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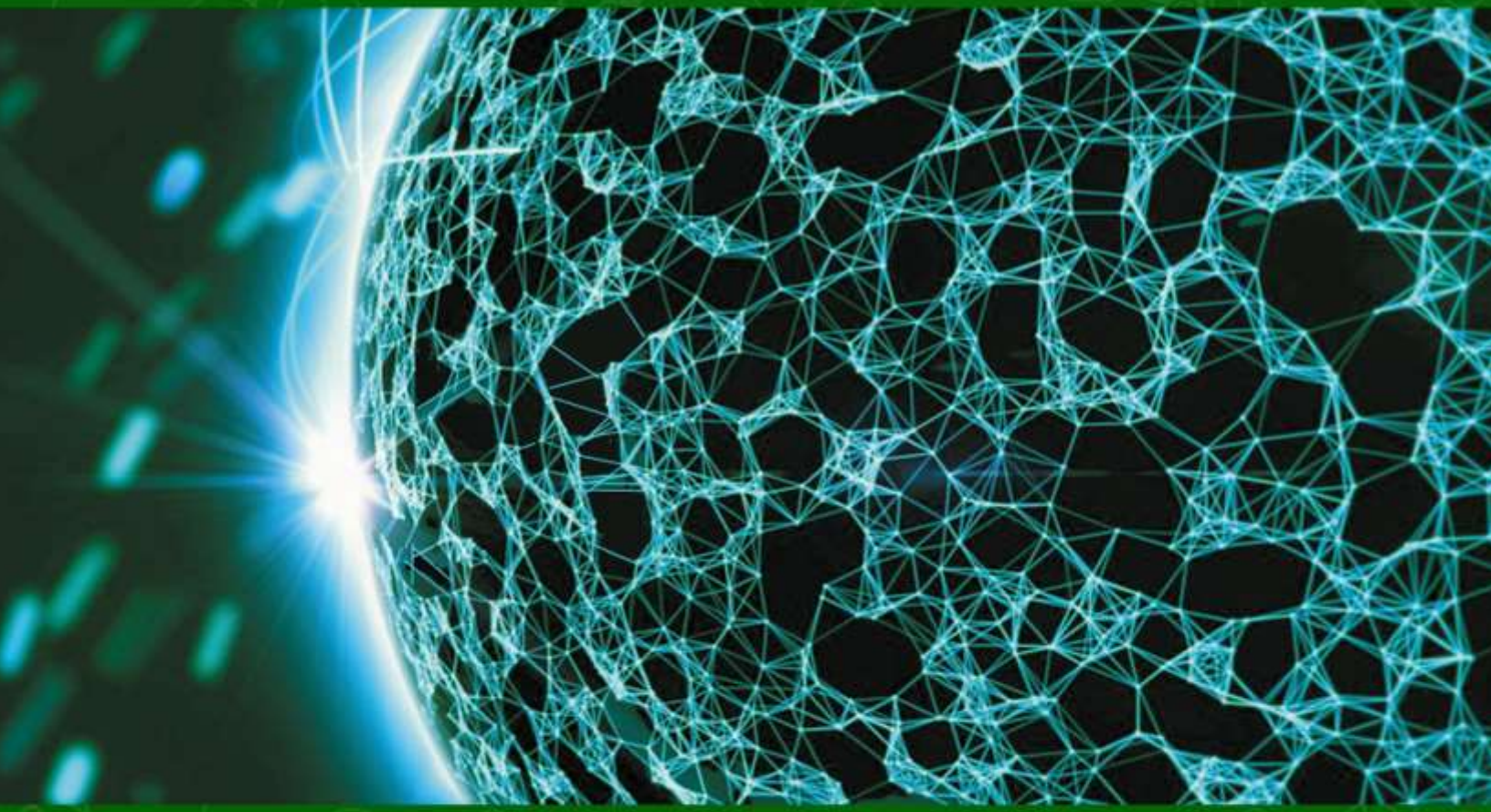
Book of Abstracts of the 2nd Seminar on Spatial Statistics and Its Applications

Shahrood University of Technology
25-26 October 2017



In the name of God

Book of Abstracts of the 2nd Seminar on Spatial Statistics and Its Applications

October 25-26, 2017

Shahrood University of Technology

Shahrood, Iran

Book of Abstracts of the 2nd Seminar on Spatial Statistics and Its Applications

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In the Name of God

Preface

Dear Participants, Colleagues, and Friends,

WELCOME to the 2nd Seminar on Spatial Statistics and Its Applications. This volume contains contributed articles at the seminar. This seminar is a two days event held with cooperation of the Iranian Statistical Association and Tarbiat Modares University of Tehran. This seminar is taking place from 25th to 26th of October, 2017 at Shahrood University of Technology. Out of 37 articles, Scientific Committee of the seminar selected 35 articles for oral presentation. We hope that this seminar will meet the expectations of all participants.

