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Bootstrap Approach for Constructing Interval Estimation of Capability Index under Non-Normal Distributions

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Abstract

Process capability indices have been considered as one of practical tools in the field of statistical quality control for measuring process performance and determining whether the process is capable or not. Most research in process capability analysis literature has focused on cases in which the quality characteristic follows the normal distribution. However, an erroneous interpretation of the process's capability may be occurred when the distribution of the process characteristics is non-normal. A new index, C_s, has been developed by considering a skewness correction factor for dealing with the circumstances under non-normality. In this article, a well-known non-parametric approach, Bootstrap resampling, is introduced and three types of Bootstrap interval estimation methods, including the standard bootstrap (SB), the percentile bootstrap (PB) and the biased corrected percentile bootstrap (BCPB) are applied. The major advantage of Bootstrap approach is that, the Bootstrap confidence intervals may be obtained without any assumption of particular distribution. A serious of simulations under various parameters is undertaken to examine and compare the performance of these methods for obtaining confidence intervals.

Keywords
Process capability indices, quality assurance, non-parametric approach, Bootstrap confidence interval.

Biography

Hui-Chuan Chen is a master student in industrial management at National Taiwan University of Science and Technology, Taiwan. She holds a bachelor degree in applied statistics at National Taichung University of Science and Technology, Taiwan. Her specific research interests include applications of quality control and process capability indices. She can be contacted at m10101104@mail.ntust.edu.tw.

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Chien-Wei Wu is currently a Professor in the Department of Industrial Engineering and Engineering Management at National Tsing Hua University (NTHU), Taiwan. Dr. Wu received his Ph.D. degree in Industrial Engineering and Management with Outstanding Ph.D Student Award from National Chiao Tung University in 2004 and the M.S. degree in Statistics from National Tsing Hua University in 2002. He worked for National Taiwan University of Science and Technology and Feng Chia University before he joined NTHU. Dr. Wu has received Dr. Ta-You Wu Memorial Award (Outstanding Young Researcher Award) from National Science Council (NSC) and Outstanding Young Industrial Engineer Award from Chinese Institute of Industrial Engineers (CIIE) in 2011. He is also serving as one of Editors-in-Chief of Quality Technology and Quantitative Management (QTQM) (SCI-E indexed) and editorial board members for various international journals. His research interests include quality engineering and management, statistical process control, process capability analysis and data analysis.