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Appendix

Variance Stabilizing Transformations for the Noncentral Chi-Square Distribution

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ABSTRACT We consider a noncentral chi-square variate $X_{\nu,\lambda}$ with ν degrees of freedom and noncentrality parameter λ and provide new variance stabilizing transformations for $X_{\nu,\lambda}$ in two situations: The first when $\nu \rightarrow \infty$ while λ remains fixed and the second when $\lambda \rightarrow \infty$ and ν remains fixed. It is shown that the resulting transformations are of order $O(\nu^{-2})$ as $\nu \rightarrow \infty$ and $O(\lambda^{-2})$ as $\lambda \rightarrow \infty$, respectively. Concrete suggestions are made for obtaining variance stabilizing and normalizing transformations of order $O(\nu^{-k})$ or $O(\lambda^{-k})$ for a general k .

Keywords Stabilizers; Normalizers.

1. Introduction

In this note we consider a set of variance stabilizing and normalizing transformations for the noncentral chi-square distributions obtained for large values of the noncentrality parameter or large values of the “degrees of freedom” parameter. A thorough description of the noncentral chi-square distribution is presented in Johnson, Kotz and Balakrishnan [11]. In addition to natural applications of this distribution in statistical inference, numerous other applications have been given in various fields such as communication theory, actuarial sciences, interest rates, and to constant elasticity of variance models which relate to volatility and stock prices.

The density function of the noncentral chi-square distribution with noncentrality parameter $\lambda \geq 0$ and “degrees of freedom” $\nu > 0$, is given by

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Establishing Consistency of M-Estimators under Concavity with an Application to Some Financial Risk Measures

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ABSTRACT We establish consistency of M-estimators under a concavity with probability tending to 1 assumption on the sample criteria functions. The true parameter must be globally identifiable, otherwise all results hold locally, but the parameter space may be unbounded. Under an additional Lipschitz condition on the criteria functions, consistent plug-in estimators for nuisance parameters are shown to lead to consistent estimators for the parameter of interest. The results are applicable to a wide variety of common estimators including mean, variance, quantiles, and Huber estimators, all of which can be derived from concave criteria functions. An illustration establishes consistency and asymptotic normality for two estimators of financial risk, that can be expressed as linear combinations of quantiles.

Keywords Lipschitz condition; Estimating equation; Nuisance parameter; Value-at-Risk; Conditional Value-at-Risk; Strictly stationary; Selection differential.

1. Introduction

In likelihood-based inference, it is highly desirable that the log-likelihood be concave in the parameters. Non-concave likelihoods can lead to serious numerical difficulties; for example, the likelihood may have several local maxima, making it difficult to select that sequence which converges to the parameter that globally minimizes the Kullback-Leibler distance between the model and the true distribution. Hence from an implementation point of view, concave likelihoods are preferred to non-concave ones, the trade-off being a potentially worse model fit. If the likelihood is not concave in a parametric setting, one could opt for a

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Using General Inverse Sampling Design to Avoid Undefined Estimator

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ABSTRACT We consider the problem of estimating a ratio for which the denominator estimator can take zero value. Under a simple random sampling (SRS) design, if all observations of the denominator variable are zero, the ratio estimator would be undefined. A natural solution is to use an inverse sampling design for which one continues sampling until at least a predetermined number of nonzero values is observed for the denominator variable. General inverse sampling proposed by Salehi and Seber [13], is a more practicable version of inverse sampling. Using Taylor expansion, we derive here an asymptotic unbiased estimator of the ratio and an approximate variance estimator for a general inverse sampling design. We use simulation to evaluate the efficiency of the developed estimator, based on a real population from the Statistical Center of Iran and an artificial population. We compute its relative efficiency over the usual SRS ratio estimator. Using general inverse sampling, we not only control the problem of an undefined estimator but also show that the developed estimator is more efficient than its counterpart of SRS.

Keywords Murthy's estimator; Rare events; Taylor expansion.

1. Introduction

Inverse sampling was first proposed by Haldane [5] in which one continues sampling until a pre-determined number of rare events of interest is observed. It is generally a more appropriate

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Transformed Test for Homogeneity of Variances

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ABSTRACT A transformed version of Bartlett test is proposed for testing homogeneity of variances with non-normal data. The transformation is intended to achieve nearing normality of the data and independence of the observations to some extent. It is evident from the simulation that the transformed test is more robust than the untransformed Bartlett test against departure from the normality assumption. The simulation results demonstrate that the proposed transformed Bartlett test performs favorably over the untransformed Bartlett test and three Levene tests on controlling the testing sizes and has testing power comparable with the Levene tests. The proposed transformed Bartlett test frees users from the burden of selecting a Levene test out of the four versions of Levene tests.

