Statistical Process Control Charts and Their Applications in Macao Schools

by

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Abstract

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by Ka Lei CHE

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Statistical Process Control (SPC) enables the use of one or more control charts to control process statistically and prevent quality problems without delay. The traditional control charts were first proposed by Walter A. Shewhart in 1924 to determine the stability of process parameters. This is based on collecting data from the process in order to estimate the model parameters. Control limits are determined from these estimates and used to monitor future data. Bayesian statistics combines prior knowledge and likelihood function via Bayesian theorem to predict the unknown parameters. Recently, Bayesian methods are widely used in SPC for application cases of small sample sizes.

Classical process control methods are not suitable when the number of data is small and, during a base period, do not have control limits. In such cases, it is almost impossible to calculate the limits and have a control chart during the base period. Thus, we use Bayesian method to compute the posterior probability based on historical and latest data to judge process stability. In the case of small sample sizes, the Bayesian method in statistical process control yields more efficient results.

In this thesis, various statistical process control methods are introduced, such as several traditional Shewhart control charts: p , np , c , u , $\overline{X}$ & R , $\overline{X}$ & S , I & MR charts, etc. By using Bayesian method, several improved process control charts are studied, and compared with traditional control charts. These improved process control charts

have more reliability and smaller probabilities of error alarm, which are caused by traditional control charts under small sample sizes. Some of these process control charts are applied to monitor changes in Macao high school. Numerical results of these applications show that process control charts have important applications in high school management and quality control.

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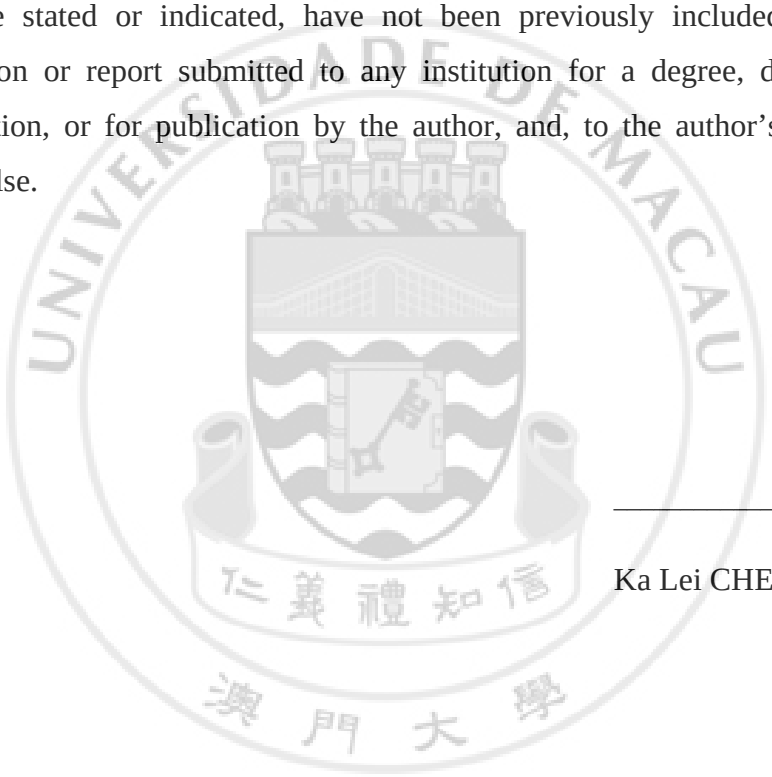
Dedication

The author declares that this thesis represents her own work with Professor Deng DING, the author's supervisor. All the work is done under the supervision of Professor Deng DING during the period 2011-2013 for the degree of Master of Science in Mathematics at the University of Macau. The results in this thesis, unless otherwise stated or indicated, have not been previously included in any thesis, dissertation or report submitted to any institution for a degree, diploma or other qualification, or for publication by the author, and, to the author's knowledge, by anyone else.



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Ka Lei CHE

To

My Parents