Development of Confidence Interval and Hypothesis Testing for Taguchi Capability Index Using a Bayesian Approach

Shu-Kai S. Fan[*] and Ching-Kuei Kao

Department of Industrial Engineering and Management, Yuan Ze University, Taoyuan County, 320, Taiwan, R.O.C.

Abstract⎯Process capability indices are designed to describe how the process of interest can achieve to meet specification limits under a condition of statistical control. One of the capability indices is denoted as C_{pm} proposed by Chan, Cheng and Spiring (1988), sometimes termed the Taguchi index. The primary goal of this paper attempts to construct a confidence interval for C_{pm}, which measures process variability as well as process centering in terms of the variation of the process mean from the target value. The confidence interval derived herein is based upon the posterior distribution of C_{pm} combined with the application of highest posterior density (HPD) arising from the Bayesian decision theory. The developed interval for C_{pm} is compared, via various simulation studies, with the one published in the recent literature obtained by using the classical two-sided approach implemented on the sampling distribution of C_{pm}. The experimental results demonstrate that the improvement achieved by the proposed confidence interval holds provided that the process center deviates from the target value. A Bayesian procedure for the hypothesis testing of the Taguchi process capability is also presented with several graphical analyses under a variety of assumed parameter configurations, illustrating an additional statistical merit of the new method while a process deviation from the target value occurs.

Keywords⎯Process capability analysis, Bayesian approach, Highest posterior density, Confidence interval

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