

Jointly Optimal Statistical Process Control and Maintenance Policy for Deteriorating Processes

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Abstract : With the advent of globalization, the market competition has become a major issue for most companies. One of the main strategies to overcome this situation is the quality improvement of the product at a lower cost to meet customers' expectations. In order to achieve the desired quality of products, it is important to control the process to meet the specifications, and to implement the optimal maintenance policy for the machines and the production lines. Thus, the overall objective is to reduce process variation and the production and maintenance costs. In this paper, an integrated model involving Statistical Process Control (SPC) and maintenance is developed to achieve this goal. Therefore, the main focus of this paper is to develop the jointly optimal maintenance and statistical process control policy minimizing the total long run expected average cost per unit time. In our model, the production process can go out of control due to either the deterioration of equipment or other assignable causes. The equipment is also subject to failures in any of the operating states due to deterioration and aging. Hence, the process mean is controlled by an Xbar control chart using equidistant sampling epochs. We assume that the machine inspection epochs are the times when the control chart signals an out-of-control condition, considering both true and false alarms. At these times, the production process will be stopped, and an investigation will be conducted not only to determine whether it is a true or false alarm, but also to identify the causes of the true alarm, whether it was caused by the change in the machine setting, by other assignable causes, or by both. If the system is out of control, the proper actions will be taken to bring it back to the in-control state. At these epochs, a maintenance action can be taken, which can be no action, or preventive replacement of the unit. When the equipment is in the failure state, a corrective maintenance action is performed, which can be minimal repair or replacement of the machine and the process is brought to the in-control state. SMDP framework is used to formulate and solve the joint control problem. Numerical example is developed to demonstrate the effectiveness of the control policy.

Keywords : maintenance, semi-Markov decision process, statistical process control, Xbar control chart

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