

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 2 Number 1

February 2004

JPSS Editorial Board

Editorial Advisors : (listed in alphabetical order according to last name)

Barry C. Arnold, Dept. of Statistics, U. of California, Riverside, CA 92521-0002, USA.
Alexander Basilevsky, Dept. of Math. and Statistics, U. of Winnipeg, Winnipeg, Manitoba, Canada R3B 2E9.
Smiley W. Cheng, Dept. of Statistics, U. of Manitoba, Winnipeg, Manitoba, Canada R3T 2N2.
James E. Gentle, Dept. of Computational Science & Informatics, George Mason U., Fairfax, VA 22030, USA.
Arjun K. Gupta, Dept. of Math. & Statistics, Bowling Green State U., Bowling Green, Ohio 43403, USA.
Chien-Pai Han, Dept. of Math., U. of Texas at Arlington, Arlington, TX 76019, USA.
Wolfgang Härdle, Institut für Statistik und Ökonometrie, Humboldt-Universität zu Berlin, Berlin, Germany.
André I. Khuri, Dept. of Statistics, U. of Florida, Gainesville, FL 32611-8545, USA.
Paul S. Levy, Division of Epidemiology and Biostatistics, U. of Illinois at Chicago, Chicago, IL 60022, USA.
Kiang Liu, Dept. of Preventive Medicine, Northwestern U., Chicago, IL 60611, USA.
Shaw-Hwa Lo, Dept. of Statistics, Columbia U., New York, NY 10027, USA.
Douglas C. Montgomery, Dept. of Industrial Engineering, Arizona State U., Tempe, AZ 85287, USA.
Sheldon M. Ross, Dept. of I. E. & O. R., U. of California, Berkeley, CA 94720, USA.
A. K. Md. Ehsanes Saleh, School of Math. And Statistics, Carleton U., Ottawa, Ontario, Canada K1S 5B6.
Robert J. Serfling, Dept. of Mathematical Sciences, U. of Texas at Dallas, Richardson, Texas 75083, USA.
Ahmad Reza Soltani, Dept. of Statistics and Operational Research, Kuwait U., Safat 13060, Kuwait.
Chih-Ling Tsai, Graduate School of Management, U. of California, Davis, CA 95616-8609, USA.
Lee-Jen Wei, Dept. of Biostatistics, Harvard U., Boston, MA 02115, USA.

Managing Advisors :

W. L. Pearn, Dept. of I. E. & Management, National Chiao-Tung U., Hsinchu, Taiwan, ROC.
Paul J. Smith, Dept. of Math., U. of Maryland, College Park, MD 20742, USA.

Chief Editor : Paul C. Chiou, Dept. of Math., Lamar U., Beaumont, TX 77710, USA.

Executive Editors :

Chihwa Kao, Center for Policy Research, Syracuse U., Syracuse, NY 13244, USA.
Andrzej Korzeniewski, Dept. of Math., U. of Texas at Arlington, Arlington, TX 76019, USA.

Associate Editors :

