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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, will be seriously considered for publication. 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.

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Lamperti's Invariance Principle for Weak Dependent Sequences in Hölder Spaces

Farida Achemine and Djamel Hamadouche
Université Mouloud Mammeri de Tizi-Ouzou

ABSTRACT We consider Lamperti's invariance principle in Hölder spaces for random variables satisfying Doukhan-Louhichi dependence condition. With some moment inequalities, we obtain a version of Lamperti's invariance principle for the polygonal interpolation of the partial sums process. Similar results are proved for the convolution smoothing of partial sums process.

Keywords Tightness; Hölder space; Invariance principle; Brownian motion; Weak dependence.

1. Introduction

The weak convergence of a sequence $(\xi_n, n \geq 1)$ of stochastic processes in some functional space provides results about the asymptotic distribution of continuous functionals of the paths. Since the Hölder spaces are topologically embedded in the spaces $C[0,1]$ of continuous functions and in the Skorokhod space $D[0, 1]$, they support more continuous functionals for statistical applications. From this point of view, the alternative framework of Hölder spaces gives functional limit theorems of a wider scope. This choice may be relevant as soon as the paths of ξ_n and the limit process (like e.g., the Brownian motion and the Brownian bridge) share some Hölder regularity. The first result in this direction seems to be Lamperti's Hölderian invariance principle [12] for the (centered and normalized) polygonal partial sums processes. This result gives the Hölderian convergence of random polygonal lines process based on a normalized partial sums of a sequence of independent identically distributed random variables to the Brownian motion for all $\alpha < 1/2$.

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Hölder Convergence of the Perturbed Empirical Process for Non-Stationary Sequences

Farid Graiche and Djamel Hamadouche
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ABSTRACT It's well-known that the sequence of smoothed empirical processes based on i.i.d. random variables with values in [0, 1] converges to the generalized Brownian bridge in $H_\alpha[0,1]$. We consider the empirical process based on non-i.d. random variables. We define the convolution smoothing $\tilde{\xi}_n$ of this process and we prove the Hölder convergence of the smoothed process to a generalized Brownian bridge. Since the convolution smoothing does not commute with the change of variable $U_i = F^{(i)}(X_i)$, we introduce a class of Hölder spaces $F_0^\alpha(\mathbb{R})$ and we prove also the Hölder convergence on the line $\mathbb{R}$. These convergences depend on the Hölderian regularity β of the distribution functions $F^{(i)}$ and the results hold for all $\alpha < \beta/2$.

Keywords Brownian bridge; Hölder space; Perturbed empirical process; Schauder decomposition; Tightness.

1. Introduction

A weak convergence of a sequence of stochastic processes is studied in the Skorokhod space $D[0, 1]$ or in the space of continuous functions $C[0,1]$, but the weak Hölder convergence offers more continuous functionals than C for statistical applications. From this point of view, the Hölder space framework gives functional limit theorems of a wider scope. This is also natural since generally the sequence $(\xi_n, n \geq 1)$ and the well-known limit processes such as the Brownian motion and the Brownian bridge have paths in Hölder spaces. The first result in this direction is Lamperti's Hölderian invariance principle [7] for the (centered and normalized) polygonal partial sums processes. This result gives the Hölderian convergence of random poly-

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A Class of Generalized Shannon-McMillan Theorems for Arbitrary Information Source on Generalized Random Selection System

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ABSTRACT In this paper, our aim is to establish a class of Shannon-McMillan theorems for arbitrary information source on the generalized random selection system by constructing the consistent distribution functions. As corollaries, we obtain some Shannon-McMillan theorems for arbitrary information source and *m*-th order non-homogeneous Markov information source. Some results which have been obtained are extended. In the proof, a new technique for studying Shannon-McMillan theorems in information theory is applied.

Keywords Generalized Shannon-McMillan theorem; The consistent distribution; *m*th-order Markov information source; Relative entropy density.

1. Introduction

Let $(\Omega, \mathcal{F}, P)$ be a probability space, $\{X_n, n \geq 0\}$ be an arbitrary information source defined on $(\Omega, \mathcal{F}, P)$ which takes values on the alphabet set $S = \{s_1, s_2, \cdots, s_M\}$ with joint distribution

$$P(X_0 = x_0, \cdots, X_n = x_n) = p\{x_0, \cdots, x_n\} > 0, x_i \in S, 0 \leq i \leq n. \tag{1}$$

Let

$$f_n(\omega) = -\frac{1}{n+1} \log p(X_0, \cdots, X_n)$$

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Characterization of Generalized Polya Eggenberger Distributions Family of the Second Kind

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ABSTRACT Janardan [5] introduced the generalized Polya Eggenberger distributions of the first and the second kinds. Here another form of generalized Polya Eggenberger distributions of the second kind, $GPED_2$, characterized by four parameters is defined and studied. The probability generating function and some of its properties such as comparisons of the original random variable and weighted random variable, are given. Recurrence relations for computation of the probabilities of $GPED_2$ are provided. The parameters of $GPED_2$ are estimated by the methods of moments, the first three moments and zero frequency, and the maximum likelihood estimations.

