



UNIVERSITY OF NIGERIA, NSUKKA
DEPARTMENT OF MATHEMATICS



NSMB
Nigerian Society for Mathematical Biology

6TH ANNUAL INTERNATIONAL WORKSHOP AND CONFERENCE ON

MATHEMATICAL MODELING AND SIMULATIONS

MATHEMATICAL ANALYSIS AND OPERATOR THEORY

(NSMB 2023)

BOOK OF ABSTRACTS

Department of Mathematics
Faculty of Physical Sciences
University of Nigeria, Nsukka

13TH - 19TH
AUGUST, 2023

BOOK OF ABSTRACTS

6TH ANNUAL INTERNATIONAL
WORKSHOP AND CONFERENCE

OF THE

NIGERIAN SOCIETY FOR MATHEMATICAL
BIOLOGY (NSMB)

Theme:
**Mathematics, Security, and the Health
of a Nation: The Link**

Date: 13TH - 19TH AUGUST, 2023

*Venue : Department of Mathematics
Faculty of Physical Sciences
University of Nigeria, Nsukka*

Programme of Events

Day 1 - 3: Monday, 14th - Wednesday, 16th AUGUST 2023

Time	Event
7am	Workshop on Modelling, Data Analysis, and Advanced Visualizations with R and Python.
5pm	Arrival/Registration for conference at the Department of Maths, UNN Prof J. O. C. Ezeilo (aka Abuja) Building

Day 4: Thursday 17th AUGUST 2023

Time	Event
9.00am	- Arrival of participant, guest and dignitaries
	- to the Conference opening ceremony
10am	- Conference opening ceremony commences
	- at Faculty of Physical Sciences Lecture Theatre
10am	- Introduction of Guests
10.10am	- National Anthem
10.15am	- Opening prayer
10.20am	- Welcoming Address by Prof. Ogbonnaya Igwe
	- Dean, Faculty of Physical Sciences, UNN
10.30am	- NSMB, President Address
	- Prof. Godwin C. E. Mbah
10.30am	- Address by the Head, Department of Mathematics, UNN
	- Dr. Obiora Collins
10.40am	- Address by the Chief Host and Declaration of the Conference open
	- Prof. Charles A. Igwe
	- Vice Chancellor
	- University of Nigeria Nsukka
11.00am - 11.35am	- Keynote address by Prof. Promise Mebine
	- Director CEO, National Mathematical Center, Abuja
11.40am	- Good will messages from other invited guests
11.50am	- Closing Remark and Vote of Thanks
	- Prof Godwin C. E. Mbah (LOC Chairman)
11.55am	- Closing prayer
12.00noon	- National Anthem
12.05pm	- Group photographs
12.30pm - 01.15pm	- Plenary lecture 1: Prof. Micah O Osilike
01.20pm - 02.05pm	- Plenary lecture 2: Prof Richard A. Kimbir
02.05pm - 02:30	- Lunch Break
02.40pm - 03.25pm	- Plenary lecture 3: Prof Eric Ofoedu
04.00pm - 7.00pm	- Parallel Session 1
07.00pm	- Closing for the day

Day 5: Friday 18th August, 2023

Time	Event	
9.00am	-	Parallel Sessions 2
11.30am	-	Parallel sessions 3
01.00pm	-	Lunch break
02.00pm	-	Parallel session 4
05.00pm	-	AGM
07.00pm	-	Conference Dinner
08.00pm	-	Closing

Saturday 19th August, 2023

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	Departure

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Part I

Contributed Talks

A: Mathematical Modeling, Mathematical Epidemiology, Applied Mathematics and Related Models

A1: Mathematical model to analyze Nipah virus foodborne disease transmission dynamics

Sunday I.S. Abang^{1*} and Godwin C.E Mbah²

¹Department of Research, National Centre for Technology Management (NACETEM), P.M.B 12, Obafemi Awolowo
University Ile-Ife, Nigeria

²Department of Mathematics, University of Nigeria Nsukka (UNN), Enugu State, Nigeria

Abstract

The first outbreak of Nipah virus disease, occurred both in human and non-human primates in developing countries of far East Asian between 1998 and 1999 and this led to many deaths. The effect of this disease is still witnessed up till date. We studied the dynamics of Nipah virus, using mathematical model and obtained a system of equations comprising of ten equations which effectively described the transmission dynamics of Nipah Virus in a population where control measures were incorporated and two major source of contacting the disease which are the traditional method of getting sap drink, popularly known as palm-wine in Nigeria from palm trees, and pig farming, these were also incorporated. We carried out stability and sensitivity analysis. The result showed that the disease-free and endemic equilibrium where both local and globally stable and we established a population immunity threshold from our model, with available data from recent outbreak, and some estimated data to validate our proposed model. Numerical simulations were carried out and our graphs show that vaccination and treatment are best for infectious population and proper handling of sap drink (palm-wine) is the best to avoid further disease spread in the population and have quicker and better recovery .

Keywords: foodborne, Nipah, Virus, palm-wine, outbreak

Paper read at the 6th International Workshop and Conference of the Nigerian Society for Mathematical Biology (NSMB) held at the University of Nigeria Nsukka 13 - 19 August 2023

A2: A MACHINE LEARNING MODEL AND APPLICATION FOR HEART DISEASE PREDICTION USING PREVALENT RISK FACTORS IN NIGERIA

Ekle, F. A.^{1*}, Agu, N. M.¹, Bakpo, F.¹, Udanor C. N.¹, and Shidali, V. ²

¹Department of Computer Science, University of Nigeria Nsukka (UNN), Enugu State, Nigeria

²Department of Internal Medicine, Federal Medical Centre, Keffi, Nigeria

Abstract

Over the past two decades, heart disease remains the principal source of death globally. According to the World Health Organization, about 17.9 million deaths occur every year internationally as a result of heart disease. The vast number of deaths is common amongst low and middle-income countries and Nigeria is at the top on the list of the most affected sub-Saharan African Nations. With the ravaging impact of heart disease in developing countries, there is need to have a reliable, accurate and efficient approach to make an early diagnosis of the disease to achieve prompt therapy or management. The purpose of this research is to develop a machine learning model and application for heart disease prediction using prevalent heart disease risk factors in Nigeria. Quantitative, qualitative, and experimental research methods were used in implementing this research. The experiment for the training and testing of the models were carried out using Decision Tree (DT), Random Forest (RF), Naïve Bayes (NB) and Voting Ensembles Classifier (VEC) with NB, DT, and RF as base learners. The DT, NB, RF and VEC machine learning algorithms gave an accuracy and error rate values of (95.83%, 0.042), (97.22%, 0.028), (97.92%, 0.021) and (96.53%, 0.035) respectively. This research developed a heart disease prediction model and application using RF machine learning algorithm. The heart disease dataset used in training the model was gotten from Federal Medical Centre Keffi, Nassarawa State, Nigeria. The developed system acts as a decision support tool for cardiologists.

Keywords: Machine learning, supervised learning machine learning algorithm, heart disease prediction, and prevalent risk factors.

Paper read at the 6th International Workshop and Conference of the Nigerian Society for Mathematical Biology (NSMB) held at the University of Nigeria Nsukka 13 - 19 August 2023

A3: MATHEMATICAL MODEL OF THE TRANSMISSION DYNAMICS OF ANTHRAX DISEASE

Omeh Chinenye^{1*}, G.C.E. Mbah², Nnaji Daniel³, Ezema Godwin I.⁴

¹⁻⁴Department of Mathematics, University of Nigeria Nsukka (UNN), Enugu State, Nigeria
Email:¹chinenye.omeh@unn.edu.ng

Abstract

Anthrax is a deadly disease, that occurs in ruminant animals such as sheep, cattle and others. The human can also contract anthrax when one comes in contact with infected animal or their product like hide, wool and so on. In this paper a system of non-linear differential equation is formulated. The model was well formulated and epidemiological meaningful by showing the positivity of the variables and obtaining the invariant region of the various compartment of the model. The equilibrium analysis [EEP] were also carried out, stability analysis based on the equilibrium points were also carried out. Finally, the Numerical simulation was done using MATLAB which helped us to show in one of the graphs that with early treatment, the disease may eventually fade out.

Keywords: Anthrax, mathematical model, Endemic equilibrium point (EEP), Numerical Simulation.

Paper read at the 6th International Workshop and Conference of the Nigerian Society for Mathematical Biology (NSMB) held at the University of Nigeria Nsukka 13 - 19 August 2023

A4: Modeling of the Transmission dynamics of Nipah Virus (NiV): Homotopy Perturbation Method (HPM) Approach

Raphael Adebisi Adewoye^{*1}, Sunday Igwe Scott Abang²

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Email:??

Abstract

Nipah virus is a life-threatening illness with serious adverse effects on both the social and economic aspects of human life. Embarking on a research to help mitigate the spread of the virus is highly necessary so as to bring improvement on human health and the social-economic status. A transmission model of the dynamics of Nipah virus infection (NiV) within a targeted population was formulated in this work by incorporating a

compartment of infected people undergoing treatment (supportive care). The model employs nonlinear mathematical model to investigate the virus transmission. The model system incorporates the human population. Necessary applicable epidemiological mathematical analyses were carried out on the model system such as stability, the basic reproduction number, local asymptotic stability (LAS), global asymptotic stability (GAS), and numerical analyses using relevant data were extensively analysed. He's Homotopy Perturbation Method (HPM) was introduced to solve the model equations. Numerical simulation was carried out to study impact of infected people undergoing treatment (supportive care) on the dynamics of Nipah virus infection transmission in the population. It was found that the spread of the virus could be contained if the infected human are isolated for basic treatment (supportive care).

Keywords: Transmission, Dynamics, Nipah virus, Homotopy Perturbation Method (HPM).

Paper read at the 6th International Workshop and Conference of the Nigerian Society for Mathematical Biology (NSMB) held at the University of Nigeria Nsukka 13 - 19 August 2023

A5: The solution of stiff initial value problems using a one-step Second Derivative Hybrid Exponentially Fitted Method

Enobabor, O.E^{*1} and Akinfenwa, O.A²

¹Department of Mathematics, Yaba College OF Technology, Yaba, Lagos

²Department of Mathematics, University of Lagos, Lagos

Email:*tinenooddy@gmail.com

Abstract

This paper is based on the derivation and implementation of a new method using the techniques of collocation and interpolation for the solution of stiff initial value problems. The new method, which is a one-step Second Derivative Hybrid Exponentially Fitted Method (SDHEFM) was found to be of order $p = 4$, A-stable and possess other basic properties of linear multistep method (LMM) which include convergence, zero-stability and consistency. The results in this paper showed that by subjecting the SDHEFM in comparison with some of the existing methods considered in terms of accuracy, the new method was found to perform numerically better than the considered existing methods.

Keywords: A-stable; Collocation; Interpolation; Off-grid point.

Paper read at the 6th International Workshop and Conference of the Nigerian Society for Mathematical Biology (NSMB) held at the University of Nigeria Nsukka 13 - 19 August 2023

A6:A MATHEMATICAL MODEL FOR THE TRANSMISSION DYNAMICS AND CONTROL OF PERTUSSIS DISEASE

Tivde, T.*¹, Usman, A.¹, Ashezua, T. T.¹, 2Mande, T. T.² and Iornumbe, S. I.²

¹Department of Mathematics, Joseph Sarwuan Tarka University, Makurdi

²Training Department, National Water Resources Institute, Kaduna

³Department of Mathematics and Computer Science, Benue State University, Makurdi

Email:*tivde.tertsegha@uam.edu.ng

Abstract

The incidence of pertussis (whooping cough) is known to have oscillated with a period of about four years since data was first collected in 1922. An infection with pertussis confers immunity for several years, but then the immunity wanes, so that reinfection is possible. A pertussis re-infection is mild after partial loss of immunity, but the reinfection can be severe after complete loss of immunity. A mathematical model for the transmission dynamics and spread of pertussis disease was formulated. Control strategies were developed and incorporated into the models. The solution of the model was obtained using Runge – Kutta Fourth Order method by employing the ODE45 module in Matlab. The Equilibria of the disease and their stability are determined. Our simulation result show that the infection rate decreases after someday of vaccination and the population

of susceptible population increases after first five weeks of vaccination. We recommend that researchers should view this study in the angle of incorporating other control measures for the disease, Pertussis

Keywords: Mathematical, pertussis, epidemiology, differential equations, stability and sensitivity analysis, control measures.

