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Aims and Scope

The *Journal of Probability and Statistical Science* (*JPSS*, ISSN 1726-3328) is a modified version of the *Journal of Propagations in Probability and Statistics* (*JPPS*, ISSN 1607-7083). *JPSS*, like its predecessor *JPPS*, is a multipurpose and comprehensive journal of probability and statistics that publishes papers of interest to a broad audience of theorists, methodologists, practitioners, teachers, and any other users of probability and/or statistics. The scope of *JPSS* is intended to be quite broad, including all the major areas of probability and statistics. Research papers involving probability and/or statistics, either theoretical or applied in nature, are all welcomed for publication consideration. Additionally, papers involving innovative techniques or methods in teaching probability and/or statistics will also be considered. Papers submitted for publication consideration will be peer reviewed. Initially, we will publish semiannually, one issue each in February and August. Hopefully, as time accrues, we will be able to publish quarterly. It is the goal of *JPSS* to publish a wide range of works involving probability and/or statistics (theoretical and/or applied in nature) and provide widespread availability of such to a broad audience of people interested in probability and/or statistics.

Finally, I would like to take this opportunity to express my deep thanks to all the supporters of the former journal *JPPS* and hope that you will be able to support this new journal *JPSS* as well.

Kuang-Chao Chang
Founding Editor of *JPSS* and *JPPS*

Taipei, Taiwan, ROC
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Estimation of the Mean Vector of a Multivariate Normal Distribution under Various Test Statistics

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Florida International University

A. K. Md. E. Saleh
Carleton University

ABSTRACT Ali and Saleh (1990) considered the preliminary test (*PT*) estimator based on the Hotelling's T_n^2 for estimating the mean vector of a *p*-variate normal distribution when it is suspected that the component means are equal but unknown. In this paper, the preliminary test maximum likelihood estimators (*PTMLE*) based on the Wald (*W*), Likelihood Ratio (*LR*) and Lagrangian Multiplier (*LM*) tests are considered. The comparative properties of the estimators are studied with respect to a specific quadratic loss function using a special covariance structure. In the neighborhood of the null hypothesis the *PTMLE* based on *LM* test has the smallest risk followed by the estimators based on *LR* and *W* tests. However, the *PTMLE* based on *W* test performs the best followed by the *LR* and *LM* based estimators when the parameter moves away from the subspace of the restrictions. The conditions of superiority of the proposed estimator for departure parameter Δ are derived. Some tables for maximum and minimum guaranteed relative efficiency of the proposed estimators have been provided. These tables allow us to determine the optimum level of significance corresponding to the optimum estimators among proposed estimators. Finally, we concluded that the optimum choice of the level of significance becomes the traditional choice using the *W* test for all ρ.

Keywords : Dominance; Lagrangian multiplier; Likelihood ratio test; Multivariate normal distribution; Non-central chi-square and *F*; Risk; Superiority; Wald test.

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Asymptotic Normality of Shot Noise on Poisson Cluster Processes with Cluster Marks

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Robert Serfling
University of Texas at Dallas

ABSTRACT Asymptotic normality is established for shot noise on Poisson cluster point processes with cluster marks, in the case that the shot noise has finite variance tending to infinity with time. Introducing straightforward conditions on the cluster model and response function, this extends previous work in the literature for the case of no clustering and supports greater flexibility in applying shot noise models. The results are illustrated in detail for power law shot noise and other forms of response function which arise in diverse applications such as semiconductor noise, Cherenkov radiation, biological information communication, financial modeling, insurance, and immigration-death processes.

Keywords: Shot noise; Poisson cluster processes; Asymptotic normality; Power law response.

1. Introduction

A shot noise model is given by superposing "shot effects" which initiate at random times and persist through random durations, possibly infinite. Such stochastic processes arise very naturally in diverse fields — see, for example, Parzen [11], Cox and Isham [2], Bondesson [1], Lowen and Teich [10], Snyder and Miller [15], and Samorodnitsky [13, 14].

