

ICRTMS-12026



ABSTRACT BOOK

International Conference
on
“Recent Trends in Mathematics & Statistics”
(ICRTMS-I)
20-21 January, 2026

Organised by

Department of Mathematics & Statistics

in collaboration with IQAC, Bahona College

&

In Association with

Assam Academy of Mathematics (AAM)

(অসম গণিত শিক্ষায়তন)



Editors: Dr. Pankaj Borah

Dr. Tousifur Rahman

Abstract book is the collection of abstract from the 1st International Conference on “Recent Trends in Mathematics and Statistics” (ICRTMS-I) held at Bahona College during 20th & 21st January, 2026 edited by Dr. Pankaj Borah, Department of Mathematics and Dr. Tousifur Rahman, Department of Statistics, Bahona College and published by Bahona College Publication Cell.

First Edition: 21 January, 2026

ISBN: 978-81-960757-8-1

Editors:

Dr. Pankaj Borah

Assistant Professor, Department of Mathematics
Bahona College

Dr. Tousifur Rahman

Assistant Professor, Department of Statistics
Bahona College

Published by: Bahona College Publication Cell

© 2026 Copyright held by the Author(s) of the individual abstract



MESSAGE

It is a matter of immense pleasure for me to convey my warm greetings and best wishes to the organizers, participants and delegates of the International Conference on “Recent Trends in Mathematics & Statistics” (ICRTMS-I), being jointly organized by the Department of Mathematics and the Department of Statistics of Bahona College, in association with the Assam Academy of Mathematics, as a part of the Diamond Jubilee Celebration Programme of the College.

Bahona College, since its establishment in 1966, has played a commendable role as a premier institution of higher education in the region, not only in imparting quality education but also in contributing significantly towards the socio-economic upliftment of the surrounding locality. Celebrating sixty years of dedicated service to society through academic excellence is indeed a moment of pride, and organizing an international conference of this nature aptly reflects the institution’s academic vision and commitment.

Mathematics and Statistics form the backbone of scientific inquiry, technological advancement and evidence-based decision-making in the modern world. The rapid developments and emerging trends in these disciplines have far-reaching implications across science, engineering, economics, data science, artificial intelligence and social research. Organizing such an event is not merely an academic exercise—it is a necessity for fostering innovation, strengthening global collaboration, enhancing research quality and ensuring that mathematical and statistical sciences continue to drive technological progress and societal development. A platform such as ICRTMS-I provides a valuable opportunity for academicians, researchers and young scholars to exchange ideas, present innovative research and foster meaningful academic collaborations.

I am confident that the deliberations, keynote lectures and scholarly interactions during this conference will enrich the participants intellectually and inspire future research endeavours. Such academic engagements are essential for nurturing a vibrant research culture and for aligning higher education with global standards of excellence.

I congratulate the organizing committee, the departments concerned and the Assam Academy of Mathematics for their dedicated efforts in conceptualizing and organizing this significant academic event. I wish the conference every success and hope that it will lead to fruitful outcomes and long-lasting academic partnerships.

With best wishes for the grand success of ICRTMS-I and the continued progress of Bahona College,



(Jiten Hazarika)

Dated 16th January, 2026

Dr. Sumbit Chaliha, M.Sc., Ph.D.
Principal

BAHONA COLLEGE

JORHAT | PIN-785101 | ASSAM

Email: principal@bahonacollege.edu.in

Website: www.bahonacollege.edu.in



MESSAGE

It gives me immense pleasure to extend my warm greetings on the occasion of the *International Conference on "Recent Trends in Mathematics & Statistics" (ICRTMS-I)* being held on 20–21 January, 2026 in online mode, organised by the Department of Mathematics & Statistics, Bahona College, in collaboration with IQAC, Bahona College, and in association with the Assam Academy of Mathematics.

In the present era of rapid scientific and technological advancement, Mathematics and Statistics play a pivotal role in addressing complex problems across diverse disciplines. This international conference provides a valuable platform for academicians, researchers, and scholars from different parts of the world to share their research findings, exchange ideas, and deliberate on emerging trends and challenges in these vital fields.

The Abstract Book of ICRTMS-I is a reflection of the intellectual rigor and scholarly contributions of the participants. I am confident that the abstracts compiled herein will stimulate meaningful discussions and inspire further research and collaboration among the academic community.

I sincerely appreciate the dedicated efforts of the organising committee, faculty members, and all those involved in successfully bringing out this abstract book and organising the conference. I also extend my best wishes to all the participants for fruitful deliberations and a memorable academic experience.

I wish the conference a grand success.



(Dr. Sumbit Chaliha)

Dated 17th January, 2026

From the Desk of the Editors

We are pleased to present the Abstract Book of the International Conference on ‘Recent Trends in Mathematics and Statistics’ (ICRTMS-I), organised by the Department of Mathematics & Statistics, Bahona College, Assam, India, in collaboration with IQAC, Bahona College, and in association with the Assam Academy of Mathematics, held on 20–21 January, 2026, and published by the Bahona College Publication Cell. This conference was organised as a part of the Diamond Jubilee Celebration marking 60 years of Bahona College. This volume is a testament to the collective academic efforts and intellectual engagement fostered through the conference.

ICRTMS-I was envisioned as a global forum to bring together researchers, academicians, and professionals working in diverse areas of Mathematics and Statistics to deliberate on recent theoretical developments, methodological innovations, and emerging applications. In the contemporary research landscape, these disciplines play a pivotal role in addressing complex problems across science, engineering, data science, economics, and interdisciplinary domains. The conference sought to encourage dialogue, collaboration, and the exchange of ideas across these rapidly evolving fields.

The abstracts compiled in this volume represent a broad spectrum of current research interests, encompassing pure and applied mathematics, probability theory, statistical inference, modelling, computational methods, data analytics, and interdisciplinary applications. The quality and diversity of contributions reflect both the depth of ongoing research and the growing relevance of mathematical and statistical approaches in addressing real-world challenges.

We express our sincere appreciation to all contributing authors for their valuable submissions and for sharing their research insights through ICRTMS-I. We are equally grateful to the keynote speakers, invited speakers, and session chairpersons for their scholarly contributions and guidance, which greatly enriched the academic deliberations. Our heartfelt thanks are also due to the reviewers, advisory committee members, and organising committee for their dedicated efforts in ensuring the academic standard and smooth conduct of the conference.

It is our hope that this abstract book will serve as a meaningful academic record of ICRTMS-I and act as a source of reference and inspiration for researchers, scholars, and students. We believe that the discussions initiated and ideas exchanged during the conference will stimulate further research collaborations and contribute to the advancement of knowledge in Mathematics and Statistics.

With best wishes for the continued success of ICRTMS-I and its future editions.

Editors

Dr. Pankaj Borah

Dr. Tousifur Rahman

ICRTMS-I 2026

Organising Committee

Chief Patron:

Prof. Jiten Hazarika, Vice-Chancellor, Dibrugarh University

Patron:

Dr. Sumbit Chaliha, Principal, Bahona College

Chairperson:

Dr. Papori Neog Bora, HoD, Department of Mathematics, Bahona College

Advisory Committee (National & International)

Retd. Prof. Gopal Hazarika, Dibrugarh University, India

Retd. Prof. L.K. Arora, NERIST, India

Prof. Tapan Senapati, Southwest University, China

Prof. Kishore Kumar Das, Gauhati University, India

Prof. Surajit Borkotoky, Dibrugarh University, India

Prof. N.N. Noor, University Malaysia Pahang Al-Sultan Abdullah, Malaysia

Prof. Manash Pratim Barman, Dibrugarh University, India

Prof. Chandra Rekha Mahanata, Gauhati University, India

Prof. Dibyojyoti Bhattacharjee, Assam University, India

Prof. M. M. Dixit, NERIST, India

Prof. Prabin Das, University of Science and Technology, Meghalaya, India

Dr. Bhim Prasad Sarmah, Tezpur University, India

Dr. Tien Anh Tran, University of Malta, Malta

Dr. Partha Jyoti Hazarika, Dibrugarh University, India

Dr. M. Hassan, MMMUT, India

Dr. Ashish Paul, Cotton University, India

Dr. Dimpal Jyoti Mahanta, The Kaziranga University, India

Dr. Sasan Tavakoli, The University of Melbourne, Australia

Dr. Naveen Kumar, Chandigarh University, India

Conveners:

Dr. Shyamali Dutta, HoD, Department of Statistics, Bahona College

Dr. Pankaj Bora, IQAC Coordinator, Bahona College

Organizing Secretary:

Dr. Tousifur Rahman, Department of Statistics, Bahona College

Dr. Pankaj Borah, Department of Mathematics, Bahona College

Members:

Mr. Alock Kumar Dutta, Department of Mathematics, Bahona College

Mr. Jayanta Bordoloi, Department of Computer Science, Bahona College

Dr. Manash Jyoti Borah, Department of Mathematics, Bahona College

Mr. Bhaskar Dowrah, Department of Botany, Bahona College

Dr. Somi Kolita, Department of Computer Science, Bahona College

Dr. Anupam Chanda, Librarian, Bahona College

Dr. Dimpal Pathak, Department of Statistics, Bahona College

Table of Content

Keynote Address	1
World Planetary Health,	1
Green Future: The Important of Mathematics and Engineering	1
<i>Keynote Speaker: Prof. Muhmad Mat Noor</i>	1
Invited Talk	1
Least-square error model for measuring the fuel consumption level of marine diesel engines based on variable factors	1
<i>Tien Anh Tran</i>	1
Development and Preliminary Validation of the Assam's Elderly Health-Related Quality of Life Scale (AE-HRQoL), Version 1.0	2
<i>Prof. Manash Pratim Barman</i>	2
Chemical Graph Theory: Graph Indices and Applications	3
<i>Dr. Biswajit Deb</i>	3
From Closure Assumptions to Predictive Mathematics: Rethinking Turbulence Modeling in CFD	3
<i>Prof. Gurunadh Velidi</i>	3
Contributing Papers	4
<u>Theme: Algebra & Analysis</u>	
A Note on Soft C-Algebra Homomorphisms and Their Results	4
<i>V. B. N. Kumari Salapu¹, P. Sundarayya^{2,*}</i>	4
Assessment of Soil Fertility on q-Rung Ortho pair Fuzzy Rough Schweizer-Sklar Prioritized Aggregation Operators	5
<i>Mehwish Sarfraz¹, Muhammad Ishfaq Khan², Nasreen Kausar³, Tapan Senapati^{4,5}, Firas Mohammed⁶</i>	5
“Some results on minimum attaining operators”	6
<i>Rekha Sinha</i>	6
Rough Neutrosophic Fuzzy Ideals in BCK-Algebras	6
<i>Anjaneyulu Naik Kalavath¹, Satyanarayana Bavanari^{2,*}</i>	6
Neutrosophic Fuzzy Ideals in BE-Algebras	7
<i>Bhuvanewari Dhanala¹, Anjaneyulu Naik Kalavath^{2,*}, Satyanarayana Bavanari^{2,*}</i>	7

Improved Fuzzy Clustering techniques based on Fuzzy Equivalent Relation for Inventory Management in a Textile production Company	7
<i>Bhoomi Patel^a, Sathya Arumugam^{b*}</i>	7
Conformal Analysis of Generalized Kropina Changes with m-th Root Finsler Metrics	8
<i>Rupashree Das^{1,*}, Vinit Kumar Chaubey²</i>	8
Convergence on Iterative Approximation of Fixed Points via a Generalized (CSC)-condition	8
<i>Kavita Sakure¹</i>	8
Advanced Algebraic Perspectives on Neutrosophic Super Hyper BCI Semigroups and Their Theoretical Implications	9
<i>Rajat Das¹, Dr. Ajoy Kanti Das^{2,*}</i>	9
Algebraic Structures of Super Hyper Monoids, Groups, and Ideals	10
<i>Suman Patra^{1,*}, Dr. Ajoy Kanti Das²</i>	10
On Weakly 1-Absorbing Prime Ideals of a Lattice	11
<i>Biswajit Deka</i>	11
A Link-Based Egalitarian Approach in a Network Situation	11
<i>Sujata Goala</i>	11
Spectral Graph-Based Encoding with Elliptic Curve Encryption	12
<i>Sarbani Gogoi^{1,*}, Somnath Paul²</i>	12
Measure of Similarity on Intuitionistic Fuzzy Sets for	13
Selecting a Good Career	13
<i>Dibakar Dutta¹ and Rubi Das²</i>	13
Applications of Rational-Type Contractions in Fuzzy Metric Spaces	14
<i>Nabanita Konwar</i>	14
Exponential Inverse Sum Indeg Index of Graphs	15
<i>^{1*}Tarun Boruah, ²Amitav Doley</i>	15
EFFECTS OF VARIABLE VISCOSITY AND THERMAL CONDUCTIVITY ON HEAT AND MASS TRANSFER IN MHD BOUNDARY LAYER FLOW PAST AN INCLINED PLATE WITH VISCOUS AND JOULE DISSIPATION IN POROUS MEDIUM	16
<i>Dr. Kabita Phukon</i>	16

Invariant Mean Operators for Spectral Graph Clustering and Community Detection	17
<i>Sowmya Shree MK¹, S Padmanabhan², Pallavi G³, Neela G¹</i>	17
The 7- & 11-dissections of some infinite q-product expansions	18
<i>Mandeep Kaur^{1*}, Vandna²</i>	18
Stability analysis of anisotropic universe with Barrow holographic dark energy	18
<i>Chandra Rekha Mahanta, Supornajeet Majumder*</i>	18
Effect of Circular Economy on a Non-Instantaneous Deteriorating Item with Preservation Technology Investment and Partial Backlog under a Fuzzy Environment	19
<i>Anita Kumari Sahu¹, V Ganesh², Susanta Kumar Indrajitsingha³, Suchana Mishra⁴</i>	19
A novel Picture fuzzy correlation-based TOPSIS approach for Unmanned Aerial Vehicle selection	20
<i>Soumendu Golui¹, Biplab Sinha Mahapatra^{2*}, G.S. Mahapatra^{3*}</i>	20
Best Proximity Point in Partial Modular Matric Space Using Simulation Function	21
<i>Purnima Phukon¹, Dr. Dipankar Das²</i>	21
Some generalized Sequence space related to lp space defined by Modulus function using Cesaro mean	21
<i>Mrinmoy Bora^{1*}, Rinku Dey²</i>	21
Qualitative analysis of a time dimensionalized opinion model with modified rumour-transmission rate: Fractal-fractional approach	22
<i>Biplab Dhar*</i>	22
Quadratic Primitive Pairs in Finite Fields Avoiding Affine Hyperplanes	22
<i>Himangshu Hazarika¹</i>	22
Applications of measure of non-compactness for solvability of an infinite system of differential equation with integral boundary condition in a tempered sequence space	23
<i>Trideep Deka</i>	23
OPERATIONS RESEARCH OPTIMIZATION TECHNIQUES FOR DUAL FUZZY RANKING IN SMART GRID AND SUSTAINABLE PROJECT SCHEDULING	24
<i>M. Sandhiya¹, H. A. Bhavithra¹, S. Sindu Devi¹</i>	24

Optimizing Traffic Flow at Urban Intersections: A Fuzzy Graph Based Approach	25
<i>Manoshi Kotoky¹, Bedakhi Baruah^{1,*}</i>	25
Fixed Point Theorems for Generalized Weak Contractive Mappings in Partial Modular Metric Spaces with Application to Integral Equations	25
<i>Liza Hazarika^{1,*}, Dr. Dipankar Das²</i>	25
Certain Properties of Analytic Functions Associated with Tremblay Fractional Derivative Operator	26
<i>S. G. Hiwale¹ and D. D. Pawar²</i>	26
A Review of Differential Operators in Geometric Function Theory (GFT)	26
M. Asha, Dr. M. Kasthuri	26
On reversely open mappings and its relationship with continuous mappings in ideal topological spaces	27
<i>Nitakshi Goyal</i>	27
Laplacian spectra of subdivision and central graph join operation and families of non regular cospectral graphs	28
<i>Dr. Manash Protim Borah</i>	28
On a class of Vector Valued Sequences associated with Multiplier and Difference Sequence Spaces.	28
<i>Vicky Karmakar^{1,*}, Rinku Dey²</i>	28
Dihedral Group Cordial Labeling and Its Encryption Decryption Framework for Standard Graphs	29
<i>A. Sudha Rani¹, S. Sindu Devi²</i>	29
Analytical Study of Time-Fractional Kaup-Kupershmidt Equation via Shehu Transform Approach	30
<i>TAPASI PASAYAT^{1,*}, ASHRITA PATRA¹</i>	30
Geometric Properties of Relative Uniform Lacunary Convergence of Double Sequences of Functions	30
<i>Munindra Regon¹ and Pranab Jyoti Dowari²</i>	30
Topological and Structural Aspects of Lacunary Weakly Convergent Double Sequences of Functions	31
<i>Sujata Saikia^{1,*} and Pranab Jyoti Dowari²</i>	31

Approximation solvability of H-Monotone Operator with Application to Caylay inclusion Problem in Banach Spaces	31
<i>Khalid Fayaz, Mohd Iqbal Bhat, Hilal Ahmad Khanday and Mudasir Ahamd Malikk</i>	31
PID Stabilization for EHD Thermal Printers	32
<i>Ranadip Roy¹, Rudra Pratap Singh², Dharmbir Prasad³, Moumita Bose⁴</i>	32
Spectral bounds and localization set of nonsingular linear two-parameter eigenvalue problems	32
<i>Bikash Chutia¹ and Niranjan Bora²</i>	32
An Infinite Family of Congruences modulo 3 for $t_5(n)$	33
<i>Dr. Bidyut Boruah</i>	33
New Similarity Measure for Generalized Fuzzy Set and its Application in Transport Optimization Problem	33
<i>Bornali Saikia^{1*} and Palash Dutta²</i>	33
ALPHA GRACEFUL LABELING IN THE CONTEXT OF m-SHADOW GRAPHS	34
<i>Jaykeen H. Jani[*], V. J. Kaneria</i>	34
A Novel Intuitionistic Fuzzy Similarity based Clustering Application to Diverse Real-world Problems	35
<i>Ritu Bhuyan^{1*}, Juthika Mahanta²</i>	35
Tropical Algebraic Methods for Interpreting Deep Neural Networks	36
<i>Mrs. Anupama Pandey¹, Pravar Mishra²</i>	36
Graph Invariants of the Identity Graph of a Symmetric Group	37
<i>Archana Rajeev¹</i>	37
ON A SUBCLASS OF ANALYTIC FUNCTIONS DEFINED BY LAGUERRE POLYNOMIAL	38
<i>AKANKSHA SAMPAT SHINDE¹, P. THIRUPATHI REDDY²</i>	38
Extension of Ordinary Cooperative Games and Their Fuzzification	39
<i>Dr. Mamta Kumari</i>	39
A Mathematical Study of Rank and Nullity in Fractal Polygon Graphs and Their Applications	39
<i>Suriya Banu. R¹, Kamali. R². *</i>	39
On degree based Laplacian and signless Laplacian spectrum of graphs	40
<i>Bablee Phukan^{*,1}, Ankur Bharali¹</i>	40

Perfect Regularity and Perfect Edge Regularity of Interval-Valued Fuzzy Graphs	40
<i>Bisna Jose^{1*}, Sunny Joseph Kalayathankal², Joseph Varghese Kureethara³</i>	40
TOPOLOGICAL PROPERTIES OF MULTI METRIC SPACES	41
<i>Debjyoti Chatterjee^{1*}, Shashi Bajaj Mukherjee²</i>	41
New Classes of β-Continuity in Neutrosophic Nano Topological Spaces	41
<i>Dr. P. Anbarasi Rodrigo¹, J. Charlet Jenisha²,</i>	41
On Zagreb Energies of Extended m-splitting Graph	42
<i>Dipakkumar N. Barad*, Vinodrai J. Kaneria</i>	42
MICRO α * -GENERALIZED HYPERCONNECTED IN MICRO TOPOLOGICAL SPACES	43
<i>Dr. P. Anbarasi Rodrigo¹, K. Selvakumari Prasha^{2*}</i>	43
New Approaches in fixed point theory in multiplicative metric space	43
<i>Satish Kumar</i>	43
A new approach to the common fixed points theorem for set-valued mappings within cone metric spaces.	44
<i>Mohsin Ahmad Dar</i>	44
Linearizations of Cubic Two Parameter Matrix Polynomial via Newton Basis	44
<i>Ankita Kakoty and Niranjana Bora</i>	44
A fuzzy MCDM model for agricultural technology selection: integrating generalized Frank operators and machine learning	45
<i>Muhammad Umar Mirza^a, Muhammad Zafar Abbas^a, Nasreen kausar^b, Rukhshanda Anjum^a, Tapan Senapati^{1*},</i>	45
Game theory and it's applications in Business world	46
<i>Dr. Supriya</i>	46
Some Numerical Descriptors of Black Phosphorus Layer Structure	47
<i>Rajdeep Bora</i>	47
A Novel Perspective on Cancer Data Clustering Through Intuitionistic Fuzzy C-Means Techniques	47
<i>Pandian Palani^a, Bhoomi Patel^b, Sathya Arumugam^c</i>	47
Application of graph theory in day- to-day life	48
<i>Jita Dutta</i>	48

“Spaces of lacunary statistically weakly convergent triple sequences with applications to sparse data modelling” 49

Md Sahid Alam^{1}, Dr. Ajoy Kanti Das²* 49

Approximation Solvability of a Class of Cayley Inclusion Problem Involving XOR Operator in Ordered Hilbert Space 50

Mahak Majeed 50

Theme: Applied Mathematics

Linear Stability of Pipe Flow with Magnetic Field and Internal Heat Source: A Non-Darcian Approach 51

Ashok Kumar 51

Electron scattering from hydrogen atom in plasmas: S-wave resonance states 52

Nirvik Masanta^{1}, Netai Das², Arijit Ghoshal² and Yew Kam Ho³* 52

Cost Optimization in a Dual Warehouse Inventory Model with Stock and Price Dependent Demand under AI Forecasting, Inflation and Trade Credit 53

Vinay Kumar Masiyare^{1}, Animesh Kumar Sharma²* 53

Compressive and rarefactive dust ion-acoustic Korteweg-de Vries solitons in an unmagnetized dusty plasma with kappa-distributed electrons 54

Tirthanath Doley^{1,2,} and Samiran Das¹* 54

CURVILINEAR MODELS OF PHYSICOCHEMICAL PROPERTIES OF BENZENOID HYDROCARBONS WITH CLOSED-NEIGHBORHOOD DEGREE-BASED MOLECULAR DESCRIPTORS 55

Monjit Chamua^{1}, Jibonjyoti Buragohain², Tarun Boruah², A. Bharali²* 55

Effects of variable viscosity and thermal conductivity on a mixed convective micropolar fluid over a porous plate 55

DR. SURAJIT DUTTA 55

Influence of MHD on the Flow Past a Porous Spherical Shell with Slip Effect 56

Tina Bucha^{1}, Madasu Krishna Prasad²* 56

Observational data analysis on the late-time cosmic acceleration in non-metricity gravity with a non-minimal matter interaction 57

J. K. Singh¹, Sonal Aggarwal^{1}, Shaily¹, Niraj Kumar¹* 57

Finite-Time Blow-Up Analysis Of a Chemotaxis-Driven Tumor Growth Model	58
<i>Chandru S, Dr G. Sathishkumar*</i>	58
Evaluating GRC Models for Effective Load Frequency Control in Multi-Area Thermal Systems	59
<i>Ch. Naga Sai Kalyan¹, Mohit Bajaj^{2,3,4}, Bhabasis Mohapatra^{*5}, Pankaj Borah⁶</i>	59
Simulation of Rice Blast Epidemics: Integrating Environment and Pathogen Biology	60
<i>Vaishnavi Kalirajan¹, Malinidevi Ramanathan^{2,*}</i>	60
Thermo-Fluid Stability of Viscous-Dissipative MHD Flows Subject to Hall Conductivity and Variable Suction	60
<i>Pralisha Mishra¹, Itishree Nayak²</i>	60
Effect of Diffusion- Thermoon Unsteady MHD Convective Flow Past an Exponentially Accelerated Vertical Plate Submerged in Porous Medium with Arbitrary Ramped Temperature	61
<i>Dr. Subhrajit Sarma</i>	61
Nonlinear Dynamics of Sovereign Debt: The Roles of Regulation and Political Influence	61
<i>Sanjay Kumar Das¹, Dr. Manmohan Das²</i>	61
Existence and Uniqueness Results for Fractional Integro-Dfferential Equations with Deviating Argument	62
<i>^{1*}Satyabrot Kalita, ² Rajib Haloi</i>	62
Stability and bifurcations in an ODE model of financial marketvolatility	62
<i>Animesh Phukan^{1*}</i>	62
Time-Changed Fractional Poisson Processes Driven by Tempered Version of the Lévy Subordinators	63
<i>Shilpa</i>	63
Mathematical framework that pioneered the concept of Black Hole: Schwarzschild and Kerr Metrics	64
<i>^{1*} Nungsangtola</i>	64
Effect of parabolically varying thickness on the free transverse vibration of fully clamped non-homogeneous rectangular plate	64
<i>Dr. Renu Saini</i>	64

Exploring Anti-Inflammatory Potential of <i>Momordica cymbalaria</i> Root Phytochemicals Through <i>In Silico</i> Studies	65
<i>M. Nishandhini</i>	65
A Review on Understanding Behaviour of Seismic Wave Propagation in Different Media	65
<i>Kanika Chadha¹, Dinesh Kumar², Kuldip Singh³, Naveen Kumar⁴</i>	65
Affects of Mathematics Anxiety on Mathematics Achievement of class-x girl students' of Dhubri District, Assam.	66
<i>Afruza Begum¹ Samiran Das²,</i>	66
A study on two compact and precise potential energy functions for diatomic molecules	67
<i>Nirvik Masanta¹ and Sujay Kumar Nayek²</i>	67
Optimization techniques in Operations research and Data science	67
<i>Salla Sravanthi¹, B. Chandrakala²</i>	67
The Intelligent API Gateway: A Proactive Framework for Automated Security, Usability, and Management in IoT Ecosystems	68
<i>Ms Amrutha Kolhar¹, Dr Sridevi²</i>	68
FUNDAMENTAL RESULTS IN THE THEORY OF HYBRID DIFFERENTIAL EQUATIONS WITH SECOND TYPE LINEAR PERTURBATIONS AND DEVIATED ARGUMENT	68
<i>^{1*}Monuj Gogoi, ²Rajib Haloi</i>	68
Numerical Simulation of Casson Fluid Flow Over a Radiatively Heated Symmetric Wedge	69
<i>Saswati Purkayastha</i>	69
Cosmological Dynamics and Parameter Optimality of the Interacting Umami Chaplygin Gas Model	69
<i>Trishit Banerjee¹, Atreyee Biswas^{2,*}</i>	69
ANALYSIS OF ROLL HYDRODYNAMIC COEFFICIENTS BY A FLOATING CYLINDER IN PRESENCE OF A BARRIER AT THE BOTTOM IN THE CHANNEL FLOW OF FINITE WIDTH	71
<i>Pankaj Borah¹, Nijara Konch^{2,*}, Mukunda Madhab Borah³</i>	71
Cosmological Dynamics of Sharma–Mittal HDE in Brans–Dicke Gravity	72
<i>R. Sathibabu & K.V.S. Sireesha</i>	72

MATHEMATICAL APPROACHES TO CLIMATE CHANGE AND ENVIRONMENTAL SYSTEMS	73
<i>Vasanthapriya R, Berlin A</i>	73
Analysis of a Finite-Capacity Queue with Reverse Balking and Position-Dependent Reneging	74
<i>Girin Saikia¹</i>	74
The Novel Harmonic Soft Decision Algorithm for Suitable Institutions and Programme Selection in Higher Studies for Students	75
<i>ANSARI. A¹, RAJENDRAN. K^{2*}</i>	75
Computational Study of Emden-Fowler Equations: A Genocchi wavelet Approach	75
<i>Pappu Kumar^{1*}, Jay Kishore Sahani²</i>	75
Holographic Reconstruction of Scalar Field Dark Energy Model in Anisotropic Bianchi Type-II Space-Time	76
<i>Tazmin Sultana¹</i>	76
Length-weight relationship, condition factor, gonadosomatic index, size at first sexual maturity, spawning season, and fecundity of <i>Cyprinion semplotum</i> (Cyprinidae) in Dikrong River, Arunachal Pradesh	76
<i>Rashmi Dutta^{1*}, Debanshu Narayan Das²</i>	76
IMAGE DENOISING USING A HYBRID VCNS–CNN–NMGPR FRAMEWORK WITH MULTI-OBJECTIVE OPTIMIZATION	77
<i>Pratibha Karki</i>	77
Hybrid Cryptographic Scheme Leveraging Bitwise AND Operations for Enhanced Security	78
<i>Suraj Pal*, Anu Kathuria</i>	78
Beyond the Traditional RSA: Design and Implementation of a Mathematical Attack Resistant Lightweight Modified RSA Algorithm For IOT Data Confidentiality	78
<i>Partha Saker^{1*}, Ajoy Kumar Khan², Rohan Debnath³, Zunaid Ahammed⁴</i>	78
Design and Implementation of a cryptanalytically strengthened RSA Algorithm for IOT Data Confidentiality	79
<i>Amit Kumar Bag^{1*}, Ajoy Kumar Khan²</i>	79
An Enhanced DGJ Iterative Method for Analysis and Accurate Numerical Simulation of Higher Order Time-Fractional KdV Equations	80

<i>Keerthika V</i>	80
Dispersion characteristics of self-gravitating complex plasmas with generalized polarization force between negative dust and cairns ions	81
<i>Himangshu Kalita¹, Karabi Devi²</i>	81
3DOFPID Controller for the Stability of Multi Area Realistic Hydro Thermal Power System with the HVDC Line	82
<i>Ch. Naga Sai Kalyan¹, Mohit Bajaj^{2,3,4}, Bhabasis Mohapatra^{*5}, Pankaj Borah⁶</i>	82
Demonstrating the Impact of Power System Realistic Constraints on the Performance of Load Frequency Control	83
<i>Ch. Naga Sai Kalyan¹, Mohit Bajaj^{2,3,4}, Bhabasis Mohapatra^{*5}, Pankaj Borah⁶</i>	83
A sustainable Multi-Objective Economic Production Quantity model under Perform, Achieve and Trade scheme in India	84
<i>Nayantara Gogoi^{1,*}, Bijoy Krishna Debnath², Tanmay Halder³</i>	84
Signal Flow Graph and Mason's Gain Formula in Analysis of Bilateral Electrical Network.	85
<i>^{1*}B. C. Phukan</i>	85

Theme: Mathematical Modeling

Mathematical Modelling of Traditional Ecological Knowledge Using Fuzzy Multi-Criteria Decision-Making for Sustainable Water Management in Tribal Regions of Tripura, Northeast India	86
<i>Nandini Gupta^{1*}, Ajoy Kanti Das², Nandan Dhar³, Ashwini Debbarma</i>	86
<i>Keywords: Fuzzy Sets, Traditional Ecological Knowledge, Multi-Criteria Decision-Making, Water Resource Management, Tribal Communities</i>	86
The Role of Mathematical Models in Understanding Complex Systems	87
<i>Shyam Sundar Panda</i>	87
A Study on Assessment of Pollution with a Focus on Transportation Mode : Special Reference to Newly Developed Smart City (NKDA)	88
<i>Madhurima Chattopadhyay^{*1}, Sayantika Mukherjee², Dipanwita Das², Amrita Saha³</i>	88
Analysis of MHD bioconvective ternary hybrid nanofluid flow over moving thin needle using Cattaneo-Christov heat flux model	89
<i>Vishal Saikia¹ and P.N. Deka²</i>	89
Mathematical Modelling and Performance Analysis of a 5G Implantable Antenna for Wireless Bio-Telemetry	89
<i>Moumita Bose^{1*}, Ajit Prasad singh², Ujjal Chakraborty³, Ranadip Roy⁴</i>	89

A Comparative Analysis of Wave Motion in Porothermoelastic Medium in Context of Green-Lindsay Model and Lord-Shulman Model 90

Dr. Divya 90

A Multi-Compartment Pollution Model with Optimal Control and PM_{2.5} Data Validation from Delhi 90

Apeksha Prajapati 90

Mathematical Modelling of Microbial Defence Mechanisms Driving Antibiotic Resistance Dynamics 91

Mr. Praveen Kumar 91

Theme: Machine Learning

Mathematical Analysis of Convex Optimization Algorithms with Applications in Regularized Machine Learning Models 92

Neela G¹, S Padmanabhan², Pallavi G³ 92

ABSTRACT 92

“Role of Mathematics in Artificial Intelligence and Machine Learning” 93

Ms. Tamanna Jain , Mrs. Anjali Mathur , Mr. Sandeep Mathur 93

Quantized Sampled-Data Control for Lag Synchronization of Inertial Memristive Neural Networks with Additive Time-Varying Delays 94

M. Kamali¹, A. Chandrasekar^{2,}, T. Radhika³* 94

The Role of Mathematics in Driving Artificial Intelligence and Machine Learning Innovations in India 95

Dr. Chitta Ranjan Malik 95

A Comprehensive Classical Machine Learning Framework for Autism Spectrum Disorder Detection Using High-Resolution Facial HOG Descriptors 96

Roopa T¹, Dr Priyamwada Sharma² 96

Deep Learning Approach for Recognition of Handwritten Kannada Vowels Using CNNs 97

Shivaraj Maleppanavarmath^{1}, Ishwar Baidari²* 97

Quasi-synchronization of delayed competitive neural networks using memory state feedback controller 98

A. R. Subhashri¹, T. Radhika^{1}, A. Chandrasekar¹* 98

**Modern Machine Learning's Mathematical Underpinnings and Methods:
An Extensive Research Overview** **98**

Dr Kshirod Sarmah 98

*Department of Computer Science, Pandit Deendayal Upadhyaya Adarsha Mahavidyalaya (A Govt.
Model College), Goalpara, Assam, India,* 98

**Predicting soaked CBR of subgrade geosynthetic-reinforced soil using
evolutionary artificial intelligence technique** **99**

Vikash kumar singh¹, Rajesh Kumar Dixit², Atul Sthapak³ 99

**Hybrid Computational Statistics and Machine-Learning Architecture for
Large-Scale EEG Signal Processing** **100**

Dr. S. Syed rafiammal 100

Theme: Mathematical Statistics

**Reliability Analysis of Cascade System using Mixtures of Rayleigh
Distributions** **101**

Dr Chumchum Doloi 101

**Formulation of Efficient Estimation Technique for population mean through
Two-phase sampling** **101**

Arnab Bandyopadhyay¹, Abhay Majumdar² and Ayush Biswas³* 101

**Formulation of an Effective Estimation Strategy for Finite Population
Variance under Two-Phase Multi Stage Cluster Sampling Scheme in
Presence of Random Non-Responses** **102**

Arnab Bandyopadhyay¹, Mithu Dey (Sarkar)² and P. Parichha³* 102

**“Contradictory Inferences in Small Samples: A Study Using Chi-Square and
Binomial Distribution Approaches”** **103**

Kamlesh Bhandari 103

**Inference for Stress-Strength Reliability Using the Exponential-Gamma
Model: Theory and Applications** **103**

Joyshree Saharia, Jonali Gogoi* 103

**Enhanced Population Mean Estimation Using an Exponential Estimator
with Known Medians of Dual Auxiliary Variables within a Neutrosophic
Approach: Applications in Agricultural Yield Prediction** **104**

Anchal Yadav¹ and Mukesh Kumar¹* 104

Statistics and Probability for Data Science and Analytics	105
<i>Vandna^{1,*}, Mandeep Kaur²</i>	<i>105</i>
The Even Power Weighted Inverse Gamma Distribution and Its Application in Medical Science	106
<i>Jumi Talukdar</i>	<i>106</i>
Beta Transmuted Maxwell Distribution	106
<i>Nandita Borah^{1,*}, Priom Seal²</i>	<i>106</i>
A New Factor-type Imputation Method for Estimation of Finite Population Mean In Case of Missing Data Tarun Kumari <i>Department of Commercial Arithmetic, Lakhimpur Commerce College, North Lakhimpur, Assam, India</i> tarun.nlp@gmail.com	107
Estimation and Real-Life Applications of a New Generalized Class of Continuous Probability Distributions	107
<i>Laba Handique</i>	<i>107</i>
OPTIMIZATION OF POULTRY FARM PRODUCTS USING LINAR PROGRAMMING MODEL	108
<i>Dr. Shyamali Dutta</i>	<i>108</i>
<u>Theme: Applied Statistics</u>	
Prediction of Rainfall in Himachal Pradesh using Statistical and Machine Learning Models	109
<i>Diya Binu George¹, Radhalakshmi K.N², Rajesh R³</i>	<i>109</i>
Explainable Machine Learning and Statistics for Early Bankruptcy Prediction: Evidence from the Taiwan Bankruptcy Dataset	110
<i>Nandini Mukherjee, Radhalakshmi K N</i>	<i>110</i>
Systematic Literature Review: E-Tendering Effectiveness, Implementation Challenges, and the Transformative Agenda in Public Sector Construction	111
<i>Elis Mardzianah Mazlan^{1,2}, Asmawan Mohd Sarman^{1,2*}, Siti Syariazulfa Kamaruddin¹</i>	<i>111</i>
Study on Curvi-Linear Regression Model for Predicting Entropy of Octane Isomers	112
<i>Aditya Pegu^{1,*}, A. Bharali²</i>	<i>112</i>
Interdependent Strategies and Uncertain Flows: An Economic Analysis of Rajasthan's Religious Tourism	112
<i>Mr. Franshu Mahipal</i>	<i>112</i>

Delay-Dependent Stochastic Stabilization and H_∞ Performance of T–S Fuzzy Markov Jump Systems under Fault-Tolerant Stochastic Sampled-Data Control	113
<i>S. Ruth Dunamis¹, T. Radhika^{2,*}, A. Chandrasekar³</i>	<i>113</i>
Statistical Process Control Approach to Reducing Errors in Financial Transactions Using Control Charts	114
<i>Dr. Ajit Goswami</i>	<i>114</i>
Reha Cast: A Smart Sensor Splint Using Data and Statistical Models for Better Rehabilitation	115
<i>¹Keerthika S, ²S. K. Kabilesh, ³Kamalesh P, ⁴Karavadi Varun Sai, ⁵Kavidass S</i>	<i>115</i>
Real Time on Board Sensor Data Monitoring in Electric Vehicles	116
<i>¹Sathishkannan B, ²S. K. Kabilesh, ³Surekha N, ⁴Shri Dharshan R C</i>	<i>116</i>
A Statistical Comparison of Retinal Imaging Modalities Using Multimodal Deep Learning Algorithms for Disease Detection	117
<i>¹R. Swaranambigai, ²Dr C. Maheswari, ³S. K. Kabilesh</i>	<i>117</i>
Semi-Markov Modelling of Multistage Call Centers with Impatient Customers and Overflow Routing	118
<i>Bhupakhi Deka¹, Priyanka Kalita²</i>	<i>118</i>
Systematic Mobile Assessment and Reporting Tool Of Condition Survey Investigation (SMART-CSI) For Building Maintenance Management Toward Digitalization.	119
<i>Asmawan Mohd Sarman^{1,2}, Elis Mardzianah Mazlan^{1,2,*}, Mohd Husni Husin¹, Habib Musa Mohamad^{1,2}, Nelly Majain^{1,2}, Tom Ngui Min Fui¹, Siti Kartini Ali Ashgar¹</i>	<i>119</i>
Stochastic Modelling and Performance Optimization of IoT Enabled Smart Manufacturing Systems via Markov Regenerative Process	120
<i>Nirikhita Goswami¹, Dr Priyanka Kalita^{2,*}</i>	<i>120</i>
Frequency analysis of monthly maximum rainfall for monsoon season: A case study for Bramaputra valley region of Assam	121
<i>Abhiit Bhuyan^{1,*}</i>	<i>121</i>
An Approach to M/M/1 Queuing Model: Balking, Reneging& Rejoining under Multiplevacation	121
<i>Gyandeep Sharma¹, Pallabi Medhi²</i>	<i>121</i>
Harnessing Statistical Applications for Evidence-Based Policy, Effective Governance, and Sustainable Development in India.	122

