A semi-Markovian Branching Process on the Clinical Cases for Modelling the Evolution of a SEIR Disease in a Large Population. Example of the BSE Epidemics

Laurence Maillard-Teyssier Christine Jacob and Jean-Baptiste Denis

INRA, Jouy en Josas, FRANCE

We first build a semi-Markovian branching SEIR process in discrete time for modelling the evolution of BSE (Bovine Spongiform Encephalopathy) in a population structured by ages. Then, assuming a rare disease, we derive from this model a recursive stochastic process on the incidence of cases as the initial size of the population increases to the infinity. We show that this limit process belongs to the class of multitype Bieneyme-Galton-Watson processes and that at each time, the number of cases is distributed according to a Poisson law conditionally to the past. We give the bifurcation parameter and calculate the extinction probability. We study the bayesian estimation and give credibility intervals for the contamination and incubation parameters. These results are first applied to the observations of BSE cases in Great Britain between 1985 and 2005.

Keywords: semi-Markovian process, BSE, epidemiology, SEIR

Estimation and Testing a Nonlinear Transformation of the Integrated Processes

Vladimir Malugin

Belarusian State University

The paper is devoted to the problem of nonlinear transformation of linearly integrated process, which is closely connected with the nonlinear cointegration problem (Jin-Lung Lin, Clive W. J. Granger. Testing Nonlinear Cointegration. International Conference on Threshold Models and New Developments in Time Series (2004)). To estimate the form of unknown nonlinear transformation tying together two time series we consider two cases. In the first one we consider the class of differentiable transformation functions for integrated of order one processes. For the given class of transformation we use a special stochastic approximation based on Taylor formula and then test stationarity property for the reminder processes. If class of functional transformation is unknown we propose to use a nonparametric estimation procedure based on a local kernel density estimates (V.I.Malugin. On the estimation of the density of random vectors with essentially dependent components. Vestnik of Belarusian State University, 2, p. 41744 (1982)). The series of residuals is tested on the stationarity by means of KPSS test and other unit root tests to examine a nonlinear cointegration propety between given time series.

Keywords: integrated and cointegrated process, Nonlinear transformation, Nonparametric density estimation
XII-th International Summer Conference
on Probability and Statistics (ISCPS)

Seminar on Statistical Data Analysis
(SDA’2006)