In particular, a (possible random) real-valued shot effect or "impulse response" function $h(t, t', y)$ represents the remaining effect at time t of an impulse initiated at time t' and may

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Some Further Asymptotic Results in a Quadratic Classification Problem for Stationary Gaussian Time Series

Gerald E. Rubin
Marshall University

ABSTRACT For the classification problem based on T observations $\boldsymbol{X}$ = ($X(0)$, $X(1),\ldots, X(T-1))'$ from the discrete-parameter, zero-mean, stationary Gaussian time series into two mutually exclusive and exhaustive categories corresponding to different covariance matrices (or different spectral density functions), we consider various quadratic discriminants. In Rubin [4], we proved that normed forms of these discriminants were close in terms of various convergence modes. In this paper, we prove some asymptotic results, including proving that standardized forms of these discriminants are asymptotically normally distributed. We also prove that the tests using normed forms of some of these discriminants are consistent.

Keywords： Classification problem; Stationary Gaussian time series; Quadratic discriminant; Covariance matrix; Spectral density function; Eigenvalue; Cumulant; Convergence in mean-square; Convergence in probability; Convergence in distribution; Consistent test.

1. Introduction

In Rubin [4], we considered various quadratic discriminants for the classification problem of the T observation vector $\boldsymbol{X}=(X(0),X(1),\ldots,X(T-1))'$ from the discrete-parameter, zero-mean, stationary Gaussian time series $\{\boldsymbol{X}(t)\}$ into two mutually exclusive and exhaustive categories corresponding to different covariance matrices (or different spectral density functions). We showed that normed forms of these discriminants were all close in the sense of almost-sure and mean-square convergence modes. We also derived expressions for the asymptotic normed means, variances, and cumulants for these discriminants.

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An Asymmetric Generalization of Gaussian and Laplace Laws

Abraham Ayebo and Tomasz J. Kozubowski
University of Nevada at Reno

ABSTRACT We study a class of skew continuous distributions on the real line that arises from symmetric exponential power laws by incorporating inverse scale factors into the positive and negative orthants. Skew and symmetric Laplace and normal laws are included in this class as special cases. We present main properties of skew exponential power laws, derive maximum likelihood estimators of their parameters, and discuss their applications in finance.

Keywords: Asymmetric Laplace law; Double exponential distribution; Exponential power distribution; Foreign currency exchange rate; Generalized error distribution; Generalized exponential distribution; Maximum likelihood estimation; Skew normal distribution.

1. Introduction

Consider a positive exponential power distribution with density

$$h(x)=\frac{\alpha}{\Gamma(1/\alpha)}\frac{1}{\sigma}\begin{cases}\exp(-x^{\alpha}/\sigma^{\alpha}) & \text{for } x\geq 0,\\ 0 & \text{for } x<0,\end{cases} \tag{1.1}$$

where $\alpha>0$ is the shape parameter and $\sigma>0$ is the scale parameter (see, e.g., Bartoszewicz [5] and references therein). A symmetrization of (1.1) leads to the Exponential power distribution (generalized error distribution) on $\mathbb{R}$ with p.d.f.

$$g(x)=\frac{\alpha}{2\sigma\Gamma(1/\alpha)}\exp(-|x/\sigma|^{\alpha}), x\in\mathbb{R}.$$

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A Nonparametric Test for Truncated Data

