Some Comparisons of Control Charts for Monitoring the Autocorrelated Process

Der-Shin Chang and Pin-Hua Dow

Institute of Statistics, National Tsing Hua University
101, 2nd Sec., Kang-Fu Road
Hsinchu, Taiwan, 30043, ROC
Chang@stat.nthu.edu.tw

Consider the AR(p) process $Z_t = \theta_1 Z_{t-1} + \cdots + \theta_p Z_{t-p} + \epsilon_t, \ t=1,2,\ldots$, where $Z_t$'s are observations, $\epsilon_t$'s are iid $N(0,\sigma^2)$. For finding effective monitoring techniques to detect the change in this process, many authors suggested fitting an appropriate time series model to the process and using the residuals to construct control chart for detecting the mean shift in the process (Alwan, 1991; Alwan & Roberts, 1988; Harris & Ross, 1991; Montgomery & Mastrangelo, 1991). In addition, Box & Ramirez (1992) further proposed a general cumulative score (Cuscore) chart, related to the Wald sequential test, to detect the change in the parameter of time series model. By the same concept of the sequential probability ratio test (SPRT), Huang & Chang (1995) proposed a control procedure for detecting the change in the parameter of AR(p) process as SPRTs applied repeatedly.

In this article, our main purpose is to compare some control charts for monitoring the changes in the AR(p) process including mean shift and parameter change. Since the usual way of comparing control charts is to compare their ARLs, the average run length, then charts having the same in-control ARLs are compared with each other by considering their out-of-control ARLs for various changes in the parameter being controlled, by this version a chart is regarded better in detecting a process change if it has a smaller ARL for the given out-of-control condition. Thus we demonstrate FIR-Cuscore chart and sequential SPRT chart with symmetric boundaries to monitor different kinds of shift in the AR(1) and AR(2) processes, and compare them with other control charts. Furthermore, we also illustrate some multivariate control charts for the bivariate AR(1) process.

REFERENCES


