



**CHARTERED INSTITUTE OF STATISTICIANS
OF NIGERIA
(CISON)**

3rd INTERNATIONAL CONFERENCE

Theme:

**FROM LEGACY TO LEADERSHIP:
50 YEARS OF PROMOTING STATISTICAL
DEVELOPMENT IN NIGERIA**

**SCHEDULE OF PRESENTATIONS
AND BOOK OF ABSTRACTS**

DATE:

12TH – 16TH OCTOBER, 2026

VENUE:

**CHIDA HOTELS EVENT CENTRE,
PLOT 226, SOLOMON LAR WAY, UTAKO,
ABUJA, NIGERIA**

SCHEDULE OF PRESENTATIONS AND BOOK OF ABSTRACTS

for

**3RD INTERNATIONAL CONFERENCE OF THE
CHARTERED INSTITUTE OF STATISTICIANS OF NIGERIA
(Celebrating 50 years of the Statistical Profession)**

THEME:

**FROM LEGACY TO LEADERSHIP: 50 YEARS OF
PROMOTING STATISTICAL DEVELOPMENT IN
NIGERIA**

Date: 12 – 16 October, 2026

**Venue: CHIDA HOTELS EVENT CENTRE, PLOT 226,
SOLOMON LAR WAY, UTAKO, ABUJA, NIGERIA**

Time: 9.00 AM to 5.00 PM DAILY



NATIONAL ANTHEM

Nigeria, we hail thee,
Our own dear native land,
Though tribes and tongues may differ,
In brotherhood we stand
Nigerians all, are proud to serve
Our sovereign Motherland.

Our flag shall be a symbol
That truth and justice reign,
In peace or battle honoured,
And this we count as gain,
To hand on to our children
A banner without stain.

O God of all creation,
Grant this our one request:
Help us to build a nation
Where no man is oppressed,
And so with peace and plenty
Nigeria may be blessed.



NATIONAL PLEDGE

I pledge to Nigeria, my country
To be faithful, loyal and honest
To serve Nigeria with all my strength
To defend her unity and uphold her honour and glory
So help me, God.

CISON ANTHEM

Stanza 1

Hail, Chartered Institute of Statisticians of
Nigeria,
Pride of our nation, beacon shining bright;
With truth and knowledge, skill and wisdom,
We guide our land to progress and light.
Integrity, excellence, and service,
Our guiding stars, our noble flame;
For Nigeria's growth and transformation,
We proudly honour our Institute's name.

Chorus

Chartered Institute of Statisticians of Nigeria!
Chartered Institute of Statisticians of Nigeria!
Forward we rise, with hearts so strong,
Guardians of knowledge, righting wrong;
Statistical science shall lead the way,
Building our nation day by day.
United in purpose, we proudly proclaim:
Excellence and service in our Institute's name!

Stanza 2

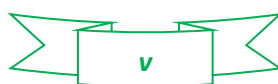
From data to wisdom, from figures to light,
We shape sound pathways, clear and right;
Through research, learning, and innovation,
We build the future of our nation.
Professionalism, honour, and vision,
Our standards upheld with steadfast care;
Chartered Institute of Statisticians of Nigeria,
Leading Nigeria everywhere!

Chorus

Chartered Institute of Statisticians of Nigeria!
Chartered Institute of Statisticians of Nigeria!
Forward we rise, with hearts so strong,
Guardians of knowledge, righting wrong;
Statistical science shall lead the way,
Building our nation day by day.
United in purpose, we proudly proclaim:
Excellence and service in our Institute's name!

Final Chorus

Nigeria, arise! Let the numbers speak,
With knowledge and truth, the future we seek;
With integrity strong and service sincere,
We build a great nation, united and dear.
Chartered Institute of Statisticians of Nigeria!
Our pride, our calling, our guiding flame!
For Nigeria's glory, we proudly stand-
Excellence and service in our Institute's name!



PREFACE

It is my pleasure, on behalf of the Editorial Committee, to present this Book of Abstracts for the 3rd International Conference of the Chartered Institute of Statisticians of Nigeria (CISON), held to commemorate 50 years of the statistical profession in Nigeria. This milestone provides an opportunity to celebrate a professional legacy, reflect on the evolution of statistical practice and consider the leadership required to shape its next chapter.

The conference theme, *“From Legacy to Leadership: 50 Years of Promoting Statistical Development in Nigeria,”* captures this dual responsibility. Legacy represents the institutions, standards, methodological advances, knowledge and public-service traditions established over five decades. Leadership challenges the profession to transform that foundation into systems and greater public value. As societies generate volumes of data, statistics must remain central to producing credible evidence, informing sound decisions and strengthening confidence in public information.

The conference programme brings together perspectives across the statistical spectrum. Its sub-themes examine the evolution of statistical systems in Nigeria; political electioneering in the era of Big Data and analytics; citizen engagement and statistical literacy; Big Data, artificial intelligence and real-time indicators for good governance; and the future of Nigeria’s National Statistical System. Collectively, these themes recognise that statistical development extends beyond conventional data production. Digital transformation, technological innovation, institutional coordination, ethical responsibility, communication, inclusiveness and the effective use of evidence are now integral to statistical development.

The contributions assembled in this volume reflect that breadth. They encompass theoretical and methodological developments alongside applications in public policy, health, economics, governance, environment, finance, social research and other areas of national and international relevance. Their diversity demonstrates statistical science's capacity to address complex problems while creating opportunities for interdisciplinary collaboration and practical innovation.

For an international audience, this conference offers a window into Nigeria’s statistical journey, achievements, challenges and aspirations. The discussions provide opportunities to share experiences across institutions and countries, compare approaches, strengthen professional networks and identify areas for collaborative research and capacity development.

As Nigeria looks towards the next fifty years, the statistical profession must remain committed to integrity, methodological rigour, innovation, accessibility and public trust. The future will require statisticians who can work across traditional methods, emerging technologies and multidisciplinary environments, while maintaining the principles that make evidence credible and useful.

I commend the authors, reviewers, conference organisers, and partners whose efforts have made this volume possible. I trust that the ideas presented here will stimulate dialogue, inspire new research, strengthen professional collaboration and contribute to the development of statistics in Nigeria and beyond.

Professor P. E. Chigbu

Editor-in-Chief, JCISON

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CONFERENCE THEME & SUB-THEMES

Theme

FROM LEGACY TO LEADERSHIP: 50 YEARS OF PROMOTING STATISTICAL DEVELOPMENT IN NIGERIA

Sub-Theme 1: EVOLUTION OF STATISTICAL SYSTEMS IN NIGERIA OVER THE LAST 50 YEARS

Sub-Theme 2: POLITICAL ELECTIONEERING IN THE ERA OF BIG DATA & ANALYTICS – STATISTICAL INSIGHTS FOR CREDIBLE ELECTIONS

Sub-Theme 3: CITIZEN ENGAGEMENT AND STATISTICAL LITERACY

Sub-Theme 4: THE NEXT 50 YEARS: VISION FOR THE NATIONAL STATISTICAL SYSTEM

Sub-Theme 5: THE NEXT 50 YEARS: VISION FOR THE NATIONAL STATISTICAL SYSTEM

Sub-Theme 6: BIG DATA, ARTIFICIAL INTELLIGENCE AND REAL-TIME INDICATORS FOR GOOD GOVERNANCE

VENUES FOR THE PLENARY AND PARALLEL SESSIONS

Chida Hotels Event Centre
Plot 226, Solomon LAR Way,
Utako, Abuja, Nigeria

PARALLEL SESSIONS AND ABSTRACTS SCHEDULED FOR PRESENTATION

OCTOBER 14, 2026

ITEM	RESPONSIBILITY	DURATION
Hall Identification for Technical Sessions/ Assignment of Sessions' Chairs	Dr. OlaOluwa Yaya (Associate Editor, CISON)	9.30am – 9.40am
Presentations at Theory & Methods Room Presentations at Applied Room A Presentations at Applied Room B Presentations at Applied Room C Presentations at Special Room 1 Presentations at Special Room 2	Coordinated by the Editorial Committee and Session Chairs: 1. Professor Sunday M. Ogbonmwan 2. Professor Olusanya E. Olubusoye 3. Professor Haruna R. Bakari 4. Professor Julian I. Mbegbu 5. Professor Augustine Iduseri 6. Professor Mary P. Iwundu 7. Professor Joseph Osawenkhæ 8. Professor Edith U. Umeh 9. Professor Ethelbert Nduka 10. Professor Polycarp Emeka Chigbu 11. Dr. Victor Ngozi Atoi & Dr. OlaOluwa Simon Yaya (Specially Selected Papers' Rapporteurs)	10.00 am – 1.30 pm
Presentations at Theory & Methods Room Presentations at Applied Room A Presentations at Applied Room B Presentations at Applied Room C Presentations at Special Room 1 Presentations at Special Room 2	Coordinated by the Editorial Committee and Session Chairs: 1. Professor Sunday M. Ogbonmwan 2. Professor Olusanya E. Olubusoye 3. Professor Haruna R. Bakari 4. Professor Julian I. Mbegbu 5. Professor Augustine Iduseri 6. Professor Mary P. Iwundu 7. Professor Joseph Osawenkhæ 8. Professor Edith U. Umeh 9. Professor Ethelbert Nduka 10. Professor Polycarp Emeka Chigbu 11. Dr. Victor Ngozi Atoi & Dr. OlaOluwa Simon Yaya (Specially Selected Papers' Rapporteurs)	02.00 pm – 5.30 pm

PLENARY SESSIONS' PRESENTERS AND OTHER PRESENTATIONS

OCTOBER 15, 2026

ITEM	RESPONSIBILITY	DURATION
CISON President's Address	Dr G. U. Ebuh (President, CISON)	10.00am – 10.15am
Goodwill Messages	Dignitaries and Institutional Members of CISON	10.15am – 11.00pm
Keynote Speech	Professor Steve MacFeely (Chief Statistician/Director, OECD Statistics & Data Directorate, Paris)	11.00am – 11.30am
Invited Paper	Dr. Alhassan Iddrisu, Government Statistician, Ghana Statistical Service, Accra. Leading in the Age of Big Data: Positioning Nigeria's Statistical System for Global Relevance	11.30am – 12.00pm
Panel Discussion: The Future of Statistics in Nigeria after 50 Years of Statistical Development	Moderator: Dr. Godstime Eigbiremolen (World Bank, Abuja) Panelists: 1. Dr. Kingsley Anosike – Hon. Comm. for Budget & Economic Planning, Abia State 2. Mr. Biyi Fafunmi – Former Director (ICT), NBS Nigeria. 3. Mr. Dotun Adekunle – Chief Operating Officer, Opay Nigeria 4. Professor Ekaete Enang – DVC (Academics), University of Calabar 5. Mr. John Wesey – Data & Analytics Consultant 6. Dr. Moses Okpanachi, Director, CBN Statistics Department 7. Dr. Yemi Kale, AfriExim Bank 8. Dr. Chigozie Utazi, Associate Professor, University of Southampton, UK.	12.00pm – 1.00pm
Vote of Thanks	Professor Polycarp Chigbu (Editor-in-Chief/Member, NOC)	1.00pm – 1.05pm

VIRTUAL PRESENTATION SESSION

OCTOBER 16, 2026

ITEM	RESPONSIBILITY	DURATION
Virtual Theory/Applied Paper Presentations	Professor Sunday M. Ogbonmwan Dr OlaOluwa Simon Yaya	9.10am – 11.10am

SCHEDULE OF PRESENTATIONS/PROGRAMME

THEORY & METHODS ROOM

Wednesday, 14 October 2026

Each paper: 20 mins

10.00 am – 1.30 pm

Chaired by Professor Sunday M. Ogbonmwan

T&M001.26: A COVARIANCE MATRIX (CM) ALGORITHM FOR ANALYSIS OF VARIANCE IN SINGLE-FACTOR EXPERIMENTS Odiakosa Osita

T&M002.26: A NEW SINE TYPE II TOPP-LEONE FRECHET SURVIVAL REGRESSION MODEL: THEORY AND APPLICATIONS M. A. Mahmud, Abubakar Awwal, W. B. Yahya and S. E. Chaku

T&M003.26: THEORY OF STAR-SCHEMA ARCHITECTURE DATA WAREHOUSE IN POLYTECHNIC EDUCATION Salisu Shehu Umar, Muhammed Adamu Obomeghie, Bello Andrew Ojutomori

T&M004.26: THE EXPONENTIAL PERKS DISTRIBUTION: PROPERTIES, ESTIMATION, AND APPLICATIONS TO COVID-19 MORTALITY AND CANCER SURVIVAL DATA A.A. Osi, M. Aminu, M. Abdu, S. Gambo

T&M005.26: DATA QUALITY IN DIGITAL HEALTH INFORMATION SYSTEMS: A THEORETICAL REVIEW OF DETERMINANTS AND IMPLICATIONS FOR EVIDENCE-BASED PUBLIC HEALTH DECISION-MAKING IN NIGERIA Yakubu Mohammed

T&M006.26: DEVELOPMENT OF NEW DISTRIBUTION FROM UNIFORM DISTRIBUTION Waheed Babatunde Yahya, Musaphau Animashahun, Taofeek Adeola Salam, Kolade Emmanuel Ayotokun

T&M007.26: DYNAMICS OF KIDNAPPING ACTIVITIES IN NIGERIA: MATHEMATICAL MODELLING APPROACH Oseni, B.A. and Egbetade, S.A.

T&M008.26: FORECASTING ACCURACY AND MODEL PERFORMANCE OF AUTOREGRESSIVE INTEGRATED MOVING AVERAGE (ARIMA) AND GENERALIZED AUTOREGRESSIVE CONDITIONAL HETEROSKEDASTICITY (GARCH) STRUCTURES ACROSS VARYING SAMPLE SIZES IN SIMULATED VOLATILITY DATA Nasiru Olakorede

THEORY & METHODS ROOM

Wednesday, 14 October 2026

Each paper: 20 mins

02.00 pm – 5.30 pm

Chaired by Professor Olusanya E. Olubusoye

T&M009.26: ON THE DEVELOPMENT OF SHIFTED GAMMA-LOGISTIC TRANSMUTED (SGLT) DISTRIBUTION FOR MODELING INDUSTRIAL DATA Edike Nnamdi, Agbedeyi Odimientimi Desmond, Braimah Joseph Odunayo and Edokpa Idemudia Waziri

T&M010.26: ON THE MODELING OF BIOMEDICAL DATASETS WITH A NEW KUMARASWAMY TYPE II GENERALIZED TOPP-LEONE INVERSE EXPONENTIAL DISTRIBUTION Ismail Adekunle Kolawole, Abubakar Yahaya, Sani Ibrahim Doguwa and Aliyu Yakubu

T&M011.26: ROBUST MODIFIED REGRESSION-CUM-EXPONENTIAL RATIO ESTIMATOR IN THE PRESENCE OF MEASUREMENT ERRORS Awwal Adejumobi, Mojeed Abiodun Yunusa, and Ahmed Audu

T&M012.26: SOME IMPROVED GENERALISED LIU-TYPE ESTIMATORS FOR LINEAR REGRESSION MODELS IN THE PRESENCE OF MULTICOLLINEARITY Okegbade A.I., Adejumo T.J., Job O., Adesina O.A., Okunlola O.O and Egbewumi A.O.

T&M013.26: ON THE MODIFIED SIMPLEX METHOD OF SOLVING LINEAR PROGRAMMING MODELS OF MAXIMISATION TYPE Olufemi A. Ayansola and Oluranti A. Afolabi

T&M014.26: QUICKFIT PRO: AN AI-ENHANCED INTERACTIVE MODELLING AND SIMULATION SOFTWARE FOR IMPLEMENTING REGULAR AND CONVOLUTED DISTRIBUTIONS Ismail Adeleke, Eno Akarawak, Daniel Alienyi and Faheed Olajide

T&M015.26: MATHEMATICAL DEVELOPMENT OF THE NEW SINE TYPE II GENERALIZED TOPP-LEONE EXPONENTIAL DISTRIBUTION WITH APPLICATIONS TO BIOMEDICAL DATA Olumi Toba Timothy, Faweya O., Akinyemi O., Obabire Akinleye Alaba

T&M016.26: MODIFIED ALTERNATE METHOD (MAM) FOR SOLVING UNBALANCED TRANSPORTATION PROBLEMS Adejuwon Samuel Oluwaseun, Adeleke Rapheal Ayantunji, Lawal Yekini Olawaye and Adarabioyo Mumini Idowu

APPLIED/APPLICABLE ROOM A

Wednesday, 14 October 2026

Each paper: 20 mins

10.00 pm – 1.30 pm

Chaired by Professor Haruna R. Bakari

APP001.26: A BAYESIAN VECTOR AUTOREGRESSION (BVAR) APPROACH TO FORECAST FREIGHT RATE VOLATILITY Rukayat Jimoh and Oluwadare O. Ojo

APP002.26: BAYESIAN SPATIOTEMPORAL MODELING OF INTERNALLY GENERATED REVENUE (IGR) IN AKWA IBOM STATE AND ITS FIRST-ORDER NEIGHBOURHOODS IN NIGERIA C. R. Egemba, S. C. Nwaosu, E. F. Udoumoh, and D. A. Kuhe

APP003.26: A NEW FLEXIBLE FRÉCHET-BASED MODEL WITH APPLICATIONS TO ECONOMIC DATA Akeem Ajibola Adepoju, Bello Olalekan Akanji, Abdulmumeen Adekunle Issa, Ibrahim Abdullahi, Salihu Gambo, Musa Uba Muhammad, Sani Salihu Abubakar, Yakubu Hussaini

APP004.26: APPLICATION OF EXPONENTIAL DEMAND AND WEIBULL DETERIORATION RATES UNDER SHORTAGE-DEPENDENT QUASI-PARTIAL BACKLOGGING ON INVENTORY MODEL Nwoba Pius Ophokenshi, Kalu Ikenga Udonsi

APP005.26: APPLICATION OF STOCHASTIC MODEL TO INBREEDING WITH HIGH MORTALITY RATE OF HYBRID IN A GIVEN POPULATION Dike A. O. and Onosemuode E. K., Egele U. O., and Arua, P. J.

