ICREM 5

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Programs & Abstracts

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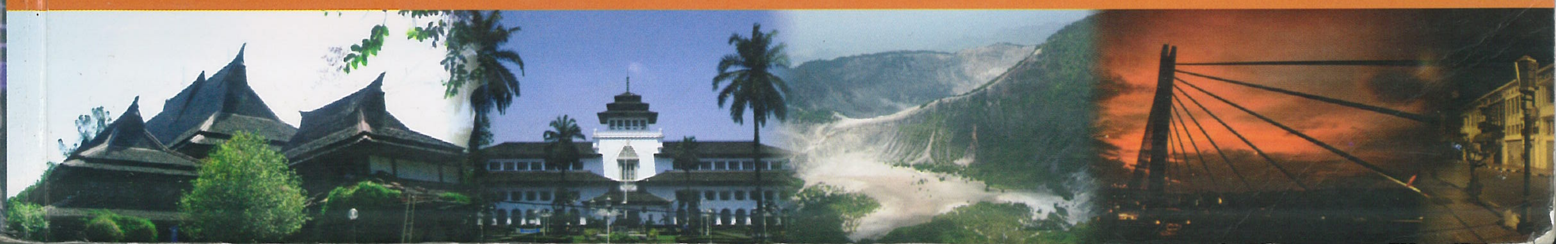

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PROGRAM OF KEYNOTE, PLENARY & INVITED TALKS

Time	Event	Chair	Venue
	Saturday, 22nd October 2011		
08.00 – 08.55	Registration		Aula Barat/West Hall
09.00 – 09.30	Opening Ceremony		Aula Barat/West Hall
09.30 – 10.10	Plenary 1 Johnny W. Lott (p. 6)	Ahmad Muchlis	Aula Barat/West Hall
10.10 – 10.40	Refreshment		
10.40 – 11.20	Plenary 2 Ragni Piene (p. 7)	Hendra Gunawan	Aula Barat/West Hall
11.25 – 11.55	Invited Talk 1 Hishamuddin (p. 16) Invited Talk 2 Udjianna S. Pasaribu (p. 12)	Oleg Ivanovich Reynov Mohd Rizam Abu Bakar	Aula Barat/West Hall Aula Timur/East Hall
12.00 – 12.30	Invited Talk 3 Nguyen Minh Tri (p. 15) Invited Talk 4 Christodor Ionescu (p. 12)	Sergey Borisenok Kamel Ariffin Mohd Atan	Aula Barat/West Hall Aula Timur/East Hall
12.30 – 13.25	Lunch		
13.30 – 14.10	Plenary 3 Yoshihiro Sawano (p. 7)	George Willis	Aula Barat/West Hall
14.25 – 17.15	Parallel Session I (12 rooms x 7 talks)		Oktagon & TVST Build.
Time	**Event**	**Chair**	**Venue**
	Sunday, 23rd October 2011		
08.00 – 09.20	Parallel Session II (12 rooms x 4 talks)		Oktagon & TVST Build.
09.30 – 10.45	Keynote Lecture by Prof. Cedric Villani (2010 Fields Medal Laureate) (p. 2)	Yudi Soeharyadi	Aula Barat/West Hall
10.45 – 11.10	Refreshment		
11.10 – 11.40	Invited Talk 5 Vu Ngoc Phat (p. 13) Invited Talk 6 Oleg Ivanovich Reynov (p. 14)	Edy Soewono Yoshihiro Sawano	Aula Barat/West Hall Aula Timur/East Hall
11.45 – 12.15	Invited Talk 7 Tudor Zamfirescu (p. 17) Invited Talk 8 George Willis (p. 15)	Saladin Uttunggadewa Oki Neswan	Aula Barat/West Hall Aula Timur/East Hall
12.15 – 13.10	Lunch		
13.10 – 13.50	Plenary 4 Wono Setya Budhi (p. 4)	Ngo Viet Trung	Aula Barat/West Hall
13.55 – 14.35	Plenary 5 Phan Thi Ha Duong (p. 5)	Iwan Pranoto	Aula Barat/West Hall
14.45 – 17.15	Parallel Session III (12 rooms x 6 talks)		Oktagon & TVST Build.
19.00 – 21.00	Conference Dinner & Cultural Night		Aula Barat/West Hall

Time	Event	Chair	Venue
Monday, 24th October 2011			
08.00 – 08.40	Plenary 6 Mat Rofa (p. 5)	Salman A. N	Aula Timur/East Hall
08.45 – 09.15	Invited Speaker 9 Sri Redjeki (p. 13) Invited Speaker 10 Mohd Rizam Abu Bakar (p. 10)	Phan Ti Ha Duong Budi Nurani	Aula Barat/West Hall Aula Timur/East Hall
09.20 – 09.50	Invited Speakers 11 Sergey Borisenok (p. 10)	Janson Naiborhu	Aula Timur/East Hall
09.50 – 10.20	Refreshment		Aula Timur/East Hall
10.30 – 11.50	Parallel Session IV (4 rooms x 4 talks)		Aula Timur/East Hall
11.50 – 12.10	Closing ceremony		Aula Barat/West Hall
12.10 – 13.10	Lunch		

PROGRAM OF PARALLEL SESSION

Parallel Session I

Time	Event
Saturday, 22nd October 2011	
14.25 – 14.45	Parallel Session I.1
14.45 – 15.05	Parallel Session I.2
15.05 – 15.25	Parallel Session I.3
15.25– 15.55	Refreshment
15.55 – 16.15	Parallel Session I.4
16.15 – 16.35	Parallel Session I.5
16.35 – 16.55	Parallel Session I.6
16.55 – 17.15	Parallel Session I.7

Parallel Session III

Time	Event
Sunday 23rd October 2011	
14.45 – 15.05	Parallel Session III.1
15.05 – 15.25	Parallel Session III.2
15.25 – 15.45	Parallel Session III.3
15.45 – 16.15	Refreshment
16.15 – 16.35	Parallel Session III.4
16.35 – 16.55	Parallel Session III.5
16.55 – 17.15	Parallel Session III.6

Parallel Session II

Time	Event
Sunday 23rd October 2011	
08.00 – 08.20	Parallel Session II.1
08.20 – 08.40	Parallel Session II.2
08.40 – 09.00	Parallel Session II.3
09.00 – 09.20	Parallel Session II.4

Parallel Session IV

Time	Event
Monday 24th October 2011	
10.30 – 10.50	Parallel Session IV.1
10.50 – 11.10	Parallel Session IV.2
11.10 – 11.30	Parallel Session IV.3
11.30 – 11.50	Parallel Session IV.4

