Professor Siotani's Contributions to Statistics

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Professor Minoru Siotani has contributed to statistics through the study of various procedures for multivariate analysis, in which the distributional problem is one of the most important topics. He derived asymptotic expansions for distributions of statistics and their percentile points in multivariate analysis. His work is published in several refereed journals listed below and is reviewed by Dudewicz [D] and Fujikoshi [F], which are published in the special issue of the American Journal of Mathematical and Management Sciences (AJMMS) in honor of Professor Siotani on his 70th birthday. Most of his contributions are detailed in Siotani, Hayakawa, and Fujikoshi [S]. This book has been read by a number of statisticians and graduate students and is cited in many articles published in international journals.

One of the great contributions by Siotani is the derivation of the asymptotic expansions for the distribution of generalized Hotelling's T_0^2 statistic for testing linear hypotheses in a multivariate linear model, say, for instance, to test a hypothesis about multinormal means. He derived asymptotic expansions not only for null distributions but also nonnull distributions ([7], [10], [23]). As a result of this work, it became possible to compare the power of three criteria, the T_0^2 criterion, the likelihood ratio criterion, and the Bartlett-Nanda-Pillai trace criterion. He also derived asymptotic expansions for the distribution of $T_{\max}^2$ statistic, which is used in simultaneous statistical inferences such as constructing confidence intervals and testing hypotheses, where $T_{\max}^2$ is the maximum of some Hotelling's T^2 statistics ([13], [51]). Other works on the simultaneous confidence intervals of means or regression parameters are given in [14], [17], and [20]. Multivariate analysis of variance is discussed in [42] and [44].

Siotani studied two procedures in discriminant analysis, Z-rule and W-rule ([33]). He also gave asymptotic expansions for the conditional distributions of the classification statistic Z and its Studentized form and studied the probability of misclassification ([35], [39]). The heteroscedastic method is proposed as a method to overcome the difficulty of statistical inferences under unequal covariance matrices in multi-sample problems. This method can be used for practical data analysis as in his work [43], which won the 1988 Wolfowitz Prize. The heteroscedastic method is applied to discriminant

analysis, which controls the probability of misclassification ([49]).

It is important to study the sample covariance matrix since many statistics in multivariate analysis are expressed by functions of the matrix. Siotani investigated asymptotic distributions of functions of a sample covariance matrix ([21]) not only under normal distributions but also under elliptical distributions ([52]). He also discussed the asymptotic distribution of functions of a correlation matrix ([31]).

His recent work is on the practical effectiveness of asymptotic expansions in making inferences and on the sample size with which the asymptotic expansion formula guarantees a certain requirement ([53], [54], [55]).

There are many publications by Siotani other than the ones listed below; 5 books (in Japanese), 17 papers in nonrefereed journals, and many technical reports (see AJMMS **15** for details). He has organized many international meetings such as the Pacific Area Statistical Conference, Japan and Korea Joint Conference on Statistics, Meeting on Multivariate Statistical Analysis and so on, and was the chief editor of the SUT Journal of Mathematics and a member of the editorial boards of international journals such as Annals of the Institute of Statistical Mathematics (AISM) and AJMMS.

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