

行政院國家科學委員會專題研究計畫成果報告

量測誤差對設計 X-bar 和 S 經濟管制的效應

**The Effects of Measurement Error on the Economic Design of
X-bar and S Control Charts**

計畫編號: NSC 89-2213-E-004-013

執行期限: 89 年 8 月 1 日 至 90 年 7 月 31 日

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1. ABSTRACT

The presence of imprecise measurement may seriously affect the efficiency of process control and production cost. A cost model is derived to determine the design parameters of the economic asymmetric \bar{X} and S control charts excluding or

including measurement errors, respectively. The effects of imprecise measurement to the performance of the economic asymmetric \bar{X} and S control charts and production cost are examined for the case where the process mean and process standard deviation may change. Application of the proposed control charts

is demonstrated through an example. Numerical examples illustrate the effects of imprecise measurement on the design parameters of the proposed control charts. It shows that the imprecision measurement may seriously affect the ability of the proposed control charts, which include measurement errors, to detect process disturbances quickly, change the sampling frequency, and increase the production cost compared to the proposed control charts excluding measurement errors. Besides, the effects of measurement error on the EWMA control chart and Zone X-bar control chart, which detects the small shift of process mean, is studied.

Keywords: Asymmetric control charts, measurement error, renewal reward processes, small shift of process mean.

中文摘要

本研究提出製程上量測值發生誤差時經濟管制圖的建構方法。建構的管制圖分別討論有量測誤差及無量測誤差之情況。數值分析結果發現量測誤差明顯影響管制圖偵測力，且有量測誤差的管制圖偵測力更差且成本更高。是以量具之校正非常重要。另外，當有量測誤差時，小偏移量之偵測，EWMA 管制圖仍優於區域 X-bar 管制圖。

關鍵字:管制圖，更新報酬過程，量測誤差。

2. RESEARCH MOTIVATION AND OBJECTIVE

Process measurements are used in construction of control charts. The performance of control charts and other statistical process tools could be seriously affected when the process measurement includes the error due to the measurement instrument.

The effect of measurement error on the operating characteristics of an \bar{X} chart, in cases where only the process mean shifts, is discussed by Bennett (1954), Mizuno (1961), Abraham(1977), Mittag (1993) and Mittag and Stemmann (1993). Kanazuka (1986) and Mittag (1995) investigate the power characteristics of the \bar{X} -R control chart where both the process mean and process spread change. Mittag and Stemmann (1998) extend the results of Mittag (1995), referring to the \bar{X} -S control chart. Rahim (1985) analysis the effects of imprecise measurement devices on the design parameters of the economic \bar{X} control chart. The effect of measurement error on the design parameters of the economic asymmetric \bar{X} and S control charts by dealing with

measurement errors that occur before and after setting up an \bar{X} -S control chart has not been addressed. Besides, the effects of measurement error on the EWMA and zone X-bar charts have not been discussed either. This study investigates (1) the effect of measurement error on the design parameters of the economic asymmetric \bar{X} and S control charts by dealing with measurement errors that occur before and after setting up an \bar{X} -S control chart, (2) the effects of measurement error on the EWMA and zone X-bar charts.

3. RESULTS AND DISCUSSION

Result:

- 3.1 A cost model is derived to determine the design parameters of the economic asymmetric X-bar and S control charts including measurement error.
- 3.2 The measurement error may seriously affect the ability of the proposed charts to detect the process disturbance, change the sampling frequency, and increase the production cost..
- 3.3 The measurement error may seriously affect the ability of the EWMA and zone charts to detect the process disturbance.
- 3.4 In the detection of small shift of process mean, EWMA chart is better than zone control chart even the measurement

error is included.

Suggestion:

All the measurement errors in the process are assumed independent. In reality, they may be dependent. So, how to solve this type problem would be our future research problem.

4. EVALUATION

All the problems described in the project are figured out as expected. One paper has been submitted to international journals. Others paper are summary and writing in English. The process control with correlated measurement errors will be discussed in future project.

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