<i>Dr. Poli Boruah</i>	122
Understanding Spatial Variation in Dementia Prevalence using Ordinary Least Square and Geographically Weighted Regression	123
<i>Sanchayita Alambyayan^{1*}, Jonali Gogoi²</i>	123
Impact of Bai–Perron Structural Breaks on the Predictive Performance of Econometric and Machine-Learning Models for Indian Equity Indices	123
<i>Sohom Majumder¹, Vivek Pathak²</i>	123
Higher-Order Expansions of the Disturbing Function: Secular Oscillations, Resonances, and Long-Term Chaos	124
<i>Ruqiyah Aslam & Prof. S.N. Hasan</i>	124
Trend Analysis of Annual Maximum Rainfall data of Cherrapunji, Meghalaya using Non Parametric Methods	125
<i>Dr. Dhruba Jyoti Bora</i>	125
A TWO-VARIABLE NONLINEAR MATHEMATICAL MODEL FOR MARRIAGE-DIVORCE DYNAMICS VALIDATED THROUGH MACHINE-LEARNING ERROR ANALYSIS	125
<i>S SINDU DEVI, A DANYA</i>	125
Factors Determining Women’s Empowerment in Rural Areas: A Statistical Analysis	126
<i>Abhinanda Bordoloi¹, Pranita Goswami², Lipi B Mahanta^{3,*}</i>	126
Incidence and Mortality of Stroke Patients in Odisha: Epidemiological Patterns from 2023–2024	127
<i>Dr. Chakrala Sreelatha¹, Keshav Kumar Padihar²</i>	127
ABSTRACT	127
Convolutional Neural Network Variants and Performance Improvements in Knee Osteoarthritis: An Overview	128
<i>Annu James</i>	128
Exploring the role of education in Teenage Pregnancy: A Mediation Analysis approach	129
<i>Baby Das^{1,*}, Manash Pratim Barman² & Julius Moinget Loibor¹.</i>	129
Health-Related Quality of Life (HRQoL) and Hypertension Status among older adults in Assam	130
<i>*Krishna Borah^{1*}, Prof. Manash Pratim Barman²</i>	130
Robustness of Two Sample Location Test in the Presence of Outliers	131

<i>Dr. Mintu Kr. Das</i>	131
Sustainable Policy Evaluation Using Multivariate Statistical Methods: Case Study on Governance in Developing Economies	131
<i>Alauddin Middy</i>	131
Forecasting of Electricity Demand in North-Eastern Region, India by ARIMA Model: A Time Series Analysis Approach	132
<i>Dr. Nibedita Mahanta,</i>	132
Geo-statistical modelling of elephant-train collision incidences using OLS and GWR regression approaches	133
<i>Dr. Rekib Ahmed</i>	133
Statistical Applications in Policy, Governance, and Sustainable Development	133
<i>B. Chandrakala¹</i>	133
Dynamic Stability and Policy Adaptation in Stochastic Feedback-Coupled Climate-Economic Models	134
<i>Dr. Mrinal Sarma, Dr. Banani Bora Hazarika</i>	134
A Comprehensive Investigation of The Sociodemographic and Maternal Risk Factors Associated to Low Birth Weight	134
<i>¹Sewali Hazarika ²Tousifur Rahman ³Manoshi Kotoky</i>	134
Daily Rainfall Frequency Analysis by using Markov Chain Probability Model: A case study of North Lakhimpur (Assam), India	135
<i>DR. RUBUL BORA</i>	135
Stochastic Modelling of Multi-server Markovian queues with Threshold-driven customer behaviour and Encouraged arrival	136
<i>Dolismita Boruah^{1,*} Pallabi Medhi</i>	136
A Simulation-Based Evaluation of Alternative Estimators in M/M/1/k Queues	136
<i>Kaustav Dutta^{1,*}, Amit Choudhury²</i>	136
Impact of the 'Mukhya Mantrir Nijut Moina Aasoni' on Academic Performance and Retention of Girls' Students: A Statistical Evaluation and Evidence	137
<i>DR. SANHITA SARMAH</i>	137
Association Between Maternal Body Mass Index and Child Survival in India: A Statistical Approach Using NFHS-5	138

<i>Sanjeev Deka, Dr. Sahana Bhattacharjee</i>	138
Threshold-based Customer Impatience in M/M/2 with Encouraged Arrival and Feedback Customer	139
<i>Satabdi Goswami, Pallabi Medhi</i>	139
Estimate and Compare Various Socio-Demographic and Treatment-Related Risk Factors That Affect the Severity of Breast Cancer	140
<i>Bornali Khound^{1*}, Dhruba Das²</i>	140
"A Review of Analytical Methods and Statistical Tools Used in Research on Janani Suraksha Yojana and Maternal Health Indicators"	141
<i>Leena Saikia^{1*}, Pranab Barua², Dimpal Jyoti Mahanta³</i>	141
A STUDY ON THE OVERVIEW OF THE EFFECT OF SUDARSHAN KRIYA YOGA ON MENTAL HEALTH	141
<i>Sneha Chanda¹</i>	141
A Bayesian support vector machine for predictive modelling of underground mine's microclimate	142
<i>Snehangshu Chatterjee^{1*}, Saurav Rukhaiyar², Ayani Nandi³, Partha Sarker⁴, Satyabrata Podder⁵</i>	142
Effect of Pollution on Lung Cancer through Logistic Model: An Analytical Approach	143
<i>Saswotika Rath, Mitali Madhusmita Nayak*</i>	143
Prediction of Child Mortality in Tanzania: Pre-Post SMOTE Based ML Techniques	144
<i>¹Julius Moinget Loibor, ²Manash P. Barman, ³Baby Das</i>	144
Censored Poisson Regression Modelling for Antenatal Care Visits	145
<i>V Suriya Kannan Asst. Professor - PG Department of Biostatistics -SFS Shrimathi Devkunvar Nanalal Bhatt Vaishnav College for women, Vaishnava College Road, Shanthi Nagar,Chromepet,Chennai-600 044. Tamil Nadu, India.</i>	145
Tweedie–Gamma Modeling of Infant Mortality Based on NFHS-5	145
<i>S. Santhana Lakshmi¹ V. Suriya² & M. Priyadharshini³</i>	145
Perception and Practice of Environmental Responsibility Among College Students: A Questionnaire-Based Study	146
<i>Dr. V. Kavitha^{1*}, Dr. J. L. Prameena Sheeja², Dr. V. Suriya³</i>	146

Keynote Address

World Planetary Health, Green Future: The Important of Mathematics and Engineering

Keynote Speaker: Prof. Muhmad Mat Noor

Universiti Malaysia Pahang Al-Sultan Abdulla, Malaysia

Summery:- The keynote address was delivered by **Professor M. M. Noor, Universiti Malaysia Pahang Al-Sultan Abdullah (UMPSA), Malaysia**. In his talk titled “*World Planetary Health, Green Future: The Importance of Mathematics and Engineering*”, he highlighted the crucial role of mathematical modeling and engineering innovations in addressing global environmental challenges and promoting sustainable development.

Invited Talk

Least-square error model for measuring the fuel consumption level of marine diesel engines based on variable factors

Tien Anh Tran

Department of Electrical Engineering, University of Malta, Msida 2080, Malta

ABSTRACT

The 1st International Conference on Recent Trends in Mathematics and Statistics (ICRTMS I) on 20-21 January 2026 has been organized successfully by Department of Mathematics & Statistics, Bahona College along with Assam Academy of Mathematics (AAM). The insights of recent mathematics development are great momentum to utilize the mathematics into the different fields in education, engineering, and business. To contribute partly on this conference, the mathematics model has been established based on the least square error theory to estimate accurately the fuel consumption mass of marine diesel engines. In this model, the complexity of uncertain factors impacting on the fuel consumption of marine diesel engines has been addressed to increase accurately the fuel consumption estimation model. Based on the least square error method, the reduction of fuel consumption estimation error will be increased. The total evaluation of this model will be presented through the performance metric including the coefficient of determination (R^2), the mean absolute error (MAE), the root mean square error (RMSE). This study is significant in determining the fuel consumption of marine diesel engines nowadays through the mathematic theory.

Development and Preliminary Validation of the Assam's Elderly Health-Related Quality of Life Scale (AE-HRQoL), Version 1.0

Prof. Manash Pratim Barman

Professor, Department of Statistics, Dibrugarh University, Dibrugarh, Assam, India, Pin: 786004

(ORCID: 0000-0002-2235-5457), Email: manash_stats@dibru.ac.in

ABSTRACT

Background and aims: The ageing phase is unavoidable in everyone's life, but the only difference is how individuals handle it. The simultaneous rise in life expectancy and decline in fertility led to a notable increase in India's elderly population, including in Assam. The study of Health-Related Quality of Life (HRQoL) among the elderly population is crucial for improving healthcare facilities and for framing government policies and programs. This study aims to provide a comprehensive sequential background of the survey instrument development process, focusing on the construction of an HRQoL measuring instrument for elderly people in Assam.

Methods: The methodology followed a systematic approach. First, item development involved identifying relevant domains, generating items using inductive and deductive methods, ensuring content validity through expert review, translating the items, and assessing face validity in the target language are conducted. Second, the evaluation of scale development included pre-testing the questionnaire, sampling and survey administration, item reduction, and factor extraction. Finally, the scale evaluation included assessing its dimensionality and testing its reliability and validity to ensure the measurement instrument's accuracy.

Results: An initial pool of 56 items across 10 conceptual domains was generated with the help of combined inductive and deductive methods. Content and face validation yielded a refined 42-item, 9-domain structure, with validity indices including I-CVI, S-CVI/Ave, and S-FVI/Ave. Finally, after completion of all the psychometric assessment tests, the HRQoL measurement instrument was finalised with 29 items and 8 domains.

Conclusion: The AE-HRQoL measuring instrument was finalised with 29 items across 8 domains.

Key Words: Elderly, HRQoL, Content Validity, Face Validity, Psychometric Test.

Chemical Graph Theory: Graph Indices and Applications

Dr. Biswajit Deb

*Associate Professor, Department of Mathematics, Birangana Sati Sadhani Rajyik Vishwavidyalaya,
Assam, India*

ABSTRACT

Chemical graph theory is a prominent branch of mathematical chemistry that plays a crucial role in analyzing the connectivity and topology of molecular structures, as well as their stability, reactivity, and other significant properties. A molecular graph provides a graphical representation of a chemical compound, where atoms correspond to vertices and chemical bonds correspond to edges. This talk aims to introduce several graph indices reported in the literature and to highlight their applications in chemical sciences.

From Closure Assumptions to Predictive Mathematics: Rethinking Turbulence Modeling in CFD

Prof. Gurunadh Velidi

University of Petroleum and Energy Studies, Dehradun, Uttarakhand, India

ABSTRACT

Turbulence modeling remains the central unresolved challenge in computational fluid dynamics, primarily due to the mathematical closure problem arising from Reynolds averaging and scale separation. This keynote revisits the mathematical foundations of turbulence models, beginning with the Reynolds-Averaged Navier–Stokes equations and extending through eddy-viscosity, Reynolds stress transport, and scale-resolving approaches. Emphasis is placed on the mathematical assumptions embedded within closure hypotheses, their implications for solution stability and realizability, and the limits they impose on predictive accuracy. The talk highlights emerging mathematical directions, including invariant-preserving closures, data-constrained model forms, and hybrid deterministic–stochastic formulations, with a focus on how mathematical rigor can restore physical consistency in turbulent flow simulations.

Contributing Papers

Theme: Algebra & Analysis

A Note on Soft C-Algebra Homomorphisms and Their Results

V. B. N. Kumari Salapu¹, P. Sundarayya^{2,*}

Department of Mathematics and Statistics, Institute of Science,

GITAM (Deemed to be University), Visakhapatnam – 530 003, Andhra Pradesh, India

*kumarisalapu@gmail.com:

ABSTRACT

In 1999, Molodtsov initiated the theory of soft sets as a new mathematical tool to deal with uncertainties in modelling problems in Engineering, Physics, Computer Science, Economics, Social Sciences, and Medical Science. Later, the properties and applications of soft set theory were studied by many authors.

A pair (F, A) over a universe set U is typically referred to as a soft set if $A \subseteq E$ and $F: A \rightarrow P(U)$ is a mapping. We use C-Algebra as the universe set while defining Soft C-Algebras. C-algebra is used to define soft C-algebras and analyze some of their properties. Additionally covered are the fundamental operations listed on Soft C-algebras, including union, bi-intersection, join, and meet, along with the attributes that go along with them and several examples.

The notion of Soft C-Algebra homomorphisms is presented in this study along with several illustrative instances and some fundamental findings.

Keywords: Soft set; C-Algebra; Soft C-Algebra; Soft C-Algebra homomorphisms;

Assessment of Soil Fertility on q-Rung Ortho pair Fuzzy Rough Schweizer-Sklar Prioritized Aggregation Operators

Mehwish Sarfraz¹, Muhammad Ishfaq Khan², Nasreen Kausar³, Tapan Senapati^{4,5},
Firas Mohammed⁶

¹*Department of Mathematics, Riphah International University Lahore, (Lahore Campus) 5400, Lahore Pakistan.*

²*School of Mathematics and Physics, China University of Geosciences, Wuhan, 430074, P. R. China.*

³*Department of Mathematics, Faculty of Arts and Science, Balikesir University, 10145 Balikesir, Turkey.*

⁴*School of Mathematics and Statistics, Southwest University, Beibei, 400715, Chongqing, China.*

⁵*Saveetha School of Engineering, Saveetha Institute of Medical and Technical Sciences, Thandalam, Chennai, 602105, Tamilnadu, India.*

⁶*International School for Medical Science and Engineering, Doha, Qatar.*

ABSTRACT

In this work, new prioritized aggregation operators (PAOs) are introduced within the q-Rung Orthopair Fuzzy Rough (q-ROFR) set framework, utilizing the parameterized Schweizer-Sklar (SS) t-norm and t-conorm theory to enhance the flexibility of handling imprecise and unclear data. The SS framework provides more flexibility by allowing the $\bar{\Delta}$ parameter to be changed than other t-norms, such as Hamacher and Lukasiewicz. The boundedness, idempotency, and monotonicity of the proposed operators, q-ROFRSS Priority Aggregation (q-ROFRSSPA), q-ROFRSS Weighted Prioritize Geometric (q-ROFRSSWPG), q-ROFRSS Prioritize Geometric (q-ROFRSSPG), and q-ROFRSS Weighted Prioritize Aggregation (q-ROFRSSWPA), are all thoroughly examined. When used in the Assessment of Soil Fertility within a Multi-Attribute Group Decision-Making (MAGDM) framework, these operators exhibit strong performance in handling unclear and untrustworthy data. The suggested methods' accuracy, dependability, and efficiency are validated through comparative analysis, making them proper instruments for intricate decision-making (DM) processes where flexibility and prioritization are crucial, such as vendor management. This research improves the application of fuzzy set (FS) theory to real-world DM, especially in situations with high uncertainty.

Keywords: SS, SS TN and TCN, MADM, q-ROFRSSPA, q-ROFRSSWPA, q-ROFRSSPG and q-ROFRSSWPG

“Some results on minimum attaining operators”

Rekha Sinha

Research Scholar, GITAM, Hyderabad

[rsinha3@gitam.in]

ABSTRACT

We present in this paper various types of characterizations of a bounded linear operator T on a Hilbert space whose minimum modulus is an eigenvalue for T , and their consequences are given. We show that many results in Hilbert space operator theory are related to such an operator.

Keywords: Minimum modulus; Numerical range; Eigenvalues; Minimum attaining operators; Spectral properties; Hilbert space.

Rough Neutrosophic Fuzzy Ideals in BCK-Algebras

Anjaneyulu Naik Kalavath¹, Satyanarayana Bavanari^{2,*}

Department of Mathematics, Acharya Nagarjuna University, Nagarjuna Nagar, Guntur, India

*Corresponding Author E-mail: nelu.fuzzy@gmail.com

ABSTRACT

This article introduces the concept of rough neutrosophic fuzzy ideals in BCK-algebras, exploring their fundamental properties and characterizations. We define a set-valued homomorphism on BCK-algebras, enabling the development of T -rough neutrosophic fuzzy ideals. Utilizing the (s, t, v) -cut of neutrosophic fuzzy sets, we provide a comprehensive characterization of these ideals, contributing to the advancement of algebraic structures and uncertainty modeling. This research expands the theoretical foundations of BCK-algebras and neutrosophic fuzzy sets, with potential applications in decision-making and data analysis.

Keywords: Rough set; T -rough set; Neutrosophic fuzzy set; Rough neutrosophic fuzzy ideal.

Neutrosophic Fuzzy Ideals in BE-Algebras

Bhuvanewari Dhanala¹, Anjaneyulu Naik Kalavath^{2,*}, Satyanarayana Bavanari^{2,*}

¹*Department of Mathematics, VVIT University, Guntur, India*

²*Department of Mathematics, Acharya Nagarjuna University, Nagarjuna, Guntur, India*

*Corresponding Author E-mail: drbsn63@yahoo.co.in

ABSTRACT

This paper explores the notion of neutrosophic fuzzy ideals in BE-algebras, investigating their properties and homomorphic behaviors. Utilizing (w, t, v) -cut sets, we examine the characteristics of these ideals, providing insights into their structure and relationships. Our results contribute to the development of neutrosophic fuzzy algebraic structures, with potential applications in uncertainty modeling and decision-making.

Keywords: Neutrosophic fuzzy set; Neutrosophic fuzzy ideal; (BE-Algebras)-Homomorphisms; (w, t, v) -cut set.

Improved Fuzzy Clustering techniques based on Fuzzy Equivalent Relation for Inventory Management in a Textile production Company

Bhoomi Patel^a, Sathya Arumugam^{b*}

^a*Research Scholar, Department of Mathematics, Government College Daman (Affiliated to Veer Narmad South Gujarat University, Surat)*

^b*Assistant Professor, Department of Mathematics, Government College Daman, Daman*

Email: sathyaarumugam.gcd@gmail.com

ABSTRACT

This paper is focused to explore a fuzzy equivalence relation-based clustering method for textile inventory classification, using a new similarity measure that combines cosine similarity and Pearson correlation. To prove the efficiency of the promising method, the traditional Euclidean based method and our proposed method are applied on the data from 216 saree items over one month. Using the silhouette coefficient method, the clustering accuracy is measured for the applied methods. While Euclidean similarity performed slightly better for broader groupings, the combined measure showed stronger cohesion and separation in more detailed clusters. These results suggest that integrating multiple similarity measures can enhance inventory classification, though further validation with larger datasets is needed.

Keywords: Fuzzy Equivalence Relation, Clustering Techniques, Inventory management, , Silhouette method

Conformal Analysis of Generalized Kropina Changes with m-th Root Finsler Metrics

Rupashree Das^{1,*}, Vinit Kumar Chaubey²

Department of Mathematics, NEHU, Shillong, Meghalaya, India

*Corresponding Author E-mail: rupashreedas72@gmail.com

ABSTRACT

The current work aims to investigate the geometric properties of Finsler metrics with m-th root under a conformal generalized Kropina transformation. We show that under the conformal transformation, these geometric quantities become rational functions in directional arguments, and we derive the equations for the fundamental tensor and spray coefficients of the transformed metrics. In addition, we investigate the necessary and sufficient conditions for the conformal generalized Kropina transformation of the m-th root metric to be locally dually flat. We also derive condition under which the conformal factor is homothety. Additionally, we provide conditions under which the transformed metric is Einstein.

Keywords: Finsler space; locally dually flat metric; conformal transformation; Einstein Finsler metric.

Convergence on Iterative Approximation of Fixed Points via a Generalized (CSC)-condition

Kavita Sakure¹

Department of Mathematics, Govt. Digvijay Auto.P.G. College, Rajnandgaon (C.G.), India Country

*Corresponding Author E-mail: kavitaage@gmail.com

ABSTRACT

We introduce and study a generalized version of the (CSC)-condition in the setting of Banach spaces. Within this generalized framework, we establish strong convergence and weak convergence results for the SPK-iterative algorithm. A comparative numerical example is also provided, showing that the SPK-iterative algorithm converges more rapidly than several existing iterative schemes. Our findings enhance and broaden the scope of the recent developments reported in the literature.

MSC: 47H09, 47H10.

Keywords: (CSC)-condition; Banach space; Convergence results; Iterative algorithms.

Advanced Algebraic Perspectives on Neutrosophic Super Hyper BCI Semigroups and Their Theoretical Implications

Rajat Das¹, Dr. Ajoy Kanti Das^{2,*}

¹Research Scholar, Department of Mathematics, Tripura University, Agartala- 799022, Tripura, India, das.rajat666@gmail.com

²Associate Professor, Department of Mathematics, Tripura University, Agartala- 799022, Tripura, India, ajoykantidas@gmail.com

*Corresponding Author E-mail: das.rajat666@gmail.com

ABSTRACT

This paper presents a unified theoretical framework for Neutrosophic SuperHyper BCI-Semigroups, a novel algebraic structure that fuses neutrosophic logic, superhyper operations, and BCI-algebraic principles into a cohesive semigroup model. The proposed structure extends classical BCI-semigroups by embedding neutrosophic triplets—truth (T), indeterminacy (I), and falsity (F)—within each element, thereby enabling the representation of uncertain, inconsistent, and incomplete information. Fundamental algebraic properties such as closure, associativity, BCI identity, and neutrosophic membership conditions are systematically formulated and verified through theoretical analysis and illustrative examples. Furthermore, this work explores the idempotent and commutative elements, homomorphisms, ideals, subsemigroups, and quotient structures associated with neutrosophic superhyper BCI-semigroups, establishing their interrelationships and functional behavior. Key theorems are introduced to demonstrate the structural consistency and uniqueness of identity and inverse elements, while the homomorphic mappings are shown to preserve neutrosophic properties across transformations. The study highlights the algebraic significance of this model as a bridge between traditional semigroup theory and neutrosophic hyperstructure logic, offering a robust mathematical foundation for handling ambiguity and contradiction in complex data environments. The proposed framework opens new directions for applications in artificial intelligence, knowledge representation, uncertain reasoning, and multi-criteria decision-making systems, positioning neutrosophic superhyper algebra as a cornerstone for future computational intelligence research.

Keywords: Neutrosophic; Super Hyper Structure; BCI-Algebras; Semigroups.

Algebraic Structures of Super Hyper Monoids, Groups, and Ideals

Suman Patra^{1*}, Dr. Ajoy Kanti Das²

¹*Research Scholar, Department of Mathematics, Tripura University, Agartala- 799022, Tripura, India, patrasuman149@gmail.com*

²*Associate Professor, Department of Mathematics, Tripura University, Agartala- 799022, Tripura, India, ajoykantidas@gmail.com*

*Corresponding Author E-mail: patrasuman149@gmail.com

ABSTRACT

This paper studies new kinds of algebraic systems called superhyper monoids, groups, and ideals. These systems are built using superhyper operations, which can give more than one result at a time. Such operations help to describe mathematical situations where results may be uncertain, overlapping, or have many possible values.

We define the main properties of these structures — such as associativity, identity, commutativity, and inverse elements — and show how they behave under superhyper operations. The paper also explains how superhyper submonoids, superhyper groups, and superhyper ideals are formed and related to each other. Several examples and theorems are included to show the logical structure and correctness of the theory.

This study helps to expand the ideas of classical algebra into a more flexible and generalized form. It also shows how superhyper algebra can be useful for handling uncertain or incomplete information in areas like fuzzy logic and neutrosophic systems. In this way, the work gives both a strong theoretical foundation and a direction for future mathematical research on complex and uncertain systems.

Keywords: SuperHyper Structure; Monoid; Group; Ideal.

On Weakly 1-Absorbing Prime Ideals of a Lattice

Biswajit Deka

Assistant Professor, Department of Mathematics, B.H.B College, Sarupeta

E-mail: biswajitdeka109@gmail.com

ABSTRACT

Let L be a lattice with 1 . In this paper, we introduce the concept of Weakly 1-absorbing prime ideals of L as a generalization of prime ideals of L . A proper ideal I of L is called a Weakly 1-absorbing prime ideal if for all nonunit elements $a, b, c \in L$ such that $0 \neq a \wedge b \wedge c \in I$, then either $a \wedge b \in I$ or $c \in I$. Some properties of Weakly 1-absorbing prime ideals are investigated. We show that a proper ideal I of L is a Weakly 1-absorbing prime ideal of L if and only if whenever $I_1 I_2 I_3 \subseteq I$ for some proper ideals I_1, I_2, I_3 of L , then either $I_1 I_2 \subseteq I$ or $I_3 \subseteq I$. A characterization for the radical of an ideal to be a prime ideal is given. Some important properties of prime ideals, radical ideals and Weakly 1-absorbing prime ideals are studied under lattice homomorphisms. Finally, we studied different properties of Weakly 1-absorbing prime ideals in product lattices.

Keywords: Lattice, Ideal, Prime ideal, 1-absorbing prime ideal, Weakly 1-absorbing prime ideal

A Link-Based Egalitarian Approach in a Network Situation

Sujata Goala

Department of Mathematics, Gargaon College, Sivasagar, Assam

ABSTRACT

In network situations, the value generated by a network directly depends on how the players form the network. A fundamental question here is, what can be a suitable allocation rule that distributes this value among the players? Two classes of allocation rules: the player-based and the link-based allocation rules are found in the literature. They signify whether players are considered to be more important or the links, respectively. A well-known link-based allocation rule is the position value. The position value follows a marginalist approach. The component-wise link-based egalitarian value proposed in this work, on the other hand, is grounded in egalitarianism. The proposed value distributes the network's total value among players in proportion to the number of links each player has. In this paper, we identify situations in which egalitarianism is more appropriate than marginalist rules. Accordingly, we study the link-based component-wise egalitarian value and propose a few characterizations to establish the uniqueness of the proposed allocation rule.

JEL Code: C71, C72

Keywords: Network situations; allocation rules; egalitarianism; Characterization.

Spectral Graph-Based Encoding with Elliptic Curve Encryption

Sarbani Gogoi^{1,*}, Somnath Paul²

Department of Applied Sciences, Tezpur University, Napaam-784028, Assam, India.

*Corresponding Author E-mail: (app23101@tezu.ac.in)

ABSTRACT

Efficient data encryption and decryption are fundamental for ensuring security in modern digital era, as converting data into an unintelligible form limits access to only authorized parties. In this study, we present a new encryption approach that brings together elliptic curve cryptography (ECC) and spectral graph theory to securely encode information. ECC is preferred in modern cryptography for achieving high security with minimal computational resources, outperforming established systems like RSA, especially when efficiency is paramount. Our method begins by representing each message as a path, then assigning antimagic labels to it. Then by calculating the Laplacian spectrum of the resulting path, we transform the encoded message in a way that adds significant protection against common attacks, including frequency and structural analysis. These transformed characters are mapped to specific points on an elliptic curve, allowing us to use ECC's key exchange process for the final stage of encryption. The result is a multi-layered security protocol in which both the mathematical properties of the graph and the recognized strength of ECC work together to obscure and protect the original message.

Throughout the paper, we explain the motivations for combining these fields and demonstrate the practical advantages and security benefits of our scheme. Examples provided show how the system can be applied for secure message transmission, and we discuss broader applications, such as image encryption, for future research. Ultimately, our approach offers an innovative and adaptable framework for secure communications suited to the demands of today's digital landscape.

Keywords: Encryption; Decryption; Elliptic Curve Cryptography; Laplacian matrix.

Measure of Similarity on Intuitionistic Fuzzy Sets for Selecting a Good Career

Dibakar Dutta¹ and Rubi Das²

¹Department of Mathematics, Barkhetri College, Nalbari, Assam, India, 781126

²Department of Mathematics, Lalit Chandra Bharali College, Maligaon, Guwahati-11,
Assam, 781011

ABSTRACT

The intuitionistic fuzzy sets(IFSs) have emerged as one of the most dynamic, versatile, and innovative instrumental techniques to deal with uncertainty and ambiguity associated with the process of decision making. This degree of similarity between two IFSs is an important measurement technique which plays a vital role in the theory of IFSs. The basic essence of this research work lies in the application of IFSs in a similarity-based method for finding careers. Our research focuses on finding out what courses are needed to develop certain skills for a particular job opportunity. Using IFSs, we relate the academic courses with the skills they try to provide, which are then connected to different career opportunities. The results show that finding employment in any field requires the completion of an undergraduate course—professional or arts and sciences—which incorporates the training in computer skills as well as a postgraduate management course, either degree or diploma. Our proposed methodology will outline the highest degree of similarity between a student's profile and their potential careers, so that the complex process can be solved efficiently. A comparative analysis of scalability, efficiency, and accuracy in reflecting true similarity illustrates the complexity of the proposed measure, which is reliable.

Keywords: Similarity measure, Good career, Skill Development, Decision Making.

Applications of Rational-Type Contractions in Fuzzy Metric Spaces

Nabanita Konwar

Department of Mathematics, Birjhora Mahavidyalaya, Bongaigaon, Assam, India

E-mail: nabnitakonwar@gmail.com

ABSTRACT

The study of generalized contraction mappings and metric spaces has played a significant role in developing a strong framework for mathematical modelling and system analysis. In particular, generalized fuzzy metric spaces offer an effective approach to reducing the inherent complexity of modelling uncertain or imprecise systems. The primary objective of this work is to introduce the notion of rational-type contractions within the setting of generalized fuzzy metric spaces. Based on this newly formulated concept, we establish an extended version of the Banach Fixed Point Theorem. The results obtained herein provide useful tools for determining solutions to nonlinear integral equations and related problems.

Keywords: Contraction mapping; Rational type contraction; Fuzzy Metric Space; Banach Fixed Point Theorem

Exponential Inverse Sum Indeg Index of Graphs

^{1*}Tarun Boruah, ²Amitav Doley

¹*Department of mathematics, Dibrugarh University, Dibrugarh, Assam, India*

²*Department of Mathematics, DHSK College, Dibrugarh, Assam, India*

tarunboruah1998@gmail.com, amitav1987doley@gmail.com

ABSTRACT

The idea of applying exponential functions to vertex-degree-based topological indices was first introduced by Rada (2019). Till now several exponential topological indices are introduced. In this work we are interested to study the Exponential Inverse Sum Indeg (EISI) index. For a graph G with vertex set $V(G)$ and edge set $E(G)$ the EISI index is defined as

$$EISI(G) = \sum_{uv \in E(G)} e^{\frac{d_u d_v}{d_u + d_v}}$$

where d_u denotes the degree of the vertex u . In this work we have studied the chemical importance of EISI index through a comprehensive QSPR (Quantitative Structure–Property Relationship) analysis. The study reveals strong correlations between the EISI index and some physicochemical properties of benzenoid hydrocarbons, demonstrating its potential utility in predictive modelling.

Beyond chemical applications, we have derived some analytical bounds on the EISI index for different classes of graphs. We have also characterized the extremal graphs for these bounds, thereby offering deeper insight into how degree distribution and structural configuration influence the index.

Collectively, these results situate the EISI index as a mathematically and chemically informative exponential topological invariant.

Keywords: Exponential topological index, QSPR analysis, ISI index, molecular graph.

**EFFECTS OF VARIABLE VISCOSITY AND THERMAL
CONDUCTIVITY ON HEAT AND MASS TRANSFER IN MHD
BOUNDARY LAYER FLOW PAST AN INCLINED PLATE WITH
VISCOUS AND JOULE DISSIPATION IN POROUS MEDIUM**

Dr. Kabita Phukon

*Department of Mathematics, Gargaon College, Sivasagar Assam, India
kabitaphukon1@gmail.com*

ABSTRACT

The influence of variable viscosity and thermal conductivity on a steady two dimensional hydromagnetic convective flow of a viscous, incompressible, electrically conducting fluid past an inclined plate with viscous dissipation in porous medium has been studied. Here the partial differential equations are converted to ordinary differential equations by using suitable similarity transformations and then solved by using Runge-Kutta method along with shooting technique. Both the fluid viscosity and thermal conductivity are considered as an inverse linear function of temperature. The effects of velocity, temperature and concentration profiles on the flow field are investigated and presented graphically for various values of governing flow parameters.

Finally, the numerical values of Skin –friction co-efficient, Nusselt number and Sheerwood number are also computed and presented in table.

Keywords: Variable viscosity, Thermal conductivity, Mass transfer, Porous medium, Dissipation.

Invariant Mean Operators for Spectral Graph Clustering and Community Detection

Sowmya Shree MK¹, S Padmanabhan², Pallavi G³, Neela G¹

¹Research Scholar, Department of Mathematics, RNS Institute of Technology, Bengaluru, Affiliated to Visvesvaraya Technological University (VTU), Belagavi, Karnataka, India

²Associate Professor, Department of CSE (AI & ML), RNS Institute of Technology, Bengaluru

³Assistant Professor, Department of Mathematics, RNS Institute of Technology, Bengaluru

Corresponding author: sowmyashree.mk@rnsit.ac.in

ABSTRACT

Spectral methods constitute one of the most powerful and widely used approaches for graph clustering and community detection, relying on the eigenspace of the graph Laplacian to reveal underlying structural partitions. However, classical formulations depend heavily on arithmetic aggregation of degrees, affinities, and embeddings, making them sensitive to noise, degree heterogeneity, and irregular connectivity patterns. In this work, we introduce a novel framework for spectral clustering based on **invariant mean operators**, a flexible family of generalized means that exhibit symmetry, homogeneity, Schur-convexity, and robustness properties rooted in inequality theory. By replacing fixed arithmetic aggregation with tunable invariant means, we develop three complementary components: (i) **mean-driven degree normalization**, (ii) **mean-regularized affinity smoothing**, and (iii) **invariant-mean spectral embedding normalization**. Theoretical analysis shows that these operators preserve essential spectral characteristics—such as positivity, ordering of Laplacian eigenvalues, and stability under perturbations—while enabling controlled transitions between robustness and sensitivity through the exponent or generator function of the mean.

We evaluate the proposed invariant-mean spectral clustering framework on standard benchmarks including synthetic stochastic block models (SBM) and real-world networks such as Cora, Citeseer, and email communication graphs. Across all datasets, invariant-mean clustering achieves improved performance over classical spectral clustering, normalized cuts, and degree-corrected baselines, particularly on graphs with noisy edges, unbalanced degrees, or weak community signals. These results demonstrate that invariant means provide a principled and adaptable tool for enhancing community detection, bridging the gap between generalized mean theory and graph learning. The framework further opens avenues for developing robust normalization schemes, hypergraph clustering, and mean-driven diffusion processes in future work.

Keywords: Invariant Means; Spectral Clustering; Community Detection; Generalized Means; Graph Laplacian; Schur-Convexity; Robust Aggregation; Graph Learning; Network Analysis.

The 7- & 11-dissections of some infinite q -product expansions

Mandeep Kaur^{1*}, Vandna²

Department of Mathematics, Abhayapuri College, Abhayapuri, Bongaigaon-783384, Assam, India

School of Engineering and Technology, CGC University, Mohali-140307, Punjab, India

*Corresponding Author E-mail: kaur.man0974@gmail.com

ABSTRACT

m -dissections of infinite product expansions play a substantial role in exploring infinite q -product expansions. Researchers have used these dissections to attain extensive and comprehensive insights into the arithmetic properties of infinite q -product expansions. In this paper, we will establish the 7-dissections of six infinite q -product expansions and the 11-dissections of four infinite q -product expansions. Moreover, we propose some infinite q -product expansions for which the 11-dissections may be established.

Keywords: q -series expansions; Infinite q -products; Dissection.

Stability analysis of anisotropic universe with Barrow holographic dark energy

Chandra Rekha Mahanta, Supornajeet Majumder*

Department of Mathematics, Gauhati University, Guwahati -781014, Assam, India

email: crmahanta@gauhati.ac.in , supornajeet20@gmail.com *

ABSTRACT

In this paper, we investigate the stability of an anisotropic universe in the context of General Relativity, incorporating Barrow Holographic Dark Energy (BHDE) along with cold dark matter (CDM) in both non-interacting and interacting scenarios. The underlying geometry is modelled using a spatially homogeneous and anisotropic Bianchi Type I space-time. To obtain exact solutions of the Einstein field equations, we assume a simple linear relation between the deceleration parameter and the Hubble parameter. The study begins with the absence of interaction between CDM and BHDE. This is followed by an extended investigation that includes interaction between the two components. The physical and kinematical properties of the model are examined through the evolution of key cosmological parameters such as the Hubble parameter, deceleration parameter, density parameters, and the equation of state (EoS) parameter. Our results indicate that the universe experiences continuous expansion, with a smooth transition from an early decelerating phase to the current accelerated phase. The stability analyses for both non-interacting and interacting BHDE models are carried out by using the squared speed of sound.

Keywords: Bianchi type I space-time; Barrow holographic dark energy; Hubble parameter; Equation of state parameter; Deceleration parameter;

Effect of Circular Economy on a Non-Instantaneous Deteriorating Item with Preservation Technology Investment and Partial Backlog under a Fuzzy Environment

Anita Kumari Sahu¹, V Ganesh², Susanta Kumar Indrajitsingha³, Suchana Mishra⁴

^{1,2}*Department of Mathematics, GIET University, Gunupur-765 002, Rayagada, Odisha, India*
anitaksahu92@gmail.com, vganesh@giet.edu

³*Department of Mathematics, NIST University, Institute Park, Berhampur-761 008, Odisha, India*

<http://orcid.org/0000-0002-2550-8076?lang=en>
susantamath86@gmail.com, susanta.indrajitsingha@nist.edu

⁴*EEE Department, Dayananda Sagar College of Engineering, Kumarswamy Layout, Bengaluru-560 078, Karnataka, India*
suchanamishra@gmail.com

ABSTRACT

This paper proposes a fuzzy inventory model for a non-instantaneous deteriorating item with partial backlogging, incorporating preservation-technology investment to mitigate product deterioration. The holding cost, deterioration rate, and preservation-technology cost are modeled as trapezoidal fuzzy parameters to capture imprecision in real-world decision environments, and are defuzzified using the graded mean integration representation method. Demand and unit profit are expressed as functions of a circularity indicator to embed circular-economy considerations within the decision framework. The objective is to determine the optimal policy that maximizes total profit while supporting reduced environmental impact. The model is solved analytically, and numerical experiments are provided to validate the results and illustrate managerial insights.

Keywords: Inventory; preservation technology investment; partial backlog; circular economy; graded mean integration representation method.

