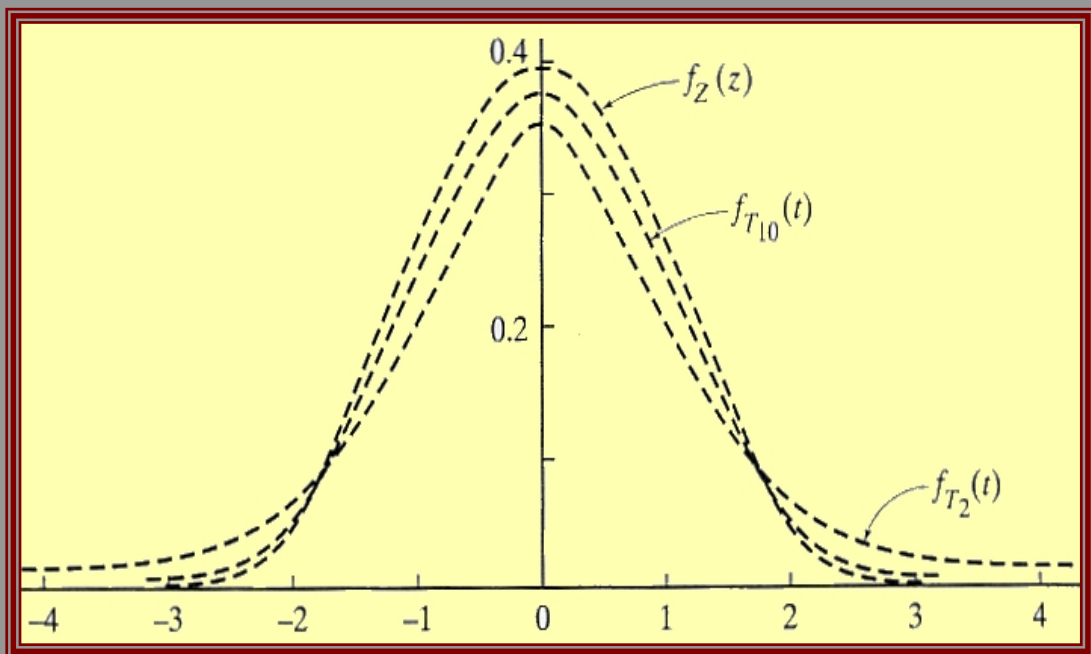


J P S S

A comprehensive journal of probability and statistics
for theorists, methodologists, practitioners, teachers, and others



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Editorial Note

There are ten articles including Editor's invited paper entitled "A moment-based bivariate density estimation methodology applicable to big data modeling" in this issue. Most of the papers are on the distributional theories and their properties along with some applications. The first article introduces a methodology for approximating the density function of a bivariate continuous distribution, which consists in adjusting a suitable initial density approximation by means of a linear combination of bivariate orthogonal polynomials. The second article proposes a new class of generalized distribution, called log-logistic extended Weibull logarithmic distribution. Different distributional characteristics of the proposed distribution along with a real life application with necessary R-codes are provided in this article. Mixture copula densities being used to model class conditional distribution is discussed in article three. Such types of densities are useful when the marginal densities of the vector of features are not normally distributed and are of a mixed kind of variables. Article four proposes the weighted likelihood estimator for the scale parameter of the two-parameter Weibull distribution when the data set has a contamination. It also examines the robust properties of the MLE and WLE for the parameters of the Weibull distribution. In article five, a first order integer valued autoregressive process is developed with generalized discrete Laplace stationary marginal distribution. Application of the proposed model is illustrated by fitting to a real data set from Saudi stock market. A method of spectral analysis of a continuous time series with irregularly spaced time intervals and to show the strength of this method within a practical setting is presented in article six. In article seven, a probability model of fertility among polygamous women that reflects the estimated mean number of children in a polygamous household is considered. It also consider a situation where each of these household has a pair of polygamous married women; the first and the second wives. A simple and quick JC method of constructing G-efficient extreme vertices design to fit linear model for a constrained mixture problem is considered in article eight. Article nine uses the three-state logit model to access the effect of unexpected macro news on exchange rate reversals. It reported the results of an empirical studies and also discusses the economical meaning behind the obtained data. The last but not the least, article ten develops the Bayesian and maximum likelihood estimators of two of popular inequality measures, namely, the Lorenz curve and Gini index for the symmetric double Pareto distribution. In order to assess the performance, the Bayes estimators are compared with the maximum likelihood estimators through Monte Carlo simulation as well as real data example.