Md. Saleh Ahmed, Dept. of Math. and Statistics, Sultan Qaboos U., Muscat, Sultanate of Oman.
Olivier Basdevant, The World Bank, Washington DC 20433, USA.
John J. Borkowski, Dept. of Mathematical Sciences, Montana State U., Bozemen, Montana 59717, USA.
Connie M. Borrer, Dept. of Industrial Engineering, Arizona State U., Tempe, AZ 85287, USA.
Chang-Tai Chao, Dept. of Statistics, National Cheng-Kung U., Tainan, Taiwan, ROC.
Mu-Chen Chen, Dept. of Business Management, Taipei U. of Technology, Taipei, Taiwan, ROC.
Chih-Hua Chiao, Dept. of Business Math., Soochow U., Taipei, Taiwan, ROC.
Po-Huang Chyou, Marshfield Medical Research Foundation, Marshfield, WI 54449, USA.
David Drain, Dept of Math. & Statistics, U. of Missouri-Rolla, Rolla, MO 65409-0020, USA
Jamie Emerson, School of Business, Clarkson U., Potsdam, NY 13676, USA.
Shu-Kai Fan, Dept. of I. E., Yuan-Ze U., Taoyuan County, Taiwan, ROC.
Jan Hannig, Dept. of Statistics, Colorado State U., Fort Collins, Colorado 80523, USA.
Chia-Ding Hou, Dept. of Statistics and Information Science, Fu Jen Catholic U., Taipei, Taiwan, ROC.
Yu-Sheng Hsu, Dept. of Math., National Central U., Chung-Li, Taiwan, ROC.
Borko D. Jovanovic, Dept. of Preventive Medicine, Northwestern U., Chicago, IL 60611, USA.
Shahjahan Khan, Dept. of Math. & Computing, U. of Southern Queensland, Toowoomba, Qld. 4350, Australia.
B. M. Golam Kibria, Dept. of Statistics, Florida International U., Miami, FL 33199, USA.
Tai-Ming Lee, Dept. of Statistics and Information Science, Fu Jen Catholic U., Taipei, Taiwan, ROC.
Tian-Shyug Lee, Graduate Institute of Management, Fu Jen Catholic U., Taipei, Taiwan, ROC.
Tze-San Lee, NCEH/EHHE, MS E70, CDC, Atlanta, GA 30333, USA.
Chung-Yi Li, Dept. of Public Health, Fu Jen Catholic U., Taipei, Taiwan, ROC.
Pen-Hwang Liao, Dept. of Mathematics, National Kaohsiung Normal U., Kaohsiung, Taiwan, ROC.
Shang P. Lin, Statistical Sciences and Epi. Div., The Nathan S. Kline Inst., Orangeburg, NY 10962, USA.
Suzanne McCoskey, Dept. of Economics, United States Naval Academy, Annapolis, MD 21402, USA.
Vincent F. Melfi, Dept. of Statistics and Probability, Michigan State U., East Lansing, MI 48824, USA.
Kunnummal Muralidharan, Dept. of Statistics, Bhavnagar U., Bhavnagar 364 002, India.
Mohammad Z. Raqab, Dept. of Mathematics, U. of Jordan, Amman 11942 Jordan.
Kevin Robinson, Dept. of Statistics, U. of Akron, Akron, OH 44325, USA.
Mohammad Salehi M., School of Mathematical Sciences, Isfahan U. of Technology, Isfahan 84156, Iran.
Yuehjen E. Shao, Dept. of Statistics and Information Science, Fu Jen Catholic U., Taipei, Taiwan, ROC.
John F. Shortle, Dept. of Systems Engineering and O. R., George Mason U., Fairfax, VA 22030, USA.
Fred Torcaso, Dept. of Mathematical Sciences, The Johns Hopkins U., Baltimore, MD 21218, USA.
Calvin K. Yu, Dept. of I. E. & Management, Mingchi Institute of Technology, Taipei, Taiwan, ROC.
Liang Zeng, Dept. of Educational Psychology, U. of Texas Pan American, Edinburg, TX 78539, USA.

Managing (and Founding) Editor : Kuang-Chao Chang, Dept. of Statistics and Information Science, Fu Jen Catholic U., Taipei, Taiwan, ROC; e-mail: stat1016@mails.fju.edu.tw.

JPSS

Journal of Probability and Statistical Science

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
February, 2004

J P S S

Journal of Probability and Statistical Science

Volume 2 Number 1 February 2004

Table of Contents

Theory and Methods

Success Run and Its Branches: Distribution of Renewal Epochs ----- Ahmad Reza Soltani and Abdul Hamid Al-Ibrahim	1
An $M/G/\infty$ Queue in Series ----- Pu Patrick Wang, William J. Gray, and Meckinley Scott	7
Four Confidence Intervals of Rate Difference under Poisson Distributions ----- Kung-Jong Lui and Chii-Dean Lin	21
On Adaptive Sampling and Generalized Regression Method of Estimating Localized Elements ----- Arijit Chaudhuri and Amitava Saha	35
Some Nonparametric Tests for Spherical Symmetry ----- Yonghong Gao	47
Detecting a Change Point in a Sequence of Extreme Value Observations ----- N. Balakrishnan and Jie Chen	55
Shrinkage Estimation of $\Pr(X < Y)$ in the Normal Case -----Ayman Baklizi	65

Teaching and Applications

The Analysis of Large Hospital Admissions Databases Using Fundamental Regression ---- Alexander Basilevsky, Scott Nowicki, and J. Trumble Waddell	81
A Comparison and Contrast of Some Methods for Sample Quartiles ----- Anwar H. Joarder and Raja M. Latif	95
Testing the Efficiency of Emerging Markets: the Case of the Baltic States ----- Virmantas Kvedaras and Olivier Basdevant	111

Appendix

Success Runs with Branches: Distribution of Renewal Epoch

Ahmad Reza Soltani and Abdul Hamid Al-Ibrahim
Kuwait University

ABSTRACT In this article we present two Markov chains based on a *success run model*, that are called here *success runs with branches*. For each model including the success run itself we present closed forms for the distribution of the renewal epoch at zero. In special cases, these families of distributions give rise to interesting negative binomial type discrete probability mass points. Certain insurance policies, and treatment stages of certain cancers can be modeled by branches of success runs. It is demonstrated how to model treatment stages of the prostate cancer disease.

Keywords : Markov chains; The k th visit; Success runs; Negative binomial type distributions.

1. Introduction

A success run, considered in this article, is a Markov chain with state space $\{0, 1, 2, \dots\}$ that only states $0, i + 1$ can be visited from the state i in each transition with probabilities p_i and q_i respectively, $p_i + q_i = 1$. Thus at each stage if the chain does not proceed one step forward it falls back to zero. A success run presents the length of the current run of successes at time n in trials that the outcome of each trial is either success or failure. The model has various applications in applied fields. Customarily a success run is applied as a probability model for the age of a newly installed device. For very recent works on success runs see [1, 2, 4]. The model is well explained in [3].