A novel Picture fuzzy correlation-based TOPSIS approach for Unmanned Aerial Vehicle selection

Soumendu Golui¹, Biplab Sinha Mahapatra^{2,*}, G.S. Mahapatra^{3,*}

*Department of Applied Mathematics, Maulana Abul Kalam Azad University of Technology,
Haringhata, Nadia-741249, India*

*Corresponding Author E-mail: (soumendu.sit@gmail.com)

ABSTRACT

Precision agriculture has significantly enhanced crop monitoring, pesticide spraying, and data-driven crop management using Unmanned Aerial Vehicles (UAVs). With more agricultural drone models offering multispectral imagery, AI-driven analytics, and variable-rate spraying mechanisms, choosing the best UAV becomes a challenging multi-criteria decision-making (MCDM) dilemma under uncertainty and vagueness. This work presents a correlation-based Picture Fuzzy TOPSIS (PF-TOPSIS) method for ranking agricultural drone solutions to overcome this issue. Initially, a fuzzy correlation measure is proposed and established by proving its properties and then extended to accommodate weights. Instead of distance metrics, the suggested TOPSIS technique utilizes a picture fuzzy correlation coefficient as a similarity measure to enhance interpretability and eliminate ranking ambiguity. Expert evaluations are used to create a decision matrix using picture fuzzy numbers to model truth-membership, falsity-membership, and neutrality in opinions. The PF-TOPSIS approach yields consistent and robust rankings of five UAVs over eight criteria. Comparison with classical fuzzy and intuitionistic fuzzy TOPSIS models reveals superior performance in handling uncertain and hesitant data.

Keywords: Unmanned Aerial Vehicles, Picture Fuzzy Set, TOPSIS, Correlation Measure,

Best Proximity Point in Partial Modular Metric Space Using Simulation Function

Purnima Phukon¹, Dr. Dipankar Das²

Department of Mathematics, Dibrugarh, Assam, India

Corresponding Author E-mail: rs_purnimaphukon@dibru.ac.in

ABSTRACT

This paper examines the existence of best proximity points in partial modular metric spaces which generalized both modular metric space and partial metric space. By employing $C\alpha F$ -simulation functions together with a suitable contractive condition, we establish new best proximity coincidence point and best proximity point theorems. These results expand fixed point theory by addressing situations where mappings lack fixed points but still admit optimal approximate solutions based on minimal distance pairs. The main theorems unify and generalize several known results in fixed point and best proximity point theory, showing the flexibility of partial modular metric spaces in treating complex nonlinear structures. The use of extended $C\alpha F$ -simulation functions provide a broader framework for proving contractive conditions beyond standard metric approaches. To illustrate the applicability of the theory, an example is presented that verifies the assumptions of the main.

Keywords: Best proximity point; Best proximity coincidence point; Simulation function; Partial modular metric space.

Some generalized Sequence space related to l_p space defined by Modulus function using Cesaro mean

Mrinmoy Bora^{1,*}, Rinku Dey²

Department of Mathematics, Jagannath Barooah University, Jorhat, Assam, India

*Corresponding Author E-mail: mrinmoyborajb@gmail.com

ABSTRACT

In this paper we have introduced the sequence spaces $l_1[M, \sigma, q]$, $l_\infty[M, \sigma, q]$, $m[\Phi, M, \sigma, q]$ define by a modular function incorporating the cesaro mean and its associated matrix domain for generalizing the classical sequence spaces. We have introduced the sequence space $m[\Phi, M, \sigma, q]$ generalizing the $m(\Phi)$ sequence space. The study demonstrates various inclusion relations between these spaces and provides their topological and structural characteristics. By expanding the theoretical framework of paranormed space, this work validates the development of functional analysis and lays the groundwork for future study and use in this area..

Keywords: Sequence Space ; Sequence spaces ,Modulus function, Seminorme, Paranormed space, Cesaro mean.

Qualitative analysis of a time dimensionalized opinion model with modified rumour-transmission rate: Fractal-fractional approach

Biplab Dhar*

Applied Science Cluster - Mathematics, UPES, Bidholi, Dehradun, India

*Corresponding Author E-mail: biplab.res@gmail.com

ABSTRACT

Fractional derivative (FD) mathematical frameworks have a long way to go to dwell with fundamental structure of realism, specifically when time dimensionality balanced in concerned during modelling real life issues. One such example is social ecosystem that has high influence on social system dynamics in creating opinions amongst a group of people due to rumour. Considering these three elements, namely, FDs, time dimensionality, and opinion dynamics, a mathematical model is made in light of an SIRS-type of epidemiological model that considers temporary immunity and nonlinear incidence rate. The circulation of information when people are linked together by complex networks is taken care of. The effect of vaccinating the population with a second, competing rumour, that mimics the effect of a vaccination approach, to overcome the effect of the original rumour is explored. This is likely to occur in the real communities where a rumour is debunked with counter information that propagates the same eventually forming an opinion. The proposed model is only qualitatively analyzed using fixed point theorems, Sumudu transform, and Sotomayor's theorem, which proves that the processes of rumour spreading are rather like the process of infectious diseases spreading.

Keywords: Re-scaled transmission, Eigenvalues, Stability analysis, Bifurcation.

Quadratic Primitive Pairs in Finite Fields Avoiding Affine Hyperplanes

Himangshu Hazarika¹

Department of Mathematics, Tezpur College, Tezpur, Assam, India

*Corresponding Author Email: himangshuhazarika10@gmail.com

Abstract: Let \mathbb{F}_{q^m} be the finite fields of order q^m , where $m \geq 2$ and q be a prime power. Given \mathbb{F}_q -affine hyperplanes A_1, \dots, A_m of \mathbb{F}_{q^m} in general position, we study the existence of a primitive element α of \mathbb{F}_{q^m} , such that $\alpha^2 + \alpha + 1$ ($\alpha \neq 0$) is also primitive in \mathbb{F}_{q^m} and the primitive pair avoids A_i for every $i = 1, \dots, m$. In particular, we employ the character sum method to attack this problem, which leads us in a natural manner to study novel incomplete character sum estimates and obtain results for fields of high order.

Keywords: Finite field, Primitive element, Free element, Character, Affine hyperplane

Applications of measure of non-compactness for solvability of an infinite system of differential equation with integral boundary condition in a tempered sequence space

Trideep Deka

Department of Mathematics, Eastern KarbiAnglong College, Sarihajan, India

E-mail : trideep7deka@gmail.com

ABSTRACT

In this study, we examine the solvability of an infinite system of third order differential equation with integral boundary condition in a tempered sequence space. We use the technique based upon measures of non-compactness with a Darbo-type fixed point theorem. Measure of non-compactness has a significant role in non-linear functional analysis. In the study of fixed point theory, differential equations, functional equations, integral equations, integro-differential equations, optimization etc., it is an important tool. Over the years many authors have been interested in analyzing the solution of various functional equations. In some of these works, the authors have limited their study to differential equations system with two point boundary conditions. This work uses a method related to Hausdorff measure of non-compactness and Green function to study the solvability conditions for an infinite system of third order three point boundary value problem. To illustrate the significance of our results, we provide some concrete examples.

Keywords: Infinite System of Differential Equations; Fixed Point Theory; Measure of non-compactness; Tempered Sequence space.

OPERATIONS RESEARCH OPTIMIZATION TECHNIQUES FOR DUAL FUZZY RANKING IN SMART GRID AND SUSTAINABLE PROJECT SCHEDULING

M. Sandhiya¹, H. A. Bhavithra¹, S. Sindu Devi¹

¹*Department of Mathematics, Faculty of Science and Humanities, SRM Institute of Science and Technology, Ramapuram, Chennai 600086.*

Corresponding author email id: sindudes@srmist.edu.in

ABSTRACT

Project scheduling uncertainty often redefines decision-making in fast-track and sustainability-driven businesses where velocity and robustness are paramount. Comparative fuzzy critical path method analysis shows two opposing but complementary views: Yager's ranking index, calculating a duration of 12.9893 days, presents a risk-buffered, conservative view resistant to workforce, material, and site fluctuation, while the Liang–Han model, with predicted completion within 9 days at a 75% membership grade, represents an optimistic, agility-led trend suited to innovation-focused projects. Applying this dual logic to national infrastructure, this research presents a hybrid fuzzy decision-making framework that incorporates Yager's integral and Liang–Han's weighted centroid approaches for smart grid project appraisal under cost–schedule uncertainty. India's National Smart Grid Mission (NSGM)'s ten completed projects-2025 were simulated with trapezoidal fuzzy numbers for optimistic, most-likely, and pessimistic financial conditions based on the Government of India (GOI) support records. The findings indicate that Yager's method provides solid baseline estimates, and Liang–Han's model emphasizes risk-sensitive adaptability, complementing each other to construct a balanced framework for open, evidence-based investment planning. By turning uncertainty into a strategic choice asset, this system facilitates the green shift, and policymakers and start-ups can reconcile fiscal responsibility with sustainable innovation.

Keywords: Ranking, Trapezoidal, Project Networks, CPM

Optimizing Traffic Flow at Urban Intersections: A Fuzzy Graph Based Approach

Manoshi Kotoky¹, Bedakhi Baruah^{1,*}

Department of Mathematics, The Assam Kaziranga University

E-mail: bedakhibaruah@gmail.com

ABSTRACT

Urban traffic congestion is becoming a serious challenge for growing cities, mainly because the number of vehicles is increasing much faster than the capacity of existing traffic control systems. Traditional fixed-time traffic signal often fails to cope with these constantly changing traffic conditions. In this work, we present a fuzzy graph- based approach for optimising signal phases at the Jorhat Baruah Chariali intersection. In our model, each traffic movement is considered as fuzzy vertex whose membership value reflects its flow intensity. In contrast, conflicts between movements are represented as a fuzzy edge. Our main aim is to show how the number of phases can be adjusted dynamically as traffic density changes by applying a fuzzy graph- based method (fuzzy graph coloring). This approach provides greater flexibility and improved safety compared to traditional static signal timing. Keywords: Fuzzy graph theory, Traffic signal, Membership grade, Fuzzy graph coloring.

Fixed Point Theorems for Generalized Weak Contractive Mappings in Partial Modular Metric Spaces with Application to Integral Equations

Liza Hazarika^{1,*}, Dr. Dipankar Das²

Department of Mathematics, Dibrugarh University, Dibrugarh, Assam, India

*Corresponding Author E-mail: iamlizahazarika@gmail.com

ABSTRACT

In this paper, we introduce generalized weak contractive type mappings in the framework of partial modular metric spaces. We establish the existence and uniqueness of fixed point under this contractive condition and provide illustrative example to support our main result. The applicability of the main result is demonstrated through an application to Fredholm integral equation, illustrating how fixed-point theory can be applied in solving mathematical problems. The results presented in this work generalize several fixed-point results from the existing literature and contributes to both theoretical and practical applications of fixed-point theory. This in turn broadens the applicability of fixed-point theorems across various mathematical, statistical, and engineering domains.

Keywords: Fixed Point; Generalized Contraction; Partial Modular Metric Spaces; Non-linear Fredholm integral Equation.

Certain Properties of Analytic Functions Associated with Tremblay Fractional Derivative Operator

S. G. Hiwale¹ and D. D. Pawar²

¹ Department of Basic Sciences and Humanities, Maharashtra Institute of Technology, Aurangabad - 431 010,, Maharashtra, India.

sandip.hiwale@mit.asia

² School of Mathematical Sciences, Swami Ramanand Teerth Marathwada University, Nanded- 431 606, Maharashtra, India.

dnyaneshwarpawar@srtmun.ac.in

ABSTRACT

In this paper, we introduce and investigate new subclass of analytic functions defined by modified Tremblay fractional derivative operator in the unit disk. We obtain coefficient inequality, distortion properties, radii properties, extreme points, closure property. Furthermore, we obtain integral transform, closure properties and Integral means inequality for the defined class.

Keywords and phrases: analytic, convex, starlike, Integral Operator, coefficient estimates.

A Review of Differential Operators in Geometric Function Theory (GFT)

M. Asha, Dr. M. Kasthuri

Department of Mathematics, D.K.M college for Women (Autonomous), Vellore -01. Affiliated to Thiruvallur University

ABSTRACT

Differential operators constitute a powerful tool in Geometric Function Theory (GFT) for constructing analytic and univalent function classes, establishing subordination relations, and deriving coefficient estimates. Classical operators such as the Sălăgean, Ruscheweyh, Al-Oboudi, Tremblay, and q-differential operators have evolved into modern generalizations involving fractional calculus, fuzzy set theory, and q-analogues. Recent advances have produced new subclasses, sharp Hankel determinant bounds, Fekete–Szegő estimates, and operator-based analytic function models. This article provides a comprehensive literature review, incorporating both foundational and contemporary operator theory in GFT.

On reversely open mappings and its relationship with continuous mappings in ideal topological spaces

Nitakshi Goyal

Department of Mathematics, Akal Degree College, Mastuana Sahib(Sangrur), India.

E-mail: goyal.nishu53@gmail.com

ABSTRACT

The theory of ideals was initiated by Kuratowski since 1930 and had won its importance by the paper of Vaidyanathaswamy in 1945. This theory had been used to study various topological properties. Since, ideals are dual to the well known concept of filters in topological spaces. Therefore, the theory of ideals also generalize the important convergence concepts like clo sure point, w-accumulation point, condensation point etc. Given a topological space (U, σ) with an ideal J on U , a topology $\sigma^*(J, \sigma)$ is given which is generally finer than the original topol ogy σ and has its corresponding Kuratowski closure operator $cl^*(M) = M \cup M^*(J, \sigma)$, where $M^*(J, \sigma) = \{e \in U : G \cap M \in J \text{ for every open subset } G \text{ of } e \text{ in } U\}$. The set operator $(.)^* : \wp(U) \rightarrow \wp(U)$, called a local function of M with respect to J and σ . After them, this theory had been further extended by many authors. In 1986, Kanicwski and Piotrowski introduced the concept of pointwise- J -continuous maps. In 1992, Hamlett and Rose introduced pointwise J -open maps and further Sivara z and Renuka Devi gave various characterizations and properties of these maps using the image and inverse image map. But for given any map $\eta : U \rightarrow W$ apart from inducing the usual image and inverse image maps between power sets there is another in duced map $\eta^\# : \wp(U) \rightarrow \wp(W)$ given by $\eta^\#(M) = \{q \in W : \eta^{-1}(q) \in M\}$ for any subset M of U . In this chapter, new type of mappings between ideal topological spaces namely J -reversely open mappings will be introduced. Further, properties and also new characterizations of J -reversely open and pointwise- J -continuous mappings are studied using the theory of local functions with respect to an ideal and with the help of this induced map $\eta^\#$. Finally, the necessary and sufficient conditions will be obtained to find out the relationship between these mappings. Examples are given to illustrate the results and provide counterexamples which show the necessity of some of the conditions assumed.

2010 Mathematics Subject Classification: Primary 54A05; Secondary 54D10, 54D30, 54C10.

Keywords: J -reversely open, pointwise- J -continuous, ideal, local function.

Laplacian spectra of subdivision and central graph join operation and families of non regular cospectral graphs

Dr. Manash Protim Borah

Assistant Professor

LTK College, Azad, North Lakhimpur

Email: mpborah36@gmail.com

ABSTRACT

We define two new graphs structures through the join operation of subdivision graph $S(G)$ and central graph $C(H)$. The two graphs are subdivision edge-central vertex join $S(G) \bar{\square} C(H)$ and subdivision vertex-central edge join $S(G) \bar{\square} C(H)$ graphs. Then, we determine the Laplacian spectra of these two graphs and generate a families L -cospectral non-regular graphs for these new graphs .

Keywords: subdivision graph, central graph, join, Laplacian spectra, cospectral graphs.

On a class of Vector Valued Sequences associated with Multiplier and Difference Sequence Spaces.

Vicky Karmakar^{1*}, Rinku Dey²

Department of Mathematics, Jagannath Barooah University, Jorhat, Assam, India

*Corresponding Author E-mail: vickykarmakar74@gmail.com

ABSTRACT

We introduced the vector valued space $m(E_k, \emptyset, \Lambda, \Delta^m)$ associate with the multiplier sequence $\Lambda = \alpha_k$ and difference space Δ^m of non-zero complex numbers and the terms of the sequence are chosen from the seminormed space E_k , seminormed by $f_k \forall k \in \mathbb{N}$. This generalizes the sequence space $m(\emptyset)$ introduced and studied by Sargent. We study some of its properties like solidity, completeness, etc. and obtained some inclusion results. We also characterize the sequence and obtain the dual to $m(E_k, \emptyset, \Lambda, \Delta^m)$. We prove some general results too. Several general results involving multiplier transformations and higher-order difference operators are also proved, demonstrating the flexibility and broad applicability of the space. Overall, the study enriches the theory of vector-valued sequence spaces and offers a unified setting for analysing multiplier sequences combined with difference sequence spaces.

Keywords: Sequence spaces, completeness, dual, Symmetric spaces.

Dihedral Group Cordial Labeling and Its Encryption Decryption Framework for Standard Graphs

A. Sudha Rani¹, S. Sindu Devi²

Department of Mathematics, Faculty of Engineering and Technology SRM Institute of Science and Technology, Ramapuram, Chennai-89, India sudharaa@srmist.edu.in 2Department of Mathematics, Faculty of Engineering and Technology SRM Institute of Science and Technology, Ramapuram, Chennai-89, India

sindudes@srmist.edu.in Correspondence author: sindudes@srmist.edu.in

ABSTRACT

In this study, we build a function $\beta: V(G) \rightarrow D_3$ and label each edge with 0 or 1 depending on whether $o(u)/o(v)$ or $o(v)/o(u)$ and order of u does not divide order of v . Let's create a new function $\gamma \theta \beta$ that counts how many edges have labels for a specific mapping θ . Divisor cordial labeling is now used if $\gamma_1 \beta - \gamma_0 \beta \leq 1$, γ is called D_3 divisor cordial labeling. Let G be a simple undirected graph. Consider the Dihedral group with eight elements. We define a function from the vertex set to elements in the Dihedral group such that for each edge, labels are assigned based on conditions contrary to the order of the element. Let $f: V(G) \rightarrow D_4$ in such a way that for each edge uv assign the label 1 if $O(u)^2 + O(v)^2 - O(u) - O(v)$ is odd, where x is even & 0 if $O(u) + O(v)$ denotes the greatest integer function less than or equal to x . Let $vg(a)$ represents the number of vertices of having label a under the mapping g & $ng(a)$ represents the number of edges of having label a under the mapping f . f is called D_4 contra mean cordial labeling if $|vg(a) - vg(b)| \leq 1$ for all a, b in D_4 and $|ng(0) - ng(1)| \leq 1$ where $ng(0)$ is the number of edges labeled as 0 and $ng(1)$ is the number of edges labeled as 1. The graph which admits g is called Dihedral group D_4 Contra Mean cordial labeling graph. Generally cordial labeling are used in cryptography, network design and image processing but by using dihedral group divisor cordial labeling used for molecular symmetry modelling, error detection and correction etc, dihedral group contra mean labeling is used for. In this paper we proved Dumbbell graph, Tad pole Graphs are D_3 divisor Cordial labeling and dihedral group contra mean labeling for some standard graphs like Splitting graph of path, umbrella graphs.

Analytical Study of Time-Fractional Kaup-Kupersmidt Equation via Shehu Transform Approach

TAPASI PASAYAT^{1*}, ASHRITA PATRA¹

School of Mathematics, Gangadhar Meher University, Sambalpur, Odisha, India

*Corresponding Author E-mail: tapashya.94@gmail.com

ABSTRACT

This study presents the application of the Shehu Transform, a powerful integral transform technique combined with an accelerated version of the Adomian decomposition method to obtain approximate analytical solutions of the fractional order Kaup-Kupersmidt equation. The proposed hybrid approach efficiently handles both linear and nonlinear fractional partial differential equations. Several numerical examples are provided to demonstrate the accuracy and effectiveness of the method. Comparative analysis between the approximate and exact solutions illustrated through graphs and tables shows excellent consistency and rapid convergence. Due to its simplicity, stability and computational efficiency the proposed approach provides a reliable framework for solving a wide range of fractional order models in applied mathematics and mathematical physics.

Keywords: Kaup-Kupersmidt equation; Accelerated Adomian Decomposition Method; Shehu Transform.

Geometric Properties of Relative Uniform Lacunary Convergence of Double Sequences of Functions

Munindra Regon¹ and Pranab Jyoti Dowari²

¹*Department of Mathematics, Dibrugarh University, Dibrugarh, Assam*

²*Department of Moridhal College, Dhemaji, Assam*

Email ID: munindraregon@gmail.com (M.Regon) pranabdowari@gmail.com (P. J. Dowari)

ABSTRACT

In this article, we introduce the notion of *relative uniform lacunary convergence* for double sequences of functions and investigate its fundamental structural characteristics. We establish essential properties such as linearity, completeness and boundedness of the associated function spaces. Furthermore, we define and study classes of relatively uniformly lacunary convergent, null and bounded double sequences of functions. A detailed analysis of key topological and geometric properties— including solidity, monotonicity, symmetry and convexity is provided to understand the behaviour of these spaces. Several inclusion relations among the newly defined classes are obtained, and the strictness of these inclusions is demonstrated through carefully constructed counterexamples.

Keywords: Relative uniform convergence, lacunary convergence, double sequence, uniform lacunary convergence.

Topological and Structural Aspects of Lacunary Weakly Convergent Double Sequences of Functions

Sujata Saikia^{1,*} and Pranab Jyoti Dowari²,

¹Department of Mathematics, Dibrugarh University, Dibrugarh, India

Email: sujatasaikiabatamari@gmail.com

²Department of Mathematics, Moridhal College, Dhemaji, India

Email: pranabdowari@gmail.com

ABSTRACT

In this paper, we introduce and develop the concept of *lacunary weak convergence* for double sequences of functions. By extending lacunary methods to the setting of weak convergence, we construct a framework that captures finer modes of convergence in two-dimensional indexing schemes. We examine several fundamental structural properties of the newly defined space, including symmetry, monotonicity, and solidity, which contribute to a deeper understanding of its internal geometry. In addition, key topological characteristics are investigated, illustrating how double sequences of functions behave under lacunary weak convergence. A variety of examples and counterexamples are presented to demonstrate the necessity of the assumptions and to highlight the strictness of inclusion relations. These results collectively enrich the theory of double sequence spaces and provide new directions for further research in functional analysis and summability theory.

Key Words: Weak convergence; lacunary sequence; lacunary weak convergence; double sequence.

Approximation solvability of H-Monotone Operator with Application to Caylay inclusion Problem in Banach Spaces

Khalid Fayaz, Mohd Iqbal Bhat, Hilal Ahmad Khanday and Mudasir Ahamd Malikk

University of Kashmir

ABSTRACT

In this paper, a new class of H -monotone operators in Banach spaces is considered and studied. The resolvent operator and Caylay approximation operator associated with the H -monotone operator are defined, and the Lipschitz continuity of Caylay approximation operator is also established. An application involves the approximation solvability of a class of generalized caylay inclusion problems with H -monotone operators in Banach spaces. By utilizing the technique of resolvent operator, an iterative algorithm is developed for solving such a class of generalized caylay inclusion problems in Banach spaces. The convergence of the iterative sequence generated by the algorithm is proven under certain suitable conditions. The applicability of the results and the iterative technique adopted is also demonstrated through numerical example. The method and results presented in this paper extend and unify the corresponding known results in this area. The results are justified by means of a numerical example analytically and graphically using Python (matplotlib).

PID Stabilization for EHD Thermal Printers

Ranadip Roy¹, Rudra Pratap Singh², Dharmbir Prasad³, Moumita Bose⁴

^{1,4} NSHM Knowledge Campus, Durgapur, West Bengal, 713212, INDIA

² Asansol Engineering College, Asansol, West Bengal, 713305, INDIA

³ SRM Institute of Science and Technology, Modinagar, Uttar Pradesh, 201204, INDIA

ABSTRACT

Electrohydrodynamic (EHD) printing is an advanced microfabrication method capable of generating submicron droplets for use in fields such as flexible electronics, biomedical engineering, and microfluidics. However, achieving stable droplet formation is difficult due to the nonlinear behavior and sensitivity of the EHD process to disturbances. Fluctuations in voltage, ink temperature, and fluid properties often result in unstable jetting, especially when working with high-viscosity inks. This study introduces an adaptive PID control scheme to regulate voltage, temperature, and droplet size in an EHD thermal printing setup. A MATLAB/Simulink model was developed to simulate system dynamics and thermal effects. The adaptive controller dynamically tunes its parameters to enhance stability and robustness. Simulation results revealed notable improvements in regulation accuracy, consistency, and droplet uniformity compared to conventional control, enabling reliable printing with complex, viscous materials.

Keywords: Electrohydrodynamic printing; EHD; adaptive controller; thermal regulation.

Spectral bounds and localization set of nonsingular linear two-parameter eigenvalue problems

Bikash Chutia¹ and Niranjana Bora²

^{1,2} Department of Mathematics, Dibrugarh University, Dibrugarh, Assam, India

¹bikash41chutia@gmail.com, ²niranjana11@gmail.com

ABSTRACT

Linear two-parameter eigenvalue problems (LTEP) are a special class of multiparameter eigenvalue problem that arises in various areas of applied mathematics and physics. In this talk, we consider nonsingular LTEP and develop new tools for analyzing spectral bounds and localization sets. We derive improved analytical bounds that yield sharper estimates for the eigenvalues, enabling a deeper understanding of the underlying spectral structure of LTEPs. In addition, we also develop localization sets that confine the eigenvalues within computable regions in the parameter space. These results provide both theoretical insights and analysis of numerical algorithms, contributing to more accurate spectral characterization and supporting the development of efficient numerical methods for solving nonsingular LTEPs.

Keywords: Linear two-parameter eigenvalue problem, Generalized eigenvalue problem, Generalized Gersgorin set, Matrix pencil.

MSC (2020): 15A18, 15A22, 47J10, 65H17.

An Infinite Family of Congruences modulo 3 for $t_5(n)$

Dr. Bidyut Boruah

CNB College, Bokakhat

ABSTRACT

We define $t_5(n)$ as the number of representation of n as a sum of five triangular numbers. Applying Ramanujan's theta function identities, from a Lambert Series we found the following results:

$$t_5(9n + 8) \equiv 0 \pmod{3} \text{ and } t_5\left(3^{2\alpha}n + \frac{23 \times 3^{2\alpha-1} - 5}{8}\right) \equiv 0 \pmod{3}.$$

Key Words: Lambert series, Congruence, Triangular Number, Theta function, Theta function Identities.

New Similarity Measure for Generalized Fuzzy Set and its Application in Transport Optimization Problem

Bornali Saikia^{1*} and Palash Dutta²

¹*Department of Mathematics, Sadiya College, Chapakhowa, Assam-786157*

²*Department of Mathematics, Dibrugarh University, Dibrugarh, Assam-786004*

Email ID: bornalisaikia19@gmail.com

ABSTRACT

Uncertainty is an inherently universal, inevitable, and prominent attribute of any decision-execution process, covering transportation problems. Since the inception of uncertainty modeling, various approaches have been introduced to capture and manage imprecise information effectively. Among these mathematical tools, fuzzy sets and intuitionistic fuzzy sets found to be highly influential and effective frameworks. In spite of that, these conventional approaches still exhibit notable limitations when addressing complex and vague environments. To conquer these limitations, this study discusses the Generalized Fuzzy Set, an expansion of the intuitionistic fuzzy set because of its flexibility and superior capability for representing uncertainty. Moreover, similarity measures have a key role in solving transportation problems under uncertain circumstances. These motivates us to propose an improved similarity measure for Generalized Fuzzy Sets. The proposed similarity measure is designed by employing the distances corresponding to membership, non-membership, and hesitancy degrees of Generalized Fuzzy Sets, and it holds all fundamental axioms of similarity measures. Additionally, numerous examples are illustrated to elaborate the effectiveness and superiority of the proposed measure, followed by its utilization to fuzzy transportation problems. As the core purpose of transportation problems is to optimize transportation costs, we modified Monalisa's method for generalized fuzzy sets by implementing the proposed similarity measure. The effectiveness of the newly modified technique is illustrated through a detailed adopted case studies and compared against established methods stated in the previous works. In conclusion, statistical tests and a comprehensive result evaluation are conducted to assess the consequences and robustness of the new method.

Keywords Intuitionistic Fuzzy Set · Generalized Fuzzy Set · Similarity Measure · Transportation Problem.

ALPHA GRACEFUL LABELING IN THE CONTEXT OF m -SHADOW GRAPHS

Jaykeen H. Jani*, **V. J. Kaneria**

Department of Mathematics, Saurashtra University, Rajkot, Gujarat, India.

*Corresponding Author E-mail: jaykeenhj@gmail.com

ABSTRACT

A graph G is represented as an ordered pair $G = (V, E)$, where V is set of vertices and E is the set of edges which connects the vertices. A graph labeling is an assignment of integers to the vertices or edges, or both, subject to certain conditions. A graph $G = (V, E)$ is said to be α -graceful if there exists one-to-one function f from V to the set $\{0, 1, 2, \dots, |E|\}$ such that each edge xy assigned the label $|f(x) - f(y)|$, then the resulting edge labels are distinct and there exist an integer k such that, $\min\{f(x), f(y)\} \leq k < \max\{f(x), f(y)\}$ for each edge xy of G . The m -shadow graph $D_m(G)$ of a connected graph G is constructed by taking m copies G_1, G_2, \dots, G_m of G , and joining each vertex u in G_i to the neighbors of the corresponding vertex v in G_j for $1 \leq i, j \leq m$. In this paper we investigate α -graceful labeling for the m -shadow graph of some graphs like, path, complete bipartite graph, bistar and cycle.

Keywords: graceful labeling, alpha labeling, m -shadow graph.

A Novel Intuitionistic Fuzzy Similarity based Clustering Application to Diverse Real-world Problems

Ritu Bhuyan^{1*}, Juthika Mahanta²

Department of Mathematics, National Institute of Technology Silchar, Cachar-788010, Assam, India

*Corresponding Author E-mail: ritu24_rs@math.nits.ac.in

ABSTRACT

In the real-world, decision-making tasks are not always based on binary logic. Uncertain and vague information can be properly quantified using a stronger tool namely Fuzzy set. Intuitionistic Fuzzy sets (IFSs) are extensions of Fuzzy sets and they can represent hesitation in the information properly. IFS based clustering tasks are employed to make groups of datasets based on their similarity measures. But IFS based similarity measures show distinct shortcomings; therefore, this study proposes a novel approach to define similarity measure, which overcomes those drawbacks. Moreover, this study also utilizes the novel measure to employ into hierarchical clustering task for diverse real-world applications. Comparative study shows that the algorithm improves efficiency of the outcomes. The study provides two major contributions: Improves the existing IFS based similarity measures to overcome existing drawbacks and proposes a hierarchical clustering algorithm to improve the efficiency as well as consistency with real-world dataset. Also, since sensitivity analysis is an important tool to drive the consistency check of the output results, this study employs a sensitivity analysis. Performance of the results based on the parameter values identify that the results are consistent with the changes of small changes but drastically change if the parameters are changed with a large margin. Overall, this study improves the existing methods of hierarchical clustering, thereby overcomes the existing limitations addressed in the current ones. This study can be also extended to other higher level of uncertain environments such as Pythagorean, Fermatean Fuzzy, q-rung Ortho pair Fuzzy sets etc. to model different levels of hesitant decision-making tasks, which is a scope of further research process.

Keywords: Intuitionistic Fuzzy set; Similarity measure; clustering; Real-world application.

Tropical Algebraic Methods for Interpreting Deep Neural Networks

Mrs. Anupama Pandey¹, Pravar Mishra²

¹Associate Professor in Mathematics, BBCIT Kachiguda, Hyderabad, India

²Vellore Institute of Technology, AP

anupamaanjesh@gmail.com

ABSTRACT

Deep neural networks (DNNs) have achieved remarkable success across domains such as computer vision, natural language processing, and decision-making systems. However, their interpretability remains a major challenge, as the internal operations of deep models often behave like “black boxes.” Tropical algebra—a mathematical framework built on the max-plus or min-plus semiring—offers a powerful set of tools to analyze the structure and behaviour of neural networks in a piecewise-linear setting. Since many widely used activation functions, especially ReLU, induce piecewise-linear transformations, tropical algebra naturally aligns with the computational geometry underlying DNNs.

This paper explores tropical algebraic methods as a pathway to interpret deep neural networks by representing feedforward layers as tropical polynomials and mapping network decision boundaries to tropical hypersurfaces. Such representations enable the decomposition of a network’s function into regions of linearity, thereby providing insights into how specific inputs activate particular linear regimes. By studying the combinatorial complexity and geometric patterns of these regions through tropical varieties, researchers can quantify expressiveness, detect redundancies in parameters, and identify dominant computational paths.

Furthermore, tropical methods facilitate model compression and robustness analysis by revealing which tropical monomials significantly contribute to network outputs. They also offer a framework for comparing architectures through their tropical footprints, enabling principled evaluation of depth, width, and activation patterns. Overall, tropical algebra provides a mathematically rigorous and computationally meaningful approach to interpretability, bridging abstract algebra, geometry, and modern deep learning. This work highlights its potential to advance transparent, reliable, and theoretically grounded neural network analysis.

Keywords: Tropical Algebra, Tropical Geometry, Piecewise-Linear Analysis, Combinatorial Complexity

Graph Invariants of the Identity Graph of a Symmetric Group

Archana Rajeev¹

Department of Mathematics, N. S. S. College, Nilamel, Kollam, Kerala, India.

*Corresponding Author E-mail: archanarajeev93@gmail.com

ABSTRACT

Algebraic graph theory is a rapidly expanding research area, which translate graph properties into algebraic ones. Our main focus is the identity graph of group introduced by Kandasamy and Smarandache. Let (G, \cdot) be a group and x, y is in G . The identity graph $G_I(G)$ of G consists of the vertex set as the elements of G and the edge set is defined as follows: x is adjacent to y in $G_I(G)$ if $x \cdot y = e$ or any one of x or y is e , where e is the identity element of G . In this paper, we discuss about some graph invariants such as connectivity, minimum degree, independence number, matching number, covering numbers, chromatic numbers and topological indices of the identity graph of a symmetric group, S_n .

Keywords: Chromatic numbers; Graph invariants; Identity graph; Topological indices.

ON A SUBCLASS OF ANALYTIC FUNCTIONS DEFINED BY LAGUERRE POLYNOMIAL

AKANKSHA SAMPAT SHINDE¹, P. THIRUPATHI REDDY²

¹*Department of Mathematics, VPMs B.N. Bhandodkar College of Science (Autonomous), Thane West -
422 601, Maharashtra, India.*

e-mail : akankshashinde1202@gmail.com

²*Department of Mathematics, DRK Institute of Science and Technology, Bowampet-500 043,
Hyderabad, Telangana, India.*

e-mail : reddypt2@gmail.com

ABSTRACT

In this paper, we introduce and investigate a new subclass of analytic functions in the open unit disk, defined by means of an operator constructed from the classical Laguerre polynomials. Using the generating function and recurrence relations of Laguerre polynomials, we formulate a linear operator that generalizes several well-known operators used in geometric function theory. The proposed subclass is characterized through a suitable subordination condition involving this Laguerre based operator, enabling a unified treatment of various geometric properties. For functions belonging to the newly defined class, we derive sharp or improved bounds for the initial Taylor Maclaurin coefficients, including estimates of the second and third coefficients and the corresponding Fekete Szego functional. Distortion and growth inequalities, radius results, and inclusion relations with classical subclasses of starlike and convex functions are also established. Additionally, special cases of the operator are shown to reduce to several known classes previously studied in the literature, demonstrating the generality and applicability of the present framework. The results obtained contribute to the expanding body of research on special-function-based subclasses of analytic functions and highlight the effectiveness of Laguerre polynomials in generating operators with rich geometric and analytic behavior. The object of the present paper is to determine coefficient estimates, distortion bounds, radii of starlike and convexity, extreme points, Hadamard product and closure property belonging to this class.

2020 Mathematics Subject Classification: 30C45.

Keywords and Phrases: analytic, starlike, convex, distortion, convolution.

Extension of Ordinary Cooperative Games and Their Fuzzification

Dr. Mamta Kumari

Assistant Professor, Department of Mathematics, Saharsa College of Engineering, Saharsa

Hatiya Gachhi, Saharsa, Bihar, India

Email: kmamta2010@gmail.com

ABSTRACT

Cooperative games provide a mathematical framework for analyzing situations in which multiple decision makers collaborate to achieve common benefits. Traditional cooperative game models assume full cooperation and unrestricted formation of coalitions. However, in real-world scenarios, players often face limitations such as restricted coalition structures and partial levels of cooperation. This paper extends the classical cooperative game framework by incorporating these two practical factors. We introduce fuzzy concepts into cooperative games to represent uncertainty, partial participation, and flexible coalition formation. The paper presents theoretical foundations, model formulation, and analytical results for cooperative fuzzy games.

Keywords: Cooperative Games; Coalition formation; Partial cooperation; Fuzzy sets.

A Mathematical Study of Rank and Nullity in Fractal Polygon Graphs and Their Applications

Suriya Banu. R¹, Kamali. R², *

Research Scholar¹, Assistant professor^{2,}, Department of Mathematics, Vels Institute of Science, Technology and Advanced Studies (VISTAS), Chennai-600117, Tamil Nadu, India 1,2**

Email: suriyabanu2020@gmail.com

ABSTRACT

Graph theory and Fractals are two important areas of mathematics that help to study complex structures in a simple way. The Fractal graphs were introduced with the key properties of self similarity, recursive iterations, and Fractal Dimension. The rank-nullity theorem offers an effective algebraic framework for analyzing iterative fractal-derived graphs. In this work, the iterated fractal polygon graphs were examined using rank and nullity as structural parameters. For each iteration, the rank of the fractal graph corresponds to the number of independent edges, and it is expressed as the difference between the number of vertices and one for the connected case. As a property of fractals, the number of vertices and edges increases systematically, while the nullity is defined as the difference between the number of edges and rank. The main concepts of rank and nullity helped in planning, controlling flow, and managing overload conditions. The proposed technique is illustrated with related examples. These new results demonstrate that the rank and nullity give a meaningful mathematical framework in an easy and clear way in real-time applications.

Keywords: Fractal Graph; Fractal Dimension; Rank; Nullity.

On degree based Laplacian and signless Laplacian spectrum of graphs

Bablee Phukan^{*},¹, Ankur Bharali¹

**Department of Mathematics, Dergaon Kamal Dowerah College, Golaghat 785614, India*

¹Department of Mathematics, Dibrugarh University, Dibrugarh 786004, India

**Corresponding author E-mail: phukanbalee@gmail.com*

ABSTRACT

The relationship between edges and vertices plays a fundamental role in graph theory and significantly influences numerous graph characteristics and applications. Examining degree distributions is essential for the analysis and modeling of complex real-world networks. In this paper, we introduce the degree based Laplacian and signless Laplacian spectrum of a simple, undirected and finite graph G and hence derive their respective energies. Furthermore, we compute these energies for several well-known classes of graphs, including complete graphs, star graphs, crown graphs, Moore graphs, and complete bipartite graphs.

Keywords: Graph spectrum, Degree Laplacian matrix, Degree signless Laplacian matrix, Degree energy.

Perfect Regularity and Perfect Edge Regularity of Interval-Valued Fuzzy Graphs

Bisna Jose^{1*}, Sunny Joseph Kalayathankal², Joseph Varghese Kureethara³

^{1}Department of Mathematics, Jyothi Engineering College, Cheruthuruthy, Thrissur, 679 531, Kerala, India*

²Department of Computer Science and Engineering, Rajagiri School of Engineering and Technology, Cochin, 682 039, Kerala, India

³Department of Mathematics, Kuriakose Elias College, Mannanam, Kottayam, 686 561, Kerala, India

**Corresponding Author E-mail: bisna89.jose@gmail.com*

ABSTRACT

Graph theory is an important branch of mathematics, which provides powerful mathematical tools to model and analyse relationships and interactions in complex systems across science, technology and everyday life. Dealing with problems with uncertainty, vagueness for realistic modelling and effective decision-making, fuzzy graphs are useful. Interval-valued fuzzy graphs generalise traditional fuzzy graphs by assigning interval-valued membership degrees, offering a more comprehensive framework for representing uncertainty and vagueness in real-world networks. Regularity and total regularity of vertices and edges are independent concepts in interval-valued fuzzy graphs. In this work, we introduce the concepts of perfect regularity and perfect edge regularity within the context of interval-valued fuzzy graphs using regularity and total regularity. The structural properties of these two notions are studied in detail. Furthermore, we explore the relationships between these two, to understand how they are interconnected.