Keywords Generalized Polya Eggenberger distributions of the first and the second kinds; Probability generating function; Moments; Maximum likelihood estimators; Lagrangian Katz family of distributions; Lagrangian Katz family of the second kind.

1. Introduction

Janardan [3] developed the family of generalized Markov-Polya distributions (*GMPD*) which has been shown to have a large number of applications. *GMPD* contains several distributions as special cases. For instance, it has binomial, hypergeometric, negative hypergeometric or beta binomial, generalized hypergeometric, generalized negative hypergeometric and Markov-Polya distributions.

Studying the properties of *GMPD*, Janardan [3] obtained, under certain conditions, a limiting distribution of *GMPD* and termed this distribution as the Generalized Polya Eggenberger distribution (*GPED*). Janardan and Rao [6] gave a number of characterizing properties for both *GMPD* and *GPED*. Janardan [3] derived the *GPED* formally and studied its

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Distribution of the Test for a Single Lower Outlier in a Gamma Sample

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ABSTRACT In this paper, we obtain the density approximant for a test statistic useful for detecting single lower outlier in a gamma sample using Jacobi orthogonal polynomial. A comparative study is carried out of the critical values obtained by using the proposed methods to the corresponding results given by Barnett and Lewis [2]. This reveals that the proposed technique provides very accurate approximation to the distribution. Finally, we present a numerical example to illustrate the proposed approximation. Monte Carlo simulations suggest that the proposed method provides very accurate approximate density to test a single lower outlier in a gamma sample.

Keywords Discordancy test; Gamma distribution; Moments; Jacobi polynomial approximants; Outliers.

1. Introduction

Problems of outliers in samples from gamma distributions, and in particular from exponential distributions, are of considerable practical importance. Gamma and exponential samples arise naturally in life-testing experiments. They arise in many contexts where Poisson processes are appropriate basic models, for example, the number of telephone calls arriving at a switchboard during any specified time interval, study of traffic flow, failure of electronic equipments, etc. A gamma distribution can also be used as an approximation to the asymptotic distribution of co-integration tests in econometric literature (Doornic [8], Boswijk and Doornik [5]). Detecting outliers plays important role in inferential statistics. For example, the distortionary

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Optimal Minimal Maintenance of Deteriorating System Subject to Exponential Failures with Maintenance and Repairs Modeled by Coxian-2 Distribution

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ABSTRACT A Markov model is considered to calculate the steady state availability of a system which may adopt several stages of degradation and is subject to random failures at each stage of degradation. All failures have exponential distributions. Minimal maintenance and partial repairs restore the system to the previous degraded stage and to the operational stage just before failure, respectively. Overhaul repair returns the system to "as good as new" after degradation failure. Maintenance and partial repairs have general distributions with square of coefficient of variation greater than or equal to one and state dependent which can be modeled by Coxian-2 distribution, while overhaul repair has an exponential distribution. Finally, the mean time to minimal maintenance maximizing the availability in case of state independent is determined.

Keywords Deteriorating system; Exponential failures and overhaul repair; Partial repair; Optimal minimal maintenance of Coxian-2 distribution.

1. Introduction

In many systems, failures can be classified into degraded and random failures, respectively, see [1]. According to Rausand and Oien [2] any random failure occurs out of a sudden and ceases one or more fundamental functions of the system which requires repair to return the system to a satisfactory condition. Degraded failure which is gradual, partial, or both may not cease the fundamental function and there can be multiple stages of degradation, and the system may fail after a certain number of stages. A repair of a degraded failure to restore the system to the previous degraded stage is considered as a minimal maintenance, see [3]. In each degrada-

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Asymptotic Properties of MLE's for Distributions Generated from a 2-Parameter Weibull Distribution by a Generalized Log-Logistic Transformation

James U. Gleaton and M. Mahbubur Rahman
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ABSTRACT A generalized log-logistic (g.l.l.) family of lifetime distributions is one in which any pair of distributions are related through a g.l.l. transformation, for some (non-negative) value of the transformation parameter (the odds function of the second distribution is the -th power of the odds function of the first distribution). We consider g.l.l. families generated from a 2-parameter Weibull distribution. It is shown that the Maximum Likelihood Estimators (MLE's) for the parameters of the generated, or composite, distribution have the properties of strong consistency and asymptotic normality and efficiency.