Paper read at the 6th International Workshop and Conference of the Nigerian Society for Mathematical Biology (NSMB) held at the University of Nigeria Nsukka 13 - 19 August 2023

A7: TRANSMISSION DYNAMICS OF DIPHTHERIA WITH CONTROLS USING MATHEMATICAL MODEL

Friday, C.K.^{*1}, Ejikeme, C.L.², Okoye, C.³, Agbebaku, D.F.⁴, Okofu, M.B.⁵, Ezeafulukwe, U.A.⁶

¹ – ⁶ Department of Mathematics, University of Nigeria Nsukka

Email: *chinedukings2013@yahoo.com

Abstract

Diphtheria is an infectious disease caused by *Corynebacterium diphtheriae*, posing a significant public health challenge worldwide. The implementation of control measures, such as vaccination programs, has greatly reduced the incidence of diphtheria. However, outbreaks still occur in certain regions, highlighting the need for additional strategies to prevent and control the disease. This research paper presents a mathematical model to explore the transmission dynamics of diphtheria disease and the impact of public enlightenment campaigns and vaccination as control measures. The model investigates the outbreak proportion since it is contractable via respiratory droplets and direct contact by obtaining the basic reproduction number. Further mathematical analysis showed the absolute and conditional eradication feasibility over short and long term, as well as the effects of the in vivo parameters based on their sensitivity index. The numerical simulation highlights the influence of public enlightenment campaigns, which aim to raise awareness about diphtheria, its transmission, and the importance of effective vaccination. Simulation results demonstrate the potential of public enlightenment campaigns in reducing diphtheria transmission. The model shows that increasing campaign effectiveness and coverage can lead to a substantial decline in diphtheria cases.

Keywords: diphtheria, mathematical model, public enlightenment, control measures. Vaccination.

Paper read at the 6th International Workshop and Conference of the Nigerian Society for Mathematical Biology (NSMB) held at the University of Nigeria Nsukka 13 - 19 August 2023

A8: Mathematical Model and Simulation of Blood Flow Dynamics in Renal Interlobar Artery of Patients with Human Immunodeficiency Virus

Abubakar, U.*¹, Ugwu, A. C.², Tivde, T.³ and Mbah, GCE⁴

¹Department of Radiography, Usmanu Danfodiyo University, Sokoto

² Department of Radiography and Radiological Sciences, Nnamdi Adzikiwe University, Awka

³Department of Mathematics, Joseph Sarwuan Tarka University, Makurdi

⁴Department of Mathematics, University of Nigeria, Nsukka

Email: *tivde.tertsegha@uam.edu.ng

Abstract

Mathematical models were developed considering wall movement, blood pulsation and flow dynamics of the blood in the interlobar artery. The formulated models were based on the fact that the motion of blood vessel wall is not only influenced by pulsation, but also other physiological processes like heartbeat, breathing, and body posture. The Newton's second Law of motion was employed in assembling the forces acting on the interlobar artery. The wall shear stress (WSS) was studied alongside, arterial walls to study the actual flow dynamics and investigate the blood flow behaviour. The results of the study were presented on both two – dimensional (2D) and three (3D) – dimensional graphs showing a more realistic interaction between the arterial

wall and the blood flow in patients with HIV/AIDS. It was deduced that the blood flow velocity decreased with time across the varying frequency from 0.20Hz to 0.50Hz in the interlobar arterial channel.

Keywords: Mathematical Modelling, Blood flow, interlobar artery, blood flow dynamics, blood flow velocity, wall shear stress.

Paper read at the 6th International Workshop and Conference of the Nigerian Society for Mathematical Biology (NSMB) held at the University of Nigeria Nsukka 13 - 19 August 2023

A9: Modelling 3D stokes flows in one-sided bumpy curved channels

Nnamdi Fidelis Okechi

Mathematics Programme, National Mathematical Centre Abuja, Nigeria.

Email: okechinnamdi@hotmail.com

Abstract

The mathematical models of 3D flows through curved channels with one-sided bumps are developed. The bumps are characterized by amplitude and wavenumbers. Two channel configurations are considered, namely, the top bumpy wall-smooth wall (T-S) configuration and the smooth wall-bottom bumpy wall (S-B) configuration. The analytical solutions of the complex flow models are given. The dependence of the flows on the parameters of the problems are shown explicitly. The present work gives a fundamental insight to describing and understanding flows in channels with protrusions.

Keywords: curved channel, bumps, amplitude, wavenumbers, flow rate.

Paper read at the 6th International Workshop and Conference of the Nigerian Society for Mathematical Biology (NSMB) held at the University of Nigeria Nsukka 13 - 19 August 2023

A10: YORUBA LANGUAGE TEXT-BASED HATE DETECTION MODEL FOR SOCIAL MEDIA

Adegoke, O. Folake^{*1}, Bakpo, Francis S.², Tenuche Bashiru³, Raiyetunbi Jude⁴

^{1,3&4} Prince Abubakar Audu University, Anyigba Kogi State

² University of Nigeria, Nsukka, Enugu State.

Email: *adegoke.fo@ksu.edu.ng

Abstract

There is an emerging problem of hate speech sharing and spreading associated with Nigerian social media. This work was targeted to develop classification model for text based hate speech in Yoruba language. Support Vector Machine (SVM) was used on crowd sourced datasets comprising 1,420 Yoruba extracted from social media platforms. Annotated 71% Yoruba text datasets were used to train the SVM classifier. The data sets were preprocessed using the Python libraries. The technologies used for the front end are HTML version 5.0, CSS version 3.0, Java script, jQuery, and Bootstrap. The back end involved the use of Laravel version 9.0, a PHP framework, and MySQL. 1008 and 412 datasets were used to train and test the Yoruba SVM classifier, respectively. The confusion matrices indicated that the trained SVM Classifier for Yoruba was able to identify Yoruba hate speech. Accuracy, Precision, Recall, F1-Score and AUC are 75.49%, 75.21%, 0.0954, 0.8410, and 0.60, respectively for Yoruba SVM Classifier. The model performance compared with other existing models showed that for Yoruba database; Naïve Bayes gave 69.09%, accuracy, and 72.64% precision. Logistic Regression gave 66.51% accuracy, and 68.89% precision. KNN gave 75.52% accuracy, and 86.91% precision. Random Forest gave 54.88% accuracy, and 50.65% precision.

Paper read at the 6th International Workshop and Conference of the Nigerian Society for Mathematical Biology (NSMB) held at the University of Nigeria Nsukka 13 - 19 August 2023

A11: MATHEMATICAL MODEL ON THE TRANSMISSION DYNAMICS, PREVENTION AND CONTROL OF COVID -19.

Agbo, Charity K.*¹ and Mbah, G.C.E.²

¹⁻² University of Nigeria, Nsukka, Enugu State.

Email: *agbocharitykc@gmail.com

Abstract

COVID-19 made a wave that so many infectious diseases did not make in a short period and left an indelible mark on the human population and the world economy. We therefore present a $S, S_V, S_{UV}, E, G_Q, P_Q, [Q]_0, I, G_T, P_T, I_0, R$ model to study the transmission dynamics of COVID-19 disease that might assist in the control of the disease. Different analyses were conducted amongst which were; equilibrium analysis, stability analysis and sensitivity analysis. The basic reproduction number was computed and the results obtained showed that if $R_0 < 1$ then COVID-19 will be controlled within the population but will persist, if $R_0 > 1$. Furthermore, a series solution of the modeled equation was obtained using Laplace Adomian Decomposition Method (LADM). Numerical simulations were carried out and the graphs obtained showed that vaccination and quarantine measures are two major ways of controlling the spread of the disease.

Keywords: COVID-19, Basic Reproduction Number, Laplace Adomian Decomposition Method (LADM), Government quarantined individuals, personally quarantined individuals.

Paper read at the 6th International Workshop and Conference of the Nigerian Society for Mathematical Biology (NSMB) held at the University of Nigeria Nsukka 13 - 19 August 2023

A12: Modeling and simulation of a two-dimensional size exclusion chromatography model considering bi-Langmuir isotherm

Ugochukwu David Uche

Mathematics Programme, National Mathematical Centre Abuja, Nigeria.

Email: uuche@nmc.edu.ng

Abstract

Size exclusion chromatography (SEC) is a separation technique that is mostly operated on large columns and for non-binding or non-interacting solutes. In reality, solutes may generally not be non-binding as solutes may be dependent on their different diffusion coefficients. A two-dimensional general rate model, which has been shown to be ideal for modelling large column diameter operations, is used to numerically simulate the process capturing both non-binding and binding phenomena. The nonlinear bi-Langmuir isotherm is applied to describe the process for a binding solute. A second order accurate finite volume scheme is implemented to obtain approximate solutions for the formulated nonlinear model equations. The obtained solutions in this work are used to demonstrate the effects of adsorption and diffusion coefficients in SEC operations for binding solutes.

Keywords: size exclusion chromatography, finite volume scheme, bi-Langmuir isotherm, two-dimensional general rate model.

Paper read at the 6th International Workshop and Conference of the Nigerian Society for Mathematical Biology (NSMB) held at the University of Nigeria Nsukka 13 - 19 August 2023

A13: The Impact of Vaccination on Covid-19 Disease Transmission Patterns in a Human Population: A Theoretical Analysis

A.B. Okrinya^{*1} and C. N. Timinibife²

¹⁻² Department of Mathematics and Computer Science, Niger Delta University, Wilberforce Island, Bayelsa State
Email: *okirinya@yahoo.com

Abstract

We construct a Mathematical model that describes the effect of vaccination on the dynamics of the transmission of COVID-19 disease in a human population. The model is a system of ordinary differential equations that describes the evolution of humans in a range of Covid-19 states due to emergence of an index case in a disease free region. The analysis of the model shows that effective vaccination can lead to disease eradication, where in the disease free state is locally asymptotically stable if the basic reproductive number, $R_0 \leq 1$ and unstable when $R_0 > 1$. The numerical simulations suggest the use of other social measures alongside vaccination in order to avert the possibility of the disease becoming endemic.

Keywords: Covid-19; modeling; vaccination; re-infection; symptomatic; asymptomatic; surface virus.

Paper read at the 6th International Workshop and Conference of the Nigerian Society for Mathematical Biology (NSMB) held at the University of Nigeria Nsukka 13 - 19 August 2023

A15: MATHEMATICAL MODEL ANALYSIS FOR NEGLECTED TROPICAL DISEASES: YAWS INFECTION AND ITS DYNAMICS

Alhassan, A.^{*1}, Abdullahi¹, S. A. and M. Abdullahi

¹ Department of Mathematics, Modibbo Adama University, P.M.B. 2076, Yola – Nigeria
Email: *aalhassan@mau.edu.ng.

Abstract

In this paper, we formulated a mathematical model of Yaws infection and its dynamics as one of the neglected tropical diseases. The disease free and disease equilibrium and basic reproduction number had been obtained using the next generation matrix. We carried out both the local and global stabilities of the disease free equilibrium in order to study the transmission dynamics of the disease. Treatment and personal and environmental hygiene were incorporated as the control measures in tackling the disease transmission. The result shows that the infection can be reduced strongly based on the numerical simulation that was carried out using Runge-Kutta R2015.

Keywords: Mathematical, Yaws, Equilibrium, Treatment, Hygiene, Simulation

Paper read at the 6th International Workshop and Conference of the Nigerian Society for Mathematical Biology (NSMB) held at the University of Nigeria Nsukka 13 - 19 August 2023

A16: Mathematical Modelling of Transmission Dynamics of Marburg Virus with effective Quarantine Approach

Washachi D. Jacob, John A. Amoka, Hycienth O. Orapine, Baidu A. A., Aliyu G. Dzarma

Department of Mathematics, Nigerian Army University, Biu.
Corresponding Author: Washachi D. Jacob, washachidekera@naub.edu.ng
Tel: +2347066804528/08022070937

Abstract

Marburg virus disease (MVD) is a severe infection with an extremely high fatality rate spread through direct and indirect contacts. Recently, there was an outbreak of deadly MVD disease. We study the transmission dynamics of MVD through the SEQIR model. We determine the basic reproduction number, the local stability and the global stability of the disease-free equilibrium. We aim to study how these control measures would be implemented in order to reduce or eliminate MVD. Numerical simulations results are provided to illustrate the dynamics of the disease in the presence of controls. Keywords: Marburg Virus, Quarantining, Local Stability, Global Stability, Bifurcation.

Paper read at the 6th International Workshop and Conference of the Nigerian Society for Mathematical Biology (NSMB) held at the University of Nigeria Nsukka 13 - 19 August 2023

A17:MATHEMATICAL MODEL FOR THE TRANSMISSION DYNAMICS OF ANTHRAX BACTERIA DISEASES WITH VACCINATION, EXPOSED EFFECTIVE TREATMENT.