Keywords: Perfectly regular interval-valued fuzzy graphs; Perfectly edge regular interval-valued fuzzy graphs

TOPOLOGICAL PROPERTIES OF MULTI METRIC SPACES

Debjoyti Chatterjee^{1,*}, Shashi Bajaj Mukherjee²

*Department of Mathematics, Jalpaiguri Government Engineering College, Denguajhar,
Jalpaiguri, India*

*Corresponding Author E-mail: debjoyti.chatterjee@jgec.ac.in

ABSTRACT

Building upon earlier development of multiset theory through the notions of the general multiset, the Q^+ -multiset, the N -multiset, and the associated multi-real number system, this paper advances the topological study of multi-metric spaces. We introduce and analyze refined topological constructs such as multi-open balls, multi-open sets, multi-closed sets, multi-limit points, and multi-derived sets within the framework of multi-metric spaces. Fundamental relationships among these notions are established, along with characterizations analogous to classical topology, examined in the context of N -multiset. Additionally, we investigate separation properties, closure operations, and interior operators in multi-metric spaces. This work extends the foundational theory of multi-metric spaces and deepens the understanding of topological concepts where multiplicity plays a central role, offering new directions for research in multiset topology and generalized metric theory.

Keywords: Multi-metric; Multi-open ball; Multi-open set; Multi-closed set.

New Classes of β -Continuity in Neutrosophic Nano Topological Spaces

Dr. P. Anbarasi Rodrigo¹, J. Charlet Jenisha²,

¹Assistant Professor, Department of Mathematics, St.Mary's College(Autonomous),(Affiliated to Manonmaniam Sundaranar University,Abishekapatti,Tirunelveli),Thoothukudi-628001, TamilNadu,India; anbu.n.u@gmail.com

²Research Scholar, Reg.No:241122112025, Department of Mathematics, St.Mary's College(Autonomous),(Affiliated to Manonmaniam Sundaranar University, Abishekapatti, Tirunelveli),Thoothukudi-628001, TamilNadu,India; jenishacharlet@gmail.com

²*Corresponding Author: jenishacharlet@gmail.com

ABSTRACT

This paper introduces and investigates **totally β -continuous** and **strongly β -continuous functions** within the framework of **neutrosophic nano topological spaces**, a structure designed to describe systems characterized by indeterminacy, vagueness, and incomplete information. We extend the classical and neutrosophic notions of β -continuity by formulating new definitions that capture stronger and more comprehensive forms of continuity under neutrosophic nano settings. Fundamental properties, hierarchical relationships, and characterizations of these functions are established, along with conditions under which totally β -continuous maps imply strong β -continuity or coincide with other well-known neutrosophic nano continuous functions. Illustrative examples are provided to demonstrate the distinctions between these classes of functions. The results presented here contribute to the enrichment of neutrosophic nano topology and offer potential applications in uncertain decision-making models, cognitive computing, and real-world environments where incomplete or imprecise data must be processed.

On Zagreb Energies of Extended m -splitting Graph

Dipakkumar N. Barad*, Vinodrai J. Kaneria

Department of Mathematics, Saurashtra University, Rajkot, India-360005

*Corresponding Author E-mail: dipak.1210@gmail.com

ABSTRACT

The study of graph energies has become an important theme in spectral graph theory due to their extensive application in mathematical chemistry, network analysis, and combinatorial optimization. In this work, we focus on the Zagreb energies associated with the extended m -splitting graph $Spl_m^*(G)$ derived from a base graph G . For the case where G is the k -regular graph, we develop a block-spectral methodology that allows the first and second Zagreb spectra of $Spl_m^*(G)$ to be characterized explicitly in terms of the adjacency spectrum of G . This framework leads to closed and computable formulas for the corresponding degree base Zagreb energies of the extended splitting construction. Furthermore, the theoretical results are implemented for several well-studied families of regular graphs, including cycles, complete graphs, complete bipartite graphs, cocktail party graphs, and crown graphs, yielding explicit expressions and demonstrating the applicability of the proposed approach. These findings contribute new spectral insights into the structural behaviour of Zagreb indices under splitting operations and open pathways for further exploration of energy based invariants in graph transformation.

Keywords: k -regular graph, First Zagreb energy, Second Zagreb energy, Extended m -splitting.

MICRO α^* -GENERALIZED HYPERCONNECTED IN MICRO TOPOLOGICAL SPACES

Dr. P. Anbarasi Rodrigo¹, K. Selvakumari Prasha^{2*}

¹Assistant Professor, Department of Mathematics, St. Mary's College (Autonomous), (Affiliated to Manonmaniam Sundaranar University, Abishekapatti, Tirunelveli) Thoothukudi- 628 001, Tamilnadu, India. E-mail: anbu.n.u@gmail.com.

^{2*}Research Scholar, Reg. No. 23112212092002, Department of Mathematics, St. Mary's College (Autonomous), (Affiliated to Manonmaniam Sundaranar University, Abishekapatti, Tirunelveli) Thoothukudi- 628 001, Tamilnadu, India.

E-mail: selvakumarprasha12345@gmail.com.

ABSTRACT

Objective: S. Chandrasekar introduced Micro Topology in 2019. We introduced a new class of Micro Generalized Closed Sets in Micro Topological Spaces. In this paper, we introduced some forms of separation axioms namely $\alpha^*g_{\mathcal{M}}$ -hyperconnected. We study the connections of these functions with other forms of Micro hyperconnected. Also we established the relation between the above function and also investigate various aspects of these functions. **Method:** The study employs rigorous analysis of these Micro functions and formal proof technique to establish their properties. Comparative analysis with some existing function is conducted to highlight the distinct characteristics of these axioms. **Finding:** The research identifies and confirms the unique features of $\alpha^*g_{\mathcal{M}}$ -hyperconnected under various operations, supported by detailed proofs and examples. **Novelty:** The research contributes to the mathematical literature by defining and exploring a new category of Micro function and comparing it with some of the existing functions.

Keywords: $\alpha^*g_{\mathcal{M}}$ -closed, $\alpha^*g_{\mathcal{M}}$ -open, $\alpha^*g_{\mathcal{M}}$ -hyperconnected.

New Approaches in fixed point theory in multiplicative metric space

Satish Kumar

Research Scholar, Department of Mathematics, Baba Mastnath University Asthal Bohar

Email- kumarsatishgcd@gmail.com

ABSTRACT

The multiplicative Metric space was introduced in 2008 by Bashirov et al. In that space the triangle inequality is replaced by multiplicative triangle inequality the literature has numerous fixed point results. It was shown that the most obtained fixed point results in such types of spaces are equivalent to the corresponding fixed point results in metric spaces. In this paper we define new directions in fixed point theory in multiplicative metric spaces by investigating new contraction on metric spaces. In this we define a new multiplicative version of Banach fixed point theorem and kannan's fixed point theorem is proved. In this we also provide some sufficient condition under which any multiplicative contraction has one and only one fixed point. Some definition and illustrative examples are also provided to illustrate the validity of our obtained results.

A new approach to the common fixed points theorem for set-valued mappings within cone metric spaces.

Mohsin Ahmad Dar

Department of Mathematics, Govt. M. L. B. Girls P. G. Autonomous College Bhopal, Madhya Pradesh, India

ABSTRACT

The aim of this paper is to create a new analytical framework for examining the existence and uniqueness of common fixed points for pairs of set-valued mappings operating inside cone metric spaces that have a normal cone with a normal constant $L > 1$. Our findings improve the applicability of common fixed point theorems and contribute to the ongoing development of generalized metric frameworks in modern mathematical analysis.

Key words : common fixed point, set-valued mapping, cone metric space.

Linearizations of Cubic Two Parameter Matrix Polynomial via Newton Basis

Ankita Kakoty and Niranjan Bora

Department of Mathematics, Dibrugarh University

ABSTRACT

In this talk, we consider a cubic two-parameter matrix polynomial in Newton basis $E_N(\lambda, \mu)$. We construct a vector space of linear two parameter matrix polynomials. We then identify a set of linearizations which lie in the vector space and describe their constructions. Finally, we identify a class of singular linearizations for a cubic two-parameter eigenvalue problem in Newton basis.

Key words: Matrix Polynomial, cubic two parameter matrix polynomial, Newton bases, linearization.

A fuzzy MCDM model for agricultural technology selection: integrating generalized Frank operators and machine learning

Muhammad Umar Mirza^a, Muhammad Zafar Abbas^a, Nasreen kausar^b, Rukhshanda Anjum^a, Tapan Senapati^{b,*},

^a*Department of Mathematics and Statistics, University of Lahore, Lahore, Pakistan*

^b*Department of Mathematics, Faculty of Arts and Science, Balikesir University, 10145 Balikesir, Turkey*

ABSTRACT

Agricultural engineering in the modern context increasingly faces challenges related to data uncertainty, variability in field conditions, and reliable decision-support tools in smart farming technologies. In order to handle such issues, this article introduces a new extension of fuzzy sets called Linear Diophantine Fuzzy Credibility Numbers, which efficiently captures ambiguity, hesitation of experts, and credibility-based uncertainty in practical evaluations. Further, a new aggregation operator called the LDFCN Frank Weighted Averaging operator is developed, and a complete multi-criteria decision-making algorithm is then formulated based on these concepts. A real-world application is presented in the context of smart crop monitoring, where four agricultural drones are evaluated against the criteria of payload capacity, camera zoom & resolution, battery endurance, and weather resistance. From the results obtained, it can be observed that the best alternative is Drone 1. Comparisons done using TOPSIS and WASPAS show that more stable and reliable results could be obtained by the proposed approach because of the improvement in its uncertainty-handling capability. Furthermore, the machine-learning module using polynomial regression is employed to predict trends in crop yield for further verification of the consistency of decision patterns. Overall, this study presents a robust intelligent decision-support framework for modern agricultural environments.

Keywords: Z number; Linear Diaphantine Z number; Frank weighted average operator; TOPSIS; MOORA ; VIKOR; WASPAS

Game theory and it's applications in Business world

Dr. Supriya

ABSTRACT

Game theory offers a fascinating way to analyze business situations. It provides a structured framework to understand how companies interact with each other, customers, and suppliers. By using mathematical models, businesses can predict outcomes based on the choices made by others. At its core, game theory looks at how players, which can be businesses or individuals, choose strategies that lead to different payoffs. One key concept is Nash equilibrium. This is a state where no player can gain by changing their strategy alone. It indicates stable outcomes in competitive environments. Businesses often use strategic pricing models based on game theory. They anticipate how competitors will react to price changes, allowing them to optimize profits while considering market dynamics. This approach helps companies set prices that can lead to better financial outcomes. Negotiation theory is another area where game theory shines. When companies negotiate with suppliers or partners, they can predict counter offers and work towards agreements that benefit all parties. This strategic approach can lead to more favorable terms and stronger partnerships. When it comes to measurement and data, game theory integrates quantitative metrics to assess business strategies. For example, companies analyze historical pricing data and competitor behavior to create dynamic pricing models. These models can adjust in real time, measuring impacts on sales and market share. Supply chain optimization is another practical application. By modeling interactions with suppliers and measuring performance indicators like delivery times and costs, companies can improve negotiation strategies. This leads to better reliability and efficiency in operations. In the digital marketing space, game theory plays a role in online ad auctions. Businesses can predict competitor bids and use metrics like click-through and conversion rates to guide their bidding strategies. This helps maximize the effectiveness of marketing campaigns. When launching new products or entering new markets, firms apply game theory to anticipate competitor reactions. The measure potential risks and payoffs, allowing for informed decision-making. This proactive approach can lead to successful product launches. In markets with few dominant players, game theory helps model interactions such as price wars or capacity expansions. Companies use data on competitor moves and market responses to navigate these challenges effectively. Innovation decisions also benefit from game theory. Companies can simulate competitor responses and market adoption to measure potential gains from investing in new technologies or business models. This helps in making informed choices about where to allocate resources. Incorporating probability theory, especially basian methods, enhances the application of game theory. By updating beliefs and strategies based on new data, businesses can improve decision accuracy under uncertainty. This combination allows for more robust strategic planning. Overall, game theory applied with measurement and data allows businesses to move beyond guesswork. They can use quantitative analysis and predictive modeling to design strategies that anticipate competitor and market responses. This leads to optimized outcomes and better risk management, making game theory a powerful tool in the business world.

Keywords: Game theory, Business, Mathematics models, Nash equilibrium, Negotiation, Strategy, Basin method.

Some Numerical Descriptors of Black Phosphorus Layer Structure

Rajdeep Bora

Department of Mathematics, Kakojan College, Jorhat, Assam, India, 785107

E-mail: rajdeepbora23@gmail.com

ABSTRACT

Topological indices and spectrum are graph invariants defined on finite graphs. A large number of topological indices is derived from the vertex degrees of graphs and is therefore termed as degree-based topological indices. These indices are calculated from graphs representing molecular structures and capture important structural features of the underlying molecules. Thus, a topological index is a numerical descriptor related to chemical composition that reflects the relationship between molecular structure and various physical properties, chemical reactivity, or biological activity. On the other hand spectrum of a graph representing a molecular structure provides quantitative structural information, such as Connectivity, Branching Stability, Electron distribution patterns by studying eigenvalues of adjacency, Laplacian, or related matrices of the graph.

In this paper, some of the degree-based topological indices, spectral properties are discussed and evaluated these descriptors for the layered structure of black phosphorus.

Keywords: Black Phosphorus, Topological Indices, Spectrum of Graph.

A Novel Perspective on Cancer Data Clustering Through Intuitionistic Fuzzy C-Means Techniques

Pandian Palani^a, Bhoomi Patel^b, Sathya Arumugam^c

^aAssistant Professor, Department of Mathematics, Pachaiyappa's College for Men, Kanchipuram

^bResearch Scholar, Department of Mathematics, Government College Daman (Affiliated to Veer Narmad South Gujarat University, Surat)

^cAssistant Professor, Department of Mathematics, Government College Daman, Daman

Email id: sathyaarumugam.gcd@gmail.com

ABSTRACT

Medical data clustering, especially for cancer diagnosis, presents significant challenges due to noise, nonlinearity, and uncertainty inherent in biomedical measurements. Traditional Fuzzy C-Means clustering effectively handles overlapping data but is limited by its sensitivity to noise and inability to represent uncertainty beyond membership degrees. To address these limitations, this paper presents a comprehensive comparative study of Intuitionistic Fuzzy C-Means and its advanced variants Kernel-based Intuitionistic Fuzzy C-Means and Possibilistic Intuitionistic Fuzzy C-Means applied to the Wisconsin Diagnostic Breast Cancer dataset. These algorithms integrate intuitionistic hesitation, kernel

mapping, and possibilistic typicality to enhance robustness and accuracy. Performance evaluation using cluster validity indices such as Silhouette Coefficient, Partition Coefficient, Partition Entropy, and Davies–Bouldin Index demonstrates that Possibilistic Intuitionistic Fuzzy C-Means achieves the best overall clustering quality, offering strong resistance to noise and improved separation between malignant and benign classes. The proposed framework provides a unified foundation for uncertainty-aware, noise-resilient clustering, enabling more reliable medical data interpretation and decision support in clinical diagnostics.

Keywords: Intuitionistic Fuzzy C-means, Data clustering, Breast cancer Data, Cluster Validity

Application of graph theory in day- to-day life

Jita Dutta

Assistant Professor, Department of Mathematics, Kakojan College

Email-duttajita@gmail.com

ABSTRACT

Graph theory is a branch of discrete mathematics that studies the relationships between objects using nodes (vertices) and links (edges). In day-to-day life, graph theory has wide applications in systems that involve connectivity and interaction. Graph provide a convenient way to represent various kinds of mathematical objects. In everyday life, many systems such as transportation networks, communication systems, social media platforms, and utility services can be represented using graphs. Graph theory helps in finding optimal routes, efficient data transmission, effective scheduling, and analysis of relationships. It is also widely used in search engines, recommendation systems, healthcare, and project management. By modeling real-world problems as graphs, graph theory simplifies complex systems and provides efficient solutions, making it highly relevant and useful in day-to-day life. It is used in transportation and navigation for finding shortest paths, in communication and computer networks for efficient data routing, and in social networks to analyze relationships and information flow. Graph theory also plays an important role in search engines, scheduling and project management, utility networks, healthcare, and recommendation systems. Graphs, as obtained, making graph theory an essential tool in modern life and technology.

Keywords: Vertices, Edges, Transportation networks, Navigation, Project management etc.

“Spaces of lacunary statistically weakly convergent triple sequences with applications to sparse data modelling”

Md Sahid Alam^{1*}, Dr. Ajoy Kanti Das²

¹ *Research Scholar, Department of Mathematics, Tripura University, Agartala-799022, Tripura, India*

alamsahid0709@gmail.com

² *Associate Professor, Department of Mathematics, Tripura University, Agartala- 799022, Tripura, India*

ajoykantidas@gmail.com

ABSTRACT

This paper introduces lacunary statistical weak convergence for triple sequences, combining lacunary blocks with statistical density and weak topology in normed spaces. We define the spaces

$$C_{0,\theta}^3 = \{(x_{uvw}) : x_{uvw} \xrightarrow{w-\theta} 0\}$$

$$C_{\theta}^3 = \{(x_{uvw}) : \exists L, x_{uvw} \xrightarrow{w-\theta} L\}$$

$$l_{\infty}^3 = \{(x_{uvw}) : \sup_{u,v,w} |f(x_{uvw})| < \infty \text{ lacunary statistically}\}$$

and prove they are linear, normed, and complete. Full characterizations of solidity, monotonicity, and symmetry are given, with $C_{0,\theta}^3$ satisfying all three, while others fail in solidity. Some strict inclusions are established through counter examples. The framework supports convergence analysis in sparse data settings, including machine learning and 3D image processing.

Keywords: Lacunary statistical weak convergence; Triple sequence space; Solidity; Monotonicity

Approximation Solvability of a Class of Cayley Inclusion Problem Involving XOR Operator in Ordered Hilbert Space

Mahak Majeed

Department of Mathematics, South Campus University of Kashmir Anantnag

J & K-192101, INDIA

Email Address: mahakpadar786@gmail.com

ABSTRACT

In this paper, we attempt to establish and study a quite new and compelling class of problems known as Cayley inclusion problem involving XOR(\oplus)-operation in ordered positive Hilbert Space. We discuss the existence of results for this class of problems using resolvent operator and Cayley operator. Further we, construct a new iterative algorithm with errors for this system of variational inclusions. Some properties of associated resolvent and Cayley operators have been discussed by invoking XOR-operations.

Keywords: Variational Inclusion; XOR(\oplus)-operation; Resolvent operator; Cayley operator; Algorithm; Convergence.

AMS Subject Classification: 47H05, 47H10, 47J25, 49J40

Theme: Applied Mathematics

Linear Stability of Pipe Flow with Magnetic Field and Internal Heat Source: A Non-Darcian Approach

Ashok Kumar

Department of Mathematics, HNB Garhwal University, Srinagar (Garhwal), Uttarakhand-246174.

Department of Mathematics, Govt. Degree College, Kathua, J&K-184101.

*Corresponding Author E-mail: Ashokk14362@gmail.com

ABSTRACT

This study examines the stability of convective flow in a vertical pipe with a magnetic field, driven by an internal heat source. To formulate governing equations, the non-Darcy Brinkman Forchheimer extended model has been used and solved numerically by the Chebyshev spectral collocation method (CSCM). Stability analysis is conducted for various fluids (mercury and liquids) corresponding to Prandtl numbers (Pr) of 0.0248 and 7, showing that increasing the magnetic field enhances the stability region, with varying effects on critical wave number (k_c) and critical Grashof number (Gr_c) depending on Pr. The analysis reveals that the magnetic field increases the velocity profile in the central region, while decreasing it near the boundary, with the velocity profile near the boundary increasing with the Darcy number (Da). Increasing Hartmann number (Ha) significantly stabilizes the flow by suppressing convective motion through Lorentz forces. For $Da = 10^{-1}$ and $Pr = 0.0248$, Gr_c increases from 6.75×10^4 at $Ha=0$ to 7.03×10^5 at $Ha=10$, indicating requirement of higher buoyancy to trigger convection. Similarly, for $Da = 10^{-2}$, Gr_c rises from 2.15×10^5 to 2.40×10^6 . Reducing Da enhances porous resistance, resulting in weaker secondary vortices and diminished convective transport, with secondary flow intensity dropping by over 60% as Da decreases from 10^{-1} to 10^{-2} . Low-Pr fluids exhibit stronger stabilization under magnetic damping compared to high-Pr fluids. Visualizations of the secondary flow in a circular cross-section, showcasing the disturbance velocities (radial, circumferential, and axial) and temperature for various Da in both absence and presence of a magnetic field. Additionally, the stream function, streamwise velocity, and temperature are depicted in the meridional cross-section of the pipe at critical parameters, providing a comprehensive understanding of the flow dynamics.

Keywords: Spectral Collocation Method; Magnetohydrodynamics; Non-Darcy model; Nusselt Number.

Electron scattering from hydrogen atom in plasmas: S-wave resonance states

Nirvik Masanta^{1,*}, Netai Das², Arijit Ghoshal² and Yew Kam Ho³

¹*Department of Mathematics, Sadhu Ramchand Murmu University of Jhargram, Jhargram 721 514, West Bengal, India*

²*Department of Mathematics, The University of Burdwan, Golapbag, Burdwan 713 104, West Bengal, India*

³*Institute of Atomic and Molecular Sciences, Academia Sinica, P.O. Box 23-166, Taipei, Taiwan 106*

* Corresponding Author E-mail: nirvikmasanta@gmail.com

ABSTRACT

Effects of plasmas on the S-wave singlet resonance states in electron-hydrogen scattering have been investigated within the framework of the stabilization method. Classical weakly coupled plasma (described by the Debye-Huckel potential) and dense quantum plasma (described by an exponential cosine screened Coulomb potential) are taken into consideration. Using an extensive Hylleraas-type basis set, it has been possible to identify the emergence of five S-wave singlet resonance states for the plasma-free case. By fitting the density of resonance states with the Lorentzian profile, energy and life-time (related to the width) of those resonances are calculated accurately. The calculated results are in good accord with the results of other reliable calculations. A comprehensive study is made on the changes experienced by the energies and widths of those states due to variation of the respective plasma parameter. It turns out that the energy of each state is lifted due to the increase in plasma screening strength, whereas the changes in the widths with respect to the plasma screening strength show a distinctive behaviour.

Keywords: Electron scattering; resonance; stabilization method; plasma.

Cost Optimization in a Dual Warehouse Inventory Model with Stock and Price Dependent Demand under AI Forecasting, Inflation and Trade Credit

Vinay Kumar Masiyare^{1*}, Animesh Kumar Sharma²

¹ *Research Scholar, Department of Mathematics, The ICFAI University, Raipur, Chhattisgarh, India*

² *Assistant Professor, Department of Mathematics, The ICFAI University, Raipur, Chhattisgarh, India*

*Corresponding Author's Email: vinaym.phd2024@iuraipur.edu.in

ABSTRACT

This study presents a dual warehouse inventory model of deteriorating products, which combines AI based demand forecasting and factoring in the impact of inflation and trade credits. The management of the perishable products in the modern supply chains considers the uncertainty of demand, escalating financial cost and storage capacity. In this model, operational and economic considerations are integrated into an overall cost minimization model. The system presupposes the small capacity in the warehouse owned (OW), and the rest of the inventory is located in the rented warehouse (RW). Weathering is represented as synthesized by the exponential decay equation. The inflation is addressed as a continuous discounting rate and the trade credit has been included based on benefits of delayed payments. A Long Short-Term Memory (LSTM) neural network is used to perform demand forecasting based on historical data that is used to predict near term inventory demands. The cost function utilizes the forecasted demand as one of the inputs. The total cost function consists of holding costs in each of the warehouses, deterioration cost, rental fee, transportation fees, purchasing and ordering costs, and trade credit benefits. Analytical differentiation is used to compute the optimal cycle length by the use of Python-based computational optimization. An example of this is given numerically, in which the demand generated by AI is then utilized to calculate the optimal cycle length and total cost. The sensitivity analysis is achieved by changing the rate of deterioration, inflation rate and trade credit period, which validates the strength and elasticity of the model. The model can be applied in such industries as FMCG, pharmaceuticals, and agro-logistics to provide a sensible, data-driven method of inventory management. It helps in decision making by managers under the conditions of perishability, inflation and uncertainty due to credit.

Keywords: Inventory Model, Deteriorating Items, Trade Credit, Inflation.

Compressive and rarefactive dust ion-acoustic Korteweg-de Vries solitons in an unmagnetized dusty plasma with kappa-distributed electrons

Tirthanath Doley^{1,2,*} and Samiran Das¹

¹*Department of Mathematics, Central Institute of Technology Kokrajhar, BTR, 783370, Assam, India*

²*Department of Mathematics, Pandit Deendayal Upadhyaya Adarsha Mahavidyalaya, Tulungia, Bongaigaon, 783383, Assam, India*

*Corresponding Author E-mail: tirthadoley@gmail.com

ABSTRACT

The present study examines the propagation characteristics of small-amplitude dust ion-acoustic (DIA) solitary waves in an unmagnetized dusty plasma comprising inertial ions, kappa-distributed electrons, and negatively charged stationary dust grains. By employing the usual reductive perturbation approach, the governing normalized fluid equations are reduced to the Korteweg-de Vries (KdV) equation, and the corresponding soliton solutions are systematically analyzed. The analysis reveals that the phase velocity as well as the DIA solitons are strongly influenced by the core plasma parameters, namely the spectral index (κ), the dust concentration ratio (μ), and the temperature ratio (α). It is found that the compressive and rarefactive fast DIA solitary waves occur for $\mu < \mu_c$ and $\mu > \mu_c$, respectively. In compressive solitons, an increase in the temperature ratio (α) reduces the soliton amplitude, whereas the opposite trend is observed for rarefactive solitons. Moreover, the soliton amplitude decreases with increasing κ when $\alpha = 0$, but increases with κ when a finite temperature ratio ($\alpha = 2$) is considered.

Keywords: Kappa distribution; Dusty plasma; Reductive perturbation method; Solitons;

CURVILINEAR MODELS OF PHYSICO-CHEMICAL PROPERTIES OF BENZENOID HYDROCARBONS WITH CLOSED-NEIGHBORHOOD DEGREE-BASED MOLECULAR DESCRIPTORS

Monjit Chamua^{1,*}, Jibonjyoti Buragohain², Tarun Boruah², A. Bharali²

Department of Mathematics, Dibrugarh University, Dibrugarh, India-786004

*Corresponding Author E-mail: monjitchamua1409@gmail.com

ABSTRACT

Topological indices are best known for their exceptional applications especially in the QSPR and QSAR studies. The importance of topological indices may be attributed to its ability to decode the relevant information about chemical molecules. The main aim of this communication is to study the predictive ability of three hitherto topological indices of Benzenoid Hydrocarbons defined in terms of the notion of closed-neighborhood degree of a vertex. In addition, regression analyses are performed to compare our indices with the five reduced reverse degree-based and sixteen degree-based topological indices reported by Ravi et al. in the year 2023 [V. Ravi, K. Desikan, Curvilinear regression analysis of benzenoid hydrocarbons and computation of some reduced reverse degree based topological indices for hyaluronic acid-paclitaxel conjugates, Scientific Reports (nature) **13**, 3239 (2023)]. We additionally evaluate, using several statistical tools, the indices that demonstrate weaker predictive performance for the physicochemical properties of chemical molecules.

Keywords: Closed-Neighborhood Degree-Based Topological indices, Benzenoid Hydrocarbons, Linear and Quadratic Regression Models.

Effects of variable viscosity and thermal conductivity on a mixed convective micropolar fluid over a porous plate

DR. SURAJIT DUTTA

CNB College, Bokakhat, Assam

ABSTRACT

Considering temperature dependent viscosity and thermal conductivity two dimensional steady laminar mixed convective micropolar fluid flow is studied. The fluid is considered as viscous incompressible, electrically conducting and radiating and is passed over a vertical stationary porous flat plate in the presence of uniform magnetic field and heat source. Viscosity and thermal conductivity are assumed to be inverse linear functions of temperature. The governing partial differential equations are converted into ordinary differential equations by using suitable similarity transformations and then solved by using fourth order Runge-Kutta shooting method. A suitable Matlab programme is developed to solve the equations. The effects of different parameters are shown by graphs, and the skin friction coefficient and Nusselt numbers are shown in tabular form.

Keywords: Mixed convection, Radiative fluid, Heat source, Variable viscosity and thermal conductivity.

Influence of MHD on the Flow Past a Porous Spherical Shell with Slip Effect

Tina Bucha^{1*}, Madasu Krishna Prasad²

1 Assistant Professor, Department of Mathematics, Anandaram Dhekial Phookan College, Haibargaon, Nagaon, Assam, India

2 Associate Professor, Department of Mathematics, National Institute of Technology Raipur-492010, Chhattisgarh, India

*Corresponding Author E-mail: tinabucha1@gmail.com

ABSTRACT

In this paper, we work on answering the questions of establishing the impact of a magnetic field on the flow through a porous spherical shell at low Reynolds numbers, subject to a slip boundary condition. The flow is divided into three regions, namely, the external region, the porous medium region, and the cavity region. The external fluid and inner cavity dynamics are characterized by the modified Stokes equation, and the porous medium region is characterized by modified Darcy's law. The continuity of the normal component of velocity and pressure and a slip in the tangential part of velocity are utilized as the boundary conditions on the interface separating the fluid and the porous medium. The stream functions in terms of the modified Bessel functions are used in order to address the problem. The expression representing the drag force on the spherical shell in a magnetic field is also obtained. The drag coefficient variations with the permeability parameter, depending on the slip parameter and on the magnetic parameter, are tabulated systematically and shown in a graphical form. Some interesting results are obtained as limiting situations.

Keywords: Spherical shell; Viscous Fluid; Stokes Flow; Darcy's law; Magnetic Force; Hartmann number.

Observational data analysis on the late-time cosmic acceleration in non-metricity gravity with a non-minimal matter interaction

J. K. Singh¹, Sonal Aggarwal^{1*}, Shaily¹, Niraj Kumar¹

1. *Department of Mathematics, Netaji Subhas University of Technology, New Delhi-110078, India*

2. *School of Computer Science Engineering and Technology, Bennett University, Greater Noida-201310, India*

*Corresponding Author: Sonal Aggarwal (sonal.aggarwal@nsut.ac.in)

ABSTRACT

We investigate the late-time cosmic acceleration in non-metricity gravity with a non-minimal matter interaction. Using the covariant formulation, we derive the gravitational field equations for a spatially flat, homogeneous, and isotropic universe and study the physical mechanism responsible for accelerated expansion. Employing recent observational datasets including Hubble, Pantheon, Gamma-Ray Burst, Gold, and Baryon Acoustic Oscillations—we obtain constraints on the late-time cosmological parameters. Our analysis shows that the cosmic acceleration predicted by non-metricity gravity with a non-minimal matter interaction is consistent with current observations. The model yields tighter constraints on the Hubble parameter compared with the standard Λ CDM framework and other modified gravity models. The estimated values of the Hubble parameter also agree well with recent measurements. Moreover, model selection criteria, namely AIC and BIC, reveal that while the Λ CDM model provides a better fit to the Hubble dataset alone, the present model performs more effectively for the Pantheon, Gamma-Ray Burst, and combined datasets, indicating its potential as a viable alternative description of late-time cosmic acceleration.

Keywords: Alternative theory of gravitation, FLRW metric, Observational constraints, Statistical analysis.

Finite-Time Blow-Up Analysis Of a Chemotaxis-Driven Tumor Growth Model

Chandru S, Dr G. Sathishkumar*

SRM Institute Of Science And Technology Ramapuram Chennai 600082 ,India

*sathishg3srmist.edu.in

ABSTRACT

This study examines a nonlinear chemotaxis-driven tumor growth model describing the interaction between tumor cell density, chemical signaling, and nutrient concentration within a bounded spatial domain under homogeneous Neumann boundary conditions. The model incorporates key biological mechanisms including cellular proliferation, signal-mediated movement, and nutrient-dependent regulation. The primary objective is to analyze the finite-time blow-up behavior of non-negative solutions, corresponding to the rapid and uncontrolled escalation of tumor cell populations. By constructing an appropriate energy functional and employing differential inequality techniques, lower estimates for the blow-up time are derived. The analytical results reveal that when system parameters exceed certain critical thresholds, the solution becomes unbounded in finite time, demonstrating conditions under which aggressive tumor progression may occur.

Keywords: Chemotaxis; Tumor growth model; Reaction–diffusion system; Finite-time blow-up; Nonlinear PDE ; Cancer dynamics;

Evaluating GRC Models for Effective Load Frequency Control in Multi-Area Thermal Systems

Ch. Naga Sai Kalyan¹, Mohit Bajaj^{2,3,4}, Bhabasis Mohapatra^{*5}, Pankaj Borah⁶

¹EEE Department, Vasireddy Venkatadri Institute of Technology, Guntur, 522508, India

²Department of Electrical Engineering, Graphic Era (Deemed to be University), Dehradun, 248002, India

³Hourani Center for Applied Scientific Research, Al-Ahliyya Amman University, Amman, Jordan

⁴Graphic Era Hill University, Dehradun, 248002, India

⁵Department of Electrical Engineering, ITER, Siksha 'O' Anusandhan (Deemed to be University), Odisha 751030, India

⁶Department of Mathematics, Bahona College, Jorhat, Assam, India -785101

*Corresponding Author Email: mohapatrabhabasis@gmail.com

ABSTRACT

The optimal frequency regulation of a multi-area thermal power system (MATPS) is assessed in this work by enforcing the secondary controller as fuzzy-aided proportional-integral-derivative (PID). The area-1 of MATPS is prone to the loading disturbance of 10% step load to analyse its dynamical behaviour. Moreover, the fruit fly algorithm (FFA) is adopted to optimally organize the parameters of fuzzy PID that can optimally regulate the MATPS behaviour. Further, the performance of the suggested controller is compared with the other control structures, and furthermore, a comparative assessment is made to demonstrate the most significant structure of the generation rate constraint (GRC). The simulation analysis performed on the MATPS reveals that the fuzzy PID is dominant and the GRC structure of the closed loop is best suited to achieving the system's optimal performance.

Keywords: fruit fly algorithm, fuzzy PID controller, generation rate constraints, stability analysis.

Simulation of Rice Blast Epidemics: Integrating Environment and Pathogen Biology

Vaishnavi Kalirajan¹, Malinidevi Ramanathan^{2,*}

PG & Research Department of Mathematics, The Standard Fireworks Rajaratnam College for Women (Affiliated to Madurai Kamaraj University), Thiruthangal Road, Sivakasi, Tamil Nadu, India.

*Corresponding Author E-mail: malinidevi-mat@sfrcollege.edu.in

ABSTRACT

This study presents and analyzes a mathematical model designed to understand the complex dynamics of Rice Blast Disease, which is caused by the destructive fungus, *Pyricularia oryzae*. The model is formulated to incorporate environmental conditions that critically influence the pathogen's life cycle, providing a realistic framework for studying disease progression in rice fields. To obtain analytical expressions for the state variables-specifically, the rates of the canopy host, latent, infected, and recovered sites-the Homotopy and the New Homotopy Perturbation Method (NHPM) is applied. This approach facilitates the derivation of closed-form solutions that reveal the impact of individual parameters on the disease. The model yields a significant ecological prediction: increasing the senescence rate of the infected site- the rate at which infected plant tissue dies and is removed-dramatically reduces the infected plant population. This finding suggests that enhancing the natural or induced removal of severely infected host tissue is a critical mechanism for achieving a disease-free rice field and effectively controlling rice blast infection.

Keywords: Rice Blast Disease; Environmental conditions; Pathogen dynamics; Perturbation techniques.

Thermo-Fluid Stability of Viscous-Dissipative MHD Flows Subject to Hall Conductivity and Variable Suction

Pralisha Mishra¹, Itishree Nayak²

^{1,2}*Department of Mathematics, Veer Surendra Sai University of Technology, Burla-768018, Odisha, India.*

pmishraphdmath24@vssut.ac.in

ABSTRACT

This study examines the stability and transport behaviour of MHD flow influenced by variable wall suction and Hall current effects, with viscous dissipation incorporated into the energy equation. The governing momentum, thermal, and species diffusion equations are reformulated to account for Hall-induced magnetic coupling, suction-driven boundary modulation, and internal viscous heating. A stable implicit finite-difference scheme with a tridiagonal matrix algorithm is employed to solve the coupled system of PDEs. Results reveal that Hall current reduces magnetic damping through transverse current generation, while variable suction enhances near-wall stabilization and suppresses boundary-layer growth. Viscous dissipation increases thermal energy, significantly affecting heat and mass transfer rates. The combined effects offer insights for advanced MHD transport systems.

Keywords: Porous medium, Viscous dissipation, Hall current, Variable suction.

Effect of Diffusion- Thermoon Unsteady MHD Convective Flow Past an Exponentially Accelerated Vertical Plate Submerged in Porous Medium with Arbitrary Ramped Temperature

Dr. Subhrajit Sarma

Department of Mathematics, G. L. Choudhury College, Barpeta Road

E-mail: sarmasj021@gmail.com

ABSTRACT

The present investigation aims to obtain an exact solution to the problem of a free convective, viscous, radiating, chemically reacting, optically thick, non-gray, and incompressible MHD flow past an exponentially accelerated semi-infinite vertical plate. A magnetic field is applied to the transverse direction of flow. The medium of flow is porous. Dufour effect and arbitrary ramped temperature are also considered in the problem. Rosseland approximation method is used to describe the flux that appears in the energy equation. The effects of different parameters on flow and transport characteristics are discussed with the help of suitable graphs. It is noticed that velocity field and concentration field decreases but temperature field increases with an upsurge in Schmidt number. Also, Nusselt number and skin friction rise with increasing chemical reaction parameter but lowers with increasing radiation parameter. Faster consumption of chemical substances decelerates both concentration and velocity but accelerates temperature of the fluid. An interesting outcome outcome of our investigation is that both Dufour effect and arbitrary ramped temperature diminishes fluid velocity.

Keywords: Transient MHD flow, thermal radiation, non- gray, optically thick, Rosseland approximation, permeability, free convection

Nonlinear Dynamics of Sovereign Debt: The Roles of Regulation and Political Influence

Sanjay Kumar Das¹, Dr. Manmohan Das²

¹*Department of Mathematics, Handique Girls' College, Guwahati-1*

²*Department of Mathematics, Bhattadev University, Bajali*

E-mail: sanjayd269@gmail.com

ABSTRACT

In this article we present a dynamical analysis of sovereign debt that integrates regulatory interference and political pressure. We have modified the classical debt-growth model by including saturation effects, regulatory inertia, and bounded political pressures. Using Runge-Kutta 4th order integration, we have investigated the stability characteristics of the proposed financial dynamics system to understand how key parameters influence the system's long-term behaviour. The results highlight critical thresholds for regulatory strategies and political pressures, providing intuitions for debt management and economic policy design.

Keywords: Dynamical Systems; Local Stability; Global Stability; Debt-Growth.