In this article we generalize a success run in two ways. For clarification, let us call the set of states $i \geq 0$ the “the main stem”. The generalization is to allow the chain, at each state

Received March 2003, revised November 2003, in final form December 2003.

Ahmad Reza Soltani is a Professor and Abdul Hamid Al-Ibrahim is an Assistant Professor in the Department of Statistics and Operations Research, Faculty of Science, Kuwait University, Safat 13060, Kuwait; emails: soltani@kuc01.kuniv.edu.kw and abdulhamid@kuc01.kuniv.edu.kw. The permanent address of Professor Soltani is Department of Statistics, College of Science, Shiraz University, Shiraz 71454, Iran.

This work was supported by Kuwait University, Research Grant No. [SS 04/01].

An M/G/ ∞ Queue in Series

Pu Patrick Wang William J. Gray
University of Alabama

Meckinley Scott
Western Illinois University

ABSTRACT This paper is concerned with an M/G/ ∞ queue in which servers are lined in series. Because of the tandem structure of servers, customers may be blocked when they finish their services. We first derive the joint probability of the number customers in service and the number in blocking. The distributions of the delay time and blocking time are also obtained. Closed form distributions of delay and blocking times for M/M/ ∞ queues are explicitly derived.

Keywords : Order statistics; Queue length; Waiting time.

1. Introduction

In a queue with multiple servers, it is usually assumed that service times are independent, identically distributed (i.i.d.) random variables. Once a service is completed, the customer leaves the system immediately without any delay. This kind of queue has many applications in telecommunication, computer sciences, among other systems. In this paper, we consider a queueing system in which customers after being served may have to wait. This is the case when customers have to leave the system in the same order as their arrivals. This is also the situation where the servers are in a tandem structure due to physical limitation or other constraints; servers are lined up in series. As an example of application, consider a production line where jobs request a service from one of group of workers and then leave in the same order as their arrivals. Consequently, customers may still have to wait even after their service is completed (not before the service). In this case, we say a customer is blocked.

In a regular M/G/ ∞ queue (no blocking), customers arrive to the system in accordance with a Poisson process of rate λ . Each customer requests a random amount of service time

Received May 2003, revised August 2003, in final form November 2003.

Pu Patrick Wang and William J. Gray are Professors in the Department of Mathematics at the University of Alabama, Tuscaloosa, Alabama 35478, USA; emails: pwang@ua.edu and bgray@gp.as.ua.edu. Meckinley Scott is a Professor Emeritus in the Department of Mathematics at Western Illinois University, Macomb, Illinois 61455, USA and the University of Alabama, Tuscaloosa, Alabama 35478, USA; emails: msscott@texturedigital.com.

Four Confidence Intervals of Rate Difference under Poisson Distribution

Kung-Jong Lui and Chii-Dean Lin
San Diego State University

ABSTRACT When the underlying disease is rare and the length of follow-up time varies between groups in cohort studies, we commonly assume a Poisson model for the number of case occurrences. In this paper, we focus interval estimation on the rate difference between two comparison groups. We consider four interval estimators, including the most frequently used interval estimator using Wald's statistic, the two test-based interval estimators developed here with and without accounting for the constraint under the null hypothesis, and the interval estimator using the asymptotic likelihood ratio test. To evaluate and compare the performance of these interval estimators, we employ Monte Carlo simulation. We find that the interval estimator using Wald's statistic may frequently have the coverage probability less than the desired confidence level when the underlying disease rate is rare. Both test-based interval estimators developed here can generally improve the coverage probability of interval estimator using Wald's statistic. Further, the interval estimator incorporating the constraint under the null hypothesis not only outperforms the interval estimator without accounting for the constraint, but also is essentially as efficient as the interval estimator using the likelihood ratio test. An example regarding the hormone use in postmenopausal women to illustrate the practical usefulness of these estimators is provided. For completeness, the SAS program for using Monte Carlo simulation to evaluate the performance of interval estimators in a variety of situations is also included.

Keywords : Confidence interval; Poisson distribution; Rate difference; Likelihood ratio test; Coverage probability; Efficiency.

1. Introduction

When investigating the effect of a risk factor on the incidence rate of a chronic disease, such as cancer (Fleiss [10], Rosner [18]) or cardiovascular disease (Doll and Hill [9]), we often

Received April 2003, revised July 2003, in final form August 2003.

Kung-Jong Lui is a Professor and Chii-Dean Lin is an Assistant Professor in the Department of Mathematics and Statistics at San Diego State University; San Diego, CA 92182-7720, USA; emails: kjl@rohan.sdsu.edu and cdlin@sciences.sdsu.edu. Professor Kung-Jong Lui is an Elected Fellow of the American Statistical Association.

