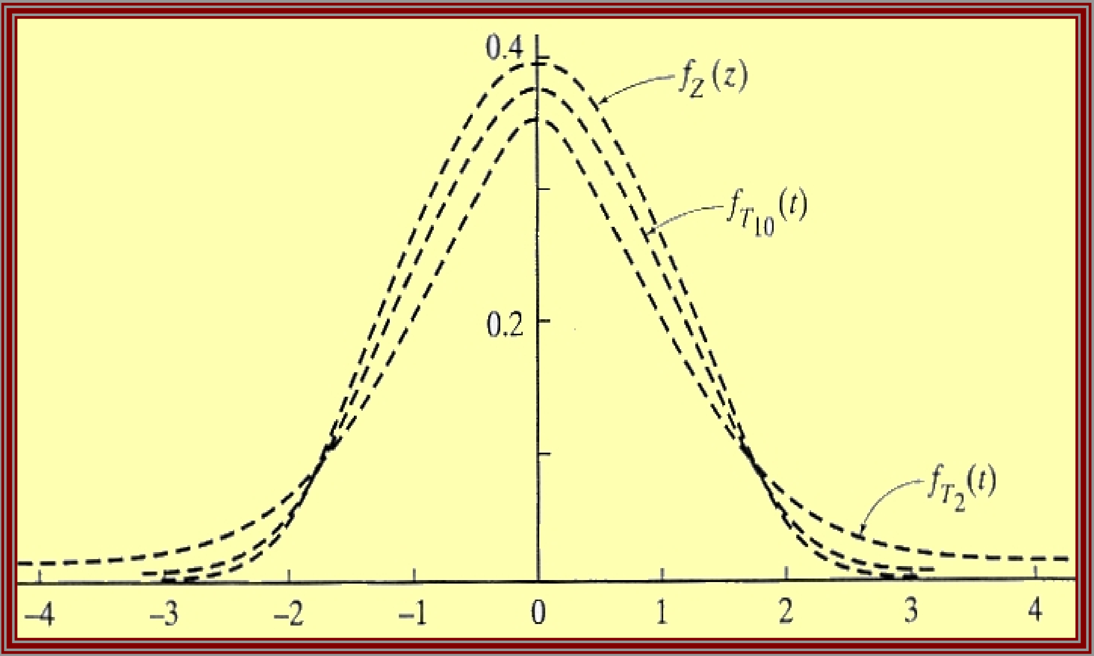
ISSN 1726-3328

JPSS

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



JOURNAL OF PROBABILITY AND STATISTICAL SCIENCE

Volume 9 Number 1 February 2011

ISSN 1726-3328

JPSS

Journal of Probability and Statistical Science

A Comprehensive Journal of Probability and Statistics
for Theorists, Methodologists, Practitioners, Teachers, and Others

Volume 9 Number 1
February 2011

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機統學誌 ***JPSS*** **ISSN 1726-3328**

Journal of Probability and Statistical Science

Published by: Susan Rivers' Cultural Institute, Hsinchu, Taiwan, ROC

(Cosponsored by: The International Chinese Association of Quantitative Management, Taiwan, ROC)

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魏蘇珊文教事業機構發行
總公司: 中華民國臺灣新竹市建美路 2 巷 26 號。

JPSS

Journal of Probability and Statistical Science

Volume 9 Number 1 February 2011

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and Statistical Science
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The *q*-Extended Inverse Gaussian Distribution

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Serge B. Provost
The University of Western Ontario

ABSTRACT This article proposes an extension of the inverse Gaussian distribution which depends on so-called q-parameters. These parameters generate pathways to many of the most commonly used statistical distributions. It will also be shown that the limiting case is connected to certain integrals arising in Astrophysics and the theory of transforms. The moments and normalizing constants of the extended distributions are derived in terms of generalized hypergeometric functions and the effects of certain parameters of interest on the distributions is illustrated graphically. A generalized integral involving a density function of a similar type is also introduced. Such generalizations should allow for greater flexibility in modeling various random phenomena encountered for instance in the social, biomedical and physical sciences.

