Mathematical Harmony in Science and Technology

PROCEEDING
South East Asian Conference on Mathematics and Its Applications

"Mathematical Harmony in Science and Technology"

isbn 978-979-96152-8-2

copyright ©2013 Mathematics Department
ITS Surabaya - Indonesia

SEACMA 2013

November, 14-15 2013
PROCEEDING

SOUTH EAST ASIAN CONFERENCE ON MATHEMATICS AND ITS APPLICATIONS
SEACMA 2013

“Mathematical Harmony in Science and Technology”

Published by:
MATHEMATICS DEPARTMENT
INSTITUT TEKNOLOGI SEPULUH NOPEMBER SURABAYA, INDONESIA
PROCEEDING

SOUTH EAST ASIAN CONFERENCE ON MATHEMATICS AND ITS APPLICATIONS

SEACMA 2013

Editor :
Prof. Dr. Basuki Widodo, M.Sc.
Prof. Dr. M. Isa Irawan, MT.
Dr. Subiono
Subchan, Ph.D
Dr. Darmaji
Dr. Imam Mukhlas
DR. Mahmud Yunus, M.Si


This Conference is held by cooperation with
Mathematics Department, ITS

Secretariat :
Mathematics Department
Kampus ITS Sukolilo Surabaya 60111, Indonesia
seacma@its.ac.id
ORGANIZING COMMITTEE

PATRONS : Rector of ITS

STEERING : Dean Faculty of Mathematics and Natural Sciences ITS

INTERNATIONAL SCIENTIFIC COMMITTEE

Prof. Basuki Widodo (ITS - Indonesia)
Prof. M. Isa Irawan (ITS - Indonesia)
Dr. Erna Apriliani (ITS - Indonesia)
Dr. Subiono (ITS - Indonesia)
Subchan, Ph. D. (ITS - Indonesia)
Dr. Abadi (Unesa-Indonesia)
Dr. Miswanto (Unair-Indonesia)
Dr. Eridani (Unair-Indonesia)
Prof. Marjono (Universitas Brawijaya Indonesia)
Prof. Toto Nusantara, M.Si (UM-Indonesia)
Dr. Said Munzir, M.EngSc
(Syiah Kuala University Banda Aceh-Indonesia)
Dr. Nguyen Van Sanh (Mahidol University-Thailand)
Prof. dr. ir. Arnold W. Heemink
(Delft Institute Applied Mathematics-Netherlands)

COMMITTEE

Chairman : Subchan Ph. D
Co-chairman : Dr. Imam Mukhlas
Secretary : Soleha, S.Si, M.Si
Tahiyatul Asfihani, S.Si, M.Si
Finance : Dian Windia Setyawati, S.Si, M.Si

Technical Programme :
Drs. Daryono Budi Utomo, M.Si
Drs. Lukman Hanafi, M.Sc.
Drs. Bandung Arry Sanjoyo, M.T.
Drs. I. G. Rai Usadha, M.Si
Moh. Iqbal, S.Si, M.Si

Web and Publication :
Dr. Budi Setiyono, S.Si, MT.
Achmet Usman Ali

Transportation and Accommodation :
Dr. Darmaji, S.Si, MT.
Yunita HL


On behalf of the Faculty of Mathematics and Natural Sciences, Institut Teknologi Sepuluh Nopember, it is a great honor and sincere to welcome all participants to the second of South East Asian Conference on Mathematics and Its Application (SEACMA 2013).

This year, Department of Mathematics, Institut Teknologi Sepuluh Nopember, have honor to organize this meaningful conference. I believe that the purpose of this conference is not only sharing knowledge among the mathematician and scholars in related fields but also to hearten new generation of expertise in mathematics to realize the science and technology advancement.

It is undeniable that there is mathematical harmony in science and technologies. Many disciplines like engineering, computer science, information technology, operational research, logistics management, risk management and many others are all the products of mathematics. Thus, it is essential that we must hold this annual conference as a stage for all scholars in finding new ideas and applications on Mathematics.