Washachi, D. Jacob¹, Aliyu Garga Dzarma¹, Orapine, Hycienth O.1, Momoh, A. A.2

¹Department of Mathematics, Nigerian Army University Biu, Borno State, Nigeria

²Department of Mathematics Modibbo Adama University, Yola

* Corresponding Author: washachidekera@naub.edu.ng , 07066804528/08022070937

Abstract

The mathematical model for the dynamics of anthrax bacteria illness transmission with vaccination, exposure effective treatment with animal hosts and the pathogens is presented in this study. The fundamental reproduction number for the anthrax model was obtained using the next-generation matrix, and the local and global stability was assessed using the Routh-Hurwitz criterion and the Castillo-Chavez method, respectively. The result shows that the diseases are both locally and globally asymptotically stable under certain conditions and unstable at Numerical simulations were performed using MATLAB R2019b. The outcomes of the computer simulations show that prompt treatment can slow or even halt the killing of anthrax bacteria. The outcome of the best control demonstrates that properly disposing of anthrax carcasses, cleaning up contaminated items, and immunizing people can slow or halt the spread of the bacteria.

Key words: Anthrax, carcasses, contaminated items, Vaccination, Local and Global Stability

Paper read at the 6th International Workshop and Conference of the Nigerian Society for Mathematical Biology (NSMB) held at the University of Nigeria Nsukka 13 - 19 August 2023

A18:MATHEMATICAL MODEL OF THE IMPACT OF CONTROL ON THE TRANSMISSION DYNAMICS OF CERVICAL CANCER DUE TO HUMAN PAPILLOMAVIRUS INFECTION

¹Tivde, T., ¹Ajogi, J. M., ¹Ashezua, T. T., and ²Tivde, N. T.

¹Department of Mathematics, Joseph Sarwuan Tarka University, Makurdi

²Department of Statistics, Joseph Sarwuan Tarka University, Makurdi

³Department of Mathematics and Computer Science, Benue State University, Makurdi,

1tivde.tertsegba@uam.edu.ng

Abstract

This paper is aimed at formulating a mathematical model for the transmission dynamics and control of HPV disease in a population. The Disease-Free Equilibrium state of the model was determined and shown to be locally asymptotically stable, after which we determined the basic reproduction number (R_0) of the model using the Jacobian method. When ($R_0 < 1$), the disease is wiped out of a population, but if ($R_0 > 1$), the disease invades such population. Finally, numerical simulations as well as sensitivity analysis were carried out

to trends in the various transmission dynamics and impact of various parameters on the model respectively. As prevalence estimates vary between sexual orientation dimensions, these findings help inform targeted HPV and cervical cancer prevention and control effort.

Key words – Human Papillomavirus (HPV), Cervical Cancer (CV), Susceptible Population (SP), Cancer/Carrier Population (CP), Infected Population (IP), Vaccinated Population (VP), Recovered Population (RP)

Paper read at the 6th International Workshop and Conference of the Nigerian Society for Mathematical Biology (NSMB) held at the University of Nigeria Nsukka 13 - 19 August 2023

A19:Mathematical modelling of the Novel Covid-19 with Age Stratification Considering Government and Personal Control Strategies in a Population

¹Queeneth Ojoma AHMAN, ²Arinze Luke OZIOKO and ³Godwin Christopher Ezike MBAH

¹Confluence University of Science and Technology (CUSTECH) Osara Kogi State.

²Federal University Lokoja (FUL) Kogi State.

³University of Nigeria Nsukka (UNN) Enugu State.

¹ahmanqo@custech.edu.ng

Abstract

In this work, we formulated a mathematical model of COVID-19 transmission dynamics with age stratification that considered government and personal interventions of control strategies with vaccinated and unvaccinated populations. The model equation was found to be well posed mathematically and epidemiologically. The Reproduction number was obtained using the next generation matrix method. The COVID - 19 Infection – Free equilibrium point was found to exist and it is locally and globally asymptotically stable when the reproduction number is less than one unit and otherwise unstable when is greater than one unit. COVID - 19 Infectious equilibrium point was found to coexist with COVID - 19 Infection-Free equilibrium point and obtained. Simulation and discussions of different variables of the model has been performed and the numerical simulation analysis, the results show that there is importance of considering age stratification with both government and personal control measures in the control of Covid-19 epidemic within the population.

Keywords: Modelling; COVID-19; Age Stratification; Government Intervention; Personal Intervention.

Subject Area: Mathematical Modelling.

Paper read at the 6th International Workshop and Conference of the Nigerian Society for Mathematical Biology (NSMB) held at the University of Nigeria Nsukka 13 - 19 August 2023

A20: Mathematical modeling on the transmission dynamics of the co-infection of COVID-19 and Monkeypox

David Omale, Godwin Onuche Acheneje, Bolarinwa Bolaji, Atokolo William

Prince Abubakar Audu University, Anyigba

* Corresponding author: omale.d@ksu.edu.ng

Abstract

In this paper, a deterministic mathematical model on the transmission dynamics of COVID-19 and Monkeypox co-infection is been formulated and analyzed. The analysis of each sub-model was carried out by studying the positivity of their solutions, their invariant regions, and the stability of the disease free equilibrium points, as well as the endemic equilibrium points. To investigate the stability of the equilibria, the basic reproduction number was obtained for each sub-model by using the next generation operator matrix. A sensitivity analysis was carried out to determine the effect of each parameter on the basic reproduction numbers. The numerical simulations shows that increasing the treatment rate and decreasing the contact rate of COVID-19, monkeypox, and their co-infection is significant in reducing the spread of infection in the community.

Keywords: Mathematical model, Sensitivity analysis, Equilibrium point, Basic Reproduction Number, Stability Analysis, Numerical Simulation.

Paper read at the 6th International Workshop and Conference of the Nigerian Society for Mathematical Biology (NSMB) held at the University of Nigeria Nsukka 13 - 19 August 2023

A21:Mathematical model on the transmission dynamics and control of Anthrax infection in human and animal population

David Omale, Godwin Onuche Acheneje, Atokolo William , Julius Idachaba Adams, Ernest Ekemini

Abstract

Mathematical Sciences Department, Prince Abubakar Audu University, Anyigba.
College of Information and Communication technology (CICT), Salem University, Lokoja.

* Corresponding author: omale.d@ksu.edu.ng

Anthrax is a very serious, acute, infectious zoonotic disease caused by the bacterium *Bacillus anthracis*. It can occur in skin, lungs, intestinal and injection. In this study a deterministic mathematical model is proposed to analyze the transmission dynamics of anthrax in human and animal population with vaccination and immunization in an already infected area. The model is shown to have exhibit both disease free equilibrium point and endemic equilibrium point respectively, which are proven to be locally asymptotically stable and globally stable when and unstable when respectively. The sensitivity analysis shows that the infection rate, vaccination rate and immunization rate are the parameters with the most positive impact on the spread. The numerical analysis shows that implementing all control measures: vaccination rate, immunization rate, education measures, are the most effective strategies in reducing the spread of anthrax within the population

Keywords: Mathematical model, Sensitivity analysis, Equilibrium point, Basic Reproduction Number, Stability Analysis.

Paper read at the 6th International Workshop and Conference of the Nigerian Society for Mathematical Biology (NSMB) held at the University of Nigeria Nsukka 13 - 19 August 2023

A22:MATHEMATICAL MODEL ON AVIAN INFLUENZA VIRUS (BIRD FLU) ON BIRD POPULATION

1Ogbodo Blessing I. and 2Mbah Godwin C. E

2University Of Nigeria, Nsukka
godwin.mbah@unn.edu.ng

1Department Of Industrial Mathematics and Applied Statistics.
Faculty Of Applied Natural Sciences

Enugu State University of Science and Technology Enugu, Enugu State,
ijeomaogbodos@gmail.com

Abstract

A mathematical model of Avian Influenza on bird population was formulated. Basic Reproduction number R_0 for the model on the bird's population was computed. It was equally proved that the model is locally and globally asymptotically stable for Disease at the Free Equilibrium (DFE) point and so, $R_0 < 1$. It was equally proved that at the unique Endemic Equilibrium (EE) point, the disease transmission is globally asymptotically stable in bird population which implies that $R_0 < 1$. Some numerical simulations and sensitivity analysis for the various parameters of the model were carried out. The effect of Vaccinated, Quarantined and Recovered classes were critically analyzed using simulation. Keywords: Avian influenza, Mathematical model, Stability analysis, Simulation.

Paper read at the 6th International Workshop and Conference of the Nigerian Society for Mathematical Biology (NSMB) held at the University of Nigeria Nsukka 13 - 19 August 2023

A23: A FRACTIONAL-ORDER MODEL FOR COVID-19 AND MALARIA CO-INFECTION

Livinus L. Iwa,^{1+*} A. Oname^{1+,2}, S. C. Inyama¹⁺

¹ Department of Mathematics, Federal University of Technology, Owerri

² Abdus Salam School of Mathematical Sciences, Government College University Katchery Road, Lahore 54000, Pakistan.

+ livinus.iw@futo.edu.ng (Livinus L. Iwa), oname2020@gmail.com (A. Oname), simeon.inyama@gmail.com (S.C. Inyama).

*Corresponding author: livinus.iwa@futo.edu.ng

Abstract

This work examines the fractional co-infection model for COVID-19 and Malaria. The existence and uniqueness of the model's solution is established using Banach and Schauder's fixed point theorems. The positivity and boundedness of the solution are also proven with the aid of Laplace transform. The stability of the model is shown using the Generalized Ulam-Hyers-Rassias's approach. The proposed model is simulated using real data from Nigeria and the numerical scheme is based on predictor-corrector algorithm method. The numerical experiment shows a good correlation with the theoretical results. The fractional order α has effects on all the compartments of the model over time and the simulations of the co-infection class indicates that singly infection with malaria does not guarantee immunity to COVID-19 and infection with COVID-19 alone does not also guarantee immunity to malaria. A careful look at the findings in this work will give a better understanding of COVID-19 pandemic and how it can be managed alongside malaria.

Keywords: COVID-19 disease, Malaria disease, co-infection, simulations, model-fitting.

Subject Area: Modeling

MSC Classification: 34C60; 92C42; 92D30; 92D25

Paper read at the 6th International Workshop and Conference of the Nigerian Society for Mathematical Biology (NSMB) held at the University of Nigeria Nsukka 13 - 19 August 2023

A24: MATHEMATICAL MODEL FOR THE TRANSMISSION DYNAMICS OF THE MONKEYPOX WITH EXPOSED, ISOLATED AND HOSPITALISED INTERVENTION

Washachi, D. Jacob¹, Aliyu G. Dzarma¹, Orapine, Hycienth O.¹, Baidu. A.A, Shuaibu. S

¹Department of Mathematics, Nigerian Army University Biu, Borno State, Nigeria

²Department of Mathematics Modibbo Adama University, Yola

* Corresponding Author: washachidekera@naub.edu.ng , 07066804528/08022070937

Abstract

This research presents a mathematical model for the transmission dynamic of the monkey pox with exposed, isolated and hospitalized intervention. The model is governed by a system of ten ordinary differential equation namely: vaccination V_H , susceptible S_H , Exposed E_H , Quarantine Q_H , Infected I_H , Hospitalized H_H , Recovered R_H , of human compartment, and rodents compartment Susceptible S_R , Exposed E_H Infected I_H . The disease free equilibrium, endemic equilibrium, reproduction number, local stability, global stability analyses were carried out on the model. The result of the system shown that the diseases free equilibrium equation is locally asymptotically stable when the reproduction number is less than unity for the model and the system has satisfied all the conditions to be globally asymptotically stable.

Paper read at the 6th International Workshop and Conference of the Nigerian Society for Mathematical Biology (NSMB) held at the University of Nigeria Nsukka 13 - 19 August 2023

A25:Mathematical Modeling and Analysis on the Transmission Dynamics of Monkeypox and Varicella Zoster Virus Coinfection.

Asogwa C.C., Aniaku S.C., Mbah E.C, Nzeh M.