Keywords Statistical Models; Distribution theory; Inverse Gaussian distribution; Moments.

1. Introduction

The inverse Gaussian distribution (also known as Wald's distribution) has numerous applications in various fields of scientific investigation, several of which are pointed out for instance in Johnson *et al.* [9] where its distributional properties are discussed at length. Jørgensen [10] carried out an extensive study of a certain generalization of the inverse Gaussian distribution that is in fact a particular case of an extension introduced in the next section, which involves additional parameters, including " q-parameters".

The effects of certain of those parameters on the proposed distributions are graphically illustrated in Section 2. Numerous known distributions are shown to be particular cases in Section 3. The moments and normalizing constants are derived as inverse Mellin transforms in

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☐Received December 2008, revised October 2010, in final form January 2011.

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☐AMS Mathematics Subject Classification: Primary: 62E15; Secondary: 62P25; 46N55.

ISSN 1726-3328

Journal of Probability
and Statistical Science
9(1), 21-34, Feb. 2011

On a Quasi-Negative Binomial Distribution-II and Its Applications

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Mir Javid Iqbal / *Central Institute of Temperate Horticulture*
Khurshid Ahmad Khan / *Govt. Women's College Nawakadal*

ABSTRACT All the moments of quasi-negative binomial distribution (QNBD) appear in an infinite series which do not seem possible to be summed. The method of moments fails to provide quick estimates of the parameters of the distribution. Moreover, the likelihood equations for each of the parameters of the distribution are not directly solvable. In this paper, we introduce quasi-negative binomial distribution-II (QNBD-II) which is unimodal and its first moment exists in a compact form and thus provides some space for estimating its parameters by the method of moments. The probability mass function of the distribution is obtained in different ways. Further, some structural properties and its relationship with some other distributions are explored and discussed. The difference differential equations demonstrate its applications in the study of micro-organisms. Different estimation techniques are also discussed. Finally, the parameters of the proposed model are estimated by using a computer programme in R-software. Applications of the proposed model to some data sets, available in the literature, are given and its goodness of fit demonstrated.

Keywords Quasi-negative binomial distribution; Recurrence relation; Difference differential equations; Chi-square fitting.

1. Introduction

The quasi-negative binomial distribution (QNBD), an interesting three parameter model, obtained in different forms by Janardan [7], Nandi and Das [16] and Sen and Jain [8] and has the probability law

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☐Received January 2010, revised September 2010, in final form December 2010.

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ISSN 1726-3328

Journal of Probability
and Statistical Science
9(1), 35-46, Feb. 2011

Generalized Logistic Distribution: Bayesian Estimation

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ABSTRACT In this paper, we consider a Bayesian approach to estimate the generalized logistic parameters. The Bayes estimators are derived for the two unknown parameters and reliability function. The Bayes estimators are derived with respect to conjugate prior for the shape parameter and, discrete prior for the scale parameter of this model. A numerical example and a Monte Carlo simulation study are presented to illustrate the results.

Keywords Symmetric and asymmetric loss functions; Maximum likelihood estimation; Bayes estimation; Monte Carlo simulation.

1. Introduction

The generalized logistic (GL) distribution has been used for modeling and analysis of life time data in medical and engineering sciences. The probability density function (pdf), cumulative distribution function (cdf) and reliability function (at some time t) of a two-parameter GL distribution are given, respectively, by

$$f(x;k,\sigma)=\frac{k}{\sigma}\cdot\frac{e^{-x/\sigma}}{(1+e^{-x/\sigma})^{k+1}},\quad -\infty<x<\infty, k>0, \sigma>0, \tag{1.1}$$

$$F(x;k,\sigma)=\frac{1}{(1+e^{-x/\sigma})^{k}},\quad -\infty<x<\infty, k>0, \sigma>0, \tag{1.2}$$

and

$$R(t;k,\sigma)=1-\frac{1}{(1+e^{-t/\sigma})^{k}}. \tag{1.3}$$

☐Received September 2009, revised September 2010, in final form December 2010.