Keywords Bartlett test; Equality of variances; Normality; Levene test; Power transformation; Robustness.

1. Introduction

The analysis of variance (ANOVA) is one of the most important and useful statistical techniques for comparing different groups or treatments with respect to their means. Let us consider testing equality of means of K populations given independent random samples $\{x_{ij} : j = 1, 2, \dots, n_i\}$ from the i th population with mean μ_i , variance σ_i^2 and distribution function $F\{\sigma_i^{-1}(x - \mu_i)\}$, $i = 1, 2, \dots, K$. The hypothesis to be tested is

$$H_0 : \mu_1 = \mu_2 = \dots = \mu_K \quad \text{versus} \quad H_1 : \mu_i \neq \mu_j \quad \text{for some} \quad H_1 : i \neq j. \quad (1)$$

A set of assumptions, namely, normal distribution, homogeneity of variances and independence

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Asymptotic Variance-Covariance Matrix of the ML Estimates Based on General Progressive Censored Data Using EM Algorithm

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ABSTRACT This article deals with the problem of estimating parameters when the data are general progressive Type-II censored sample by using the EM algorithm. First, we generalize the results of Ng *et al.* [19] for finding the asymptotic variance-covariance matrix of the maximum likelihood estimates (MLE's) when the first r observations are missing from the progressive scheme. Secondly, we propose an EM algorithm for the MLE's under the general progressive Type-II censoring. In order to show the usefulness of the proposed technique, we consider the lognormal model as an example. Finally, we carry out some Monte Carlo simulations based on 10,000 runs each.

Keywords EM algorithm; maximum likelihood estimates; general progressive Type-II censoring; Life time data; Asymptotic variances; Missing information; Lognormal distribution; Simulation experiment.

1. Introduction

The scheme of progressively censored sample s have been studied, among others, by Davis and Feldstein [12], Sen [21], Halperin *et al.* [16], Viveros and Balakrishnan [22], Bandyopadhyay and Chattopadhyay [7], Yuen and Tse [23], Aggarwala and Balakrishnan [1], Balakrishnan *et al.* [5], Guilbaud [15], Balakrishnan *et al.* [6], Ali Mousa and Jaheen [2], Basak and Balakrishnan [8], Raqab [20], Alvarez-Andrade and Bordes [3], Bordes [9], and Hofmman *et al.* [17]. The scheme of censoring was extensively studied by Balakrishnan and Sandhu [4]. On the basis of a general Type-II progressively censored sample, Fernández [14] has considered the problem of estimating exponential parameter.

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Estimation of the Common Mean of Two Normal Populations Using Within and Cross Ranked Set Sampling

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ABSTRACT The problem of estimating the common mean of two normal distributions using ranked set sampling (RSS) is considered. Two approaches of taking the RSS sample are investigated: The within- populations RSS (WRSS) and the cross-populations RSS (CRSS). The two cases of known and unknown variances are studied. The suggested estimators, using the above two approaches of sampling, are compared to their simple random sampling (SRS) counterparts estimators.

Keywords Common mean; Ranked set sampling; Cross populations ranked set sampling; Within populations ranked set sampling; Conditional efficiency.

1. Introduction

It is very common to have data available from two different distributions that share the same mean value; for example: Items produced by a factory usually share the same nominal weight. Two or more machines may be used to weigh these items. Thus, the items weighted by the two machines have the same mean value but different variances (different precisions).

The problem of estimating the common mean of two independent normal populations is an old and well-known problem. It has been considered by many authors. Graybill and Deal [13] showed that, if we have two independent random samples X_1, X_2, \dots, X_{n_1} and Y_1, Y_2, \dots, Y_{n_2} from two normal populations with common mean μ and different unknown variances σ^2 and τ^2 respectively, then

$$\hat{\mu}_{SRS}^* = \frac{S_2^2/n_2}{(S_1^2/n_1) + (S_2^2/n_2)} \bar{X} + \frac{S_1^2/n_1}{(S_1^2/n_1) + (S_2^2/n_2)} \bar{Y}$$

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Use of Known Correlation Coefficient in Construction of Ratio-Product Estimator for Estimating the Finite Population Mean

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ABSTRACT A ratio-product estimator for estimating the population mean of the variable under study using known correlation coefficient is proposed. Under simple random sampling without replacement (SRSWOR) scheme, the expressions of bias and mean squared error (MSE) up to first order of approximation are derived. The regions of preference are obtained under which it is better than usual ratio estimator, sample mean, product estimator and that considered by Singh and Tailor [11]. An empirical study is carried out to illustrate the performance of the constructed estimator over others.