Existence and Uniqueness Results for Fractional Integro-Differential Equations with Deviating Argument

^{1*}Satyabrot Kalita, ² Rajib Haloi

¹Department of Applied Sciences, Tezpur University, Tezpur, Assam, India

²Department of Applied Sciences, Tezpur University, Tezpur, Assam, India

[*skalita5656@gmail.com](mailto:skalita5656@gmail.com)

ABSTRACT

We investigate the existence and uniqueness results for a fractional integro-differential equation with deviating argument in a Banach space using nonlinear condition

$${}_c D^\tau v(t) = h(t, v(t), v(\phi(t, v(t)))) + \int_0^t g(t, s, v(s)) ds, t \in [0, I], I > 0, 0 < \tau < 1,$$

$$v(0) = v_0 - f(v),$$

Where, caputo fractional derivative of order τ is denoted by ${}_c D^\tau$, $h: [0, I] \times W \times W \rightarrow W$, $g: [0, I] \times [0, I] \times W \rightarrow W$ are continuous and also $f: K \rightarrow W$ is continuous. Here $(W, \|\cdot\|)$ is Banach space and $K = K([0, I], W)$ represents the Banach space consisting of all continuous functions defined on $[0, I] \rightarrow W$ equipped with the topology of uniform convergence, where the corresponding norm is represented by $\|\cdot\|_C$.

The results are obtained by using contraction mapping principle and Krasnoselskii's fixed point theorem.

Keywords: Fractional integro-differential equations, Krasnoselskii's fixed point theorem, contraction principle, Arzela Ascoli theorem.

Stability and bifurcations in an ODE model of financial market volatility

Animesh Phukan^{1*}

¹Department of Mathematics, Gauhati University, Guwahati 781014, Assam, India

*author of correspondence: phukananimesh123@gmail.com

ABSTRACT

In this paper, we study the inception of chaotic behavior in market volatility by defining and analyzing a system of nonlinear ordinary differential equations (ODEs). We first develop an ODE model that embodies the salient features of the volatility dynamics. The existence and uniqueness of solutions are investigated by employing the ODE theory to make sure the system is well posed. Stability analysis is performed by linearizing the equilibrium points and considering their local dynamics. To investigate how qualitative changes may occur as a result of changing parameters, we perform a study of bifurcations and identify transitions from stable to oscillatory and chaotic solutions. The joint analysis yields information on when the volatility of a market is likely to display intricate and chaotic patterns, providing an explanation of the nonlinear processes that contribute to financial turmoil.

Keywords: Mathematical model; Stability; Bifurcation; Financial market.

Time-Changed Fractional Poisson Processes Driven by Tempered Version of the Lévy Subordinators

Shilpa

Department of Mathematics and Statistics, Central University of Punjab, Bathinda, India

Corresponding author email id: shilpa17garg@gmail.com

ABSTRACT

The fractional Poisson process has emerged as a versatile stochastic framework for characterizing random event patterns over time. Owing to its flexible structure, it plays a significant role in diverse domains such as telecommunications, traffic and transport systems, queueing models, insurance risk analysis, physical sciences, and reliability engineering. Lévy subordination provides a powerful framework for generating new stochastic processes by introducing a Lévy process as a random time change. Recent years have seen growing interest in subordination-based extensions of the fractional Poisson process, as these techniques address several of its inherent limitations. By incorporating jumps and heavy-tailed features, Lévy subordination enables more realistic modelling of complex systems encountered in finance, physics, hydrology, and related fields, thereby enhancing both the flexibility and accuracy of probabilistic models. In this paper, we introduce a time-changed version of the fractional Poisson process obtained by subordinating it with an independent tempered Mittag-Leffler subordinator. We investigate its distributional properties, including the probability mass function, Laplace transform, mean, variance, covariance, and first passage time. Connections to partial differential equations are established, along with the asymptotic behaviour of fractional moments and the long-range dependence feature. The process exhibits overdispersion, making it suitable for modelling scattered data in complex real-world systems.

Keywords: fractional Poisson process, Lévy subordination, tempered Mittag-Leffler subordinator, asymptotic behaviour.

Mathematical framework that pioneered the concept of Black Hole: Schwarzschild and Kerr Metrics

^{1*} Nungsangtola

¹Department of Physics, Fazl Ali College, Mokokchung - 798601, Nagaland

**Corresponding Author: nungsangtola20@gmail.com*

ABSTRACT

Einstein Field Equations represented by a set of mathematical equations that skillfully elucidates the underlying relationship between space time curvature and mass-energy distribution in the universe. Schwarzschild metrics derived a century ago is one of the well-known exact solutions of Einstein Field Equation. The metrics can be interpreted as an external gravitational field due to a spherically symmetric mass. The solution gives a satisfactory explanation of curvature of space time around static stars and in describing the simplest model of black hole. Despite the widespread utility and acceptance, the conventional Schwarzschild solution has certain limitations. Kerr metrics is another solution of the Einstein field equation that explain the nature of spacetime around a massive rotating body. Thus, Kerr metrics can be interpreted as external gravitational field due to massive rotating bodies and black holes. Kerr black hole is defined by its axially symmetric nature. The metrics becomes distinctive only for precise values of rotational momentum and multipole moment. Both the metrics predicts the existence of black hole but with very different and distinct physical characteristics. One of the pressing challenges in general relativity is seeking accurate analytical solution of Einstein Field Equations. With Schwarzschild and Kerr metrics as the theoretical backbone, various modified theories have been established that are useful in understanding modern black hole physics and astrophysics today.

Keywords: Einstein field equation, Schwarzschild metric, Kerr metrics, black hole.

Effect of parabolically varying thickness on the free transverse vibration of fully clamped non-homogeneous rectangular plate

Dr. Renu Saini

Assistant Professor, Department of Mathematics, Maharaja Agrasen College, University of Delhi

ABSTRACT

In the present paper, the free transverse vibrations of non-homogeneous CCCC rectangular plate with bidirectional thickness variation have been analysed. The non-homogeneity of the plate material is assumed to arise due to the exponential variations in Young's modulus and density of the plate material with the in-plane coordinates while the parabolic thickness variations is taken along two concurrent edges of the plate. The energy principle has been used to derive the equation of motion for such a model. Governing partial differential equation has been reduced to eigenvalue problem using generalized differential quadrature method. The lowest three eigenvalues of the corresponding eigenvalue problems have been considered as the first three natural frequencies. Numerical computations have been carried out for CCCC boundary condition i.e. fully clamped plate using MATLAB. The effect of various parameter on the frequency has been analysed and presented in graphical form. A comparison of results has been made.

Exploring Anti-Inflammatory Potential of *Momordica cymbalaria* Root Phytochemicals Through *In Silico* Studies

M. Nishandhini

*Assistant Professor, Department of Bioinformatics, Vels Institute of Science, Technology & Advanced
Studies (VISTAS), Chennai, Pallavaram*

ABSTRACT

Medicinal plants represent a rich reservoir of bioactive phytochemicals with significant therapeutic potential. *Momordica cymbalaria* (Roxb.) has been traditionally recognized for its anti-inflammatory and medicinal properties, yet its root-derived metabolites remain underexplored at the molecular level. In the present study, Phytochemical compounds from the methanolic extracts of the roots obtained from **in vivo grown plants of *M. cymbalaria*** were subjected to ***in silico* analyses** to evaluate their drug-like behavior and therapeutic relevance. Bioactive compounds identified from GC–MS/LC–MS data were retrieved from public chemical repositories and screened against selected protein targets associated with inflammation and arthritis. Molecular docking studies were performed to predict the binding affinity and interaction patterns of the phytoconstituents with key targets, while ADMET and drug-likeness evaluations were carried out using established computational tools. The results revealed that several root-derived compounds demonstrated strong binding energies, favourable hydrogen bonding interactions, and compliance with pharmacokinetic properties, suggesting their potential as lead molecules for anti-inflammatory or anti-arthritic drug development. This integrated phytochemical and computational approach highlights the therapeutic promise of *M. cymbalaria* root metabolites and provides a scientific basis for future experimental validation and drug discovery efforts.

Keywords: anti-inflammatory, binding affinity, pharmacokinetic properties and lead molecules

A Review on Understanding Behaviour of Seismic Wave Propagation in Different Media

Kanika Chadha¹, Dinesh Kumar², Kuldip Singh³, Naveen Kumar⁴

Department of Mathematics, Chaudhary Bansi Lal University, Bhiwani – 127031, Haryana (India)

Email: kanikachadha655@gmail.com,

ABSTRACT

Propagation of wave is fundamental phenomenon in study of the seismic activity, crucial in understanding internal structure of the earth and its response during earthquakes. Propagation of seismic waves involving body waves, surface waves like Rayleigh wave and Love wave have been considered in different models. This review explores the complex interaction between seismic waves focusing on how they propagate through earth's different layers and their respective impacts on ground motion. Various models and their corresponding boundary conditions has been reviewed in present work.

Keywords: Seismic Waves, Wave Propagation, Layered Media, Half space.

Affects of Mathematics Anxiety on Mathematics Achievement of class-x girl students' of Dhubri District, Assam.

Afruza Begum¹ Samiran Das²,

*¹ Research Scholar, Department of Mathematics, Central Institute of Technology
Kokrajhar, Assam, India*

² Department of Mathematics, Central Institute of Technology Kokrajhar, Assam, India

ABSTRACT

The purpose of the present study was to investigate the influence of mathematics anxiety on mathematics achievement of class-x girl students' of Dhubri district, Assam. This study selected 375 class-x girl students' as sample by using simple random sampling and Cochran's sample detection formula from the six educational blocks of Dhubri district. By using a reliable and valid questionnaire, the primary data collected from the student and the secondary data collected from the District Education Office (DEO) Dhubri in the form of class-ix board exam result of those particular class-x girl students'. Various statistical technique like description sampling, t-test, and one way ANOVA has been used to analyze this investigated result by using Statistical Package for the Social Sciences (SPSS). It has been found that the mean difference among the rural and urban class-x girl students' mathematics performance in their previous class-ix examination, by using t-test is not significant. On the other hand the ANOVA test showed the significant difference in mathematics achievement based on the questionnaire of the rural and urban class-x girl students' mathematics anxiety. Thus mathematics anxiety, affects the girl students' mathematics performance. Hence, the concern teachers should strive to understand the mathematics anxiety and improve his/her teaching strategies to overcome the mathematical anxiety of the girl students'.

Keyword:-Mathematics anxiety, Achievement, Teaching strategies.

A study on two compact and precise potential energy functions for diatomic molecules

Nirvik Masanta¹ and Sujay Kumar Nayek²

¹*Department of Mathematics, Sadhu Ramchand Murmu University of Jhargram, Jhargram-721514, West Bengal, India*

²*Department of Mathematics, Netaji Nagar Day College, Kolkata 700092, West Bengal, India*

Corresponding Author: sujay_nayek@yahoo.com

ABSTRACT

A potential energy function (PEF) for diatomic molecules contains some parameters. Molecular spectroscopic data are used to find out the values of these parameters in terms of the equilibrium radius r_e , dissociation energy D_e and the force constant k . The study of diatomic molecules embedded with a potential energy function is of the utmost importance. It helps us in acquiring knowledge on the energy spectra of various eigenstates of a diatomic molecule and other thermodynamic properties of it. The selection process of the functional form of an interaction potential model is a complex task and crucial because it directly involves determining the numerical stability, transferability, physical accuracy, and vibrational-rotational energy levels of diatomic molecules. Choice of inappropriate functional form of PEF means every calculation related to spectroscopic become inaccurate and unreliable, distortion of thermodynamic properties, or break down of dynamical predictions. Here, in the present article, our objective is to discuss some important information regarding two PEFs for diatomic molecules, namely, Kratzer potential and Morse potential, which give precise bound state energy eigenvalue solutions to the Schrodinger equation.

Keywords: potential energy function, diatomic molecule, Kratzer potential, Morse potential

Optimization techniques in Operations research and Data science

Salla Sravanthi¹, B. Chandrakala²

Department of Mathematics, Bankatlal Badruka College for Information Technology, Kachiguda, Hyderabad, India *bandarisravanthi1989@gmail.com

ABSTRACT

Optimization techniques play a pivotal role in both **Operational Research (OR)** and **Data Science**, serving as the foundation for decision-making and predictive modelling. In OR, optimization focuses on identifying the most efficient solutions under given constraints, commonly applied in resource allocation, scheduling, and logistics. Techniques such as **Linear Programming**, **Integer Programming**, **Dynamic Programming**, and **Metaheuristics** are widely used to solve complex operational problems. Conversely, in Data Science, optimization is integral to model training and performance enhancement, where methods like **Gradient Descent**, **Convex Optimization**, and **Hyperparameter Tuning** are employed to minimize error functions and improve predictive accuracy. While OR emphasizes constraint-based decision-making for operational efficiency, Data Science leverages optimization for learning algorithms and data-driven insights. This paper explores the synergy between these domains, highlighting their methodologies, applications, and the growing importance of hybrid approaches in solving real-world challenges.

Keywords: Linear Programming, Dynamic Programming, Gradient, Convex Optimization .

The Intelligent API Gateway: A Proactive Framework for Automated Security, Usability, and Management in IoT Ecosystems

Ms Amrutha Kolhar¹, Dr Sridevi²

Department of Computer Science, Karnatak University Dharwad, India

Corresponding author E-mail: amruthakolhar@kud.ac.in

ABSTRACT

The rapid expansion of APIs in IoT application packages presents serious security, usability, and lifecycle management issues. Because they lack the intelligence to handle dynamic endpoints or proactively resolve vulnerabilities, traditional API gateways function reactively. In order to automate security and administration inside IoT ecosystems, this article presents a revolutionary framework called the Intelligent API Gateway. Four key features are integrated into our proactive model: dynamic re-authentication of vulnerable endpoints; continuous authentication optimality and usability testing; automated API discovery and inventory to maintain a real-time census of endpoints; and a context-aware recommendation engine to direct developers toward secure usage practices. Through the implementation of a proof-of-concept, we show how effective the framework is at independently locating and protecting API endpoints while giving users useful information. The findings show that IoT apps have a stronger security posture and a considerable decrease in manual oversight. A fundamental change from reactive API administration to an intelligent, automated, and comprehensive paradigm is provided by this study.

Keywords: Intelligent API Gateway; IoT Security; API Management; Automated Authentication

FUNDAMENTAL RESULTS IN THE THEORY OF HYBRID DIFFERENTIAL EQUATIONS WITH SECOND TYPE LINEAR PERTURBATIONS AND DEVIATED ARGUMENT

^{1*}Monuj Gogoi, ²Rajib Haloi

^{1,2}Department of Applied Sciences, Tezpur University, Sonitpur, Assam, India

[*mgogoi096@gmail.com](mailto:mgogoi096@gmail.com)

ABSTRACT

Quadratic perturbations of nonlinear differential equations have attained a lot of interest recently; these differential equations are known as hybrid differential equations. In this work, we investigate the existence of hybrid differential equations with linear perturbations of second type and deviated arguments in a Banach space,

$$\frac{d}{dt}(x(t) - f(t, x(t), x(\varphi(t, x(t)))) = g(t, x(t)), t \in K,$$

$$x(t_0) = x_0 \in \mathbb{R},$$

where, $f: K \times \mathbb{R} \times \mathbb{R} \rightarrow \mathbb{R}$, $g: K \times \mathbb{R} \rightarrow \mathbb{R}$ and $\varphi: K \times \mathbb{R} \rightarrow K$ are continuous and $K = [t_0, t_0 + a)$ be a bounded interval in \mathbb{R} .

Keywords: Hybrid differential equation, existence theorem, deviated argument.

Numerical Simulation of Casson Fluid Flow Over a Radiatively Heated Symmetric Wedge

Saswati Purkayastha

Department of Mathematics, Rangapara College, Rangapara-784505, Assam, India

Email: saswati1001@gmail.com

This study presents a detailed computational analysis of boundary layer forced convection flow with heat transfer over a symmetric wedge, considering a non-Newtonian Casson fluid subjected to thermal radiation effects. The governing partial differential equations describing the flow and thermal fields are transformed into their non-dimensional counterparts using appropriate similarity transformations. The resulting boundary value problem is solved numerically using the MATLAB built-in BVP4C algorithm. The influences of key dimensionless parameters on velocity and temperature distributions are examined and illustrated through comprehensive graphical representations. Furthermore, numerical values of the skinfriction coefficient and Nusselt number are evaluated to assess the impact of various physical parameters on surface shear stress and heat transfer rates. The findings reveal significant parameter-dependent variations in the flow and thermal characteristics, emphasizing the relevance of the present investigation to a wide range of industrial and engineering processes involving non-Newtonian fluid behaviour and radiative heat transfer.

Keywords: Symmetric wedge, Casson fluid, MATLAB bvp4C, radiation.

Cosmological Dynamics and Parameter Optimality of the Interacting Umami Chaplygin Gas Model

Trishit Banerjee¹, Atreyee Biswas^{2,*}

¹*Department of Applied Mathematics, Maulana Abul Kalam Azad University of Technology
Haringhata, West Bengal 741249, India*

²*Department of Applied Mathematics, Maulana Abul Kalam Azad University of Technology
Haringhata, West Bengal 741249, India*

²Department, Organisation, Address, City, Country

*Corresponding Author E-mail: trishit23@gmail.com

ABSTRACT

Unified dark fluid descriptions have emerged as promising alternatives to the standard Λ CDM cosmology, particularly in light of strong observational evidence for cosmic acceleration obtained from Type Ia supernovae [3, 4]. Among unified models, the Umami Chaplygin Gas (UCG) introduced by Lazkoz et al.[1] generalizes the Chaplygin family through a nonlinear equation of state,

$$p_d = -\frac{\rho_d}{\alpha_0 + \beta\rho_d^2},$$

While earlier analyses largely relied on non-interacting formulations or on binomial expansions of the form $(\alpha_0 + \beta\rho_d^2)^{-1}$, the present work performs a fully non-perturbative investigation of an *interacting* UCG scenario. A **fundamental novelty** of this work lies in the simultaneous inclusion of (i) a dark-sector interaction and (ii) a completely approximation-free numerical treatment of the nonlinear UCG

dynamics that ensures correct behaviour in the intermediate-density regime, where analytic approximations are known to break down.

The interaction is modeled as: $Q = 3\lambda H\rho_d$,

which enables a continuous exchange of energy between dark energy and dark matter. The background evolution is governed exactly by

$$\begin{aligned}\frac{d\rho_d}{dN} &= -3\left(1 - \lambda - \frac{1}{\alpha_0 + \beta\rho_d^2}\right)\rho_d, \\ \frac{d\rho_m}{dN} &= -3\rho_m + 3\lambda\rho_d,\end{aligned}$$

with $N=\ln a$ and the Hubble parameter reconstructed through

$$H(z) = \sqrt{\frac{\rho_d(z) + \rho_m(z)}{3}}.$$

A further contribution of this work is the incorporation of a multi-probe observational analysis with 27 Hubble measurements[6], Union2.1 SNe Ia sample [5], and an extensive set of Baryon Acoustic Oscillation (BAO) measurements. The analysis incorporates all commonly reported BAO observables, including

$$\frac{r_s}{D_V(z)}, \quad \frac{D_V(z) r_{s,\text{fid}}}{r_s}, \quad \frac{D_A(z)}{r_s}, \quad \frac{D_H(z)}{r_s}, \quad H(z)r_s$$

The full likelihood is minimized using a hybrid global–local optimization pipeline.

For the interacting UCG model, we obtain the best-fit parameter set

$$H_0 = 66.83, \quad \Omega_{d0} = 0.66, \quad \lambda = 0.2607, \quad \alpha_0 = 5.101, \quad \beta = 0.746,$$

corresponding to the derived Umami parameters

$$\omega = 1/|\alpha_0| = 0.196, \quad A = 1/|\beta| = 1.340.$$

The combined dataset yields total chi-square value of 722.55 with chi-square/dof = 1.16 demonstrating that the interacting UCG model provides an excellent fit to low- and intermediate-redshift data.

Keywords: Interacting Dark Energy; Umami Chaplygin Gas; Cosmological Dynamics; Parameter Estimation.

ANALYSIS OF ROLL HYDRODYNAMIC COEFFICIENTS BY A FLOATING CYLINDER IN PRESENCE OF A BARRIER AT THE BOTTOM IN THE CHANNEL FLOW OF FINITE WIDTH

Pankaj Borah¹, Nijara Konch^{2,*}, Mukunda Madhab Borah³

Department of Mathematics, Bahona College, Jorhat, Assam

Department of Mathematics, D.C.B. Girls' College, Jorhat, Assam

Department of Physics, D.C.B. Girls' College, Jorhat, Assam

ABSTRACT

In this paper, our study relates to the roll motion by a vertical floating cylinder in the presence of a coaxial cylindrical obstacle at the bottom in the channel of finite width. On consideration of a vertical hollow cylinder that allows in motion of small roll oscillations in the presence of a cylindrical barrier plate in the channel. The technique towards the solution of the problem of roll radiation is to be solved under the linear water wave and potential theory. The whole fluid region can be decomposed into three regions and the corresponding boundary-value problems are developed in each identified region. The multipole of channel, variables of separation, and matched eigenfunction expansion tools are applied to find the solution to the respective formulated boundary value problems. The obtained solutions are allowed to find the radiation forces in the form of added mass and damping coefficients acting on a proposed device. In order to take care of the various effects of such forces on the device, a set of various results of added mass and damping coefficients are presented with different parameters of the device. All the results of added mass and damping coefficients are presented graphically along with various parameters of the device. The remarkable influence of the width of the walls of the channel, radius, and drafts of the cylindrical structure are observed on the added mass and damping coefficients

Keywords: Radiation, Channel Multipole, Added Mass, Damping Coefficient, Roll Motion

Cosmological Dynamics of Sharma–Mittal HDE in Brans–Dicke Gravity

R. Sathibabu & K.V.S. Sireesha

Department of Mathematics and Statistics, GSS, GITAM Deemed to be University, Visakhapatnam, India.

ABSTRACT

This work investigates the Sharma–Mittal Holographic Dark Energy (SMHDE) model within the framework of Brans–Dicke (BD) theory by considering a Bianchi type (BT)-III anisotropic space-time. The Universe is modelled with two components: pressure-less matter and SMHDE. We examine the dynamical behaviour of key cosmological parameters, including the deceleration parameter, Equation of state (EoS) parameter, state finder diagnostics, skewness, scalar field, and squared speed of sound, with respect to cosmic time. The results show that the Universe undergoes a smooth transition from an early decelerated phase to a late-time accelerated expansion, with the EoS parameter dynamically evolving from quintessence-like behaviour to phantom crossing. The scalar field and matter density remain negligible at early times but grow sharply at late epochs, highlighting the role of Sharma–Mittal entropy corrections. Comparative analysis with the Λ CDM model reveals that, while SMHDE reproduces the essential late-time acceleration of Λ CDM, it provides a richer phenomenology through dynamical dark energy evolution, phantom divide crossing, and entropy-driven corrections. These findings demonstrate that the SMHDE model in BD gravity offers an observationally consistent and theoretically extended alternative to the standard Λ CDM cosmology. We further analyze the classical stability or instability of the proposed models by examining the squared sound speed parameter.

Key Words: Bianchi type-III, Sharma Mittal holographic dark energy, Brans-Dicke theory, Dark energy, Cosmological dynamics.

MATHEMATICAL APPROACHES TO CLIMATE CHANGE AND ENVIRONMENTAL SYSTEMS

Vasanthapriya R, Berlin A

Department of ECE, Jansons Institute of Technology, Karumathampatti, Coimbatore, India.

vasanthapriya359@gmail.com

ABSTRACT

Climate change is now a major concern across the world, and its effects are becoming clearer every year. We can see this through rising temperatures, unpredictable weather, and noticeable changes in natural ecosystems. Since climate change involves many different environmental processes happening at the same time, mathematical methods are useful for studying it in a structured way. These methods help organize and analyze large climate datasets, making it easier to identify patterns. Techniques such as differential equations, numerical simulation, and statistical forecasting are often used to understand changes in greenhouse gas levels, rainfall patterns, sea levels, and extreme climate events. They also help scientists estimate future conditions and explore possible solutions. Environmental systems are complex and sometimes behave in unexpected ways. Approaches like system dynamics, optimization techniques, and machine learning help provide more accurate results in areas such as water resource analysis, pollution tracking, and biodiversity research. With the increasing availability of satellite and sensor-based climate data, mathematical modelling has become even more important for planning and decision-making. Overall, mathematical approaches play an important role in understanding climate change and supporting sustainable environmental planning.

Keywords: Climate change, Mathematical modelling, Environmental systems, Simulation.

Analysis of a Finite-Capacity Queue with Reverse Balking and Position-Dependent Reneging

Girin Saikia¹

Darrang College (Autonomous), Tezpur – 784001, Assam, India

¹girin.stats@gmail.com

ABSTRACT

This study looks at a queuing system that has limited space, several servers, and customers who may behave impatiently in different ways. We find the stationary probabilities of how many customers are in the system at any time. Using these probabilities, we calculate important measures such as the average number of customers in the system and the average queue length. In this model, two types of impatience are included: reverse balking, where customers are more likely to join when the queue looks shorter, and position-dependent reneging (PDR), where customers may leave the queue depending on how far they are from service. A numerical example is also given to show how the model works in practice, and several additional performance measures are computed. These results help us understand how different forms of impatience affect the queue, such as how often customers leave, how crowded the system becomes, and how efficiently the servers can work. Overall, the study provides a simple way to measure and explain the effects of impatience in real-life service situations, such as hospitals, banks, call centres, or ticket counters, where customers do not always wait patiently.

Mathematics Subject Classification:(2000)MSC 60K25, 90B22

Key words: Performance Measures, Position-Dependent Reneging, Queuing System, Reverse Balking, Sensitivity Analysis

The Novel Harmonic Soft Decision Algorithm for Suitable Institutions and Programme Selection in Higher Studies for Students

ANSARI. A¹, RAJENDRAN. K^{2*}

*Research Scholar¹, Associate Professor², Department of Mathematics,
Vels Institute of Science, Technology & Advanced Studies (VISTAS), Pallavaram, Chennai,
Tamil Nadu, India^{1,2*}.*
Email: ansari27497@gmail.com¹

ABSTRACT

Graduate study is the origin of a student's career. Decision-making on choosing an adoptable graduate programme and institution for a student is a complex situation for every student and their parent. Soft set reduces uncertainty in each decision-making problem. This paper introduces a novel, innovative harmonic soft set decision algorithm (HS-DA), which is distinct from the traditional soft set decision algorithms, based on weights, ranks, a matrix, and fuzzy logic. HS-DA was developed by combining a harmonic univalent function and soft set concepts. It is simple and easy to explain that the interpretability of the harmonic soft decision algorithm is high for manual and algorithmic computations. A harmonic function increases the unbiasedness of the analysis process. Univalent condition breaks the tie for the optimal decision. Also, illustrative examples and Python code for the HS-DA are given in the paper.

Keywords: Harmonic; univalent; soft set; decision.

Computational Study of Emden-Fowler Equations: A Genocchi wavelet Approach

Pappu Kumar^{1*}, Jay Kishore Sahani²

¹University Department of Mathematics, Jai Prakash University, Chapra, Bihar, India

²Department of Mathematics, D.A.V. PG College, Siwan, JPU, Bihar, India

*Presenting Author E-mail: pkumar.rs.apm12@itbhu.ac.in

ABSTRACT

The Emden-Fowler equation is an important problem in spherical astronomy, mathematical physics such as stellar structure, thermal explosions, thermionic currents, isothermal gas sphere and thermal behavior of spherical cloud of gas. In this approach, using Genocchi wavelet truncated expansion, our governing Emden-Fowler equation has been converted into the set of algebraic equations which can be further solved by Newton-Raphson method. The equation has been analysed numerically with the help of test problems under the homogeneous and nonhomogeneous cases. The desired level of accuracy can be achieved by taking only small number of basis points. The proposed method has proved numerically that it is quite efficient and even produces better results as compared to other earlier published studies.

Keywords: Emden-Fowler Equation, Genocchi Wavelet, Absolute Error.

Holographic Reconstruction of Scalar Field Dark Energy Model in Anisotropic Bianchi Type-II Space-Time

Tazmin Sultana¹

Department of Mathematics, Eastern Karbi Anglong College, Sarihajan, Assam (India)

Email: tazmingu@gmail.com

ABSTRACT

In this paper, we study the correspondence between the quintessence energy density with the holographic dark energy in anisotropic Bianchi type II cosmological space-time. This correspondence allows reconstructing the quintessence potential and the dynamics of scalar field model, which describes the accelerated expansion of the Universe. The exact solutions to the corresponding Einstein's field equations are obtained for variable deceleration parameter.

Keywords: Holographic dark energy, Quintessence, Bianchi type-II space-time.

Length-weight relationship, condition factor, gonadosomatic index, size at first sexual maturity, spawning season, and fecundity of *Cyprinion semiplotum* (Cyprinidae) in Dikrong River, Arunachal Pradesh

Rashmi Dutta^{1*}, Debanshu Narayan Das²

¹Department of Zoology, Gargaon College, Simaluguri, Sivasagar, Assam

² Department of Zoology, Rajiv Gandhi University, Doimukh, Itanagar, Arunachal Pradesh

*Email of Corresponding author: rashmidutta07@gmail.com

ABSTRACT

The present study describes the length-weight relationships (LWRs), condition factor (K), size at first maturity, spawning season, sex ratio, and fecundity of the Assamese King fish *Cyprinion semiplotum* (McClelland, 1839) from the Dikrong River, Arunachal Pradesh. A total of 393 samples (157 females and 236 males), ranging from 122.40 to 285.20 mm for males, that in females from 142.02 to 300.42 mm, and from 35.00 to 118.30 mm in total length for juveniles. The length-weight relationship (LWRs) study showed positive allometric growth (3.043) with a regression coefficient (r^2) of 0.9421. The results of the study indicated that the population had a significantly higher proportion of females than males (χ^2 test, $p < 0.05$). Using a logistic regression, it was determined that the standard lengths at 50% maturity were 159.0 mm for males and 167.5 mm for females. Based on the monthly variations in the gonadosomatic index, *C. semiplotum* spawned over a long period from June to September, with a peak in August. According to the size distribution of oocytes, *C. Semiplotum* appeared to show a high degree of spawning synchronicity. The fecundity of *C. semiplotum* increased linearly with standard length and body weight, but showed no significant correlation with ovary weight. The mean fecundity of 12040.57 eggs and the mean relative fecundity of 60.15 eggs per gram of body weight suggest that *C. semiplotum* might be especially vulnerable to exploitation. The current study will contribute to the conservation of this economically important species while enhancing fish stock analysis for appropriate management.

Key words: *Cyprinion semiplotum*, Length-weight relationship, fecundity, length at first maturity

IMAGE DENOISING USING A HYBRID VCNS–CNN–NMGPR FRAMEWORK WITH MULTI-OBJECTIVE OPTIMIZATION

Pratibha Karki

Department of Statistics, Tripura University

Corresponding Email: pratibha.karki02@gmail.com

ABSTRACT

Image denoising remains a fundamental yet challenging problem in image restoration, especially under high noise levels where classical smoothing methods overly blur structural details and deep learning models introduce residual artifacts. To address these limitations, this paper proposes a novel hybrid denoising framework that integrates a pretrained Convolutional Neural Network (CNN) with a patch-based Neighborhood Multidimensional Gaussian Process Regression (NMGPR) model optimized using Variable Constrained Neighborhood Search (VCNS) Algorithm. The CNN performs initial coarse denoising and texture recovery, while VCNS adaptively tunes the NMGPR hyperparameters (patch size, stride, neighbourhood radius, and covariance kernel weights) together with a blending coefficient (η) between CNN and GPR outputs. Experimental evaluations on standard benchmark images demonstrate that the proposed VCNS–CNN–NMGPR model significantly outperforms state-of-the-art denoising algorithms including NL-means, Classical GPR, BLS-GSM, DnCNN, and NMGPR approach. Results show substantial improvements in PSNR and SSIM with consistently lower NMSE, confirming the efficiency of the proposed algorithm over the existing algorithm. Overall, the proposed hybrid VCNS–CNN–NMGPR framework establishes a robust foundation for next-generation denoising methodologies, demonstrating strong potential for further extensions into real-time, large-scale, and domain-specific imaging applications.

Keywords: Optimization, Variable Neighborhood Search, Gaussian Process Regression, Convolutional Neural Network.

Hybrid Cryptographic Scheme Leveraging Bitwise AND Operations for Enhanced Security

Suraj Pal*, Anu Kathuria

*Department of Computer Engineering, The Technological Institute of Textile & Sciences (TIT&S),
Bhiwani, Haryana, India*

*Department of Mathematics, The Technological Institute of Textile & Sciences (TIT&S), Bhiwani,
Haryana, India*

*Corresponding Author Email: tanwarsuraj051@gmail.com

ABSTRACT

Cryptography is the art of hiding secured/confidential information from others for the sake of privacy. The rapid evolution of cyber threats necessitates the development of robust cryptographic techniques capable of safeguarding sensitive information. Here in this study, we propose a novel approach based on the concept of “Number Theory” and the Bitwise AND operator to enhance security while maintaining computational efficiency. We present a detailed algorithm design and analysis with symmetric encryption and asymmetric encryption. It mainly outlines the key methods used in the proposed hybrid cryptographic scheme employing the Bitwise AND operator.

Keywords: Hybrid Cryptography; Bitwise AND Operator; Key Mixing.

Beyond the Traditional RSA: Design and Implementation of a Mathematical Attack Resistant Lightweight Modified RSA Algorithm For IOT Data Confidentiality

Partha Saker^{1*}, Ajoy Kumar Khan², Rohan Debnath³, Zunaid Ahammed⁴

*Department of Computer Science and Engineering, Narula Institute of Technology Under MAKAUT,
Kolkata, India^{1,3,4}*

Department of Computer Engineering, Mizoram University, Aizawl, India²

[*pscsedu1989@gmail.com](mailto:pscsedu1989@gmail.com)¹

ABSTRACT

The internet of things make connection a many small devices to the internet but there is a limited battery and processing power which makes it hard to use strong encryption for data confidentiality. The RSA algorithm is a well-known method or a technique for securing data but its standard form is to very slow and energy consuming for tiny IOT devices. It can be broken by powerful mathematical attacks which factorize the large numbers. This paper proposes a new and modified RSA algorithm which designed specifically for IOT environment. Our designed algorithm makes it lightweight which uses less memory and processor power and more energy efficient to extend the battery life of the particular devices. The modification strengthens the algorithm's core to resist common mathematical attacks, particularly integer factorization. The results show that significantly reduces computational time and energy consumption which compared to standard RSA while maintaining a high level of security to ensure the data confidentiality. This provides a practical and Secure solution for protecting the sensitive information in the resource-constrained IOT applications.

Keywords: Lightweight Cryptography, IOT Security, RSA Modification, Mathematical Attack Resistance.

Design and Implementation of a cryptanalytically strengthened RSA Algorithm for IOT Data Confidentiality

Amit Kumar Bag^{1*}, Ajoy Kumar Khan²,

Department of Computer Engineering Mizoram University, Aizawl, India^{1,2}

**amitbag7689@gmail.com¹*

ABSTRACT

The widespread use of Internet of Things (IOT) devices having the limited power and processing ability creates a major challenge for data security. In the design and practical implementation of the modified algorithm, this paper presents to make it significantly more secure. The approach of this paper alters the core mathematical structure of RSA to make it more resistant to common attacks without adding excessive computational burden. A prototype of this algorithm for resource-constrained devices has been proposed to demonstrate the result for strengthened version that successfully maintains a high level of data confidentiality while operating efficiently within the strict limit of IOT devices. The work provides a visible pathway to deploying to robust for more long-term security for sensitive data across the IOT networks.

Keywords: IOT Security, Cryptanalytic Resistance, Confidentiality Protocol, Resource-Constrained Devices.

An Enhanced DGJ Iterative Method for Analysis and Accurate Numerical Simulation of Higher Order Time-Fractional KdV Equations

Keerthika V

Research Scholar, Department of Mathematics, Vellalar College for Women, Erode-638012, Tamil Nadu, India.

ABSTRACT

Nonlinear fractional partial differential equations (FPDEs) with higher-order spatial derivatives, such as the Sawada–Kotera–Ito, Lax’s KdV, Kaup–Kupershmidt, and Caudrey Dodd–Gibbon equations, provide accurate models for complex nonlinear wave phenomena but are notoriously difficult to solve due to strong nonlinearity and non-local Caputo fractional derivatives. This work presents a parameter-free enhanced iterative scheme built on a modified Daftardar Gejji and Jafari (DGJ) algorithm for obtaining rapidly convergent series solutions of such high order time-fractional KdV-type equations. The proposed method avoids auxiliary parameters, special transforms, and perturbation assumptions, and instead uses contraction mapping principles to construct the solution directly in an iterative manner with low computational overhead. Applications to four distinct higher-order time-fractional KdV equations show that the obtained series solutions match closely with known exact or benchmark analytical solutions for different fractional orders, confirming the accuracy and reliability of the technique. A rigorous analytical framework is developed to prove existence and uniqueness of the solutions, establish convergence criteria, and verify Ulam–Hyers stability, ensuring robustness with respect to small perturbations in initial data. Furthermore, graphical simulations of the evolving wave profiles highlight the influence of the fractional order α on the propagation and deformation of nonlinear waves.

Dispersion characteristics of self-gravitating complex plasmas with generalized polarization force between negative dust and Cairns ions

Himangshu Kalita¹, Karabi Devi²

¹ *Department of Mathematics, Dibrugarh University, Dibrugarh–786004, Assam, India
Email: himangshu.kalita@dibru.ac.in*

² *Department of Mathematics, Golaghat Commerce College, Golaghat–785621, Assam, India
Email: dkarabi0@gmail.com*

ABSTRACT

The linear propagation of dust-acoustic waves in a nonthermal self-gravitating complex plasma is investigated in the presence of a generalized polarization force between negative dust and Cairns ions. The plasma model comprises negatively charged dust grains, nonthermal Cairns-distributed ions, and Cairns–Tsallis hybrid electrons, representative of astrophysical star forming dust molecular clouds. Using the fluid description for the dust component coupled with Poisson’s equation and appropriate nonthermal equilibrium distributions for the light species, the governing equations are linearized about a homogeneous equilibrium to obtain a gravitationally modified dispersion relation. The effects of the polarization force on wave dynamics are analyzed through the dependence of the wave frequency on the wave number. The results show that polarization effects play a significant role in modifying the dispersion properties and frequency spectrum of dust-acoustic waves. This study provides fundamental insight into polarization-induced wave behavior in nonthermal self-gravitating dusty plasmas and establishes a baseline for future nonlinear and gravitational wave investigations in astrophysical environments.

Keywords: Dust-acoustic waves, Nonthermal plasma, Cairns distribution, Cairns–Tsallis electrons, Polarization force, Dispersion relation.

3DOFPID Controller for the Stability of Multi Area Realistic Hydro Thermal Power System with the HVDC Line

Ch. Naga Sai Kalyan¹, Mohit Bajaj^{2,3,4}, Bhabasis Mohapatra^{*5}, Pankaj Borah⁶

¹*EEE Department, Vasireddy Venkatadri Institute of Technology, Guntur, 522508, India*

²*Department of Electrical Engineering, Graphic Era (Deemed to be University), Dehradun, 248002, India*

³*Hourani Center for Applied Scientific Research, Al-Ahliyya Amman University, Amman, Jordan*

⁴*Graphic Era Hill University, Dehradun, 248002, India*

⁵*Department of Electrical Engineering, ITER, Siksha 'O' Anusandhan (Deemed to be University), Odisha 751030, India*

⁶*Department of Mathematics, Bahona College, Jorhat, Assam, India -785101*

**Corresponding Author Email: mohapatrabhabasis@gmail.com*

ABSTRACT

This work suggests the enforcement of donkey and smuggler algorithm, an optimized three-degree-of-freedom proportional-integral-derivative for the load frequency control study. This approach is validated on the multi-area realistic hydrothermal system subjected to 10% step load perturbation. The analysis of the multi-area realistic hydrothermal system is conducted with and without the incorporation of the high-voltage direct current line. However, the performance efficacy of the donkey and smuggler algorithm is validated by the performances of the path finder algorithm, differential evolution, and gravitational search algorithm. Later, the effect of employing the high voltage direct current line with the multi-area realistic hydrothermal system on its performance is demonstrated. Simulation results revealed that an improvement in investigated realistic model system performance was reported with consideration of the high voltage direct current tie- line.