Greatly thank to all supportive session including organizing committee, keynote speakers, invited speakers, paper reviewers, participants and sponsors. This event will not achieve without you all. Finally, I hope that the outcome of SEACMA 2013 will be pleasing and most useful to everybody.

Sincerely yours,

Prof. Dr. R.Y. Perry Burhan
Dean
Message from the Chairman
Organizing Committee

On behalf of the organizing committee it is my pleasure to welcome you to the South East Asian Conference on Mathematics and Its Applications. The conference aims to provide a forum for academics, researchers, and practitioners to exchange ideas and recent developments on mathematics. The conference is expected to faster networking, collaboration and joint effort among the conference participants to advance the theory and practice as well as to identify major trends in mathematics.

We are also very pleased to welcome keynote speakers of the conference: Prof. Dr. Ir. Arnold W. Heemink, from Delft Institute of Applied Mathematics, Netherlands, Prof. Dr. Muhammad Isa Irawan, MT, from Institut Teknologi Sepuluh Nopember, Surabaya, Indonesia, and Dr. Said Munzir, M.EngSc, from Syiah Kuala University, Indonesia, Dr. Nguyen Van Sanh, from Department of Mathematics, Faculty of Science, Mahidol University, Thailand.

We will spend about a day together for the conference. This conference is attended delegates and contributors from Indonesia, Malaysia, Thailand, and Netherlands. Such a spread of participation from around the world confirms the appropriateness of the “National” label of this conference. There are 35 papers to be presented orally. Papers presented in the conference will be included in the conference proceeding to be published at the conference.

The organizing committee would like to express our deepest appreciation to ITS Rector, keynote speakers, head of departments of Mathematics of ITS, and sponsors for the support, without all mentioned this conference may not be happened. Furthermore, my appreciation goes to the members of the committee for their hard work and cooperative teamwork in the preparation of the conference. Finally, we wish all participants enjoy a fruitful scientific and human discussion.

Subchan, PhD
Conference Chairman
CONTENTS

Cover i
Organizing Committee iii
Message from Dean Faculty of Mathematics and Natural Sciences iv
Message from Chairman of Organizing Committee v
Contents vi
Tentative Schedule ix

Abstract of Keynote Speaker
1. Model Reduced Variational Data Assimilation: An Ensemble Approach To Model Calibration (A.W. Heemink)
2. Computational Optimal Control: Past, Current and Future Trends (Said Munzir)
3. An Introduction to Some Kinds of Radicals for Module Theory (Nguyen Van Sanh)
4. Optimization Combination of Number, Dimension, and Mooring Time of the Ships in PT. (Persero) Pelabuhan Indonesia III Gresik Harbor Using Genetic Algorithms (M. Isa Irawan)

Mathematics Papers
PM1 Partial Ordered Bilinear Form Semigroups in Term of Their Fuzzy Right and Fuzzy Left Ideals (Karyati, Dhoriva Uwatul Wutsqa)
PM2 \( \eta \)-Dual of Some New Double Sequence (Sumardyono, Soepama D.W. and Supama)
PM6 Construction Of Suboptimal Solution of the Stick and Rope Problem Using Sequence of Semicircle (Abrari Noor Hasmi and Iwan Pranoto)
PM7 A Laplace Transform DRBEM for Time-Dependent Infiltration from Periodic Flat Channels (Imam Solekhudin)
PM10 On The Total Irregularity Strength Of Gears (R. Ramdani, A.N.M. Salman and H. Assiyatun)
PM11 Construction Of Cone Difference Space-c_0 (Sadjidon and Sunarsini)
PM12 The Star Partition Dimention Of Corona Product Graph (Darmaji)
AM1 Measuring and Optimizing Conditional Value at Risk Using Copula Simulation (Komang Dharmawan)
AM4 Biomass Feedstock Optimization for the Production of Methane Gas from Water Hyacinth, Elephant Grass and Rice Straw Waste (Suharmadi and Sumarno)
AM5 Application of Disturbance Compensating Model Predictive Control (DC-MPC) On Ship Control System (Sari Cahyaningtias, Tahiyyatul Asfihani, Subchan)
AM6 The Application of Ensemble Kalman Filter to Estimate the Debris Flow Distribution (Ngatini, Erna Apriliani, Imam Mukhlash, Lukman Hanafi, and Soleha)

