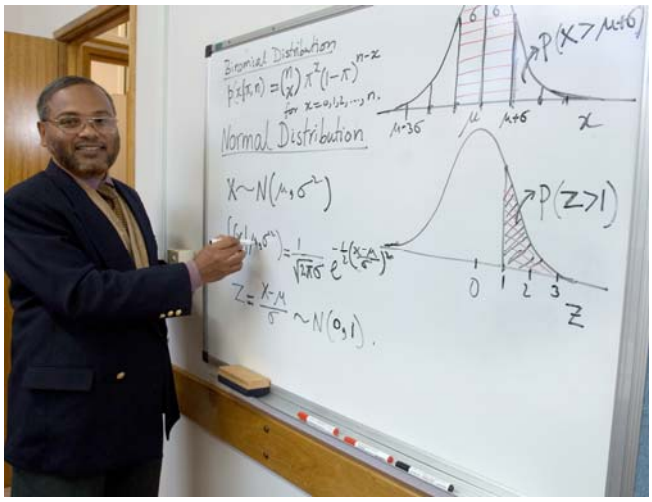
RESEARCH IN STATISTICAL INFERENCE

USQ FACULTY OF SCIENCES

PRELIMINARY TEST AND STEIN-TYPE ESTIMATION, TEST AFTER PRETEST, META-ANALYSIS, MULTIVARIATE STUDENT-T MODELS AND PREDICTIVE INFERENCE



Dr Shahjahan Khan
Associate Professor in Statistics
Department of Mathematics and Computing, USQ

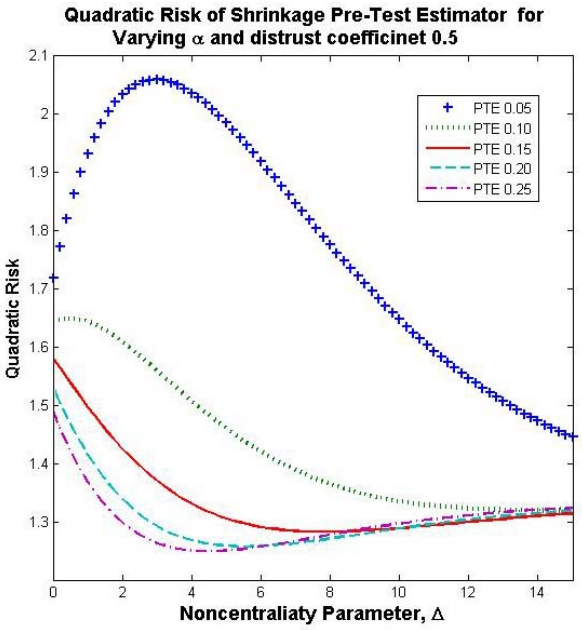
Following are my fields of research

My research work ranges from the improved estimation/test and predictive inference for linear models such as simple and multiple regression, multivariate simple and multiple regression, parallelism, and ANOVA models, to multivariate analysis and meta-analysis of data from randomised control trials. I have also worked with various linear models having Student-t and elliptical error distributions. Some specific projects are covered below.

Improved estimation

Traditionally the unknown population mean is estimated by the sample mean. Improved estimators, use both sample and non-sample prior information to achieve better statistical properties such as admissibility, accuracy and efficiency. Improved estimators such as the preliminary test, shrinkage and positive-rule shrinkage estimators perform better than the traditional estimators under certain conditions. When a number of alternative estimators are available to estimate an unknown parameter (scalar or vector) a natural question is, which one should be used and why?

The choice obviously depends on the objective of the study and some appropriate criteria to judge the relative performance of the estimators. Most common/popular of these criteria include *unbiasedness, mean squared error* (mse) and *quadratic risk*. It is desirable that a good estimator will meet the most important/ appropriate criterion determined by the researcher, and over perform the rest.

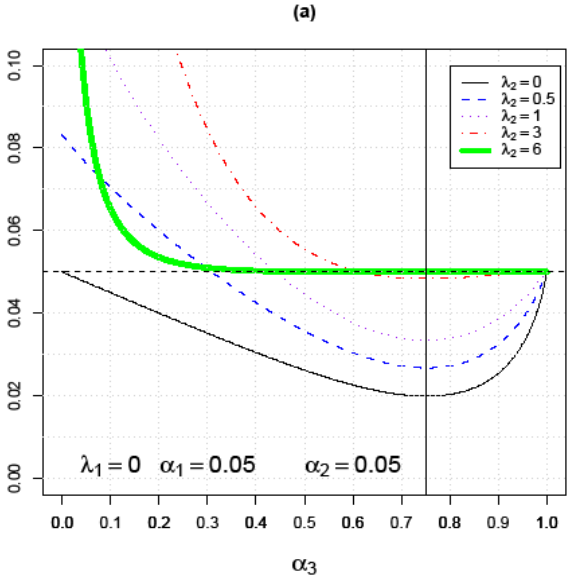


DOCTOR OF PHILOSOPHY

Program code	DPHD
CRICOS code	031453C
Duration	3 years full time on-campus 5 years part-time by distance
Mode of study	On-campus attendance requirements are negotiated as part of the application process
Start date	March, July
Campus	Toowoomba