APP006.26: ASSESSMENT OF PROBABILITY DISTRIBUTIONS FOR GROUND WATER QUALITY DATA COLLECTED IN BICHI LOCAL GOVERNMENT AREA OF KANO STATE
Auwalu Ibrahim, A. A. Osi and Yakubu Hussain

APP007.26: ASSESSMENT OF AGE MIS-REPORTING USING 2006 POPULATION CENSUS DATA
Igwe, N. O., Okonta, C. A., J., Okeahialam, A. H., and Akani-Omiko, T. U.

APPLIED/APPLICABLE ROOM A

Wednesday, 14 October 2026

Each paper: 20 mins

02.00 pm – 5.30 pm

Chaired by Professor Julian I. Mbegbu

APP008.26: BEYOND THE HEADCOUNT: THE STRATEGIC ADVANTAGES OF BIOMETRIC ELECTORAL PROXIES FOR EVIDENCE-BASED DEVELOPMENT PLANNING IN NIGERIA
Dagyat, Gabriel Pam

APP009.26: COMPUTING THE PROXIMITY AVAILABILITY METRIC (PAM) VIA GAUSSIAN DECAY: A STATISTICAL APPROACH TO MEASURING PRIMARY EDUCATION VULNERABILITY DAGYAT, Gabriel Pam

APP010.26: CONTRIBUTIONS OF SELECTED MACRO-ECONOMIC INDICATORS TO GROSS DOMESTIC PRODUCT IN NIGERIA Adeoye, A.O, Ojo O.D, Raji S.T, Okeniyi O.M., Adewoye, K.B., Adebisi, K., Bello, L.K. and Oyeboode, T.A.

APP011.26: ECONOMETRIC ANALYSIS OF THE DYNAMIC RELATIONSHIP BETWEEN NIGERIAN GROSS DOMESTIC PRODUCT AND SOME ACTIVITY SECTORS: APPLICATION OF COINTEGRATION AND ERROR CORRECTION MECHANISM Oluranti A. Afolabi, Yemisi O. Akinlade, and Taofeek O. Yahya

APP012.26: EVALUATING ANN, KNN, RF, SVM FOR EARLY RISK PREDICTION IN HEART DISEASE, DIABETES, AND HEPATITIS; A COMPARATIVE STUDY
Turman Henry, Christiana J. Bakut, Nuga K. Adetayo, Turman Felicia and Handan T. Elisha

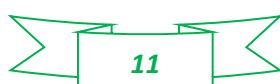
APP013.26: EXPLORING THE LINK BETWEEN STATISTICAL LITERACY AND CITIZEN ENGAGEMENT IN DATA-DRIVEN GOVERNANCE IN NIGERIA
Ejiofor Chidimma Florence

APP014.26: FORECASTING INFLATION RATE IN NIGERIA FROM 2000–2026 USING ARIMA MODELS ESTIMATION VIA THE LEVENBERG–MARQUARDT ALGORITHM
Ikpotokin O., Ehilen O. S. and Nwaka R. N.

APPLIED/APPLICABLE ROOM B

Wednesday, 14 October 2026

Each paper: 20 mins



10.00 pm – 1.30 pm
Chaired by Professor Mary P. Iwundu

APP015.26: FORECASTING NIGERIA'S MACROECONOMIC INDICATORS USING ARIMA MODELS: A TIME SERIES ANALYSIS OF UNEMPLOYMENT, INFLATION, GDP AND EXCHANGE RATE Ikpotokin, O. and Ehilen, O. S.

APP016.26: FORECASTING WITH FEW DATA SAMPLES: A COMPARISON STUDY OF INTELLIGENT AND REGRESSION TECHNIQUES Muhammad Sani Gaya, Abdulhameed Ado Osi, and Muftahu Zubairu Ringim

APP017.26: HIERARCHICAL CLUSTERING FOR SPATIAL PATTERN RECOGNITION OF RADIOACTIVITY LEVELS OF SELECTED METALS IN SOIL SAMPLES FROM FEDERAL POLYTECHNIC KALTUNGO, NIGERIA. Handan Timothy Elisha, Sarki Sunday Habila, Isa Aliyu Kargi, Ishaya Iliyasu and Aminu Suleiman Mohammed

APP018.26: LEGACY TO LEADERSHIP: 50 YEARS OF ICT-DRIVEN STATISTICAL DEVELOPMENT IN NIGERIA Victor Iduma Okocha

APP019.26: LIBERATION OF PANDEMIC VARIABLES USING ARTIFICIAL INTELLIGENCE AND STATISTICAL MODELS Kabiru Bala, Muhammad Alhaji Dauda, Muhammad Sani Galadima, Dauda Habu Chiroma, Yahya Kodabu

APP020.26: LONG-TERM TRENDS, VARIABILITY, AND FORECASTING OF CLIMATE CHANGE INDICATORS IN KOGI STATE, NIGERIA: A TIME SERIES ANALYSIS Deborah Aladi Daikwo and Benson Ade Eniola Afere

APP021.26: MACHINE LEARNING TECHNIQUES IN PREDICTING PATIENT SURVIVAL OUTCOMES IN PROSTATE CANCER James Tolulope Olayemi, B. Shehu, and Rilwanu Ahmad Umar

APPLIED/APPLICABLE ROOM B
Wednesday, 14 October 2026
Each paper: 20 mins
02.00 pm – 5.30 pm
Chaired by Professor Ethelbert Nduka

APP022.26: STATISTICAL ANALYSIS OF MARRIAGE AND DIVORCE IN JAMA'A LOCAL GOVERNMENT AREA OF KADUNA STATE NUGA Kehinde Adetayo, TURMAN Henry, OMOTOLA Adeniyi Andrew

APP023.26: MODELING AND FORECASTING OF MULTIVARIATE TIME SERIES USING VECTOR AUTOREGRESSIVE (VAR) AND COINTEGRATION TECHNIQUES Alaba Akinleye Obabire, Rita Nneka Nwaka, and Olumi Toba Timothy

APP024.26: MODELING CARGO THROUGHPUT AT CALABAR PORT: A BOX-JENKINS APPROACH Ekott, E. N.

APP025.26: MODELING FUEL CONSUMPTION HETEROGENEITY IN SELECTED CARS USING LOGISTIC QUANTILE REGRESSION Besta Okey Onyegbuchulem, Chialuka Adline Onyegbuchulem, Obiageri Ogwo and Emmanuel Oliwe

APP026.26: MODELLING AND FORECASTING NAIRA/DOLLAR EXCHANGE RATE USING ARIMA MODEL Khalid Ibrahim Abbo, Tasi'u Musa and Humaida Ahmad
Nigerian Army Education Corp

APP027.26: MULTIPLE REGRESSION ANALYSIS OF STUDENTS' PERFORMANCE USING VARIABLE SELECTION PROCEDURES Eric Uchenna Oti and Thomas Bulus Gata

APP028.26: ON THE SEARCH FOR OPTIMAL BEST GENERALIZED AUTOREGRESSIVE SCORE (GAS) MODELS FOR CAPTURING JUMPS AND ASYMMETRY IN THE NIGERIAN STOCK PRICE INDEX RETURNS Momoh, Besiru Bello, Andrew Ojutomori Obomeghie, A.M

APPLIED/APPLICABLE ROOM C
Wednesday, 14 October 2026
Each paper: 20 mins
10.00 pm – 1.30 pm
Chaired by Professor Augustine Iduseri

APP029.26: THE NEXT 50 YEARS: A VISION FOR A RESILIENT, DIGITALISED AND DECENTRALISED NATIONAL STATISTICAL SYSTEM IN NIGERIA Shariah Abdulazeez Hassan

APP030.26: SPATIAL PERSISTENCE, REVENUE TRAJECTORIES AND PERFORMANCE CLUSTERS OF NIGERIAN STATES Ibeh Gabriel C., Nwosu Dozie F., Ukaigwe Chidinma C., Onyekwe Chukwuenyem E. and Igbo Celestine A.

APP031.26: STATISTICAL CAPACITY BUILDING IN PUBLIC SECTOR Young-Harry Joseph

APP032.26: STATISTICAL HYPOTHESIS TESTING ON REFERENCE MATERIALS IN DETERMINING UDAWA LITHIUM ORE'S WORK INDEX FOR COMMINUTION CIRCUIT DESIGN Faruq N. Musa, Usman M. Akindele and Nurudeen A. Arowona

APP033.26: STATISTICAL INFERENCE FOR THE REPRODUCTION NUMBER OF LASSA FEVER: CONFIDENCE INTERVAL ESTIMATION USING THE DELTA METHOD B.O. Ajala, S.O. Are, J.A. Akinyemi, M.I. Ekum, A.S. Duyile, J.U. Barrah-Ajala

APP034.26: STATISTICAL METHOD FOR THE ANALYSIS OF RESULTS FROM CONTROLLED COMPARATIVE DIAGNOSTIC SCREENING TEST AND CLINICAL TRIALS FOR A CONDITION IN A POPULATION Matthew Chukwuma Michael; Oyeka, I.C.A.; Ajibade, F. Bright; Onyiorah, A.A.; Efobi, C. C.

APP035.26: MULTIVARIATE DISCRIMINANT ANALYSIS OF RISK FACTORS FOR SEVERE BRONCHOPNEUMONIA IN UNDER-FIVE CHILDREN IN NIGER STATE B. Maijama'a, M.O. Adenomon, S.S. Ahmed and E.S. Chaku

APPLIED/APPLICABLE ROOM C
Wednesday, 14 October 2026
02.00 pm – 5.30 pm
Chaired by Professor Edith Umeh

APP036.26: THE ROLE OF BIG DATA, ARTIFICIAL INTELLIGENCE (AI), AND REAL-TIME INDICATORS IN PROMOTING GOOD GOVERNANCE. Oriko Blessing Chimaobi, Dr. Nwogbaga Nweso Emmanuel, Dr. Nwoba Pius Ophokenshi

APP037.26: TIME SERIES MODELING OF ANNUAL TEMPERATURE OF JOS HIGHLAND DATA Elem-Uche, O., Nsude, F. I., Okereke, E. W., Madu, C. Ibina, E. O.

APP038.26: TIME SERIES MODELING OF SOLAR RADIATION IN KEBBI STATE, NIGERIA: AN ARIMA-BASED FORECASTING FRAMEWORK FOR ENERGY POLICY Ibrahim Musa Mahuta, Usman Aliyu, Mansur Suleiman Kardi, and Adamu Isah Kamba

APP039.26: STATISTICAL ASSESSMENT OF TRENDS, PREVALENCE AND SOCIO DEMOGRAPHIC CORRELATES OF SOME SELECTED CANCER TYPES AT UNIVERSITY OF NIGERIA TEACHING HOSPITAL (UNTH), ITUKU-OZALLA, ENUGU OKANCHI, Louis Chukwunweike; IGWENAGU, Chinelo Mercy; EZEANI, Chinyere Maria

APP040.26: CROSS-DOMAIN EVALUATION OF DEEP AND CLASSICAL ANOMALY DETECTION MODELS: STATISTICAL INSIGHTS ON GENERALISABILITY FOR BIG DATA GOVERNANCE IN NIGERIA MacGeorge Chukwunwike George, Mary Mgbekem, Christian E. Onwukwu, Effanga Okon Effanga

APP041.26: PANEL DATA ANALYSIS OF SELECTED DEMOGRAPHIC AND ECONOMIC DETERMINANTS OF GDP GROWTH IN EMERGING AND DEVELOPED ECONOMIES Kumafan Shadrach Dzaan, Jonathan Atsua Ikughur, David Adugh Kuhe and Enobong Francis Udoumoh

APP042.26: BAYESIAN A-OPTIMALITY CRITERIA FOR RIDGE AND LASSO REGRESSION MODELS TO DETERMINE THE MACROECONOMIC FACTORS OF NIGERIAN ECONOMIC GROWTH Winifred L. Paul-Pam, Nwaosu S. C, Ikughur J. A. and Peter O.

APP043.26: MULTIVARIATE ANALYSIS OF VARIANCE OF BENISEED YIELD AND YIELD RELATED TRAITS IN BADEGGI, NIGER STATE, NIGERIA M. N. Yisa, T. Hamza, M. B. Abubakar, M. Daniel

APP044.26: EVALUATING THE EFFECT OF BUDGET IMPLEMENTATION ON ECONOMIC GROWTH IN NIGERIA F. E. ITIVEH and OKEKE KELECHI LIVINUS

SPECIAL PAPERS' ROOM 1

Wednesday, 14 October 2026

10.00 pm – 1.30 pm

Each paper: 20 mins

Chaired by Professor Polycarp Emeka Chigbu

SP&TM001.26: MULTIVARIATE WEIBULL-COPULA FRAMEWORK FOR REAL-TIME ANOMALY DETECTION IN INTERNET TRAFFIC: SIMULATION-BASED ANALYSIS Friday I. Agu, Robert Andok, Jaromír Klarak, Jean Rosemond Dora, Onyekachi Williams

SP&TM002.26: STUDY ON OPTIMAL DESIGN FOR GENERALIZED LINEAR MODEL WITH MULTINOMIAL RESPONSE OF FOUR CATEGORIES Ibrahim Yusuf. Ibrahim, Abubakar Yahaya, Tasi'u Musa, Yahaya Zakari

SP&TM003.26: ROBUST PARAMETRIC VARIANCE TESTS BASED ON MEAN ABSOLUTE DEVIATIONS FOR ONE SAMPLE SITUATION: THEORY AND APPLICATIONS Rasaki Y. Akinbo, Kayode Ayinde, O. O. Alabi, H. A Bello and W. G. Ogunmefun

SP&TM004.26: UNIFIED ROBUST REGRESSION UNDER HIGH CORRELATION AND OUTLIER CONDITIONS IN GAUSSIAN REGRESSION MODELS: A MONTE CARLO INVESTIGATION AND APPLICATIONS T. J. Adejumo, O. A. Adesina and T. S. Fayose

SP&TM005.26: pdhs: A PYTHON LIBRARY FOR PROGRAMMATIC ACCESS TO DHS DATA TO ENHANCE REPRODUCIBLE PUBLIC HEALTH RESEARCH R. S Adejumo

SP&TM006.26: A NEW KERNEL ESTIMATOR IN DENSITY ESTIMATION WITH DATA APPLICATION Israel Uzuazor Siloko, Edith Akpevwe Siloko and Cyril Chukwuka Ishiekwene

SP&TM007.26: A RAYLEIGH-CAUCHY ERROR DRIVEN ADAPTIVE TIME SERIES MODEL FOR HEAVY-TAILED ECONOMIC PROCESSES IN NIGERIA Olatunji Taofik Arowolo, Matthew Iwada Ekum, Toyin Omoyeni Oguntola, and Adeyinka Solomon Ogunsanya

SP&TM008.26: ON ADDITIVE AND MULTIPLICATIVE INTERACTION USING RECONSTRUCTED DATA Ezeh, F.C. and Mbegbu, J.I.

SPECIAL PAPERS' ROOM 2

Wednesday, 14 October 2026

Each paper: 20 mins

10.00 pm – 1.30 pm

Chaired by Professor Professor Joseph Osawenkhae

SP&AA001.26: A HIERARCHICAL NORMAL-POWER-LOGISTIC FRAMEWORK FOR ROBUST CANCER GENE DISCOVERY FROM CPG METHYLATION DATA Matthew Iwada Ekum, Christian Heumann, Bolarinwa Olumide Ajala, Eno Emmanuella Akarawak, Christopher Oladimeji Fakorede, Joseph Adekunle Akinyemi, Stephen Olusegun Are, Toyin Omoyeni Oguntola, Adeyinka Abiodun Iwada-Ojeniyi

SP&AA002.26: DIGITAL FINANCIAL INNOVATION AND MONETARY POLICY TRANSMISSION IN WEST AFRICA: PANEL EVIDENCE FROM ECOWAS ECONOMIES Umeokwobi Richard, Victor Ocheni, Obeta John, and Dalhatu Bello Central Bank of Nigeria and Hochschule für Technik und Wirtschaft, Berlin

SP&AA003.26: RANGE-BASED MULTIVARIATE GENERALIZED AUTOREGRESSIVE CONDITIONAL HETEROSKEDASTICITY MODELLING OF NIGERIA OIL AND GAS STOCK RETURNS Mohammed Tanimu, Audu Isah, Yisa Yakubu, and Olayiwola Matthew Adetutu

SP&AA004.26: STATISTICAL ANALYSIS OF ENVIRONMENTAL POLLUTION AND ITS HEALTH IMPLICATIONS IN URBAN AREAS OF NIGERIA: A MULTI-CITY ASSESSMENT, 2019-2023 Benson Ade Eniola Afere and Deborah Aladi Daikwo

SP&AA005.26: ANALYSIS OF THE KNOWLEDGE OF OFFICIAL STATISTICS IN NIGERIA Turman Henry, Sunday Charity, Ndan R. Taliyen, Vincent Kanwai, Christiana J. Bakut

SP&AA006.26: INVESTIGATING DYNAMIC RELATIONSHIPS BETWEEN NIGERIAN AGRICULTURAL COMMODITY PRICES AND INFLATION USING DCC-COINTEGRATED MODEL Akano R.O., Otaru O.P., Umar S.S., Onoghojobi B., and Silas A.

SP&AA007.26: ENVIRONMENTAL SUSTAINABILITY AND DEVELOPMENT DYNAMICS IN NIGERIA: A STATISTICAL ASSESSMENT OF LAND USE CHANGE, URBANIZATION, AND POPULATION GROWTH (1960-2024) OLUBIYI, Adenike Oluwafunmilola, OLAJIDE, Oluwamayowa Opeyimika, OLAYEMI, Michael Sunday,

APP008.26: SPATIAL CLUSTERING AND HOTSPOT ANALYSIS OF ROAD TRAFFIC ACCIDENTS IN NIGERIA: A STATE-LEVEL INVESTIGATION USING ADVANCED SPATIAL STATISTICS Awopeju Kabiru Abidemi, and Ajibade F. Bright

PAPERS ON STATISTICAL THEORY AND METHODS

T&M001.26: A COVARIANCE MATRIX (CM) ALGORITHM FOR ANALYSIS OF VARIANCE IN SINGLE-FACTOR EXPERIMENTS

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ABSTRACT

This paper introduces a covariance matrix (CM) algorithm for one-way ANOVA, offering improved computational efficiency, accuracy, and variance representation compared to traditional sum-of-squares methods. The approach demonstrates theoretical rigor, methodological clarity, and practical advantages in single-factorial designs.