Abstract

Monkeypox Virus (MPXV) and Varicella Zoster Virus (VZV) are both highly infectious Diseases that have continued to affect millions of people globally on yearly basis. The deterministic mathematical model for the transmission dynamics of the coinfection using a system of nonlinear ordinary differential equation is constructed and found to be well-posed. The reproduction numbers of the submodels are derived and stability of the equilibrium points of each of them discussed. The disease free equilibrium points of the submodels are shown to be both locally and globally stable if the basic reproduction numbers are less than one and unstable if they are greater than one respectively. The sensitive analysis of each of the parameters is carried out to determine how their changes in value affect the dynamical behavior of the diseases. The bifurcation analysis of the threshold, when each of reproduction number is equal to one is also investigated. The coinfection reproductive number was derived and the disease free equilibrium point found to be conditionally stable. To support the analytical results, different simulations cases were performed on the models.

Key words: Modeling, sensitivity Analysis, Transcritical bifurcation, Simulation.

Paper read at the 6th International Workshop and Conference of the Nigerian Society for Mathematical Biology (NSMB) held at the University of Nigeria Nsukka 13 - 19 August 2023

A26: Application of Differential Transformation Technique on Nipah Virus Mathematical Model and Sensitivity Analysis

Arinze Luke Ozioko*¹, Sunday Igwe Scott Abang², Sunday Emmanuel Fadugba³,Kekana Malesela⁴, Remigius Okeke Aja⁵, Godwin Christopher E. Mbah⁶

¹Department of mathematics, Federal University Lokoja, Kogi State, Nigeria

²National Centre for Technology management,an Agency of Federal Ministry of Science and Technology PRODA Training Institute, Enugu Stat.

³Department of Physical Sciences, Mathematics Programme, Landmark University, Omu-Aran, Nigeria

⁴Department of Mathematics and Statistics, Tshwane University of technology, Pretoria, South Africa

⁵Department of Mathematics, Michael Okpara University of Agriculture,Umudike, Nigeria

⁶Department of Mathematics,University of Nigeria,Nsukka

*corresponding author's email: arinze.luke@fulokoja.edu.ng

Abstract

The Nipah virus has emerged as a significant public health concern, with outbreaks causing severe morbidity and mortality. Mathematical modeling is a valuable tool to understand the dynamics of Nipah virus transmission and develop effective control strategies. This research aims to conduct sensitivity analysis to provide insights into the sensitivity of model parameters and employ the Differential Transformation Method (DTM) to obtain a reliable solution for the Nipah virus model.

Mathematics Subject Classification (2020). 68U20,34L16,34A05,92D30,92D25

Keywords. Nipah Virus, Differential Equation, Differential Transformation , Solution, Sensitivity Analysis

Paper read at the 6th International Workshop and Conference of the Nigerian Society for Mathematical Biology (NSMB) held at the University of Nigeria Nsukka 13 - 19 August 2023

A27: MATHEMATICAL MODEL ANALYSIS FOR NEGLECTED TROPICAL DISEASES: YAWS INFECTION AND ITS DYNAMICS

*1Alhassan, A., 1Abdullahi, S. A. and M. Abdullahi

1Department of Mathematics, Modibbo Adama University, P.M.B. 2076, Yola – Nigeria

*Corresponding Author: aalhassan@mau.edu.ng.

Abstract

In this paper, we formulated a mathematical model of Yaws infection and its dynamics as one the neglected tropical diseases. The disease free and disease equilibrium and basic reproduction number had been obtained using the next generation matrix. We carried out both the local and global stabilities of the disease free equilibrium in order to study the transmission dynamics of the disease. Treatment and personal and environmental hygiene were incorporated as the control measures in tackling the disease transmission. The result shows that the infection can be reduced strongly based on the numerical simulation that was carried out using Runge-Kutta R2015.

Keywords: Mathematical, Yaws, Equilibrium, Treatment, Hygiene, Simulation

Paper read at the 6th International Workshop and Conference of the Nigerian Society for Mathematical Biology (NSMB) held at the University of Nigeria Nsukka 13 - 19 August 2023

A28:RE-EMERGENCE OF LASSA FEVER DISEASE: THE MATHEMATICAL THEORY OF INTEREPIDEMIC EFFECT IN ACTION

1Obasi, Chinedu and 2Ofor, Paschal

Department of Mathematics, AIFCE Owerri, Imo State

1obasi1212@gmail.com

Abstract

The Lassa fever virus is one of several viruses that are likely to cause a future epidemic as reported by WHO due to re-emergence. The re-emergence of Lassa fever is due to the phenomenon called interepidemic effect. According to the current status of the interepidemic effect, any public health control measure taken to reduce the basic reproduction number will definitely make the disease to take a very long time to re-emerge. The interepidemic effect theory suggests that implementing public health control measures to reduce the basic reproduction number (R_o) of a disease can extend the time between epidemics and delay its re-emergence. R_o represents the average number of secondary infections generated by a single infected individual in a completely susceptible population. By reducing R_o through interventions such as vaccination, improved hygiene, vector control, and better healthcare infrastructure, the disease's ability to spread is limited, leading to longer periods of low disease activity. This short expository note establishes the fact that the re-emergence of Lassa fever disease is actually the mathematical theory of interepidemic effect in action.

Keywords: Lassa fever, Mathematical modeling, Interepidemic effect, Re-emergence

Paper read at the 6th International Workshop and Conference of the Nigerian Society for Mathematical Biology (NSMB) held at the University of Nigeria Nsukka 13 - 19 August 2023

A29:A MATHEMATICAL MODEL OF MEASLES WITH VACCINES AND TREATMENT

P. O. Onalo¹, D. F. Agbeba^{2*}, C. L. Ejikeme³, C. Okoye⁴, M. B. Okofu⁵

^{1,2,3,4,5}Department of Mathematics, University of Nigeria Nsukka.

Email: ¹onalophilip6ths@gmail.com, ²dennis.agbeba@unn.edu.ng, ³chioma.ejikeme@unn.edu.ng,

⁴Chukwudi.okoye@unn.edu.ng, ⁵mary.okofu@unn.edu.ng

*Corresponding author's email: dennis.agbeba@unn.edu.ng

Abstract

Despite the fact that an effective vaccination is available, the measles sickness still exists in various regions of the world. With a greater than 90% attack rate measles is not only a health but also an economic problem as it spread very quick leading to a lot of persons been hospitalized or seeking medical help. This calls for ongoing research to perhaps eliminate the disease's spread by instituting hospitalization as a method of treatment. A deterministic ordinary differential equation model for the transmission dynamics of measles was formulated. The basic reproduction number (R_0) was computed using the method of the next generation matrix (NGM). The model equilibrium results are obtained, while the stability is investigated. Numerical simulations were carried out using a classical fourth order Runge-kutta method in MATLAB to illustrate the theoretical analysis. From the simulations, we investigated and established that the disease will continue to be prevalent in our society irrespective of the rate of vaccination, provided the contact rate between susceptible humans, infectious humans and infected surfaces is not properly controlled and reduced significantly. It was equally established that the outbreak of measles can be drastically lowered to a negligible degree with the use of vaccine to control the spread of morbillivirus. . **Keywords:** Measles, Vaccine, Hospitalization, Mathematical Modelling.

Paper read at the 6th International Workshop and Conference of the Nigerian Society for Mathematical Biology (NSMB) held at the University of Nigeria Nsukka 13 - 19 August 2023

A30:Global Stability and Sensitivity Analysis of a Mathematical Model on Ebola Virus Disease Transmission Dynamics

Ndidiamaka Edith Didigwu, Atindiga Simon Terhemmen and Obasi Chinedu

Department of Industrial Mathematics/ Applied Statistics, Enugu State University of Science and Technology, Enugu, Nigeria.

Department of Basic Sciences, Akperan Orshi Polytechnic, Yandev, Gboko.

Department of Mathematics, Alvan Ikoku Federal College of Education, Owerri, Nigeria .

Email: edith.didigwu@esut.edu.ng, sirstayhemmen@gmail.com

Abstract

In this study, we carried out the global stability analysis of the disease-free and endemic equilibrium of a mathematical model developed for the impact of socio-economic status on the transmission dynamics of Ebola virus disease. The result obtained shows that the disease-free and endemic equilibrium are globally asymptotically stable when the associated disease threshold parameter is less than unity. Sensitivity analysis of the effective reproduction number was carried out and the result obtained showed that the parameters $\beta, \gamma_l, \gamma_h, \gamma_f$, and k_h increases the value of R_e when increased, meaning that they increase the endemicity of the virus as they have positive indices, while the parameters $\epsilon, \eta, \varphi, \theta_l, \theta_h, \delta_l, \delta_h, e_l, e_h$ and ρ decreases the value of R_e , implying that they decrease the endemicity of the virus as they have negative indices.

Paper read at the 6th International Workshop and Conference of the Nigerian Society for Mathematical Biology (NSMB) held at the University of Nigeria Nsukka 13 - 19 August 2023

B: Mathematical Analysis, Operator Theory, Pure Mathematics and Other Sciences

B1: K-Step Block Implicit Adams Method for Approximate solution for Initial Value Problems Using Bernstein Polynomials

Ayeni, O.M¹, Okunuga, S.A² and Abdulganiy, R.I³

¹Department of Mathematics, Yaba College of Technology, Yaba, Lagos

²Department of Mathematics, University of Lagos, Lagos

³Distance Learning Institute, University of Lagos, Lagos

Email: ¹yinka_ayeni@yahoo.com, ²sokunga@unilag.edu.ng, ³profabdulcalculus@gmail.com

Abstract

This paper investigated a class of k-step Block Implicit Adams Method (BIAM) for the integration of first order initial value problems in which the E polynomial is employed as the basis function. The BIAM for the initial value problems is constructed via multistep collocation techniques and applied in block structure as simultaneous numerical integration which makes it self-starting. An analysis of BIAM shows that the proposed method is zero stable, consistent, convergence and A-stable. Our results show that the BIAM using Bernstein polynomials provides a highly accurate and efficient means for approximating solutions to initial value problems.

Key Words: Block implicit Adams method, Bernstein polynomials, A-Stability, Approximate solution

Paper read at the 6th International Workshop and Conference of the Nigerian Society for Mathematical Biology (NSMB) held at the University of Nigeria Nsukka 13 - 19 August 2023

B2: APPLICATION OF LEGENDRE POLYNOMIAL TO CLASSIFYING PARTIAL ONE-TO-ONE TRANSFORMATION SEMIGROUP

Kehinde Rotimi

Department of Mathematics, Federal University Lokoja

Email: rotimi.kehinde@fulokoja.edu.ng

Abstract

The main aim of this paper work is to apply the Legendre Polynomial to classification of Partial one-to-one Transformation Semigroup.

Key Words: Transformation, Semigroup, Partial one-to-one, Polynomial, Classification.

Paper read at the 6th International Workshop and Conference of the Nigerian Society for Mathematical Biology (NSMB) held at the University of Nigeria Nsukka 13 - 19 August 2023

B3:SOME ALGEBRAIC AND COMBINATORIAL PROPERTIES OF SEMIGROUPS OF INJECTIVE PARTIAL CONTRACTION MAPPINGS.

Kehinde Rotimi

Department of Mathematics, Federal University Lokoja
Email:rotimi.kehinde@fulokoja.edu.ng

Abstract

A transformation α in partial one-to-one for which $(\forall x, y \in X_n, |x_\alpha - y_\alpha| \leq |x - y|)$ is said to be a contraction mapping. In this paper, we shall list and investigate the cycle structure and Geen's relation of elements of the Semigroup and established some algebraic and combinatorial properties.

Key Words: Injective, Contraction, Mapping, Cycle structure, Green's relation.

Paper read at the 6th International Workshop and Conference of the Nigerian Society for Mathematical Biology (NSMB) held at the University of Nigeria Nsukka 13 - 19 August 2023

B4: Convergence of Numerical Solution for Heat Equation

A.O. Odio¹, Omeh C.², P.U. Nwokoro³, Mbah E⁴, Mmadukafe C.A⁵, Onyekaba K.S⁶

¹⁻⁶Department of Mathematics, University of Nigeria, Nsukka
Email: ²chinenye.omeh@unn.edu.ng

Abstract

The work is on convergence of numerical solution for heat equation. In this problem, we consider a suitable difference scheme whose dependent variable u is the control which depends on multiplicity of space variables $x_1, x_2, x_3, \dots, x_n$ and time variable t . Here, u is defined on suitable subspaces of the space of definition. This type of function u , is said to be admissible and also, satisfies the Taylor series expansions. Also, the difference scheme in question satisfy the numerical properties such as consistency, stability and convergent. Numerical solution obtained were found to be consistent, stable and convergent.

Key Words: Convergence, numerical solution, numerical scheme, consistency, stability admissible function.