Keywords Auxiliary variable; Bias; Mean-squared error; Correlation coefficient and ratio-product estimator.

1. Introduction

It is common practice to use the auxiliary variable for improving the precision of the estimate of a parameter. The use of supplementary information has been dealt at great length for improving estimators in sample surveys (see Cochran [2], Sukhatme and Sukhatme [15]) and the references therein. Cochran [1] developed the ratio estimator to estimate the population mean or total of the study variable y by using supplementary information on an auxiliary variable x , positively correlated with y . The ratio estimator is most effective when the relationship between y and x is linear through the origin and the variance of y is proportional to x . When the auxiliary variate x is negatively correlated with the study variate y , Murthy [5] proposed the product estimator for the population mean or total.

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A Note on Linear Combination of Two U-Statistics for Testing New Better Than Used

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ABSTRACT Testing exponentiality against positive aging has been an active research area in the past three decades. A particular type of positive aging, namely the new better than used distributions is useful in the study of replacement policies. Two classes of test statistics for testing exponentiality against new better than used alternative are proposed, which are the linear combinations of U-statistics. The asymptotic distributions of the proposed class of tests are studied. The performance of the members of the classes of tests is studied in terms of Pitman asymptotic relative efficiency in comparison with the tests due to Hollander and Proschan [9] and Ahmad ([1], [2]). It is observed that the newly proposed tests are better for some value of the subsample size and mixing coefficient.

Keywords New better than used, U-statistic, Linear combination, Asymptotic relative efficiency.

1. Introduction

The modeling of the probability distribution of life time of units is an important aspect in reliability theory. The exponential distribution is a popular model which is useful wherever the 'no aging' phenomenon is evident. 'No aging' means that the probability distribution of the life time of a unit does not change with the knowledge that the unit has already survived for a given time. In contrast, the term 'positive aging' is used to denote the situation where the performance of a unit deteriorates with its age. Classes of life distributions based on notion of aging have been introduced in the literature. Some of the classes of life distributions based on aging are increasing failure rate (IFR), increasing failure rate average (IFRA) and new better than used (NBU). The chain of implication of these life distributions is given by

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An Impact of the U.S. and the U.K. Return Rates' Volatility on the Stock Market Returns: An Evidence Study of Japan's Stock Market Returns

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ABSTRACT This paper combines the idea of the self-exciting threshold autoregressive model (Tsay, [20]) and the idea of the GJR-GARCH model (Glosten *et al.* [12]) to propose a double variable's threshold-GARCH model, and uses this model to discuss U.S. and U.K. stock price return rate volatility rates on the influence of return volatility for the Japan stock market, while at the same time one also takes the threshold values by the U.S. and U.K. stock price return rate volatilities' positive and negative values. The empirical result demonstrates that the AR(1)-double variable's threshold-GARCH(1, 1) model discussing the U.S. and the U.K. stock price return rate volatilities to the Japan stock market return influence is indeed appropriate, and also the response to the Japan stock market has an asymmetrical effect. The empirical result also shows the different influence of the good news and the bad news of the four kinds of combinations of the proposed model. The information of U.S. and U.K. stock price return rate volatilities is able to affect the Japan stock market returns' volatility. The U.S. and U.K. stock price return rate volatilities are truly able to affect the stock market return volatilities' variation risks. As such the double variable's threshold- GARCH model has the best explanatory ability as compared to the models of the SETAR and the GJR-GARCH with a single variable threshold.

Keywords Stock market return; GARCH; Asymmetrical effect; SETAR; GJR-GARCH; Double variable's threshold-GARCH; Student's t distribution.

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The Utilization of Well Weight Growth Curves to Predict Dehydration

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ABSTRACT In this retrospective study, an alternate method of dehydration determination is described using extrapolation of weights from the National Center for Health Statistics (NCHS) growth charts commonly used with pediatric patients to monitor weight gain. Since well children have been found to grow at rates approximating these curves unless ill, it seemed reasonable that each child's individual curve could be calculated and approximated as previously described. A significant deviation from the individual curve would then reflect acute dehydration and/or growth retardation from chronic illness, genetic conditions, or malnutrition. Assuming the child is otherwise healthy, the majority of deviation off the curve should reflect fluid loss in appropriate clinical circumstances such as gastroenteritis.

Keywords Cubic spline; Interpolation; Least squares; Weight growth curve.

1. Description of the Experiment

Well and sick weight data for 114 male children and 87 female children was collected from the records of University of West Virginia Hospital Family Practice Clinic in Morgantown, West Virginia. The typical data for each child consisted of the birth date and a finite sequence of

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