We wish to express our most sincere gratitude to our colleagues all who helped us for this publication. We gratefully acknowledge the careful efforts of our students in the Department of Statistics at Shahrood University of Technology. We also wish to thank all sponsors for their great support in holding this seminar.

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Spatial Prediction of Proportions: A Comparison of Beta-Binomial Kriging and Binomial Cokriging

Leila Abedinpour Liiarjadmeh, Hossein Baghishani, Negar Eghbal

Department of Statistics, Shahrood University of Technology

Abstract: The popular model for spatial count responses in finite populations is constructed based on binomial distribution. In many applications, due to the over dispersion, to use binomial distribution is not appropriate and can result in inefficient inferences regarding the estimation of parameters and spatial prediction. In order to eliminate the defects of the binomial model, an alternative approach for modeling spatially correlated proportions is to use a beta-binomial distribution. Beta-binomial kriging is simpler compared to binomial cokriging and provides more precise predictions under different conditions. In this paper, we evaluate the performance of two proposed models by using a simulation study.

Keywords: Over dispersion, Variogram , Beta-binomial kriging , Binomial cokriging, Spatial random field

Irregularly Shaped Spatial Cluster Detection Based on Adaptive Minimum Spanning Tree Using Confidence Interval

Ali Abolhasani*, Safieh Mahmoodi
Department of Mathematical Sciences, Isfahan University of Technology

Abstract: After reviewing some spatial clustering methods, a new algorithm is proposed to detect irregularly shaped spatial clusters. Simulation is done. The new algorithm is fast and detects irregularly shaped spatial clusters exactly in simulated example.

Keyword: Scan statistic, Minimum spanning tree, Validity index, Linear time subset scan, Fast scan algorithm, Hypothesis testing.

Comparing Three Estimators in Spatial Sampling

Asieh Abtahi
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Abstract: Spatial sampling is a cost-efficient way to conduct surveys for ecological and environmental studies and monitoring projects. Various sampling techniques are used when the study area is restricted in size, but national and other wide ranging surveys will often rely on systematic sampling. The systematic sample is in particular preferable as a sampling method when nearby sampling units show a high degree of positive correlation. An undesirable property of systematic sampling is that there is no known method allowing unbiased estimation of the uncertainty in these surveys. A number of alternative variance estimation methods have been tested and reported by various authors. The objective of the current study is to review spatial sampling and to compare the three estimators recommended respectively by Aune-Lundberg and Strand (2014), McGarvey et al. (2016) and Brus and Saby (2016). The comparison was done, in Geir-Harald Strand (2017), by applying all three estimators to samples drawn from a single, large dataset with known properties.

Keywords: Spatial sampling, Systematic sample Uncertainty Variance, Land cover Area frame survey.

Clustering of High Dimensional Spatial Data

Ameneh Abyar*, Mohsen Mohammadzadeh, Kiomars Motarjem

Department of Statistics, Tarbiat Modares University

Abstract: Nowadays, the rapid development of science in various fields and the speed of recording and analysis of information has caused the statisticians to face a huge amount of complex information which makes it impossible to enforce existing methods. As a large number of explanatory variables can lead to overlapping, the high number of them causes the divergence of usual models from the actual pattern of data. One of the solution options to provide analyzing them is to identify hidden groups in these data. For this purpose, the highly efficient and applicable data clustering method is used for diagnostic analysis of high-dimensional data, which is usually based on uncorrelated data. But we often deal with data that is spatially correlated. In this paper, in a simulation study, the performance of high-dimensional discriminant analysis method is considered in the data clustering and the effect of the spatial correlation in the data on the efficiency of this method is evaluated in order to provide suitable solutions for analyzing such data.

Keywords: Clustering, Discriminant analysis, High dimensional spatial data.

