SUMMARY OF Ph.D. DISSERTATION

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Title

A Study of Statistical Issues in Selective Assembly: Optimal Binning Strategies under Squared Error Loss

Abstract

Selective assembly is a cost-effective approach for improving the quality of a product assembled from two components when the quality characteristic is the clearance between the mating components (or the sum of the relevant dimensions of the mating components). In this approach, the components are measured and sorted (or binned) into several groups according to their dimensions, and the product is assembled by selecting mating components from corresponding groups. Some important statistical and mathematical issues arise in selective assembly.

Determining optimal partition limits for the dimensional distributions of the components is one of the important issues. Mease et al. (2004) studied optimal partitioning of the dimensional distributions under squared error loss when the two component dimensions are identically distributed after re-centering. Chapters 2 and 3 of this Ph.D. dissertation present some extensions of Mease et al. (2004) to handle the presence of measurement error and a tolerance constraint on the clearance, respectively. In Chapter 2, sufficient conditions under which the set of optimal partition limits is unique are given and the effect of measurement error on expected squared error loss is evaluated. In Chapter 3, it is shown that the set of optimal partition limits, which minimizes expected squared error loss subject to the tolerance constraint, is unique provided that the dimensional distribution is strongly unimodal. The constrained optimal partitioning is compared with the unconstrained optimal partitioning and equal width partitioning.

Another important issue is how to handle the case in which the two component dimensions have unequal variances. It has been proposed in previous studies that the component with smaller variance be manufactured at two shifted means. Chapter 4 studies the problem of determining the optimal mean shift under squared error loss. Assuming normal distributions, it is shown that the optimal mean shift is uniquely determined. It is also shown that using the optimal mean shift considerably reduces expected squared error loss compared to the no shift case.