AM7 Modeling Consumer Prices Index Data in Yogyakarta using Truncated Polynomial Spline Regression (Dhoriva Urvatul Wutsqa and Yudhistirangga)

AM8 Flow Patterns Characteristics in Agitated Tank with Side Entering Impeller (Sugeng Winardi, Tantular Nurtono, Widiyastuti, Siti Machmudah, and Eka Lutfi Septiani)

AM10 Flood Gate Control of Barrage Using Ensemble Kalman Filter Based On Nonlinier Model Predictive Control (NMPC) (Evita Purnaningrum and Erna Apriliani)

AM15 Calculation of Moving Vehicles with Video Using Expectation Maximization Algorithm (Budi Setiyono, R. Arif Firdaus Lazuardi, and Shofwan Ali Fauji)


AM17 Testing Proportion for Portfolio Profit of CAPM and LCAPM (Retno Subekt, Rosita Kusumawati)

AM18 Numerical Simulation of Linear Water Waves Using Smoothed Particle Hydrodynamics (Rizal Dwi Prayogo and Leo Hari Wiryanto)

AM19 Mathematical Model of Drag Coefficient of Tandem Configuration on Re = 100 (Chairul Imorn, Suhrariningsih, Basuki Widodo, and Triyogi Yuwono)

AM20 Performance Evaluation of Two-Microphone Separation with Convolutive Speech Mixtures (Irwanlyah and Dhany Arifianto)

AM22 Bayesian Analysis for Smoothing Spline in Semiparametric Multivariable Regression Model Using WinBUGS (Rita Diana, I. Nyoman Budiantara, Purhadi, and Satwiko Darmesto)


AM25 Study of Comparation Between Finite Difference and Crank- Nicholson Method in Heat Transfer (Lukman Hanafi and Durmin)

AM27 Multi-level Stock Investment Evaluation Using Fuzzy Logic (Mahmod Bin Otman)

AM28 The Relationship Between Parvate-Gangal Mean Value Theorems and Holder Continuous Function of Order $\alpha \in (0,1)$ on The Cantor Set (Supriyadi Wibowo and Pangadi)

AM29 Calibration Of Rainfall Data by Using Ensemble Model Output Statistic (EMOS) (Dian Anggraeni, Heri Kuswanto, Irhamah, and Waskitho Wibisono)

AM30 Full Conditional Distributions of Bayesian Poisson-Lognormal 2-Level Spatio-Temporal Extension for DHF Risk Analysis (Mukhsar, Iriawan, N. Ulama, B. S. S, Sutikno, and Kuswanto, H)

AM31 Fuzzy Inference System Implementation On Rainfall Events Prediction At North Surabaya (Farida Agustini Wijdajati and Dynes Rizky Navianti)
| AM32 | Monochromatic wave propagating over a step  
      | (L.H. Wiryanto and M. Jamhuri) |
| AM33 | The Normal Form For The Integral Of 3-Dimensional Maps Derived From A  
      | $\Delta\Delta$ Sine-Gordon Equation (Zakaria L, Tuwankotta J.M., and Budhi M.W.S) |
| AM34 | Stability Analysis of Lotka-Volterra Model with Holling Type II Functional  
      | Response (Abadi, Dian Savitri, and Choirotul Ummah) |
| AM35 | On The Construction of Prediction Interval for Double Seasonal Holt-Winters  
      | : a Simulation Study  
      | (Arinda R. Lailiya, Heri Kuswanto, Suhartono and Mutiah Salamah) |
| AM36 | Bayesian Neural Networks for Time Series Modeling  
      | (Fitriasari, K, Iriawan, N, Ulama, B. S and Sutikno) |
| AM37 | Upper Bound And Upper Limit of The Optimum Interpolation Function of  
      | Filter Bank (Dhany Arifianto) |
Full Conditional Distributions of Bayesian Poisson-Lognormal 2-Level Spatio-Temporal Extension for DHF Risk Analysis