- **B. M. Golam Kibria**, *JPSS* Editor-in-Chief

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Appendix

A Moment-Based Bivariate Density Estimation Methodology Applicable to Big Data Modeling

Hossein Zareamoghaddam Serge B. Provost
University of Western Ontario

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Brock University

ABSTRACT This paper introduces a methodology for approximating the density function of a bivariate continuous distribution. This approach consists in adjusting a suitable initial density approximation by means of a linear combination of bivariate orthogonal polynomials. Such adjustments are shown to be mathematically equivalent to making use of standard bivariate polynomials. Once extended to apply to density estimation, the proposed technique readily lends itself to the modeling of massive data sets. Several illustrative examples are presented.

Keywords Bivariate density estimation; Bivariate Hermite polynomials; Bivariate normal distribution; Density approximation; Joint moments.

1. Introduction

When density functions do not have closed form representations or they assume complicated forms that may for instance involve special functions, it may be desirable to replace them by certain relatively simple moment-based approximations. However, unlike the approximants that are proposed in this paper, such approximations, which include Pearson curves (Solomon and Stephens [15]), Edgeworth expansions (Edgeworth [5]), Johnson curves (Elderton and Johnson [6]), Gram-Charlier expansions (Charlier [3]) and the saddlepoint approximations (Daniels [4] and Reid [13]) can prove inadequate. This is the case for example when the target distributions are not unimodal.

It may happen that different distributions have the same moments, which is often referred to as the “moment problem”. Rao [10] provided conditions that ensure the uniqueness of a density function with respect to its moment sequence, $\mu(i)$, $i = 0, 1, 2, \dots$. A sufficient condition

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A New Class of Generalized Distributions for Survival and Lifetime Data Analysis: Theory and Applications

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Shujiao Huang *University of Houston*

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University of Ibadan*

ABSTRACT A new generalized class of distributions called the Log-logistic Extended-Weibull Logarithmic (LLoGEWL) distribution is developed and presented. Structural properties of the LLoGEWL distribution including moments, order statistics, Rényi entropy, mean and median deviations, Bonferroni and Lorenz curves, and maximum likelihood estimates are derived. The special case of log-logistic Weibull logarithmic (LLoGWL) distribution is studied in detail. This distribution contains the log-logistic Weibull, log-logistic Rayleigh logarithmic, log-logistic Rayleigh, log-logistic exponential logarithmic, log-logistic exponential, log-logistic logarithmic and log-logistic distributions as special cases or sub-models. The structural properties of the LLoGWL distribution including the hazard function, reverse hazard function, quantile function, moments, conditional moments, mean deviations, Bonferroni and Lorenz curves, distribution of order statistics, L-moments and Rényi entropy are derived. Method of maximum likelihood is used to estimate the parameters of this new distribution. A simulation study to examine the bias, mean square error of the maximum likelihood estimators for each parameter is presented. Finally, real data examples are presented to illustrate the applicability and usefulness of the proposed model.

Keywords Generalized distribution; L-Moments; Logarithmic distribution; Log-logistic distribution; Log-logistic Weibull distribution; Maximum Likelihood estimation; Weibull distribution.

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Mathematics Subject Classification: 62E15; Secondary 60E15.

Supervised Classification Using Finite Mixture Copula

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ABSTRACT Use of copula for statistical classification is recent and gaining popularity. For example, statistical classification using copula has been proposed for automatic character recognition, medical diagnostic and most recently in data mining. Classical discrimination rules assume normality. But in this data age time, this assumption is often questionable. In fact features of data could be a mixture of discrete and continues random variables. In this paper, mixture copula densities are used to model class conditional distributions. Such types of densities are useful when the marginal densities of the vector of features are not normally distributed and are of a mixed kind of variables. Authors have shown that such mixture models are very useful for uncovering hidden structures in the data, and used them for clustering in data mining. Under such mixture models, maximum likelihood estimation methods are not suitable and regular expectation maximization algorithm is inefficient and may not converge. A new estimation method is proposed to estimate such densities and build the classifier based on mixture finite Gaussian densities. Simulations are used to compare the performance of the copula based classifier with classical normal distribution based models, logistic regression based model and independent model cases. The method is also applied to a real data.

Keywords Clayton copula; Copula; Finite mixture model; Gaussian copula; Logistic regression; Statistical Classifier.

1. Introduction

Significant research has been done in classification areas such as automatic character recognition, medical diagnostic and data mining. Unsupervised processings have been proposed by authors such as Derrode and Pieczynski [3]. However, in this data age time, we can partition the data and build reliable estimates. In recent years, there have been many exciting developments both in the methodology and applications point of views. These developments

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Weighted Likelihood Estimator of Scale Parameter for the Two-parameter Weibull Distribution with a Contamination

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ABSTRACT In this article, we propose the weighted likelihood estimator for the scale parameter of the two-parameter Weibull distribution when the data set has a contamination. This method assigns zero weights to observations with small likelihood. We also examine the robust properties of the MLE and WLE for the parameters of the Weibull distribution. To examine the performance of the WLE method as compared to the MLE methods, and found that the WLE method out-performs the MLE method based on the relative bias and quadratic risk values.