PROGRAM OF PARALLEL SESSION

No	TIME	PRESENTERS	AUTHORS	TITLES
Parallel Session I: Saturday, 22nd October 2011				
CONTRIBUTED TALKS: 7 · 20 minutes, 14.25 - 15.25 & 15.55 - 17.15 WIB				
Paralel Session I Room 1 Analysis				
CHAIR : Bobby Gunara				
1	14.25 – 14.45	Sadeq Thabit (p. 222)	Sadeq Thabit and Hailiza Kamarulhaili	Almost Regularity, π-Normality and Generalized Closed Sets in Topological Spaces
2	14.45 – 15.05	Jong Tan (p. 217)	Jong Tan, Zainul Abidin and Herry Kwee	Application of AdS/CFT Correspondence in Superconductor
3	15.05 – 15.25	Oleg Reynov (p. 180)	Oleg Reynov* and Qaisar Latif	Grothendieck-Lidskiĭ theorem for subspaces and factor spaces of L_p-spaces
15.25 – 15.55 REFRESHMENT				
CHAIR : Herry Kwee				
4	15.55 – 16.15	Herry Kwee (p. 126)	Herry Kwee, Jong Tan and Zainul Abidin	Asymptotic Freedom in Holographic QCD
5	16.15 – 16.35	Takeshi Iida (p. 102)	Takeshi Iida	A characterization of a multiple weights class
6	16.35 – 16.55	Bobby Gunara (p. 78)	Bobby Gunara	Static Spacetimes of Constant Scalar Curvature in D-Dimensional Einstein-Maxwell-Higgs Theory
Paralel Session I Room 2 Mathematics Education				
CHAIR : K. Raghavendran				
1	14.25 – 14.45	Farzaneh Saadati (p. 187)	Farzaneh Saadati, Rohani Ahmad Tarmizi, Ahmad Fauzi Mohd Ayub	Utilization of technology in Mathematics learning; Engineering students' perception through Facebook interaction
2	14.45 – 15.05	Karlimah (p. 116)	Karlimah	Mathematical Communication And Problem Solving Abilities: Experiment With Student Elementary Teacher By Using Problem Based Learning
3	15.05 – 15.25	Abdul Halim Abdullah (p. 21)	Abdul Halim Abdullah and Effandi Zakaria	Students' Perceptions towards the Generating Conjectures Learning Strategy Using Geometer's Sketchpad Software
15.25 – 15.55 REFRESHMENT				
CHAIR : Abdul Halim Abdullah				
4	14.25 – 14.45	K.Raghavendran (p. 172)	K. Raghavendran	Algebraic Method For Obtaining Anti Derivatives Without Integration
5	16.15 – 16.35	Tri Sagirani (p. 188)	Tri Sagirani and Dewiyani Sunarto	Design And Developing Prototype Application For Math Content Search Based On Multimedia (Case Study In Surabaya Math Learning Community)
6	16.35 – 16.55	Nelvin Nool (p. 154)	Nelvin Nool	Effectiveness of an Improvised Abacus in Teaching Addition of Integers

7	16.55 – 17.15	Atje Setiawan Abdullah (p. 21)	Atje Setiawan Abdullah	Prediction of Quality Education of Elementary School in Indonesia using Spatial AutoRegressive (SAR) and Expansion Spatial AutoRegressive (ESAR) Models
Paralel Session I Room 3 Applied Math				
CHAIR : Basuki Widodo				
1	14.25 – 14.45	Dumitru Vieru (p. 106)	Dumitru Vieru*, Corina Fetecau, Mehwish Rana	Starting solutions for the flow of second grade fluids in a rectangular channel due to an oscillating shear stress
2	14.45 – 15.05	Constantin Fetecau (p. 71)	Constantin Fetecau*, Nazish Shahid, Masood Khan	Flow of a fractional Oldroyd-B fluid over a plane wall that applies a time-dependent shear to the fluid
3	15.05 – 15.25	J.M.Tuwankotta (p. 226)	J.M. Tuwankotta, E. Hariadi	On Periodic Solution Of A Predator-Prey Type Of Dynamical System With Time Periodic Perturbation
15.25 – 15.55 REFRESHMENT				
CHAIR : Dumitru Vieru				
4	15.55 – 16.15	E. Hariadi (p. 87)	E. Hariadi, J.M. Tuwankotta	Swallowtail In Predator Prey Type Of System With Time-Periodic Perturbation
5	16.15 – 16.35	Basuki Widodo (p. 234)	Basuki Widodo, M. Siing, Sofwan Hadi, Solikhin	Numerical Simulation of Flow Routing for Simulating Flood Propagation in River Flow
6	16.35 – 16.55	Hamzah Sakidin (p. 190)	Hamzah Sakidin	Simplified Hydrostatics UNBab Mapping Function For Global Positioning System (GPS) Tropospheric Delay
7	16.55 – 17.15	Masaji Watanabe (p. 234)	Masaji Watanabe and Fusako Kawai	Modeling and simulation in study on biodegradation of xenobiotic polymers
Paralel Session I Room 4 Statistics				
CHAIR : Nahdiya Zainal Abidin				
1	14.25 – 14.45	Budi Nurani (p. 139)	Budi Nurani Ruchjana	Least Squares Estimation of Generalized Space Time AutoRegressive (GSTAR) Model and Its Properties
2	14.45 – 15.05	Farrukh Mukhamedov (p. 150)	Farrukh Mukhamedov and Mansoor Saburov	Quantum Markov chains vs Gibbs measures
3	15.05 – 15.25	Hasan Husna (p. 101)	Hasan Husna and Noor Fadhilah Ahmad Radi	Modeling the Distribution of Extreme Share Return in Malaysia Using Generalized Extreme Value (GEV) Distribution
15.25 – 15.55 REFRESHMENT				
CHAIR : Hasan Husna				
4	15.55 – 16.15	Muhammad Nur Aidi M.S (p. 29)	Muhammad Nur Aidi M.S and Tuti Purwaningsih	Comparison of Spatial Ordinal Logistic Regression Analysis, Principal Component Spatial Ordinal Logistic Regression and The Non-Spatial Analysis to Predict Poverty Status of Districts in Java Island
5	16.15 – 16.35	Nahdiya Zainal Abidin (p. 25)	Nahdiya Zainal Abidin, Mohd Bakri Adam and Habshah Midi	Hypothesis Tests of Goodness-of-fit for Fr´echet Distribution: A comparative study
6	16.35 – 16.55	Henry Junus Wattimanela (p. 236)	Henry Junus Wattimanela	The Mapping of Main Source Income on Three Group of Islands in Maluku Province - Indonesia