Paper read at the 6th International Workshop and Conference of the Nigerian Society for Mathematical Biology (NSMB) held at the University of Nigeria Nsukka 13 - 19 August 2023

B5: Stability of Numerical Solution for Wave Equation

A.O. Odio¹, P.U. Nwokoro², Omeh C.³, Ezue B.E⁴, Mmadukafe C.A⁵, Onyekaba K.S⁶

¹⁻⁶ Department of Mathematics, University of Nigeria, Nsukka
Email:²chinenye.omeh@unn.edu.ng

Abstract

The stability of numerical solution for wave equation is studied. We consider also a multi-level difference scheme in the form

$$\frac{u_j^{n+1} - u_j^{n-1}}{2\delta t} = \frac{u_{j+1}^n - u_{j-1}^n}{2\delta x}$$

and also, show that the scheme is stable in accordance to Von-Neumann condition for stability. In this paper, it is seen that, the numerical results become closer to each other as the i and j terms become large. Hence the computational result in Table 1 is stable. Key word: Stability, multi-level difference scheme, Von Neumann, difference equation, central difference

Key Words: Stability, multi-level difference scheme, Von Neumann, difference equation, central difference scheme and symmetric matrix

Paper read at the 6th International Workshop and Conference of the Nigerian Society for Mathematical Biology (NSMB) held at the University of Nigeria Nsukka 13 - 19 August 2023

B6: ADMM-TYPE METHOD FOR FINDING SOLUTIONS TO CONSTRAINED CONVEX OPTIMIZATION PROBLEM

Emmanuel Akaligwo*¹

¹ Department of Mathematics, Federal University Lokoja, Kogi State, Nigeria
Email:??

Abstract

This paper is concerned with a certain class of algorithms of constrained convex optimization in Hilbert space. The algorithms discussed and analyzed are one weakly and one strongly convergent ADMM-type algorithm for convex, linearly constrained optimization. Equipping the associated Hilbert space with the correct weighted scalar product, the analysis of this method is accomplished using the proximal point method. At the end, the numerical behavior of the discussed algorithms is demonstrated using collection of examples.

Keywords: ??

Paper read at the 6th International Workshop and Conference of the Nigerian Society for Mathematical Biology (NSMB) held at the University of Nigeria Nsukka 13 - 19 August 2023

B7: SOME SOLUTIONS TO CONSTRAINED CONVEX OPTIMIZATION PROBLEM

Emmanuel Akaligwo*¹, Musa Ibrahim², George Akuchu³, Micah Osilike⁴

¹⁻² Department of Mathematics, Federal University Lokoja, Kogi State, Nigeria

³⁻⁴ Department of Mathematics, University of Nigeria, Nsukka, Nigeria Email: *emmanuel.akaligwo@fulokoja.edu.ng

Abstract

This research paper is concerned with a certain class of algorithms for the solution of constrained convex optimization problems in Hilbert spaces. The first algorithms discussed and analyzed are one weakly and one strongly convergent ADMM-type algorithm for convex, linearly constrained optimization. By equipping the associated Hilbert space with the correct weighted scalar product, the analysis of these two methods is accomplished using the proximal point method and the Halpern method. At the end of this article, the numerical behavior of the discussed algorithms is demonstrated on a collection of examples.

Keywords: ??

Paper read at the 6th International Workshop and Conference of the Nigerian Society for Mathematical Biology (NSMB) held at the University of Nigeria Nsukka 13 - 19 August 2023

B8: Some Solutions to Constrained Convex Optimization Problems

Emmanuel Akaligwo^{*1}, Musa Ibrahim², George Akuchu³, Micah Osilike⁴

¹⁻²Department of Mathematics, Federal University Lokoja, Kogi State, Nigeria

³⁻⁴Depart of Mathematics, University of Nigeria, Nsukka, Nigeria Email: *emmanuel.akaligwo@fulokoja.edu.ng

Abstract

This research paper is concerned with a certain class of algorithms for the solution of constrained convex optimization problems in Hilbert spaces. The first algorithms discussed and analyzed are one weakly and one strongly convergent ADMM-type algorithm for convex, linearly constrained optimization. By equipping the associated Hilbert space with the correct weighted scalar product, the analysis of these two methods is accomplished using the proximal point method and the Halpern method. At the end of this article, the numerical behavior of the discussed algorithms is demonstrated on a collection of examples.

Keywords: ??

Paper read at the 6th International Workshop and Conference of the Nigerian Society for Mathematical Biology (NSMB) held at the University of Nigeria Nsukka 13 - 19 August 2023

B9: Reconstruction of 2-D Refractive Index for Inverse Scattering Data Using Eikonal Approximation

Charles Ekene Chika¹ and M.A Hooshyar^{*2}

¹ University of Nigeria, Nsukka, Enugu State, Nigeria

² The University of Texas at Dallas, USA

Email:¹ charles.chika@unn.ed.ng

Abstract

A method is developed to construct refractive index that depends on two spatial variables from scattering data. This method noniteratively recovers refractive index from forward scattering amplitude for electromagnetic plane waves incident at different angles and frequencies. Numerical examples are presented to show the implementation feasibility of the method, which indicates that the method is effective and simple to implement.

Keywords: Eikonal approximation, scattering, inverse problem.

Paper read at the 6th International Workshop and Conference of the Nigerian Society for Mathematical Biology (NSMB) held at the University of Nigeria Nsukka 13 - 19 August 2023

B10: BI-BASIS FUNCTION BLOCK METHOD FOR THE SOLUTION OF OPTIMAL CONTROL MODEL FOR MOSQUITO AND INSECTICIDE

Adamu Samuel¹, Aduroja², O. O. and Kida³, M.

¹Department of Mathematics, Nigerian Army University Biu, Borno State, Nigeria

²Department of Mathematics, University of Ilesha, Ilesha, Osun State, Nigeria

³Department of Mathematics, Borno State University, Borno State, Nigeria

Abstract

Bi-basis scheme based on the combination of Lucas and Bubaker polynomials for the solution of optimal control problem modelled for mosquito and insecticide via forward-backward sweep methods using Pontryagin's principle. The technique was used to generate a set of hybrid schemes at selected grid and off-grid points with implementation in block. Stability and convergence of the block method is discussed which is found to be convergent and zero stable and of order 6. A MATLAB code is written for the implementation of the method.

The results obtained by the block method clearly shows that, mosquitoes can be minimize to a large extent using block method while reducing the harmful effect of the insecticide which subsequently reduce the spread of disease malaria.

Keywords: Optimal control problems, Forward-backward sweep methods, Pontryagin's principle, Classical Runge-Kutta method

Paper read at the 6th International Workshop and Conference of the Nigerian Society for Mathematical Biology (NSMB) held at the University of Nigeria Nsukka 13 - 19 August 2023

B11:COMBINATORIAL PROPERTIES OF TRANSFORMATIONAL SEMIGROUP THEORY

Rotimi Kehinde and Habib O Abdulazeez

Department of mathematics Federal University, Lokoja

Corresponding author's email: Rotimi.kehinde@fulokoj.edu.ng

Abstract

Let $f : X_n \rightarrow X$, where $X_n = 1, 2, 3, \dots, n$ for some fixed n and X is a nonempty finite set then f is a semigroup provided that the closed function is associative. If an element n is moved from the domain to the co-domain of f , then by combinatorial analysis, useful properties are established using effective methodologies. The functional properties ignited as a result of the combinatorial truthfulness consists of partial transformations and all of its sub-semigroups. Results obtained have practical application in computer science especially in the areas of cryptography and automata theory.

Keywords: Finite, Semigroup, Combinatorial analysis, Functional, Partial transformation

Paper read at the 6th International Workshop and Conference of the Nigerian Society for Mathematical Biology (NSMB) held at the University of Nigeria Nsukka 13 - 19 August 2023

B12: MODIFIED JACKKNIFE KIBRIA-LUKMAN ESTIMATOR FOR THE POISSON REGRESSION MODEL

Henrietta Ebele Oranye¹, Fidelis Ifeanyi Ugwuowo¹ and Kingsley Chinedu Arum¹

¹Department of Statistics, University of Nigeria Nsukka, Enugu State

henrietta.oranye@unn.edu.ng

Abstract

Poisson regression is one of the methods to analyse count data and, the regression parameters are usually estimated using the maximum likelihood (ML) method. However, the ML method is sensitive to multicollinearity. Multicollinearity occurs when there is linear dependency among the explanatory variables. Multicollinearity often leads to unstable maximum likelihood estimates. In this study, we developed Modified Jackknifed Poisson Kibria-Lukman (MJPKL) estimator to mitigate multicollinearity in the Poisson regression model. We theoretically compared the MJPKL estimator with some existing estimators and obtained the condition for the superiority of MJPKL. A simulation study and real-life application were conducted to compare the performance of the estimators. It is evident from the simulation and real-life results that the Modified Jackknifed Poisson K-L estimator (MJPKLE) gives better results than other estimators under some conditions. Finally, the MJPKL estimator reduces the bias of the PKL estimator and dominates every estimator considered in this study.

Keywords: Maximum likelihood method, Poisson regression, Multicollinearity, Kibria- Lukman estimator

Paper read at the 6th International Workshop and Conference of the Nigerian Society for Mathematical Biology (NSMB) held at the University of Nigeria Nsukka 13 - 19 August 2023

B13: Convergence Analysis of a New Relaxed Algorithm with Inertial for Solving Split Feasibility Problems

Ferdinand U. Ogbuisi*, Yekini Shehu and Jen-Chih Yao

*Department of Mathematics, University of Nigeria, Nsukka.

*E-mail address: ferdinand.Ogbuisi@unn.edu.ng

Abstract

In this paper, we introduce a new algorithm for solving split feasibility problems in Hilbert spaces. The algorithm stems from the relaxed CQ method and the alternated inertial step method. The proposed algorithm uses variable step-sizes which are updated at each iteration by a cheap computation without linesearch. This step-size rule allows the resulting algorithm to work more easily without the prior knowledge of the operator norm. Numerical experiments are implemented to illustrate the theoretical results and also to compare with existing algorithms.

Keywords: *Split feasibility problems; relaxed CQ-algorithms; Alternated inertial method; Bounded linear operator; Hilbert space.*

Paper read at the 6th International Workshop and Conference of the Nigerian Society for Mathematical Biology (NSMB) held at the University of Nigeria Nsukka 13 - 19 August 2023

B14: Optimal Control with the effect of Ivermectin and Livestock Availability on Malaria transmission

Ochigbo, J.E.*, Ndam, N.J. ** and Sirisena, U.W. **

* Department of Mathematics and Statistics, Federal University Wukari P. M. B 1020, Wukari-Taraba State, Nigeria.

**Department of Mathematics, University of Jos, P. M. B 2084, Jos-Plateau State, Nigeria.

Corresponding email: j.ochigbo@fuwukari.edu.ng

Abstract

The conventional methods for controlling malaria leaves a gap which may be the reason that it remains a global threat. Here, mathematical model for malaria with ivermectin treated livestock and humans (an uprising tool with the potential of filling the gap), insecticide bed net, and treatment of infectious individuals as control tools was formulated and analyzed. The basic reproduction number, was estimated and the local stability of the disease-free equilibrium point is asymptotically stable if . Analysis of the local stability of the endemic equilibrium shows that the malaria model undergoes a forward bifurcation. was found to be most sensitive to the mosquito biting rate and the proportion of bloodmeal on human with cattle availability based on sensitivity analysis. Although the result of an optimal control analysis with time dependent controls shows that a combination of all three controls gives the best result but due to limited resources, the use of ivermectin and treatment of infective human is recommended to be adopted in malaria intervention programs as it also strongly affects both the infective human and mosquito populations with the potential of contributing significantly to the disease elimination within a minimal time frame.

Keywords: Mathematical modeling, Malaria, Ivermectin, Optimal control.