Keywords: optimization algorithms; load frequency control; multi-area realistic hydrothermal system; 3DOFPID controller.

Demonstrating the Impact of Power System Realistic Constraints on the Performance of Load Frequency Control

Ch. Naga Sai Kalyan¹, Mohit Bajaj^{2,3,4}, Bhabasis Mohapatra*⁵, Pankaj Borah⁶

¹*EEE Department, Vasireddy Venkatadri Institute of Technology, Guntur, 522508, India*

²*Department of Electrical Engineering, Graphic Era (Deemed to be University), Dehradun, 248002, India*

³*Hourani Center for Applied Scientific Research, Al-Ahliyya Amman University, Amman, Jordan*

⁴*Graphic Era Hill University, Dehradun, 248002, India*

⁵*Department of Electrical Engineering, ITER, Siksha 'O' Anusandhan (Deemed to be University), Odisha 751030, India*

⁶*Department of Mathematics, Bahona College, Jorhat, Assam, India -785101*

*Corresponding Author Email: mohapatrabhabasis@gmail.com

ABSTRACT

The regulation of the interconnected electrical network frequency is a crucial indicator that can directly reflect on its stability. Thus, the interconnected power system (IPS) is equipped with the automatic control mechanism that can handle the system behaviour under loading uncertainties. The automatic control mechanism is the load frequency control (LFC) that can gear up in taking the necessary actions to regulate the IPS frequency. In this work, the three-degree-of-freedom proportional-integral-derivative (3DOFPID) controller is enforced as an LFC regulator using fruit fly algorithm (FFA). The operational performance of the FFA-tuned 3DOFPID is tested on the two-area realistic constraints-based power system (TARCPS) model for 10% step load disturbance (SLD). However, the efficacious performance of the 3DOFPID is validated with the other control structures reported in the literature. Further, the impact of the realistic constraints on TARCPS model performance is demonstrated, and the necessity of considering them with the system is also justified. Furthermore, the TARCPS is incorporated with the HVDC tie-line, and the obtained results confirmed the enhancement in system dynamical behaviour. Lastly, the sensitivity test is carried out to confirm that the imposed control mechanism is reliable.

Keywords: Fruit fly algorithm, TARCPS model, HVDC line, 3DOFPID controller.

A sustainable Multi-Objective Economic Production Quantity model under Perform, Achieve and Trade scheme in India

Nayantara Gogoi^{1,*}, Bijoy Krishna Debnath², Tanmay Halder³

Department of Applied Sciences, School of Engineering

Tezpur University, Sonitpur, Napaam- 784028, Assam, India

*Corresponding Author E-mail: nayani5@tezu.ernet.in

ABSTRACT

This paper presents a Multi-Objective Economic Production Quantity (MOEPQ) model to analyze the impact of government-initiated non-renewable energy-saving policies on production and inventory decisions. Although carbon emission reduction has become a global priority, India has not yet established a formal carbon market; instead, mechanisms such as the Perform, Achieve and Trade (PAT) scheme and Renewable Energy Certificate (REC) mechanisms are introduced in Indian industrial sector that serve as alternatives for carbon emission reduction, as lower energy consumption directly translates into reduced carbon emissions. To examine these effects, two MOEPQ models are developed: a baseline model without energy-saving intervention and an enhanced model incorporating PAT-based energy efficiency incentives. Both models integrate production, inventory, transportation, and energy consumption costs within a unified multi-objective framework aimed at minimizing total cost and total non-renewable energy consumed. The models are solved using the Non-Dominated Sorting Genetic Algorithm II (NSGA-II) to generate Pareto-optimal solutions, which are further evaluated using a Multi-Criteria Decision Analysis (MCDA) method, specifically the Technique for Order Preference by Similarity to an Ideal Solution (TOPSIS), to identify the most preferred solutions under multiple performance measures. The results highlight that implementing PAT incentives significantly reduces non-renewable energy consumption and overall system cost, leading to more sustainable production planning. Additionally, sensitivity analyses of key policy and market parameters provide managerial insights into the practical applicability and effectiveness of energy-saving interventions in industrial operations.

Keywords: Multi-Objective Economic Production Quantity Model; Perform, Achieve and Trade Scheme; Energy consumption; Non-dominated Sorting Genetic Algorithm II.

Signal Flow Graph and Mason's Gain Formula in Analysis of Bilateral Electrical Network.

¹**B. C. Phukan**

¹*Faculty for Department of Mathematics, [Jorhat Engineering College, Assam, India](#) and
[Email: bcphukan.jec@gmail.com](mailto:bcphukan.jec@gmail.com)*

ABSTRACT

The transfer function of an electrical network can be calculated using several techniques, including Kirchhoff's rules, two-point network theory, nodal analysis, and the time constant method. An alternative approach to algebraically determining the transfer function is to use the Signal Flow Graph (SFG). A directed, weighted graph is used to represent a node and branches in a single flow graph. Here, we construct a signal-flow graph of a Bilateral electrical network and analyze it using Mason's gain formula and the signal-flow graph's reduction rules.

Keywords: Transfer function, Mason's formula, Signal Flow Graph, Unilateral Electrical Network.

Theme: Mathematical Modeling

Mathematical Modelling of Traditional Ecological Knowledge Using Fuzzy Multi-Criteria Decision-Making for Sustainable Water Management in Tribal Regions of Tripura, Northeast India

Nandini Gupta^{1*}, Ajoy Kanti Das², Nandan Dhar³, Ashwini Debbarma

¹*Associate Professor, Department of Environmental Science, Bir Bikram Memorial College, Agartala-799004, Tripura, India, nandiniguptabbmc@gmail.com*

²*Associate Professor, Department of Mathematics, Tripura University, Agartala-799022, Tripura, INDIA, ajoykantidas@gmail.com*

³*Research Assistant, Department of Environmental Science, Bir Bikram Memorial College, Agartala-799004, Tripura, India*

⁴*Field Investigator, Department of Environmental Science, Bir Bikram Memorial College, Agartala-799004, Tripura, India*

**Corresponding Author: nandiniguptabbmc@gmail.com*

ABSTRACT

This study integrates Traditional Ecological Knowledge (TEK) with Fuzzy Multi-Criteria Decision-Making (MCDM) to evaluate sustainable water resource management in four tribal villages of Tripura, India—Athukthang, Twikalai Kami, Nabachandra Para, and Twisikam Kami. These villages rely on local water sources such as rainwater harvesting systems, streams, and wells, managed through generations of TEK-based practices. Field surveys, interviews, and observations were conducted to collect data on water use, seasonal variability, and community management strategies. A fuzzy MCDM framework using Triangular Fuzzy Numbers (TFNs) was applied to assess five key criteria: reliability, seasonal availability, ecological impact, accessibility, and cultural significance. The Fuzzy Weighted Average and centroid defuzzification methods were used to compute sustainability scores for each water source. Results show that rainwater harvesting and stream systems are the most sustainable, with defuzzified scores ranging between 0.61 and 0.83, while wells and Water Pits show moderate sustainability (0.527). The findings confirm that TEK-based practices effectively balance reliability, ecological health, and cultural values. Integrating TEK with fuzzy decision models provides a systematic and flexible approach to managing uncertainty in community water systems. This combined framework can support policymakers and researchers in designing adaptive, community-centred strategies for sustainable water in tribal regions.

Keywords: Fuzzy Sets, Traditional Ecological Knowledge, Multi-Criteria Decision-Making, Water Resource Management, Tribal Communities

The Role of Mathematical Models in Understanding Complex Systems

Shyam Sundar Panda

Department of Mathematics, S.C.S Autonomous College, Puri – 752001 Odisha, India

shyamsundarpanda92@gmail.com

ABSTRACT

Mathematical modelling is a key tool for understanding and predicting the behaviour of complex systems in physical, biological, and social areas. By translating real-world phenomena into mathematical expressions, models enable researchers to analyse patterns, test ideas, and predict outcomes accurately. In physical systems, modelling describes the natural laws that control motion, energy, and matter. In biological contexts, it provides insight into population changes, disease spread, and physiological processes. This connection bridges the gap between theory and experimentation. Similarly, in social systems, mathematical models illustrate human interactions, economic trends, and social network dynamics. This allows policymakers and scientists to assess the effects of people's collective behaviours. The use of mathematical modelling across different fields shows its broad power. It turns abstract equations into practical tools for innovation, sustainability, and informed choices. This study highlights the value of mathematical models as both descriptive and predictive tools for understanding the complex mechanisms that shape our natural and social worlds. Mathematical modelling simplifies complex systems and improves our ability to make reliable, evidence-based decisions. Researchers use methods like differential equations, statistics, and computational simulations to represent processes that change over time. In physics, models simulate planetary motion, heat transfer, and wave propagation, forming the basis for scientific and technological progress.

Keywords: Mathematical Modelling; Complex Systems; Computational Simulation; Interdisciplinary Applications.

A Study on Assessment of Pollution with a Focus on Transportation Mode : Special Reference to Newly Developed Smart City (NKDA)

Madhurima Chattopadhyay^{*1}, Sayantika Mukherjee², Dipanwita Das², Amrita Saha³

¹Research Scholar, Department of Environmental Science, Amity University Kolkata

²Assistant Professor, Department of Environmental Science, Amity University Kolkata

³Associate Professor, Department of Environmental Science, Amity University Kolkata

*Corresponding author, mail id: madhurima.chattopadhyay@s.amity.edu

ABSTRACT

To fulfill the target of sustainable goals under the flag of RIO Summit 1991, the Government of India has increased its pace to build Smart Cities throughout the Country over the past decades. Millions of Rupees are being allocated in different areas of the country to build smart sustainable cities and to be in the upgraded version of comparable world scenario of developed nations. However, it was found out that despite providing necessary supply for constructing smart urban environment, there has been still a gap to fill this void. To ensure this the study has been conducted in different zones of Newtown Kolkata Development Authority (NKDA) with evidence of noise level and presence of suspended particulate matter. The road dust from highways and roads and emissions from vehicular transit are the main constituents of respirable particulate matter. Apart from natural spontaneous sources, non-spontaneous sources may occur due to vehicular transit of citizens which excludes source of eateries and construction sites. Standard error method for source of sound level and its correlation to particulate matter level has been described. The probability has also been discussed for usage of cooling system within vehicle which is also a directional process for vehicular emission. The potential health effects due to such activities are also discussed.

Key words: Pollution Assessment, Air Pollution, Noise Pollution, Transportation Mode, Health Effects, Respirable Particulate Matter.

Analysis of MHD bioconvective ternary hybrid nanofluid flow over moving thin needle using Cattaneo-Christov heat flux model

Vishal Saikia¹ and P.N. Deka²

¹Department of Mathematics, Majuli College, Majuli, Pin-785106, India

²Department of Mathematics, Dibrugarh University, Dibrugarh, Pin-786004, India

E-mail: vishal.saikia.vs@gmail.com

ABSTRACT

This investigation considers an MHD ternary hybrid nanofluid and is incorporated by motile microorganisms. The flow is considered over a moving slender needle. This numerical study analyzes the effects of viscous dissipation, Joule heating, and chemical reactions in a Darcy-Forchheimer porous medium. The energy equation is developed using the Cattaneo-Christov heat flux model and numerical solutions are carried out using Keller Box implicit finite difference scheme. Impact of emerging parameters on velocity, temperature, concentration and microorganism concentration profiles are analyzed from graphical plotting.

Keywords: Motile microorganisms; Darcy-Forchheimer; Keller Box

Mathematical Modelling and Performance Analysis of a 5G Implantable Antenna for Wireless Bio-Telemetry

Moumita Bose^{1,*}, Ajit Prasad Singh², Ujjal Chakraborty³, Ranadip Roy⁴

^{1,4}NSHM Knowledge Campus Durgapur

²BSNL, Durgapur, West Bengal

³NIT, Silchar, Assam

Abstract

This paper presents a compact 5G-enabled implantable antenna designed for wireless bio-telemetry applications with a dimension of 4.1 mm × 4.5 mm × 0.5 mm. The performance of the proposed antenna was studied with the help of mathematical modelling and link budget calculation. It operates efficiently within the sub-6 GHz 5G spectrum at 1.888 GHz resonance frequency, ensuring low-latency and high-data-rate communication for real-time health monitoring. The antenna designed using biocompatible materials and optimized for operation in the lossy human tissue environment, it achieves good impedance matching and stable performance under lossy skin tissue. The miniaturized structure incorporates meandered and slot-loaded elements to achieve a good impedance matching and maintain reliable performance in a compact footprint. The result confirms that the antenna achieves a fractional bandwidth exceeding 9% and gain of -35.9 dBi under 4 mm depth of skin tissue, with a specific absorption rate (SAR) well within IEEE safety limits. The radiation characteristics demonstrate robust link reliability. The integration of 5G capabilities enhances the data throughput, enabling continuous, real-time transmission of physiological data for advanced diagnostics, remote monitoring, and closed-loop therapeutic systems. This design represents a significant step toward the development of next-generation smart implantable devices for personalized healthcare.

A Comparative Analysis of Wave Motion in Porothermoelastic Medium in Context of Green-Lindsay Model and Lord-Shulman Model

Dr. Divya

divyabatra1982@gmail.com

Department of Mathematics, Kishan Lal Public College, Rewari, Haryana, India-123401

ABSTRACT

The present study aims to analyze the behaviour of reflection of wave from porothermoelastic half-space in context of Green-Lindsay model and Lord-Shulman model under impedance boundary conditions. Existence of three longitudinal waves i.e. primary wave (P -wave), thermal wave (T -wave), porous-wave (Ps -wave) and one transversal wave (SV -wave) is observed propagating with distinct velocities. Amplitude ratios and energy ratios due to incidence of each wave is computed numerically by opting two distinct models: Green-Lindsay model and Lord-Shulman model. Energy ratios obtained for these models are analyzed and presented graphically. Law of conservation of energy is preserved for these two models at each angle of incidence. The results so obtained are useful in field of structure related problems, geophysics and earthquake engineering.

Key words: porous medium, reflection, impedance boundary, amplitude ratios, energy ratios

A Multi-Compartment Pollution Model with Optimal Control and $PM_{2.5}$ Data Validation from Delhi

Apeksha Prajapati

Nirmala College Ranchi

ABSTRACT

In India, environmental pollution is something we all experience every day in all the three form air, water and soil. This work, introduces a mathematical model that describes how pollution moves between three compartments: air (P_1), water (P_2), and soil (P_3). The model uses simple decay rates, transfer between compartments, and complex interaction terms to mimic real pollution behaviors like trapping chemicals and saturation and also studies how different cleaning efforts can reduce pollution and how combining them can make the biggest difference.

To reflects real situations, model has been compared with actual $PM_{2.5}$ data from Delhi. The results show that combined model follows real pollution trends much closely than a simple air-only model. The optimal control is also introduced to find the most effective way to reduce pollution over time. Simulations are performed for better clarity and understanding and it shows that coordinated actions lower pollution faster and keep it at safer levels.

Keywords. Pollution, Mathematical model, Optimal control, Equilibrium points, Pollution Reproduction Number.

Mathematical Modelling of Microbial Defence Mechanisms Driving Antibiotic Resistance Dynamics

Mr. Praveen Kumar

Assistant professor, Department of Mathematics, Saharsa college of Engineering Saharsa, Hatiya Gachhi Saharsa, Bihar, India

*k.praveen.parwaha@gmail.com (only one)

ABSTRACT

These days, we observe a serious problem of antibiotic failure in treating diseases due to the adaptation and mutation of bacteria against antibiotics. It is a major global health concern, as resistant strains reduce the effectiveness of treatments. Therefore, we study the defence mutations of bacteria against antibiotics by developing a nonlinear differential equation model that describes the mechanisms of antibiotic resistance, including bacterial growth, mutation, and competitive interactions between sensitive and resistant strains. The goal of this study is to investigate how bacterial defence mutations contribute to the dynamics of antibiotic resistance. We also analyse the numerical solutions of the developed model using numerical methods. This investigation helps us in optimizing antibiotic treatment strategies, such as minimizing the emergence of resistant strains during therapy and ensuring the correct use of antibiotic doses against resistant strains.

Keywords: Antibiotic ⁽¹⁾ ; Bacteria mutation ⁽²⁾ ; Non-linear Differential model ⁽³⁾ ; Treatment optimisation ⁽⁴⁾

Theme: Machine Learning

Mathematical Analysis of Convex Optimization Algorithms with Applications in Regularized Machine Learning Models

Neela G¹, S Padmanabhan², Pallavi G³

¹Research Scholar, Department of Mathematics, RNS Institute of Technology, Bengaluru, Affiliated to Visvesvaraya Technological University (VTU), Belagavi, Karnataka, India

²Associate Professor, Department of CSE (AI & ML), RNS Institute of Technology, Bengaluru

³Assistant Professor, Department of Mathematics, RNS Institute of Technology, Bengaluru

Corresponding author: neela.g@rnsit.ac.in

ABSTRACT

Convex optimization provides a foundational framework for addressing diverse challenges in applied mathematics, operations research, and data-driven modeling. This study presents a rigorous mathematical analysis of convex optimization algorithms, with a focus on their convergence properties, stability criteria, and regularization behavior in machine learning applications. We investigate gradient-based and proximal-point methods under convex and strongly convex regimes, incorporating penalty-driven regularization to enhance generalization and robustness. The analysis delineates conditions for Lipschitz continuity, strong duality, and convergence rates of first-order methods, offering theoretical guarantees for algorithmic reliability. Particular attention is given to convex regularizers—such as L1, L2, and elastic-net penalties—and their role in mitigating overfitting while promoting sparsity and interpretability in predictive models. Through a synthesis of analytical insights and computational validation, the study demonstrates how convex optimization principles underpin the design of efficient and scalable learning algorithms. The proposed framework bridges optimization theory with statistical learning, contributing to the development of mathematically grounded, reproducible models. Future directions include adaptive convex schemes and hybrid algorithmic strategies tailored for high-dimensional and large-scale data environments.

Keywords: Convex optimization, Regularization, Proximal algorithms, Convergence analysis, Machine learning.

“Role of Mathematics in Artificial Intelligence and Machine Learning”

Ms. Tamanna Jain , Mrs. Anjali Mathur , Mr. Sandeep Mathur

Jodhpur institute of engineering and technology, Jodhpur, Rajasthan

E-mail : tamannajain@7014@gmail.com

ABSTRACT

Mathematics is the basic foundation of Artificial Intelligence (AI) and Machine Learning (ML). Every modern AI system—whether it is a chatbot, a self-driving car, or a recommendation engine—uses mathematical ideas to learn and make decisions. The main mathematical areas that support AI and ML are linear algebra, calculus, probability, and optimization.

Linear algebra helps in representing data as vectors and matrices, which makes it easier for computers to process large amounts of information. Calculus is used to train models by adjusting parameters step by step to reduce errors and improve results. Probability and statistics help machines deal with uncertain or changing information, while optimization techniques make learning faster and more accurate.

This paper discusses how these mathematical tools are used in different branches of engineering such as mechanical, electrical, and computer engineering. Examples include fault detection in machines, predictive maintenance, smart control systems, and image recognition. The combination of mathematics and engineering allows systems to think and learn from experience, leading to smarter and more efficient solutions.

Overall, mathematics not only strengthens how AI and ML work but also opens new possibilities for innovation in technology. Understanding these mathematical principles helps engineers design intelligent systems that can solve real-world problems in a reliable and meaningful way.

Keywords: Mathematics, Artificial Intelligence, Machine Learning, Optimization, Engineering Applications.

Quantized Sampled-Data Control for Lag Synchronization of Inertial Memristive Neural Networks with Additive Time-Varying Delays

M. Kamali¹, A. Chandrasekar^{2,*}, T. Radhika³

*Department of Mathematics, School of Advanced Sciences, Vellore Institute of Technology, Vellore
632 014, Tamilnadu, India.*

*Corresponding Author E-mail: chandrudhana28@gmail.com (A. Chandrasekar)

ABSTRACT

This study addresses the lag synchronization problem of inertial memristive neural networks (IMNNs) affected by additive time-varying delays (ATVDs) within a quantized sampled-data control (QSDC) framework. Since IMNNs are inherently second-order systems governed by both inertial and memristive dynamics, the original model is reformulated into an equivalent first-order representation through the introduction of suitable auxiliary variables, allowing for a more systematic stability analysis. To overcome the combined difficulties introduced by delays, sampling effects and quantization, an advanced looped Lyapunov–Krasovskii functional (LKF) is constructed. This LKF seamlessly integrates sampling information, communication delays, and the quantization mechanism into a unified analysis framework. Furthermore, a recently developed free-weighting-matrix integral inequality (FWMII) is employed to establish synchronization conditions that are computationally tractable and significantly less conservative, expressed in terms of linear matrix inequalities (LMIs). Extensive numerical experiments confirm the strong effectiveness, robustness, and superior performance of the proposed control strategy.

Keywords: Inertial memristive neural networks; Quantized sampled-data control; Lag Synchronization; Additive time-varying delay.

The Role of Mathematics in Driving Artificial Intelligence and Machine Learning Innovations in India

Dr. Chitta Ranjan Malik

*Assistant Professor, Maa Manikeshwari University (Erstwhile, Kalahandi University), Bhawanipatna,
Kalahandi, Odisha, INDIA.*

Email: chittaranjanju2@gmail.com

ABSTRACT

The paper investigates mathematics' fundamental significance in influencing the rapidly evolving landscape of Artificial Intelligence (AI) and Machine Learning (ML) innovations in India. As the country strives to become a global hub for AI-driven solutions, mathematical principles—including linear algebra, calculus, probability, optimisation theory, graph theory, and statistics—are central to algorithmic design, model correctness, and computational efficiency. The study focusses on how mathematical reasoning drives advances in neural networks, deep learning, natural language processing, computer vision, and predictive analytics. It also examines India's developing ecosystem of AI research, academic institutions, start-ups, and government initiatives such as Digital India and India AI Mission, demonstrating how a strong basis in mathematics is critical for innovation, ethical AI development, and scalable implementation. The study contends that improving mathematical education, encouraging multidisciplinary collaboration, and investing in mathematical research are key to India's leadership in next-generation AI and machine learning technology. The paper emphasises the importance of mathematics in driving India's AI future by linking theoretical constructs to practical applications in sectors such as healthcare, agriculture, defence, and governance.

Keywords: Algorithm Design, Artificial Intelligence, India AI Mission, Machine Learning, Start-ups.

A Comprehensive Classical Machine Learning Framework for Autism Spectrum Disorder Detection Using High-Resolution Facial HOG Descriptors

Roopa T¹, Dr Priyamwada Sharma²

¹Assistant Professor, Department of Computer Applications, Dr NSAM First Grade College

²Associate Professor, Department of Computer Applications, Rajib Gandhi Proudhyogiki Vishwavidyalaya (RGPV), Bhopal

ABSTRACT

Autism Spectrum Disorder (ASD) requires early and reliable detection to enable timely intervention, yet many recent facial-image approaches rely on deep learning models that are computationally expensive, data-hungry, and difficult to interpret in clinical settings. This work proposes a complete, interpretable, and deployment-ready ASD detection pipeline that uses only handcrafted Histogram of Oriented Gradients (HOG) descriptors and classical machine learning models. The publicly available Kaggle ASD facial dataset is fully reconstructed by merging all partitions, removing duplicates, and enforcing a balanced label scheme, yielding 5,872 color facial images (2,936 autistic, 2,936 non-autistic) resized to 224×224 pixels. Each image is converted to a 26,244-dimensional high-resolution HOG vector and compressed to 300 principal components, retaining 53.75% of the variance.

Twenty classical models—including ensemble methods, linear classifiers, kernel support vector machines, K-nearest neighbours, discriminant analysis, Naïve Bayes, and XGBoost—are trained on the PCA-reduced features and evaluated on an independent test set. The best models (Decision Tree, XGBoost, Bagging, Hist Gradient Boosting, Random Forest, and Extra Trees) achieve test accuracies between 0.89 and 0.94, F1-scores up to 0.94, sensitivities up to 0.93, specificities up to 0.97, and ROC–AUC values as high as 0.99. A calibrated Decision Tree, selected as the final model for its interpretability, obtains 94.21% accuracy, 93.19% sensitivity, 95.24% specificity, and a Brier score of 0.1118, demonstrating both strong discrimination and well-calibrated probabilities. The overall contribution is a rigorously evaluated classical machine learning framework that rivals deep learning performance while remaining transparent, computationally lightweight, and suitable for real-time ASD screening interfaces.

Keywords: Autism Spectrum Disorder, Machine Learning, Histogram of Oriented Gradients, Principal Component Analysis, Facial Image Analysis, Classical Models, XGBoost, Decision Tree, ROC–AUC, Probability Calibration.

Deep Learning Approach for Recognition of Handwritten Kannada Vowels Using CNNs

Shivaraj Maleppanavarmath^{1*}, Ishwar Baidari²

Department of Computer Science, Karnatak University Dharwad-580003, India

*shivgmth@gmail.com

ABSTRACT

Handwritten character recognition is a challenging and important task in pattern recognition and computer vision, particularly for Indian scripts like Kannada language, which contain complex shapes, curves, and diacritical marks. Accurately recognizing handwritten Kannada vowels is especially difficult due to high variability in writing styles and differences between characters. Despite these challenges, effective recognition is vital for automating document processing, preserving cultural and historical texts, and enabling seamless human-computer interaction. Advances in computational methods, especially deep learning, offer promising solutions by learning complex spatial features from images, reducing the need for manual feature engineering, and improving recognition accuracy. Developing robust Kannada script recognition can extend to other Indic scripts and multilingual datasets, supporting AI applications and digital preservation. This study employs a deep learning approach using a Convolutional Neural Network (CNN) to learn spatial features from images. Using a dataset of 15 Kannada vowel classes pre-processed into grayscale images, the method achieves 94.33% test accuracy, demonstrating its ability to handle intra-class variability and robustly recognize complex character shapes. This approach not only aids in building automated systems for Kannada text recognition but also provides a foundation for extending recognition to the full Kannada script, other Indic scripts, and multilingual handwritten datasets. By leveraging modern deep learning and mathematical modelling, this work advances artificial intelligence, machine learning, and computer vision, enabling more accurate handwritten text processing and supporting the digital preservation of regional languages.

Keywords: Kannada vowels, Handwritten character recognition, Convolutional Neural Networks, Machine learning.

Quasi-synchronization of delayed competitive neural networks using memory state feedback controller

A. R. Subhashri¹, T. Radhika^{1*}, A. Chandrasekar¹

¹*Department of Mathematics, School of Advanced Sciences, Vellore Institute of Technology, Vellore-632 014, Tamilnadu, India.*

*Corresponding Author E-mail: (radhigru@gmail.com)

ABSTRACT

This paper investigates the quasi-synchronization behaviour of delayed competitive neural networks under a memory state feedback control framework. To address the challenges posed by time delays and competitive dynamics, suitable Lyapunov–Krasovskii functionals (LKFs) are constructed. Based on these functionals, sufficient conditions for achieving quasi-synchronization are derived in terms of linear matrix inequalities (LMIs), ensuring computational tractability and robustness. Numerical simulations are presented to validate the effectiveness of the proposed criteria and demonstrate the practical relevance of the theoretical findings.

Keywords: Competitive Neural Networks; State-feedback controller; Quasi-synchronization; Time-varying delay.

Modern Machine Learning's Mathematical Underpinnings and Methods: An Extensive Research Overview

Dr Kshirod Sarmah

Department of Computer Science, Pandit Deendayal Upadhyaya Adarsha Mahavidyalaya (A Govt. Model College), Goalpara, Assam, India,

kshirodsarmah@gmail.com

ABSTRACT

This paper presents a thorough investigation of the mathematical foundations behind recent improvements in machine learning (ML). As ML continues to progress and permeate numerous application fields in Artificial Intelligence (AI) understanding its mathematical foundations becomes vital for both theoretical advancement and practical implementation. We examine fundamental mathematical concepts such as calculus, probability theory, linear algebra, and optimization, explaining their functions in modern machine learning architectures. The study delves deeper into the ways in which these mathematical frameworks facilitate innovative paradigms including geometric deep learning, deep learning, and reinforcement learning. This research provides a thorough reference for scholars and practitioners looking to enhance their comprehension of machine learning's mathematical foundations and lays the groundwork for future advancements in the field by combining theoretical ideas with their real-world applications in contemporary algorithms. Lastly, the work deciphers the information-theoretic underpinnings of state-of-the-art generative models such as VAEs and GANs. This text provides a thorough review of the essential language of mathematics that defines, permits, and constrains the current and future terrain of machine learning by integrating these various mathematical threads, from classical statistics to contemporary differential geometry.

Keywords: Mathematical frameworks, Artificial Intelligence, Machine Learning, Principal Component Analysis, deep Learning.

Predicting soaked CBR of subgrade geosynthetic-reinforced soil using evolutionary artificial intelligence technique

Vikash kumar singh¹, Rajesh Kumar Dixit², Atul Sthapak³

^{1,2}*Department of Civil and Environmental Engineering, National Institute of Technical Teachers Training and Research (NITTTR), Bhopal, Madhya Pradesh, 462002, India*

³*Department of Civil Engineering, Ujjain Engineering College, Ujjain, Madhya Pradesh, 456006, India*

*Corresponding Author Email: vikashcivil07@gmail.com

ABSTRACT

The construction of safe and sustainable pavements has increasingly incorporated geosynthetic-reinforced soil technology in recent years. A key indicator of subgrade soil strength is the California Bearing Ratio; however, a standardized system for assessing the CBR of reinforced subgrade soils is lacking. The samples of soil, red mud and muram, the sample which gives maximum CBR value amongst the above would be chosen for further reinforcing the soil with geosynthetic in various layers at different positions. This work examines the performance of intelligent modeling approaches for forecasting the CBR of reinforced soils, using a comprehensive dataset of 102 soil samples gathered from an ongoing highway construction site. The models assessed include Artificial Neural Networks (ANN) models (BRNN, LMNN and DENN etc.) used to different training algorithms are developed. To assess predictive accuracy, we employed an independent experimental dataset, a multi-criteria evaluation approach, external validation techniques, and conventional statistical performance indices. Among the models tested, the ANN demonstrated superior predictive performance. Additionally, current study datasets were used to try to validate the models found in the literature. Sand, fine content, plastic limit, plasticity index, maximum dry density, and optimal moisture content were determined to be the most important input parameters in creating the soaking CBR of geosynthetic reinforced soils based on the findings of Pearson's correlation study.

Keywords: Machine learning; Intelligent predictive modeling; Geosynthetic reinforcement; California bearing ratio.

Hybrid Computational Statistics and Machine-Learning Architecture for Large-Scale EEG Signal Processing

Dr. S. Syed rafiammal

*Assistant Professor (Selection Grade), Department of Electronics and communication engineering,
BS Abdur Rahman*

Crescent Institute of science and Technology. Tamilnadu,

Orcid id: 0000-0002-5916-6924

ABSTRACT

The rapid expansion of large-scale neural recording technologies and open-access EEG repositories has reshaped brain-signal research, enabling new advances in computational statistics, machine learning, and big-data analytics. EEG remains a widely used non-invasive modality for studying brain dynamics, yet its noisy, non-stationary, and high-dimensional characteristics create significant challenges for scalable and automated interpretation. Traditional pipelines depend heavily on manual feature engineering, limiting adaptability across subjects and tasks. To address these issues, this work presents an integrated computational framework that combines statistically grounded preprocessing, multimodal feature extraction, advanced machine-learning architectures, and scalable big-data processing for efficient and interpretable EEG analysis.

The framework begins with robust statistical preprocessing using ICA, wavelet denoising, adaptive thresholding, and outlier detection to separate neural activity from physiological artifacts. Time–frequency methods such as STFT, empirical mode decomposition, and multitaper spectral estimation are employed to capture transient spectral dynamics. Feature extraction merges classical statistical descriptors—entropy, autoregressive coefficients, Hjorth parameters, and connectivity measures—with learned deep representations from compact CNNs (e.g., EEGNet) and recurrent models such as LSTM and Bi-RNN.

Machine-learning modules integrate supervised classifiers, deep networks, and probabilistic models to effectively capture nonlinear, temporal, and spatial dependencies. Domain adaptation and transfer-learning strategies are incorporated to improve cross-subject generalization, while Bayesian inference supports uncertainty-aware decision-making.

To address increasing data volumes, the pipeline uses distributed frameworks such as Spark, Dask, and GPU-accelerated processing, enabling efficient handling of millions of EEG samples and supporting real-time or near real-time applications.

Keywords: Big-data analytics, Time frequency analysis, Feature extraction, Neural connectivity

Evaluations on motor imagery, eye-state detection, and cognitive workload datasets demonstrate 8–15% accuracy improvement over traditional hand-crafted approaches, with reduced cross-subject variance and enhanced interpretability. The results establish the proposed framework as a scalable, robust, and transparent solution for next-generation EEG analytics.

Theme: Mathematical Statistics

Reliability Analysis of Cascade System using Mixtures of Rayleigh Distributions

Dr Chumchum Doloi

*Assistant Professor, Department of Statistics, Pandit Deendayal Upadhyaya Adarsha Mahavidyalaya,
Tulungia, Assam, India*

chumchum.doloi@gmail.com

ABSTRACT

This paper investigates the reliability analysis of a cascade system under the assumption that both stress and strength follow a mixture of two Rayleigh distributions. Expressions for system reliability R_n are derived for the general case as well as for specific forms of the Rayleigh distribution. Numerical results and graphical illustrations are provided to demonstrate the behavior of the system reliability under various parameters. The practical implications and applications of reliability across various fields are discussed. The results are discussed and interpreted to highlight the effects of the mixture parameters on reliabilities.

Formulation of Efficient Estimation Technique for population mean through Two-phase sampling

Arnab Bandyopadhyay^{1,*}, Abhay Majumdar² and Ayush Biswas³

^{1.} **Associate Professor, Mathematics Department of Basic Sciences and Humanities, Dr. B. C. Roy Engineering College, Durgapur – 713206, West Bengal*

Email : arnab.bandyopadhyaya@bcrec.ac.in

²*School of Basic and Applied Sciences, B.Sc (Hons) Statistics and Data Analytics, Adamas University, Barasat – Barrackpore Road, Jagannathpur, Kolkata- 700126, West Bengal*

ABSTRACT

This study develops an advanced chain exponential logarithmic ratio type estimator for efficient estimation to deal with the population mean successfully in the two-phase sampling. The proposed estimator synthesizes the advantages of ratio, logarithmic, and exponential transformations to optimally exploit information from two auxiliary variables when complete auxiliary data are unavailable. Based on large-sample approximations through Taylor series expansion and transformation of relative error terms Mean square error (MSE) are derived. Optimal conditions for the MSE are established, ensuring the estimator's efficiency and stability across varying population structures.

Through natural population and simulated populations, which represent diversity in the correlation structure within the study variable and auxiliary variables, we evaluate the implementation of the proposed estimator. Empirical results demonstrate that the estimator consistently achieves higher

Percent Relative Efficiency (PRE) compared with classical ratio, product, regression, exponential and chain type estimators. The superiority becomes more pronounced when auxiliary variables exhibit strong associations with the study variable. Overall, the proposed approach offers a theoretically sound and practically viable framework for improving estimation accuracy in large-scale surveys, particularly in agricultural, environmental, industrial, and health studies where auxiliary data are accessible but direct measurement is costly.

Keywords: Study Variable, Auxilliary Variable, Expectation of errors, Estimators, Types of Estimators, Transformation of Estimators, Mean Square Error (MSE) of Estimators, Percent Relative Efficiency (PRE), Efficiency Comparison of Estimators

Formulation of an Effective Estimation Strategy for Finite Population Variance under Two-Phase Multi Stage Cluster Sampling Scheme in Presence of Random Non-Responses

Arnab Bandyopadhyay^{1,*}, Mithu Dey (Sarkar)² and P. Parichha³

¹. *Department of Basic Science & Humanities (Mathematics), Dr. B. C. Roy Engineering College, Durgapur-713206, India

²Department of Basic Science & Humanities (Mathematics), Asansol Engineering College, Asansol-713305, India

³Department of Mathematics, National Institute of Technology, Durgapur – 713209, India

Email: *arnabbandyopadhyay4@gmail.com, mithu.maths@aecwb.edu.in, parthaparichha1989@gmail.com, *Corresponding Author: Arnab Bandyopadhyay

ABSTRACT

This research addresses the formulation of efficient estimation technique for population variance under two-phase multi stage cluster sampling scheme. Using auxiliary information at estimation stage, we have constructed a general class of estimators which is efficient as well as found effective in reducing nuisance impact of random non-responses in practical surveys. Several estimators are shown to belong to the proposed class. Properties of the class of estimators developed have been deduced. Numerical evidences are provided by using natural populations and simulation studies to highlight the superiority of the proposed strategy over existing strategies. The outcomes of the proposed strategy have been suitably recommended to the survey statisticians for real life survey applications problems.

Keywords: Variance Estimation, Cluster Sampling, Random Non-Responses, Loss in Efficiencies, Mean Square Errors, Two-Phase Sampling, Two- Stage Cluster Sampling 2010

Mathematics Subject Classification: 62D05 1

“Contradictory Inferences in Small Samples: A Study Using Chi-Square and Binomial Distribution Approaches”

Kamlesh Bhandari

Email-kamlesh.bhandari@jietjodhpur.ac.in

Department of Mathematics, JIET Group of Institutions, JIET Universe, Mogra-Village, Pali Road, Jodhpur (India)

ABSTRACT

The present study investigates the inconsistency that arises when different statistical methods are applied to the same small sample dataset. Specifically, we examine the results obtained by using the Chi-square test and those derived by fitting a Binomial distribution. The Binomial distribution was fitted to the observed sample frequencies, and the conclusions were compared with those obtained through the Chi-square goodness-of-fit test. Our analysis reveals a notable contradiction between the two approaches, suggesting that traditional Chi-square methods may be less reliable for small sample sizes. This study highlights the importance of selecting an appropriate statistical technique based on sample characteristics and provides insights into the limitations of commonly used methods.

Inference for Stress-Strength Reliability Using the Exponential-Gamma Model: Theory and Applications

Joyshree Saharia*, Jonali Gogoi

Department of Statistics, Assam University, Silchar

Email: joyshreesaharia@gmail.com

ABSTRACT

The stress-strength reliability measure, defined as $R = P(Y < X)$, is a widely used index in reliability analysis, representing the probability that a system's strength exceeds the applied stress. This paper investigates the Exponential-Gamma stress-strength model, assuming the stress variable follows an exponential distribution while the strength variable follows a gamma distribution. Analytical expressions for the reliability function are derived and estimation of reliability is developed using maximum likelihood and uniformly minimum variance unbiased approaches, and both exact and asymptotic confidence intervals are obtained. A detailed Monte Carlo simulation study evaluates the finite-sample properties of the proposed estimators, highlighting the superior small-sample performance of the uniformly minimum variance unbiased estimators (UMVUE) and the asymptotic efficiency of the maximum likelihood estimators (MLE). The practical usefulness of the model is demonstrated through real data applications, showing that the Exponential-Gamma framework provides an effective and tractable tool for modeling system reliability in applied settings.