7	16.55 – 17.15	Farah Kristiani (p. 52)	Pricilla Natalia Budiman and Farah Kristiani*	Comparison Between Education Insurance And Savings
Paralel Session I Room 5 Graph				
CHAIR : A. A. G. Ngurah				
1	14.25 – 14.45	Darmaji (p. 55)	Darmaji*, Saladin Uttunggadewa, Rinovia Simanjuntak and Edy Tri Baskoro	The partition dimension of bipartite and tripartite graphs minus a matching
2	14.45 – 15.05	Corry Corazon Marzuki (p. 136)	Corry Corazon Marzuki*, A. N. M. Salman, M. Miller	On the total irregularity strength of cycles and paths
3	15.05 – 15.25	Asmiati (p. 47)	Asmiati*, Edy Tri Baskoro	Characterizing all graphs containing an odd cycle with the locating-chromatic number 3
15.25 – 15.55 REFRESHMENT				
CHAIR : Asmiati				
4	15.55 – 16.15	Ira Apni Purwasih (p. 171)	Ira Apni Purwasih*, Edy Tri Baskoro, Hilda Assiyatun	The locating-chromatic number of certain Halin graph
5	16.15 – 16.35	Reza Faisal (p. 69)	Reza Faisal*, Edy Tri Baskoro	The locating chromatic number of Cartesian product graphs $P_m \times P_n$ and $P_m \times C_n$
6	16.35 – 16.55	A.A.G. Ngurah (p. 152)	A. A. G. Ngurah	On super edge-magic deficiency of join graphs
7	16.55 – 17.15	Farikhin (p. 70)	Farikhin and Ismail Mohd	An Algorithm Based On Interpolation Points For Norm-2 Reduced Order Model
Paralel Session I Room 6 Algebra				
CHAIR : Susila Windarta				
1	14.25 – 14.45	Rand Alfaris (p. 38)	Rand Alfaris and Hailiza Kamarulhaili	Two New Rings And Fields Based On Jr-2cn And Jr-3cn
2	14.45 – 15.05	Ismail Abdullah (p. 107)	Shahrina Ismail and Kamel Ariffin Mohd Atan	On the Solutions to the Diophantine equation $x^4 + y^4 = 2z^2$
3	15.05 – 15.25	Ismail Abdullah (p. 20)	Ismail Abdullah*, Nur Hafiza Zakaria and Kamaruzzaman Seman	Application of Statistical Tests to Evaluate the Security Level of Two Xored-Based A5 Crypto Systems
15.25 – 15.55 REFRESHMENT				
CHAIR : Ismail Abdullah				
4	15.55 – 16.15	Zahid Raza (p. 180)	Zahid Raza	On the Critical Group of W_{3n}
5	16.15 – 16.35	Isamiddin S.Rakhimov (p. 58)	Fatanah Deraman and Isamiddin S.Rakhimov*	Isomorphism classes and invariants for a subclass of nine-dimensional filiform Leibniz algebras
6	16.35 – 16.55	Rosjida Ambawani (p. 42)	Rosjida Ambawani, Rukman Hertadi, Irawati	Algebraic Structure of Genetic Code and Its Application
7	16.55 – 17.15	Susila Windarta (p. 241)	Susila Windarta and Kiki Ariyanti Sugeng	Cryptographic Hash Function From Lubotzky Phillips Sarnak Expander Graph
Paralel Session I Room 7 Applied Math				
CHAIR : Iszuanie Ilias				
1	14.25 – 14.45	Livia Owen (p. 165)	Livia Owen* and Johan Matheus Tuwankotta	Bogdanov-Takens Bifurcations in three coupled oscillators system with energy preserving nonlinearity

2	14.45 – 15.05	Wikaria Gazali (p. 75)	Wikaria Gazali and Abraham Salusu	Particular Solution of Ordinary Differential Equations with Balanced Method
3	15.05 – 15.25	Mohamed Faris Laham (p. 128)	Mohamed Faris Laham and Isthrinayagy Krishnarajah	General Local Solution of Lotka-Volterra Model
15.25 – 15.55 REFRESHMENT				
CHAIR : Wikaria Gazali				
4	15.55 – 16.15	Iszuanie Ilias (p. 102)	Iszuanie Ilias, Habshah Midi and Mohd Armi Abu Samah	The Effective Multi-Criteria Decision Making in Choosing Broadband Providers in Serdang: Analytical Hierarchy Process
5	16.15 – 16.35	Putu Harry Gunawan (p. 79)	Putu Harry Gunawan and Suprijadi Haryono	An Application of Graham Scan Algorithm for Surface Detection in Droplet Surface with SPH Method
6	16.35 – 16.55	Made Sanjaya (p. 191)	Mada Sanjaya and Mustafa Mamat	Numerical Simulation Chaotic Synchronization of Non-Autonomous Fourth Order Circuit and Its Application For Secure Communication
7	16.55 – 17.15	Rizka Zakiah Drajat (p. 63)	Rizka Zakiah Drajat, Zaki Suud, Edy Soewono and Agus Yodi Gunawan	Thermal Hydraulic Analysis of Gas Cooled Fast Reactor using Genetic Algorithm
Paralel Session I Room 8 Math Education				
CHAIR : Saras Krishnan				
1	14.25 – 14.45	Wayan Agustina (p. 29)	Wayan Agustiana	Evaluative Study of Bilingual Mathematical Learning on The National School which International Standard in Denpasar
2	14.45 – 15.05	M.J. Dewiyani Sunarto (p. 61)	M.J. Dewiyani Sunarto and Tri Sagirani	The Thinking Process Profile The Students of Informatics System Department in Solving The Mathematics Problem Based on The Personality Type and Gender
3	15.05 – 15.25	Sahar Bayat (p. 50)	Sahar Bayat, Maryam Kargar and Rohani Ahmad Tarmizi	Mathematics Attitudes among Malaysian University Students
15.25 – 15.55 REFRESHMENT				
CHAIR : Wayan Agustina				
4	15.55 – 16.15	Nor'Ain Mohd. Tajudin (p. 216)	Nor'Ain Mohd. Tajudin, Noor Shah Saad, Nurulhuda Abd Rahman, Asmayati Yahaya, Hasimah Alimon, Mohd. Uzi Dollah and Mohd Mustamam Abd Karim	Mapping the Level of Scientific Reasoning Skills to Instructional Methodologies among Malaysian SME (Science-Mathematics-Engineering) Undergraduates
5	16.15 – 16.35	Saras Krishnan (P.120)	Saras Krishnan and Noraini Idris	Knowledge Dimensions In Hypothesis Test Problems
6	16.35 – 16.55	Yenita Roza (p. 184)	Yenita Roza and Puspita Murni	Implementation Of Realistic Mathematics Education (Rme) Within Cooperative Learning Model To Improve Students' Activities And Achievement In Mathematics At Sma Cendana Pekanbaru, Riau
7	16.55 – 17.15	Rr. Kurnia Novita Sari (p. 195)	Rr. Kurnia Novita Sari*, Udjianna S. Pasaribu	Semivariogram Model and Estimation of Ordinary Kriging (Cases : The Mathematics Scores of The National Final Examination of The Junior High Schools in Bandung City