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Mapping of Depression in Hamadan Province Using Spatial Bayesian Model

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Abstract: Introduction: Depression is one of the most common psychological disorders and the fourth main cause of developing other disorders in depressed subjects. Depression, in the worst case, can lead to suicide. Considering the importance of this disease and its high prevalence, it is necessary to perform studies to determine high risk areas. One of the appropriate methods in analyzing any data sets is generating and reviewing the charts, which in spatial epidemiology they are referred to as disease mapping. Disease mapping involves a set of statistical methods that leads to estimate geographical distribution of the disease by providing accurate maps based on prevalence, incidence and mortality of the disease. In this study, mapping of the incidence of depression in HAMADAN province is investigated. Methods: In this study, the data of new cases of depression reported during 2008 to 2016 in Hamadan province, separated by cities of the province, were analyzed. Spatial Bayesian model (BYM) was used to determine the pattern of spatial changes of relative risk (RR) of the disease. Results: according to obtained map, during 2008 to 2016, the highest rates of depression incidence were in Hamadan, Bahar, and Asadabad cities, respectively. Conclusion: Since in all obtained maps in different years, the highest rate of depression incidence was observed in Hamadan city, it is recommended that health authorities take the necessary interventions to reduce the risk of this disease in this city.

Keywords: Bayesian, Hamadan, Mapping, Depression, Spatial model.

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Bayesian Analysis of Spatial Semiparametric Survival Models

Mina Badakhshan*, Negar Eghbal, Hossein Baghishani

Department of Statistics, Shahrood University of Technology

Abstract: Due to developing tools for recording spatial data and extending spatial databases in recent years, spatial survival models has received a great deal of attention. Indeed, its reason is the critical role that geographical information can play in predicting survival function. In this paper, two most commonly-used semiparametric survival models including proportional hazards and proportional odds, are introduced, and MCMC algorithms are given for Bayesian fitting of the models. Different type of censoring mechanisms including the right, left and interval censored are also considered. A real example explains the application of the models.

Keywords: Bayesian inference, Proportional hazards model, Proportional odds model, spatial correlation, Frailty models.

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Spatial Analysis of Crime Rate in Capital of Iran

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Abstract: Debarment and controlling urban crimes are essential tasks in social security and civic management. To this end, we must understand the nature, variability and reasons for occurrence of crimes based on geographic regions of the city. Therefore, spatial analysis of urban crimes is important for city managers. In this article, we use a spatial beta regression for the analysis of wickedness crime rate in capital of Iran (Tehran). A Gaussian copula is used for modeling the spatial correlation and the inference is undertaken using a likelihood-based approach.

Keywords: Wickedness, Lattice data, Conditional autoregressive spatial models, Gussian copula.

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Spatio-temporal Modeling of fMRI Data for Detecting Activated Brain Regions and Functional Connectivity Among Regions

Nasrin Boroumandnia[*1], Hamid Alavi Majd[1], Farid Zayeri[1], Ahmad Reza Baghestani[1], Seyyed Mohammad Tabatabaei[2], Fariborz Faeghi[3]

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Abstract: One of the main challenges in fMRI studies is modeling the 3-dimensional spatial dependence of imaging data. In addition, these kind of data have longitudinal dependence and are as time series. In recent years, Bayesian spatio-temporal models have been extended in this area. These models allows to detect activated regions of brain related to a typical task. The other aim of fMRI studies is functional connectivity between regions of brain which is reached by clustering of time series based on their similar characteristics. Because of huge size of data and complicated 3-dimentional spatial and temporal correlation structures, some work have ignored the mentioned characters to simplify the modeling. In this paper, statistical modeling of fMRI data has been considered. The proposed model account for the 3-dimensional complex spatial correlation using Ising prior and clustering of time series by imposing Diriclet process on the error terms of model. Also this model estimates the hemodynamic response function for each voxel separately. For posterior inference, we combine auxiliary variable method and also Neal algorithm 8 with MCMC sampling approach. We employ our method for auditory data set.

Keywords: fMRI data, 3-dimention spatial correlation structure, Ising prior.