Mukhsar¹, Iriawan, N², Ulama, B. S. S³, Sutikno⁴, Kuswanto, H⁵

¹PhD Student of Statistics Department Institut Teknologi Sepuluh Nopember (ITS) Surabaya, Mathematics Department Haluoleo University Kendari-Indonesia
mukhsar10@mhs.statistika.its.ac.id;mukhsar_unhalu@yahoo.com
²,³,⁴,⁵ Statistics Department Institut Teknologi Sepuluh Nopember (ITS) Surabaya
nur_i@statistika.its.ac.id,brodjo1_su@statistika.its.ac.id,
sutikno@statistika.its.ac.id, heri_k@statistika.its.ac.id

Abstract. Bayesian Poisson-lognormal 2-level (BP2L) spatio-temporal arranged to analyze the DHF relative risk. The parameters of model are estimated by its full conditional distributions. Analytical procedures to obtain the full conditional distributions for BP2L spatio-temporal have been described in proceedings of 3rd Annual Basic Science International Conference 2013. Random effects of the BP2L spatio-temporal have considered as spatial. In the real phenomena, the random effects show generally space-time varying. This paper is to extend the BP2L which is considering the random effects as space-time varying. The extension is called the extended of BP2L (EoBP2L) spatio-temporal. The purpose of this study is to determine the expression of the full conditional distributions of EoBP2L spatio-temporal. The investigation result showed that the full conditional distributions of the EoBP2L spatio-temporal are closed form; hence, the Gibbs sampler can be used for estimating the parameters.

Keywords: Bayesian Poisson-Lognormal, closed form, DHF, full conditional distribution

1 Background
DHF case is influenced by heterogeneity and uncertainty factors [1,2]. Spatial convolution or Poisson-Lognormal model introduced to accommodate these factors [3,4,5]. By [6,7] has applied the model that implemented in 31 districts of Surabaya DHF data on 2010. The result has shown a realistic model.

In another hand, it has been shown that DHF case varies temporally also [8,9] introduced the development of convolution model into a spatio-temporal term by adding temporal trend using Bayesian approach. DHF case is also hierarchically structured data, as shown in [6]. It has been demonstrated that DHF case is nested to district as level 1 and each district is nested to Surabaya city as level 2 (or 2-level hierarchy). By [10] has considered the development of
convolution model in 2-level hierarchy, called Bayesian Poisson-Lognormal 2-level (BP2L) spatio-temporal. The uncertainty factors in the BP2L spatio-temporal have considered as spatial term.

The aim of this paper is to develop the BP2L spatio-temporal which is considering the uncertainty factors in space-time term, called the extended of BP2L (EOBP2L) spatio-temporal. The EOBP2L spatio-temporal would have a complex joint posterior of parameters model, so that parameter estimation needs the computational intensive approach. One way to solve the estimation is by constructing full conditional distribution and employing Gibbs sampler or Metropolis-Hasting algorithm. These algorithms require the appropriate method for generating the parameters of model [11,12,13]. When the full conditional distribution has closed form, the Gibbs sampler is simpler be used. Otherwise, Metropolis-Hasting is more appropriate [14,15,16]. The simplest way to identify the closed-form of full conditional distribution is by characterizing the pattern of functional form of Poisson distribution, normal distribution, gamma distribution, logarithmic functions, exponential functions, or Taylor series. When Gibbs sampler is appropriate, WinBUGS is used to estimate these parameters [17,18].