Keywords: Covariance Matrix Algorithm; ANOVA; Experimental Design; Variance Components; Randomised Block Design; Youden Square.

T&M002.26: A NEW SINE TYPE II TOPP-LEONE FRECHET SURVIVAL REGRESSION MODEL: THEORY AND APPLICATIONS

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ABSTRACT

Survival analysis is a critical statistical methodology widely applied to model time-to-event data, particularly in medical research where understanding the duration until events such as death or disease recurrence is essential. Traditional survival models often struggle to capture the complex patterns present in real-world clinical data, motivating the development of more flexible approaches. This study introduces the Sine Type II Topp-Leone Frechet Survival Regression Model, specifically tailored for analyzing the survival times of liver and breast cancer patients. The model combines the flexibility of the Frechet distribution with the distinctive properties of the Sine Type II Topp-Leone family, enabling a nuanced representation of complex survival behaviours. The analysis is based on a dataset recording survival times (in months) for patients undergoing liver cancer treatment, with event status defined as $d = 1$ (death) and $d = 0$ (censored). Key covariates include patient age, sex (0 = male, 1 = female), a novel blood test result, and initial tumor size, facilitating a comprehensive assessment of prognostic factors. Model parameters are estimated using the maximum likelihood method. Findings demonstrate that the proposed model effectively captures intricate survival patterns and provides clinically relevant

insights, representing a significant advancement in statistical modeling for cancer survival analysis.

Keywords: Sine Type II Topp-Leone-G, Frechet distribution, Regression model, Hazard function, Maximum likelihood, Order Statistics.

T&M003.26: THEORY OF STAR-SCHEMA ARCHITECTURE DATA WAREHOUSE IN POLYTECHNIC EDUCATION

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ABSTRACT

In modern educational systems, data-driven decision-making has become essential for improving institutional performance and student outcomes. Polytechnics generate large volumes of data from academic, administrative, and financial activities. However, these datasets are often fragmented across multiple systems, limiting their usefulness for analysis. This paper focused on the theory of star-schema architecture data warehouse as suitable for polytechnic educational system. The study demonstrates how integrating data into a centralized warehouse enhances analysis, reporting, supports academic planning, and improves institutional efficiency. The proposed model emphasizes simplicity, scalability, and query performance, making it suitable for educational environments with limited technical resources.

Keywords: Data-driven, Fragmented, Polytechnic, Warehouse, Star-Schema,

T&M004.26: THE EXPONENTIAL PERKS DISTRIBUTION: PROPERTIES, ESTIMATION, AND APPLICATIONS TO COVID-19 MORTALITY AND CANCER SURVIVAL DATA

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Technology, Wudil, Nigeria

Department of Statistics, Biniyaminu Usman Polytechnic
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ABSTRACT

This paper introduces a novel three-parameter lifetime distribution called the Exponential Perks Distribution (EPD), derived by applying the Exponential-G family generator to the classical Perks distribution. We derive explicit expressions for the probability density function, cumulative distribution function, quantile function, moments, moment generating function, characteristic function, survival function, hazard function, and order statistics. The hazard function can exhibit increasing or decreasing failure rates, offering flexibility for modeling various real-world phenomena. Maximum likelihood estimation is employed for parameter estimation, and a comprehensive Monte Carlo simulation study demonstrates the consistency and asymptotic properties of the estimators. The practical utility of the EPD is illustrated using two real datasets: daily COVID-19 death counts in China (January– March 2020) and survival times of blood cancer patients from Saudi

Arabia. The EPD is compared against the Topp-Leone Weibull, Kumaraswamy Weibull, Exponentiated Perks, and Chen Perks distributions using AIC, BIC, Cramér-von Mises, Anderson-Darling, and Kolmogorov-Smirnov criteria. In both applications, the EPD consistently provides the best fit, outperforming all competing models. The proposed distribution serves as a flexible and effective tool for modeling positively skewed and survival-type data in medical and epidemiological research.

Keywords: Exponential-Perks distribution, lifetime data, maximum likelihood estimation, hazard function, COVID-19 mortality, cancer survival.

T&M005.26: DATA QUALITY IN DIGITAL HEALTH INFORMATION SYSTEMS: A THEORETICAL REVIEW OF DETERMINANTS AND IMPLICATIONS FOR EVIDENCE-BASED PUBLIC HEALTH DECISION-MAKING IN NIGERIA

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ABSTRACT

Reliable statistical evidence is the foundation of effective public health decision-making, yet the quality of data flowing through digital health information systems in Nigeria remains inconsistent. This paper presents a theoretical review of data quality in digital health information systems, with attention to the routine health information system (RHIS) and the District Health Information Software 2 (DHIS2) platform that anchors reporting across Nigeria's health sector. Drawing on the World Health Organization Data Quality Review framework, the Performance of Routine Information System Management framework, and the classical data quality dimensions literature, the paper synthesises evidence on the technical, organisational, and behavioural determinants of data quality, and examines their implications for statistical development and evidence-based policy. The review finds that incomplete reporting, weak internal and external consistency, inadequate data use culture, and fragmented interoperability persist as recurring threats to data quality, despite considerable investment in digital platforms and national policy frameworks. The paper argues that improving data quality in Nigeria's digital health information systems requires a deliberate, multi-level strategy that combines technical system design with organisational governance and behavioural change among data producers and users. Recommendations are offered for statisticians, health information managers, and policymakers seeking to strengthen the statistical backbone of Nigeria's health system as the country marks fifty years of statistical development.

Keywords: data quality, digital health, health information systems, DHIS2, routine health information system, Nigeria

T&M006.26: DEVELOPMENT OF NEW DISTRIBUTION FROM UNIFORM DISTRIBUTION

Waheed Babatunde Yahya, Musaphau Animashahun, Taofeek Adeola Salam, Kolade Emmanuel Ayotokun

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ABSTRACT

The uniform distribution has served as foundation for development of several probability distributions because of its mathematical simplicity and wide range of its application. Motivated by discrete arithmetic probability distribution proposed by Olatinwo, Animashahun and Ayotokun (2019), this study developed a continuous analogue, referred to as continuous arithmetic distribution. The proposed probability density function was derived analytically from continuous uniform distribution and rigorously examined to verify its validity as a probability model. The distribution was shown to satisfy the fundamental conditions of a continuous probability distribution, including non-negativity and unit total probability. Furthermore, its important statistical properties, particularly the expectation and variance were derived in closed form. The findings established that the proposed distribution is mathematically consistent and extended the existing family of arithmetic distribution from discrete to the continuous domain. This development provides an additional framework for modeling continuous random variables and contributes to the growing body of probability distribution theory. The proposed distribution may serve as a useful alternatives in statistical modeling where its underlying assumptions are appropriate, thereby creating opportunities for further theoretical development and practical applications

Keywords: continuous arithmetic distribution, continuous uniform distribution, probability density function, mathematical expectation, variance, probability theory.

T&M007.26: DYNAMICS OF KIDNAPPING ACTIVITIES IN NIGERIA: MATHEMATICAL MODELLING APPROACH

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ABSTRACT

This paper proposes a mathematical model to study the dynamics of kidnapping activities in Nigeria. The model incorporates a class of humans subdivided into susceptible (S), kidnappers (K), Kidnap Victims (K_V), Detained Kidnappers (K_d), Rehabilitated Kidnappers (K_r) and Rescued Individuals (R). The two equilibrium points of the model naming kidnapping-free and kidnapping endemic equilibria are obtained. An epidemiological threshold called the basic reproduction number is derived and a qualitative analysis of the model is carried out to investigate the asymptotic stability of the equilibria. A locally stable kidnapping-free equilibrium at the basic reproduction number less than the unity is proved through the analysis of characteristics equation. Furthermore, a sensitivity analysis is performed to examine the contributory effects of parameters of the model to the

eradication and spread of kidnapping in finite time. Sensitivity analysis reveals the importance of reducing kidnapping rate while increasing rescue rate of abducted victims through appropriate intervention strategies by all tiers government and stakeholders in crime control.

Keywords: Mathematical control, Kidnapping, Equilibrium Point, Basic Reproduction Number, Sensitivity Analysis.

**T&M008.26: FORECASTING ACCURACY AND MODEL PERFORMANCE OF
AUTOREGRESSIVE INTEGRATED MOVING AVERAGE (ARIMA) AND
GENERALIZED AUTOREGRESSIVE CONDITIONAL HETEROSKEDASTICITY
(GARCH) STRUCTURES ACROSS VARYING SAMPLE SIZES IN SIMULATED
VOLATILITY DATA**

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ABSTRACT

This study explores the properties and forecasting performance of AR(1)-GARCH(1,1) process simulated volatility datasets across various sample sizes. Descriptive statistics confirm that all datasets exhibit near-zero mean, with increasing sample size leading to larger extremes and higher standard deviations, reflecting the inherent volatility clustering. Stationarity tests reveal that, consistent with the model's theoretical properties, small samples ($n=50$ and 100) often incorrectly suggest non-stationarity, whereas larger samples ($n=250$ and above) correctly identify stationarity. A comprehensive model selection process identified optimal ARIMA and GARCH configurations for each sample size based on likelihood, AIC, RMSE, and MAE metrics. For small samples ($n=50$), the ARIMA(0,1,0)+GARCH(1,1) model achieved the best fit with a log-likelihood of 179.1975, RMSE of 1.49×10^{-5} , and MAE of 1.35×10^{-5} . As sample size increased, models with more complex ARIMA structures, such as ARIMA(1,0,0)+GARCH(1,1) and ARIMA(1,0,2)+GARCH(1,1), demonstrated improved forecast accuracy, with the largest sample ($n=1000$) favoring the high-order ARIMA(4,0,4)+GARCH(1,1) model, which achieved an RMSE of 4.09×10^{-6} and MAE of 3.54×10^{-6} , alongside a high log-likelihood of 29,289. Overall, the results underscore that integrating ARIMA and GARCH models enhances predictive performance, especially with larger datasets where complex mean structures can be reliably estimated, emphasizing the importance of tailored model selection based on data size and complexity.

Keywords: Forecasting, ARIMA, GARCH, Volatility, Time Series, Volatility.

T&M009.26: ON THE DEVELOPMENT OF SHIFTED GAMMA-LOGISTIC TRANSMUTED (SGLT) DISTRIBUTION FOR MODELING INDUSTRIAL DATA

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ABSTRACT

This paper proposed a new three-parameter continuous probability model called the Shifted **Gamma-Logistic Transmuted (SGLT) distribution**, developed by integrating a shifted gamma- logistic baseline structure, and a quadratic rank transmutation map. The proposed SGLT distribution provides remarkable flexibility in modeling diverse data shapes, including symmetric, skewed, heavy-tailed and J-shaped, patterns. Its cumulative distribution function is obtained through the transmutation of a gamma-logistic baseline, while the corresponding probability density function reveals a wide range of shapes useful for real-world applications. We derive some fundamental mathematical properties of the SGLT distribution, including its moments, moment generating function, reliability and hazard rate functions. Estimation of the model parameters was carried out using maximum likelihood estimation (MLE). Simulation studies show the consistency of the estimators, while application to real-world industrial data demonstrate the superior performance of the SGLT distribution compared to existing competing models. The SGLT distribution therefore offers a powerful and flexible alternative for modeling complex lifetime and industrial datasets.

Keywords: Gamma-logistic, transmutation, survival, estimation, maximum likelihood.

T&M010.26: ON THE MODELING OF BIOMEDICAL DATASETS WITH A NEW KUMARASWAMY TYPE II GENERALIZED TOPP-LEONE INVERSE EXPONENTIAL DISTRIBUTION

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ABSTRACT

In this study, a new five-parameter lifetime distribution called the Kumaraswamy Type II Generalized Topp-Leone Inverse Exponential distribution was introduced. An expansion for the probability distribution functions and cumulative density function was carried out which was used to derive some mathematical and statistical properties of the distribution such as the moments, moment generating function, quantile function, survival function, hazard function, and probability weighted Moment. The estimation of the parameters by

maximum likelihood method was discussed. Two real life datasets were used to show the fit and flexibility of the new distribution over some lifetime distributions in literature. The results showed that the new distribution fits better into the two datasets considered.

Keywords: Kumaraswamy, Inverse, $K_wT_2GTLIEx$, Type II Topp-Leone, Moments,

T&M011.26: ROBUST MODIFIED REGRESSION-CUM-EXPONENTIAL RATIO ESTIMATOR IN THE PRESENCE OF MEASUREMENT ERRORS

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ABSTRACT

Statistical analysis focuses on providing an accurate model for future policies, it is therefore important to collect and use the data carefully and minimize the possibility of various types of errors. Measurement error is one of the non-sampling errors that occur in almost every survey. Existing proposed class of estimators for population in the presence of measurement errors may give unreliable estimate, which will lead to wrong conclusion. To address this gap, logarithm transformation of auxiliary information was incorporated into the existing method to robust modified regression-cum-exponential ratio estimator that will give more reliable estimate of the population mean of the study variable in the presence of measurement errors. The properties of the (Bias and MSE) of the modified estimators were derived. The efficiency condition of the proposed estimators over the existing estimator considered in this study were established. The results of simulation studies and empirical study revealed that the proposed estimator have minimum MSE and higher PRE and as such are efficient and can produce better estimate of the population mean compared to the existing estimators considered in this study.

Keywords: Estimate, Estimator, Measurement error, Robust, Survey

T&M012.26: SOME IMPROVED GENERALISED LIU-TYPE ESTIMATORS FOR LINEAR REGRESSION MODELS IN THE PRESENCE OF MULTICOLLINEARITY

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ABSTRACT

One of the techniques of biased estimation in Linear regression is the Generalised Liu-type regression estimation, though, it requires shrinkage parameters k and d , where d is a function of k . Although, Different forms and types of shrinkage parameter k has been proposed in literature including Kibria (2003) and Muniz et al (2009) while Shakalliogu and Kasciranla (2006) were among several authors that proposed the shrinkage parameter d evidenced with smaller Mean Square Error when compared with other existing d . Hence the need to improve the Existing Generalised Liu-type Estimator in Linear regression model plagued with Multicollinearity in the presence of Heteroscedasticity. Data was

generated using Monte-Carlo experiment with ($R=1000$), ($p=3$) and $n=10, 20, 30, 50, 75$ and 100 . $U_t \sim N(0, \sigma^2)$. The values of error variance $\sigma^2 = 1$, $\delta=1$, while $\rho = 0.7, 0.75, 0.8, 0.85, 0.9, 0.95$ and 0.99 . At each replication for specified sample size, multicollinearity and error variance level, the performance of the existing and improved generalized Liu-type estimators were examined using the Mean Square Error (MSE) criterion and ranked afterwards. The study concluded the improvement of the shrinkage parameters k and d with $\frac{1}{(\text{Max}(\text{VIF}_s))}$ in all sample situations for generalised Liu-type estimators, except when $\rho \geq 0.95$ and $n \geq 75$ when no improvement is best. The study therefore recommends improvement of the shrinkage parameters k and d with $\frac{1}{(\text{Max}(\text{VIF}_s))}$ in generalised liu-type estimation.

Keywords: Biased, Estimation, generalised liu-type, Parameter, Ridge, Regression, Multicollinearity, and Monte Carlo simulation.

T&M013.26: ON THE MODIFIED SIMPLEX METHOD OF SOLVING LINEAR PROGRAMMING MODELS OF MAXIMISATION TYPE

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ABSTRACT

This research paper provides a comprehensive investigation into the linear programming (LP) model, an optimization paradigm that gained immense prominence during the Second World War for solving complex military logistic challenges. At the heart of LP is the simplex solution procedure, a highly effective mathematical algorithm utilized to unearth feasible and optimum solutions. Over the decades, the application of linear programming has transcended its military origins, deeply embedding itself within diverse civilian sectors including agriculture, manufacturing production, health systems optimization, financial planning, and global transportation networks. Fundamentally, linear programming addresses the pervasive challenge of scarce resource allocation, demanding an optimum mathematical solution that achieves either the absolute maximization of economic benefits or the strict minimization of operational costs. While several eminent scholars and mathematicians have suggested and refined different methods of solving LP problems—such as the Regular Simplex, Revised Simplex, Two-Phase, and Big-M methods—these traditional approaches often suffer from high computational complexity and exhaustive iterative requirements. This study, therefore, presents an alternative, highly efficient method for resolving LP problems: a modified algorithmic approach empirically found to be significantly simpler and faster than its traditional counterparts. This new methodical approach is a modified regular simplex method that guarantees the exact same optimal solution as existing methods, but with a reduced computational footprint. Through rigorous numerical examples and comparative tableau analyses, this study successfully validates the simplicity, accuracy, and results-oriented claims of the modified method. Consequently, the newly modified simplex method will serve as a vital catalyst for encouraging more robust research, algorithmic development, and practical industrial applications of linear programming models in the modern era.

T&M014.26: QUICKFIT PRO: AN AI-ENHANCED INTERACTIVE MODELLING AND SIMULATION SOFTWARE FOR IMPLEMENTING REGULAR AND CONVOLUTED DISTRIBUTIONS

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ABSTRACT

Recently, a number of new convoluted and generalized distributions have been developed to adequately model naturally occurring and emerging real-life data. However, applications and implementation of the newly developed distributions are constrained due to lack of implementation tools. The goal of this research is to develop a spreadsheet-based software that can simulate from and fit data to the convoluted and generalized distributions. The proposed software possesses the capabilities to provide outputs on descriptive statistics, parameter estimation, goodness of fit tests using K-S, Anderson, Chi square, AIC, DIC and negative log-likelihood as well as generate animated and interactive graphs. The resulting software is named QuickFit. This software provides answers to the following questions: What methods and theories are widely used by researchers and practitioners? What are the most commonly mentioned and sought after convoluted distributions that analysts have always wanted to implement? How are the newly distributions used, and what are the problems with their implementation? Is it possible to develop an indigenous interactive tool that is simple, intuitive and flexible to fit many distributions simultaneously? The software is available at <https://quickfitng.com/>. To extend the software to cover inference based modelling, QuickFit-Pro is being developed by incorporating AI to support importing data from available databases, inferential analysis, curve fitting, machine learning models, as well as correlation and other plots. The QuickFit Pro will run in both Window and Andriod.