Paralel Session I Room 9 Graph				
CHAIR : Saib Suwilo				
2	14.25 – 14.45	Dedy Tatanto (p. 221)	Dedy Tatanto*, Edy Tri Baskoro	On Ramsey $(2K_2, 2P_n)$-Minimal Graphs
2	14.45 – 15.05	Carol Zamfirescu (p. 138)	Carol Zamfirescu	Planar hypohamiltonian graphs
3	15.05 – 15.25	Kristiana Wijaya (p. 240)	Kristiana Wijaya and A.A.G Ngurah	On Degree-Magic Labelling of Graphs
15.25 – 15.55 REFRESHMENT				
CHAIR : Carol Zamfirescu				
4	15.55 – 16.15	Rita Suzana (p. 213)	Rita Suzana, Rizki Amelia and Hilda Assiyatun	Game Chromatics Number of Certain Classes of Circulant Graphs
5	16.15 – 16.35	Suhadi Wido Saputro (p. 192)	Suhadi Wido Saputro*, Edy Tri Baskoro, A. N. M. Salman and Djoko Suprijanto	The metric dimension of composition product of a star
6	16.35 – 16.55	Hadi Muhshi (p. 147)	Hadi Muhshi* and Edy Tri Baskoro	On Ramsey $(3K_2, P_3)$-minimal graphs
7	16.55 – 17.15	Saib Suwilo (p. 212)	Saib Suwilo	Exponents of Two-colored Digraphs Consisting of Two Cycles
Paralel Session I Room 10 Applied Math				
CHAIR : Azmin Sham Rambely				
1	14.25 – 14.45	Halimatus-sadiyah (p. 85)	Halimatussadiyah Halimatussadiyah and Mada Sanjaya	Mathematical and Numerical Analysis Three-Stage Chaotic Colpitts Oscillator For Wireless Power Transfer
2	14.45 – 15.05	Tutuka Ariadji (p. 44)	Tutuka Ariadji, Edy Soewono, Prasandi Abdul Aziz, Anas Asy Syifa, Lala Septem Riza, Kuntjoro Adji Sidarto and Pudjo Sukarno	A Robust Method Using Genetic Algorithm In Determining An Optimum Horizontal Well Direction And Length For A Petroleum Field Development
3	15.05 – 15.25	Sapto Indratno (p. 104)	Sapto Indratno and Alexander Ramm	Dynamical Systems Method for solving ill-conditioned linear algebraic systems
15.25 – 15.55 REFRESHMENT				
CHAIR : Sapto Indratno				
4	15.55 – 16.15	Roslinda Nazar (p. 112)	Khamisah Jafar, Roslinda Nazar*, Anuar Ishak and Ioan Pop	Numerical investigation of MHD flow and heat transfer over a stretching/shrinking sheet with external magnetic field, viscous dissipation and Joule heating
5	16.15 – 16.35	Ferry Jaya Permana (p. 168)	Ferry Jaya Permana, Dharma Lesmono and Erwinna Chendra	Modelling LQ45 Index Using Variance Gamma
6	16.35 – 16.55	Azmin Sham Rambely (p.177)	Azmin Sham Rambely* and Hamida Ali Shafter	Optimization of Lower Limb Muscular Load Sharing Problem of School Backpack Load Carriage via Summation of Muscle Forces
7	16.55 – 17.15	Abdukholik Arzikulov (p. 19)	Abdukholik Arzikulov and Abduhakim Abduhamidov	Ulugbek's seventh trigonometric function and problems concerning family heritage

Paralel Session I Room 11 Analysis				
CHAIR : Andreas P. Wijaya				
1	14.25 – 14.45	See Keong Lee (p. 130)	See Keong Lee	Hypergeometric functions and subclasses of Harmonic Mappings
2	14.45 – 15.05	Wan Sabhi Salmi Wan Hassan (p. 90)	Wan Sabhi Salmi Wan Hassan* and Suzeini Abdul Halim	Partial Sums of certain p-valent functions and certain integral operator
3	15.05 – 15.25	Fiki Akbar (p. 35)	Fiki Akbar* and Bobby Gunara	Local Existence of N=1 Supersymmetric Gauge Theory in Four Dimensions
15.25 – 15.55 REFRESHMENT				
CHAIR : Wan Sabhi Salmi				
4	15.55 – 16.15	Suzan J. Obaiys (p. 164)	Suzan J. Obaiys*, Z.K. Eskhuvatov and N.M.A. Nik Long	The Numerical Treatment of Hypersingular Integrals
5	16.15 – 16.35	Andreas P. Wijaya (p. 239)	Andreas P Wijaya and Wono S Budhi	Non-Linear Inversion for Integral Equation of Scattered Wavefield
6	16.35 – 16.55	Seramika Ari Wahyoedi (p. 232)	Seramika Ari Wahyoedi* and Bobby Gunara	Static Multi-Centered Metric in (n+1)-Dimensional Manifold
7	16.55 – 17.15	Agus Suroso (P. 210)	Agus Suroso*, Freddy P. Zen, Arianto and Bobby E. Gunara	Accelerating Universe from Nonminimal Derivative Coupling in Five Dimension
Paralel Session I Room 12 Statistics				
CHAIR : Irlandia Ginanjar				
1	14.25 – 14.45	Sutawanir Darwis (p. 58)	Sutawanir Darwis and Agus Yodi Gunawan	Exploring EnKF Stability Under Different Type Reservoir Models
2	14.45 – 15.05	Norhaslinda Ali (p.40)	Norhaslinda Ali, Mohd Bakri Adam, Noor Akma Ibrahim and Isa Daud	Tree-based Threshold Model for Non-stationary Extremes
3	15.05 – 15.25	Takuya Yamano (p. 242)	Takuya Yamano	Various bounds on a divergence in nonextensive statistical mechanics
15.25 – 15.55 REFRESHMENT				
CHAIR : Norhaslinda Ali				
4	15.55 – 16.15	Norsida Hasan (p. 88)	Norsida Hasan, Mohd Bakri Adam, Norwati Mustapha and Mohd Rizam Abu Bakar	Sensitivity of Missing Values in Classification Tree for Large Sample
5	16.15 – 16.35	Irlandia Ginanjar (p. 77)	Irlandia Ginanjar	Analyzing Objects, Object Characteristics and Assessor in Sorting Task and Characteristics Data Using Hybrid Distatis
6	16.35 – 16.55	Utriweni Mukhaiyar (p. 149)	Utriweni Mukhaiyar, Udjianna S. Pasaribu, Wono Setya Budhi, Khreshna Syuhada	The Influence of Spatial Weight to the Invers of Autocovariance Matrix of The Generalized Space Time Autoregressive Models
7	16.55 – 17.15	Nora Muda (p. 145)	Nora Muda and Lee Yuen Hoon	Time series analysis of gold production in Malaysia