On Adaptive Cluster Sampling and Generalized Regression Method of Estimating Localized Elements

Arijit Chaudhuri

Indian Statistical Institute

Amitava Saha

National Sample Survey Organisation

ABSTRACT Adaptive cluster sampling introduced by Thompson [9] and further developed by Thompson [10] and Thompson and Seber [11], Chaudhuri [1], Salehi and Seber ([7], [8]), Chaudhuri, Bose, and Ghosh [2] among others is a promising sample selection procedure to capture relevant population elements concentrated in unknown locations in a specified geographical territory. Chaudhuri [1], in particular, has shown that if any initially chosen sampling scheme provides an unbiased estimator for a finite population total along with an unbiased estimator for its variance, then it is capable of yielding a revised adaptive cluster sampling scheme providing an alternative unbiased estimator for the total with an unbiased variance-estimator, possibly with a higher accuracy and an assured increase in the information content. Since analogously a generalized regression (greg) predictor or estimator based on an initial design is Asymptotically Design Unbiased (ADU) and equivalently Asymptotically Design Consistent (ADC) and continues to be so when revised on being based on an extended adaptive cluster sampling initiated therefrom with an achievable increase in information, we illustrate how it fares in different situations when the initial sample-size is modest. Our findings are numerically illustrated through simulations from live data concerning earners through rural small-scale industries in the unorganized sector that are sparsely scattered in a given district in West Bengal, India. We also numerically illustrate how our procedure fares vis-à-vis a comparable single stage conventional cluster sampling employing the classical regression estimator.

Keywords : Adaptive cluster sampling; Conventional cluster sampling; Generalized regression estimator; Mean square error; Two-stage Rao-Hartley-Cochran scheme; Unbiased variance estimation.

Received June 2003, revised September 2003, further revised October 2003, in final form November 2003.

Arijit Chaudhuri is a CSIR Emeritus Scientist in the Applied Statistics Unit, Indian Statistical Institute, Kolkata 700108, India; email: achau@isical.ac.in. Amitava Saha is presently working as Deputy Director in the Directorate General of Mines Safety, Dhanbad, Jharkhand-826001, India, email: saha_amitava@hotmail.com. Research of the first author is partially supported by CSIR grant no. 21(0539)/02 EMR-II.

Some Nonparametric Tests for Spherical Symmetry

Yonghong Gao

University of Missouri-Kansas City

ABSTRACT Some tests based on spatial sign data and rank data are proposed for testing null hypothesis of spherical symmetry. The asymptotic distributions of the proposed tests are all chi-squared. A small simulation study of the empirical power is conducted to compare the performance of the proposed tests with the normal theory likelihood ratio test.

Keywords : Correlation coefficient; Depth function; Sign data; Spherical symmetry; Rank data; Runs test.

1. Introduction

A $p \times 1$ random vector X is said to have a spherical symmetric distribution if $X - \lambda$ and $g(X - \lambda)$ have the same distribution for all $p \times p$ orthogonal matrices g and for some $p \times 1$ vector λ . The normal theory based test for spherical symmetry is likelihood ratio test. Baringhaus [1] proposed a von Mises type consistent test for spherical symmetry. The robust test introduced by Kariya and Eaton [6] is uniformly most powerful when the alternative distribution is elliptical symmetry. The majority of the nonnormal theory based tests are not convenient in practice. In this paper we propose three simple and easy to implement tests based on spatial signs and ranks of the data. The bases for our tests are some well-known facts about the spherical symmetry distribution. One fact is that if the distribution of X is spherical symmetric about the origin then $\|X\|$ and $S(X) = \|X\|^{-1}X$ are independent and $S(X)$ is uniformly distributed on S_p , the unit hypersphere in p -dimensional space. Another fact is about the structure of the covariance matrices $\Sigma = \text{Var}(X)$ and $\Sigma_S = \text{Var}(S(X))$ when the distribution is spherical symmetry. The matrices Σ and Σ_S are both kI_p -type, where I_p denotes the p -dimensional identity matrix. In section 2 we use multivariate correlation coefficient to test the independence of $\|X\|$ and $S(X)$. In section 3 depth-based test is discussed using the structure of Σ_S . In section 4 we study a reordered multivariate runs test. The idea of reordering the observations

Received March 2003, revised July 2003, further revised Oct. 2003, in final form Nov. 2003.

Yonghong Gao is an Assistant Professor in the Department of Mathematics and Statistics at the University of Missouri-Kansas City, Kansas City, Missouri 64110, USA; emails: gaoy@umkc.edu.

Detecting a Change Point in a Sequence of Extreme Value Observations

N. Balakrishnan

McMaster University

Jie Chen

University of Missouri-Kansas City

ABSTRACT In this paper, we present a case study of detecting a change point in a sequence of maximum value observations. We frequently encounter maximum observations in our daily life. In such cases, we may be concerned whether there has been a change in the location parameter of these maximum observations. The Schwartz Information Criterion (SIC) procedure and a Mann-Whitney-based sign test are recommended for such a change point detection problem. For multiple change points detection, a binary segmentation procedure combined with the Mann-Whitney-based sign test is presented. The methods are applied to a simulated data set and a daily maximum temperature data set secured from Kansas City, USA, for analysis of change points.