T&M015.26: MATHEMATICAL DEVELOPMENT OF THE NEW SINE TYPE II GENERALIZED TOPP-LEONE EXPONENTIAL DISTRIBUTION WITH APPLICATIONS TO BIOMEDICAL DATA

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ABSTRACT

In this study, a new probability model referred to as the Mathematical Development of the New Sine Type II Generalized Topp-Leone Exponential distribution is proposed and mathematically developed. The model is constructed by integrating the sine-generated transformation with the Type II generalized Topp-Leone family using the exponential distribution as the baseline model. The fundamental statistical properties of the proposed distribution are derived in detail. These include the probability density and cumulative functions, moments, Quantile function, and order statistics. Based on the graphical,

numerical, and empirical evidence, the study concludes that our models represents a significant improvements over existing Topp-Leone-based distributions. The density and distribution plots confirm that the model offers enhanced flexibility through its additional shape parameters. The estimation results demonstrate that both the MLE, and MPSE perform satisfactorily, with small bias and mean squared error values observed for larger sample sizes. These findings indicate that the model is reliable for practical applications. Furthermore, the superior goodness-of-fit results particularly the lower AIC and BIC values, confirm that our models provide a better representation of real data than the competing models considered. Overall, the combined evidence from tables, figures, plots, and numerical values confirms that the New Sine Type II Topp-Leone family outperforms existing alternatives both theoretically and empirically. The consistency between graphical behavior, simulation results, and real data applications supports the robustness and applicability of the proposed distribution for modelling lifetime and biomedical datasets.

Keywords: Topp-Leone, Distributions, Parameters, Properties, Generalized

T&M016.26: MODIFIED ALTERNATE METHOD (MAM) FOR SOLVING UNBALANCED TRANSPORTATION PROBLEMS

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ABSTRACT

Transportation problems deal with two different problems; these are (i) Balanced Transportation and (ii) Unbalanced Transportation, in which several research works had been done on the transportation problem in the past. These have revealed the capabilities of the individual methods and their shortcomings. In this research, we developed a modified alternate method (MAM) for solving unbalanced transportation problems with comparative suitability to some existing methods of initial basic feasible solutions in transportation problems. A given unbalanced transportation problem is converted to a modified unbalanced transportation problem by increasing the demand/supply of an origin/destination and the same is solved by the proposed methods. Furthermore, a study was conducted to measure the performance of the new method, and six other methods under this situation. Also, we numerically compared the performance of the new method with the North-West Corner Method (NWCM = 169), Least Cost Method (LCM = 140), Vogel's Approximation Method (VAM = 149), Inverse Coefficient of Variation Method (ICVM = 139), Average Opportunity Cost Method (AOCM = 139), Methods of Standard Deviation (SDM = 149) and Modified Distribution (Modi = 139) Method. It can be said conclusively that a modified alternate method (MAM) for solving unbalanced transportation problems provides a remarkable Initial Basic Feasible Solution by ensuring minimum transportation cost.

Keywords: Unbalanced transportation problem, MNA method, modified TPs, abundance of availability, demand and supply.

PAPERS ON APPLIED/APPLICABLE STATISTICS

APP001.26: A BAYESIAN VECTOR AUTOREGRESSION (BVAR) APPROACH TO FORECAST FREIGHT RATE VOLATILITY

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ABSTRACT

The paper explores the dynamics of fluctuations of freight rates in the maritime industry in the post-pandemic period that is marked by a structural change in the supply chain and a change in the demand in the trading market. The study uses Bayesian Vector Autoregression (BVAR) to address the problem of econometric modeling that comes with the traditional models when modeling the complex relationships and interaction among the factors of the macroeconomy and freight rates. The Bayesian econometric approach outperforms the VAR by leveraging informative priors to avoid the over-parameterization issue in order to give more precise parameters in the presence of market noise. The information contained in the model is the Baltic dry index (BDI), Shipping Index, Crude Oil Prices and Exchange rate. By using Minnesota Priors and the Normal-Wishart, the study concludes that post-pandemic volatility will become more dependent on the energy prices and regional maritime chokepoint shocks, relative to traditional demand volume considerations. The experiment indicates that BVAR has a higher out-of-sample prediction capability than VAR and ARIMA. The research can provide information to shipping companies, logistics companies and policymakers with a complex predictive model of financial risk and decision making.

APP002.26: BAYESIAN SPATIOTEMPORAL MODELING OF INTERNALLY GENERATED REVENUE (IGR) IN AKWA IBOM STATE AND ITS FIRST-ORDER NEIGHBOURHOODS IN NIGERIA

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ABSTRACT

State internally generated revenue (IGR) serves as an alternative revenue for State governments. Several factors can be responsible for poor revenue mobilization by a government. Some of these factors are economic, demographic, and/or fiscal factors. This study fits a Bayesian spatiotemporal Durbin model on internally generated revenue of Akwa Ibom State and its first-order neighbourhoods in Nigeria. Data was obtained from the records of National Bureau of Statistics (NBS), spanning from 2008 through 2024. The macroeconomic variables employed in this study are State internally generated revenue (IGR), Total taxes, Population density and Economic activity for Akwa Ibom, Abia, Cross River and Rivers State. This study employed the integrated nested Laplace approximation (INLA) method for the estimation of model parameters. The constant (10.571), IGR at time

lag one (0.563), total tax at current time (0.671), total tax at time lag one (-0.614), and the spatial lag of population density at time lag one (0.297) significantly influences the IGR of Akwa Ibom State and its first-order neighbouring States. None of the States under study has a significant spatial or temporal random effects. The phi for spatial value of 50% indicates that the IGR of a given State could be as a result of random factors than location factors. Significant state-time interaction effects were observed in the four States under study, indicating the presence of significant fluctuations in IGR across the States. The CPO values > 0.01 , indicate that the fitted model has a good predictive fit. The study concluded that there is a significant and positive population density spatial spillover effect on the IGR of a given State from its first-order neighbouring States. The study recommends that State governments particularly that of Akwa Ibom State and its first-order neighbouring States should focus on high-impact drivers of IGR in the State, such as improving policies related to effective tax collection both on high and low population density areas of the State.

APP003.26: A NEW FLEXIBLE FRÉCHET-BASED MODEL WITH APPLICATIONS TO ECONOMIC DATA

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ABSTRACT

This paper presents a novel three-parameter lifetime distribution termed the Type I Half Logistic Topp-Leone Fréchet (TIHLTL-Fr) distribution, derived by compounding the Type I Half Logistic Topp-Leone-G (TIHLTL-G) generator with the Fréchet baseline distribution. The proposed model provides greater flexibility to enhance modeling of heavy-tailed and skewed characteristics commonly encountered in reliability, survival, and extreme value data. The structural characteristics and features of the proposed TIHLTL-Fr distribution's density and functions and related characteristics are examined. Parameter estimation is carried out via the maximum likelihood approach, and a comprehensive Monte Carlo simulation study is conducted to assess the efficiency of the estimator under distinct sample sizes. The TIHLTL-Fr distribution effectiveness in practice and its comparative superiority was demonstrated through Nigeria's inflation rate and crude oil price data, where it outperforms some existing competing models using two primary Information Criteria (IC). The proposed model offers a great flexibility for modelling lifetime and extreme phenomena across various applied fields.

Keywords: TIHLTL-G family; Crude oil price; Inflation rate; Maximum likelihood estimation; Monte Carlo simulation; Heavy-tailed distribution.

APP004.26: APPLICATION OF EXPONENTIAL DEMAND AND WEIBULL DETERIORATION RATES UNDER SHORTAGE-DEPENDENT QUASI-PARTIAL BACKLOGGING ON INVENTORY MODEL

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ABSTRACT

A system of an inventory model for deteriorating items (Yam) with an exponential demand and a three-parameter Weibull distribution deterioration rate is presented in this paper. The development of the model is computed and analyzed under the assumptions and notations of a quasi-partial backlogging, which means that whenever the product (yam) is not available, a greater percentage of the customers will queue and wait for its availability again in the market.. The deterministic and stochastic exponential demand rate reveals a unilateral growth in demand and supply of the item. The objective of the model is to minimize the total inventory cost. The accelerating function of time shows instantaneous rate of deterioration, hence Weibull distribution. In deriving this model, we provide straightforward analytically method, employed novel R code to obtain numerical result, and we apply a real-world example to show how to solve the problems. We are proposing of conducting a sensitivity analysis to demonstrate how various model parameters affect the optimal values of the policy variables in the model.

Keywords: Exponential decreasing demand, Inventory modeling, Three-parameter Weibull deterioration, partial backlogging, Sensitivity analysis, optimal values.

APP005.26: APPLICATION OF STOCHASTIC MODEL TO INBREEDING WITH HIGH MORTALITY RATE OF HYBRID IN A GIVEN POPULATION

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ABSTRACT

A five state Markov Chain model is used to determine the pattern of gene distribution in a given population with high mortality rate. Artificial selection of the parents was used to determine the frequencies of the offspring. The paper is meant to examine the movement pattern of the gene hybrid in relation to that of the pure dominant and pure recessive in the population. The result from table eleven shows that, while the gene of the hybrid is reducing in a geometric rate, that of the pure dominant and pure recessive are increasing. This work will help both animals and plants breeders know danger associated with diseases that cause high mortality rate in any given population and to rescue the situation by knowing the types of species to cross.

Keywords: Inbreeding, Recessive, Dominant Markov Chain, Gene

APP006.26: ASSESSMENT OF PROBABILITY DISTRIBUTIONS FOR GROUND WATER QUALITY DATA COLLECTED IN BICHI LOCAL GOVERNMENT AREA OF KANO STATE

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ABSTRACT

This research describes the application of probability distributions to identify the best-fitted distribution to a practical problem involving groundwater data analysis. In this paper, three groundwater datasets including calcium, magnesium, and chloride are fitted to the normal, lognormal, gamma, Weibull, logistic, and log-logistic distributions to select the best groundwater model. The measures of goodness of fits such as the Akaike information criterion (AIC), Bayesian information criterion (BIC), and log-likelihood are computed to compare the fitted models. The results show that the gamma distribution gives better fits for calcium and magnesium datasets while the lognormal distribution provides a better fit for the chloride dataset than other competing models.

Keywords: Groundwater Data, Probability Distributions, Goodness of fit measures

APP007.26: ASSESSMENT OF AGE MIS-REPORTING USING 2006 POPULATION CENSUS DATA

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ABSTRACT

This research analyzed age and sex report on 2006 population census data. The collected data was analyzed using Age ratio, the United Nations Age-sex Accuracy Index and Myer's index. The analyses carried out using age ratio showed that among the age groups, there were some people who were not supposed to belong to some age groups but were classified into such groups and there were some people who were supposed to belong to some age groups but were mis-classified into some other age groups. The value for United Nations Age-sex Accuracy Index (UNAI) also gave an indication of high level of age mis-reporting. The value for Myers's Index showed that in the age reporting, some people preferred quoting ages that ended in particular digits. Hence each of the methods of analyses gave an indication of age mis-reporting during the 2006 population census. We recommend that statistical analyses should be carried out on the collected age data using the demographic techniques to determine the accuracy of the collected data before using it for developmental planning.

Keywords: Census data, Age ratio, the United Nations Age-sex Accuracy Index and Myer's index

APP008.26: BEYOND THE HEADCOUNT: THE STRATEGIC ADVANTAGES OF BIOMETRIC ELECTORAL PROXIES FOR EVIDENCE-BASED DEVELOPMENT PLANNING IN NIGERIA.

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ABSTRACT

In rapidly developing economies, reliance on decadal, static census data creates a demographic lag that severely distorts infrastructure planning and resource allocation. This paper introduces a biometric-geospatial framework that replaces static population denominators with an Effective Population proxy anchored in Total Votes Cast (TVC). By treating polling units as granular "human sensors," this model captures the kinetic reality of spatial demand. Tailored for development planners and policymakers, this paper outlines the distinct structural advantages of using biometric electoral data: absolute demographic integrity, high spatial resolution, dynamic recency, and the precise measurement of functional demand. Ultimately, this framework transitions governance evaluation from geographic guesswork to a precise science, providing an audited, evidence-based engine for targeting structural friction points and ensuring development deliverables track actively verified populations.

APP009.26: COMPUTING THE PROXIMITY AVAILABILITY METRIC (PAM) VIA GAUSSIAN DECAY: A STATISTICAL APPROACH TO MEASURING PRIMARY EDUCATION VULNERABILITY

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ABSTRACT

Standard spatial statistics frequently rely on discrete, binary, or categorical survey data to measure community access to basic infrastructure. These rigid models fail to capture the continuous, non-linear friction of physical space, resulting in step-function drops that misrepresent structural disenfranchisement. This paper introduces the Proximity Availability Metric (PAM), a novel statistical framework that translates distance into a continuous spatial distribution via a friction-adjusted Gaussian distance decay function. By calibrating the decay variance (δ^2) to a 1.5km universal walking standard for primary-aged children, the PAM model calculates a high-fidelity vulnerability score (0 to 5) for each population unit. The results demonstrate that replacing linear spatial assumptions with this continuous Gaussian model provides a statistically superior index of primary education vulnerability, equipping policymakers with an objective metric to optimise the placement of critical infrastructure.

APP010.26: CONTRIBUTIONS OF SELECTED MACRO-ECONOMIC INDICATORS TO GROSS DOMESTIC PRODUCT IN NIGERIA

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ABSTRACT

This Research examined the contribution of some economic sectors to the Gross Domestic Product (GDP) of Nigeria and to Formulate a regression model for annual Gross Domestic product (GDP) The data set (in ₦ million) covered period of 30 years from 1981 to 2010 for the following variables; Y = Gross Domestic Product, with X_i , $i= 1,2,3,4$ corresponding to contributions from Agricultural Sector, Building and Construction Sector, Wholesale and Retail Sector and Service Sector. The Multiple Linear Regression technique was used to fit a model for the GDP as $y = 96826.549 + 1.113x_1 + 0.032x_2 + 0.154x_3 + 2.437x_4$. The coefficient of determination (R^2) shows that the four economic variables considered explained 99.7% of the variation in the nation's GDP. The percentage contribution of each of the economy variables considered explained 99.7% of the variation in the nation's GDP. The percentage contributions of each of the economic variables were also obtained as follow: Agricultural Sector, 46.6%; Building and Construction Sector, 1.7%; Wholesaler and Retailers sector, 18.3% and Service Sector, 20.2%. The Analysis of Variance shows that the overall regression is significant and the individual t-test of the variables x_1 (Agricultural sector), x_3 (Wholesaler and Retailers sector), x_4 (Service Sector) have linear effect on Total Gross Domestic Product. That is, they all found to be statistically significant and hence, does really contribute to the variation in dependent variable (Total Gross Domestic Product). But x_2 (Building and construction sector) is not statistically significant.

Keywords: contribution, economic sectors and Gross Domestic Product

APP011.26: ECONOMETRIC ANALYSIS OF THE DYNAMIC RELATIONSHIP BETWEEN NIGERIAN GROSS DOMESTIC PRODUCT AND SOME ACTIVITY SECTORS: APPLICATION OF COINTEGRATION AND ERROR CORRECTION MECHANISM

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ABSTRACT

Time series data are distinct because they are usually with natural temporal ordering. This paper conducts an econometric analysis of the dynamic relationship between Nigeria's Gross Domestic Product (GDP) and three major activity sectors namely; Agriculture, Industry, and Services. Applying cointegration and error correction mechanism (ECM) on the Annual time series data of the variables, a Unit root tests (Augmented Dickey-Fuller, Phillips-Perron) revealed all four variables were non-stationary in levels but stationary after first differencing, i.e., $I(1)$. The Johansen cointegration test indicates at least one cointegrating equation among the variables was significance at 5%. Long-run coefficients showed that Services (0.58) and Agriculture (0.33) contribute positively and significantly to GDP, while Industry shows a smaller and less stable coefficient. The estimated error

correction term (ECT) is negative and statistically significant confirming that a stable long-run equilibrium exists. Approximately 43% of any short-run deviation from equilibrium is corrected annually, implying a moderate speed of adjustment back to the long-run path. The analysis showed that the Nigerian economy exhibits a stable long-term equilibrium relationship between GDP and its agricultural, industrial, and service sectors. Services and agriculture drive long-run growth, while industry's role is weaker and volatile. Policy should focus on industrial structural transformation and service sector resilience.

Keywords: Cointegration, Error Correction Mechanism, Nigeria GDP, Agriculture, Industry, Services, Long-run Equilibrium.

APP012.26: EVALUATING ANN, KNN, RF, SVM FOR EARLY RISK PREDICTION IN HEART DISEASE, DIABETES, AND HEPATITIS; A COMPARATIVE STUDY

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ABSTRACT

This research investigates the predictive capability of Artificial Neural Networks (ANN), Support Vector Machines (SVM) and K-Nearest Neighbours (KNN) in the early prediction of risks of chronic disease, using different data sets (Heart Disease, N=303; Diabetes, N=768; Hepatitis, N=155). To tackle high-dimensional noise and large class imbalances typical of medical infrastructure data, raw data was processed via standardised median/mode imputation, z-score normalisation and Synthetic Minority Over-Sampling Technique (SMOTE). Model parameters were optimised by 5-fold cross-validation grid searches. In descriptive matrices, the best baseline accuracy was obtained with Random Forest (M = .873, SD = .082), followed by ANN (M = .871, SD = .079). In inferential validation using paired-samples t-tests (df = 3) across cross-validation iterations, Random Forest outperformed KNN (t = 5.37, p = .013) and SVM (t = 6.21, p = .008). ANN also showed statistically significant better performance compared to SVM (t = -8.34, p = .004) and KNN (t = -4.39, p = .022). The mean performance difference between Random Forest and ANN was not statistically significant (t = 1.41, p = .252), indicating similar predictive capabilities. In contrast, instance-based spatial boundaries led to suboptimal performance for KNN (M = .826, SD = .096). The results validate that the ensemble and deep learning frameworks provide better, non-linear pattern extraction for automated clinical risk stratification.

Keywords: Paired-samples t-test; Comparative Evaluation; Machine learning; Hyperparameter tuning; Predictive modelling.