References

[1] F. Kawai and M. Watanabe and M. Shibata and S. Yokoyama and Y. Sudate and S. Hayashi, (2004), MComparative study on biodegradability of polyethylene wax by bacteria and fungi, *Polymer Degradation and Stability* **86** : 105 114 doi: 10.1016/j.polymdegradstab.2004.03.015

[2] M. Watanabe and F. Kawai, (2005), Numerical simulation of microbial depolymerization process of exogenous type, In Rob May and A. J. Roberts, editors, *Proc. of 12th Computational Techniques and Applications Conference, CTAC-2004, Melbourne, Australia in September 2004, ANZIAM J.* **46(E)** : C1188 C1204
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[3] M. Watanabe and F. Kawai, (2010), Effects of microbial population in degradation process of xenobiotic polymers, In P. Howlett and M. Nelson and A. J. Roberts, editors, *Proceedings of the 9th Biennial Engineering Mathematics and Applications Conference, ANZIAM J.* **51** : C682 C696
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[4] Masaji Watanabe and Fusako Kawai and Sadao Tsuboi and Shogo Nakatsu and Hitomi Ohara, (2007), Study on Enzymatic Hydrolysis of Polylactic Acid by Endogenous depolymerization model, *Macromolecular Theory and Simulations* **16** : 619 626 doi:10.1002/mats.200700015

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Modeling and simulation in study on bird flu infection process within a poultry farm

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The source of bird flu or avian influenza is the influenza virus H5N1. After intrusion of H5N1 into a poultry farm, some infected birds die at an early stage and some others stay alive longer. Nevertheless, infected birds remain as sources of infection regardless of being alive or dead. Analysis based on a mathematical model has shown that a state free of infection can be made secure against infection of bird flu by proper vaccination and proper removal of infected birds. It has also shown that a state free of infection cannot be made secure by vaccination without removal of infected birds, but that it can be made secure by removal of infected birds without vaccination [1]. The virus concentration has also been taken into account in modeling an infection process of bird flu within a poultry farm [2, 3]. Here, the study on infection processes of H5N1 within a poultry farm is continued with the aim of proposing strategies against outbreaks of bird-flu.

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Modeling and simulation in study on bird flu infection process within a poultry farm

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Abstract

The source of bird flu or avian influenza is the influenza virus H5N1. After intrusion of H5N1 into a poultry farm, some infected birds die at an early stage and some other stay alive longer. Nevertheless, infected birds remain as a source of infection regardless of being alive or dead. Analysis based on a mathematical model has shown that a state free of infection can be made secure against infection of bird flu by proper vaccination and proper removal of infected birds. It has also shown that a state free of infection cannot be made secure by vaccination without removal of infected birrd without vaccination [6] The virus concentration has also been taken into account in modeling an infection process of bird flu within a poultry farm [7,8]. Here, the study on infection processes of H5N1 within a poultry farm is continued with the aim of proposing strategies against outbreaks of bird flu.

Key words: bird flu, poultry farm, infection process

1 Introduction

Since outbreaks of bird flu (avian influenza) prevailed in 2003, poultry farms have always been under constant threat of loss due to the epidemic disease. Source of the disease originates from virulence produced by influenza virus H5N1 endogenous to wild birds such as ducks. Unlike wild birds, infection of the virus brings to domestic birds serious symptoms that eventually lead to death.

Primary factors of outbreak of bird flu include existence of avian influenza virus as source of disease, poultry as hosts of virus, and environment as medium for transmission of epidemic, and it is likely to provide opportunities for infection under inappropriate supervision of a poultry farm. Vaccination is an effective measure to reduce the risk of infection both for humans and for domestic animals [1].

A mathematical model consisting of ordinary differential equations has been proposed and analyzed to determine time evolution of populations of susceptible birds and infected birds. In a production process of a poultry farm, the entire population of birds is kept constant at the manageable capacity by supply of new healthy birds when vacancies are created, or by shipping of healthy birds when the entire population exceeds the capacity. After intrusion of influenza virus, some of infected birds die while some others stay alive longer. However, infected birds remain as a source of infection regardless of being alive or dead, unless they are completely removed from the entire population. Our mathematical model is based on these factors. It has been shown by analysis based on the model that the population of domestic birds can be made secure against infection by proper vaccination and proper removal of infected birds. It has also been shown that the population cannot be made secure by vaccination alone and that security can be achieved by removal of infected birds alone without vaccination [6].

In this study, the mathematical model is extended to cover time evolution and spatial distribution of populations of susceptible birds and infected birds, and concentration of bird flu virus. The model is numerically analyzed to simulate transition of their distributions, and to propose a control strategy against outbreak of bird flu within a poultry farm.

2 Modeling bird flu infection process within poultry farm

Contamination of a poultry farm with bird flu divide the population of domestic birds into two classes, class of healthy birds susceptible to infection and class of infected birds. The SI model (1) is analyzed to study evolution of the population of susceptible birds x and the population of infected bird y as a part of avian-human influenza model [3].

$$\frac{dx}{dt} = c - bx - \omega xy, \qquad (1)$$
$$\frac{dy}{dt} = \omega xy - (b + m)y.$$

Here parameter c is the rate at which new birds are born, parameter b is the death rate for susceptible birds and infected birds, and parameter m is the additional death rate for infected birds. The term ωxy denotes the number of susceptible birds infected per unit time, and it is proportional to the number of susceptible birds x and the number of infected birds y.

The model (1) is not adequate for closed systems such as poultry farms. In a poultry production process in a farm, the entire population of domestic bird is balanced with the capacity of the farm by shipping of healthy birds when the entire population exceeds the capacity, and by supply of new birds when vacancies are created by shipping of healthy birds or death of healthy or infected birds. Then the first two terms in the right hand side of the equation (1) is replaced with $a\{c-(x+y)\}$. Parameter c denotes the capacity of the farm, and parameter a denotes the time rate of supply. All the infected domestic birds eventually die from the disease. Some of infected birds die of the disease and others stay alive longer, but regardless of being alive or dead, infected birds remain as sources of infection unless they are removed from the population. The rate of removal of infected bird is proportional to the population of infected birds, and the second term in the right hand side of the equation (1) is replaced with $-my$, where m is the removal rate. The foregoing discussion leads to the following system of differential equations [6].

$$\frac{dx}{dt} = a\{c-(x+y)\} - \omega xy, \tag{2}$$
$$\frac{dy}{dt} = \omega xy - my.$$

Here c, ω, and m are positive parameters.