ABSTRACTS

Sozopol, Bulgaria 17-25 June, 2006
Contents

Alawneh, A. Calculation of Steady-State Probabilities of M/M Queues ........5
Alsaidi, A. Statistical Analysis of the Influence of Explicit vs. Implicit Instructional Approaches during a Technology-based Curriculum on Students' Understanding of Nature of Science (NOS) ......................................................... 5
Al-Saidy, O., AL-Samarraie, A. Regression Estimators Using Extreme Ranked Set Sampling ................................................................. 6
Atanasov, D. A Robust Modification of Metric Unfolding Procedure ........ 6
Atanasov, D., Stoimenova, V., Yanev, N. Estimators in Branching Processes with Immigration ................................................................. 7
Benchetlah, A. A Stochastic Control Approach to a Fokker-Planck Equation, Reciprocal Processes ......................................................... 8
Boscaiu, V. Residuals Analysis of some GLM models ................................... 8
Christofozov, D., Mateev, P., Mutafchiev, L. Statistical Expertise Needed to Train Data Mining ................................................................. 10
Dabula, W., Lednicki, B. Estimation of Fraction in Population based on Partially Realized Random Sample ..................................................... 11
Dias, G., Santos, C., Cleuziou, G. Automatic Knowledge Representation using a Graph-based Algorithm for Language-Independent Lexical Chaining ........ 13
Donchev, D. An Excursion Characterization of the First Hitting Time of Brownian Motion in a Smooth Boundary ............................................... 13
Donchev, D., Kralchev, D. On the Moving Boundary Hitting Probability for a Brownian Motion ................................................................. 14
Ford, K. Probability Estimates for Random Walks with Barriers ..................... 14
Gayraud, G., Gauthierat E. Parametric Estimation in Noisy Blind Deconvolution: a New Estimation Procedure .............................................. 15
Georgieva, R., Atanassov, E., Gurov, T., Ivanovska, S., Karaivanova, A., Nedjalkov, M. SALUTE - GRID Application for problems in quantum transport. Part I: Importance separation algorithms ..................................... 16
González, M., Martínez, R., Slavtchova-Bojkova, M. Stochastic Monotony and Continuity Properties for the Extinction Time of Age-Dependent Branching Processes: an Application to Epidemic Modelling ................................................. 16
Guerguelova, R. Correlated Probit Models for Joint Analysis of Repeatedly Measured Binary, Ordinal and Continuous Outcomes ......................... 17
Ivanovska, S., Atanassov, E., Georgieva, R., Gurov, T., Karaivanova, A.,
Nedjalkov, M. SALUTE – GRID Application for problems in quantum transport. Part II: Hybrid algorithms and parallelization ........................................ 18
Jaradat, A., Smadi, M. Asymptotic Efficiencies of the Survival Functions Estimators for the Exponential Distribution ......................................... 19
Jordanova, P. $(G, \lambda)$-extremal Processes and their Connection with Max-stable Processes ........................................................................... 19
Kalinov Testing for $(Bio)$Equivalence .................................................. 19
Kazemnejad, A., Akhoond, M.R. Application of Mixture Regression Model in Modeling Length of Stay in Hospital ........................................ 20
Kharin, A. Robustness in Sequential Testing of Hypotheses on Parameters of Random Sequences ................................................................. 20
Kharin, Y. Discrete Time Series with “Long Memory” ............................ 21
Klebanov, L., Yakovlev, A. A New Type of Stochastic Dependence Revealed in Gene Expression Data ............................................................. 22
Kolkovska, E. Occupation Measure of Classical Risk Processes ............ 23
Malugin, V. Estimation and Testing a Nonlinear Transformation of the Integrated Processes ................................................................. 24
Markovski, S., Bakeva, V. Uniformity obtained by Quasigroups: Part II .... 25
Mihova, M., Popeska, Z. Multistate Systems with Graduate Failures and Equal Transition Intensities ......................................................... 25
Milanov, V., Nickolov, R. Entropy Based Approach to Finding Interacting Genes Responsible for Complex Human Diseases .................................. 26
Milenkov, K., Daskalova, N. A Simple Kernel-based Parameter Estimation 26
Mimbela, J.A.L. Finite Time Blowup and Stability of a Reaction-Diffusion Equation with a Time-dependent Lévy Generator .......................... 27
Minkova, L. Reinsurance by the Polya-Aeppli Risk Model ........................ 28
Mitov, G., Mitov, K. An Option Pricing Formula based on Branching Processes 28
Mitov, I., Pancheva, E. Sum and Extremal Processes over Explosion Area .... 28
Mota, M., Gonçalves, M., Martinez, R. Controlled Multitype Branching Models: Geometric Growth 29
Mouhoubi, Z., Aissani, D. Stability of the Inventory - Backorder Process in the $(R,S)$ Inventory/Production Model ........................................ 30
Moussas, C., Noncheva, V. Extraction of Fraud Schemes from Trade Series 30
Mutafchiev, L., Kamenov, E. The Number of Parts of Given Multiplicity in a Random Integer Partition ...................................................... 31
Neykov, N., Filzmoser, P., Dimova, R., Neytchev, P. Robust Fitting of Mixture Models ................................................................. 31
Nickolov, R., Milanov, V. A Test of Association Between Qualitative Trait and a
Scientific Program
XII-th International Summer Conference on
Probability and Statistics
and Seminar on Statistical Data Analysis
Sozopol, Bulgaria 17-25 June, 2006

18 June, Sunday, Morning
09:00 - 09:15 Opening

Biostatistics
Chair: Christine Jacob

9:20 - 9:50 Klebanov, L., Yakovlev, A. A New Type of Stochastic Dependence Revealed in Gene Expression Data
9:50 - 10:10 Milanov, V., Nickolov, R. Entropy Based Approach to Finding Interacting Genes Responsible for Complex Human Diseases
10:10 - 10:30 Nickolov, R., Milanov, V. A Test of Association Between Qualitative Trait and a Set of SNPs