Keywords Generalized log-logistic families; 2-parameter Weibull distribution.

1. Introduction

Gleaton and Lynch [2] examined the reliability of a particular physical system, an inhomogeneous bundle (varying cross-sectional areas) of brittle elastic fibers subjected to tensile stress. It was shown that, for equal load sharing, the Maximum Entropy Principle implies that the fiber survival distributions are related to each other through a *generalized log-logistic* (g.l.l.) transformation, defined below. More generally, this type of relationship between the survival distributions for the components of a system will hold for systems having the following characteristics: i) there is a parallel system of components, each subjected equally to the same load, or input; ii) each component's response is proportional to the component load, up to the point of component failure; iii) there are differences among the constants of proportionality of the component responses; and iv) component responses are conditionally in-

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Misclassified Ordinal Data in Case-Control Studies

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ABSTRACT This paper studies the estimation problem for case-control studies with misclassified ordered polychotomous data. Under an assumption that misclassification only occurs between adjacent categories of the exposure variable, a bias-adjusted generalized odds ratio and a linear trend test were proposed to account for misclassification errors. The data of nasal carrier rates for streptococcus pyogenes among healthy children provided from the main study was used to illustrate on how to conduct a sensitivity analysis because the validation data are not available. A unique strength of this paper is that the sensitivity analysis presented here is probably the only viable way to conduct such a study in case the validation data are not available.

Keywords Generalized odds ratio; Linear trend test; Misclassification; Ordinal scale.

1. Introduction

Case-control studies with misclassified data are widely studied for the 2 × 2 contingency tables (see, for example, Fleiss, et al. [8]; Rothman and Greenland [21]). Works on testing independence in ordered polychotomous 2 × K ($K \geq 3$) contingency tables are also done by several people (Emerson and Moses [7]; Graubard and Korn [10]). Yet there appear little works for case-control studies if the collected polychotomous data are misclassified. The reason why the polychotomous case-control data might be misclassified is exactly the same as that for 2 × 2 contingency tables, that is, if the data are collected from personal interview for a person to recall or from a proxy as a substitute to provide the needed information (Humble *et al*. [12], Nelson *et al*. [19]). By borrowing the terminology from Marshall [17], what Marshall *et al*. [15] considered is called a direct-misclassification, that is, the authors assumed the observed table as a correctly classified table and then generated the misclassified table from the observed table by choosing arbitrarily some known misclassification probability. Afterwards they studied the trend

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Three Stage Quantitative Randomized Response Model

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ABSTRACT This article extends Ryu *et al*. [9] two stage randomized response model (RRM) assuming simple random sampling with replacement (*srswr*) sampling design and stratified random sampling design. Though, the simple random sampling without replacement (*srswor*) design is more efficient than *srswr* sampling design but they become equally efficient when population is infinite or practically large. Thus assuming an infinite population, it has been observed that with *srswr* and stratified random sampling, the estimator proposed on the basis of this extension is unconditionally more efficient than the estimators proposed by Greenberg *et al*. [3], Eichhorn and Hayre [2], Gupta *et al*. [4] and Ryu *et al*. [9]. It would definitely be better than Ryu *et al.* [9] RRM under any random sampling design because of extended number of stages. Actually, we intend to compare the two RRM's assuming any sampling design and the proposed extension is found to be better in *srswr* situation and stratified random sampling protocol. The respondents are assumed to be completely truthful in reporting their answers.

Keywords Randomized response technique; Estimation of mean; Stratified random sampling; Evasive answer bias; Privacy protection.

1. Introduction

Since the introduction of randomized response (RR) model by Warner [10] as an alternative survey method to decrease the evasive answer bias in the estimates obtained by direct response survey methodology, a large number of randomized response methods have been developed. The objective of all these methods is to reduce response error, non-response and the evasive answer bias by protecting the respondent's privacy. Stratified random sampling is now being applied in the more recent developments, e.g., Hong *et al.* [5], Kim and Warde [7] and Ryu *et al*. [9]. Based on Ryu *et al*. [9] RRM, we present a model which is more efficient than those of Greenberg *et al*. [3], Gupta *et al*. [4] and Ryu *et al*. [9] RRMs under the assumption

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Appendix

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