One stationary point of the system (2) is

$$(x,y) = (c,0), \tag{3}$$

which corresponds to the state free of infection. Another stationary point of the system (2) is

$$(x,y) = \left(\frac{m}{\omega}, \frac{a(c\omega - m)}{\omega(a+m)}\right). \tag{4}$$

The y component of the stationary point (4) is positive if and only if

$$c\omega - m > 0, \tag{5}$$

and it is negative if and only if

$$c\omega - m < 0. \tag{6}$$

The stationary point (4) is practically significant under the condition (5), while it is practically insignificant under the condition (6). It is desirable that the stationary point (3) is stable in the sense that the state always returns to the original state after change due to intrusion of bird flu. It is shown that stationary point (3) is unstable under the condition (5), and that it is asymptotically stable under the condition (6). It is also shown that stationary point (4) is asymptotically stable under the condition (5), and that it is unstable under the condition (6) [6].

In order to propose effective measures against outbreaks of bird flu, it is important to grasp temporal and spatial distribution of virus concentration. However, systems (1}) and (2) provide no information concerning virus concentration. Note that time rate in increase of virus concentration is proportional to itself. Decrease of susceptible birds due to infection is proportional to the population of susceptible birds, and it is also proportional to the virus concentration. Decreased amount of susceptible birds due to infection is the increased amount of infected birds. The rate of increase in virus concentration is controlled by the population of infected birds as hosts. The increasing rate is positive when the virus population is below the capacity of the hosts. It is positive when the virus concentration falls below the capacity of the hosts, and it becomes negative when the virus population exceeds the capacity of the hosts.

The foregoing discussion leads to the following system.

$$\frac{\partial x}{\partial t} = a\{c-(x+y)\} - \sigma xz, \quad \frac{\partial y}{\partial t} = \sigma xz - my, \quad \frac{\partial z}{\partial t} = py - qz + \lambda \frac{\partial^2 z}{\partial \xi^2}. \tag{7}$$

Here $x = x(\xi, t)$, $y = y(\xi, t)$, and $z = z(\xi, t)$ are the population of susceptible birds, the population of infected birds, and virus concentration, respectively, and ξ is the one dimensional coordinate variable and t is the time. In the limit $\lambda \to \infty$, it may be assumed that the solutions become spatially homogenous, and the system (7) becomes the following system [5].

$$\frac{dx}{dt} = a\{c-(x+y)\} - \sigma xz, \quad \frac{dy}{dt} = \sigma xz - my, \quad \frac{dz}{dt} = py - qz. \tag{8}$$

Here

$$\sigma = \omega r, \qquad r = \frac{q}{p}$$

3 Dominant states based on bird flu infection model

Stationary points of the system (8) are constant solutions, and they are obtained by setting the right hand sides equal to 0. There are two stationary points of system (8). One stationary point is

$$(x,y,z)=(c,0,0), \tag{9}$$

and the other is

$$(x,y,z)=\left(\frac{m}{\omega},\frac{a(c\omega-m)}{\omega(a+m)},\frac{a(c\omega-m)}{r\omega(a+m)}\right). \tag{10}$$

Note that the y component and z component of stationary point (10) are positive under condition (5), where the stationary point is practically significant. Note also that they are negative under condition (6), and that it is practically insignificant. For $m=0$, stationary point (10) is

$$(x,y,z)=\left(0,c,\frac{c}{r}\right). \tag{11}$$

and it coincides with the stationary point (9) for $m=c\omega$. As m increases from 0 to $c\omega$, stationary point (10) moves on a curve connecting the points (11) and (9). Figure 1 shows the stationary point (9) and the curve defined by the equation (10).

Let (ξ,η,ζ) be a stationary point of the system (8). The stability of (ξ,η,ζ) is determined by the eigenvalues λ_1, λ_2, and λ_3 of the coefficient matrix of the variational system

$$\frac{d}{dt}\begin{bmatrix} x \\ y \\ z \end{bmatrix}=\begin{bmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{bmatrix}\begin{bmatrix} x \\ y \\ z \end{bmatrix}, \tag{12}$$

Where

$$\begin{aligned} a_{11}&=-(a+r\omega\zeta), & a_{12}&=-a, & a_{13}&=-r\omega\xi, \\ a_{21}&=r\omega\zeta, & a_{22}&=-m, & a_{23}&=r\omega\xi, \\ a_{31}&=0, & a_{32}&=p, & a_{33}&=-pr. \end{aligned}$$

Those eigenvalues are the solutions of the cubic equation

$$\lambda^3+c_2\lambda^2+c_1\lambda+c_0=0. \tag{13}$$

where

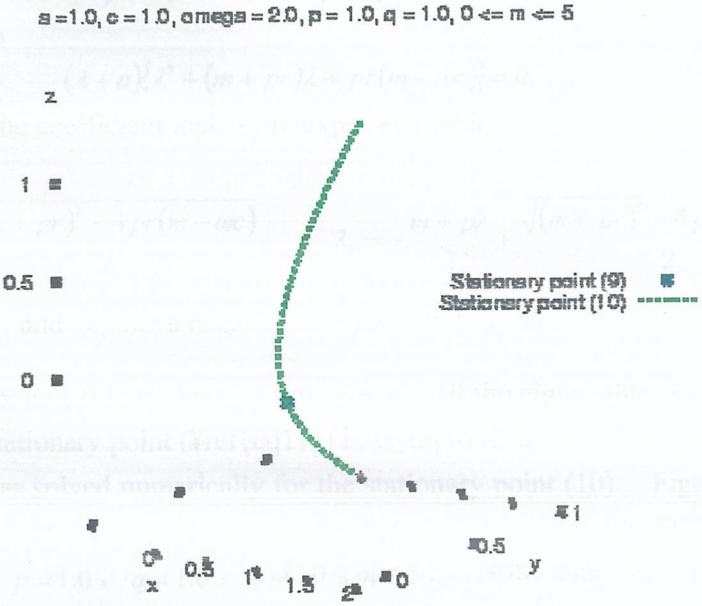

Figure 1: Stationary point (9) and stationary point (10) for $a = 1.0$, $c = 1.0$, $\omega = 2.0$, $p = 1.0$, $q = 1.0$, and $0 \le m \le 5$.

$$c_2 = -(a_{11} + a_{22} + a_{33}),$$

$$c_1 = \begin{vmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{vmatrix} + \begin{vmatrix} a_{11} & a_{13} \\ a_{31} & a_{33} \end{vmatrix} + \begin{vmatrix} a_{22} & a_{23} \\ a_{32} & a_{33} \end{vmatrix}$$

$$= a_{11}a_{22} - a_{12}a_{21} + a_{11}a_{33} - a_{13}a_{31} + a_{22}a_{33} - a_{23}a_{32},$$

$$c_0 = \begin{vmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{vmatrix}$$

$$= (a_{11}a_{22}a_{33} + a_{12}a_{23}a_{31} + a_{13}a_{21}a_{32} - a_{11}a_{23}a_{32} - a_{12}a_{21}a_{33} - a_{13}a_{22}a_{31}).$$

Stationary point (ξ, η, ζ) is asymptotically stable when the real parts of λ_1, λ_2, and λ_3 are all negative [2], and it is unstable when at least one of the eigenvalues has positive real part.