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Tunghai University

ABSTRACT Under left truncation, a pair of independent random variables *U* and *V* are observable only when $U \geq V$. Let *F* and *G* denote the distribution functions of *U* and *V* with lower boundaries a_f and a_g respectively. The nonparametric maximum likelihood estimate of $\overline{F}(x) = 1 - F(x)$, $\overline{F}_n(x)$, was first introduced by Lynden-Bell [3]. When $a_f \geq a_g$, the consistency results for the estimate $\overline{F}$ were proved by Woodroofe [7]. He and Yang [1] provided the consistency results for $\overline{F}_0(x)$ $= P(U > x \mid U \geq a_g)$ without having to assume $a_f \geq a_g$. Given the sample size *n*, let $f_n = inf\{x : F(x) \geq 1/n\}$ denote the n^{-1}th quantile of *F*. Similarly define g_n for *G*. In this note, it is pointed out that when $f_n < g_n$, $\overline{F}_n$ can badly overestimate $\overline{F}_0$. In applying the estimate $\overline{F}_n$, it is important to be confident that $f_n \geq g_n$. Motivated by the work of Maller and Zhou [4], for censored data, two nonparametric tests, $\widetilde{\alpha}_n$ and q_n-test, are proposed for testing the hypothesis H_0 : $f_n \leq g_n$ versus H_a : $f_n > g_n$. Our investigation shows that both the $\widetilde{\alpha}_n$ and q_n-test are practically useful.

Keywords: Truncated data, Nonparametric test.

1. Introduction

Let *U* and *V* be two independent positive random variables representing the lifetime and the truncation time associated with a subject under study. Let *F* and *G* denote the distribution functions of *U* and *V* with lower boundaries

$$a_f = inf\{x : F(x) \geq 0\} \quad \text{and} \quad a_g = inf\{x : G(x) \geq 0\},$$

respectively. Similarly, given the sample size *n*, let

$$f_n = inf\{x : F(x) \geq 1/n\} \quad \text{and} \quad g_n = inf\{x : G(x) \geq 1/n\}$$

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On a Non-preemptive Priority Queueing System with a Single Server Simultaneously Dealing with Two Heterogeneous Queues $M/G_1/1$ and $M/G_2/1$

Kailash C. Madan and Walid Abu-Dayyeh
Yarmouk University

ABSTRACT We study a non-preemptive priority queueing system with a combination of M/G1/1 and M/G2/1 queues. Two classes of units, priority and non-priority, arrive at the system in two independent Poisson streams. Under a non-preemptive priority rule, the server provides heterogeneous general service to the priority units and the non-priority units. We have obtained steady state probability generating functions of the queue size as well as the system size. Corresponding results for some special cases, including known results of the M/G1/1 and the M/G2/1 queues, have been derived.

Keywords**：**Priority and non-priority units, independent Poisson streams, non-preemptive priority rule, general heterogeneous service, steady state.

2. Introduction

Many authors including Cobham [5], Phipps [16], Schrage [17], Jaiswal [9], Madan [13], Simon [18], Takagi [19], and Choi and Chang [4] have investigated priority queues. These authors and several others have studied single server or multi-server queues with two or more priority classes under preemptive or non-preemptive priority rules. All these authors essentially assume the same service time distribution for all classes of units with identical or different service rates. In a recent paper, Abate and Whitt [1] have studied a queueing system with two class units having different service times. However, the present model studied by us is

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A Note on Generalized Gamma Family

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ABSTRACT A new definition of generalized gamma (GG) family is introduced. General formulae for the determination of moments of various distributions belonging to the GG family are derived and applied.

Keywords：Generalized gamma family, Moments, Skewness, Kurtosis.

3. Introduction

The family of GG distribution was first introduced by Stacy [6]. According to Stacy [6], if $(X/a)^p = Z$ (for $p > 0$ and $a > 0$) follows gamma distribution, then the distribution of X is called GG distribution. Later on Johnson and Kotz [3] defined it by introducing one more parameter. According to Johnson and Kotz [3], if

$$\left(\frac{X-b}{a}\right)^p = Z \quad (\text{for } p > 0 \text{ and } a > 0)$$

follows gamma distribution then the distribution of X is called GG distribution. However, family of GG distribution is a subfamily of the exponential family of distributions. The distribution of a random variable X belongs to the one-parameter exponential family (Barndorff-Nielson [1]), if the pdf of X is of the form

$$f(x,\theta) = \exp\{a(x)b(\theta) + c(\theta) + h(x)\} \tag{1.1}$$

A large number of distributions belong to this family and can be obtained for suitable choices

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A Note on Estimation for an Exponential Hazard Rate

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National Central University

ABSTRACT There are two ways to estimate the parameter of the minimum of two independently exponentially distributed random variables. We make comparisons between these two estimators based on mean square error and Pitman's measure of closeness. The results are useful in reliability analysis.