APP013.26: EXPLORING THE LINK BETWEEN STATISTICAL LITERACY AND CITIZEN ENGAGEMENT IN DATA-DRIVEN GOVERNANCE IN NIGERIA

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ABSTRACT

This study examines the relationship between statistical literacy and citizen engagement in data-driven governance in Nigeria, with data self-efficacy introduced as a mediating variable. In today's governance systems, as government relies on statistical evidence and digital data systems while making decisions, the citizens are expected to comprehend and interact with this data in meaningful ways. However, the ability to understand statistical information may not immediately translate into active civic engagement. Therefore, this study proposes that in addition to statistical literacy, citizens' capacity to independently work with and apply data (referred to as data self-efficacy) may help explain how statistical literacy influences citizen engagement in governance processes. A cross-sectional survey design will be adopted, employing purposive sampling and structured questionnaires to obtain data on statistical literacy, data self-efficacy and citizen engagement from 555 respondents. Structural Equation Modelling will be used to evaluate the direct and mediated relationships among the variables. The findings are expected to provide valuable insights for enhancing citizen engagement in Nigeria's evolving data-driven governance.

Keywords: Statistical literacy, Data self-efficacy, Citizen Engagement, Data-driven Governance, Structural Equation Modelling.

APP014.26: FORECASTING INFLATION RATE IN NIGERIA FROM 2000–2026 USING ARIMA MODELS ESTIMATION VIA THE LEVENBERG–MARQUARDT ALGORITHM

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ABSTRACT

Accurate forecasting of inflation is essential for macroeconomic policy formulation and monetary planning. This study models annual inflation in Nigeria from 2000 to 2026 using an Autoregressive Integrated Moving Average (ARIMA) specification whose parameters are estimated via the Levenberg–Marquardt (LM) nonlinear optimization algorithm. Unlike conventional estimation procedures, the LM algorithm blends gradient descent and Gauss–Newton strategies to enhance convergence robustness in nonlinear least-squares contexts. Model orders were selected using autocorrelation and partial autocorrelation functions. The proposed approach demonstrates stable parameter estimation and reliable forecasts of inflation dynamics. The LM algorithm estimated the ARIMA parameters which modeled the inflation rate data with 94% test performance from the adjusted R^2 , mean squared error of 2.38 and a mean absolute error of 0.86. **Key words:** Levenberg-Marquardt Algorithm, Time Series, ARIMA, Inflation, Forecasting.

APP015.26: FORECASTING NIGERIA'S MACROECONOMIC INDICATORS USING ARIMA MODELS: A TIME SERIES ANALYSIS OF UNEMPLOYMENT, INFLATION, GDP AND EXCHANGE RATE

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ABSTRACT

This study examines the dynamics and forecasts behavior of Nigeria's key macroeconomic indicators using Autoregressive Integrated Moving Average (ARIMA) models. Annual data on unemployment rate (% of labour force), inflation rate, GDP, and exchange rate obtained from the World Bank for the period 1960–2024 were analyzed within a univariate time-series framework. Stationarity was assessed using unit root tests of Augmented Dickey-Fuller (ADF) and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) tests as well as rolling mean and variance, and appropriate ARIMA specifications were selected based on autocorrelation and partial autocorrelation functions. The empirical results indicate that the selected ARIMA models adequately capture the autoregressive structure of the series, with statistically significant parameters and no evidence of residual autocorrelation. Prediction evaluations based on MAE, RMSE, MAPE, and adjusted R^2 demonstrate strong predictive performance, particularly for unemployment and GDP. The long-horizon projections suggest gradual convergence toward stable paths for most variables, although exchange rate forecasts indicate persistent volatility. The findings reaffirm the suitability of ARIMA models for forecasting low-frequency macroeconomic data and provide useful insights for macroeconomic planning and policy formulation in Nigeria.

Keywords: ARIMA, Time Series Analysis, Macroeconomic Forecasting, ADF, KPSS.

APP016.26: FORECASTING WITH FEW DATA SAMPLES: A COMPARISON STUDY OF INTELLIGENT AND REGRESSION TECHNIQUES

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ABSTRACT

Forecasting refers to the estimation of future outcomes through the use of historical data. An accurate forecast enhances efficiency and minimizes cost. Uncertainty associated with weather conditions, coupled with load variation and limited data samples, contributes immensely to the difficulty in realizing a reliable prediction. This paper presents a comparison of Auto Regressive Integrated Moving Average (ARIMA), Auto Regressive with eXogenous input (ARX), Nonlinear Auto Regressive with eXogenous input (NARX) and Radial Basis Function Neural Network (RBFNN) approaches for forecasting.

Experimental (full-scale) data from the Tamburawa Water Treatment Plant in Kano State, Nigeria, was used to validate the developed models. Simulation results indicated that the intelligent model (RBFNN) excellently outperformed the regression models in terms of percentage error, achieving a testing MAPE of 1.0847%, though with a MAD of 2.7672 and RMSE of 23.2623. The intelligent model could serve as a useful forecasting tool.

Keywords: Forecasting, limited data, regression models, intelligent models, water treatment plant.

APP017.26: HIERARCHICAL CLUSTERING FOR SPATIAL PATTERN RECOGNITION OF RADIOACTIVITY LEVELS OF SELECTED METALS IN SOIL SAMPLES FROM FEDERAL POLYTECHNIC KALTUNGO, NIGERIA.

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ABSTRACT

Exposure to ionising radiation from naturally occurring radiation in soil has potential environmental and public health risks, particularly in parts influenced by geological features and anthropogenic activities such as quarrying. This study aims to apply hierarchical cluster analysis to investigate the spatial distribution and existence of natural groupings of K-40, Ra-226, and Th-232 activities in soil samples obtained from 40 locations within Federal Polytechnic Kaltungo, Gombe State, Nigeria. Single and complete linkage methods were implemented on Euclidean distance matrices to identify natural groupings among the sampling sites using the R statistical package. The optimal number of clusters was determined through the elbow and silhouette methods and was found to be k=2. The research defines cluster 1 to consist of AB3 and AB4, which were observed to exhibit elevated radionuclide concentrations with mean levels of K-40, Ra-226, and Th-232 measured at 827.5 Bq/kg, 105.3 Bq/kg and 209.3 Bq/kg, respectively, and observed to be locations near mountainous areas and quarry operations. The remaining locations formed cluster 2 and showed a rather lower level of radiation as one moved away from the mountains. The research thus recommends that urgent action is necessary to see to the restriction of human activities around these mountainous.

Keywords: Dendrogram, Hierarchical Clustering, Quarry, R package., Radionuclides.

APP018.26: LEGACY TO LEADERSHIP: 50 YEARS OF ICT-DRIVEN STATISTICAL DEVELOPMENT IN NIGERIA

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ABSTRACT

This paper assesses Nigeria's 50-year experience in ICT-driven statistical development, emphasizing key achievements, challenges faced, and lessons learned. It examines ICT's contribution to statistical capacity enhancement, data collection, and dissemination, identifying pathways to position Nigeria as a statistical development leader in Africa. The results demonstrate considerable progress in statistical infrastructure, data quality, and accessibility, driven by ICT investments. To consolidate Nigeria's statistical gains and foster informed decision-making and development, the paper advocates for increased investment in ICT infrastructure, capacity building, and data analytics.

APP019.26: LIBERATION OF PANDEMIC VARIABLES USING ARTIFICIAL INTELLIGENCE AND STATISTICAL MODELS

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ABSTRACT

Antiretroviral therapy (ART) remains the primary treatment to stabilize HIV/AIDS, but success depends heavily on strict medication adherence and timing. Evaluating how the duration of ART usage impacts patient outcomes is critical for long-term management. This study evaluates the impact of ART duration (in years) on patient outcomes by comparing the predictive performance of blended Artificial Intelligence (AI) and statistical regression models. Data were randomly sampled from 300 HIV/AIDS patients undergoing ART. Two modelling approaches were compared: AI models, including Adaptive Neuro-Fuzzy Inference Systems (ANFIS), Support Vector Machines (SVM), and Artificial Neural Networks (ANN); and statistical models, including Multiple Linear Regression (MLR), Stepwise Linear Regression (SWLR), and Robust Linear Regression (RLR). Model accuracy was evaluated using Mean Squared Error (MSE) and the Coefficient of Determination (DC). Among the AI models, ANFIS achieved the highest predictive accuracy with a DC of 80.0%, outperforming SVM (75.5%) and ANN (70.2%). Within the statistical models, RLR provided the best fit with a DC of 70.0%, superior to MLR (68.0%) and SWLR (58.7%). Overall, the AI-driven ANFIS model demonstrated the highest predictive precision for evaluating ART duration effects. Advanced AI models, particularly ANFIS, outperform traditional statistical methods in predicting the long-term progression and duration effects of ART. These predictive tools can help healthcare providers optimize treatment adherence strategies and personalize patient care.

Keywords: AI models, ANFIS, Hidden neurons, Pandemic variables, Robust regression, Statistical models

APP020.26: LONG-TERM TRENDS, VARIABILITY, AND FORECASTING OF CLIMATE CHANGE INDICATORS IN KOGI STATE, NIGERIA: A TIME SERIES ANALYSIS

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ABSTRACT

Reliable, locally resolved evidence on the direction and magnitude of climate change is essential for adaptation planning in rain-fed agrarian economies, yet such evidence remains scarce at the sub-national scale in Nigeria. This study analyses long-term trends, variability, and the forecastability of various climate indicators, air temperature, rainfall, relative humidity, solar radiation, and wind speed, for Kogi State, North-Central Nigeria, using monthly records for the period 1991-2023. The non-parametric Mann-Kendall test and Sen's slope estimator were used to detect and quantify monotonic trends; stationarity was assessed with the Augmented Dickey-Fuller (ADF) and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) tests; and seasonal autoregressive integrated moving-average (SARIMA) models were fitted for short-term forecasting and validated on a 36-month hold-out using the root-mean-square error (RMSE), mean absolute error (MAE), and mean absolute percentage error (MAPE). Results reveal a statistically significant warming trend of 0.028°C per year ($p < 0.001$), a significant decline in annual rainfall of 8.4mm per year ($p = 0.006$), a marginal increase in solar radiation and wind speed, and no significant trend in relative humidity. A SARIMA(1, 0, 1)(1, 1, 1)₁₂ model produced accurate temperature forecasts (MAPE = 1.68%), while rainfall forecasts captured the seasonal cycle but with larger relative error owing to the dry-season zero-inflation typical of tropical wet-dry regimes. The forecasts indicate continued warming and a tendency toward reduced and more variable rainfall over the projection horizon. The findings imply intensifying agro-climatic stress for Kogi State and underscore the need for climate-smart agriculture, improved water-resource management, and strengthened early-warning and monitoring systems.

Keywords: climate change; Mann-Kendall test; Sen's slope; SARIMA; forecasting; Kogi State; Nigeria.

APP021.26: MACHINE LEARNING TECHNIQUES IN PREDICTING PATIENT SURVIVAL OUTCOMES IN PROSTATE CANCER

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ABSTRACT

This study investigates the application of machine learning techniques in predicting patient survival outcomes among prostate cancer patients using data from Kalgo Medical Centre, Kebbi State. A quantitative experimental research design based on supervised classification was adopted; utilizing a dataset of 225 confirmed prostate cancer cases. The models implemented include Logistic Regression, Support Vector Machine (SVM), Random Forest, Gradient Boosting, and Artificial Neural Network (ANN). Model performance was evaluated using accuracy, precision, recall, F1-score, and Area Under the

Curve (AUC), with data split into training (69.8%) and testing (30.2%) sets. The results indicate that the Artificial Neural Network outperformed all other models, achieving the highest accuracy (94.1%) and AUC (95.4%) on the testing dataset, followed by Gradient Boosting and Random Forest. Logistic Regression recorded the lowest performance, highlighting the limitations of linear models in capturing complex, non-linear relationships. Feature importance analysis revealed that age is the most significant predictor of survival, followed by risk factors, marital status, and test outcome status. The findings shows the effectiveness of machine learning models, particularly ANN, in improving survival prediction and supporting clinical decision-making. This study contributes to the limited body of research using localized datasets in Nigeria and provides a context-specific predictive framework for prostate cancer prognosis.

Keywords: Prostate Cancer, Machine Learning, Survival Prediction, Artificial Neural Network, Gradient Boosting, Random Forest, Support Vector Machine, Logistic Regression.

APP022.26: STATISTICAL ANALYSIS OF MARRIAGE AND DIVORCE IN JAMA'A LOCAL GOVERNMENT AREA OF KADUNA STATE

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ABSTRACT

This study presents a statistical analysis of marriage and divorce patterns in Jama'a Local Government Area of Kaduna State, Nigeria, based on 144 divorce cases recorded between May 2022 and June 2026. Using descriptive and inferential statistical techniques, the study examines demographic characteristics, causes of divorce, and factors associated with marital dissolution. Findings reveal that 81.9% of divorce petitions were filed by women, with physical violence (35.4%) and neglect/emotional abuse (28.5%) being the predominant causes. The mean age of divorcing men was 39.6 years compared to 34.2 years for women, with an average age difference of 6.1 years. Muslim couples constituted 61.1% of cases and had significantly shorter marriage durations (mean = 4.0 years) compared to Christian couples (mean = 8.3 years) ($t = -5.91$, $p < 0.001$). The study reveals an alarming upward trend in divorce cases, increasing from 4 cases in 2022 to 55 cases in 2025. These findings have significant implications for marriage counseling, family policy, and community intervention programs in Northern Nigeria.

Keywords: Divorce, Domestic Violence, Family Dissolution, Marriage, Jama'a LGA, Kaduna State, Statistical Analysis.

APP023.26: MODELING AND FORECASTING OF MULTIVARIATE TIME SERIES USING VECTOR AUTOREGRESSIVE (VAR) AND COINTEGRATION TECHNIQUES

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ABSTRACT

This study investigates the modeling and forecasting of multivariate time series using Vector Autoregressive (VAR) and Vector Error Correction Models (VECM). The objective is to capture the dynamic interrelationships among multiple time-dependent variables and enhance forecasting performance. Simulated multivariate data exhibiting interdependence and stochastic trends were generated to mimic real-world scenarios. Preliminary analysis using the Augmented Dickey-Fuller test indicated that the series were non-stationary at levels but became stationary after first differencing. The Johansen cointegration test revealed the presence of at least one cointegrating relationship, suggesting a long-run equilibrium among the variables. Consequently, a VECM was estimated. The results showed significant short-run dynamics and a stable long-run relationship among the variables. Impulse response analysis indicated that shocks to one variable had both immediate and persistent effects on others, while forecast error variance decomposition revealed that a substantial proportion of variability in each variable could be explained by innovations in other variables within the system. Furthermore, the multivariate models demonstrated superior forecasting performance compared to baseline univariate approaches, with lower Root Mean Square Error (RMSE) and Mean Absolute Error (MAE) values. The findings highlight the importance of accounting for interdependencies in time series modeling and confirm the suitability of VAR/VECM frameworks for multivariate forecasting. This study provides a foundation for applying these techniques to real-world datasets in future research.

APP024.26: MODELING CARGO THROUGHPUT AT CALABAR PORT: A BOX-JENKINS APPROACH

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ABSTRACT

Forecasting cargo throughput matters for how a port plans its berths, equipment and labour. This study models monthly cargo throughput at the Calabar Port Complex of the Nigerian Ports Authority using the Box-Jenkins approach, comparing non-seasonal ARIMA and seasonal SARIMA models. We analysed 264 monthly observations from January 2003 to December 2024. The series showed a long upward trend, a recent decline and a clear yearly cycle, and was non-stationary, so we applied regular and seasonal differencing. We fitted 95 candidate models and ranked them by the AIC, BIC and HQIC. The best non-seasonal model was ARIMA(0,1,1), but the seasonal SARIMA(1,1,2)(0,1,1)₁₂ model was far superior, lowering the AIC by about 580 points and confirming that the

annual cycle carries real information. The chosen model passed all diagnostic checks, with white-noise, normally distributed residuals and an in-sample MAPE of 22.0%. Its twenty-four-month forecast for 2025–2026 reproduces the seasonal rhythm projecting monthly throughput of roughly 141,000 to 174,000 tonnes whereas the non-seasonal model yields only a flat line. The results offer a practical planning tool and show why seasonality must be modelled explicitly in port forecasting.

Keywords: Box–Jenkins methodology; ARIMA; SARIMA; model selection; cargo throughput; Calabar Port; seasonality; forecasting.

APP025.26: MODELING FUEL CONSUMPTION HETEROGENEITY IN SELECTED CARS USING LOGISTIC QUANTILE REGRESSION

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ABSTRACT

Fuel consumption of automobiles varies widely due to differences in engine characteristics, driving conditions, and vehicle design. Traditional regression models such as Ordinary Least Squares focus only on average fuel consumption, thereby ignoring the distribution's tails where high-consumption and low-consumption vehicles lie. This study addresses this gap by applying Logistic Quantile Regression to analyze factors influencing fuel consumption across multiple quantiles of selected car models in Nigeria, 2018 to 2024. The objective is to examine how engine size, vehicle weight, transmission type, age, and horsepower affect fuel consumption at the 10th, 25th, 50th, 75th, and 90th quantiles. Data were collected on 250 selected cars spanning Toyota, Honda, Hyundai, and Kia brands from the Nigerian Federal Road Safety Corps vehicle database and auto dealer records. Results show significant asymmetry in the determinants of fuel consumption. Engine size and vehicle weight have stronger positive effects at upper quantiles Q75–Q90, indicating they drive high fuel consumption more than average consumption. Transmission type is significant only at lower quantiles Q10–Q25, suggesting automatics improve efficiency mainly for already efficient cars. Age of vehicle becomes statistically significant from the median upward, with older cars consuming disproportionately more fuel at Q90. The study concludes that a one-size-fits-all policy on fuel efficiency is inadequate. Policy implications recommend targeted interventions: engine downsizing and weight reduction for high-consumption vehicles at upper quantiles, while maintenance and transmission upgrades benefit low-to-median consumption cars.