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Spatio-temporal Statistical Models for Analyzing of fMRI Data

Nasrin Boroumandnia[*1], Hamid Alavi Majd[1], Farid Zayeri[1], Ahmad Reza Baghestani[1], Seyyed Mohammad Tabatabaei[2], Fariborz Faeghi[3]

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Abstract: Functional Magnetic Resonance Imaging, fMRI, is an MRI technique that measures the brain's activity as a result of stimulus, indirectly. The fMRI data have complicated 3-dimentional spatial and temporal correlation structures. In addition, the behavior of the hemodynamic response is very important in this kind of study. In recent years, fMRI studies have been highly regarded. Also Statistical methods have a crucial role in analyzing fMRI data. These data have certain characteristics and it is very important to consider these features in statistical modelling. The size and complexity of the data and also big number of parameters in model are the reasons why Bayesian statistical approaches have widely been considered. This type of data analysis has not had their real values in Persian scientific journals. So in this article we introduce various statistical approaches in analyzing of fMRI data. For reaching this goal, first the different fMRI studies and the structure of data are explained, then statistical approaches are introduced in every field.

Keywords: fMRI studies, Hemodynamic Response Function, 3-Dimentional Spatial and Temporal Correlation Structures, Statistical Bayesian Approach.

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Semiparametric Modeling of Spatially Correlated Survival Data with Copula Functions

Nasrin Ebrahimi*, Mohsen Mohammadzadeh

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Abstract: In some survival data analysis, in addition to determining the effect of different risk factors on survival time, the existence of potentially dependencies between survival times is interested. When survival data are dependent, the copula functions can be used for modeling the dependency structure. In this paper, a Gaussian copula function is used to modeling the spatial survival data and a two-stage method is applied for estimating the model parameters. Finally the precision of the estimates is evaluated in a simulation study.

Keywords: Multivariate Survival Data, Copula Function, Marginal Models, Proportional Hazard Model.

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Tensor Decomposition of Spatio-Temporal Random Field Covariance Function

Meysam Esmati*, Mohsen Mohammadzadeh

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Abstract: Using a spatio-temporal covariance function is the most common approach for considering the correlation structure of data in the analysis of the data. This method contains restrictive assumptions such as stationarity and separability of the random field. Although these conditions will simplify the fit of a valid model to the spatio-temporal covariance function, but in some applications these assumptions may not be realistic. In this paper, a possible framework based on the tensor decomposition of a spatio-temporal covariance function is proposed for modeling the spatio-temporal correlation structure of a nonstationary and no separable random field. Finally, the proposed approach is used for modeling and prediction of wind speed data.

Keywords: Spatio-Temporal Data, Spatio-Temporal Covariance, Tensor Decomposition

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Beta-Binomial Kriging for Modeling Spatial Proportions and Analysis of Divorce Proportions in Provinces of Iran

Ali Fathkhani*, Mohsen Mohammadzadeh

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Abstract: In many practical studies, the response variables such as rates have values in (0, 1) interval. The common linear regression model may not be proper for modelling these kinds of data because of non stablishing the basic assumptions. The Beta regression model has been introduced in recent years for modelling such observations. Beta distribution is a flexible density family on (0, 1) that covers the symmetric and skewed shapes. Beta regression model is based on assumption that response variable is Beta distributed. In this model the reparametrized beta distribution that is consists of the mean and the precision parameter is applied for modelling response variable. This paper will present an alternative approach for modelling spatially correlated proportions called Beta-Binomial Kriging, that is relatively simple compared to other models, and provides more accurate predictions. Then, the application of the beta-binomial kriging and beta regression models for divorce data in all provinces in Iran is demonstrated. Next, the accuracy of the beta-binomial kriging and beta regression models are compared.

Keywords: Spatial proportions, Beta-binomial kriging model, Beta regression model, Divorce

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Estimation of Parameters of Spatio-Temporal: Frequency Domain Approach

Fatemeh Gharanjik*, Mahnaz Khalafi, Majid Azimmohseni

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Abstract: Over the past decade, there have been some important advances in methods for constructing and parameter estimating of valid spatio-temporal covariance function. In this paper a new frequency domain approach is proposed to estimating parameters of spatio-temporal covariance functions. The method is applied with a real data of drought indices in Golestan province.

Keywords: Cross-periodogram, Frequency variogram, Spatio-temporal covariance.

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Modeling of Crime Data with Spatial Beta Regression Using Integrated Nested Laplace Approximation

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Abstract: Usually Beta regression models are useful for modelling continuous rates (proportions) that are affected by independent variables. Sometimes for Bayesian inference of these models, the posterior distributions cannot be constructed in closed form and Markov chain Monte Carlo (MCMC) algorithms for solving related integrals due to large number of parameters may be time-consuming and even faced with problem of divergence. Using approximate Bayesian inference could be a solution for obtaining these posterior distributions. In this paper, the integrated nested Laplace approximation is used in analysis of spatial Beta regression model. In addition, the advantages and disadvantages of this method are compared with MCMC methods in terms of time and accuracy. Finally, the application of this model is shown for determining the relationship between crime data and social factors in Tehran city.