Keywords : Change point; Model selection; Information criterion; SIC; Sign test.

1. Introduction

Change point analysis is an on-going active topic in statistical studies after the first paper concerning a change point was published by Page [5]. The major reason for this continued is that change point analysis has wide range of applications not only in the statistical literature but also in many practical areas such as quality controls, weather forecasting, applied finance, medical studies, and so on. Sen and Srivastava [7] considered the single change point problem for mean vector in a sequence of multivariate Gaussian observations. Later, Srivastava

Received September 2002, revised March 2003, further revised October 2003 and , in final form December 2003.

N. Balakrishnan is a Professor in the Department of Mathematics and Statistics at McMaster University, Hamilton, Ontario, Canada L8S 4K1; email: bala@mcmaster.ca, website: <http://icarus.math.mcmaster.ca/bala/bala.html>. Professor Balakrishnan is a Fellow of the American Statistical Association and an elected member of the International Statistical Institute. He is currently the Editor-in-Chief of the journal *Communications in Statistics/Series A and Series B*. Jie Chen (corresponding author) is an Associate Professor in the Department of Mathematics and Statistics at the University of Missouri-Kansas City, Kansas City, Missouri 64110-2499, USA; email: chenj@umkc.edu.

Shrinkage Estimation of $\Pr(X < Y)$ in the Normal Case

Ayman Baklizi
Yarmouk University

ABSTRACT We consider the problem of estimating $R = \Pr(X < Y)$ in the normal case. The cases of paired data from a bivariate normal distribution as well as two independent samples of possibly unequal sizes from two normal populations are considered. We develop various shrinkage estimators of R that incorporate the prior information R_0 . The shrinkage factors are determined by utilizing the p -value of testing $H_0 : R = R_0$ and its distribution in the alternative parameter space. Another shrinkage factor is derived by minimizing the mean squared error of the corresponding shrinkage estimator. The performance of the new estimators is investigated and compared with the maximum likelihood estimator using Monte Carlo methods. It is found that some of these estimators are very successful in taking advantage of the prior available estimate.

Keywords : Shrinkage estimation, Bivariate normal distribution, P -value, Stress-strength model.

1. Introduction

The problem of making inference about $R = \Pr(X < Y)$ has received a considerable attention in literature. This problem arises naturally in the context of mechanical reliability of a system with strength X and stress Y . The system fails any time its strength is exceeded by the stress applied to it. Another interpretation of R is that it measures the effect of the treatment when X is the response for a control group and Y refers to the treatment group. Various versions of this problem have been discussed in literature. Owen *et al.* [10] considered this problem for paired observations on jointly distributed random variables having equal variances. Inference procedures are discussed in Church and Harris [1] and

Received October 2003, revised November 2003, further revised December 2003, in final form January 2004.

Ayman Baklizi is an Assistant Professor in the Department of Statistics, Yarmouk University, Irbid, Jordan; email: baklizi1@yu.edu.jo.

The Analysis of Large Hospital Admissions Databases Using Fundamental Regression

Alexander Basilevsky
The University of Winnipeg

Scott Nowicki J. Trumble Waddell
Winnipeg Regional Health Authority

ABSTRACT Consider a finite human population part of which is selected, by some event, into a subset. Such subsets of populations, for example mortalities due to car accidents or annual hospital admissions, can be considered as non-random samples where non-randomness originates with some attribute(s) of the population rather than from self-selection or systematic pre-selection by the sampler. A common difficulty is that non-randomness usually distorts and biases a statistical comparison between samples. Thus variables such as age and gender must often be controlled for when attempting to determine whether hospital use is related to socio-economic variables such as income, education, occupation, and so forth. In the present paper we use the nonparametric classical regression model to compute a regression relation between annual hospital stays and demographic age and gender variables. The conditional expectations can then be used for control purposes or as an aid for future forecasting of hospital use.

Keywords : Nonparametric regression; Age-gender adjustment; Conditional expectations; Conditional variance; Correlation ratio; Variable transformation; Inpatient length of stay; Socio-economic status; Winnipeg Regional Health Authority.

1. Introduction

The demand for hospital services is an important variable when dealing with the management and planning of health requirements of a given population. Thus it is of some interest to be able to compare the health status of residents of different areas, cultural or socio-economic backgrounds and so forth who use health resources. Such studies are at times carried out by a direct comparison of indicators of health status and services by utilizing

Received November 2002, revised June 2003, in final form August 2003.

Alexander Basilevsky is a Professor in the Department of Mathematics and Statistics at the University of Winnipeg, Winnipeg, Manitoba, Canada R3B 2E9; email: math.stats@uwinnipeg.ca. Professor Basilevsky was the former president-at-large of the Statistical Association of Manitoba. He is the author of the two books: *Statistical Factor Analysis and Related Methods* and *Applied Matrix Algebra in Statistical Sciences*. Scott Nowicki (corresponding author) and J. Trumble Waddell are Senior Statisticians, Population Health and Health Systems Analysis, Winnipeg Regional Health Authority, Winnipeg, Manitoba, Canada R3C 4Y1; emails: snowicki@wrha.mb.ca and JWaddell@wrha.mb.ca.