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ISSN 1726-3328

Journal of Probability
and Statistical Science
9(1), 47-61, Feb. 2011

Empirical Likelihood for Coefficients of Linear Forward-Backward Stochastic Differential Equations

Yuxia Su — *Qufu Normal University*
Lu Lin — *Shandong University*

ABSTRACT In this paper, we construct the confidence intervals with profile empirical likelihood for the coefficients of the linear F-BSDE. Though there is a plug in nonparametric estimator in the estimating equation, and the data are mixing dependent, the empirical log-likelihood ratio statistic still tends to a standard χ^2 variable in distribution. Simulation results are reported and a comparison between the empirical likelihood method proposed and the least squares method is performed in terms of coverage accuracy and average lengths of confidence intervals.

Keywords Empirical likelihood; Linear forward-backward stochastic differential equation; Confidence intervals.

1. Introduction

Backward Stochastic Differential Equations (Abbreviated as BSDE hereafter) were introduced by Bismut [1] for the linear case and by Pardoux and Peng [12] for general case. The theory of BSDE has been considered with great interest in the recent years because of its connection with the non-linear partial differential equations (or more generally, the theory of non-linear semi-groups) and stochastic control problems. At the same time, in mathematical finance, the theory of hedging and pricing of contingent claim is typically expressed in terms of BSDEs. Indeed, the problem is to determine the price of a contingent claim $\xi \geq 0$ of maturity *T*; which is a contract that pays an amount ξ at time *T*: In a complete market it is possible to construct a portfolio, which has the final wealth ξ. Thus, the dynamic value of replicating portfolio Y_t is given by a BSDE with a generator *f*, and Z_t corresponding to the hedging portfolio.

☐Received February 2010, revised September 2010, in final form October 2010.

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☐The paper is supported by RFDP (20070422034) of China, NSF projects (Q2007A05) of Shandong Province of China and USF (XJ201016) of Qufu Normal University of China.

ISSN 1726-3328

Journal of Probability
and Statistical Science
9(1), 63-67, Feb. 2011

Optimality of Gaussian Kernel Function on Derivative Estimations

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ABSTRACT Let $\phi(x)$ and $\phi^{(k)}(x)$ denote the probability density function and its k-th order derivative of a standard Gaussian random variable respectively. For positive integer i, we will calculate $\int_{-\infty}^{\infty} x^i \phi^{(k)}(x)dx$ and use it to present an optimal property of the kernel derivative estimator with standard Gaussian kernel.

Keywords Gaussian probability density function; Kernel derivative estimator.

1. Introduction

Let $\phi(x)$ and $\phi^{(k)}(x)$ denote the probability density function and its k-th order derivative of a standard Gaussian random variable respectively, where k is a positive integer. Then

$$\phi(x) = \frac{1}{\sqrt{2\pi}} \exp\left\{-\frac{x^2}{2}\right\}, \quad -\infty < x < \infty$$

and

$$\phi^{(k)}(x) = P_k(x)\phi(x) \tag{1}$$

where $P_k(x)$ is a k-th order polynomial in x. For instances,

$$P_1(x) = -x, \qquad P_2(x) = x^2 - 1,$$

$$P_3(x) = -x^3 + 3x, \quad P_4(x) = x^4 - 6x^2 + 3,$$

and

☐Received December 2009, revised November 2010, in final form December 2010.

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☐AMS Classification: Primary 62.

ISSN 1726-3328

Journal of Probability
and Statistical Science
9(1), 69-81, Feb. 2011

Effect of Non-Response on a Class of Estimators of Population Mean on Current Occasion in Successive Sampling on Two Occasions

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ABSTRACT This paper considers the problem of estimating the population mean on current occasion in successive sampling on two occasions when there is non-response on the second (current) occasion. A class of estimators is defined and its properties are studied. An empirical study is given in support of the present study.

Keywords Study variate, Successive sampling, Non-response, Variance.

1. Introduction

The use of the entire information collected in the previous occasion in constructing estimator on current occasion was first introduced by [6]. Latter, it was generalized by [10], [3], [14], [15], [16], [17], [1], [19] and [22].