Keywords Contamination; Maximum likelihood estimator; Outlier; Weibull distribution; Weighted likelihood estimator.

1. Introduction

The Weibull distribution is widely used in many fields such as engineering [1], biomedical sciences [2], ecology [3], etc. The Weibull distribution is named after the Swedish scientist Waloddi Weibull who associated this distribution with the strength of materials in 1939. This distribution is useful in describing wear-out or fatigue failures [4]. As further practical applications of the two-parameter Weibull distribution we mention wind energy assessment, rainfall amount, prediction of water levels, and analysis of lifetime of materials. The Weibull distribution is often used as the first step for modeling some real phenomenon.

An assumption of known shape parameter is appropriate for many real lifetime analysis problems. For example, in engineering applications we often assume that the shape parameter is

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An Integer Valued Process with Generalized Discrete Laplace Marginals

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ABSTRACT In this paper, a first order integer valued autoregressive process is developed with generalized discrete Laplace stationary marginal distribution (INARZ(1)). This autoregressive process is constructed using Pegram's mixing operator due to Pegram [16]. This is a more versatile model compared to the other existing count models. This symmetric INARZ(1) model can have either a positive or a negative lag-one autocorrelation. The autoregressive model studied by Biswas and Song [3] for positive integers is extended in our study to \mathbb{Z} (including both positive and negative integers). Higher order processes are also developed for the new model. Parameters of the INARZ(1) model are estimated by maximum likelihood method and a simulation study is conducted to study the performance of the estimates. Application of the proposed model is illustrated by fitting this model to a real data set from Saudi stock market.

Keywords Generalized discrete Laplace distribution; Integer valued autoregressive process; Pegram's operator; Symmetric innovations.

1. Introduction

Recently, there has been growing interest in the field of modelling time series of counts. Count data arises in many practical situations; examples are, the number of voltage fluctuations which an electronic machine can withstand before failure, the number of patients admitted each day in a hospital and the number of transactions done on shares of a product each day in a stock market. Several approaches have been developed in literature to model integer valued time series data. Jacob and Lewis [6, 7] developed and studied first order autoregressive models with support on \mathbb{Z}_+ . They defined the model as, a random linear combination of independent random variables which can accommodate positive correlations.

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Computational Aspects of Spectral Estimations and Periodicities in Irregularly Observed Data

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ABSTRACT Stochastic processes are collections of random variables indexed by time. With time series it has been seen that spectral properties provide important and relevant information about the data. The purpose of this paper is to demonstrate a method of spectral analysis of a continuous time series with irregularly spaced time intervals and to show the strength of this method within a practical setting. Considering a continuous time process observed at arbitrary time points the authors develop a linear filter over these observed measurements. This paper establishes that given certain conditions the spectral density of the random linear filter converges in mean square to the spectral density of the original process. In practice, continuous records are nonexistent due to the limitations in which the observations are collected. The authors choose observations over a discrete net of points and illustrate the practicality and strength of the method by investigation of properties of introduced operations over randomly chosen time points.

Keywords Irregular time observations; Linear filter; Spectral density; Spectrum; Stationary process; Transfer function.

1. Introduction

The spectral analysis of time series detects frequencies inherent to the data, which in turn provides the opportunity for signal reconstruction. Despite the complexity of this task, several researchers have discussed highly effective methods of signal extraction (see Zurbenko and Porter [32], Rao *et al.* [24], Potrzeba and Zurbenko [23]). Various applications in astronomy, acoustics, electro-engineering, and communications use periodic signal detection. Those signals are usually constructed from several frequencies and are covered by strong noise with some observations missed. For example, naturalist Sidney Chapman [6] proved the existence of tidal waves in the atmosphere and explained the importance of the tidal waves in regards to the effects

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Modelling Fertility among Polygamous Households

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ABSTRACT In this paper we propose a probability model of fertility among polygamous women that reflects the estimated mean number of children in a polygamous household. We considered a situation where each of these household has a pair of polygamously married women; the first and the second wives. We also considered a situation where the second wife may have some children of her own that she could bring into the marriage. The joint probability distribution of the fertility pattern of these women as well as their conditional probability distributions was obtained. These probability distributions obtained were illustrated with real life situation.

Keywords Expected mean number of children; Fertility pattern; Joint probability distribution; Marginal distribution; Polygamous household; Probability distribution; Probability mass function.