2 Bayesian Poisson-Lognormal 2-level Spatio-Temporal Extension

The most commonly encountered model based on district count is Poisson model. It is appropriate when there is a relatively rare event of DHF in relatively large population each district. Suppose the DHF count $y_{st}$ is identically distributed Poisson with parameter $\lambda_{st}$. Poisson variability is influenced by $\lambda_{st}$ that depends on district $s$ and time $t$. The relationship with this issue is that the extended of Bayesian Poisson-Lognormal 2-level (EOBP2L) spatio-temporal. The EOBP2L spatio-temporal is the extension of the model as described by [10], where it is expressed as,

$$
\begin{align*}
\lambda_{st} &= e_{st} \exp \left[ \beta_0 + \sum_{p=1}^{P} x_{pst}^{T} \beta_p + u_{st} + v_{st} + (\alpha + \delta_s)z \right], \quad s=1,...,S, \quad t=1,...,T, \quad p=1,...,P, \\
y_{st} | \lambda_{st} &\sim \text{Poisson}(\lambda_{st})
\end{align*}
$$

where $S$ is the number of locations, $T$ is length of time observation, $P$ is the number of covariates, $e_{st}$ is an expected count in district $s^{th}$ at time $t^{th}$, $x_{pst}$ is $p^{th}$ covariate in district $s^{th}$ at time $t^{th}$, $u_{st}$ is uncorrelated random effect at district $s^{th}$ at time $t^{th}$, $v_{st}$ is correlated random effect (CAR model) at district $s^{th}$ at time $t^{th}$, and
$(\alpha + \delta_t)_t$ is trend temporal. Likelihood and joint prior distribution of (1) are defined respectively as,

$$p(y_{1T}, \ldots, y_{S_T} | \lambda) = \prod_{t=1}^{T} \prod_{i=1}^{S} \left[ e^{y_{st}!} \exp \left( \beta_0 + \sum_{p=1}^{P} \beta_p x_{stp} + u_{st} + (\alpha + \delta_t)_t y_{st} \right) \right]$$

(2)

where

$$\lambda = \{\beta_0, \beta_p, \alpha, u_t, \delta_t, \tau_u, \tau_v, \tau_\alpha\}$$

and

$$p(\lambda) = p(\beta_0)p(\beta_p | \tau_\beta)p(\alpha | \tau_\alpha)p(u_{st} | \tau_u)p(\delta_t | \tau_\delta)p(\tau_u)p(\tau_v)p(\tau_\delta)p(\tau_\beta)$$

(3)

Based on equation (2) and (3), joint posterior would be

$$p(\lambda | y_{1T}, \ldots, y_{S_T}) \propto A \times B \times p(\beta_0)p(\beta_p | \tau_\beta)p(\alpha | \tau_\alpha)p(u_{st} | \tau_u)p(\delta_t | \tau_\delta)p(\tau_u)p(\tau_v)p(\tau_\delta)p(\tau_\beta),$$

(4)

where

$$A = \prod_{t=1}^{T} \prod_{i=1}^{S} \left[ e^{y_{st}!} \exp \left( \beta_0 + \sum_{p=1}^{P} \beta_p x_{stp} + u_{st} + (\alpha + \delta_t)_t y_{st} \right) \right]$$

and

$$B = \exp \left( - \sum_{t=1}^{T} \sum_{i=1}^{S} e_{st} \exp \left( \beta_0 + \sum_{p=1}^{P} \beta_p x_{stp} + u_{st} + (\alpha + \delta_t)_t y_{st} \right) \right).$$

**Definition 1. (Full conditional distribution) [16].** Suppose joint posterior (4),

$$p(\lambda | y_{1T}, \ldots, y_{S_T}) = \frac{p(\lambda) \prod_{t=1}^{T} \prod_{i=1}^{S} p(y_{st} | \lambda)}{\Omega_\lambda} d\lambda,$$

then full conditional distribution for example $u_{st}$ is defined as

$$p(u_{st} | y_{1T}, \ldots, y_{S_T}, \beta_0, \beta_p, \alpha, u_t, \delta_t, \tau_u, \tau_v, \tau_\alpha) = [u_{st}] \propto p(u_{st} | \tau_u)p(y_{1T}, \ldots, y_{S_T} | \lambda),$$

and treats the other parameters except $u_{st}$ are constant.
**Definition 2. (Closed form)** [15]. Suppose \( p(u_{st} | \tau_u) \) follows standard distribution as in Figure 1, the full conditional distribution for example \([u_{st}] \propto p(u_{st} | \tau_u) p(y_{st} | x, y_{s}) \), is closed form if it gives a standard distribution.