Keywords: Spatial Beta Regression Model, Integrated Nested Laplace Approximation.

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A New Algorithm for Likelihood Inference of SGLMM's with skew Latent Variables

Fatemeh Hosseini*, Omid Karimi
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Abstract: In the many studies about Spatial Generalized Linear Mixed Models (SGLMM's) models, it is a standard assumption that the spatial latent variable has normal distribution. Although the Gaussian assumption for the spatial latent variable leads to simple mathematical calculation, but violation of the assumption may easily invalidate the statistical inference. In this paper, the closed skew normal (CSN) distribution which is more flexible and includes the normal distribution is considered for the spatial latent variables. In SGLMM's the likelihood function contains a high-dimensional integral and has not a closed form, so it is evaluated numerically. In this paper based on an approximation approach and Expectation Maximization gradient algorithm a new approximate algorithm is introduced for SGLMM's with CSN spatial latent variables.

Keywords: Approximate Likelihood Approach, Closed Skew Normal, Spatial Generalized Linear Mixed Models.

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Modeling and Forecasting Mortality Rate Using Spatial Statistics

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Abstract: Mortality forecasts are nowadays widely used to create and modify retirement pension schemes, disability insurance systems and other social security programmers . Experience shows that static life tables overestimate death probabilities. The reason for this overestimation is that static life tables, through being computed for a specific period of time, cannot take into account the decreasing mortality trend over time. Dynamic mortality tables overcome this problem by incorporating the influence of the calendar when graduating mortality. After detrending the raw data, the residuals dependence structures is analyzed by considering them as a realization of a homogeneous Gaussian random field. In this paper, we first apply the Lee-Carter and median-polish methods for estimation of mortality rate. The estimation of the parameters of the Lee-Carter model can be carried out the singular value decomposition and generalized linear models. The estimated structures are then compared for prediction of mortality rates using goodness-of-fit criterion. We finally apply different methods to model the mortality data of Isfahan and forecast the mortality rate on a period for which we have no data.

Keywords: Dynamic Life Tables, Lee-Carter Model, Spatial Statistics, Singular Value Decomposition, Median-Polish.

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Estimation and prediction with spatial regressive-autoregressive models

Hassan Itam, Yadollah Vagheiy*, Hamidreza Nilisani

Department of Statistics, University of Birjand

Abstract: In the recent years, various models have been used to model and predicting spatial data. Some of these models (such as spatial regression model) includes independent variables and some others (such as unilateral spatial autoregressive models) don't have independent variable. In this paper, we introduce some spatial models and then to estimate the parameters and prediction by the regressive-autoregressive model, Finally, using an irregular spatial data set, we describe how to estimate the model parameters and prediction the spatial data using the spdep package in R software.

Keywords: Spatial Models, Spatial Autoregressive Model, Spatial Prediction, Regressive-Autoregressive Model.

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Prediction based Spatio-temporal Autoregressive-Moving Average (STARMA) Models

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Abstract: The Spatio-Temporal AutoRegressive-Moving Average (STARMA) models have gained widespread popularity in many domains, including imaging, transport, business, criminology and etc.. These models are useful tool in modeling time series that correspond to different spatial locations (which are called spatio-temporal series). In this paper, we first introduce the STARMA modes, then discuss about determining the order of the model using autocorrelation and partial autocorrelation functions. The parameters of the model are estimated by maximum likelihood, then goodness of the fitted model is evaluated by considering the residuals. Given observed values, the conditional expectation of the model will be used for the spatio-temporal prediction. We perform the above steps for a particular case, STARMA(1,2;1,1), using the "starma" package in R software by a simulation study. Finally, as an application of this model, we model the crime data was reported in Boston, Massachusetts, USA.

Keywords: Spatio-Temporal autoregressive-moving average model, Prediction, Stationarity, Neighborhood, Criminology.