Testing after Pretest

The idea of using non-sample prior information in the form of pretesting for improving properties of estimators is applied in the testing regime to achieve better power of the ultimate test. For example, to test the intercept of a simple regression model, prior information from previous investigations or expert knowledge on the suspected value of the slope is potentially beneficial. Any uncertainty on the value of the slope is removed by performing a pretest before testing the intercept. The impact of the pretest on the performance (power and size) of the ultimate test is studied. Defining unrestricted test (UT), restricted test (RT) and pretest test (PTT) the power functions are derived. Analytical and graphical comparisons of the three tests are obtained by studying the power functions. The problem can be addressed for both parametric and non-parametric set ups. Robust procedure based on M-estimator can also be used to formulate a test and deriving its power function. In comparison to the other non-pretest based test, the PTT based on pretest performs better and its power function behaves somewhat similarly to the quadratic risk function of the preliminary test estimator (PTE).



Size and power of the pretest test for selected nominal significance level

Predictive Inference

Prediction distribution is the conditional distribution of future responses, and is the basis for many predictive inferences. Unlike the common practice of estimating parameters of a model or performing tests of hypotheses regarding the parameters involved, often the aim of a researcher/practitioner is to predict the value of a (or a set of) future response(s) from a given model. The technique of prediction is used in many real world situations as it has a common sense appeal and simple interpretation. The method is useful in both univariate and multivariate problems. Predictive inference is possible for models with independent as well as dependent and correlated responses. Bayesian and other approaches are adopted for the purpose of predictive inference. Application of predictive inference includes problems in areas such as tolerance regions, model selection, process control, optimisation, perturbation and many others.

Meta-analysis of Independent Studies

Statistical methods to make inference by combining data from independent studies based on randomised control trials are of much use in medical practices. Estimating the odds ratio and relative risks for dichotomous outcomes as well as the mean of continuous outcome variables using confidence intervals and testing homogeneity of the studies are of prime importance. Checking of study bias and handling heterogeneity are essential to improve the reliability of the study results. Both classical and Bayesian approaches can be used.

The Multivariate Student-t and Elliptic Models

The customary use of the normal model is under serious question when the population distribution is symmetric but have heavier tails than the normal distribution. Also, the normal model fails to incorporate dependent but uncorrelated responses. In such cases, the multivariate Student-t distribution provides an appropriate model for the population. Such a model can be viewed as a mixture of normal and inverted gamma distributions. The model is further generalised to the family of elliptic distributions. The distribution of the sum of the squares and product matrix for the multivariate Student-t model as well as the predictive distribution of future model have been proposed. Similar results for the matrix T model are also obtained.

Brief Biography of Dr Shahjahan Khan

I have a PhD degree and an MSc degree in Statistics from the University of Western Ontario, Canada.

I am an elected Fellow of the Royal Statistical Society (RSS), United Kingdom, and an elected Member of the International Statistical Institute (ISI), Netherlands, also a life member of the Islamic Countries Society of Statistical Sciences (ISOSS), and Bangladesh Statistical Association.

I am the elected President of the Islamic Countries Society of Statistical Sciences (ISOSS), 2005-2009.

I am the founding Chief Editor of the Journal of Applied Probability and Statistics (JAPS), USA.

I was awarded the ISOSS Gold Medal for Outstanding contribution to statistical research and development of the ISOSS in 2007, and the Multicultural Service Award by the Premier of Queensland, Australia in 2002.

I have published over 58 research papers in different international refereed journals, and presented more than 60 talks including many invited and key-note addresses.

Do any of my research areas interest you? If so, let me supervise your research project.

FURTHER INFORMATION

Email	khans@usq.edu.au
Telephone	+61 7 4631 5532
Web	www.sci.usq.edu.au/staff/khans/

USQ UNIVERSITY OF SOUTHERN QUEENSLAND
fulfilling lives

PHONE + 61 7 4631 2362
FAX + 61 7 4635 9225
EMAIL international@usq.edu.au
WEB www.usq.edu.au/international

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