pISSN 2010-376X
eISSN 2010-3778

WORLD ACADEMY OF SCIENCE, ENGINEERING AND TECHNOLOGY

ISSUE 81 SEPTEMBER 2013 ISTANBUL

www.waset.org

Asymmetric Tukey's Control Chart Robust to Skew and Non-Skew Process Observation

S.Sukparungsee

Abstract In reality, the process observations are away from the assumption that are normal distributions which should use an asymmetric chart rather than robustness of the asymmetric Tukey's control chart for skew and non-skew distributions as Lognormal and Laplace distributions. Furthermore, the performances in detecting of a change in parameter of asymmetric and symmetric Tukey's control charts are compared by Average ARL (AARL). The results found that the asymmetric performs better than symmetric Tukey's control chart for both cases of skew and non-skew process observation.

Keywords Asymmetric control limit, average of average run length, Tukey's control chart and skew distributons.

I. INTRODUCTION

SATISTICAL Process Control (SPC) charts are widely used for monitoring, measuring, controlling and improving quality of production in many areas of application, for example, in industry and manufacturing, finance and economics, epidemiology and health care, environmental sciences and other fieled. Control charts are usually designed and evaluated under the assumption that the observations from a process are independent and identically distributed (i.i.d.) and from a normal distribution. In real applications, there are many situations in which the process data come from a non-normal distribution, for example, an Exponential, Laplace, Student-t of Gamma distribution (see, e.g., Borror et al. [1]; Stoumbos and Reynolds [2]; Mititelu et al. [3]; Sukparungsee and Novikov [4]). Process with data from a non-normal distribution need to be monitored by appropriate control charts.

Recently, many types of control charts are proposed which an appropriate control chart must be selected under many assumptions and several factors. Specially, for this kind of process monitoring, individual control charts take only one sample o measure due to economic issue for a company. Consequently, Tukey's control chart has been popular used for individual process which Alemi (2004) [5] who was first proposed. Torng and Lee (2008) [6] and Torng et al. (2009) [7] have been investigated the average run length of Tukey's control chart. There are many advantage of using Tukey's control chart which it is easy to use and simple control limits setup. It can be used with not only non-Normal observations but also when distribution of process is unknown . Furthermore, Tukey's control chart does not sensitive to unusual data such as an outlier.

Consequently, this paper aim to study the performance of Tukey's control chart robust to the skew distribution processes such exponential and Laplace distributions. They are usually represented as lifetime of products and growth rate of a company, respectively.

II.TUKEY'S CONTROL CHART AND THEIR PROPERTIES

A.Tukey's Control Chart with Symmetric Control Limit

In 2004, Alemi who first proposed the Tukey's control chart which applied the principle of Box-plot to obtain the control limits. The control limits of Tukey's control chart are presented by Torng and Lee (2008) under assumption a known population. They used the symmetric control limits so-called SCL-Tukey's control chart which control limits as follows:

$$\text{UCL} = F^{-1}(0.75) + L(LQR)$$

$$\text{LCL} = F^{-1}(0.25) - L(IQR)$$

where UCL and LCL are upper and lower control limits, respectively. The $F^{-1}(0.75)$ and $F^{-1}(0.25)$ are the third quartile (Q3) and first quartile (Q1) and IQR is the InterQuartile Range (IQR = Q3-Q1). The value of L is a coefficient of control limit which this value of L is a coefficient of control limit which this value of L is usually set as 1.5 for the case of a normal distribution assumption (Ryan(2000)).

B.Tukey's Control Chart with Asymmetric Control Limit

In 2011, Lee [8] extended the Tukey's control chart with asymmetrical control limits so called ACL-Tukey's control chart to detect a change in parameter of skew population. The upper and lower control limit of ACL-Tukey's control chart can be written as following:

$$\text{UCL} = F^{-1}(0.75) + L_1(LQR)$$

$$\text{LCL} = F^{-1}(0.25) - L_2(IQR)$$

where L_1 and L_2 are the upper and lower control limit coefficients, respectively. The value of $F^{-1}(0.75)$ and