Keywords：Hazard rate.

1. Introduction

Series system is an important model in reliability analysis. A k components series system fails if any one of its k components fails. Therefore, the life time of the system is the minimum life time of the k components. The reliability of a series system can be evaluated by information from components or system. This paper studies how to decide which information gives better statistical inference.

2. Main Results

Consider $k = 2$ components system first. Let X and Y denote the life times of the two components, and Z denote the life time of the series system, i.e., $Z = \min\{X, Y\}$. In addition, assume X, Y are independent and exponentially distributed random variables with density functions

$$f_X(t) = \lambda_X \exp\{-\lambda_X t\} \quad \text{and} \quad f_Y(t) = \lambda_Y \exp\{-\lambda_Y t\}$$

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Convex Combination of Estimators

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University of Rhode Island

ABSTRACT A convex combination of several estimators is proposed and discussed. If all the estimators are unbiased and uncorrelated, then the proposed estimator is unbiased and has minimum total mean square error (MSE) in the class of convex estimators. Applications include a simple approach to obtain the usual pooled estimators having the minimum total MSE in the class of convex estimators, along with covariances and the corresponding total MSE of these estimators.

Keywords: Coefficient of kurtosis; Convex combination; Covariance matrix; Mathematica; Total mean square error; Unbiased estimate.

1. Introduction

It is well-known that when combining two uncorrelated estimators to form a better estimator of a parameter, the resulting estimator is often a convex combination of the two estimators. One method of estimation is to form the joint distribution and obtain the maximum likelihood estimator (MLE). More generally, with several estimators the so-called pooled estimator can also be found by the maximum likelihood method. Some relevant literature on pooling estimates can be obtained from Han and Bancroft [4], Bancroft and Han [1], and Glass [2] among others. In many introductory statistics texts, pooled estimates of means, proportions, and variances are often just stated with little explanation since the distribution theory needed for the maximum likelihood method is beyond the mathematical level of many students.

The previously mentioned estimation technique requires knowledge of the underlying distributions. The proposed convex combination estimator does not require such distributional assumption. However, it does necessitate knowing the covariance matrices of the dis-

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Cost Growth Models for NASA's Programs

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ABSTRACT Under two cost growth indices: annual absolute and relative cost growth, probability and statistical models are constructed for the cost growth of NASA's programs. Each NASA's program is basically comprised of many subsystems/ components. The levels of technology maturity for subsystems and/or components are generally very different. NASA uses a scale of 1 (lowest) to 9 (highest) to rate the technology readiness level (TRL) of each subsystem/component. By using Johnson's four-parameter family of bounded, unbounded, or lognormal distributions, probability models are constructed for subsystems/components of different TRLs. From the built probability models, subsystems/components with technology readiness levels rated as TRL6 or TRL8 have much higher relative cost growth than those with other ratings. This implies that judgmental ratings of subsystems/components of TRL6 or TRL8 made by NASA's program managers are less accurate. In contrast to subsystems/components, statistical models are built for the programs themselves. From the constructed statistical models, the program's annual absolute cost growth is shown to grow at a rate of 5.9% of the program's initial cost estimate with a standard error of 0.3%, while the program's annual relative cost growth grows at a rate of 1.6% of the weighted average of technology readiness levels among the program's subsystems/components with a standard error of 0.3%. We believe that NASA's program managers will benefit from the result of this research in their wrestling with the cost growth of NASA's program in the future.

Keywords: Cost growth indices, Johnson's four-parameter distributions, Maximum likelihood estimation, NASA's technology readiness levels.

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