For the stationary point (9),

$$a_{11} = -a,\ a_{12} = -a,\ a_{13} = -r\omega c,\ a_{21} = 0,\ a_{22} = -m,\ a_{23} = r\omega c,\ a_{31} = 0,\ a_{32} = p,\ a_{33} = -pr,$$

$$c_2 = a + m + pr, \quad c_1 = am + apr + mpr - prwc, \quad c_0 = apr(m - \omega c),$$

and equation (13) bccomcs

$$\lambda^3 + (a+m+pr)\lambda^2 + (am+apr+mpr-prwc)\lambda + apr(m-\omega c) = 0.$$

which is factored to

$$(\lambda + a)\{\lambda^2 + (m+pr)\lambda + pr(m-\omega c)\} = 0.$$

The eigenvalue of the coefficient matrix are expressed with

$\lambda_1 = -a$,

$$\lambda_2 = -\frac{m+pr}{2} - \frac{\sqrt{(m+pr)^2 - 4pr(m-\omega c)}}{2}, \qquad \lambda_3 = -\frac{m+pr}{2} + \frac{\sqrt{(m+pr)^2 - 4pr(m-\omega c)}}{2}.$$

For $0 \le m < \omega c$, λ_1 and λ_2 have negative real parts, but λ_3 has a positive real parts, and the stationary point (9) is unstable. For $m > \omega c$, all the eigenvalues have negative real parts and the stationary point (¥ref{eq11}) is asymptotically stable.

Equation (13) was solved numerically for the stationary point (10). Figure 2 shows numerical solutions of the equation (13) for the stationary point (10) for $a = 1.0$, $c = 1.0$, $\omega = 2.0$, $p = 1.0$, $q = 1.0$, and $0 \le m \le 5$. Note that the characteristic equation always have at least one real-valued eigenvalue. The other two eigenvalues are also real-valued for the specified range of parameters. Figure 2 shows that all the eigenvalues are negative for $0 \le m < 2.0$.

Figure 2 also shows that two eigenvalues are negative, and that one eigenvalue is positive for $m > 2.0$. The numerical result shows that the stationary point (10) is asymptotically stable for $0 \le m < 2.0$, and that it is unstable for $m > 2.0$.

4 Numerical results based on bird flu infection model

System (8) was solved numerically for 100 initial values

$$x = i \times 0.5, \quad y = j \times 0.5, \quad z = k \times 0.5,$$

for $i = 0, 1, 2, 3, 4$, $j = 0, 1, 2, 3, 4$, $k = 1, 2, 3, 4$, using the fourth-order Adams-Bashforth-Moulton Predictor-Corrector in PECE mode in conjunction with Runge-Kutta Method to generate values of approximate solution at the first three steps [4, 5]. Numerical results were obtained with time step length 0.001 for 100000 steps and $m = l \times 0.25$ $(l = 0, 1, \ldots, 20)$. Figures 3 - 5 show the stationary points (9) and (10), and the numerical solutions for $a = 1.0$, $c = 1.0$, $\omega = 2.0$, $p = 1.0$, $q = 1.0$, and for three different values of m, $m = 1.5$, $m = 2.0$, and $m = 2.5$.

For $m = 1.5$, all the numerical solutions terminated in the sphere of radius 0.001 centered at the stationary point (10), which shows that it is asymptotically stable. For $m = 2.0$, all the numerical solutions terminated in the sphere of radius 0.001 centered at the stationary point (9), which shows that it is asymptotically stable.

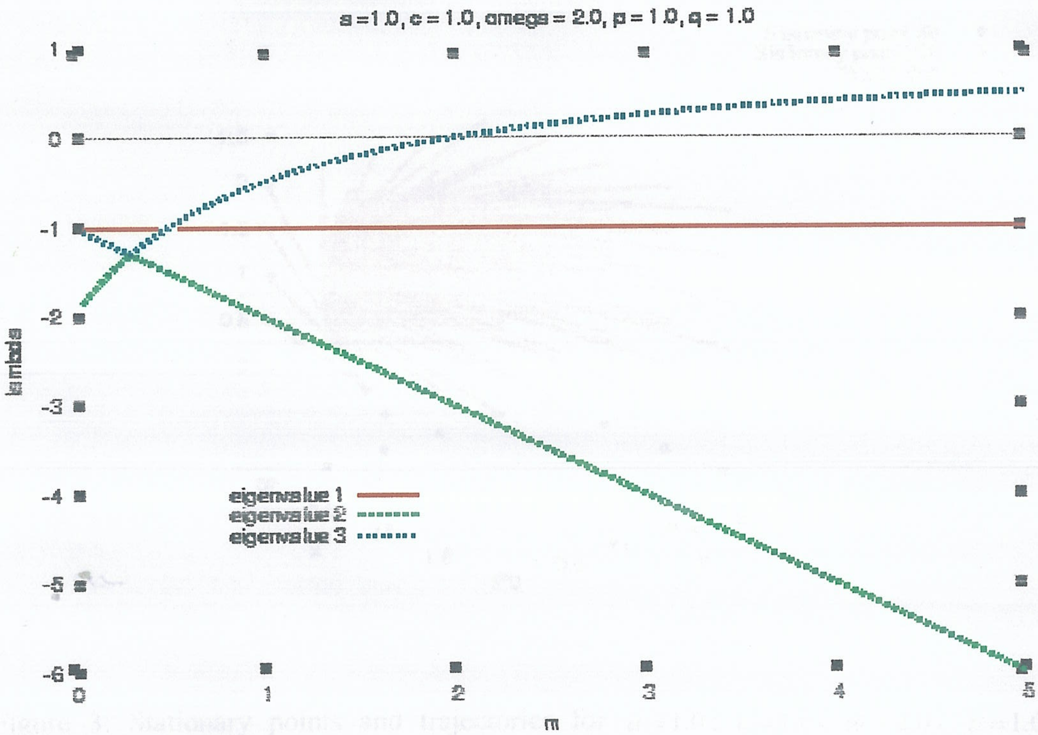

Figure 2: Eigenvalues associated with the stationary point (19) for $a=1.0$, $c=1.0$, $\omega=2.0$, $p=1.0$, $q=1.0$, and $0\le m\le 5$.