Paper read at the 6th International Workshop and Conference of the Nigerian Society for Mathematical Biology (NSMB) held at the University of Nigeria Nsukka 13 - 19 August 2023

B15:Characteristic Cardio-Vascular Acoustics in an Inchoate Turbulence

Francis E. Nzerem

Department of Mathematics and Statistics, University of Port Harcourt,
E-mail: francis.nzerem@uniport.edu.ng

Abstract

The integrity of animated life, especially of humans, is enhanced by a physiological cardiovascular flow. Blood flow goes fuzzy in the event of turbulence. In pathological states, vascular stenosis is an ostensible culprit in turbulence. Whether turbulence supervenes from physiological state or otherwise, an associated sound (bruit) that is incongruous with the normative flow acoustics pervades the abutting vascular tissues. Such a sound originates from a source point that is more or less within the inception of stenosis. The trust of this paper is to ascertain the vascular sound field that emanates from a source point and to show that incipient turbulence is largely due to stenosis. In order to achieve this, the paper supplied the windowed equations of motion of a fluid body occupying a given vascular region with the aim of deriving the fluid density form of the acoustic analogy. Nevertheless, the key parameter in vascular acoustics is turbulent pressure. Therefore, it was considered and its relationship with acceleration at the monitor points on the aortic surface was furnished. The cardiovascular system was seen to admit Kelvin-Voigt's viscoelastic model and therefore the equations describing the model was employed in the present case. The use of the aortic lumen boundary specifically suggests that hemodynamic pressure fluctuation and an associated turbulent flow precipitates murmur in the vicinity of aortic stenosis which resolves distally.

Keywords: Fluctuations; Stenosis; Reynolds stress; Murmurs; Fourier/Wavelet transform; equations of flow.

Paper read at the 6th International Workshop and Conference of the Nigerian Society for Mathematical Biology (NSMB) held at the University of Nigeria Nsukka 13 - 19 August 2023

B16:Numerical Analysis on Cellular Wound Repair Model

NKUTURUM Christiana and NWAGOR Peters

Department of Mathematics, Rivers State University, Port Harcourt
christienkutupurum245@gmail.com

Department of Mathematics/Statistics, Ignatius Ajuru University of Education, Port Harcourt

Abstract

Cellular wound is inconsistency of variations of stress that a cell suffers due to external and internal environmental changes caused by some physical, chemical, infectious, biological, nutritional or immunological factors. Cellular wound repair is a vital biological process needed to avoid cell damage, death and loss as to maintain tissue homeostasis and prevent inflammation. The study titled numerical analysis on cellular wound repair model considered two conservation equations of the rates of cell density and chemical concentration (which covers all types of therapy and other efforts to achieve healing). The study revealed that the two functional forms of the chemical control present were activator and inhibitor control mitosis of the cell. The result showed that in the normal healing of wound with a square or circular domain, the inhibition mechanism appears full thickness of the matrix domain before the activation mechanisms when simulated. Secondly, the wound is considered repaired when the cell density is between 75% and 80% of unwounded value of 0.75 and 0.8. This study showcased that the unwounded state or domain is stable while the wounded domain is unstable with little perturbations. Finally, the result revealed that the difference between activation and inhibition mechanisms is prove of wound repair which is the link between mathematics, health and nation (The People).

Keywords: Cellular wound; Repair; Cell density; Chemical concentration; Activator; Inhibitor

Paper read at the 6th International Workshop and Conference of the Nigerian Society for Mathematical Biology (NSMB) held at the University of Nigeria Nsukka 13 - 19 August 2023

B17:A simulation of An E-Agricultural Frame-Work for Improved Food Security in Nigeria

Modesta, Ero Ezema¹, Celestine I Ugwu^{2*}, Usman, Victor M³
^{1,2,3}Computer Science Department, University of Nigeria Nsukka, Nigeria

Abstract

The current food scarcity in Nigeria need urgent attention to save life. The agricultural industry relies heavily on data collection and analysis. Thus, there is an ongoing need for farmers to have access to the appropriate data at the appropriate time, in the appropriate guidelines, and through the appropriate channel, all of which may enhance food security and promote the growth of agricultural value chains. One of the key underlying challenges for farmers in Nigeria and throughout sub-Saharan Africa is lack of access to information about markets, market pricing, and logistics that may improve their productivity and earnings. The much localized nature of agriculture, however, makes it difficult to provide these details since each situation requires unique information. Efficient use of ICTs may provide these requirements for contextual information. E-Agriculture is defined as the provision of agricultural knowledge and information services using contemporary information and communication methods and technology with the aim of increasing agricultural production, efficiency, sustainability, and food security. With the goal of fostering more all-encompassing growth in the country's agricultural value chain, this paper introduces a simulation of an e-agriculture framework that gives smallholder farmers access to support services by way of a centralized hub for data on market prices, logistics, and financial products. Food security, mobile phone, agricultural value chain, and ICT framework are all essential concepts in the context of "e-Agriculture."

Keywords: E-Agriculture, Food Security, ICT, farmers

Paper read at the 6th International Workshop and Conference of the Nigerian Society for Mathematical Biology (NSMB) held at the University of Nigeria Nsukka 13 - 19 August 2023

B18:Analysis of Post Covid-19 Lockdown Offline-Customer Service Delivery In Access Bank Akwanga Branch: A Queuing Theory Approach

Livinus. L. Iwa a* and Monday A. Audu b

a Department of Mathematics, Federal University of Technology, Owerri, Nigeria.

b Department of Mathematics, Nasarawa State University, Keffi, Nigeria.

Alogla27@gmail.com (Monday A. Audu)

*Corresponding Author: livinus.iwa@futo.edu.ng

Abstract

Queues are formed when different people require similar services in the same place and at the same time interval, especially when current demand exceeds the current capacity to serve. In this paper, we present a post COVID-19 lockdown analysis of the offline-customer delivery unit of Access Bank Akwanga Branch using Queuing theory. We develop a suitable model for the system and used the quantitative method for the analysis, with the primary data obtained from observation. Results from the analysis show a reduction in customers' waiting time, thereby encouraging COVID-19 preventive measure of social distancing; increasing the number of servers in the customer care unit causes a decrease in the average waiting time of customers in queue as well as in the system, implying an automatic adherence to COVID-19 safety measures. This means that Queuing theory improves customers waiting time as well as encourages social distancing.

Keywords: Queuing Theory, COVID-19, Modeling in Bank, Lockdown, Access Bank Akwanga, Social Distancing

MSC Classification: 90B22

Subject Area: Operations Research: Queues and Services

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B19:Statistical Analysis of Students' Knowledge, Perception of Personal Hygiene and dietary habits

*Karokatose, G. B.1; Ayodeji, A. A2; Aromolaran, A.D.3; Bamidele, G.I.4; Karokatose, T. E.5; Ogundele, D. H.6

Department of Statistics^{1,2,3,4,6}, Yaba College of Technology, Yaba, Lagos State, Nigeria.

Department of Physics,⁵, University of Ilesa, Ilesa, Osun State, Nigeria.

*gbenga.karokatose@yabatech.edu.ng

Abstract

The study assessed the knowledge and practices of personal hygiene among some selected students of Yaba College of Technology, Yaba, Lagos. It focused on determining the factors that influence personal hygiene among young people. A descriptive cross - sectional design was utilised which adopted a multistage sampling method to the students from the appropriate class and level. A pre-tested, structured questionnaire was used to collect all relevant data from 269 students. Frequency distribution was used to analyse the categorical data while Friedman test was used to determine associations between some selected variables with the aid of statistical package for social science- SPSS (version 23). The result revealed that majority of the students (about 94%) had knowledge of personal hygiene and there is significant relationship between class, gender, age and the attitude of the students on personal hygiene and dietary habits ($p < .05$). Additionally, religion does not have any significant relationship with the attitude of the students towards personal hygiene and dietary habits ($p < .05$). It is concluded that the students are aware of the practices of personal hygiene. Also, a good number of them have high level of personal hygiene dietary habits.

Keywords: Personal Hygiene, Knowledge, Age group, Gender, Students.

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B20:EFFECTS OF TWO PARAMETERS FOUNDATION ON UNIFORM BEAM SUBJECTED TO MOVING CONCENTRATED LOADS WITH CLAMPED-CLAMPED AND CLAMPED FREE BOUNDARY CONDITIONS

JIMOH, A

DEPARTMENT OF MATHEMATICS AND STATISTICS, CONFLUENCE UNIVERSITY OF SCIENCE AND TECHNOLOGY, OSARA, KOGI STATE, NIGERIA.

E-Mail: jimad2007@gmail.com

Abstract

The effects of two parameters foundations on uniform beam traversed by concentrated loads with clamped-clamped and clamped-free boundary conditions is investigated in this paper. The solution technique is base on the Generalized Fourier integral transform with the series representation of the Dirac-Delta function, a modification of Struble's asymptotic method and integral transformation techniques in conjunction with convolution theory. Analytical solution and numerical analysis showed that higher values of axial force N , shear modulus G and Foundation modulus K , reduced the response amplitudes of the beam when is under the action of moving concentrated loads. However, higher values of shear modulus G are required for a more noticeable effect than the values of foundation modulus K . Also, the critical speed for the system traversed by moving force is found to be smaller than that under the influence of moving mass, hence resonance is reaches earlier in the moving mass problem than that of the moving force problem.

Keywords: Uniform Elastic beam, two parameters foundation, Concentrated Loads, Resonance, Moving force, Moving mass, Critical Speed, Clamped-Clamped, Clamped-Free.

Paper read at the 6th International Workshop and Conference of the Nigerian Society for Mathematical Biology (NSMB) held at the University of Nigeria Nsukka 13 - 19 August 2023

B21: A NECESSARY AND SUFFICIENT CONDITION FOR MATRIX SOLUTION $\Phi(t)$ OF $\dot{\Phi}(t) = A(t)\Phi(t)$ TO BE A FUNDAMENTAL MATRIX

¹S. E. ANIAKU, ²E.C. Mbah and ³C.C Asogwa

^{1,2,3} Department of Mathematics, University of Nigeria, Nigeria
stephen.aniaku@unn.edu.ng, emmanuel.mbah@unn.edu.ng and chukwuma.asogwa@unn.edu.ng

Abstract

In this paper, the role played by fundamental matrix in the determination of solution $x(t)$ of the control systems of the form $\dot{x}(t) = A(t)x(t) + b(t)$ were ex-rayed. A necessary and sufficient condition for the matrix solution $\Phi(t)$ of $\dot{\Phi}(t) = A(t)\Phi(t)$ to be a fundamental matrix was also given .

keywords: Homogeneous system, Linear independent, Fundamental matrix, Trace of a matrix.

Paper read at the 6th International Workshop and Conference of the Nigerian Society for Mathematical Biology (NSMB) held at the University of Nigeria Nsukka 13 - 19 August 2023

B22: Estimation of Population Proportion of Demographic Characteristics in Stratified Population with Direct Responses

¹Tivde, T. N. ¹Ikughur, J. A., ²Tivde, T. and ¹Uba, T.

¹Department of Statistics, Joseph Sarwuan Tarka University, Makurdi the then University of Agriculture, Makurdi

²Department of Mathematics, Joseph Sarwuan Tarka University, Makurdi the then University of Agriculture, Makurdi
nguavesetertseghe@gmail.com, ikughur.jonathan@uam.edu.ng and tivde.tertseghe@unn.edu.ng

Abstract

The effect of various demographic characteristics on the society has been studied with the sole aim of determining the estimates of proportions in a stratified population. The study presented estimates of proportions for persons possessing demographic characteristic such as marital status (Single (never married), Married, Widowed, Divorced and Separated), educational qualification and income level in a stratified population when direct responses are realised. Estimation of population proportions and stratified sampling while computing the confidence intervals for such populations. The data was obtained using questionnaire based on direct responses. The questionnaire was validated thereby checking the internal consistency of the instrument using the Chronbach alpha. The confidence intervals are presented with coefficient of variation under the design-based inference. The coefficients of variations across the critical demographic characteristics problematic to the area were identified and on marital status are widowed, divorced and separated persons. The study show that the most problematic demographic characteristic of Konshisha Local Government Area is income level followed by educational level of the Konshisha people. Useful recommendations were given, thereby calling on the government, philanthropists, public and good spirited individuals to venture into the improvement of the lively hood of the people in the study area.

Key words: Estimates of proportions, demographic characteristics, stratified population, direct responses.

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C: Pure Mathematics and Other Sciences - Virtual participants

C1:STABILITY ANALYSIS OF 2-POINT SUPER CLASS OF BBDF FOR SOLVING STIFF IVPs OF ODEs

Ja'afar Aliyu

Department of Mathematics and Statistics, Federal Polytechnic, Bauchi.
Email: pgmth190233@students.umyu.edu.ng, Phone No: 08035609924

Abstract

A stability analysis of 2-point super class of backward differentiation formula for integrating first order stiff IVPs is derived. The proposed scheme approximate two solution values at a time per integration step. The stability properties are achieved and found to be both zero and A-stable and of order 3 capable of solving stiff IVPs of ODEs. Approximates result from the system of stiff ODE problems considered are found to favorably validate the proposed method in terms of accuracy of the scale error and less executional time. Hence, the proposed scheme can be used for solving for stiff IVPs of ODEs.