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Simultaneous Modeling of the Mean and Precision Parameters of Spatial Beta Generalized Linear Mixed Model

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Abstract: Standard regression model is used for modeling continuous response variables. In practice we encountered with response variables lie in the interval (0,1). Beta regression model is introduced for modeling these kinds of data. In this paper, the mean and precision parameters of the beta distribution are modeled, considering the spatial correlation structure in the mean model. Bayesian approach is used for parameter estimation. Performance of this model and Gaussian model are compared as well . Application of this model for analysis of Household Income and Expenditure data of Tehran, the capital city of Iran, is presented.

Keywords: Beta Regression, Precision Parameter, Bayesian Approach, Household Income and Expenditure Survey.

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Bayesian and Approximate Bayesian Analysis of the house Price Data in Tehran

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Abstract: The house prices of Tehran city are correlated by their locations under regions and districts. Also, sold house price are different in different months, therefore the data are correlated by time. To analysis of this data, the spatio-temporal models is used. In this paper, the different spatio-temporal models are considered for the house price data, and Bayesian approach is applied for fitting of the Models and predicting in new locations and in the coming days. Duo to the dimension increasing in locations and times, many of the spatio-temporal models don't have efficiency and they are not particularly well suited for computational speed. An appropriate approach is applied approximate Bayesian approach by Gaussian Markov random field. The best model is introduced by the mean square error and the computing time, then prediction map of the Tehran house price is presented.

Keywords: Approximate Bayesian approach, Bayesian approach ,Spatio-temporal models.

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Spatial First Order Discrete Hidden Markov Model

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Abstract: Hidden Markov models (HMM) are well known powerful and flexible statistical methods for modeling one dimensional time series data. They are used when vector of observation and hidden states are processed. Sometimes we deal with a matrix of data (spatial structure) instead of a vector, in this situation there is urgent need to define new extension of HMM models which can be consider spatial structure of data. Discrete HMM (DHMM) is type of HMMs with discrete observation and states. In this study, we present new extension of first order DHMM for data with more than one dimension which is a spatial generalization of first order DHMM. As a matter of fact, our new model will be able to model matrix of observation and hidden states.

Keywords: Discrete hidden Markov model, Spatial structure.

Shrinkage Estimation of Probability Density Functions Based on Spatial Data

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Abstract: Nonparametric estimation of probability density functions, is a very useful tool in statistics. The kernel method is popular and applicable to dependent data, including time series and spatial data. But at least for the joint density, one has had to assume that data are observed at regular time intervals or on a regular grid in space. Though this is not very restrictive in the time series case, it often is in the spatial case. In fact, to a large degree it has precluded applications of nonparametric methods to spatial data because such data often are irregularly positioned over space. In the present article, we develop the well-known Shrinkage estimator of a probability density function for non-gridded spatial data. In this respect, we provide the asymptotic characteristics of the proposed estimator under a set of local alternatives.

Keywords: Asymptotic normality, Irregularly positioned spatial data, Kernel estimate, Shrinkage.

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Robust Estimation and Prediction with Bounded Influence in Spatial Small Area Estimation

Anvar Mohammadi*, Mohsen Mohammadzadeh

Department of Statistics, Tarbiat Modares University

Abstract: Small area estimation methods have been widely considered in recent years. The main purpose of these models is to use auxiliary information to improve direct estimates. Spatial similarity between neighboring areas is one category of these useful information and spatial small area models have been developed to use this information. In addition, due to the small sample size in small area issues, the results are easily affected by outliers. Therefore various studies have been conducted recently on the robust methods in this field. Current robust methods have so far focused on controlling the effects of outliers in response variable. But the effect of outlying values in explanatory variables is still not controlled by these methods. This article is presented robust methods for Spatial Small area estimation that can control the influence of outliers in response variable and the explanatory variables simultaneously. The performance of these methods has been evaluated in simulation studies.

Keywords: Small area estimation, Spatial small area estimation, Robust small area estimation, GM-estimators, Leverage points.

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Testing for stationary of spatial data

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Abstract: Sometimes, in environmental studies, we are dealing with observations that are not independent of each other, and their dependence is typically due to the location and location of observation in the studied space. Such observations are called spatial data. Due to the structure and spatial correlation between such data, the usual methods of statistics for their analysis are not applicable and it is necessary to correlate data in their analysis. For the analysis of these data, simple assumptions such as static, isotropic, and so on are considered in practice. Therefore, the validity of these simplifying assumptions of the model is essential in the data under investigation. Our goal in this paper is to study the static supposition of this type of data using Fourier transform properties.

