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Original article

Computational procedure of assessing lifetime performance index of Weibull lifetime products with the upper record values

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Abstract

Process capability indices (PCIs) are used to measure process potential and performance. This study constructs an uniformly minimum variance unbiased estimator (UMVUE) of the lifetime performance index based on the upper record values for Weibull lifetime model. Then the UMVUE of the lifetime performance index is utilized to develop the new hypothesis testing procedure in the condition of known lower specification limit. Finally, two examples are presented to assess the behavior of this test statistic for testing null hypothesis under given significance level. Moreover, the product managers can then employ the new testing procedure to determine whether the process adheres to the required level.

Keywords: Process capability indices; Weibull distribution; Upper record values; UMVUE; Data transformation

1. Introduction

Process capability analysis is an effective means of measuring process performance and potential capability. In conventional, automotive, semiconductor and integrated circuit (IC) assembly manufacturing industries, process capability indices (PCIs) are utilized to assess whether product quality meets the required level. For instance, Montgomery [19] (or Kane [14]) proposed the process capability index C_L (or C_{PL}) for evaluating the lifetime performance of electronic components, where L is the lower specification limit, since the lifetime of electronic components exhibits the larger-the-better type quality characteristic of time orientation. Tong et al. [22] constructs the uniformly minimum variance unbiased estimator (UMVUE) of C_L and built the hypothesis testing procedure based on the complete sample from one-parameter exponential distribution. The purchasers can then employ the testing procedure to determine whether the lifetime of electronic components adheres to the required level. Manufactures can also utilize this procedure to enhance process capability.

Practically, a product family is usually composed of several models, which result in different specifications. Generally, the quality characteristics of a product can be classified into three types; the nominal-the-best, the smaller-the-better and the larger-the-better types. Chen et al. [5,6] have discussed the entire process capability for smaller-the-better and

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