Keywords: Stress-strength reliability; Standby redundancy; MLE; UMVUE; Confidence intervals

Enhanced Population Mean Estimation Using an Exponential Estimator with Known Medians of Dual Auxiliary Variables within a Neutrosophic Approach: Applications in Agricultural Yield Prediction

Anchal Yadav^{1*} and Mukesh Kumar¹

¹*Department of Statistics, University of Lucknow, Lucknow-226007, Uttar Pradesh, India.*

Emails: mukesh.stat@gmail.com; yancahl635@gmail.com

*Correspondance: yancahl635@gmail.com

ABSTRACT

In conventional statistical research, population parameters are usually estimated using methods that assume the availability of exact and fully reliable data. Yet, many real-world situations produce observations that are uncertain, vague, or represented as intervals rather than fixed numbers. To address this complexity, several modified forms of classical estimators particularly neutrosophic ratio-type estimators and their enhanced variants have been developed. In this study, a new estimator termed the **neutrosophic ratio-cum-product exponential estimator** is proposed. This estimator utilizes information from two auxiliary variables simultaneously and is specifically formulated to achieve more accurate estimation of the population mean under indeterminate data environments. The performance of the estimator is assessed using well-known criteria such as the Mean Square Error (MSE) and Percentage Relative Efficiency (PRE). The superiority of the proposed method is validated through a combination of empirical datasets and extensive simulation experiments. Furthermore, its practical value is demonstrated using a real agricultural dataset. The comparative analysis reveals that the proposed estimator consistently outperforms all competing estimators discussed in the study. To further emphasize the advantage of neutrosophic techniques over their classical counterparts, a detailed simulation investigation is also provided. The simulation outcomes for classical estimators are compared with those of their neutrosophic versions, showing clear improvement. In addition, **graphical representations of MSE and PRE values** are included to visually highlight the estimator's efficiency and overall performance.

Keywords: Classical Statistics, Neutrosophic Statistics, Logarithmic Ratio Type Estimator, Auxiliary Information, Bias, Mean Squared Error (MSE), Percentage Relative Efficiency (PRE)

Statistics and Probability for Data Science and Analytics

Vandna^{1,*}, Mandeep Kaur²

¹*School of Engineering and Technology, CGC University, Mohali-140307, Punjab, India*

²*Department of Mathematics, Abhayapuri College, Abhayapuri-783384, Assam, India*

*dr.vandna.paul@gmail.com

ABSTRACT

In the digital age, statistics and probability serve as foundational pillars of data science and analytics, providing the mathematical framework and reasoning necessary to extract meaningful insights from complex, high-volume datasets across various industries. This paper provides a comprehensive overview of statistical and probabilistic reasoning, covering a range of techniques from the fundamentals of descriptive and inferential statistics to advanced topics such as Bayesian modelling, spectral methods, high-dimensional data analysis, and statistical machine learning. A particular focus is placed on the integration of statistical principles in modern machine learning tasks, including model validation and evaluation, interpretability, and real-time analytics. The survey also examines the application of statistics and probability in specific sectors, including healthcare and biomedical data science, environmental modelling and analysis, smart infrastructure and buildings, and understanding human behaviour and decision-making. The paper highlights the versatility of statistical tools in addressing real-world challenges. Furthermore, the paper discusses modern challenges and considerations in statistics and data science, such as data quality, model complexity, and fairness, as well as ethical concerns in automated decision-making systems. It concludes with a glimpse into the future of statistics and data science, mentioning topics such as explainable AI, topological data analysis, and AI-augmented statistical inference. In general, the paper aims to bridge the gap between theory and practice in the field, offering insights that will be valuable to both statisticians and machine learning practitioners and encouraging a more thoughtful and interdisciplinary approach to the development of reliable and transparent data-driven systems.

Keywords: Probability; Data Science; Machine Learning; Predictive Analytics.

The Even Power Weighted Inverse Gamma Distribution and Its Application in Medical Science

Jumi Talukdar

Department of Statistics , Gauhati University, Gopinath Bordoloi Nagar, Guwahati, India

*Corresponding Author E-mail: talukdarj156@gmail.com

ABSTRACT

This study introduces a novel form of the inverse gamma distribution, termed the even power weighted inverse gamma distribution, which is derived by applying an even power to the weight function . Some of its properties, such as moments, reliability function, and entropy function, are explored. Parameter estimates of the suggested distribution are obtained using the method of maximum likelihood estimation. The applicability of the proposed distribution is demonstrated through a real-life application in medical science.

Keywords: Weight function; Gamma distribution; Reliability function; Entropy function.

Beta Transmuted Maxwell Distribution

Nandita Borah^{1,*}, Priom Seal²

¹*Department of Statistics, Pragjyotish College, Guwahati, India*

²*Department of Statistics, Gauhati University, Guwahati, India*

*Corresponding Author E-mail: (nanditaborahnandini@gmail.com)

ABSTRACT

In this paper, a new generalization of the Maxwell distribution is proposed and studied. The genesis of the beta distribution and transmuted map is used to develop the Maxwell distribution and the newly proposed distribution is named as the Beta Transmuted Maxwell Distribution. Several mathematical properties including moments, mean deviation, residual life, distribution of order statistics and the reliability analysis are discussed. Parameter estimation is carried out using the method of maximum likelihood. A simulation study is performed to evaluate the behaviour of the estimators. Finally, the utility and flexibility of the proposed model are demonstrated through an application to a real dataset.

Keywords: Maxwell Distribution; Transmuted Distribution; Simulation; Maximum Likelihood Estimation.

A New Factor-type Imputation Method for Estimation of Finite Population Mean In Case of Missing Data

Tarun Kumari

Department of Commercial Arithmetic, Lakhimpur Commerce College, North Lakhimpur, Assam, India

tarun.nlp@gmail.com

ABSTRACT

This paper proposes a new factor-type imputation method for handling missing data under simple random sampling (SRS). The method exploits the correlation between the study variable and two auxiliary variables to generate efficient replacements for missing observations. A corresponding point estimator for the finite population mean is developed, offering improved estimation performance in the presence of non-response. The expressions for the bias and mean square error (MSE) of the proposed estimator are derived in terms of the population parameters. Both analytical derivations and empirical evaluations indicate that the proposed estimator demonstrates superior efficiency compared to the existing estimators examined in this study. Theoretical findings are further validated through simulation experiments conducted on two distinct population data sets.

Keywords: estimator, imputation, bias, mean square error, simple random sampling, auxiliary variable.

Estimation and Real-Life Applications of a New Generalized Class of Continuous Probability Distributions

Laba Handique

Department of Statistics, Darrang College (Autonomous), Tezpur, Assam, India

Email: handiquelaba@gmail.com

ABSTRACT

A new family of generalized class of continuous probability distribution is proposed by using Topp-Leone-Burr-XII distribution as the base line distribution in the generalized Marshall Olkin-Gconstruction called the generalized Marshall Olkin Topp-Leone-Burr-XII distribution. Explicit expressions for survival and density function, are expressed in terms of corresponding expressions of Topp-Leone-Burr-XII distribution. Asymptotes and shapes of the proposed distribution are graphically studied. The parameter estimation by method of maximum likelihood is discussed. A new goodness-of-fit test for the proposed model in the case of real-life data is proposed. Finally, proposed distribution is compared with sub models and recently introduced lifetime models by considering two real life data fitting applications. In both the real-life data sets proposed model is found to be the best one in terms of different goodness-of-fit tests as well as model selection criteria.

Keywords: Generalized Marshall-Olkin family, Topp Leone-G family, Goodness of fit, MLE

OPTIMIZATION OF POULTRY FARM PRODUCTS USING LINAR PROGRAMMING MODEL

Dr. Shyamali Dutta

Assistant Professor, Department of Statistics, Bahona College, Jorhat, Assam-785101

Email id: duttasd250@gmail.com

ABSTRACT

The poultry industry has become the fastest growing sector in both the livestock and in agriculture sector in India. Because poultry meat and eggs are of high quality, nutritious, and reasonably priced, demand for them is rising more quickly. The need for poultry feed is rising along with the demand for eggs and poultry meat. The majority of the ingredients used in poultry feed are also utilized in human nutrition. As a result, market competition and rising costs are affecting these key feed ingredients and poultry feed as a whole. The purpose of this study is to develop a linear programming model that allows small scale poultry business owners to maximize their profits while minimizing farm costs, with feeds being the only resource optimized. This study introduced a linear programming approach to reduce the feed expenses for small-scale poultry business owners. The Simplex method has been employed to develop and resolve the Linear Programming model. This includes developing objective function, demand constraints, nutrient requirement constraints and non-negativity constraints. Also information on the prices of locally available feed ingredients, their availability and nutrient composition are presented here for the development of Linear Programming model equations.

Key Words: Poultry feed cost, Optimization, Linear Programming ,simplex method

Theme: Applied Statistics

Prediction of Rainfall in Himachal Pradesh using Statistical and Machine Learning Models

Diya Binu George¹, Radhalakshmi K.N², Rajesh R³

Department of Statistics and Data Science, CHRIST (Deemed to be University), Bengaluru, India

*Corresponding Author E-mail: diyabinu.george@stat.christuniversity.in

ABSTRACT

Climate change greatly influences hydrological cycles, affecting precipitation and extreme weather events. Accurate rainfall prediction is crucial for effective water resource management and disaster preparedness, especially in regions like Himachal Pradesh. This study develops and evaluates various statistical and machine learning models for rainfall prediction, incorporating key climatic variables such as temperature, wind speed, and relative humidity. Both linear and non-linear modeling approaches are explored to capture complex relationships among meteorological variables. The findings demonstrate the benefits of using exogenous predictors in standard models. Among all the models tested Extreme Gradient Boosting (XGBoost) emerged as the best technique for modeling non-linear rainfall behavior. These results highlight the potential of integrating machine learning with climatic variables to enhance rainfall prediction, providing valuable insights for policymakers and disaster management authorities in addressing challenges posed by climate variability.

Keywords: ARIMAX; Machine learning; Climate change; XGBoost.

Explainable Machine Learning and Statistics for Early Bankruptcy Prediction: Evidence from the Taiwan Bankruptcy Dataset

Nandini Mukherjee, Radhalakshmi K N
Christ (Deemed to be University), Bangalore

ABSTRACT

Bankruptcy prediction is vital for stakeholders, yet most studies focus on short-term horizons, leaving little room for corrective action. This study extends the timeline by developing machine learning models to predict bankruptcy risk 2–3 years in advance using the Taiwan bankruptcy dataset. Unlike traditional approaches limited to a few financial ratios, we utilize a high-dimensional set of profitability, liquidity, leverage, efficiency, and cash flow indicators. Since the class disproportion is very intense, we use resampling techniques and cost-sensitive learning. I am using several trained models, such as documenting logistic Regression, documenting random forests, documenting XG Boost, and documenting ensemble voting classifiers with a focus on demonstrating predictive accuracy, rare event sensitivity, and confidence. Explainable AI mechanisms are also utilized to illustrate important financial ratios that contribute to early risk indicators. The study introduces enhancements to the current learning by integrating meaningful financial measures, misalignment management methodologies, and clarifiable machine learning, alongside the probable usefulness of situation anticipatory and transparent early warning systems.

Systematic Literature Review: E-Tendering Effectiveness, Implementation Challenges, and the Transformative Agenda in Public Sector Construction

Elis Mardzianah Mazlan^{1,2}, Asmawan Mohd Sarman^{1,2*}, Siti Syariazulfa Kamaruddin¹

¹*Faculty of Engineering, Universiti Malaysia Sabah, Kota Kinabalu, Sabah 88400, MALAYSIA.*

²*Advanced Construction Technology (ACT) Research Unit, Faculty of Engineering, Universiti Malaysia Sabah, Sabah 88400, MALAYSIA.*

**Corresponding Author E-mail: asmawan@ums.edu.my*

ABSTRACT

The transition to digital governance necessitates the rigorous examination of e-tendering adoption within the public sector, particularly for large-scale, high-value public works such as university construction projects. This systematic literature review (SLR) synthesizes findings from 157 peer-reviewed articles and reports published between 2000 and 2025, aiming to delineate the relationship between e-tendering systems and procurement outcomes. The review utilizes a robust thematic analysis, structured around the People, Process, Technology, and Environment (PPTE) framework, to classify documented benefits, implementation barriers, and critical success factors (CSFs). Key findings confirm that while e-tendering delivers substantial gains, including improved efficiency (with evidence of up to 42% cost reduction in tendering costs) and enhanced auditability and transparency, its ultimate effectiveness is frequently derailed by persistent socio-technical challenges. These challenges chiefly include resistance to change among stakeholders and growing cyber-security vulnerabilities. Furthermore, the review establishes the necessity of integrating theoretical frameworks, such as the Technology-Organization-Environment (TOE) and Institutional Theory, to better model complex public sector adoption dynamics and inform policy. The findings contribute a consolidated roadmap for policymakers in public sector agencies and higher education institutions (HEIs) seeking sustainable digital procurement transformation in construction. This provides a critical resource for managing change and mitigating risks in the shift toward fully digital procurement processes.

Keywords: E-Tendering, Digital Transformation, Construction Projects, PPTE Framework.

Study on Curvi-Linear Regression Model for Predicting Entropy of Octane Isomers

Aditya Pegu^{1,*}, A. Bharali²

^{1,2}*Department of Mathematics, Dibrugarh University, India, 786004*

^{*}¹adityapegu92@gmail.com, ²a.bharali@dibru.ac.in

ABSTRACT

In this study, we perform linear and curvi-linear regression model for Quantitative Structure Property Relationship(QSPR) analysis to predict the entropy of Octane Isomers using topological indices(TIs) derived from the chemical graph of Octane Isomers. We choose degree-based and their corresponding neighborhood degree-based TIs for the analysis and compared their relation with the entropy of Octane Isomers. The acquired results are quite remarkable. The TIs can also be considered to predict various physicochemical properties of different chemical compounds and scientist may consider it to design new drugs.

Interdependent Strategies and Uncertain Flows: An Economic Analysis of Rajasthan's Religious Tourism

Mr. Franshu Mahipal

Research Scholar, Department of Mathematics, Tantia University, Sri Ganganagar, India

Email-franshumahipal007@gmail.com

ABSTRACT

This study analyses the economic significance and strategic behavior shaping Rajasthan's religious tourism sector by integrating game theory with stochastic financial modeling. Rajasthan hosts several major pilgrimage centers including Pushkar, Nathdwara, Salasar Balaji, Khatu Shyam Ji, and the renowned **Ajmer Sharif Dargah** that collectively draw millions of pilgrims annually. Religious tourism contributes approximately **8–10%** of the state's total tourism revenue, fostering employment and supporting associated industries such as hospitality, transportation, local retail, and handicrafts. Despite its importance, the sector operates under considerable uncertainty driven by seasonal fluctuations, festival-related surges, infrastructural constraints, and exogenous shocks linked to climate variability and digital behavioral shifts. To examine these challenges, the study employs Nash Equilibrium and Stackelberg leadership models to conceptualize strategic interactions among government agencies, private service providers, and local communities. The results indicate that cooperative equilibria supported by coordinated infrastructure investment, effective regulation, and service innovation produce the most efficient outcomes. Additionally, stochastic approaches, including Poisson arrival processes and Monte Carlo revenue simulations, are used to estimate volatility in pilgrim inflows across major sites. These models highlight the sector's high sensitivity to ritual calendars, peak seasons, and unpredictable external events, underscoring the need for risk-adjusted and adaptive policy planning.

Overall, the study provides a structured analytical framework for understanding Rajasthan's religious tourism economy and offers evidence-based recommendations for building a more sustainable, resilient, and strategically aligned tourism policy for the state.

Keywords: Religious Tourism, Game Theory, Stochastic Modeling, Rajasthan Economy.

Delay-Dependent Stochastic Stabilization and H_∞ Performance of T–S Fuzzy Markov Jump Systems under Fault-Tolerant Stochastic Sampled-Data Control

S. Ruth Dunamis¹, T. Radhika^{2,*}, A. Chandrasekar³

Department of Mathematics, School of Advanced Sciences, Vellore Institute of Technology, Vellore-632 014, Tamilnadu, India.

*Corresponding Author E-mail: radhigru@gmail.com (T. Radhika)

ABSTRACT

This paper presents a fault-tolerant stochastic sampled-data controller (FTSSDC) for stabilizing Takagi–Sugeno (T–S) fuzzy Markov jump systems (MJSs) with time-varying delays (TVDs) and external disturbances. The proposed controller incorporates time-varying sampling intervals, enabling a dynamic response that enhances control effectiveness. Actuator faults are addressed through a stochastic sampling mechanism embedded within the T–S fuzzy MJSs framework, ensuring robustness under uncertain operating conditions. To improve the precision of stability analysis, a new Lyapunov–Krasovskii functional (LKF) with additional delay-dependent cross terms is constructed, allowing a more detailed characterization of system dynamics. An improved reciprocally convex inequality (IRCI) is also developed to achieve tighter integral estimates. By integrating the enhanced LKF and IRCI, delay-dependent stabilization criteria are derived in the form of linear matrix inequalities (LMIs), guaranteeing stochastic stability and ensuring the required H_∞ performance level. These LMI-based conditions offer efficient and conservative solutions compared to existing methods while enabling systematic verification and controller synthesis. Simulation results demonstrate the effectiveness of the proposed FTSSDC, confirming superior control performance, enhanced stability, and improved disturbance attenuation.

Keywords: Fault-tolerant stochastic sampled-data controller, Takagi-Sugeno fuzzy Markov jump systems, improved reciprocally convex inequality, H_∞ performance.

Statistical Process Control Approach to Reducing Errors in Financial Transactions Using Control Charts

Dr. Ajit Goswami

Department of Statistics, DHSK Commerce College, Dibrugarh , Assam

*agoswami09@gmail.com

ABSTRACT

In the modern financial environment, accuracy and reliability in transaction processing are critical to maintaining customer trust and operational efficiency. This study applies the principles of Statistical Process Control (SPC) to monitor and reduce the number of errors in financial transactions. By employing control chart techniques—specifically the Shewhart, Exponentially Weighted Moving Average (EWMA), and Cumulative Sum (CUSUM) charts—the research aims to identify process variations, detect abnormal patterns, and support continuous quality improvement in financial operations. Using a simulated dataset representing 30 days of transaction error counts, control limits were established to distinguish between common-cause and special-cause variations. The results demonstrate that control charts provide a powerful visual and analytical tool for identifying process instability and guiding corrective measures. Findings indicate that the implementation of SPC methods can significantly reduce error rates, enhance process capability, and improve the overall accuracy of financial systems. The study highlights the potential of SPC as a low-cost, data-driven approach to quality assurance in the financial services sector, with implications for digital banking, payment processing, and financial audit functions.

Keywords: Statistical Process Control; Control Chart; Financial Transactions; Error Reduction;

Reha Cast: A Smart Sensor Splint Using Data and Statistical Models for Better Rehabilitation

¹Keerthika S, ²S. K. Kabilesh, ³Kamalesh P, ⁴Karavadi Varun Sai, ⁵Kavidass S
*Department of Electronics and Communication Engineering, Jansons Institute of Technology,
Coimbatore, Tamilnadu, India*

*Corresponding Author E-mail : kabileshsk@gmail.com

ABSTRACT

Fracture rehabilitation usually depends on periodic clinical assessments, which may not capture real-time changes in healing. Traditional splints only provide physical support and lack intelligent monitoring and feedback capabilities. To address this, we present **RehaCast**, a sensor-integrated smart splint designed to support optimized rehabilitation through data-driven insights. The system uses embedded sensors to continuously collect key parameters such as motion, pressure, temperature, and muscle response during recovery. The collected data is analyzed using **mathematical modeling and statistical techniques**, including regression analysis, time-series forecasting, and correlation analysis, to predict healing progress and identify early signs of improper immobilization or delayed recovery. Statistical optimization methods are applied to personalize therapy recommendations, helping clinicians make informed decisions on exercise intensity, safe mobility levels, and rehabilitation timelines. Techniques such as Principal Component Analysis (PCA) and ANOVA are used to determine the most influential recovery factors. Pilot testing indicates improved functional recovery, better tracking accuracy, and reduced rehabilitation duration compared to conventional splints. The results were validated using t-tests and confidence interval analysis, demonstrating the effectiveness of the system. RehaCast showcases the integration of mathematics, statistics, and biomedical technology to create a smart, adaptive, and personalized rehabilitation platform. This work highlights the growing role of quantitative methods in healthcare innovation.

Keywords: Smart Splint, Rehabilitation Analytics, Statistical Modeling, Predictive Recovery

Real Time on Board Sensor Data Monitoring in Electric Vehicles

¹Sathishkannan B, ²S. K. Kabilesh, ³Surekha N, ⁴Shri Dharshan R C

*Department of Electronics and Communication Engineering, Jansons Institute of Technology,
Coimbatore, Tamilnadu, India*

*Corresponding Author E-mail : kabileshsk@gmail.com

ABSTRACT

Electric vehicles utilize a number of sensors that aid in the observation of the condition of the battery, as well as the safety of the car. However, in many existing systems, sensor data is logged but not fully harnessed for real-time analysis. This reduces the effectiveness of car maintenance plans. This paper describes a live onboard system for monitoring data read by sensors installed in an electric vehicle. The system monitors the operating parameters in a continuous fashion when the vehicle is operational. It receives live readings directly from battery voltage and current sensors, temperature sensors, motor speed sensors, and vibration sensors. The readings are preprocessed onboard by means of fundamental preprocessing operations such as filtering. Simple mathematical and statistical methods are employed to analyze variations in system dynamics over time. Time series analysis assists in monitoring battery drainage, temperature variation, as well as motor loading while a vehicle is in use. Correlation analysis assists in identifying variations in power consumption, temperature, and use of a vehicle. Threshold values enable monitoring to detect unusual situations like overheating, strange current consumption, and motor stress. The processed information will be presented through a real-time dashboard, which will allow drivers and service technicians to monitor the status of vehicles, as well as get notifications whenever values exceed safe limits. Experiments carried out on normal and stressed driving cycles have shown that the proposed method can improve defect visibility, promote maintenance on time, and generally improve the reliability of vehicles. It has been proved in this research that constant monitoring of onboard sensors can be of high benefit in ensuring improved electric vehicle safety and reliability.

Keywords : Electric Vehicles, Onboard Sensors, Real-Time Monitoring, Battery Health, Vehicle Diagnostics

A Statistical Comparison of Retinal Imaging Modalities Using Multimodal Deep Learning Algorithms for Disease Detection

¹R. Swaranambigai, ²Dr C. Maheswari, ³S. K. Kabilesh

¹*Department of Electronics and Communication Engineering, Jai Shriram Engineering College, Tirupur, Tamilnadu, India*

²*Department of Electrical and Electronics Engineering, Kongu Engineering College, Perundurai*

³*Department of Electronics and Communication Engineering, Jansons Institute of Technology, Coimbatore, Tamilnadu, India*

rswaranambigai@gmail.com

ABSTRACT

Retinal diseases, including diabetic retinopathy, age related macular degeneration, and glaucoma, are leading causes of vision impairment globally. Early and precise detection plays a crucial role in preventing disease progression and vision loss. This study presents a comprehensive comparative analysis of durable retinal imaging modalities Color Fundus Photography (CFP), Optical Coherence Tomography (OCT), Optical Coherence Tomography Angiography (OCTA), Fluorescein Angiography (FA), and Ultra-Widefield (UWF) Imaging to evaluate their diagnostic performance in detecting retinal condition. Using multi center imaging datasets and standardized evaluation criteria, we assess the diagnostic accuracy, sensitivity, specificity, and clinical applicability of each modality. CFP remains a cost effective and widely used screening tool, while OCT provides high resolution cross-sectional imaging, vital for assessing retinal layers affected in macular and glaucomatous diseases. OCTA offers a non-invasive visualization of microvascular blood flow, enabling early detection of neovascular changes, whereas FA, despite its invasive nature, is considered the gold standard for visualizing vascular leakage and neovascularization. UWF imaging expands retinal coverage to detect peripheral lesions often missed by conventional imaging. Our results highlight the complementary roles of these modalities, suggesting integrated multi modal approaches augmented by artificial intelligence can enhance diagnostic precision and patient management. This comparative study underscores the importance of tailored imaging strategies in clinical ophthalmology and advances future research directions in retinal disease diagnosis.

Keywords: Retinal imaging, Optical Coherence Tomography, Fluoresce in angiography, Ultra-widefield Imagin.

Semi-Markov Modelling of Multistage Call Centers with Impatient Customers and Overflow Routing

Bhupakhi Deka¹, Priyanka Kalita²

^{1,2}*Statistics Department, Bhattadev University, Bajali, Assam, India*

E-mail: bhupakhi@gmail.com

ABSTRACT

Traditional analytical frameworks for staffing multistage call centers largely rely on Continuous-Time Markov Chain (CTMC) models, which impose exponential assumptions on service times, customer patience, and transition dynamics. While these assumptions ensure analytical tractability, they limit the ability to represent operational behaviors such as general service-time variability, heterogeneous abandonment patterns, and time-dependent overflow between service stages. To address these limitations, this study develops a Semi-Markov Process (SMP) formulation derived from an established CTMC model for two-stage call centers with impatient customers. The proposed SMP preserves the structural state representation and workflow logic of the CTMC framework while introducing general state-dependent holding-time distributions to accommodate non-exponential system characteristics. Within this modelling setting, performance measures primarily expected waiting time and related waiting-based indicators are examined to evaluate the applicability and potential advantages of adopting a semi-Markov representation for multistage call center operations. The study additionally explores the feasibility of integrating lightweight machine-learning components as complementary tools for estimating waiting-time metrics under varying operational conditions. Overall, this work establishes a more flexible and empirically aligned modelling paradigm for call-center systems, with relevance to a broader class of service and queueing environments.

Keywords: Semi-Markov Process; Multistage Call Centers; Reneging.

Systematic Mobile Assessment and Reporting Tool Of Condition Survey Investigation (SMART-CSI) For Building Maintenance Management Toward Digitalization.

Asmawan Mohd Sarman^{1,2}, Elis Mardzianah Mazlan^{1,2,*}, Mohd Husni Husin¹, Habib Musa Mohamad^{1,2}, Nelly Majain^{1,2}, Tom Ngui Min Fui¹, Siti Kartini Ali Ashgar¹

¹*Faculty of Engineering, Universiti Malaysia Sabah, Jalan UMS, 88400 Kota Kinabalu, Sabah, MALAYSIA*

²*Advanced Construction Technology (ACT) Research Unit, Faculty of Engineering, Universiti Malaysia Sabah, Sabah 88400, MALAYSIA.*

*Corresponding Author E-mail: elis@ums.edu.my

ABSTRACT

Most people use applications on their smartphones to manage their daily activities because it is easy to carry and more convenient to use. Towards fulfilling the Industrial Revolution 4.0, SMART-CSI is developed to manage building maintenance and to produce a tool to ease the Condition Survey Investigation (CSI) process. SMART-CSI is the application that can be used to report any defects that are witnessed at the building. To ease the reporting process, building users can use the SMART-CSI application to report the defects to the administration for action to be taken. Besides that, in the report form, there is also a condition survey investigation using the CSP 1 matrix that shows the condition of the building. Condition Survey Protocol (CSP) 1 matrix is one of the methods to assess and investigate the condition of a building. Hence, the application can do two things, which are report building maintenance and assess condition survey investigation using CSP 1 matrix. The process of development is using Ionic framework, which is one of the mobile applications development software. The database to save and manage the data collected from the application is stored using an online database, which is are MySQL database. The application is simple; however, it can give a huge benefit to the user, especially the administrator of the building.

Keywords: Reporting tools; Condition survey investigation; CPS 1 matrix; SmartCSI;

Stochastic Modelling and Performance Optimization of IoT Enabled Smart Manufacturing Systems via Markov Regenerative Process

Nirikhita Goswami¹, Dr Priyanka Kalita^{2,*}

Department of Statistics, Bhattadev University, Bajali, Assam-781325, India

*Corresponding Author E-mail: sta.priyanka@bhattadevuniversity.ac.in

ABSTRACT

The optimization of production facilities within IoT-enabled smart manufacturing systems has emerged as a key focus of current research, with the goal of increasing cost efficiency and operational effectiveness. In this research, two different kinds of heterogeneous repeated services and a modified vacation policy are combined with an $M^X/G/1$ queue system to depict the smart manufacturing facility. The IoT-enabled facility includes two main categories of production-type 1 and type 2 services as well as operations such close-down tasks, warehouse with different capacity (type 1 and type 2 vacations), dormant periods and start-up activities. Explicit equations for the steady-state queue size distribution and system size probabilities are obtained by using embedded Markov chain and Markov Regenerative Process approaches. The study focuses on optimizing the total production cost by improving control parameters P and M , while also offering real-time monitoring via IoT based data analytics. Furthermore, the model illustrates the trade off between predicted total cost and throughput, helping decision makers to maximize production efficiency. The proposed stochastic process shows how IoT integration improves system responsiveness, reduced idle periods and increases manufacturing productivity.

Keywords: $M^X/G/1$; Modified vacation policy; Markov Regenerative process; Cost optimal policy.

Frequency analysis of monthly maximum rainfall for monsoon season: A case study for Bramaputra valley region of Assam

Abhiit Bhuyan^{1,*}

Commerce, C.K.B. College, Teok, Jorhat, India

*Corresponding Author E-mail: abhijitckbc@gmail.com

ABSTRACT

In this study a regional rainfall frequency analysis for monsoon season of Brahmaputra valley of Assam has been carried out by using L-moment parameter estimation method. For this purpose, monthly maximum rainfall data of 11 sites has been collected from Indian Meteorological Centre, Guwahati. Five three parameter probability distributions namely generalized extreme value (GEV), generalized logistic (GLO), Pearson type 3 (PE3), generalized Pareto (GPA) and generalized normal (GNO) are used in this study. Regional homogeneity has been tested for our data set by using the heterogeneity measure. It has been observed from heterogeneity measure that the study region is found to be a homogeneous one. The two goodness of fit tests i.e. Z-statistics criteria and L-moment ratio diagram are used for finding out the best fitting distribution. It has been observed from goodness of fit test that the GLO distribution is identified as the best fitting distribution for our study region. The regional rainfall frequency model has been developed by using the GLO distribution for our study region.

Keywords: Rainfall frequency analysis; Heterogeneity measure; Probability distribution; L-moment;

An Approach to M/M/1 Queuing Model: Balking, Reneging & Rejoining under Multiple vacation

Gyandeep Sharma¹, Pallabi Medhi²

^{1,2}Department of Statistics, Gauhati University, Assam, India

*Corresponding author email: gyan98@zohomail.com

In this paper, we investigate a single-server Markovian queuing model considering customer's impatience under multiple vacation policy. The server does not provide service to customers during vacation periods, and customers may either renege or balk in this state. During active state, customers neither renege nor balk. Additionally, the queuing system has a notification mechanism where the system notifies all balked customer that the server is active. As a result, a fraction of balked customer may rejoin the system with certain probability again forming an additional input stream along with the regular arrival of customer. Various system parameters have been presented to evaluate system efficiency. Sensitivity analysis is performed to examine the impact of system parameters on different performance measures. A cost model is framed on the proposed queuing model on which we apply Genetic Algorithm (GA) to determine the minimum cost and optimal values for system parameters. This approach aids management in optimizing customer service while maintaining cost efficiency.

Harnessing Statistical Applications for Evidence-Based Policy, Effective Governance, and Sustainable Development in India.

Dr. Poli Boruah

Assistant Professor, Department of Economics, L.T.K. College, Azad, North Lakhimpur.

Email ID : poliboruah11@gmail.com

ABSTRACT

Statistical applications have become an indispensable tool for evidence-based policymaking, effective governance, and sustainable development in India. In a rapidly evolving socio-economic landscape, policymakers require accurate, timely, and reliable data to design, implement, and monitor policies that address complex challenges such as poverty, healthcare, education, urbanization, and environmental sustainability. This paper examines the role of statistical methods and data analytics in supporting informed decision-making processes at both central and state levels. It highlights how statistical tools, including survey sampling, econometrics, big data analytics, and predictive modeling, enable governments to assess policy impacts, allocate resources efficiently, and identify areas of intervention. Case studies from sectors such as health, agriculture, and urban planning illustrate the practical utility of statistical applications in tracking developmental outcomes, optimizing program effectiveness, and fostering transparency and accountability. Furthermore, the integration of advanced statistical techniques into governance frameworks enhances the capacity to anticipate emerging socio-economic trends, mitigate risks, and promote inclusive growth. Despite progress, challenges such as data quality, accessibility, methodological gaps, and limited statistical literacy among stakeholders persist and need to be addressed to maximize the potential of data-driven governance. The study concludes that institutional strengthening, investment in statistical infrastructure, and capacity-building initiatives are crucial for leveraging statistical applications to achieve sustainable development goals in India. By fostering a culture of evidence-based policymaking, statistical applications can significantly contribute to efficient governance, socio-economic equity, and long-term sustainability.

KEYWORDS: Evidence-based policy, governance, optimizing program, statistical applications, sustainable development.

Understanding Spatial Variation in Dementia Prevalence using Ordinary Least Square and Geographically Weighted Regression

Sanchayita Alambyayan^{1*}, Jonali Gogoi²

Department of Statistics, Assam University, Silchar-788011, Silchar, Assam India,

*Corresponding author Email-ID: alambyayan.sancha2998@gmail.com

ABSTRACT

Dementia is a health disorder and about 10 million new cases reported annually. The present study investigates how the spatial factors associated with dementia prevalence by using ordinary least square (OLS) and geographically weighted regression (GWR) approach. Compared to OLS, GWR showed improve model accuracy in spatial analysis. The result shows that poor air quality consistently increases dementia prevalence, whereas factors such as healthcare provision, environmental quality, and urban density vary across region, indicating the need for region specific strategies. Overall, the findings highlighted the importance of spatially explicit analyses in understanding complex epidemiological patterns and guiding geographically targeted public health policies.

Keywords: Dementia, geographically weighted regression, ordinary least squares, spatial factor.

Impact of Bai–Perron Structural Breaks on the Predictive Performance of Econometric and Machine-Learning Models for Indian Equity Indices

Sohom Majumder¹, Vivek Pathak²

¹*Research Scholar, Department of Management, ICFAI University, Sikkim*

²*Associate Professor, Department of Management, ICFAI University, Sikkim*

Abstract

Financial time series for equity indices are well known to exhibit structural breaks arising from crises, policy shifts and macroeconomic shocks. Ignoring such breaks can distort model estimation and lead to misleading in-sample and out-of-sample performance. This study investigates how structural breaks affect the short-horizon predictive accuracy of alternative modeling families for Indian stock indices. Using daily data for the NIFTY 50 and selected sectoral indices, this study applies the Bai–Perron multiple breakpoint test to identify statistically significant changes in the mean and dependence structure of returns. The resulting break dates define distinct regimes, such as pre- and post-COVID and pre- and post-geopolitical shock periods. Within each regime, and on the pooled sample, this study estimate, a set of classical econometric models—ARIMA, ARDL, GARCH-type specifications, vector autoregressions (VAR), and Markov-switching autoregressive models—and compare them with benchmark machine-learning classifiers, including regularised logistic/ordinal regression, Random Forests, Gradient Boosting and XGBoost-based ordinal models. Forecast targets are defined as one-step-ahead return direction and multi-class ordinal movements. Performance is evaluated using accuracy, balanced accuracy, macro-F1, AUROC and Brier scores, and differences are assessed via Diebold–Mariano and Wilcoxon signed-rank tests. Preliminary evidence suggests that regime-specific

estimation significantly improves forecast performance and that the relative ranking of econometric versus machine-learning models itself changes across structural regimes, highlighting the importance of explicit break detection in stock-market forecasting.

Keywords: Structural breaks, Bai–Perron test, Indian equity indices, NIFTY 50, time series forecasting, econometric model.

Higher-Order Expansions of the Disturbing Function: Secular Oscillations, Resonances, and Long-Term Chaos

Ruqiyah Aslam & Prof. S.N. Hasan

*Department of Mathematics, School of Sciences, Maulana Azad National Urdu University,
Hyderabad, India.*

Email: ruqiyahaslam@gmail.com

ABSTRACT

The study of gravitationally bound many-body systems is important in celestial mechanics, as they represent various structures in the universe, such as planetary systems, star clusters, and galaxies. For $n > 2$, these systems have no closed-form solutions, and resonances further complicate their dynamics. To study such systems, we define the disturbing function as the perturbing potential, whose gradient allows us to write the equations of motion in a form suitable for perturbation analysis. This function contains all the information about the system, including energy and angular momentum exchanges between bodies. It helps us understand how planets, moons, and other bodies gravitationally influence one another and modify each other's orbits. Expanding the disturbing function into a series is particularly useful because it reveals the rich dynamical behavior of multi-body systems. While many well-known expansions exist in the literature, in this paper we extend them by including higher-order terms. These additional terms are crucial for describing systems in which the semi-major axes of two bodies are very close to each other, the orbital eccentricities are large, or the orbital inclinations relative to the reference plane are significant. By incorporating higher-order terms, we show how they drive long-term changes in eccentricity and inclination. Far from being minor corrections, these higher-order terms can govern long-term orbital evolution, drive large-amplitude changes in eccentricity and inclination, and are a primary source of chaotic behavior in multi-body systems.

Keywords: Celestial Mechanics; Disturbing Function; Perturbation; Dynamical Systems;

Trend Analysis of Annual Maximum Rainfall data of Cherrapunji, Meghalaya using Non Parametric Methods

Dr. Dhruba Jyoti Bora

Assistant Professor, Department of Mathematics, Kaliabor College

Email-dhrubabora24@gmail.com

ABSTRACT

In this study it is tried to analyse the rainfall pattern of Cherrapunji. Meghalaya. For this study annual maximum rainfall data of Cherrapunji over a period of 30 years (1984-2013) has been taken. Non-parametric methods Mann-Kendall (MK) Test, Sen's Slope Estimator and Pettitt's Test has been applied for the study. MK test shows that the rainfall trend is decreasing while Sen's slope estimator reveals that the annual maximum rainfall of Cherrapunji is decreasing at the rate of 7.3 mm per year. Pettitt's test shows that the rainfall pattern is declining from the year 2006.

Keyword: *Rainfall trend, Mann-Kedall test, Sen's Slope, Pettitt's Test.*

A TWO-VARIABLE NONLINEAR MATHEMATICAL MODEL FOR MARRIAGE-DIVORCE DYNAMICS VALIDATED THROUGH MACHINE-LEARNING ERROR ANALYSIS

S SINDU DEVI, A DANYA

SRM INSTITUTE OF SCIENCE AND TECHNOLOGY, RAMAPURAM, CHENNAI.

ABSTRACT

Machine Learning provides a powerful data-driven framework for evaluating the predictive accuracy of mathematical models. In this study, we develop a two-variable nonlinear differential equation model representing the dynamics between Married and Divorced populations and we validate its performance using machine-learning regression methods. Prediction errors obtained from multiple machine-learning algorithm are evaluated against the corresponding errors of the analytical model, enabling a quantitative assessment of the model's fidelity. The result show that the machine-learning models generate errors that closely align with the trajectories of the mathematical model, indicating strong structural agreement between the data-driven and equation-based approaches. This demonstrates that the proposed mathematical model accurately captures the essential marriage-divorce dynamics and is consistent with the patterns learned by machine-learning algorithms. The study highlights the utility of machine-learning error analysis as a model tool for validating nonlinear social system models.

KEYWORDS: Nonlinear Differential Equations, Mathematical Modeling, Machine-Learning Validation, Error metrics.