It is well known especially in human surveys that information is usually not obtained from all the sample units even after callbacks. [5] suggested a procedure of sub-sampling the non-respondents in order to adjust for the non-response in a mail survey. It was latter used by various authors including [9], [7], [8], [2], [11], [30], [31] and [18].

In successive sampling on two occasions we assume that information on all the n units is available on the first occasion (i.e. there is no non-response on the auxiliary variable x). On the other hand at the second occasion we consider the two situations:

Situation I There is non-response on second occasion for both matched portion and unmatched portion of the sample, see [2].

Situation II There is non-response on second occasion only for unmatched portion of the sample, see [18].

☐Received April 2009, revised June 2010, in final form August 2010.

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ISSN 1726-3328

Journal of Probability
and Statistical Science
9(1), 83-92, Feb. 2011

On Robustness of Variable Charts for Alpha Distribution

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ABSTRACT The acceptance sampling plans for lot-to-lot quality variation and similar concepts have been put in the robust Bayesian framework. However, in this set up, updating the basic distribution in view of prior variations in its parameters is still to be investigated. Following the concept, study deals with the analysis of the robust character of charts for variables for alpha distribution when variations in lot-to-lot quality are suspected.

Keywords Alpha distribution, robustness, control charts.

1. Introduction

$\alpha-$distribution is introduced by Vysokovskii [13] as a result of wear analysis of broad nosed cutting tools. It has also been developed to model the life characteristic of machine components which deteriorate according to a scheme of non-stationary linear random wear process and successfully used in variety of situation such as modelling the cutting tool life (Kendall and Sheikh [5] and Pandit and Sheikh [8]), monitoring the dimensions of machine parts for statistical quality control (Pronikov [9]) and in size modelling (Ahmad and Chaudhary [1]). Kattan [4] obtained the strength-reliability of the product considering $\alpha-$distribution as strength as well as stress distribution. Recently, Khan and Islam [6] obtained the strength-reliability for $\alpha-$distributed stress with respect to finite strength.

The density function of $\alpha-$distribution with parameters α and c is

$$f(y)=\frac{C}{\sqrt{2\pi\alpha}}\frac{1}{y^{2}}\exp\left[-\left\{\frac{1}{2\alpha}\left(1-\frac{c}{y}\right)^{2}\right\}\right];\quad 0<y<\infty,\alpha,c>0.$$

☐Received February 2010, revised December 2010, in final form January 2011.

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☐2010 Mathematics Subject Classifications: 62N05.

ISSN 1726-3328

Journal of Probability
and Statistical Science
9(1), 93-104, Feb. 2011

A Skew-Normal Approximation to the Distribution of Aggregate Claims

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ABSTRACT It has been observed that the third central moment of aggregate claim under both the compound Poisson and compound negative binomial distribution is nonzero. In fact, for positive claim amount distributions, the third central moment of aggregate claim is positive in each case. This skewed nature of the distribution of aggregate claim assures that a normal approximation may not be appropriate to approximate the aggregate claim distribution. In this study, a more general approximation to the distribution of aggregate claims using the skew-normal distribution has been sought. In many occasions the obtained results of skew-normal approximation are better than or compatible with that of translated gamma approximation technique.

Keywords Aggregate claim; Compound Poisson process; Skew-normal distribution; Translated gamma distribution.

1. Introduction

In actuarial mathematics the collective risk model is a random process that generates claims for a portfolio of policies. This process is characterized in terms of the portfolio as a whole rather than in terms of individual policies comprising the portfolio (Bowers *et al*. [6]). Consider the aggregate claims arising from a general insurance risk over a certain period of time, typically one year. At the start of the period, the insurer does not know how many claims will occur, and if claims do occur, what the amounts of these claims will be (Dickson [9]). Thus the modeling of aggregate claims involves with these two sources of variability. Suppose that N is the number of claims occurring in an insurance portfolio over a time interval, and it follows a homogeneous Poisson process with intensity λ. Let Y_i, $i = 1, 2, ..., n$,

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☐Received July 2010, revised September 2010, in final form December 2010.

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☐2000 Mathematics Subject Classification: 62P05, 62E17.

ISSN 1726-3328