1. Introduction

In the United Nation's World Population Policies [11], one of the most striking releases was the upward revision in fertility rates in many African countries. Comparing fertility rates across Africa, data from ICF International (Shoumaker [10]) showed that there is significant correlation between fertility and polygamy prevalence. It is believed that most men enter polygamous marriage partly because of economic needs and partly because of a possible lack of children especially male children by the first wife (Hayford and Agadjanian [5]). It is possible that the second wife may already have some children of her own that she could bring into the marriage. The choice over whether a man remains a monogamy or transit into polygamy is largely, though not completely exogenous to the existing woman (Odwe [8]). However, once a husband opts for polygamy, decision over the number of children is not likely to exclude preferences of the woman. Wives in a polygamous marriage tend to compete among themselves for their husband attention and for children, with the second wife often intending to have more children than the first; hence the two wives may have different fertility patterns (Isiugo-Abanihe [6], Josephson [7], Adiri *et al.*

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G-Efficient Extreme Vertices Designs to Fit Linear Model for Mixture Experiments

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ABSTRACT Extreme vertices designs with high G-efficiency are enviable for fitting linear models to constrained mixtures. This article provides a simple and quick JC method of constructing G-efficient extreme vertices design to fit linear model for a constrained mixture problem. Our method incorporates the logic of covering maximum experimental region in the selection of extreme vertices and hence directly yields mixture design with high G-efficiency in few numbers of combinations.

Keywords Constrained Mixture; Extreme vertices; G-efficiency; JC method; Linear model; Mixture design.

1. Introduction

Many industrial products, such as plastics, alloys, ceramics and fibers are blends and they are manufactured by mixing two or more ingredients or components in the pre defined proportions. Such proportion of each component (C_i) in a blend or mixture is between 0% (0.0) to 100% (1.0) or is within specified boundaries $[l_i, u_i]$, lower bound l_i and upper bound u_i , $i = 1, 2, \dots, q$. We assume that the response of a mixture experiment depends only on the proportions of these components and not on the amount of the mixture. Then a mixture design problem is a selection of mixing proportions of q components called mixture design points, such that component level X_i satisfy the constraints

$$0 \leq l_i \leq X_i \leq u_i \leq 1; \quad (1)$$

$i = 1, 2, \dots, q$ and

$$\sum X_i = 1 \quad (2)$$

where l_i, u_i are the lower and upper specified boundaries, $i = 1, 2, \dots, q$. Then experimental region

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How Does Periodically Released News Impact on the Reversals of Major Currency Rates ?

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ABSTRACT Unexpected macroeconomic news exerts latent yet significant influences on foreign exchange markets. In this paper, we use three-state logit model to access the effect of unexpected macro news on exchange rate reversals. In order to investigate the potential impact induced by worldwide financial crisis happened in mid 2007, the whole study period is divided into two sub-periods: pre-crisis period and post-crisis period. Experiments reveal that the significant news, except FOMC's interest rate decision, that causes exchange rate reversals completely changes from interest rate and growth news to production and employment after the crisis. We report the results of our empirical studies and also discuss the economical meaning behind the obtained data.

Keywords Change point; Exchange rates; Multinomial logistic regression; Price reversal; Unexpected macroeconomic news.

1. Introduction

Some periodically released news about macroeconomic fundamentals exerts significant influences on foreign exchange markets. How does this type of news about economy as a whole further transmit into reversal of currency rates? The topic confronted by this question-the causes of short term price reversal-is of major interest to investors of exchange rates market. It does however remain one of the least well understood issues.

Mussa [14] indicated that approximately 90% of exchange rate movements are unanticipated and the primary reason for such drift is connected to unexpected news about macroeconomic fundamentals since the anticipated component of the news effect has usually been in-

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Estimation of the Lorenz Curve and Gini Index for the Symmetric Double Pareto Model

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ABSTRACT Inequality measures are very popular in many fields. Nevertheless, samples obtained from many of these fields typically exhibit long tails on both sides which is one of the main characteristics of the symmetric double Pareto distribution. This study concerns developing Bayesian and maximum likelihood estimators of two popular inequality measures, namely, the Lorenz curve and Gini index for the symmetric double Pareto distribution. The Bayes estimators, using two different loss functions, are compared with the maximum likelihood estimators through a Monte Carlo simulation as well as real data example.

Keywords Bayes estimators; Gini index; LINEX loss function; Lorenz curve; MLE, Squared error loss function; Symmetric double Pareto distribution.

1. Introduction

The double Pareto (DP) distribution (Reed [24]) is a skewed distribution that exhibit the power law behavior in both sides. The DP distribution can be used to model the distribution of incomes and many other phenomena in many fields, such as finance, archaeology, biology, environmental science and physics (Reed [24], Kotz *et al.* [16], Rachev [23], Toda [26]).

In this paper, we consider the symmetric DP (SDP) distribution. The probability density function and the distribution function of the SDP distribution are respectively given by:

$$f(x; \theta, \beta) = \frac{\theta}{2\beta} \begin{cases} \left(\frac{x}{\beta}\right)^{\theta-1}, & \text{for } 0 < x < \beta \\ \left(\frac{x}{\beta}\right)^{-\theta-1}, & \text{for } x \geq \beta \end{cases}$$

and

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