A Comparison and Contrast of Some Methods for Sample Quartiles

Anwar H. Joarder and Raja M. Latif

King Fahd University of Petroleum and Minerals

ABSTRACT A remainder representation of the sample size $n = 4m + r$ ($r = 0, 1, 2, 3$) is exploited to write out the ranks of quartiles exhaustively which in turn help compare ranks for quartiles provided by different methods available in the literature. The criterion of the equisegmentation property that the number of integer ranks below the first quartile, that between the consecutive quartiles, and that above the third quartile are the same, has been used to compare and contrast different methods. Four segmentation identities can be obtained for each method of quartiles which show clearly the number of observations in each of the four quarters if the observations are distinct. The Halving Method and the Remainder Method have been proposed for the calculation of sample quartiles. The quartiles provided by each of these two methods satisfy the equisegmentation property if the observations are distinct. More interestingly, in these two methods r also represents the number of quartiles having integer ranks.

Keywords : Quartiles; Remainders; Modulus; Quantiles.

1. Introduction

Quartiles, deciles, percentiles or more generally fractiles are uniquely determined for continuous random variables. A p^{th} quantile of a random variable X (continuous or discrete) is a value x_p such that $P(X < x_p) \leq p$ and $P(X \leq x_p) \geq p$. Let X be a continuous or discrete random variable with probability function $f(x)$ and the cumulative distribution function $F(x) = P(X \leq x)$. If the distribution is continuous, then $P(X < x_p) = p$ and $P(X \leq x_p) = p$ since $P(X = x_p) = 0$. Therefore, for the continuous case, $F(x_p) = p$.

The quartiles $Q_1 = x_{0.25}$, $Q_2 = x_{0.50}$ and $Q_3 = x_{0.75}$ for a continuous random variable with cumulative distribution function $F(x)$ are defined by $F(x_{0.25}) = 0.25$, $F(x_{0.50}) = 0.50$ and

Received August 2003, revised October 2003, in final form November 2003.

Anwar H. Joarder is an Associate Professor and Raja M. Latif is an Assistant Professor in the Department of Mathematical Sciences at King Fahd University of Petroleum and Minerals, Dhahran, Saudi Arabia 31261; emails: anwarj@kfupm.edu.sa and raja@kfupm.edu.sa.

Testing the Efficiency of Emerging Markets: the Case of the Baltic States

Virmantas Kvedaras
Vilnius University

Olivier Basdevant
World Bank

ABSTRACT There is little evidence on the efficiency of the early stage capital market in transition countries, although market structure developments and the learning process could define the framework for efficient markets. Are financial markets efficient and, if not, are there any signs of evolving to the efficient capital market in the three Baltic States? This article is designated to answer this question by combining the methodology for testing the efficiency of capital market using the variance ratio robust to heteroscedasticity with the state-space representation, which enables us to use an efficient filtering technique – the Kalman filter – to get time varying autocorrelations. The official Estonian, Latvian, and Lithuanian Stock Exchange market indices TALSE, DJRSE, and LITIN comprising the most liquid part of the stock market in a respective country are analysed. The main conclusion that can be drawn is that financial markets in the Baltic States with some turbulence are approaching a weak form efficiency, at least when the linear price forecasting rules are used.

Keywords : Kalman filter; Market efficiency; Variance ratio; Time varying autocorrelation.

1. Introduction

The question of efficiency of the financial market is crucial for transitional economies, as, in general, efficiency will determine the financial market capacity to allocate free capital efficiently (see Fama [20], Grossman [26], Stiglitz [58]). This article explores whether financial markets in the three Baltic States are efficient.

The major original contribution of this article is the analysis of the efficiency during the transition process. To be more precise, after general testing for linearity of the conditional

Received April 2003, revised September 2003, in final form December 2003.

Virmantas Kvedaras is an assistant Professor in the Department of System Analysis of Economy, Faculty of Economics, Vilnius University, Vilnius, Lithuania; email: vkved@takas.lt. Olivier Basdevant (corresponding author) is Advisor to the Executive Director for France, The World Bank, Washington DC 20433, USA; emails: obasdevant@worldbank.org. The views expressed in this paper are those of the authors and do not necessarily represent those of the World Bank.

Published by: Susan Rivers' Cultural Institute, Hsinchu, Taiwan, Republic of China

(Partially sponsored by: International Chinese Association of Quantitative Management, Taiwan, ROC)

Submission and Review Policies

1. Three hard copies of the manuscript written in English should be mailed to the **Managing Editor** at the address provided below. Submission of manuscript by email attachment is also welcome.
2. A manuscript is accepted only with the understanding that the text has not appeared in any other publication, and that it is not being simultaneously reviewed by another journal.
3. Submitted manuscripts are reviewed by a mutually blind process, meaning that the reviewers will not know the names of the authors and vice versa.
4. If an article is approved for publication, the author(s) will be asked to provide an electronic copy of the paper, in **Micro-soft Word** or **PCTEX** format, on floppy disk or through an email attachment. The authors will also be required to transfer their copyright on certain conditions to the publisher.