Keywords: block, IVPs, ordinary differential equation, zero stable, order.

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C2:THE RELEVANCE OF MATHEMATICS, STATISTICS AND MEASUREMENTS IN PRINT JOURNALISM AND RESEARCH

NWAEZEIHENATUOHA, PETER CHUKWUGHALUM

DEPARTMENT OF MASS COMMUNICATION FACULTY OF ARTS AND HUMANITIES UNIVERSITY OF NIGERIA, NSUKKA

peter.nwaezeihenatuoha.93049@unn.edu.ng 08038725325

Abstract

No activity of a rational man is devoid of simple logical calculations, and this is an expression of mathematical functions. From the time he wakes up in the morning till he retires in the evening, man consciously or unconsciously applies basic mathematics to solve his social problems. In Mass Communication, especially in print journalism and research in the print media involving content analysis, mathematics plays indispensable roles because there are fundamental calculations and measurements to determine (whether photo news or texts) page makeup, dimension, space allotment, news placement, story position, coverage depth, number of words and paragraphs, typography etc. Anchoring on two theories – framing and graphic design laws – this paper utilized content analysis to investigate the relevance of mathematics in the print media (newspaper and magazine) and in print research involving textual analysis. Through a purposive sampling, newspapers and journal paper samples were selected from a plethora of Nigerian dailies and journal articles, for analysis. Findings showed basic mathematics were applied in newspaper publication and production. Furthermore, results also indicated

mathematical decisions, statistics and measurement applied in the content analysis research investigating the manifest contents of newspapers and magazines.

Key words: Mathematics, print journalism, research, framing, graphic design.

Paper read at the 6th International Workshop and Conference of the Nigerian Society for Mathematical Biology (NSMB) held at the University of Nigeria Nsukka 13 - 19 August 2023

C3: An Internet of Things Sensor-Based Fish Pond Datasets for Predicting Fish Growth

1C.N. Udanor, *1Uzo B.C, 1Ogbuokiri B.O, 1Obayi A.A, 2Kama M. O, 3Asogwa C. N.

1Department of Computer Science, University of Nigeria

2 Veritas University, Bwari. Abuja

3 Enugu State Polytechnic

Corresponding Author: blessing.uzo@unn.edu.ng

Abstract

During the Lacuna Agriculture Fund 2020 project grant award (<https://lacunafund.org/datasets/agriculture/>) aimed at building agricultural datasets, our team designed and developed an IoT-edge-Cloud microcontroller-based system aimed at remotely monitoring and collecting physico-chemical parameters from catfish aquaponics pond water. The primary deliverable from the project was a labelled dataset containing water quality parameters like water temperature, pH, dissolved oxygen, turbidity, dissolved ammonia, and nitrate from 12 aquaponics ponds, which was stored at: (<https://www.kaggle.com/datasets/ogbuokiriblessing/sensor-based-aquaponics-fish-pond-datasets>). This dataset comes handy in developing machine learning models for predicting catfish health and yield in terms of weight, and length. This indigenous data repository is made available in the cloud for fish farmers and machine learning researchers. Predicting catfish yield with machine learning can be done by building a predictive model that takes into account various factors that affect catfish growth and yield. Some factors that may be relevant for such a model include: water quality, feed type and quantity, stocking density, water exchange rate, and other environmental factors. Presently each of the datasets that contain not less than 128,206 rows and 11 columns have been used to build machine learning models with accuracies not less 98% after being trained with algorithms like Linear Regression, Ridge Regression, Lasso Regression, K-Neighbors Regressor, and Decision Tree Regressor. XGBoost Regressor performed well for both fish weight and fish length models and was adopted for the final model.

Keywords: Internet of Things, Fish dataset, Machine learning, Aquaponics, Yield prediction.

Paper read at the 6th International Workshop and Conference of the Nigerian Society for Mathematical Biology (NSMB) held at the University of Nigeria Nsukka 13 - 19 August 2023

C4: Public Sentiment towards petrol price increase in Nigeria: Analysis of Social Media Posts.

¹Uzo Blessing Chimezie, ²Okwueze Chisom Nneoma, ¹Collins Udanor, ³Blessing Ogbuokiri, ¹Obayi Adaora Angela, ⁴Mary Ofuru Kama

¹University of Nigeria, Nsukka

²Enugu State Polytechnic

³York University, Toronto, Canada and University of Nigeria, Nsukka, Nigeria

⁴Veritas University, Bwari. Abuja

Corresponding Author: Okwueze Chisom Nneoma, chisom.okwueze.pg02510@unn.edu.ng

Abstract

In Nigeria, petrol's influence on the economy is substantial, as its price changes affect various economic aspects, impacting citizens' livelihoods and mental health. The recent fuel price increase has raised concerns about its social and economic consequences. While existing research has explored economic and travel effects, little is known about the psychological impact of such price hikes. This study seeks to assess the efficacy of

machine learning algorithms in analyzing natural language data from social media, with a focus on sentiment analysis and natural language understanding. By utilising natural language processing algorithms on text-based social media data, such as tweets and Facebook posts, the research aims to identify and categorise sentiments expressed by individuals in response to the fuel price increase. The ultimate goal is to gain insights into the potential psychological effects of the price increase, providing valuable information to inform future policy decisions. Understanding public sentiment through social media can help policymakers comprehend the overall impact of economic changes on citizens' mental well-being. Armed with this knowledge, policymakers can make more informed decisions that consider the public's emotional response to fuel price fluctuations, ultimately leading to more thoughtful and impactful policy measures.

Keywords: Fuel price increase, psychological effects, Natural Language Processing, Machine Learning, Sentiment Analysis.

Subject Area: Machine Learning (Computer Science)

Paper read at the 6th International Workshop and Conference of the Nigerian Society for Mathematical Biology (NSMB) held at the University of Nigeria Nsukka 13 - 19 August 2023

C5: A NECESSARY AND SUFFICIENT CONDITION FOR LOCAL AND GLOBAL NULL - CONTROLLABILITY

¹S. E. ANIAKU, ² E.C. Mbah and ³ C.C Asogwa

^{1,2,3} Department of Mathematics, University of Nigeria, Nigeria

stephen.aniaku@unn.edu.ng, emmanuel.mbah@unn.edu.ng and chukwuma.asogwa@unn.edu.ng

Abstract

The problem of null-controllability for linear non-autonomous system of the form $\dot{x}(t) = A(t)x(t) + B(t)u(t)$, $x(t) \in X$ and $u(t) \in \Omega \subset U \equiv \mathbb{R}^m$ where X and U are complex Banach spaces are considered. Necessary and sufficient condition is given for global Ω -null controllability of the system. In this case, the condition that origin will be an interior point of the control set Ω —does not apply.

keywords: Null - controllability, scalar function, support function, compact set.

Paper read at the 6th International Workshop and Conference of the Nigerian Society for Mathematical Biology (NSMB) held at the University of Nigeria Nsukka 13 - 19 August 2023

C6: THE RELEVANCE OF MATHEMATICS, STATISTICS AND MEASUREMENTS IN PRINT JOURNALISM AND RESEARCH

NWAEZEIHENATUOHA, PETER CHUKWUGHALUM

DEPARTMENT OF MASS COMMUNICATION

FACULTY OF ARTS AND HUMANITIES UNIVERSITY OF NIGERIA, NSUKKA

peter.nwaezeihenatuoha.93049@unn.edu.ng 08038725325

Abstract

No activity of a rational man is devoid of simple logical calculations, and this is an expression of mathematical functions. From the time he wakes up in the morning till he retires in the evening, man consciously or unconsciously applies basic mathematics to solve his social problems. In Mass Communication, especially in print journalism and research in the print media involving content analysis, mathematics plays indispensable roles because there are fundamental calculations and measurements to determine (whether photo news or texts) page makeup, dimension, space allotment, news placement, story position, coverage depth, number of words and paragraphs, typography etc. Anchoring on two theories – framing and graphic design laws – this paper utilized content analysis to investigate the relevance of mathematics in the print media (newspaper and magazine) and in print research involving textual analysis. Through a purposive sampling, newspapers and journal paper samples were selected from a plethora of Nigerian dailies and journal articles, for analysis. Findings showed basic mathematics were applied in newspaper publication and production. Furthermore, results also indicated

mathematical decisions, statistics and measurement applied in the content analysis research investigating the manifest contents of newspapers and magazines.

Key words: Mathematics, print journalism, research, framing, graphic design.

Paper read at the 6th International Workshop and Conference of the Nigerian Society for Mathematical Biology (NSMB) held at the University of Nigeria Nsukka 13 - 19 August 2023

C7:AN APPLICATION OF MACHINE LEARNING IN DETERMINING THE EFFECT OF TEACHING METHODS ON THE ACADEMIC PERFORMANCE OF STUDENTS

Ezugwu, O.A., Aneke, S.O, and Uzo, I.U.

Department of Computer Science, University of Nigeria, Nsukka

Corresponding author : stephen.aneke@unn.edu.ng

Research Area : Machine Learning

Abstract

The concept and issue of academic activities on campuses have received broad discussions and are now open knowledge. The Internet of Things (IoT), typically comprises a network of people, devices (mobile and non-mobile), and 'things' (as hosts) which are linked together by a common goal has revolutionized academic learning in recent years. A university or college campus was designed to enhance education through the utilization of both physical and academic infrastructures that employ the use of recent technologies to bring about effective learning and management of the educational sector. This work aims to study the various existing teaching methods on campuses and consequently apply machine learning tools to find the best teaching method for maximum learning. The quantitative research methodology will be used to apply to the dataset of students' records. The expected result will be to discover the appropriate machine learning algorithm for determining the student's academic performance.

Keywords: academic activities, machine learning, academic performance, teaching methods, prediction.

Paper read at the 6th International Workshop and Conference of the Nigerian Society for Mathematical Biology (NSMB) held at the University of Nigeria Nsukka 13 - 19 August 2023

C8:TRANSMISSION DYNAMICS OF DIPHTHERIA WITH CONTROLS USING MATHEMATICAL MODEL

Friday, C.K, Ejikeme, C.L, Okoye, C., Agbebaku, D.F, Okofu, M.B, Ezeafulukwe, U.A

Department of Mathematics, University of Nigeria Nsukka.

Abstract

Diphtheria is an infectious disease caused by *Corynebacterium diphtheriae*, posing a significant public health challenge worldwide. The implementation of control measures, such as vaccination programs, has greatly reduced the incidence of diphtheria. However, outbreaks still occur in certain regions, highlighting the need for additional strategies to prevent and control the disease. This research paper presents a mathematical model to explore the transmission dynamics of diphtheria disease and the impact of public enlightenment campaigns and vaccination as control measures. The model investigates the outbreak proportion since it is contractable via respiratory droplets and direct contact by obtaining the basic reproduction number. Further mathematical analysis showed the absolute and conditional eradication feasibility over short and long term , as well as the effects of the in vivo parameters based on their sensitivity index. The numerical simulation highlights the influence of public enlightenment campaigns, which aim to raise awareness about diphtheria, its transmission, and the importance of effective vaccination. Simulation results demonstrate the potential of public enlightenment campaigns in reducing diphtheria transmission. The model shows that increasing campaign effectiveness and coverage can lead to a substantial decline in diphtheria cases.

Keywords: diphtheria, mathematical model, public enlightenment, control measures. Vaccination.

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C9: Optimization Control on the Health Security of a Nation using Oxidative Stress and Respiratory Disease Model

NKUTURUM Christiana and OLAWUYI, Oluseye Mojirayo

Department of Mathematics, Rivers State University, Port Harcourt
christienkukurum245@gmail.com Department of Basic Science, Alvan Ikoku College of Education, Owerri

Abstract

The anatomical and functional properties of the respiratory system made it extraordinarily susceptible to oxidative stress because of its large area of exposure to the external environment. However, it is the cellular and tissue injury caused by oxidants through air pollutants that plays vital role in the pathogenesis of lungs disorders such as lung cancer, asthma, COVID-19, cystic fibrosis, chronic obstructive pulmonary disease (COPD), acute respiratory distress syndrome (ARDS) and idiopathic pulmonary fibrosis (IPF). This study revealed that there are two types of wave function involved in the transmission dynamics of respiratory diseases; such as a wave moving in the positive x-direction as $x(t) = A\cos(\omega t + \phi)$ and in the negative x-direction as $y(x, t) = A\sin(kx + \omega t + \phi)$. The study showed that from inception respiratory disease transmission had a wave-like behavior in terms of number of cases and deaths just like COVID-19. This study also revealed that the health implications were of negative impact on human beings and the nation at large in that it reduces the quality of services rendered to the different sectors of life. Above all, this paper recommended that governments should prioritize services to prevent damage to the cells and tissues in the human body, respond to violence as essential services during emergency to secure the health of the nation. Finally, there should be public health foundation for all networks.