Keywords: Logistic quantile regression, Fuel consumption, Vehicle efficiency, Engine size, Heterogeneity

APP026.26: MODELLING AND FORECASTING NAIRA/DOLLAR EXCHANGE RATE USING ARIMA MODEL

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ABSTRACT

Exchange rates are critical economic indicators that reflect the value of one currency relative to another. The exchange rate between the Nigerian Naira and the US Dollar has been characterized by significant volatility and unpredictability, which poses a considerable challenge for economic stability and planning in Nigeria. The aim of this research is to model and forecast the Naira/Dollar exchange rates. The methodology adopted was Autoregressive Integrated Moving Average. The result revealed that ARIMA (0,1,1) is the best model for forecasting the future exchange rate of Naira to Dollar. The results of the forecast evaluation statistics: 0.27212 and 0.07171 are very close to zero indicating good forecast which shows that ARIMA (0,1,1) is reliable and accurate for Naira-Dollar exchange rate forecast. We further recommend for its adoption in any study involving forecasting a time series variable.

Keywords: Volatility, Forecast, ARIMA Model

APP027.26: MULTIPLE REGRESSION ANALYSIS OF STUDENTS' PERFORMANCE USING VARIABLE SELECTION PROCEDURES

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ABSTRACT

Regression analysis provides us with useful aid in the prediction of models; it examines and also explores relationships between variables. In this paper, the students' Grade Point Average (GPA) in Computer Science department, Federal Polytechnic, Ekowe at the end of 2017/2018 first academic section which is the response (dependent) variable was regressed on four predictive (independent) variables namely: Chemistry, Mathematics, English and Physics. The predictive variables are the Joint Admissions and Matriculation Board (JAMB) subjects offered by the respective students of Computer Science department that were given provisional admission into the department. The forward, backward elimination and stepwise selection procedures were used in selecting the best predictor variable subsets. It was observed from the results that the same subsets of predictor variables were selected for both forward and stepwise selection procedure. It is also seen that not all the linear function of the unknown parameters $\beta_1, \dots, \beta_4$ are zero meaning that the explanatory variables have significance influence on the dependent variable Y.

Keywords: Multiple regression; Dependent variable; Predictor variables; Linear function; Sum of squares.

**APP028.26: ON THE SEARCH FOR OPTIMAL BEST GENERALIZED
AUTOREGRESSIVE SCORE (GAS) MODELS FOR CAPTURING JUMPS AND
ASYMMETRY IN THE NIGERIAN STOCK PRICE INDEX RETURNS.**

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ABSTRACT

This paper examined the variants of Generalized Autoregressive Scores (GAS) models on Nigerian stocks using All Share Index (ASI) as proxy. The four conditional distribution assumptions of GAS models considered were Normal, Student t , Generalized Error Distributions and Student Skew- t version of the models. The data used span between 1st January 2014 and 26th November, 2025 covering about 2780 data. These were obtained from the NES data bank and Google colab and E-view 7.0 were used for the analysis. The Analysis revealed that the GAS Skew- t model demonstrates a substantially better fit to the data compared to the GARCH(1,1) model, as indicated by its much lower AIC and BIC values. This suggests the importance of incorporating skewness and heavy tails, as well as a more flexible score-driven update mechanism, in modeling financial returns volatility for this dataset. The selection of the better model for each distribution has been based on the minimum information criteria and log-likelihood. Therefore, the GAS Skew- t models demonstrates substantially better fit to the data in estimating and forecasting the market trends volatility.

Keywords: GAS Models, All Share Index, Minimum Information Criterion, Beta-skew- t -GARCH (1,1) mode, Log- Likelihood.

**APP029.26: THE NEXT 50 YEARS: A VISION FOR A RESILIENT, DIGITALISED
AND DECENTRALISED NATIONAL STATISTICAL SYSTEM IN NIGERIA**

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ABSTRACT

As the Chartered Institute of Statisticians of Nigeria (CISON) marks fifty years of the statistical profession in Nigeria, it is necessary to interrogate the trajectory that the National Statistical System (NSS) should take over the next half-century. This paper adopts a desk-based, qualitative document-analysis design to examine the structural, technological and institutional readiness of Nigeria's statistical architecture for the period 2026–2076. Drawing on the Statistics Act (2007), the National Strategy for the Development of Statistics, and recent continental data-ecosystem literature, the study finds that the NSS remains constrained by fragmented sub-national capacity, weak inter-agency data-sharing protocols, donor dependence and slow integration of artificial intelligence and real-time administrative data. The paper argues that the next fifty years must be anchored on four pillars: full digitalisation of data infrastructure, statistical federalism that strengthens State Bureaus of Statistics and Local Government statistics units, legislative modernisation of the Statistics Act to compel timely data-sharing among Ministries, Departments and Agencies, and sustained domestic financing of statistics as a public good. The paper concludes that without a deliberate shift from donor-driven, survey-based statistics

towards an integrated, technology-enabled and federally distributed statistical system, Nigeria risks repeating the data gaps of the last fifty years into the next.

Keywords: National Statistical System, statistical capacity, data ecosystem, digitalisation, Nigeria

APP030.26: SPATIAL PERSISTENCE, REVENUE TRAJECTORIES AND PERFORMANCE CLUSTERS OF NIGERIAN STATES

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ABSTRACT

This study examines the dynamic behaviour of subnational tax revenue performance across Nigerian states, focusing on persistence, mobility, and spatial patterns over the period 2019–2024. Using a longitudinal dataset, tax revenue is standardised on a per capita basis to ensure comparability across states. The analysis employs a Markov transition framework to capture movements across performance categories, complemented by trajectory analysis and spatial diagnostics based on Local Indicators of Spatial Association (LISA). The results reveal a high degree of persistence, with approximately 65.9% of observations remaining in the same category over time. Transition probabilities indicate strong structural stability among both low- and high-performing states, while upward mobility is limited and largely confined to adjacent categories. Trajectory analysis further shows that most states experience stable or only marginal changes. Spatial analysis indicates limited evidence of widespread clustering; however, a small number of states exhibit statistically significant local spatial dependence, which remains robust across alternative spatial weight specifications. These findings suggest that subnational fiscal disparities in Nigeria are largely structural and path-dependent. The persistence of these disparities highlights the need for targeted policy interventions aimed at strengthening revenue mobilisation capacity in lower-performing states.

Keywords: Subnational tax revenue; Internally generated revenue; Markov transition; Fiscal persistence; Revenue mobility; Spatial dynamics; Nigeria

APP031.26: STATISTICAL CAPACITY BUILDING IN PUBLIC SECTOR

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ABSTRACT

The Nigerian public sector is crucial in building efficiency and productivity. The skills and knowledge of Nigeria public sector plays a major role in delivery services to citizens. This study examines the various agency with the responsibility of capacity building in the public sector using various agency such as the central bank of Nigeria, ministries, department and agencies. We examine the public sector challenges in capacity building the pro and cons of staff training in respect to capacity building. This research will

contribute to public to sector capacity building, suggest recommendations that are practical for government and policy makers. The effect of delayed staff training on services and productivity delivery, the necessity of investing in human capital in government sector which leads to better effectiveness, efficiency and accuracy of government operations. It also seeks to find potential solution to enhance workers dedication and passion for development. Furthermore, it will lead to improvement in the public sector.

Keywords: Capacity building, Public Sector, Data, Policy

APP032.26: STATISTICAL HYPOTHESIS TESTING ON REFERENCE MATERIALS IN DETERMINING UDAWA LITHIUM ORE'S WORK INDEX FOR COMMINUTION CIRCUIT DESIGN

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ABSTRACT

In mineral processing, the Bond Work Index is a critical parameter for estimating the energy required for comminution and for designing efficient grinding circuits. However, the accuracy of work index determination depends largely on the suitability of the reference materials used in grindability tests. This study, therefore, evaluates the statistical suitability of selected reference materials for determining the work index of Udawa Lithium ore. Spodumene samples obtained from Udawa Village, were subjected to grindability tests using granite, hematite, and magnetite as reference materials. Specific gravities of 3.0, 2.7, 5.1 and 5.0 were obtained for spodumene, granite, hematite and magnetite, respectively. Homogenised samples were prepared and analysed in accordance with the Bond-modified energy equation. A t-test statistical method was applied to determine the suitability of the reference materials relative to the test ore. Grindability tests revealed that the 80% passing size (P80) fractions of the feed for spodumene, granite, hematite, and magnetite were 523.1 μm , 355.5 μm , 358.4 μm , and 418.85 μm , while the corresponding product sizes were 236.50 μm , 179.6 μm , 257.59 μm , and 242.67 μm . Based on these values, the average work index of the Udawa Lithium ore was calculated to be 14.5 kWh/t. Statistical analysis yielded p-values of 0.989, 0.999, 0.889, and 0.879 for the feed fractions and 0.989, 0.899, 0.999, and 0.989 for the product fractions at a 5% level of significance, indicating strong statistical agreement between the reference materials and the test ore. The findings confirm that the selected reference materials are suitable for work index determination of Udawa Lithium ore. The experimental parameters obtained provide valuable data for accurate comminution circuit design and improved efficiency in lithium ore processing.

Keywords: Spodumene; Comminution; Grindability; Statistical evaluation

APP033.26: STATISTICAL INFERENCE FOR THE REPRODUCTION NUMBER OF LASSA FEVER: CONFIDENCE INTERVAL ESTIMATION USING THE DELTA METHOD

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ABSTRACT

Lassa fever remains a major public health concern in West Africa, with transmission dynamics often assessed using the basic reproduction number (R_0). However, most studies rely on point estimates without quantifying uncertainty, which may lead to misleading policy decisions. This study aims to develop a statistical framework for estimating R_0 and its confidence intervals for Lassa fever. Specifically, the objectives are to estimate model parameters of a Lassa fever model, and construct confidence intervals via the Delta Method. Existing literature highlights the widespread use of compartmental models and next-generation matrices for R_0 estimation, but reveals limited attention to uncertainty quantification. A deterministic Lassa fever model incorporating human and rodent populations will be analysed using weekly outbreak data obtained from National Centre for Disease Control (NCDC). The Delta Method is applied to approximate the variance of R_0 and construct confidence bounds. By providing confidence bounds, this study will make decision-makers to understand beyond simple point estimates, especially in systems exhibiting phenomena like backward bifurcation, where reducing the mean R_0 below 1 may not guarantee eradication.

Keywords: Lassa fever; basic reproduction number; Delta Method; confidence intervals; uncertainty quantification.

**APP034.26: STATISTICAL METHOD FOR THE ANALYSIS OF RESULTS FROM
CONTROLLED COMPARATIVE DIAGNOSTIC SCREENING TEST AND
CLINICAL TRIALS FOR A CONDITION IN A POPULATION**

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ABSTRACT

In Controlled comparative prospective or retrospective studies involving matched pairs of sample data of subjects in a population, the responses of subjects to a predisposing factor or to a condition may be simply dichotomous but a broader classification into more than two mutually exclusive groups is finer and more informative. More so, the classical methods of analyzing paired or matched pairs (t-test, z-test and chi-square tests) are either based on the assumption of normality or they are unstable with variation in sample sizes. This work developed a new method for the analysis of results from controlled comparative clinical trials in which the outcomes are on mutually exclusive ordinal groups such that the assumption of normality and stability with sample size cannot be an impediment. The proposed method was tested with data obtained through a retrospective approach from a random sample of 200 malaria patients at the Nnamdi Azikiwe Teaching Hospital Nnewi. The new method which is based on proportions is capable of estimating the probabilities that the responses of subjects who were administered a particular treatment are higher or lower than the responses of subjects who were administered the other treatment. Compared with the traditional chi-square test of independence, the new method produced a higher chi-square statistic value, 36.57, against 16.279 produced by the traditional chi-square test suggesting that the new method is more efficient and more powerful.

Keywords: controlled comparative study, chi-square test, retrospective, prospective, clinical trial.

APP035.26: MULTIVARIATE DISCRIMINANT ANALYSIS OF RISK FACTORS FOR SEVERE BRONCHOPNEUMONIA IN UNDER-FIVE CHILDREN IN NIGER STATE

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ABSTRACT

Chronic bronchopneumonia or chronic non-progressive pneumonia, occurs worldwide and commonly affects lambs up to 12 months of age. It is an illness, usually caused by infection, in which the lungs become inflamed and congested, reducing oxygen exchange and leading to cough and breathlessness. It affects individuals of all ages but occurs most frequently in children and the elderly. Among children, pneumonia is the most common cause of death worldwide. This study applies discriminant analysis models to predict the prevalence of broncho-pneumonia status in infants. The data used in this study were collected from health institutions in Minna south. Six predictor variables which are well-recognized for characterizing broncho-pneumonia in infants were considered. These are; Malnutrition, Weight of Baby at Birth, Father's Education, Age of Baby, Father's Occupation and Baby's gender. Two hundred and twenty five (225) infants with low birth weight were randomly selected from health institutions to build up the discriminant model. It was discovered that weight of baby at birth has the highest discriminating power at 0.725, whereas the father's education variable has the least discriminatory power with 1. The probability of correct classification reached 87.2%, followed by the second group with broncho-pneumonia, where the probability of correct classification was 60%. The probability of overall correct classification is 75.1%, with a macro classification error of 24.9%. We concluded that increasing the sample size has a significant impact on the correct classification of observations. The recommendations were given in the study.

Keywords: Discriminant Analysis, Broncho-pneumonia, Predisposing, Risk Factors, Malnutrition

APP036.26: THE ROLE OF BIG DATA, ARTIFICIAL INTELLIGENCE (AI), AND REAL-TIME INDICATORS IN PROMOTING GOOD GOVERNANCE.

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ABSTRACT

The exigency of Big Data, the speedy advancement of Artificial Intelligence (AI) and machine learning (ML), the implementation or deployment of real-time digital indicators via smart devices, online platforms and sensors, have critically transformed how the public institutions and governments function all over the world. Governments deeply depend on technologies driven by data to enhance accountability, transparency, citizen participation, policy formulation, and public service delivery. This paper examines the role of Big Data and AI in promoting good governance through predictive analytics, automated decision-

making, smart monitoring systems, and real-time performance indicators. This study equally explores how governments can tactfully adopt and incorporate or integrate digital technologies to tackle continual governance challenges. It specifically examines how these technologies can improve accountability to reduce corruption, and transparency, streamline the processes of administration to improve efficiency. Therefore, using a qualitative and analytical research approach, this article draws a conclusion that integrating or incorporating AI-powered governance systems with transparent regulatory structure or frameworks can greatly improve sustainable development and public administration.

Keywords: Big data, good governance, artificial intelligence, real-time indicator, machine learning

APP037.26: TIME SERIES MODELING OF ANNUAL TEMPERATURE OF JOS HIGHLAND DATA

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ABSTRACT

This paper modeled the annual temperature of Jos highland data from 1951 to 2020 using a non-Gaussian autoregressive class of time series model. The unit root test was applied to ascertain that the data was stationary. The autocorrelation function (ACF) and partial autocorrelation function (PACF) were used to identify the pattern and model suitable for the data. The results show that the data is stationary at a 5-percent level of significance. The descriptive statistics, ACF and PACF show that the data can be modeled using non-Gaussian autoregressive models of order one satisfactorily. However, the Gaussian first-order autoregressive model (Gaussian AR(1)) was compared with the non-Gaussian first-order autoregressive model (Garima AR(1)) using Akaike information criterion (AIC) and Bayesian information criterion (BIC). The result showed that the AIC and the BIC values for the Garima AR(1) model was the lowest indicating that the Garima AR(1) model is a better model for modeling the annual temperature of Jos highland data. Hence, the paper recommends the use of Garima AR(1) to predict the annual temperature of Jos.

Keywords: First-order autoregressive, Akaike information criterion, Bayesian information criterion, Garima distribution, Stationarity.

APP038.26: TIME SERIES MODELING OF SOLAR RADIATION IN KEBBI STATE, NIGERIA: AN ARIMA-BASED FORECASTING FRAMEWORK FOR ENERGY POLICY

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ABSTRACT

Electric power consumption has significantly increased in recent decades. Traditional energy sources such as oil, coal, and nuclear power have a negative impact on the environment. As a result, researchers have shifted attention toward renewable sources such as solar, wind, and marine energy. Solar energy production has grown significantly over the last decade, but power fluctuation driven by the variability of solar radiation remains a challenge. This study analyzes daily average solar radiation data for Kebbi State, Nigeria, using the ARIMA modeling approach, with data sourced from the Nigerian Meteorological Agency (NiMet), Birnin Kebbi for 34 weeks and 4 days (from 1st November 2024 to 30th June 2025). After model identification and evaluation based on AIC and BIC criteria, ARIMA (1, 1, 2) was selected as the optimal model. The fitted model equation is: $Y_t = 2.60346e-05 - 0.0424045t-1 - 1.90854 t-1 + 0.908543 t-2$. The model successfully captures short-term dynamics in the radiation pattern and was used to forecast solar radiation levels for 150 days ahead. This forecasting framework offers a valuable tool for energy planning and solar power deployment in semi-arid regions like Kebbi State.

Keywords: ARIMA, PACF, Solar Radiation, ACF, KPSS

APP039.26: STATISTICAL ASSESSMENT OF TRENDS, PREVALENCE AND SOCIO DEMOGRAPHIC CORRELATES OF SOME SELECTED CANCER TYPES AT UNIVERSITY OF NIGERIA TEACHING HOSPITAL (UNTH), ITUKU-OZALLA, ENUGU

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ABSTRACT

Cancer is a terminal illness spreading across regions and various countries of the world. The most prevalent forms of cancer differ significantly between nations and regions. As a result, the search for sustainable strategies to coping with the increasing burden of cancer has been a growing concern among researchers. This study empirically assessed the behaviour of reported cases of some selected cancer types at University of Nigeria Teaching Hospital (UNTH), Ituku Ozalla, Enugu. Specific objectives of the study were to estimate the prevalence rates, show the trends of cancer diseases for the period, determine the major stage at diagnosis for the various cancer diseases, and determine the socio-demographic correlates of the selected cancer types in the study area. Period covered was from 2009-2022. Relevant data were extracted from folders of 471 cancer patients in the hospital. Statistical techniques such as descriptive statistics and binary logistic regression

were employed in the analyses of the data set. The descriptive results revealed increasing trends and prevalence of cancer types, while findings from the binary logistic regression identified age at diagnosis as the commonest socio-demographic determinant of cancer burdens. Based on the findings of the study, early presentation of cancer for diagnosis and treatment was recommended as an important step to reducing cancer burdens in the area. It was also recommended that Government should show more commitment towards fighting this terminal illness by providing facilities for cancer diagnosis and treatment be made available in the region, while the population should be sensitized on the essence of regular cancer check-ups.