Keywords: Fourier transform, unstable processes, static processes, spectral density function.

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Augmented Spatial Beta Regression Model

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Abstract: Usually, a regression model is used for modelling continuous response variables. In practice, we may encounter with response variables in the closed interval [0,1] that may also include some values, such as zero and one, with positive chances bigger than their corresponding probability to the Beta distribution. In this paper, the augmented Beta regression model is introduced and it is extended for modelling spatially correlated data. In these models, the normality is usually assumed for random effect. But, it will be shown that when the distribution of the random effect is not symmetric, the normality assumption is a non-realistic and restrictizing assumption. So, it is shown how to apply a skewed distribution such as Skew-Normal, Skew-T, Skew-Slash and Skew-Normal/Independent distributions for random effect in the augmented Beta mixed regression model. Then the mean and precision parameters of the beta distribution are modelled, and their parameters are estimated by the Bayesian approach. Next, the performance of the provided model is evaluated in a simulation study. Finally, the application of this model is shown for analyzing the proportions of employed persons in households.

Keywords: Spatial Beta regression, Spatial augmented Beta regression, Bayesian approach, Labor force survey.

Spatial Survival Model with Closed Skew Gaussian Random Effects

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Abstract: Random effects of frailty components are used in survival models to enter the unknown risk factors. But in many cases, there may be a spatial correlation between the survival times. In this case, a Gaussian random field is usually considered for spatial random effects while entering this component to the model convert survival model to spatial survival model. But the consideration of a Gaussian random field for spatial random effects in a model may also sometimes not correspond to reality. In this paper, by considering a skew Gaussian random field for random effects in spatial survival model, the effect for deviance from Gaussian random effect assumption on parameter estimates of spatial survival model is considered. we will show with a simulation study that the deviation from the assumption of Gaussian random effects will have an effect on the estimation of the parameters of the spatial survival model.

Keywords: Spatial Survival Data, Frailty, Spatial Survival Model, Close Skew Gaussian Random Field.

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Survey on Spatial Data Clustering

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Abstract: Spatial clustering provides a universal insight into the distribution of data in the study region. Thus, such a clustering process is a significant step towards the decision making process in such application areas as crime measures, public safety measures, type of disease in various locations ecological problems, public health measures, weather patterns and effective transportation facilities. There are several methods and algorithms for clustering that each one of them has advantages and limitations of processing multidimensional data as spatial process. In this paper, we focus on spatial clustering algorithms that based on the assignment of data to clusters were classified into four categories: partitioning, hierarchical, density-based and grid-based method. The aim of this paper is a review study of the existing clustering algorithms that can process spatial data. The spatial clustering algorithm that is chosen should satisfy the requirements of the application for which the study is undertaken. Also, the algorithm should be effective in processing the data with noise and outliers as they are inherently present in geographical datasets. We show that Older clustering algorithms for spatial data made significant compromises in order to accomplish their tasks and As knowledge about the problems inherent in the clustering of spatial data grew, algorithms improved both in speed and effectiveness.

Keywords: Spatial Data, Spatial Clustering, Clustering Algorithm.

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ML estimation of small area for spatial gamma count responses by using HDC method

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Abstract: In applications of small area, count responses are observed in abundance. To use Poisson distribution for analysis of over dispersed or under dispersed count data is always challenging. In order to account for lack of equivalent dispersion in these types of responses, we introduce a new spatial regression model for lattice data in small areas. This model is based on the gamma-count distribution. Given the complexity of calculating the likelihood function of model , we use a hybrid approximation method called HDC for inferencing based on likelihood . A simulation study will also evaluate the methodology and show the application of our proposed model for real data related to mortality of larynx cancer in Germany.

Keywords: Small area, ML estimation, Gamma count, Data cloning, HDC, INLA.

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Multivariate Count-distance Base Copulas for Analysis of Spatial Point Pattern Data

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Abstract: Copula functions are powerful tools for construction the multivariate distribution of dependent continues variables in terms of their marginal distributions. Dependent count discrete data arise in the areas of spatial point pattern process. In this fields, it is necessary to find the correlation structure of counts variables and the distance to the special focus. These dependency is considered based on Poisson-Weibull distribution. In this paper, we extend the work by O to trivariate distribution by implementing the introducing of concentric buffers around to the special focus and pair copula to build a valid spatial point pattern copula. Next, for prediction of counts, trivariate distribution is achieved based on the continuous extension of counts random variables. Finally, based on achieved function we predict the number of Rats in terms of the number of Cockroaches and distance to focus in some important regions in Madrid city of Spain.