Managing Editor : Kuang-Chao Chang, Associate Professor, Department of Statistics and Information Science, Fu Jen Catholic University, Taipei, Taiwan, Republic of China.
Phone: (02)2903-1111 ext. 2754, Fax: (02)2903-3753, e-mail: stat1016@mails.fju.edu.tw.

Associate Managing Editors :

Sy-Mien Chen, Dept.of Mathematics, Fu Jen Catholic U., Taipei, Taiwan, ROC.

Tong-You Wu, Dept. of Business Administration, Fu Jen Catholic U., Taipei, Taiwan, ROC.

Production Editors :

Chih-Chiang Cheng, Dept. of E.E., National Sun Yat-Sen U., Kaohsiung, Taiwan, ROC.

Sam Shyue-Ping Chi, Dept. of Information Management, Fu Jen Catholic U., Taipei, Taiwan, ROC.

Publisher: Harold C. H. Chen, Head, Susan Rivers' Cultural Institute. Address: 26, Lane 2, Chien Mei Road, Hsinchu, Taiwan, ROC. Phone: (03)5716594, Fax: (03)5712524.

Subscription Rates (including postage and handling)

Regular rates : US \$28/per year for individuals; US \$48/per year for libraries and institutions.

Discounted rates :

US \$48/every two years and US \$66/every three years for individuals;

US \$78/every two years and US \$98/every three years for libraries and institutions.

Additional charge for air mail : US \$18/per year.

Appendix

1. Table of Contents / *JPPS* Vol. 2 No. 1
2. Table of Contents / *JPPS* Vol. 2 No. 2
3. Table of Contents / *JSSS* Vol. 1 No. 1
4. Table of Contents / *JSSS* Vol. 1 No. 2
5. Subscription Forms
6. Others

Table of Contents

Theory and Methods

Confidence bounds of the Weibull shape (extreme-value scale) parameter using pilot samples ----- Paul C. Chiou and Paul Dawkins	1
On Euler's Königsberg bridge problem for random graphs ----- Andrzej Korzeniowski	11
An unequally spaced mean-change model: abrupt change ----- Tze-San Lee	19
Inference of variance components using Markov Chain Monte Carlo ----- Tai-Ming Lee and Chia-Ding Hou	33
Testing for structural change of a time trend regression in panel data: Part I ----- Jamie Emerson and Chihwa Kao	57

Applications and Practice

Exchange rates and learning-a Rand/US dollar model ----- Olivier Basdevant, Sansia Brink, and Reneé Koekemoer	77
A note on confidence interval estimation in attributable risk for a case-control study ----- Po-Huang Chyou	97
Effects of gestalt configuration on spatial compatibility ----- Swei-Pi Wu and Rungtai Lin	105

Teaching and Education

Explaining marginal and joint density functions of order statistics through identities ----- Sy-Mien Chen and Yu-Sheng Hsu	113
An inductive proof for a closed form formula in truncated inverse sampling ----- Kuang-Chao Chang	117

Table of Contents

Invited Papers

A simple derivation of a mean and variance in a truncated inverse sampling problem -----	Sheldon M. Ross	123
Generalized linear models in the analysis of industrial experiments ---	Connie M. Borror, Alejandro Heredia-Langner, and Douglas C. Montgomery	127
Invariance of prediction from a mixture model under a nonsingular linear transformation -----	André I. Khuri	145
Differentiating graded toxicities in phase I cancer clinical trial designs -----	Shang P. Lin and T. Timothy Chen	149
Compatibility and near compatibility in multiple assessment of Bayesian networks -----	Barry C. Arnold, Enrique F. Castillo, and José María Sarabia	161

General Research Papers

Theory and Methods

Preliminary test confidence sets for the mean of a multivariate normal distribution -----	Paul C. Chiou and A. K. Md. Ehsanes Saleh	177
Systematic simple Latin square sampling (+1) design and its optimality -----	Mohammad M. Salehi	191
An improved Kolmogorov inequality for the Bernoulli random variables with unequal means -----	Chung-Bow Lee and Ren-Tai Kuo	201
Testing for structural change of a time trend regression in panel data: Part II -----	Jamie Emerson and Chihwa Kao	207

Applications and Practice

Economic design with preferred quality for welding using neural approximation and genetic algorithm -----	Mu-Chen Chen and Hsien-Yu Tseng	251
Examining a theoretical model for predicting performance on a teacher certification test -----	Liang Zeng	261