Keywords: Cancer types; Prevalence; Trends; Binary logistic regression

APP040.26: CROSS-DOMAIN EVALUATION OF DEEP AND CLASSICAL ANOMALY DETECTION MODELS: STATISTICAL INSIGHTS ON GENERALISABILITY FOR BIG DATA GOVERNANCE IN NIGERIA

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ABSTRACT

The growing adoption of artificial intelligence for fraud detection, cybersecurity, digital payments, and public sector monitoring raises a critical statistical question; do sophisticated deep-learning anomaly detectors consistently outperform simpler classical methods, or does relative performance depend on the structure of the data? This study conducted a cross-domain evaluation of eight anomaly detection models comprising Autoencoder, Variational Autoencoder, Deep SVDD, attention guided VAE-Att, Isolation Forest, One-Class Support Vector Machine, Local Outlier Factor, and Principal Component Analysis. The models were assessed on six completed datasets representing controlled high-dimensional data, financial fraud, network intrusion, cybersecurity, and Nigerian digital payments. Precision, recall, F1-score, AUROC, and AUPRC were used to distinguish threshold dependent classification from continuous anomaly ranking quality. Results showed no uniform model family dominance. Deep learning produced the best F1-score on NSL-KDD and the Nigerian FinTech Dataset, while classical approaches led on CreditCard Fraud, UNSW-NB15, and CIC-IDS2017, while the Synthetic dataset produced a tie. The largest deep-learning advantage occurred on NSL-KDD, where VAE-Att exceeded the best classical model by 0.112303 F1 points. Conversely, classical models led by 0.046382, 0.044091, and 0.057355. F1 points on CreditCard Fraud, UNSW-NB15, and CIC-IDS2017, respectively. These findings indicate that anomaly detection generalisability is dataset dependent rather than architecture dependent. Model selection for governance applications should therefore consider feature structure, anomaly prevalence, threshold behaviour, operational costs, and validation context rather than assuming that greater architectural complexity guarantees superior performance.

Keywords: anomaly detection, model benchmarking, deep learning, classical machine learning, generalisability, statistical evaluation, big-data governance, Nigeria.

APP041.26: PANEL DATA ANALYSIS OF SELECTED DEMOGRAPHIC AND ECONOMIC DETERMINANTS OF GDP GROWTH IN EMERGING AND DEVELOPED ECONOMIES

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ABSTRACT

Economic growth remains a central indicator of macroeconomic performance and development, with its trajectory shaped by a complex interaction of demographic, monetary, health, and urbanization factors. This study examined selected demographic and economic determinants of gross domestic product growth (GDPG) in emerging and developed economies using panel data econometric techniques comprising 660 observations. The study specifically investigated the effects of population growth (POPG), broad money growth (BMG), health expenditure growth (HEG), life expectancy at birth (LEB), birth rate (BR), and urban population growth rate (UPGR) on GDPG. Descriptive statistics, pooled ordinary least squares, two-way fixed and random effects models, panel specification tests, Pesaran cross-sectional dependence and CADF unit-root tests, Johansen Fisher panel cointegration, Dynamic Panel Fully Modified OLS (FMOLS), Panel Vector Error Correction Model (PVECM), and Dumitrescu-Hurlin causality tests were employed. The results showed substantial variability in GDPG, which averaged 4.2096%, while all variables significantly departed from normality. The estimates of Pooled OLS, fixed and random effects models consistently revealed that population growth, broad money growth, health expenditure growth, and life expectancy at birth positively and significantly influenced GDP growth whereas, birth rate and urban population growth had negative and significant impacts on GDP growth. The redundant fixed-effects test rejected pooled OLS ($p < 0.001$), whereas the Hausman test supported the two-way random-effects specification ($\chi^2 = 6.8749$, $p = 0.3326$). However, significant cross-sectional dependence was initially detected (Pesaran CD = 4.8637, $p < 0.001$). All variables were $I(1)$, and Johansen Fisher tests confirmed six panel cointegrating relationships. Dynamic FMOLS revealed significant positive long-run effects of POPG (0.9150), BMG (0.2131), LEB (0.1986), and HEG (0.6734), while BR (-0.1434) and UPGR (-0.1489) exerted significant negative effects. The PVECM indicated significant short-run dynamics, with 69.53% of disequilibrium corrected within one period ($EC = -0.69525$, $p < 0.001$). Dumitrescu-Hurlin tests revealed extensive bidirectional predictive causality, particularly between GDPG and POPG, BMG, LEB, and BR. The findings underscore the importance of integrated demographic, monetary, health, and urban-development policies for sustained economic growth. The study recommends that Governments should coordinate demographic, monetary, health, and urban-development policies to promote sustainable and inclusive economic growth.

Keywords: GDP Growth; Demographic Determinants; Economic Determinants; Panel Data Analysis; Emerging Economies; Developed Economies.

APP042.26: BAYESIAN A-OPTIMALITY CRITERIA FOR RIDGE AND LASSO REGRESSION MODELS TO DETERMINE THE MACROECONOMIC FACTORS OF NIGERIAN ECONOMIC GROWTH

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ABSTRACT

Economic growth in Nigeria is influenced by numerous macroeconomic factors that are often highly correlated, creating multicollinearity and potentially producing unstable and imprecise regression models coefficient estimates. This study applied Bayesian A-optimality criteria to determine the macroeconomic determinants of economic growth in Nigeria while addressing multicollinearity and parameter uncertainty. The study considered thirteen variables, with GDP growth rate as the response variable. Ridge regression, with an optimal penalty parameter $\lambda = 0.244$, retained all thirteen predictors, whereas Lasso regression with $\lambda = 1.331$, selected six predictors which are inflation rate, interest rate, foreign direct investment(FDI), unemployment rate, money supply and exports. Among these variables selected FDI and Exports positively contribute to the economic growth, while others decrease the growth of the economy as they increase. The Lasso model is a better model as it produce lower MSE (7.277) and higher R^2 (0.529) compared with Ridge model which recorded an MSE (7.818) and R^2 (0.517). Furthermore, Lasso recorded a lower Bayesian A-optimality criterion value of 5.323 compared with 6.705 for ridge, indicating lower aggregate posterior uncertainty under the specified Bayesian framework. The findings demonstrate that ridge is useful for coefficient shrinkage and retain all predictors, while Lasso provides variable selection and a more parsimonious model. The study recommends further investigation using other Bayesian optimality criteria and additional macroeconomic variables.

Keywords: Bayesian A-optimality, multicollinearity, Variable Selection, Penalized regression, Economic Factors.

APP043.26: MULTIVARIATE ANALYSIS OF VARIANCE OF BENISEED YIELD AND YIELD RELATED TRAITS IN BADEGGI, NIGER STATE, NIGERIA

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ABSTRACT

Beniseed (*Sesamum indicum* L.) is an important oilseed crop in Nigeria, valued for its nutritional, economic and industrial significance. However, differences in varietal characteristics and environmental conditions can substantially influence yield and associated agronomic traits. This study evaluated the combined effects of variety and location on yield and selected yield related traits of thirteen Beniseed varieties: Ex-Sudan, Nic-Blanco, SN603, Kenana 4, NCRIBEN 01M, NCRIBEN 02M, NCRIBEN 03L, ICEASE 0001, ICEASE 00013, ICEASE 00018, ICEASE 00020, E8 (Check), and Bogoro Local. The experiment was conducted during the 2021 cropping season at Badeggi and Mokwa in Niger State and Yandev in Benue State, using a randomized complete block design with three replications. Data were collected on flowering, plant height, branching, capsule characteristics, maturity, seed weight and yield. Multivariate Analysis of Variance

(MANOVA) was performed using SPSS version 26 to determine the effects of variety, location and their interaction on the combined response variables. The results revealed highly significant multivariate effects of variety, location and variety $\times$ location interaction ($p < 0.001$). The partial eta squared values indicated substantial effects of variety (0.430–0.960) and location (0.816–0.931), while the variety $\times$ location interaction also showed considerable effects (0.439–0.835). These findings demonstrate substantial variation among Beniseed varieties and significant environmental influence on their overall agronomic performance. The significant interaction further indicates that varietal performance was location dependent. The study highlights the usefulness of MANOVA for simultaneous evaluation of correlated yield and yield related traits and provides valuable information for varietal selection, breeding programmes and location specific Beniseed production recommendations.

Keywords: Beniseed; Multivariate analysis of variance; yield; yield related traits; location

APP044.26: EVALUATING THE EFFECT OF BUDGET IMPLEMENTATION ON ECONOMIC GROWTH IN NIGERIA

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ABSTRACT

This study evaluates the effect of federal budget implementation on economic growth in Nigeria using annual time-series data for 1981–2023. Nominal Gross Domestic Product (NGDP) is used as the proxy for economic growth, while capital expenditure (CAPEX), recurrent expenditure (RECEX), and domestic debt (DDEB) are used as fiscal indicators of budget implementation. The study adopts an ex post facto design and applies the Two-Stage Least Squares (2SLS) instrumental-variable technique to address possible endogeneity arising from simultaneity and reverse causality between fiscal policy and economic activity. One-year lagged values of the fiscal variables are employed as instruments. To maintain comparability across national-account rebasing, the NGDP series is harmonized using the 2019 overlap year, and all variables are transformed into natural logarithms. Unit-root results indicate that the variables are integrated of order one, while the Johansen procedure provides evidence of a long-run relationship. The 2SLS estimates show that recurrent expenditure has a positive and statistically significant effect on NGDP, with an elasticity of 0.7197 ($p = 0.0004$). Capital expenditure has a positive but statistically insignificant coefficient of 0.0058 ($p = 0.9646$), while domestic debt has a positive but statistically insignificant coefficient of 0.2828 ($p = 0.1092$). The model records an R-squared of 0.9902. Diagnostic results indicate normally distributed and homoscedastic residuals, while HAC/Newey–West standard errors are used to obtain inference robust to serial correlation. The findings indicate that the observed effect of budget implementation on nominal economic activity is dominated by recurrent expenditure rather than capital expenditure or domestic debt. The study recommends improving capital-budget execution, strengthening performance-based budgeting, linking borrowing to productive investment, and enhancing monitoring and accountability.

Keywords: budget implementation; economic growth; fiscal expenditure; capital expenditure; recurrent expenditure; two-stage least squares

SPECIAL PAPERS SELECTED

SPECIAL PAPERS' ROOM 1

Wednesday, 14 October 2026

10.00 am – 1.30 pm

Chaired by Professor Polycarp Emeka Chigbu

SP&TM001.26: MULTIVARIATE WEIBULL-COPULA FRAMEWORK FOR REAL-TIME ANOMALY DETECTION IN INTERNET TRAFFIC: SIMULATION-BASED ANALYSIS

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ABSTRACT

Due to heavy-tailed behavior, feature dependence, and evolving cyberattacks, accurate detection of anomalous Internet traffic remains a critical challenge. This study introduces a multivariate Weibull-copula model for real-time anomaly detection that combines Weibull marginal modeling, copula-based dependence structures, adaptive thresholding, and sliding-window monitoring. The study focuses on Monte Carlo simulation analysis involving 16.6 million observations under multiple traffic regimes, dependence levels, and attack scenarios. The findings based on the simulation study revealed that the maximum likelihood estimator (MLE) consistently provided better Weibull parameter estimates and that the fitted copula models successfully recovered the underlying dependence structures. The proposed anomaly measure achieved good detection performance across marginal, dependence, mixed, and stealth anomalies, with considerable performance observed for mixed attacks (F1-score = 0.8693; AUC = 0.9905). Compared with the baseline univariate Weibull detector, Isolation Forest, One-Class SVM, Local Outlier Factor, Autoencoder, and COPOD-like methods, the introduced approach achieved better overall accuracy, recall, F1-score, AUC, and false alarm performance. These achieved results indicate that incorporating copula-based dependence information substantially enhances anomaly detection while preserving the interpretability and computational efficiency of Weibull-based statistical modeling.

Keywords: Multivariate Weibull distribution; Copula modeling; Anomaly detection; Internet traffic analysis.

SP&TM002.26: STUDY ON OPTIMAL DESIGN FOR GENERALIZED LINEAR MODEL WITH MULTINOMIAL RESPONSE OF FOUR CATEGORIES

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ABSTRACT

Experiment with categorical responses arise naturally in a rich variety of scientific disciplines. There are many applications where categorical response arises naturally. A researcher designing an experiment has to decide on the number and allocation of design points. Optimal design helps in making this decision. However, optimal design depends on the unknown parameters of the model for a non-linear response like multinomial logistic regression model. This has been a major factor contributing to the complexity in developing design methodology for nonlinear models. Much effort has been devoted to this problem. A common approach is to design an experiment to be efficient for a best guess of the parameter value which leads to locally optimal design. This locally optimal design faces serious problem of how to take into account the uncertainty about the parameter values, to handle this problem, Bayesian approach was proposed. We developed efficient Locally and Bayesian D-optimal designs for multinomial logistic responses using the baseline-category logit model with non-proportional odds assumptions. The Fisher Information Matrix (FIM) was constructed, Locally D-optimal designs were developed for linear predictors with one covariate, two covariates, and two covariates with interaction terms. The equivalence theorem confirmed the optimality of these designs, with sensitivity plots validating their efficiency. Results showed that Locally D-optimal designs improved with wider design spaces but were highly sensitive to parameter misspecification. Bayesian D-optimal designs were then developed using Normal, and Uniform prior distributions. The result demonstrated that, Bayesian optimal Design outperformed Locally optimal design.

Keywords: Optimal design, Multinomial logistic regression, Locally D-optimal design, Bayesian D-optimal design, Fisher Information Matrix

SP&TM003.26: ROBUST PARAMETRIC VARIANCE TESTS BASED ON MEAN ABSOLUTE DEVIATIONS FOR ONE SAMPLE SITUATION: THEORY AND APPLICATIONS

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ABSTRACT

Hypothesis testing about variances of the population(s) is a needful prerequisite in choosing appropriate parametric test statistics about the mean(s) of population(s), among other usages. This paper developed some new parametric test statistics based on mean absolute deviation from the population mean, sample mean and sample median to test hypotheses about population variances in one sample case. In this case, the asymptotic distributions of the various mean absolute deviations were obtained with their test statistics not only in their absolute forms but also in their ordered forms. To address challenges in controlling Type 1 error in small sample situations, the test statistics were modified. The modifier depends on both sample size and a parameter d . Using Monte Carlo Simulation Studies, we determined the values of d that produced acceptable Type 1 error rates. Additionally, we evaluated the power and robustness of the proposed test statistics and compared them with existing ones. Results further establish the necessity for their modification as the modified test statistics provide better Type 1 errors with good power and robustness. The major advantage of the developed test statistics over the existing ones lies on their share characteristic of good Type 1 error, power, and robustness. Results from real life data applications also support the results from the simulation studies.

Keywords: Test statistics, Monte Carlo Simulation Studies, Type I error rates, Power, Robustness.

SP&TM004.26: UNIFIED ROBUST REGRESSION UNDER HIGH CORRELATION AND OUTLIER CONDITIONS IN GAUSSIAN REGRESSION MODELS: A MONTE CARLO INVESTIGATION AND APPLICATIONS

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ABSTRACT

This study proposes some new classes of robust regression estimators in Robust New Biased-Based (RNBB) estimators designed to simultaneously address the challenges of

multicollinearity and outliers in Gaussian regression models. By integrating various robust regression techniques such as MM-estimator, Least Median of Squares (LMS), Least Trimmed Squares (LTS), Least Absolute Deviation (LAD), Least Quartile of Squares (LQS), and S-estimator into the New Biased-Based (NBB) framework, the study develops and evaluates several robust hybrid estimators using the Mean Squared Error (MSE) criterion. A Monte Carlo simulation was conducted in R under varying conditions of sample size, correlation levels, error variance, and outlier proportions to assess estimator performance. Results showed that while Ordinary Least Squares (OLS) performed poorly under high multicollinearity and contamination, the proposed robust estimators consistently achieved lower MSEs, demonstrating superior stability and efficiency. Among them, the Robust LTS–New Biased-Based (NBB_LTS) estimator emerged as the overall best performer, followed closely by the NBB_LQS estimator. Applications to real-life datasets including the economic data and the Portland cement data further confirmed the practical superiority of the proposed estimators. These findings highlight the RNBB family’s effectiveness in producing reliable parameter estimates under complex data conditions.

Keywords: Robust Regression, Multicollinearity, Outliers, New Biased-Based Estimator (NBB), Mean Squared Error (MSE), Monte Carlo Simulation.

SP&TM005.26: pdhs: A PYTHON LIBRARY FOR PROGRAMMATIC ACCESS TO DHS DATA TO ENHANCE REPRODUCIBLE PUBLIC HEALTH RESEARCH

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ABSTRACT

The Demographic and Health Surveys (DHS) Program provides some of the most widely used population-based health data in low- and middle-income countries, supporting research on fertility, maternal and child health, nutrition, and health service coverage. Despite its importance, access to DHS microdata often relies on manual downloads, varying file formats, and ad hoc preprocessing, creating barriers to efficient, transparent, and reproducible research; particularly within the Python ecosystem. We present *pdhs*, an open-source Python library that enables programmatic access to DHS data through automated interaction with the DHS Application Programming Interface (API) and approved microdata downloads. The library supports querying DHS metadata, retrieving indicators from the DHS STATcompiler, and downloading and parsing microdata into efficient Polars DataFrames for scalable analysis. We describe the design and core functionality of *pdhs* and demonstrate its use through a case study examining trends in total fertility rate across multiple countries and survey waves. By integrating DHS data access directly into Python-based workflows, *pdhs* reduces manual intervention, minimizes processing errors, and facilitates reproducible, version-controlled analytical pipelines. The library enables seamless integration of DHS data with modern Python tools for statistical analysis, geospatial modeling, and machine learning. *pdhs* addresses a critical gap in reproducible public health research infrastructure and provides a flexible foundation for scalable, transparent analyses using DHS data.