Coffee Break
11:20 - 11:40 Kalinov, K. Testing for (Bio)Equivalence
11:40 - 12:00 Tsitovich, I., Naumova, E., Tsitovich, F. Markov Chain Order Estimating and its Applications in Bioinformatics
12:00 - 12:20 Jaradat, A., Smadi, M. Asymptotic Efficiencies of the Survival Functions Estimators for the Exponential Distribution

18 June, Sunday, Afternoon

Robust Statistics
Chair: E. Stoimenova

16:00 - 16:20 Neykov, N., Filzmoser, P., Dimova, R., Neytchev, P. Robust Fitting of Mixture Models
16:20 - 16:40 Kharin, A. Robustness in Sequential Testing of Hypotheses on Parameters of Random Sequences
16:40 - 17:00 Atanasov, D. A Robust Modification of Metric Unfolding Procedure

Coffee Break

Stochastic Models
Chair: E. Pancheva

17:30 - 18:00 Bulinskaya, E. Sensitivity Analysis of Some Applied Probability Models
18:30 - 18:50 Minkova, L. Reinsurance by the Polya - Aeppli Risk Model

Wellcome party
20:30 - 23:00
19 June, Monday, Morning

Statistical Inference
Chair: B. Shishkov

9:00 - 9:30  Kharin, Y. Discrete Time Series with "Long Memory"
9:30 - 9:50  Gayraud, G., Gautherat E. Parametric Estimation in Noisy Blind Deconvolution:
            a New Estimation Procedure
9:50 - 10:10 Gautherat, E., Bertall, P., Harari-Kermadec, H. Empirical Discrepancies and
            Quasi-Empirical Likelihood : Exponential Bounds
10:10 - 10:30 Gueorguieva, R. Correlated Probit Models for Joint Analysis of Repeatedly Measured
           Binary, Ordinal and Continuous Outcomes

Coffee Break

11:00 - 11:30 Stoimenova, E. Smoothed Density Estimation of Interval Censored Data
11:30 - 11:50 Malugin, V. Estimation and Testing a Nonlinear Transformation of the Integrated
           Processes
11:50 - 12:10 Al-Saidy, O., AL-Samarrasie, A. Regression Estimators Using Extreme Ranked
           Set Sampling
12:10 - 12:30 Moussas, C., Noncheva, V. Extraction of Fraud Schemes from Trade Series

19 June, Monday, Afternoon

Statistical Inference
Chair: Y. Kharin

16.00 - 16:30  Oja, H., Sirkia, S., Eriksson, J. Scatter Matrices, Kurtosis and Independent
               Components
               Stochastic Models
16:50 - 17:10  Veleva, E. Joint Densities of Correlation Coefficients for Samples from Multivariate
               Standard Normal Distribution
17:10 - 17:30  Shishkov, B. On the Use of Higher-Order Statistical Tests in Signal Processing

Coffee Break

Poster Session

18:00 - 18:40  Alsaidl, A. Statistical Analysis of the Influence of Explicit vs. Implicit Instructional
               Approaches during a Technology-based Curriculum on Students’ Understanding of
               Nature of Science (NOS)
Dias, G., Santos, C., Cleuziou, G. Automatic Knowledge Representation using a Graph-based
Algorithm for Language-Independent Lexical Chaining
Milenkov, K., Daskalova, N. A Simple Kernel-based Parameter Estimation
Stoynov, P. Lévy Processes and some Generalizations
Stoynov, Y., Stoimenova, E. Histogram density estimator for censored data
Toncheva, N. Two Random Variables Dependence Function
Veleva, A. An Educational Technology for the Formation of Transcendental Thinking
Wakeel, M. Linear Regression with Poisson Error

18:00 - 19:00 Meeting ECO-NET-2006, Chair: Christine Jacob
20 June, Tuesday, Morning

**Branching Processes**

Chair: J.A.L. Mimbela

- 9:00 - 9:30  Yanev, G. On Extreme Value Results in Branching Processes
- 9:30 - 10:00  Mota, M., González, M., Martínez, R. Controlled Multitype Branching Models: Geometric Growth
- 10:00 - 10:30  Yarovaya, E. Branching Symmetric Random Walk on d-dimensional Lattice