Keywords: Health security; oxidative stress; respiratory disease model; wave functions

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C10: ESTIMATING ESSENTIAL PARAMETERS OF THE STOCHASTIC DYNAMICS FOR CERTAIN FINANCIAL MARKET

Maurice Nnamdi ANNORZIE

Department of Mathematics, Imo State University, P.M.B. 2000, Owerri, Nigeria.
e-mail: mnannorzie@gmail.com; mnannorzie@imsu.edu.ng

Abstract

The stochastic dynamics and behaviour of the daily scheduled financial transactions at the Nigerian Stock market (NSM), operated by the Nigerian Stock Exchange (NSE) as a whole are characterized by the trading activities of the Nigerian All-Share Index (NASI). This paper shows the procedure of computing some essential parameters needed to be estimated in order to obtain the required stochastic model of the Stochastic Differential Equation (SDE), in the analysis of the NASI data (1990-2007) namely:- the drift, volatility, Hurst parameter, while the fourth, the Gaussian random numbers, generated randomly during simulation by the exact computer package used with respect to the appropriate, in a long range dependent market phenomenon. The historical NASI data of NSE were studied, analyzed and characterized using the Rescaled Range Statistics (R/S) with a four-quarter moving average of the NASI data within the given time interval, as an estimation method. By modeling the dynamics of the NSM using the NASI as a proxy, their essential parameters were characterized by means of a Stochastic Differential Equation (SDE) in the form of an exponential fractional Brownian motion (fBm), as required in the model given by, where is the required time interval.

KEYWORDS: Stochastic Differential Equation, Drift, Volatility, Hurst parameter, Gaussian random numbers.

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C11: MODELING AND SIMULATING THE SPREAD OF TWO TERRORIST GROUPS IN A STEADY POPULATION

ATINDIGA, SIMON TERHEMEN¹, NDIDIAMAKA EDITH DIDIGWU² AND AZUABA, EMMANUEL³

BASIC SCIENCES DEPARTMENT, AKPERAN ORSHI POLYTECHNIC, YANDEV, GBOKO1 email:
sirstayhemen@gmail.com

INDUSTRIAL MATHEMATICS/APPLIED STATISTICS,
ENUGU STATE UNIVERSITY OF SCIENCE AND TECHNOLOGY, AGBANI, ENUGU, NIGERIA2 email:
edith.didgwu@esut.edu.ng

DEPARTMENT OF MATHEMATICAL SCIENCES, BINGHAM UNIVERSITY, KARU-NIGERIA3
email: Emmanuel.azuaba@binghamuni.edu.ng

Abstract

In this work, we formulated and developed a non-linear mathematical model which studied the growth and spread of two terrorist groups in a constant population. The model was transformed into proportions and four terror equilibria were found and analyzed to show that each of the terror equilibria state was locally asymptotically stable. The model was solved using fourth order Runge-Kutta method embedded in Maple 17 mathematical software and the results showed that the ex- terror compartment $A(t)$ played a role of checking the dynamics/spread of each of terror groups $B(t)$ and $C(t)$. It was also discovered that, a terror group loses her members as a result of poor policies and unequal representation of the interests of her members. It became practical that, the ex- terror class $A(t)$ influenced major decisions of each of the other groups $B(t)$ and $C(t)$ since it has impact on the flow of members into and out of these terror groups. The graphs arising from the results of the numerical simulation gave an interesting scenario in the mathematical way and recommendations were made that emphasis should be tailored towards halting recruitment of new members into terror groups from the non- terror class, the other terror group(s) as well as the ex- terror class of the community; this will ensure the non-growth and survival of terror activities in the coming years. It was also recommended that a varying population as well as a heterogeneously mixed population be considered in studying such a model.

Key words: equilibria, terror and simulation

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C12: Convergence of Numerical Solution for Heat Equation

A.O. Odio¹, Omeh C.², P.U. Nwokoro³, E.C Mbah ⁴ Mmadukafe C.A⁵, Onyekaba K.S⁶

¹⁻⁶Department of Mathematics, University of Nigeria, Nsukka

Abstract

The work is on convergence of numerical solution for heat equation. In this problem, we consider a suitable difference scheme whose dependent variable u is the control which depends on multiplicity of space variables $x_1, x_2, x_3, \dots, x_n$ and time variable t . Here, u is defined on suitable subspaces of the space of definition. This type of function u , is said to be admissible and also, satisfies the Taylor series expansions. Also, the difference scheme in question satisfy the numerical properties such as consistency, stability and convergent. Numerical solution obtained were found to be consistent, stable and convergent.

Key word: Convergence, numerical solution, numerical scheme, consistency, stability admissible function.

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C13: The Impact of vaccination and enlightenment on a non-linear Ebola virus disease model

Okoye, C*, Friday, C.K, Ejikeme, C.L, Agbebaku, D.F, Okofu, M.B, Mba, B.I

Department of Mathematics, University of Nigeria Nsukka.

chukwudi.okoye@unn.edu.ng, chinedukings2013@yahoo.com, chioma.ejikeme@unn.edu.ng,

dennis.agbebaku@unn.edu.ng, mary.okofu@unn.edu.ng, bernard.mba@unn.edu.ng

Corresponding Author email: chukwudi.okoye@unn.edu.ng

Abstract

This paper addresses the spread of Ebola Virus Disease in human population by developing a non-linear model that studies the impact of vaccine and enlightenment. The disease free equilibrium of the model is shown to be locally and asymptotically stable provided the associated reproduction number is less than unity. We prove the existence of the endemic equilibrium point for all $R_0 > 1$. The formulated model was shown to be mathematically well-posed and epidemiologically meaningful. The sensitivity analysis was obtained and MATLAB was used to obtain the numerical simulations of the state variables in comparison to the analytical deductions. The data fittings to the model shows the global effects of vaccine application on the system in regards to human response to enlightenment.

Keywords: impact, Ebola virus, enlightenment, Vaccination. MSC Classification: Epidemiological Mathematical Model Subject Area: Mathematics

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C14: MATHEMATICAL ASSESSMENT OF THE ROLE OF INTERVENTIONS AND SOCIO-ECONOMIC IMPACT OF COVID-19

¹Abah Roseline Toyin, ²Calistus Ngonghala

¹University of Abuja, Abuja Nigeria ²University of Florida, USA

Abstract

The world has been witnessing a devastating pandemic known as Coronavirus (Covid 19) disease since its first outbreak in China in December 2019. It's been of great public health and socioeconomic impact due to its high morbidity and mortality leading to great devastation of mankind and the economy. With the continual emergence of new strains of the coronavirus leading to a new wave of the disease, and the lack of effective pharmacological intervention, this research is focused on assessing the role of intervention and the socioeconomic impact of the disease on public health. The socio-economic impact, morbidity and mortality of covid-19 are so significant to public health, such that if slack intervention measures are applied this can lead to a zero equilibrium state (it's a state where a population is totally wiped out in the absence of intervention to the disease) in the nearest future, hence urgent and safe interventions such as Public enlightenment, face-masking in public, social distancing, contact-tracing, phone detection, isolation, quarantine will be explored in this research.

the role of interventions in curbing the covid-19 and its social-economic impact on public health. A mathematical model will be formulated and some qualitative analysis applied to find the disease-free equilibrium state (a state where a population is free from disease). The effective reproductive number R_e which is an epidemiological threshold, in the presence of intervention must. It must be less than unity for COVID-19 to be completely wiped out, which means that the disease free equilibrium state is locally asymptotically stable. Available and relevant data to the dynamics of the transmission of the disease would be assessed and used to simulate the model.

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C15: Mathematical model of COVID-19 transmission dynamics incorporating booster vaccine program and environmental contamination

N. I. Akinwande¹, T. T. Ashezua⁴, R. I. Gweryina⁴, S. A. Somma¹, F. A. Oguntolu¹, A. Usman³, O. N. Abdurrahman¹, F. S. Kaduna⁴, T. P. Adajime⁵, F. A. Kuta², S. Abdulrahman⁶, R. O. Olayiwola¹, A. I. Enagi¹, G. A. Bolarin¹, M. D. Shehu¹

Abstract

¹Department of Mathematics, Federal University of Technology Minna, Nigeria
²Department of Microbiology, Federal University of Technology Minna, Nigeria
³Department of Statistics, Federal University of Technology Minna, Nigeria
⁴Department of Mathematics, Federal University of Agriculture, Makurdi, Nigeria
⁵Department of Epidemiology and Community Health, Benue State University, Makurdi, Nigeria
⁶Department of Mathematics, Federal University Birnin Kebbi, Nigeria
Corresponding email: ttashezua@gmail.com

COVID-19 is one of the greatest human global health challenges that causes economic meltdown of many nations. In this study, we develop an SIR-type model which captures both human-to-human and environment-to-human-to-environment transmissions that allows the recruitment of corona viruses in the environment in the midst of booster vaccine program. Theoretically, we prove some basic properties of the full model as well as investigate the existence of SARS-CoV-2-free and endemic equilibria. The SARS-CoV-2-free equilibrium for the special case, where the constant inflow of corona virus into the environment by any other means, Ω is suspended ($\Omega = 0$) is globally asymptotically stable when the effective reproduction number $R_0 < 1$ and unstable if otherwise. Whereas in the presence of free-living Corona viruses in the environment ($\Omega > 0$), the endemic equilibrium using the center manifold theory is shown to be stable globally whenever $R_0 < 1$. The model is extended into optimal control system and analyzed analytically using Pontryagin's Maximum Principle. Results from the optimal control simulations show that strategy E for implementing the public health advocacy, booster vaccine program, treatment of isolated people and disinfecting or fumigating of surfaces and dead bodies before burial is the most effective control intervention for mitigating the spread of Corona virus. Importantly, based on the available data used, the study also revealed that if at least 70% of the constituents followed the aforementioned public health policies, then herd immunity could be achieved for COVID-19 pandemic in the community.

Keywords: COVID-19, Booster vaccine program, Environmental contamination, Bifurcation, Optimal control analysis
MSC: 97Mxx, 92B05, 34D23, 37G99

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C16: HOMOTOPY PERTURBATION ANALYTIC SOLUTION OF COVID-19 TRANSMISSION DYNAMICS MODEL WITH VACCINATION AND TREATMENT

¹Alwell, U., ² Mbah G. C. E. and ³Uwakwe, J. I.
^{1,3}Department of Mathematics, Alvan Ikoku Federal College of Education Owerri, Imo State
²Department of Mathematics, University of Nigeria, Nsukka
alwelluzoma@gmail.com

Abstract

The study used Homotopy Perturbation Method (HPM) which is a semi-analytical technique for solving linear and nonlinear differential equations to obtain analytical solution for a nonlinear differential system of the COVID-19 transmission dynamics model with vaccination and treatment as controls. HPM gave convergent

series solution which obtains the maximised error for the nonlinear ODE of the COVID-19 model. We derived the first two terms to obtain the convergent solutions of zero-order deformation. The zero-order deformation equation is given of the form; $(1-p)$ (linear terms of given differential equations) + p (linear and nonlinear all terms).

Keywords: Homotopy, perturbation, model and COVID-19.

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C17: Mathematical Modeling On The Transmission Dynamics Of Malaria-Zika Virus Co-infection And Control

G.C.E.Mbah, Okoro Udu ukpai, Oko Nlia

University Of Nigeria Nsukka

okorouduukpai@mail, albert1960.on@gmail

Abstract

Malaria and Zika Virus are among the most endemic diseases and thus of major public health concern in tropical developing countries. In addition to true co-infection of malaria and Zika virus ,false diagnoses due to similar signs and symptoms and false positive result in testing methods, leading to improper controls, are one of the major challenges on managing these diseases. In this study we developed deterministic mathematical models describing the co-infection dynamics of malaria and zika virus. Through mathematical analysis of models we will determine the distinct features of malaria and zika virus infection dynamics respectively ,as well as the relationships associated to their co-infection. And however adopt a sustainable method that both diseases need to be managed concurrently with emphasis on the use of inoculation,Wolbacha and other Strategies for successful control of the co-epidemics.

Keywords:Malaria-Zika Virus,Co-infection,Transmission,Dynamics,Wolbacha.

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