Keywords: DHS, public health, demographic, health surveys

SP&TM006.26: A NEW KERNEL ESTIMATOR IN DENSITY ESTIMATION WITH DATA APPLICATION

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ABSTRACT

One of the most applied non-parametric statistical techniques in probability density estimation is the kernel estimation method. The popularity of the kernel estimator is due to its widespread uses in numerous disciplines that involves data analysis and visualization. The effectiveness of kernel techniques in data analysis and visualization has resulted in new kernel estimators by researchers. In this paper, a new kernel estimator is derive using the Hermite polynomial functions. The bias and variance of the new kernel estimator were obtained as well as the asymptotic mean integrated squared error, which is the performance measure. We obtain the optimal bandwidth that determines the degree of the smoothness of the kernel estimate. Numerical verification of the proposed kernel estimator with simulations and real data examples demonstrates dominance and superiority over the conventional estimator in terms of performance.

Keywords: Bandwidth, Bias, Density, Kernel Estimator, Variance.

SP&TM007.26: A RAYLEIGH-CAUCHY ERROR DRIVEN ADAPTIVE TIME SERIES MODEL FOR HEAVY-TAILED ECONOMIC PROCESSES IN NIGERIA

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ABSTRACT

Many macroeconomic and governance-related time series in emerging economies exhibit volatility clustering, asymmetric fluctuations, structural instability, and heavy-tailed behaviour that are not adequately captured by conventional Gaussian based forecasting models. Motivated by the flexibility of the recently developed Rayleigh-Cauchy Distribution (RCD), this study proposes a Rayleigh-Cauchy Autoregressive Conditional Heterogeneous Time Series (RC-ARCHTS) model for modelling volatile economic processes. The proposed framework incorporates Rayleigh-Cauchy innovations within an autoregressive conditional heteroskedastic structure to account for heavy-tailed shocks and nonlinear volatility dynamics. Theoretical properties of the model, including

conditional moments, stationarity conditions, and maximum likelihood estimation procedures, are presented. Monthly Nigerian inflation data from 2000 to 2025 were used to evaluate the performance of the proposed model. The RC-ARCHTS model was compared with ARIMA, Gaussian-GARCH, and Student-t GARCH models using standard forecasting accuracy measures. Empirical results indicate that the proposed framework provides improved forecasting performance and greater flexibility in capturing extreme inflationary movements. The study extends the application of the Rayleigh-Cauchy distribution from independent observations to stochastic time series modelling and provides an alternative heavy-tailed framework for analysing macroeconomic volatility in emerging economies.

Keywords: Rayleigh-Cauchy distribution, heavy-tailed time series, conditional heteroskedasticity, macroeconomic volatility, inflation modelling, Nigeria.

SP&TM008.26: ON ADDITIVE AND MULTIPLICATIVE INTERACTION USING RECONSTRUCTED DATA

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ABSTRACT

Unavailability of data for assessing epidemiological interaction in public health studies is a challenge particularly when only marginal summaries are reported. In epidemiology, the joint effect of two or more risk factors is mostly assessed using additive and multiplicative interaction scales. These scales of interaction are assessed only from a three-way contingency table, which are not always reported in public health studies. This study focuses on the development and application of an algebraic procedure for reconstructing three-way contingency data from marginal totals to enable determination of interaction when it exists.

The reconstructed data was utilized to examine additive and multiplicative interaction between tobacco and alcohol and their effect on development of hypertension under the factorial design framework. The evidence of positive interaction on both the additive and multiplicative scales justifies the presence of interaction in the data and the validity of the reconstructed three-way contingency data.

The result showed that from the additive scale about 9.4% of the hypertensive cases can be attributed to interaction, while on the multiplicative scale about 52% of the jointly exposed individuals are more likely to develop hypertension. This study highlights the effectiveness of algebraic reconstruction techniques in recovering detailed data structures from limited information, thereby enabling more comprehensive epidemiological analyses.

Keywords: Additive interaction, Multiplicative interaction, Hypertension, Reconstructed data, Epidemiology

SPECIAL PAPERS' ROOM 2
Wednesday, 14 October 2026
10.00 am – 1.30 pm
Chaired by Professor Polycarp Emeka Chigbu

**SP&AA001.26: A HIERARCHICAL NORMAL-POWER-LOGISTIC FRAMEWORK
FOR ROBUST CANCER GENE DISCOVERY FROM CPG METHYLATION DATA**

**Matthew Iwada Ekum ¹, Christian Heumann ², Bolarinwa Olumide Ajala ³, Eno
Emmanuella Akarawak ⁴, Christopher Oladimeji Fakorede ⁵, Joseph Adekunle
Akinyemi ⁶, Stephen Olusegun Are ⁷, Toyin Omoyeni Oguntola ⁸, Adeyinka Abiodun
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ABSTRACT

In practice, many high-throughput epigenomic data sets, especially in terms of CpG methylation profiles, have considerable violations of the traditional Gaussian distribution assumptions, including skewed distributions, heavy tails, and multi-modality due to heterogeneity. Such properties can reduce the efficiency of the traditional statistical modelling approach typically used in differential methylation analysis. This paper proposes the use of a new Gene-Level Normal-Power{Logistic} Distribution (GL-NPLD) method for cancer gene identification. Specifically, this paper extends the existing Normal-Power{Logistic} Distribution into a hierarchical regression model, linking CpG-level variation and inference at gene level via the latent transformation. A Bayesian regularisation technique is used to mitigate problems related to dimensionality and instabilities of the parameter estimates. The proposed method was implemented on a set of cancer methylation data derived from the traditional limma analysis and shown to significantly outperform traditional approaches based on Gaussian and Gamma distributions, both in terms of fitting performance and prediction power measured using likelihood and information criteria. It was also demonstrated that the GL-NPLD method could detect more meaningful genes linked to cancer-related pathways.

Keywords: Normal-Power {Logistic} Distribution, Cancer Genomics, CpG Methylation, Hierarchical Modelling, Epigenomics, Gene Discovery

**SP&AA002.26: DIGITAL FINANCIAL INNOVATION AND MONETARY POLICY
TRANSMISSION IN WEST AFRICA: PANEL EVIDENCE FROM ECOWAS
ECONOMIES**

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ABSTRACT

This study examines how digital financial innovation (DFI) influences monetary policy transmission across 15 ECOWAS economies over the period 2000–2023. Using a composite DFI index constructed from mobile penetration, internet usage, financial inclusion, and banking infrastructure indicators, the analysis employs Feasible Generalised Least Squares with AR(1) correction and Panel Error Correction Models to assess the short- and long-run effects of DFI on inflation and lending rates. Results indicate that DFI exerts no statistically significant effect on inflation across the full panel, though sub-sample analysis reveals a significant inflation-reducing effect during the early phase of digital adoption (pre-2015) that dissipates thereafter. In contrast, digital financial deepening consistently and significantly reduces lending rates across all country groupings and time periods, suggesting that DFI enhances credit market efficiency and strengthens monetary policy transmission through the interest rate channel. The money supply remains the dominant determinant of inflation in the region, underscoring the continued relevance of conventional monetary instruments. These findings carry important implications for central banking strategy and digital finance regulation in West Africa.

Keywords: Digital Financial Innovation, Monetary Policy Transmission, Panel Error Correction Model, Financial Inclusion, West Africa

**SP&AA003.26: RANGE-BASED MULTIVARIATE GENERALIZED
AUTOREGRESSIVE CONDITIONAL HETEROSKEDASTICITY MODELLING OF
NIGERIA OIL AND GAS STOCK RETURNS**

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ABSTRACT

Nigeria oil and gas sector often experience significant price fluctuations and volatilities that are frequently driven by unanticipated supply-demand imbalances or geopolitical risks. Range-based multivariate volatility models were employed by extending the Diagonal Baba-Engle-Kraft-Kroner (DBEKK) model to a Range-Based DBEKK framework to model these dynamics. The analysis used secondary daily high, low, opening, and closing prices of top-performing and consistent stocks; Conoil Plc, Oando Plc, Seplat Energy Plc, and TotalEnergies listed on the Nigerian Exchange (NGX) from 5th January 2015 to 17th March 2026. The data was analysed across RB-MGARCH with Parkinson Estimator (for zero drift), RB-MGARCH with Rogers-Satchel's Estimator (for non-zero drift) and Adaptive RB-MGARCH (adapt to zero and non-zero drift). The estimated results of the models showed strong volatility persistence, particularly in the zero-drift RB-MGARCH model ($B1 = 0.7939-0.9696$, $p < 0.01$). The adaptive RB-MGARCH model effectively accommodated both zero and non-zero drift conditions with significant

variance parameters ($M(2,2) = 1.74 \times 10^{-8}$; $M(3,3) = 6.49 \times 10^{-6}$, $p < 0.01$). The model comparison indicated that the RB-MGARCH model with zero drift (Parkinson estimator) and exogenous variables provides the best fit, while the Rogers–Satchell specification performed poorly and the ARB-MGARCH model remained unaffected by the inclusion of exogenous variables.

Keywords: Adaptive RB-MGARCH, Oil and Gas Returns, Range-Based DBEKK, Volatility Modelling

SP&AA004.26: STATISTICAL ANALYSIS OF ENVIRONMENTAL POLLUTION AND ITS HEALTH IMPLICATIONS IN URBAN AREAS OF NIGERIA: A MULTI-CITY ASSESSMENT, 2019-2023

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ABSTRACT

Rapid, poorly regulated urbanisation has made ambient air pollution a leading environmental health risk in Nigerian cities, yet quantitative evidence linking measured pollution to population health outcomes remains scarce. This study provides a multi-city statistical assessment of ne particulate matter (PM_{2.5}), nitrogen dioxide (NO₂), sulphur dioxide (SO₂) and carbon monoxide (CO) and their association with respiratory and mortality outcomes across eight major Nigerian cities (Lagos, Abuja, Port Harcourt, Kano, Ibadan, Kaduna, Benin and Onitsha) over 2019-2023 ($n = 40$ cityyear observations). A combined cross-sectional and time-series design was analysed using descriptive statistics, one-way ANOVA and the KruskalWallis test, t-tests, the χ^2 test of independence, Pearson correlation, multiple linear regression, ARIMA modelling with Augmented DickeyFuller (ADF) testing, and a WHO concentrationresponse health-risk assessment. Mean PM_{2.5} reached $74.18 \mu\text{gm}^{-3}$, roughly ve times the WHO interim-target value of $15 \mu\text{gm}^{-3}$, with every city exceeding the guideline in all study years. PM_{2.5} diered significantly across cities (ANOVA $F = 18.42, p < 0.001$) and rose significantly over time ($p < 0.001$). Pollutants were strongly correlated with respiratory deaths, asthma cases and hospital admissions ($r \geq 0.92$) and negatively with life expectancy ($r = -0.944$ for PM_{2.5}). Regression conrmed PM_{2.5}, NO₂, SO₂ and CO as signicant predictors of respiratory mortality and reduced life expectancy. ARIMA forecasts project continued increases through 2028, with lower prediction bounds remaining above the WHO limit. Risk assessment placed Port Harcourt, Lagos and Onitsha in the high-to-very-high categories. The findings provide robust, policy-relevant evidence of asustained urban air-quality crisis and an escalating health burden in Nigeria.

Keywords: ambient air pollution; PM_{2.5}; urban Nigeria; respiratory mortality; ARIMA forecasting; health-risk assessment

SP&AA005.26: ANALYSIS OF THE KNOWLEDGE OF OFFICIAL STATISTICS IN NIGERIA

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ABSTRACT

This study assesses technical knowledge, institutional views, and consumption patterns related to Official Statistics (OS) and the National Statistical System (NSS) in Nigeria. Cross-sectional data were collected from data professionals and users (N = 164) across a variety of administrative ecosystems using a multistage stratified random sampling framework. Descriptive metrics demonstrate severe systemic gaps: 50.0% of respondents reported no standalone OS modules in higher education, whereas 56.0% rarely or never used outputs from central data-producing institutions (NBS, CBN, NPC). Operational issues, particularly the deployment of untrained field collectors (37.2%), were highlighted as the primary cause of poor data quality. Inferential validation using a chi-square contingency test demonstrated that data usage frequency is significantly associated with an individual's specific occupational or academic discipline ($\chi^2(12) = 63.86$, $p < .001$). Despite widespread professional scepticism, an overwhelming consensus (94.5%) mandates the formalisation of applied OS coursework in university curricula. Structural policy reforms prioritising sub-national technical synchronisation, open-access open data repositories, and standardised fieldwork training are strongly recommended to remediate institutional data vacuity.

Keywords: National Statistical System, Official Statistics, Educational deficit, Data utilisation, Institutional trust.

SP&AA006.26: INVESTIGATING DYNAMIC RELATIONSHIPS BETWEEN NIGERIAN AGRICULTURAL COMMODITY PRICES AND INFLATION USING DCC-COINTEGRATED MODEL

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ABSTRACT

Nigeria's persistent food inflation, driven by volatile agricultural commodity prices, poses significant challenges to macroeconomic stability and household welfare. This study investigates the dynamic relationships between Nigerian maize and rice prices and inflation – proxied by the Consumer Price Index (CPI) – using a Dynamic Conditional Correlation (DCC)-Cointegrated approach. The study establishes long-run cointegrating relationships, estimates time-varying conditional correlations via DCC-GARCH, and assesses directional price linkages across macroeconomic sub-periods from 2015 to 2025, with parameters estimated using maximum likelihood. Results confirm long-run equilibrium relationships between maize prices, rice prices, and inflation, with dynamic

correlations intensifying markedly during periods of economic stress, consistent with volatility clustering effects. Directional analysis reveals asymmetric transmission dynamics, with commodity prices functioning as net transmitters of inflationary pressures during crisis episodes. These findings inform targeted agricultural price stabilization policies and coordinated monetary interventions to reduce Nigeria's vulnerability to food-driven inflation.

Keywords: Dynamic Conditional Correlation, Cointegration, Agricultural Commodity Prices, DCC-GARCH, Inflation, Food Price Dynamics

SP&AA007.26: ENVIRONMENTAL SUSTAINABILITY AND DEVELOPMENT DYNAMICS IN NIGERIA: A STATISTICAL ASSESSMENT OF LAND USE CHANGE, URBANIZATION, AND POPULATION GROWTH (1960–2024)

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ABSTRACT

Over the past five decades, Nigeria has experienced rapid population growth, urban expansion, agricultural intensification, and economic transformation, with significant implications for environmental sustainability. Understanding these long-term environmental changes is critical for evidence-based policy formulation and sustainable development planning. This study examines the trends, relationships, and sustainability implications of selected environmental and socioeconomic indicators in Nigeria from 1960 to 2024. Specifically, the study investigates changes in forest area, agricultural land use, renewable energy consumption, population growth, urbanization, and economic development. Secondary data were obtained from the World Bank Development Indicators database. The Mann–Kendall trend test and Sen's slope estimator were employed to assess long-term trends, while Pearson and Spearman correlation analyses were used to examine relationships among variables. Ridge regression was utilized to identify key determinants of environmental change in the presence of multicollinearity. Furthermore, an Environmental Sustainability Index (ESI) was developed to evaluate Nigeria's environmental performance over time. Preliminary findings reveal significant declines in forest area and renewable energy consumption alongside substantial increases in agricultural land, population, urbanization, gross domestic product, and GDP per capita. The Environmental Sustainability Index indicates a steady deterioration in environmental sustainability throughout the study period. The findings demonstrate the important role of statistical methods in monitoring environmental change and providing evidence for sustainable development policies.

Keywords: Environmental Sustainability, Urbanization, Land Use Change, Forest Area, Renewable Energy, Mann–Kendall Test, Ridge Regression, Nigeria.

SP&AA008.26: SPATIAL CLUSTERING AND HOTSPOT ANALYSIS OF ROAD TRAFFIC ACCIDENTS IN NIGERIA: A STATE-LEVEL INVESTIGATION USING ADVANCED SPATIAL STATISTICS

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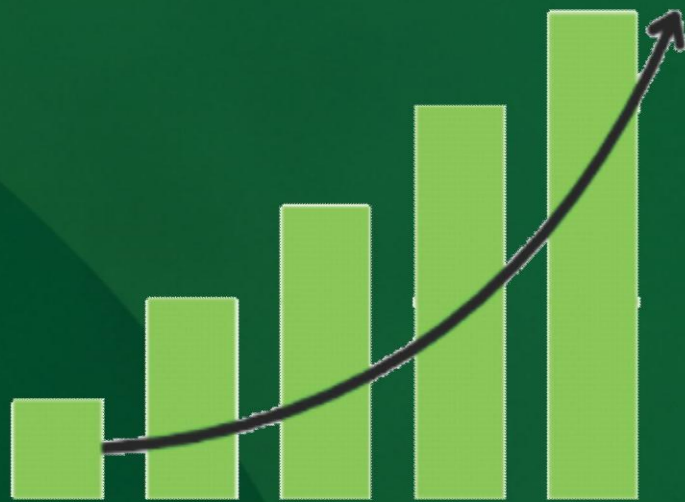
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ABSTRACT

Road traffic accidents continue to pose a serious public health and economic challenge in Nigeria, with marked differences in risk across regions. This paper examines the spatial patterns and clustering of road crashes across the 36 states and the Federal Capital Territory using advanced spatial statistical techniques. Relying on secondary data from the National Bureau of Statistics, the study adopts a quantitative, cross-sectional design and applies a structured analytical approach that includes exploratory spatial data analysis, global and local spatial autocorrelation, and hotspot detection methods. The analysis is conducted over two time periods (2013–2017 and 2018–2022) to assess the stability and evolution of crash patterns over time. The results show clear evidence that road crashes are not randomly distributed but are spatially clustered, with identifiable high-risk (hotspot) and low-risk (cold spot) areas across the country. These findings suggest that crash occurrences in one state are influenced by neighboring states, reflecting strong spatial dependence. The study further highlights how differences in infrastructure quality, traffic composition, and levels of urbanization contribute to these patterns. It also draws attention to persistent data challenges, particularly underreporting and spatial bias in official records, which may affect the accuracy of analysis. Overall, the study demonstrates the importance of incorporating spatial thinking into road safety planning and provides a practical, evidence-based foundation for targeted interventions, improved resource allocation, and more effective policy decisions aimed at reducing road traffic accidents in Nigeria.

Keywords: Modelling, Probabilistic, Geospatial, Expectation, Hotspot



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