Improving the Performance of linear profile based Multivariate Control Chart in the presence of outliers

Prakash S. Chougule
Associate Professor & Head
Department of Statistics
Rajarshi Chhatrapati Shahu College, Kolhapur (MS), India

A b s t r a c t:
The well known parameter estimation method ordinary least square is not robust to outlier. To overcome this problem, many researchers proposed alternative parameter estimation methods in regression. The purpose of this study is to compare the performance of Hotelling T^2 control chart based on non robust as well as robust parameter estimation procedure like OLS, M, S, Insha Ullaha , MM, etc. The performance of these control charts evaluated to simulation study

Keywords: Statistical process control, False Alarm, Hotelling's T^2, Outliers, Robust estimation.

Introduction:

Quality can play an important role in the success and achievement of various service and manufacturing industries. Statistical Process Control (SPC) is an excellent and most sopasticated process monitoring method, which can be used in the manufacturing industry to attain the process stability and to improve the quality of the output of the process by reducing the variation. The variation in the output is classified into chance cause of variation and assignable cause of variation The chance cause of variation are the background noise is due to small and unavoidable causes. The chance cause of variation is the part of the any production process and in the presence of chance cause variation the process is in control The other assignable cause of variation is targeted by Statistical Process Control. A process in the presence of assignable cause of variation is said to be out of control. Statistical Process Control methods are available to detect the presence of special cause of variation in the production process. The Control chart is one of the important tool in SPC Kit. It is graphical process control tool when significant changes have occurred in the production process. The original concept of the control chart was proposed Shewhart (1924) and it has been used extensively in industry since the Second World War especially in Japan and the USA after about 1980.

Control Chart as a visual tool is to determine a production process is in statistical control or not. if the control chart shows the production process is not in control then changes or correction should be made to the process parameters to ensure process and product consistency. Monitoring a process using control chart first requires expressing the in control state of the process, and then this information is used to detect out of control process state. Hence there are two different phases of a control chart application. The distinction between these two phases is important, because different types of statistical methods are appropriate for each phase.

Phase I is retrospective analysis of the observations from the process. It is an initial step. In Phase I analysis aims is to check the in control state of the process and establish an on line monitoring scheme. Identification of an exact appropriate probabilistic model for observations is essential. Based on the selected model of the observations, an appropriate control chart is selected and then the parameters required for the control chart design are estimated. Although the parameter estimation step of a Phase I analysis may be skipped when the parameters can be assumed to be known. in practice this is often not the case.

In Phase I analysis, estimated parameters are first used to calculate trial control limits of the selected control chart, and this control chart is used to identify outliers that are the points exceeding the control limits. Outliers can be classified either to correspond to an out-of-control process state or to an in-control process state. Note that a false alarm rate is also expected for an in-control process, i.e., some observations may fall close but outside the control limits even though the process operates in an in-control state without a process upset.

Therefore, outliers are investigated for possible process upsets. If identified, corrective actions are taken and the corresponding outliers are filtered from the Phase I observations. The output of a Phase I analysis is a model for the in-control state, which is then used to design a control chart for online process monitoring in Phase II. The chart being used in Phase II might be different from the one in Phase I, e.g., a cumulative sum or exponentially weighted moving average chart. Phase I analysis will lead to parameter estimation from incomplete data if outliers are filtered.On the other hand, if such outliers are erroneously kept in the sample, they are expected to influence the parameter estimates used in chart design, and consequently the process monitoring performance in Phase II. It is well known that in conventional statistical process control applications one is traditionally concerned with monitoring performance of a process or product using