Editorial

Bharatendra K. Rai

Department of Decision and Information Sciences,
Charlton College of Business,
University of Massachusetts – Dartmouth,
285 Old Westport Road, North Dartmouth,
Dartmouth, MA 02747-2300, USA
E-mail: brai@umassd.edu

Tirthankar Dasgupta

Department of Statistics,
Harvard University,
Cambridge, MA 02138, USA
E-mail: dasgupta@stat.harvard.edu

Biographical notes: Bharatendra K. Rai is an Assistant Professor of Business Statistics at the Charlton College of Business, University of Massachusetts – Dartmouth. He completed PhD in Industrial Engineering from Wayne State University, Detroit and later worked at Ford Motor Company as quality/reliability engineer. His research interests include quality/reliability engineering, robust design, and applications in forecasting, data mining, and pattern recognition. He has a Master's in Quality, Reliability, and OR from Indian Statistical Institute and another Master's in Statistics from Meerut University. He has over 15 years of professional experience that includes work at Ford and Indian Statistical Institute.

Tirthankar Dasgupta is an Assistant Professor of Statistics at Harvard University. He completed his PhD in Industrial Engineering from Georgia Institute of Technology, Atlanta. His research interests include Design of Experiments (DOE), statistical and engineering process control, applications of statistics in nanotechnology, quality engineering and quality management. He also has eight years of consulting experience in Indian industries and has dual Master's Degrees in Applied Statistics and Quality, Reliability and Operations Research from the Indian Statistical Institute.

This special issue aims to provide research papers that capture interesting problems and provide new ideas in the area of Mahalanobis-Taguchi System (MTS) analysis. As we know, with rapid advances in technology, use of automated data collection methods is on steep rise. Situations that call for decision-making with voluminous datasets involving several variables are being encountered in ever increasing number of fields. MTS aims to provide users with an effective decision-making methodology in such situations. Successful applications of MTS have been reported by companies such as Nissan, Ford, Delphi, Xerox, Yamaha, etc. The MTS approach has attracted constructive

criticism by leading academic researchers, at the same time numerous successful case studies reported from industries indicate its usefulness from practitioners' point of view. Some of the technical issues raised about MTS has also attracted attention of researchers and motivated them to come up with approaches that address the shortcomings pointed out by critiques.

This special issue consists of six papers by leading researchers and practitioners working in the area of MTS and related field. The paper 'Evaluating an adaptive One-Factor-At-a-Time search procedure within the Mahalanobis-Taguchi System', by Foster, Jugulum, and Frey propose and evaluate an alternative search procedure to be used within the MTS framework. They employ an adaptive one-factor-at-a-time search for feature selection and retain features only if they contribute positively to the signal-to-noise ratio. They compare the proposed approach with orthogonal arrays and forward selection using two case studies. The results indicate that the proposed adaptive one-factor-at-a-time experimentation provided greater improvements on the median with the same or fewer design alternatives being explored and also exhibited good ability to generalise to new instances after training. The large benefits of adaptive one-factor-at-a-time search observed in the two case studies are attributed to interaction size and synergy.

Six Sigma methodology continues to be vastly popular approach to quality in companies across the globe. In the paper 'Integrating the improvement and the control phase of Six Sigma for categorical responses through application of Mahalanobis-Taguchi System (MTS)', as the title suggests, Dasgupta proposes a new framework for facilitating integration of improvement and control phases of Six Sigma for categorical responses using MTS. The proposed unified framework exploits the versatility of MTS as a tool for classification, variable selection and monitoring, and the inherent similarity of the Mahalanobis distance and Hotelling's T^2 statistic. MTS here is used as a common tool for variable screening and monitoring. The proposed framework and its workability is explained and illustrated using a simulated example. The variable selecting ability of MTS is examined at different levels of internal and external noise and compared with ordinary and stepwise logistic regression. The results obtained from the simulation study shows that MTS does a reasonable job in situations where the underlying statistical model is fairly complex and non-standard, and the size of the abnormal group is small compared to the size of the normal group.

The statement that MTS is 'data analytic' rather than 'probability distribution based' has contributed to unease of statistics community towards MTS. In the paper 'A comparison study and discussion of the Mahalanobis-Taguchi System', Kim, Tsui, Sukchotrat, and Chen attempt to incorporate statistical thinking into the ad-hoc parts of MTS by a comparison with other multivariate statistical methods. The paper presents similarities and differences between MTS and a classification method with regard to the construction of the decision rule and variable selection. The authors note that variable selection in MTS has the potential to reduce the computational effort for handling high-dimensional data sets.

Multivariate diagnosis and pattern recognition abilities of MTS are often compared with artificial neural networks. The comparisons, however, have been limited to neural networks as a standalone process with no effort made to address the shortcomings of both MTS and neural networks by combining strengths of both. The paper titled 'Classification, feature selection and prediction with Neural-network Taguchi System', by Rai attempts to combine the strengths of MTS and neural networks to overcome their

individual weaknesses and explores the use of a resulting new approach Neural-network Taguchi System (NTS) using a tool-breakage prediction problem. The results obtained provide an interesting comparison between MTS and NTS. The proposed NTS framework also provides new and interesting ideas for future research. As optimisation of neural network parameters involves computer experiments, use of Design and Analysis of Computer Experiments (DACE) approach is also suggested holding good potential for future research.

In the next paper 'An unsupervised classification scheme for multi-class problems including feature selection based on MTS philosophy', by Das and Mukherjee a novel unsupervised classification algorithm is proposed to meet the increasing demand in the domain of pattern classification and feature selection. The authors indicate the proposed scheme to be a multi-class unsupervised classifier with the basic philosophy of supervised MTS based monitoring procedure. The paper presents an extensive comparative study between MTS and the proposed scheme using various simulated experiments for different types of correlation structure and location parameters, published data and real-life data sets of different sizes and dimensions. The authors report several special merits of the proposed algorithm such as domain-knowledge independent thresholds, multi-class separation, identifying process shifts during multivariate process-monitoring and feature selection in case of detection of abnormals. The paper also cautions that when number of observations becomes too large, computational complexity will increase exponentially.

The final paper titled 'Forecasting consumer satisfaction for vehicle ride using a multivariate measurement system', is an interesting case study by Cudney, Jugulum and Paryani. The author's note that the goal of this research is to efficiently forecast consumer satisfaction measured as a function of available vehicle level performance data by developing a multivariate measurement system using the MTGS approach. Using MTGS, a measurement scale is constructed and a reduced set of useful variables is then identified for vehicle ride that are sufficient for the measurement scale to make effective predictions.

The Guest Editors would like to thank all the authors for submitting and revising papers for the special issue. We also wish to extend our sincere thanks to those individuals who acted as reviewers for the papers submitted to this issue. The Guest Editors would also like to express their sincere appreciations to Dr. Angappa Gunasekaran, the Editor-in-Chief, for his advice, help and support to make this special issue come into being.