\[
\begin{align*}
 p(\beta) &\sim \text{flat}() \\
p(\alpha) &\sim N(0, \tau_\alpha) \\
p(\tau_u) &\sim G(\epsilon_1, \epsilon_2) \\
p(\tau_\alpha) &\sim G(b_1, b_2) \\
p(\tau_\beta) &\sim G(\alpha_1, \alpha_2) \\
p(\beta_\mu) &\sim N(0, \tau_\beta)
\end{align*}
\]

Based on Definition 1, prior distribution in Figure 1, and joint posterior (4) are used to create a full conditional distribution for each parameter of model (1). Analytical procedure the full conditional distributions of the model are only illustrated for example \(u_{st}\) and \(v_{st}\).

**Full conditional distribution for \(u_{st}\)**

\[
[u_{st}] \propto \left[ \frac{1}{\sqrt{2\pi\tau_{u}}} \right]^{ST} \exp \left[ -\frac{1}{2\tau_u} \sum_{t=1}^{T} \sum_{s=1}^{S} u_{st} y_{st} - \sum_{t=1}^{T} \sum_{s=1}^{S} e_{st} \exp(u_{st}) \frac{\sum_{t=1}^{T} \sum_{s=1}^{S} u_{st}^2}{2\tau_u} \right].
\]

Taylor series around \(\tau_u = 0\) in (5) is used to approximate the \(\exp(u_{st})\) [19], then obtained

\[
[u_{st}] \propto \left[ \frac{1}{\sqrt{2\pi\tau_{u}}} \right]^{ST} \exp \left[ -\frac{1}{\tau_u} \sum_{t=1}^{T} \sum_{s=1}^{S} (y_{st} - e_{st}) u_{st} - \frac{1}{2\tau_u} \left(1 + \tau_u e_{st}\right) u_{st}^2 \right].
\]

Suppose

\[
B_{21} = \sum_{t=1}^{T} \sum_{s=1}^{S} (y_{st} - e_{st}), \quad B_{22} = \sum_{t=1}^{T} \sum_{s=1}^{S} \left(1 + \tau_u e_{st}\right),
\]

then (6) can be written

\[
[u_{st}] \propto \exp \left( -\frac{2\tau_u B_{21}}{B_{22}} \right) \left[ \frac{1}{\sqrt{2\pi\tau_u}} \right]^{ST} \exp \left[ -\frac{1}{2\tau_u} \left(\frac{-2\tau_u B_{21}}{B_{22}} + u_{st}\right)^2 \right].
\]
Based on the Definition 2, full conditional distribution for $u_{st}$ is closed form,

$$u_{st} \sim N\left(\frac{2\tau_{u(i)}^{(0)}B_{21}}{B_{22}}, \left(\tau_{u(i)}^{(0)}\right)^{ST}\exp\left(-\frac{2\tau_{u(i)}^{(0)}B_{21}}{B_{22}}\right)\right), \tau_{u(i)}^{(0)} \text{ initial value.}$$

Full conditional distribution for $v_{st}$

$$\begin{vmatrix} v_{st} \end{vmatrix} \propto \exp\left\{ \sum_{t=1}^{T} \sum_{s=1}^{S} y_{st} - e_{st} + \rho \tau_{v} \sum_{j \in \alpha(s)} v_{j} \right\} v_{st} \sim \frac{1}{2\tau_{v}} \left( \tau_{v}^{2}D_{s} + \tau_{v}^{2} \right) v_{st}^{2} \left( \tau_{v}D_{s} \right)^{ST} \left( \frac{2\pi}{2\pi} \right)^{2}. \tag{8}$$