Keywords: Copula Functions, Point pattern Data, Count-distance Base Copulas.

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Spatial Regression for Bimodal and Skewed Data

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Abstract: Bimodal spatial data typically occur in different applied situations. However, considerable research has not been devoted to analysis of such data. In this paper, by proposing a flexible multivariate distribution, we introduce a spatial regression model for analyzing bimodal spatial data. We apply the likelihood approach for fitting the proposed model. We also evaluate the performance of our model as an alternative to usual spatial regression by using simulated and real examples.

Keywords: Bimodal data, Spatial regression, Maximum likelihood estimation.

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View of Half-Spectral Space-Time Covariance Functions

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Abstract: In this paper we introduce a class of space-time covariance models called half-spectral. The half-spectral representation of a covariance function is a special case of standard spectral representations. We show half-spectral models are easy to define naturally, and we show many half-spectral models have several nice modeling properties. Also we will be mentioned restrictions and requirements for the listed models to be of the desired properties.

Keywords: Half-spectral model, Space-time covariance, Spectral Density.

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Approximate Bayesian Analysis of Spatial Point Pattern for Northwest Earthquakes of Iran by Log Gaussian Cox Processes

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Abstract: In this paper, Bayesian modeling of spatial point pattern for the northwest earthquakes of Iran is considered. These earthquakes are related to the northern fault of Tabriz and we aim to estimate the corresponding intensity function. MCMC algorithms are traditional tools for Bayesian analysis of spatial point patterns due to their complex posterior distributions. These algorithms for large spatial data are slow and suffer from convergence diagnostic and weak mixing. We use log Gaussian Cox process to analyze earthquakes points pattern due to its flexibility and modeling by the integrated nested Laplace approximation (INLA) method. The INLA method, compared to MCMC algorithms, is very fast and avoids convergence diagnostic and mixing problems.

Keywords: Earthquake Data, Log Gaussian Cox Process, Integrated Nested Laplace Approximation, Point Processes, Intensity Function.

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Stein-Type and Pretest Estimators in Spatial Autoregressive Models

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Abstract: In this paper, we develop stein-type estimators for a spatial autoregressive model. We employ the pretest and shrinkage estimation procedures to estimate the regression coefficients vector, which may be subject to certain restrictions. We provide the analytic expressions for the asymptotic biases and risks of the proposed estimators under quadratic loss function, and investigate their relative performance to the unrestricted least-squares estimator. We show that the risk of our proposed shrinkage estimators is strictly less than that of the unrestricted least-squares one in the most part of parameter space. A simulation study is also conducted to evaluate the performance of the proposed estimators.

Keywords: Asymptotic bias and risk, Shrinkage estimators, Spatial autoregressive model, Spatial data, Stein-type and pretest estimators.

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Comparison of Kriging and Artificial Neural Networks for the Spatial Prediction

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Abstract: The purpose of this paper is to investigate the application of Artificial Neural Networks (ANNs) for spatial prediction. A major advantage of ANNs is the ability to learn from data, even if there is not much information about the intended dataset. On the other hand, Kriging, as one of the most widely used geo-statistical methods for spatial prediction, has acceptable performance, but it requires some expertise for fitting the correlation model (semi-variogram). In this paper, using different simulated spatial data, we will compare the predictive accuracy of these two methods. Results shows that the two geo-statistical methods (universal kriging and regression-kriging) outperform neural network method. Although the prediction of the neural network for simulated data sets is not better than Kriging, the results shows that the neural network can be a good competitor for Kriging prediction.

Keywords: Regression Kriging, Neural Kriging, spatial prediction.

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Analysis of a Spatial Autoregressive Model in the Presence of Missing Data

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Abstract: Sometimes data, as a spatial random field, include missing values. Spatial observed and missing values that are in connectivity could contain useful information for improvement of spatial analysis. In this case Autoregressive models can be used for modeling data. But maximum likelihood estimation of parameters results time consuming calculation and local maximums. In this paper we introduce "Vectorized Maximum Likelihood" and verify the analysis of models in presence of missing values.

Keywords: Autoregressive Model, Maximum Likelihood Estimation , Missing Data, Spatial Data.