple times so that they would generate the data. After the data was gathered and pre-processed an analysis was conducted and sent to train the Machine Learning models. This work's proposed solution and presented data serve as a proof of concept that there are additional sensors that could be used to authenticate users, namely the gyroscope. Capturing typing characteristics of users, our solution managed to achieve a 97.7% accuracy using Support Vector Machines in authenticating users.

CS 035: PROGRAM HIERARCHY COMPOSITION USING FORMAL CONCEPT ANALYSIS

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Abstract: An important consideration in object-oriented programming is the construction of the class hierarchy. The construction of the hierarchy is often done without any clear methodology or tool. This construction becomes complex as the size of the hierarchy increases and when there is the need to modify the hierarchy due to the evolution of software requirements. Formal Concept Analysis (FCA) allows for maximal factorization of objects while preserving specialization relationships. This work used the FCA to derive concept hierarchy from a collection of objects and their attributes. The results show that in constructing the class hierarchy, greater insights were achieved in the identification of sub-hierarchies that needs restructuring.

Keywords: OOP, object, attribute, class hierarchy, Formal Concept Analysis (FCA).

CS 036: LOMAX GUMBEL TYPE TWO DISTRIBUTION WITH APPLICATIONS TO LIFETIME DATA

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Abstract: The Gumbel Type-Two (GTT) distribution among many classical distributions has been found to lack the capacity to adequately fit some random phenomenon due to its monotonic failure rates thereby limiting its application. The Lomax-Generator was employed in this study to generalize the GTT distribution in order to derive the Lomax Gumbel Type-Two (LGTT) distribution capable of providing better modeling fits to real dataset. The new distribution has the Lomax Inverse Exponential distribution as a special case; the reliability and hazard rates functions were investigated. The distribution is unimodal, positively skewed and close to bell shape depending on parameter values. The quantile, median and order statistics were derived while the method of maximum likelihood estimation was used for estimating the parameters of the distribution. The proposed distribution demonstrated its potentials for modeling events whose distributions tends to be platykurtic, leptokurtic and approximately symmetric. Two lifetime survival datasets were analyzed using the distribution and results revealed the importance of application of LGTT distribution to the datasets with superior modeling fits than other four generalizations of GTT distributions existing in literatures derived using other generator. Three additional real life datasets were also used to compare the performance of LGTT with some distributions derived using Lomax as generator, results of analysis revealed that LGTT exhibits greater flexible potentials for modeling the real life datasets.

Keywords: Lomax-Generator, Gumbel type-two distribution, Monotonic failure rates, Lomax Gumbel type-two distribution, Platykurtic, Leptokurtic.