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Process targeting with multi-class screening and measurement error

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In this paper, a Process Targeting model for a three-class screening problem is developed. The model extends the work in the literature by incorporating a measurement error present in inspection systems. The strategy adopted, to nullify the effect of measurement error, is to introduce the concept of 'cut-off points', i.e. the decision during inspection is based on these cut-off points rather than specification limits of the various product grades. This model considers cut-off points as decision variables. In addition, an illustrative example is presented that compares model performance with the model presented in Min and Jang (1997). Sensitivity analysis is also conducted to study the effect of various model parameters, particularly measurement error on expected profit, optimal process mean and cut-off points.

1. Introduction

In a manufacturing environment, a product has to pass through a number of processes, undergoing diverse operations before obtaining a final form. Owing to the inherent and technological inconsistencies, especially for mechanical, chemical etc systems, there is bound to be some variations in the final product. In order to minimize such variations, and to improve the overall characteristics of the product, quality control became an essential part of manufacturing. Process Targeting is one of the areas in the economics of quality control that has received a lot of interest from the researchers in recent times.

The Targeting problem was initiated by Springer (1951) for the canning problem. The objective was to minimize the expected cost. Hunter and Kartha (1977) presented a similar model, for the case of maximization of profit, where under-filled cans are sold in a secondary market. Bisgaard *et al*. (1984) extended the above case where the under-filled cans are sold at a price proportional to the can fill. In Golhar (1987), the model presented is for the case where the under-filled cans are reprocessed at a fixed cost. Golhar and Pollock (1988) considered the case where the fill is expensive and an artificial upper limit is also determined alongside the process mean. Golhar and Pollock (1992) studied the effect of variance reduction on the profit. Arcelus (1996) introduced the product uniformity via a Taguchi quadratic loss function. In Min and Jang (1997), a situation where inspection is based on a three-class screening is considered. Hong and Elsayed (1999) studied the effect of measurement error on the optimal mean settings for the case of a two-class screening situation.

There are many other directions in which the targeting problem has evolved, e.g. the use of various sampling plans instead of full inspection in Carlsson (1989),

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