5 Discussion

Recall that the stationary point (9) corresponds to the state free of infection. Our analysis shows that it can be made asymptotically stable by taking the value of m large. Recall also that m is the removal rate of infected birds, and it can be made large by secure management of the farm. Our analysis based on the model (8) shows that outbreak can be prevented by proper removal of infected birds. It also shows that removal of infected birds is essential for prevention of outbreak within a poultry farm as is shown in analysis of the previous model.

Spot-check, so-called rapid test, is conducted in practice to detect infection by H5N1 virus. In a rapid test, some birds are taken randomly from a flock, and if one bird is found positive for infection, all the birds in the farm are disposed of. To conduct a rapid test, blood or serum samples are collected from cloaca or anus by swab, and kept in

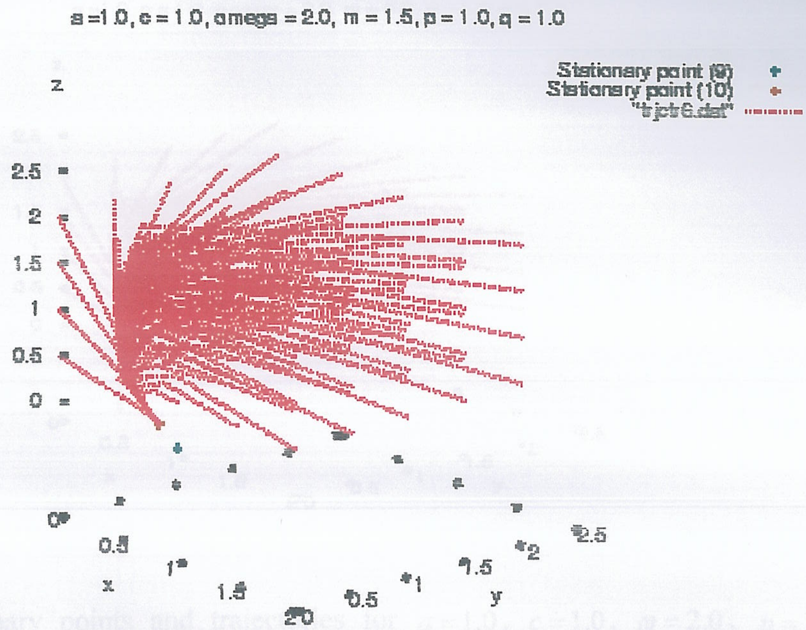

Figure 3: Stationary points and trajectories for $a = 1.0$, $c = 1.0$, $\omega = 2.0$, $p = 1.0$, $q = 1.0$, and $m = 1.5$. All the numerical solutions converge to the stationary point (10).

glycerol for analysis. Analysis of serum takes approximately forty five minutes, while analysis of dirt takes approximately two hours. In order to make a chicken farm more secure against bird flu, it is necessary to develop a detection system to cover the entire population in an appropriate time span for proper removal of infected birds. Our results show that it will only be necessary to dispose of infected birds, not all the birds in the farm.

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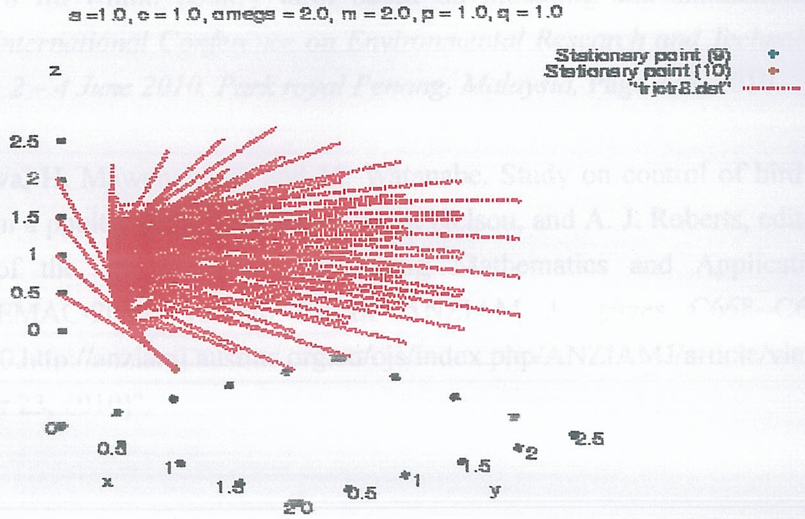

Figure 4: Stationary points and trajectories for $a=1.0$, $c=1.0$, $\omega=2.0$, $p=1.0$, $q=1.0$, and $m=2.0$. Stationary points (9) and (10) coincide for $m=c\omega$.

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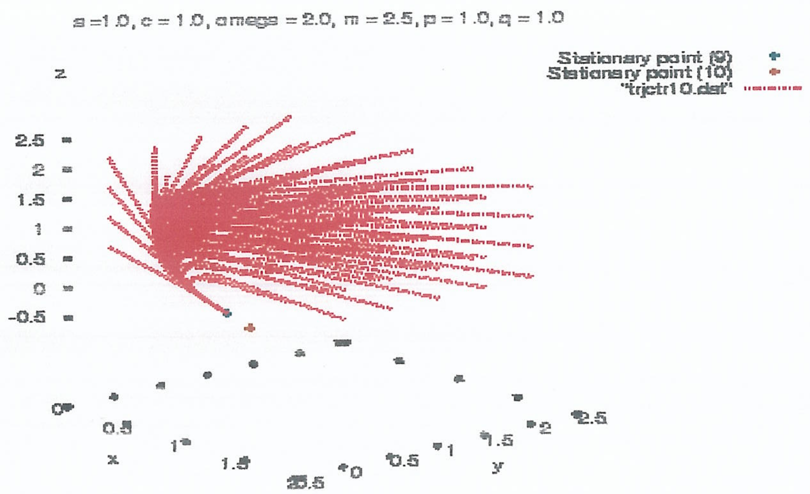

Figure 5: Stationary points and trajectories for $a = 1.0$, $c = 1.0$, $\omega = 2.0$, $p = 1.0$, $q = 1.0$, and $m = 2.5$. All the numerical solutions converge to the stationary point (9).

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