Factors Determining Women's Empowerment in Rural Areas: A Statistical Analysis

Abhinanda Bordoloi¹, Pranita Goswami², Lipi B Mahanta^{3,*}

¹*Department of Statistics, Gauhati University, Guwahati, Assam, INDIA*

²*Pragjyotish College, Guwahati, Assam, INDIA*

³*Mathematical and Computational Sciences Division, Institute of Advanced Study in Science and Technology, Guwahati, Assam, INDIA*

Email: abhinandabordoloi2018@gmail.com

ABSTRACT

Women's empowerment is one of the momentous issues of contemporary development policies in developing countries. This research study delves into the determinants of women's empowerment in rural areas of Assam, India, employing statistical techniques such as logistic regression. Drawing on data collected from 823 respondents, the study examines the influence of education, income, occupation, gender inequality on women's decision-making abilities within the family context. The findings reveal that education emerges as a significant predictor of women's empowerment, consistently impacting their decision-making autonomy across various models. Specifically, higher levels of education are associated with increased empowerment, highlighting the critical role of educational empowerment in fostering women's agency and autonomy. Furthermore, gender inequality within the household also exerts a notable influence on women's decision-making, underscoring the need for addressing patriarchal norms and promoting gender equity. However, women's income does not emerge as a significant predictor in the models, suggesting that economic empowerment alone may not suffice to enhance women's decision making abilities. Overall, the study contributes valuable insights into the multifaceted nature of women's empowerment and underscores the importance of educational empowerment in promoting gender equality and women's rights in rural India.

Keywords: Women empowerment; Rural area; Statistical Analysis.

Incidence and Mortality of Stroke Patients in Odisha: Epidemiological Patterns from 2023–2024

Dr. Chakrala Sreelatha¹, Keshav Kumar Padihar²

¹ Assistant Professor, HOD, Department of Statistics, Rajendra University, Balangir

² Research Scholar, Department of Statistics, Rajendra University, Balangir

ABSTRACT

Background:

Stroke remains a major contributor to morbidity and mortality in India. Odisha, in particular, has shown notable geographic and demographic variations in stroke burden. This study examines stroke incidence, mortality, and population characteristics in Odisha using data extracted from the Global Burden of Disease (GBD) Study for the years 2018–2019.

Methods:

Secondary data were obtained from the Global Burden of Disease (GBD) 2023 database, focusing on stroke estimates for Odisha. Patient characteristics were summarized by age group, gender, and stroke type. Age-specific incidence rates were calculated using GBD-estimated population denominators. Crude incidence rate and age-standardized incidence rate (ASR) were computed using the direct method with the WHO World Standard Population (2000–2025). Mortality rates and case-fatality proportions were derived from GBD stroke-related deaths for the same period.

Results:

Stroke incidence in Odisha demonstrated a steep rise with advancing age, with the highest burden observed among individuals aged 65 years and above. Ischemic stroke accounted for the majority of cases, whereas hemorrhagic stroke contributed disproportionately to mortality.

Conclusion:

GBD-based estimates highlight significant age-related and geographic inequalities in stroke burden in Odisha. The combination of higher incidence in older adults and elevated mortality in rural regions underscores the need for enhanced stroke prevention, early detection, and improved access to emergency stroke care. These findings provide evidence-based insights to support state-level public health planning.

Keywords: Stroke, Incidence, Global Burden of Disease (GBD), Crude incidence rate and age-standardized incidence rates.

Convolutional Neural Network Variants and Performance Improvements in Knee Osteoarthritis: An Overview

Annu James

Karunya Institute of Technology and Science

ABSTRACT

Convolutional Neural Networks have improved pattern recognition, particularly in processing visual data, by efficiently extracting features and learning patterns for classification. Their applications span image and video recognition, medical imaging, NLP, and autonomous systems, though challenges like data dependency and interpretability remain. In knee osteoarthritis (KOA) analysis, deep learning approaches, including CNNs, statistical shape models, transfer learning, and hybrid models, have shown remarkable success. ResNet-based architectures achieved high accuracy in total knee replacement classification, while CNN-based segmentation models attained over 97% Dice Similarity Coefficient in cartilage and knee segmentation. Multi-task CNNs and Dense Neural Networks improved OA progression prediction (AUC 0.79), and CNN-LSTM models enhanced severity grading. Feature Pyramid Networks facilitated abnormality detection, and transfer learning models like ResNet50, VGG16, and InceptionNetv3 significantly improved accuracy, with ResNet50 reaching 95%. Additionally, 3D CNNs enabled better spatial feature extraction for precise OA severity classification. These advancements underscore CNN's potential in automating KOA diagnosis and personalized treatment planning. The study also discuss disadvantages of using CNN.

Exploring the role of education in Teenage Pregnancy: A Mediation Analysis approach

Baby Das^{1,*}, Manash Pratim Barman² & Julius Moinget Loibor¹.

¹Research Scholar, Department of Statistics, Dibrugarh University.

²Professor, Department of Statistics, Dibrugarh University.

ABSTRACT

Background: Teenage pregnancy remains a persistent public health and social concern, particularly in developing regions like Assam, India. Early childbearing affects educational attainment, restricts economic opportunities, and increases health risks for both mothers and infants. Despite its high prevalence, limited research has examined the complex pathways through which education influences adolescent motherhood in Assam.

Objectives: This study investigates how education mediates the relationship between socio-demographic factors such as place of residence, wealth index, religion, and caste and teenage pregnancy among women of reproductive age in Assam.

Methods: Using data from the fifth round of the National Family Health Survey (NFHS-5, 2019–21), the study analyzed a weighted sample of 16,643 women who had given birth. Descriptive statistics, chi-square tests, multinomial and binary logistic regression, and Structural Equation Modeling (SEM) were employed to examine both direct and indirect effects. Education was treated as a mediating variable between the exogenous factors and teenage pregnancy.

Results: The overall prevalence of teenage pregnancy in Assam was 27.7%, with a mean age at first birth of 21.14 years. Educational attainment showed a strong inverse association with early childbearing; women with secondary ($\beta = -0.29$, $p < 0.001$) and higher ($\beta = -2.78$, $p < 0.001$) education were significantly less likely to experience teenage pregnancy compared to those with no education. Wealth and religion exhibited both direct and indirect effects on teenage pregnancy through education, while caste showed negligible influence. The mediation analysis confirmed that education acts as a key pathway through which socioeconomic and religious factors affect adolescent fertility outcomes.

Conclusions: Education significantly reduces the likelihood of teenage pregnancy and mediates the impact of social and economic determinants. The findings highlight the need to strengthen educational access, particularly for rural and marginalized girls. Enhancing girls' education, economic empowerment, and health awareness can serve as sustainable strategies to mitigate teenage pregnancy in Assam.

Keywords: Teenage Pregnancy; Mediation Analysis; Education; Assam.

Health-Related Quality of Life (HRQoL) and Hypertension Status among older adults in Assam

***Krishna Borah**^{1*}, **Prof. Manash Pratim Barman**²

^{1*}*Research Scholar, Department of Statistics, Dibrugarh University, Dibrugarh, Assam, India, Pin: 786004*

(ORCID: 0009-0005-5722-3787), Email: krishnaborah04@gmail.com

²*Professor, Department of Statistics, Dibrugarh University, Dibrugarh, Assam, India, Pin: 786004*

(ORCID: 0000-0002-2235-5457), Email: manash_stats@dibru.ac.in

ABSTRACT

Background and aims: Population ageing is one of the most significant demographic transitions and is considered a crucial demographic issue that warrants considerable attention. Identification and prediction of significant risk factors associated with hypertension can have a major influence on preventing hypertension in this population segment. The objective of this study is to identify the risk factors associated with hypertension and compare the performance of specific machine learning algorithms in predicting the risk of hypertension.

Methods: This study is based on five types of popular supervised machine learning (ML) algorithms for predicting risk factors of hypertension, which are: Logistic Regression (LR), Random Forest (RF), CatBoost, Gradient Boosting and Extreme Gradient Boosting (XGB) to build the most appropriate predictive model, along with the identification of important risk factors associated with hypertension.

Results: Primary data were collected to achieve the study's objective. A sample of 658 elderly individuals was selected for this study using a scientifically calculated sample size method. The prevalence of hypertension was 71.1% (95% CI 67.5-74.5) among older adults in Assam. The CatBoost algorithm reached its highest performance in terms of accuracy (0.75), precision (0.75), recall (0.74), and F1 score (0.74). However, the highest AUC value was observed for both CatBoost and Extreme Gradient Boosting (XGB), i.e., 0.87.

Conclusion: The study's findings provide valuable insights for healthcare providers, policymakers, and researchers in developing targeted interventions and policies to improve the well-being of older adults who face the adverse effects of hypertension.

Key Words: Hypertension, Older adults, Health-related quality of life (HRQoL)

Robustness of Two Sample Location Test in the Presence of Outliers

Dr. Mintu Kr. Das

Dept. of Statistics, D.H.S.K. Commerce College, Dibrugarh, Assam, India

Email: mintu.dhskcc@gmail.com

ABSTRACT

The two independent sample t-test is a parametric test used to determine whether the two samples have been drawn from the populations with same mean. This test helps us to generalize our findings to the concerned population under study. To generalize the results from such a test, some summary measures are used. One such measure is the p -value whose smaller values leads to rejection of null hypothesis. The test results are subjected to the fulfillment of underlying assumptions. Very often, the presence of outliers in a data set violates the assumptions leading to inappropriate inferences. Here, an attempt has been made to examine the robustness of the two-sample t-test. Through simulation, the proportion of rejection of the null hypothesis has been compared between t-test and its nonparametric counterpart in presence of outliers.

Key words: Outlier, t-test, p -value, robustness.

Sustainable Policy Evaluation Using Multivariate Statistical Methods: Case Study on Governance in Developing Economies

Alauddin Middya

Ph.D. Research Scholar, Department of Education, RKDF University, Ranchi, Jharkhand, India.

Gmail: alauddineducation@gmail.com

ABSTRACT

Sustainable development in developing economies hinges on effective governance policies that balance economic growth, social equity, and environmental preservation. However, evaluating these policies remains challenging due to multifaceted interdependencies among socioeconomic, environmental, and institutional variables. This study employs multivariate statistical methods to rigorously assess the impact of sustainability-focused governance initiatives, using a case study of South Asian developing nations (India, Bangladesh, and Nepal) from 2015–2024. Drawing on panel data from World Bank indicators, United Nations Sustainable Development Goals (SDGs) metrics, and national governance reports, we apply Principal Component Analysis (PCA) to reduce dimensionality and identify key latent factors influencing policy outcomes, such as institutional quality, resource allocation efficiency, and environmental compliance. Subsequent Multivariate Analysis of Variance (MANOVA) tests evaluate differential effects across policy domains (e.g., renewable energy subsidies vs. anti-corruption reforms), controlling for covariates like GDP per capita and urbanization rates. Cluster analysis further segments countries into governance archetypes, revealing patterns of policy synergy or conflict. Results indicate that integrated policies combining economic incentives with regulatory enforcement yield a 28% higher

SDG alignment score compared to siloed approaches, with PCA explaining 72% of variance in sustainability indices. Nepal's community-driven forest governance emerges as a high-performing cluster, while institutional bottlenecks in Bangladesh amplify environmental degradation risks. These findings underscore the need for adaptive, data-driven policymaking to mitigate trade-offs in resource-scarce settings. By bridging statistical rigor with policy praxis, this research offers a replicable framework for evidence-based governance in the Global South, fostering resilient pathways toward Agenda 2030. Limitations include data granularity in informal economies, suggesting avenues for future spatiotemporal modelling.

Keywords: Sustainable Policy Evaluation, Multivariate Statistical Methods, Governance in Developing Economies, Principal Component Analysis (PCA), Sustainable Development Goals (SDGs), Panel Data Analysis.

Forecasting of Electricity Demand in North-Eastern Region, India by ARIMA Model: A Time Series Analysis Approach

Dr. Nibedita Mahanta,

Assistant Professor, Department of Statistics, Bhattadev University, Bajali, Assam

E-mail: nibedita666@gmail.com,

ABSTRACT

Accurate forecasting of electricity demand plays a key role for attaining Sustainable Development Goal (SDG)-7 which focuses on ensuring access to affordable, reliable, sustainable and modern energy for all by 2030. Here, attempt has been made to forecast electricity demand of the North Eastern Region (NER), India by ARIMA model considering data from 2004-2024. The application of Phillips Perron test for testing the stationarity of the given data series reveals that the series becomes stationary at first order difference. ARIMA (0, 1, 2) model has been selected by following the results of Akaike Information Criterion(AIC). When the parameters of the model (0, 1, 2) are statistically analyzed along with the residual ACF and PACF, it has been found effective for forecasting purpose with 2.11% MAPE only. Forecasting of electricity demand of the North Eastern Region for the next five years has been done with the selected ARIMA (0, 1, 2) model.

Keywords: ARIMA, Electricity Demand, Forecasting, North-Eastern Region.

Geo-statistical modelling of elephant-train collision incidences using OLS and GWR regression approaches

Dr. Rekib Ahmed

Assistant Professor, Department of Geography, Pandit Deendayal Upadhyaya Government Model College, Katlicherra

ahmed.rekib2@gmail.com

ABSTRACT

Railway networks form a critical part of eco-friendly transport infrastructure, yet they also pose serious risks to wildlife. In Assam, India, collisions with trains frequently result in the death of wild Asian elephants. This research examines how elephant–train collision (ETC) frequencies relate to the spatial patterns of elephant abundance and train traffic within 10 km² grid cells surrounding 11 key railway stretches. Both ordinary least squares (OLS) regression and geographically weighted regression (GWR) were employed to explore these associations. The OLS analysis showed that elephant and train densities together accounted for 37% of the observed variation in ETC occurrences, whereas the GWR approach explained 83% of that variation. Spatially varying coefficients from the GWR model revealed strong and positive influences of both predictors on ETC rates in the Mariani–Nakachari and Khatkhati–Dimapur sections. In contrast, the Habaiapur–Diphu stretch displayed a markedly negative association between elephant density and ETC frequency, suggesting that high collision levels may be suppressing elephant numbers in this region. These findings underscore the urgent need for long-term measures to reduce collisions by ensuring secure movement corridors and adequate ecological support systems for elephants along railway routes.

Key words: Elephant-train collision, ordinary least squares, geographically weighted regression, elephant density, train density.

Statistical Applications in Policy, Governance, and Sustainable Development

B. Chandrakala¹

Department of Statistics, Bankatlal Badruka College for Information Technology, Kachiguda, Hyderabad, India

*chandrakalaallagani@gmail.com

ABSTRACT

This paper explores the role of statistical methods in policy-making, governance, and sustainable development. Using a synthetic dataset, we apply descriptive statistics, correlation analysis, regression modelling, and hypothesis testing to demonstrate how data-driven insights can inform policy decisions. Results highlight weak correlations among variables, a regression model with limited explanatory power, and hypothesis testing outcomes that guide interpretation of policy effectiveness. These findings underscore the importance of robust statistical frameworks for evidence-based governance and achieving Sustainable Development Goals (SDGs).

Keywords: Statistical Methods; Sustainable development; Correlation; Regression.

Dynamic Stability and Policy Adaptation in Stochastic Feedback-Coupled Climate-Economic Models

Dr. Mrinal Sarma, Dr. Banani Bora Hazarika

Narangi Anchalik Mahavidyalaya, Narengi, Guwahati, Assam

E-Mail: mrinal1973@gmail.com (Dr. M Sarma)

banani.bora73@gmail.com (Dr. B. B. Hazarika)

ABSTRACT

In this work, a comprehensive stochastic climate–economic model is developed, incorporating joint feedback mechanisms, nonlinear system dynamics, and real-time adaptive policy control. Unlike traditional deterministic frameworks, this model explicitly captures the propagation of uncertainty across both economic variables and climate indicators, providing a more realistic representation of how shocks evolve and interact over time. To evaluate the system’s behaviour, Lyapunov analysis is employed, enabling the demonstration of mean-square stability under varying policy and feedback conditions. The findings indicate that excessively high levels of responsiveness in policy adjustments can introduce oscillatory patterns and destabilise the coupled system. In contrast, moderate and carefully calibrated feedback significantly enhances stability and ensures smoother long-term trajectories for both climate and economic components. Overall, the proposed framework offers valuable insights for formulating resilient climate policies that remain effective even in highly uncertain environments, supporting more informed decision-making for sustainable development.

A Comprehensive Investigation of The Sociodemographic and Maternal Risk Factors Associated to Low Birth Weight

¹Sewali Hazarika ²Tousifur Rahman ³Manoshi Kotoky

^{1,3}*Department of Mathematics, The Assam Kaziranga University, Jorhat, Assam, India,
PIN 785006*

²*Department of Statistics, Bahona College, Jorhat,
PIN 785101*

sewalihazarika24@gmail.com (Corresponding author)

ABSTRACT

A child's health is a consequence of several different variables together, such as biological, socioeconomic, environmental, and parental influences. Socio-economic status has a major impact on children's health. Low birth weight (LBW) remains a major public health concern globally, particularly in developing countries, where it significantly contributes to neonatal morbidity, mortality and long-term developmental complications.

The main goal of this study is to assess existing research findings on the influence of various sociodemographic and maternal factors contributing to LBW. Relevant studies from diverse populations

were reviewed to identify consistent patterns and key determinants. The review highlights that maternal age, education, socioeconomic status, occupation, and place of residence play significant roles in influencing birth outcomes. Strengthening maternal health services, improving nutritional support, promoting education and socioeconomic empowerment, and ensuring timely and adequate antenatal care are crucial strategies to reduce the prevalence of LBW and improve overall maternal and child health outcomes.

Keywords: Low birth weight, Sociodemographic Factors, Maternal Risk Factors, Antenatal Care,

Daily Rainfall Frequency Analysis by using Markov Chain Probability Model: A case study of North Lakhimpur (Assam), India

DR. RUBUL BORA

C N B COLLEGE, BOKAKHAT, ASSAM

ABSTRACT

Weather knowledge in general, and rainfall knowledge in specific, is essential for executing pre-cultivation procedures and sound crop planning. The majority of this study is focused on rainfall, including the highest and lowest amounts of rainfall, as well as their variations. A daily rainfall frequency analysis has been performed in this study. For that, we have collected the daily rainfall data of Sivsagar for the last 15 years from the IMD (Indian Meteorological Department), Guwahati. By using a 2-state Markov Chain model, we have observed that the wet and dry days during the 122-days rainy season fall between 68 to 98 days and 24 to 50 days, respectively. During the pre-monsoon season, however, the projected wet and dry days are 23 to 51 days and 60 to 69 days, respectively. For the post-monsoon season, these ranges are 2 to 22 days and 70 to 90 days. A dry day is expected after 3 to 7 consecutive rainy days, while a wet day is likely after 2 to 3 consecutive dry days. The aggregate expected values of the spell lengths suggest that a dry day will follow 2 to 3 consecutive wet days, and a wet day will follow 2 consecutive dry days throughout the rainy season, which runs from June to September. As a result, the weather cycle is expected to endure 5 days during this time period.

Keywords: Conditional probability, Unconditional probability, Observed and Expected probabilities

Stochastic Modelling of Multi-server Markovian queues with Threshold-driven customer behaviour and Encouraged arrival

Dolismaita Boruah^{1,*} Pallabi Medhi

Department of Statistics, Gauhati University, Jalukbari, Guwahati, 781014, Assam, India

*dolismitaboruah2014@gmail.com

ABSTRACT

We present a stochastic model for a multi-server, infinite-capacity Markovian queuing system, incorporating encouraged arrivals, threshold limits, state dependent balking and position-dependent renegeing. These characteristics are common in real-life queuing systems. Our model is unique because it combines all these characteristics at once, something not done before in the literature. We derive steady-state probabilities and closed-form expressions for various performance measures using Markov process and probability generating function methods. Besides the usual performance measures, we also introduce new ones to better evaluate the system's effectiveness. We perform a comprehensive sensitivity analysis to examine how changes in system parameters impact performance measures. A numerical example is included to show the practical effectiveness and flexibility of the model.

Keywords: Threshold limit, encouraged arrival, state dependent balking, Markovian.

A Simulation-Based Evaluation of Alternative Estimators in M/M/1/k Queues

Kaustav Dutta^{1,*}, Amit Choudhury²

¹ *Department of Statistics, Pandit Deendayal Upadhyaya Adarsha Mahavidyalaya, Eraligool, Sribhumi, Assam, India*

² *Department of Statistics, Gauhati University, Guwahati, Assam, India*

*Corresponding Author E-mail: kaustav0708@gmail.com

ABSTRACT

This paper investigates the concept of alternative estimators within the frequentist framework for estimating various performance measures of the single server Markovian queuing system with finite system capacity (M/M/1/k model). Building on the foundational work of Zheng and Seila (2000) who mathematically demonstrated the non-existence of expectations and standard errors for substitution estimators of performance measures in the M/M/1 model and subsequently proposed alternative estimators based on an upper bound for traffic intensity, we extend their methodology to the M/M/1/k queues. Through extensive simulation studies, we show that these estimators exhibit stable and well-behaved properties in comparison to conventional substitution estimators. Additionally, we offer a practical and implementable guideline for selecting the required upper bound on traffic intensity when applying alternative estimators. Overall, this study provides a robust and generalizable framework for researchers and practitioners seeking improved estimation techniques for queuing systems.

Keywords: Alternative estimators, M/M/1/k Queuing model, Performance measures, Simulation study.

Impact of the 'Mukhya Mantrir Nijut Moina Aasoni' on Academic Performance and Retention of Girls' Students: A Statistical Evaluation and Evidence

DR. SANHITA SARMAH

Statistics Department, Jorhat Kendriya Mahavidyalaya, India

ABSTRACT

The present study examines the impact of the 'Mukhya Mantrir Nijut Moina Aasoni' scheme, a flagship initiative of Government of Assam, on the academic performance and retention of girl students, using institutional data from a single college in Assam. The scheme, designed to enhance educational continuity among girls by providing financial and social support, has been evaluated through a combination of descriptive and inferential statistical analyses. Primary data were collected using a structured questionnaire focusing on academic improvement, attendance, motivation, and challenges faced by beneficiaries. Statistical tools such as mean score analysis, chi-square tests, t-tests, and correlation analyses were employed to assess associations between scheme benefits and academic indicators. The findings indicate a positive influence of the scheme on retention, attendance regularity, and overall academic engagement, with a significant proportion of beneficiaries reporting enhanced motivation and reduced financial stress. Evidence from the institution suggests that the scheme contributes to narrowing gender gaps in education and strengthens the continuation of higher education among girls. This study provides empirical support for the effectiveness of the Nijut Moina initiative and offers policy-focused insights for further improvement of girl centric educational schemes in Assam. The study concludes that "Nijut Moina Aasoni" has substantially contributed to strengthening Girls' Education in Assam but continued monitoring and targeted interventions are essential to maximize long term benefits.

Key words : Girl's Education, Nijut Moina Aasoni, Inferential statistical analysis, retention

Association Between Maternal Body Mass Index and Child Survival in India: A Statistical Approach Using NFHS-5

Sanjeev Deka, Dr. Sahana Bhattacharjee

Department of Statistics, Gauhati University

ABSTRACT

Under-five mortality remains a critical public health concern in India despite substantial improvements in maternal and child healthcare services. Maternal nutritional status, commonly assessed through Body Mass Index (BMI), is an important predictor of child survival but remains insufficiently explored using nationally representative data. This study examines the association between maternal BMI and under-five mortality by using unit-level data from the National Family Health Survey-5 (2019-21). Children born in the five years preceding the survey were included, and under-five mortality was measured as a binary outcome. Maternal BMI was categorized into underweight, normal, and overweight/obese groups. Descriptive statistics, chi-square tests, and binary logistic regression were applied to estimate the unadjusted and adjusted effects of maternal BMI on child survival. The results indicate a higher probability of under-five mortality among children born to underweight mothers compared to those with normal BMI. After adjusting for socioeconomic, demographic, and child-level characteristics, maternal underweight remained a significant predictor of mortality risk. The findings highlight the importance of improving maternal nutritional status as a key strategy to reduce child mortality in India. This study demonstrates an integrative biostatistical approach using large-scale survey data and provides evidence for targeted maternal-child health interventions.

Threshold-based Customer Impatience in M/M/2 with Encouraged Arrival and Feedback Customer

Satabdi Goswami, Pallabi Medhi

Department of Statistics, Gauhati University

ABSTRACT

This paper analyses a heterogeneous two server queueing model where each server operates at a distinct service rate with infinite system capacity embodying encouraged arrivals, threshold-dependent impatience and customer feedback. The encouraged arrival process captures situations in which potential customers are motivated to join the system under favourable service conditions, while the threshold-based control mechanism reflects practical scenarios wherein customers exhibit patience up to a specified waiting limit, followed by renegeing and balking response. Furthermore, the model includes a feedback feature through which a proportion of served customers may rejoin the system for repeated fresh service, thereby enhancing the applicability of the model to real-life queueing environment. Steady-state probabilities are obtained through balance equations from which closed-form expressions of having 'n' number of customers in the system are derived. These expressions provide analytical formulations for various measures of performance. To check the effects of arrival rate, service heterogeneity, impatience rate along with feedback probability on overall system performance, a sensitivity analysis is carried out. A comprehensive cost analysis is formulated to evaluate the economic implication of system parameters including cost optimization of the system using Particle Swarm Optimization (PSO) technique. In addition, an empirical case study is incorporated to validate the applicability of the proposed model.

Keywords: Heterogeneous servers, threshold-dependent impatience, customer feedback, Particle Swarm Optimization (PSO)

Estimate and Compare Various Socio-Demographic and Treatment-Related Risk Factors That Affect the Severity of Breast Cancer

Bornali Khound^{1*}, Dhruba Das²

1 Research Scholar, Department of Statistics, Dibrugarh University, India

2 Assistant Professor, Department of Statistics, Dibrugarh University, India

*Corresponding Author E-mail: bornalikhound2019@gmail.com

ABSTRACT

Breast cancer is the most common malignancy among women in India and remains a major public health challenge. In Assam, delayed diagnosis and limited access to treatment continue to impact patient prognosis. This study aims to estimate and compare the effect of various socio-demographic and treatment-related risk factors on the severity and survival outcomes of breast cancer patients. This retrospective cohort study was conducted among histopathologically confirmed breast cancer patients treated between 2017 and 2022 at a tertiary care center in Dibrugarh, Assam. Data were extracted from hospital records, including demographic, reproductive, clinical, and treatment variables. Survival time was measured from the date of diagnosis to death or last follow-up. Kaplan–Meier curves, log-rank tests, and Cox proportional hazards regression were applied to identify significant predictors of mortality. The study found that breast cancer is the most commonly diagnosed cancer among women in the region, with a median of survival time of 167.0 [139.0, 195.0] weeks. The overall 5-year survival rate was approximately 40%. Advanced clinical stage (Stage III–IV), older age, low education level, absence of breastfeeding, and higher BMI were also associated with poorer outcomes. Patients receiving complete multimodality treatment (surgery with chemotherapy and others) demonstrated substantially better survival compared with those undergoing no therapy (HR = 0.53, 95% CI 0.32–0.89). The study highlights that Late-stage presentation, without taking treatments, were major determinants of poor survival. Socio-demographic and reproductive factors further influenced disease severity. Strengthening early detection programs, improving treatment adherence, and promoting awareness regarding modifiable risk factors are crucial for improving breast cancer outcomes in Assam.

Keywords: Breast cancer, Survival analysis, Cox proportional hazards model, Socio-demographic factors, Assam.

"A Review of Analytical Methods and Statistical Tools Used in Research on Janani Suraksha Yojana and Maternal Health Indicators"

Leena Saikia^{1*}, Pranab Barua², Dimpal Jyoti Mahanta³

^{1,3}*Department of Mathematics, The Assam Kaziranga University, Jorhat, Assam, India, PIN 785006*

Department of Statistics, Jagannath Barooah University, Jorhat, Assam, India, PIN 785001

*¹leenasaikia749@gmail.com

ABSTRACT

A major maternal health creativity within the National Health Mission, the Janani Suraksha Yojana (JSY) intends to lower maternal and newborn mortality in India and increase institutional deliveries. Using statistical techniques and secondary data from national surveys and published research, this review study assesses the efficacy and use of JSY. The initiative significantly improves maternal healthcare access, especially among underprivileged populations. According to statistical assessments of measures including institutional delivery rates, maternal death ratio, newborn mortality rate and prenatal care use. The assessment also finds inconsistencies in service delivery, delays in payment rewards and differences in program performance between states. This study offers a thorough knowledge of JSY's accomplishments, difficulties and policy inferences by including quantitative evidence. The role of different analytical methods used in the stated studies would also be observed. The results indicate that although JSY has improved maternal and infant health outcomes, optimizing its long-term effects would need bolstering monitoring systems and improving timely benefit distribution.

Keywords: India, Janani Suraksha Yojana, Maternal Healthcare, Statistical assessments.

A STUDY ON THE OVERVIEW OF THE EFFECT OF SUDARSHAN KRIYA YOGA ON MENTAL HEALTH

Sneha Chanda¹

Assistant Professor, Department of Statistics, Birjhora Mahavidyalaya, Borpara, Bongaigaon-783380, Assam, India.

Corresponding Author E-mail: snehachanda12@gmail.com

ABSTRACT

Sudarshan Kriya Yoga is a breathing technique which is creating wonders. This has been gifted by 'His Holiness Sri Sri Ravi Shankar'. It is a rhythmic breathing technique that can significantly benefit mental health by reducing stress, anxiety and depression. Various research has been carried out to study its effect on physical and mental health.

Since everything follows a rhythm. So, it is very much important that our body is functioning in a proper rhythm. Whenever, there is an imbalance in the rhythm of our body, we come across several negative emotions, which leads to some mental issues. So, it is very important to focus on our physical and mental well-being. In this paper, we will discuss how it affected the mental health among a group of individuals.

Keywords: Sudarshan Kriya Yoga; Stress; Anxiety; Depression.

A Bayesian support vector machine for predictive modelling of underground mine's microclimate

Snehangshu Chatterjee^{1*}, Saurav Rukhaiyar², Ayani Nandi³, Partha Sarker⁴, Satyabrata Podder⁵

Research Scholar, Department of Science and Engineering, Academy of Scientific and Innovative Research (AcSIR), Dhanbad, India¹

CSIR-CIMFR, Mining Technology Division, Nagpur Research Centre, Maharashtra, India²
Department of Electronics and Communication Engineering, Ramgarh Engineering College, Jharkhand, India³

Department of Computer Science and Engineering, Narula Institute of Technology Under MAKAUT, Kolkata, India⁴

Department of Mechanical Engineering, Elite College of Engineering, Kolkata, India⁵

[*snehangshuchatterjee@acsir.ac.in](mailto:snehangshuchatterjee@acsir.ac.in)

ABSTRACT

Accurate prediction of the underground mine microclimate is very much vital for the operational safety and ventilation efficiency. The traditional model in rare case fails to quantify the forecast of uncertainty. This research promulgates a novel application of Bayesian support vector machine to predict the temperature and humidity within a deep underground mine. Formulating the SVM within a probabilistic framework, the proposed model leverages the historical sensor data incorporating depth, external weather, geothermal temperature and machinery heat which help to generate the full predictive distributions instead of a single point estimate. The demonstration of results where the Bayesian SVM achieves the standard accuracy with a Root Mean Square Error for temperature. The capability which allows for predictive risk management and informed the decision making for offering a significant advancement over the deterministic approaches the study has been concluded that Bayesian SVM is a powerful and practical tool for enhancing thermal condition forecasting and more energy efficient mining operations. The Bayesian SVM approach offers a very powerful tool for mining planners and engineers, delivering not only accurate microclimate forecasts but also a crucial quantification of uncertainty.

Keywords: Bayesian SVM, Underground Mine Microclimate, Geothermal Temperature, Uncertainty Quantification.

Effect of Pollution on Lung Cancer through Logistic Model: An Analytical Approach

Saswotika Rath, Mitali Madhusmita Nayak*

Department of Mathematics, Siksha 'O' Anusandhan (Deemed to be University), Bhubaneswar, Odisha, India

Email: rsaswotika@gmail.com, mitalinayak@soa.ac.in

ABSTRACT

Air pollution ranks high among environmental factors responsible for lung cancer, but the extent of its influence on tumour growth dynamics is still not very clearly understood. The paper is present study use a logistic growth model to analyse the effect of long-term exposure to ambient particulate matter (PM_{2.5}) and co-pollutants on the development of lung tumours through time. Through a combination of epidemiological data and mathematical modelling, and show the changes in tumour volume due to different levels of pollution, which is one of the consequences that previous studies have mainly investigated through risk assessments. The model developed in this research determines that, during pollutant exposure, crucial parameters that influence growth are modified, such as the intrinsic proliferation rate, deceleration term, and carrying capacity. Increased exposures to the pollutants lead to the shifting of the point of tumour growth inflexion to an earlier time and the raising of the baseline growth rates, which all correspond with the biological processes involving oxidative stress, DNA damage, inflammation, microRNA changes, and immune system malfunction. The pollution-dependent parameter in the model is solved analytically, and the output of the analysis is presented in graphical form. Peak reliability and pertinence of the proposed framework are further confirmed through sensitivity analyses as well.

Keywords: Tumour growth, logistic model, PM_{2.5}, lung cancer modelling, sensitivity analysis

Prediction of Child Mortality in Tanzania: Pre-Post SMOTE Based ML Techniques

¹Julius Moinget Loibor, ²Manash P. Barman, ³Baby Das

¹Research Scholar, Department of Statistics, Dibrugarh University, India (juliusmoinget@gmail.com)

²Department of Statistics, Dibrugarh University, India (manash_stats@dibru.ac.in)

³Department of Statistics, Dibrugarh University, India (dbabydas@gmail.com)

ABSTRACT

In this study, five (5) Machine Learning (ML) techniques were used to identify an appropriate model for predicting child mortality in Tanzania using the current Demographic and Health Survey dataset. The performance of these ML models was evaluated before and after applying the Synthesis Minority Over-sampling Technique (SMOTE) to balance the child mortality dataset. Before applying SMOTE, the Decision Tree (DT) model was found to be the best predictive model with an accuracy of 95%. The study results indicated that after applying SMOTE, the Random Forest model (RF) performed best among other ML models for predicting child mortality in Tanzania as achieving an accuracy of 92% and an area under the curve of 94%. The RF model identified the top eleven (11) most significant risk factors influencing child mortality after applying SMOTE were total children ever born, birth order number, mothers' age group, child age, zone, mothers' occupation, wealth index combined, current marital status, self-reported health status, anemia level, and mothers' level of education. The local interpretable model agnostic explanation (LIME) technique was used to determine the explainability of the RF model. The key risk factors (feature importance) identified for predicting child mortality in Tanzania using LIME include covered by health insurance, Zone, child age, anemia level, and wealth index combined.

Keywords: Child mortality, Prediction, Machine Learning, Model evaluation, SMOTE

Censored Poisson Regression Modelling for Antenatal Care Visits

V Suriya Kannan

Asst. Professor - PG Department of Biostatistics -SFS

*Shrimathi Devkunvar Nanalal Bhatt Vaishnav College for women, Vaishnava College Road,
Shanthy Nagar,Chromepet,Chennai-600 044. Tamil Nadu, India.*

ABSTRACT

Antenatal care (ANC) visit data from large-scale maternal health surveys often contain censored count values resulting from top-coding, misreporting, confidentiality-driven suppression, or “don’t know” responses. Such censoring distorts the distribution of the outcome variable and limits the applicability of standard count regression models. This study explores three major analytical strategies for handling censored count data—Multiple Imputation, Small Area Estimation, and Censored Poisson Regression—within the context of ANC utilization. The methodological framework specifies ANC visits as the dependent variable and incorporates demographic, socioeconomic, maternal, household, and health-access characteristics as predictors. Censored Poisson regression is formulated using a likelihood-based approach that accounts for right-censoring in the observed counts, while Multiple Imputation addresses partial nonresponse and Small Area Estimation supports inference for geographically disaggregated populations. Model specification, estimation steps, interpretation of incidence rate ratios, and key diagnostic procedures such as dispersion checks and information-based criteria are described to support rigorous analysis of censored ANC visit data.

Keywords: Censored Poisson Regression, Antenatal Care Visits, Maternal Health, Count Data Modelling, INLA, NFHS Data.

Tweedie–Gamma Modeling of Infant Mortality Based on NFHS-5

S. Santhana Lakshmi¹ V. Suriya² & M. Priyadharshini³

^{1,2,3}*PG Department of Biostatistics,*

S.D.N.B Vaishnav College for Women Chrompet Chennai -44 ;

Email : santhanalakshmi.s@sdbnvc.edu.in¹, suriya.v@sdbnvc.edu.in²

ABSTRACT

Infant mortality remains one of the most critical indicators of a country’s health status and socio-economic development. This study analyzes data from the National Family Health Survey (NFHS-5) to examine the patterns, determinants, and disparities associated with infant mortality in India. The study explores demographic, socio-economic, maternal, and health-care–related factors that influence infant survival outcomes. To model these determinants, a Tweedie regression model is applied and its performance is compared with a Gamma model to evaluate improvements in handling mixed and zero-inflated characteristics of the data. The findings provide stronger, more reliable insights that can support policymakers and public health planners in strengthening maternal and child health programs, enhancing targeted interventions, and reducing infant deaths in India.

Keywords: Infant mortality, Maternal and demographic factors, Tweedie regression, Gamma model, NFHS -5(2019-21).

Perception and Practice of Environmental Responsibility Among College Students: A Questionnaire-Based Study

Dr. V. Kavitha^{1*}, Dr. J. L. Prameena Sheeja², Dr. V. Suriya³

¹Assistant Professor, PG Department of Environmental Sciences, S.D.N.B Vaishnav College for Women,

Chrompet, Chennai -44

²Associate Professor, Department of Environmental Sciences, S.D.N.B Vaishnav College for Women, Chrompet, Chennai -44

³Assistant Professor, PG Department of Biostatistics, S.D.N.B Vaishnav College for Women, Chrompet, Chennai -44

*Corresponding Author E mail id : kavichipli@gmail.com

ABSTRACT

Growing environmental pressures demand strengthened individual and collective responsibility, particularly among youth who will shape future sustainability agendas. This study investigates the perception and practice of environmental responsibility among college students through a structured questionnaire-based approach. The survey, administered to undergraduate students from Shrimathi Devkunvar Nanalal Bhatt Vaishnav College for Women (Autonomous), Chromepet, examined four key dimensions: environmental awareness, attitudinal orientation, behavioural commitment, and engagement in sustainability-related activities. Quantitative analysis using descriptive statistics and correlation measures revealed that although students possess a high level of awareness of environmental issues, this understanding does not always translate into consistent pro-environmental action. Factors such as personal motivation, lifestyle constraints, and limited exposure to practical environmental initiatives influenced the extent of behavioural adoption. The findings highlight the importance of enhancing experiential learning opportunities and encouraging student-led green initiatives to strengthen environmental responsibility. This study offers valuable insights into promoting sustainable behaviour among young adults and contributes to the broader discourse on environmental education and youth-led sustainability.

Keywords: Sustainability mindset, environmental awareness, youth behaviour, green campus initiatives, ecological responsibility

1st International Conference on “Recent Trends in Mathematics and Statistics” (ICRTMS-I)



20th & 21st January, 2026

Editors:



Dr. Pankaj Borah

Assistant Professor, Department of Mathematics
Bahona College



Dr. Tousifur Rahman

Assistant Professor, Department of Statistics
Bahona College

Published by: Bahona College Publication Cell

© 2026 Copyright held by the Author(s) of the individual abstract

ISBN



978-81-960757-8-1