**Coffee Break**

- 11:30 - 12:00  Mailard-Teyssier, L., Jacob, C., Denis, J.-B. A semi-Markovian Branching Process on the Clinical Cases for Modelling the Evolution of a SEIR Disease in a Large Population. Example of the BSE Epidemics
- 12:00 - 12:30  González, M., Martínez, R., Slavtchova-Bojkova, M. Stochastic Monotony and Continuity Properties for the Extinction Time of Age-Dependent Branching Processes: an Application to Epidemic Modelling

20 June, Tuesday, Afternoon

**Branching Processes**

Chair: M. Gonzalez

- 15:30 - 16:00  Sagitov, S. Size-biased Branching Processes with Overlapping Generations
- 16:00 - 16:30  Mitov, G., Mitov, K. An Option Pricing Formula based on Branching Processes
- 16:30 - 17:00  Ramos, A., Molina, M., del Puerto, I. Some Probabilistic Results in a Bisexual Branching Process with Immigration

**Coffee Break**

- 17:30 - 18:00  Zbaganu, G. Branching Processes and Insurance
- 18:00 - 18:30  Atanasov, D., Stoimenova, V., Yanov, N. Estimators in Branching Processes with Immigration
- 18:30 - 19:00  Yakovlev, A., Yanov, N. Branching Processes and Cell Proliferation with Continuous Labeling

21 June, Wednesday

**Excursion**

9:00-19:00

22 June, Thursday, Morning

**Stochastic Processes**

Chair: L. Mutafchiev

- 9:00 - 9:30  Ford, K. Probability Estimates for Random Walks with Barriers
- 9:30 - 9:50  Donchev, D. An Excursion Characterization of the First Hitting Time of Brownian Motion in a Smooth Boundary
- 9:50 - 10:10  Donchev, D., Kralchev, D. On the Moving Boundary Hitting Probability for a Brownian Motion
- 10:10 - 10:30  Stoev, S., Taqqu, M. Limit Theorems for Maxima of Heavy-tailed Terms with Random Dependent Weights

**Coffee Break**

- 11:00 - 11:30  Mimbela, J.A.L. Finite Time Blowup and Stability of a Reaction - Diffusion Equation with a Time-dependent Lévy Generator
- 11:30 - 11:50  Jordanova, P. (G, )-extremal Processes and their Connection with Max-stable Processes
22 June, Thursday, Afternoon

Stochastic Processes
Chair: K. Ford

16:00 - 16:30  Mutafchiev, L., Kamenov, E. The Number of Parts of Given Multiplicity in a Random Integer Partition
16:30 - 16:50  Markovski, S., Bakeva, V. Uniformity obtained by Quasigroups: Part II
16:50 - 17:10 Benchettah, A. A Stochastic Control Approach to a Fokker-Planck Equation, Reciprocal Processes

Coffee Break
17:30 - 17:50

17:50 - 18:10  Tsitovitch, I., Bubnov, Y., Melik-Gaykazova, E. On Robust Models of Multi-service System Traffic
18:10 - 18:30  Alawnah, A. Calculation of Steady-State Probabilities of M/M Queues
18:30 - 18:50  Mihova, M., Popeska, Z. Multistate Systems with Gradate Failures and Equal Transition Intensities

Boscaiu, V. Residuals Analysis of some GLM models

Farewell Diner
20.30 - 23.00

23 June, Friday, Morning

Stochastic models
Chair: P. Mateev


Coffee Break
10:30 - 10:50

11:30 - 11:50  Ivanovska, S., Atanassov, E., Georgieva, R., Gurov, T., Kariaivanova, A., Nedjalkov, M. SALUTE - GRID Application for problems in quantum transport. Part II: Hybrid algorithms and parallelization
11:50 - 12:10  Kazemnejad, A., Akhoond, M.R. Application of Mixture Regression Model in Modeling Length of Stay in Hospital
12:10 - 12:30  ?Ozdemir, A.I. A Comparative Performance Analysis of the Turkish Industrial Sectors in Terms of ERP Success

23 June, Friday, Afternoon

Coffee Break
16:00 - 16:30

Free Discussions, Computer Demonstrations, Meetings

18:30 - 19:00  Closing