Taylor series around $v_{st}^{*} = 0$ in (8) is used to approximate the $\exp(v_{st}^{*})$,

$$\begin{vmatrix} v_{st} \end{vmatrix} \propto \exp\left\{ \sum_{t=1}^{T} \sum_{s=1}^{S} y_{st} - e_{st} + \rho \tau_{v} \sum_{j \in \alpha(s)} v_{j} \right\} v_{st} \sim \frac{1}{2\tau_{v}} \left( \tau_{v}^{2}D_{s} + \tau_{v}^{2} \right) v_{st}^{2} \left( \tau_{v}D_{s} \right)^{ST} \left( \frac{2\pi}{2\pi} \right)^{2}. \tag{9}$$

Suppose

$$C_{21} = \sum_{t=1}^{T} \sum_{s=1}^{S} \left( y_{st} - e_{st} + \rho \tau_{v} \sum_{j \in \alpha(s)} v_{j} \right), \quad C_{22} = \sum_{t=1}^{T} \sum_{s=1}^{S} \left( \tau_{v}^{2}D_{s} + \tau_{v}^{2} \right).$$

then (9) can be expressed

$$\begin{vmatrix} v_{st} \end{vmatrix} \propto \exp\left\{ \sum_{t=1}^{T} \sum_{s=1}^{S} C_{st} - \left( \frac{2\tau_{v}C_{21}}{C_{22}} \right)^{ST} \right\} v_{st} \sim \frac{1}{2\tau_{v}} \left( \tau_{v}^{2}D_{s} + \tau_{v}^{2} \right) v_{st}^{2} \left( \tau_{v}D_{s} \right)^{ST} \left( \frac{2\pi}{2\pi} \right)^{2}.$$ 

Based on the Definition 2, full conditional distribution for $v_{st}$ is closed form,

$$v_{st} \sim N\left(\frac{2\tau_{v}^{(0)}C_{21}}{C_{22}}, \left(\tau_{v}^{(0)}D_{s}\right)^{ST}\exp\left(-\frac{2\tau_{v}^{(0)}C_{21}}{C_{22}}\right)\right), \tau_{v}^{(0)} \text{ initial value.}$$

Full conditional distributions for the other parameters are also closed form which created similar to $u_{st}$ and $v_{st}$, given in Figure 2.
Corollary. Given EoBP2L spatio-temporal (1), if set of likelihood (2) and prior (3) are following the assumptions in Figure 1, then its full conditional distributions are closed form.

3 Conclusions and Future Research

Full conditional distributions of EoBP2L spatio-temporal are closed form (Figure 2). Gibbs sampler is, therefore, used for estimating the parameters. Further research is to apply EoBP2L spatio-temporal using Surabaya DHF data.

4 Acknowledgments

This article is a part of Laboratory’s research grant and doctoral research at Statistics Department of Institut Teknologi Sepuluh Nopember (ITS), Surabaya, Indonesia, granted by LPPM Institut Teknologi Sepuluh Nopember (ITS). We thank Head of BPS and BMKG Surabaya city.

\[ \beta_0 \sim \exp \left\{ \sum_{i=1}^{T} \left( y_{it} - \mu_{it} \exp(\beta_0) \right)^2 \right\} \]

\[ \beta_i \sim N \left( \frac{\sum_{i=1}^{T} y_{it} \exp(\beta)}{\sum_{i=1}^{T} \exp(\beta)}, \frac{1}{\sum_{i=1}^{T} \exp(\beta)} \right) \]

\[ u_{it} \sim N \left( \frac{2u_{it}}{B_{it} + \epsilon_{it}}, \frac{\epsilon_{it}}{B_{it} + \epsilon_{it}} \right) \]

\[ \nu_{it} \sim N \left( \frac{2
u_{it}u_{it}}{G_{it} \nu_{it}}, \frac{\nu_{it}}{G_{it} \nu_{it}} \right) \]

\[ \alpha \sim N \left( \frac{2\alpha_{ij}}{F_{ij}}, \frac{1}{F_{ij}} \right) \]

\[ \delta_{ij} \sim N \left( \frac{2\delta_{ij}}{D_{ij}}, \frac{1}{D_{ij}} \right) \]

Figure 2. Full conditional distributions of EoBP2L spatio-temporal

References