Teaching and Educational Articles

The effects of various process parameters through the integration of SPC and EPC -----	Yuehjen E. Shao, Lieh-Chiang Lo, Yu-Shan Zhang, Jia-Shiun Pan, Shin-Ru Shiau, and Shr-iun Chen	271
A note on coupon collecting problem -----	Kuang-Chao Chang	279

Table of Contents

Editor's Invited Papers

On Post-Hoc Assessments of "Disease Cluster Alarm Rates" ----- Paul S. Levy, Borko D. Jovanovic, and Donald H. Hedeker	1
Using the Transform Approximation Method to Analyze Queues with Heavy-Tailed Service ----- John F. Shortle, Martin J. Fischer, Donald Gross, and Denise M. B. Masi	15
On the Exact Distribution of Hotelling's T^2 When Sampling from a Normal Mixture Model ----- Alphonse K. A. Amey and A. K. Gupta	29

General Research Papers

Some Asymptotic Results in a Quadratic Classification Problem for Stationary Gaussian Time Series ----- Gerald E. Rubin	41
Using a Genetic Algorithm to Generate Small Exact Response Surface Designs ----- John J. Borkowski	65
Comparisons of Tests for AR(1) Parameter in Regression Models with Autocorrelated Errors ----- Nalini Ravishanker and Chih-Ling Tsai	89
Parametric Bayesian Analysis of Interval-Censored and Doubly-Censored Survival Data ----- M. Luz Calle	101
Bayesian Analysis of Repeated Surveys in Small Areas ----- Yih Su and Jing-Shiang Hwang	117
One Simple Test of Symmetry ----- Yonghong Gao	129
A Note on Change Point Analysis in a Failure Rate ----- Jie Chen	135

Table of Contents

Editor's Invited Papers

Estimation of the Mean Vector of a Multivariate Normal Distribution under Various Test Statistics ----- B. M. Golam Kibria and A. K. Md. E. Saleh	141
Asymptotic Normality of Shot Noise on Poisson Cluster Processes with Cluster Marks ----- Filemon Ramirez-Perez and Robert Serfling	157

General Research Papers

Theory and Methods

Some Further Asymptotic Results in a Quadratic Classification Problem for Stationary Gaussian Time Series ----- Gerald E. Rubin	173
An Asymmetric Generalization of Gaussian and Laplace Laws ----- -- Abraham Ayebo and Tomasz J. Kozubowski	187
A Nonparametric Test for Truncated Data ----- Pao-Sheng Shen	211
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	221
A Note on Generalized Gamma Family ----- M. S. Rahman, S. Nahar, and M. A. Karim	243
A Note on Estimation for an Exponential Hazard Rate ----- Sy-Mien Chen and Yu-Sheng Hsu	249

Teaching and Applications

Convex Combination of Estimators ----- Chun Jin, Robert H. Crouse, and R. Choudary Hanumara	255
Cost Growth Models for NASA's Programs ----- Tze-San Lee and L. Dale Thomas	265

JPSS
Journal of Probability and Statistical Science

Subscription Form

(for individuals)

Subscriber's Name : _____ **Phone :** _____

Affiliation : _____ **Email :** _____

Mailing Address : _____

Subscription (in year) : _____ (from _____ to _____)

Total Amount : U.S.\$ _____

Signature : _____ **Date :** _____

Please return the form and the cheque (in U.S.\$ and payable to **Susan Rivers' Cultural Institute**) to

Dr. Kuang-Chao Chang (Managing Editor, ***JPSS***)
Department of Statistics and Information Science
Fu Jen Catholic University
510 Chung Cheng Road, Hsinchuang
Taipei Hsien, **Taiwan**, ROC

Thank you very much !

Subscription Rates (including postage and handling)

Regular rates : US \$28/per year for individuals; US \$48/per year for organizations.

Discounted rates : US \$48/every two years and US \$66/every three years for individuals; US \$78/every two years and US \$98/every three years for organizations.

Additional charge for air mail : US \$18/per year

Subscribe to *JPSS* now and get one copy of *JPSS* first issue free !

JPSS
Journal of Probability and Statistical Science

Subscription Form

(for organizations)

Name of Organization : _____

Mailing Address : _____

Contact Person : _____

Phone : _____ **email :** _____

Subscription (in year) : _____ (from _____ to _____)

Total Amount : U.S.\$ _____

Signature of Contact Person : _____ **Date :** _____

Please return the form and the cheque (in U.S.\$ and payable to **Susan Rivers' Cultural Institute**) to

Dr. Kuang-Chao Chang (Managing Editor, ***JPSS***)
Department of Statistics and Information Science
Fu Jen Catholic University
510 Chung Cheng Road, Hsinchuang
Taipei Hsien, **Taiwan**, ROC

Thank you very much !

Subscription Rates (including postage and handling)

Regular rates : US \$28/per year for individuals; US \$48/per year for organizations.

Discounted rates : US \$48/every two years and US \$66/every three years for individuals; US \$78/every two years and US \$98/every three years for organizations.

Additional charge for air mail : US \$18/per year

Subscribe to *JPSS* now and get one copy of *JPSS* first issue free !