



Allameh Tabatabaie University
Faculty of Statistics, Mathematical and Computer
Department of Statistics

A thesis submitted in partial fulfillment for the degree of PHD in
Statistics

Topic

**Using the Markov Chain Approach for Statistical
and Economic-Statistical Design \bar{X} Control Chart
with Variable Sampling Rate under Weibull Shock
Model**

By

Bahman Fasihi

Supervisor

Dr. Reza Pourtaheri

Advisor

Dr. Mohammad Bameni Moghadam

September 2022

Abstract

Statistical process control is an effective method for monitoring and improving the quality of an organization's production and services, and the control chart is a major tool of this method. In the design of the control chart, the optimal determination of the three design parameters of the sample size, the sampling interval and the coefficient of the control limits are of great importance. For this purpose, many researchers have focused their opinion on how to design a control chart and have presented different ideas including statistical, economic and statistical-economic design. Economic designs of control charts require a distribution for the process failure mechanism. For simplicity, the length of time the process remains in control is often assumed to be an exponential distribution where the hazard rate is constant. In this situation, the sampling intervals are considered fixed. In many situations in the industry, the system is deteriorating and the probability of system failure increases with time. As a result, under these conditions, it is more reasonable to choose a distribution function with an increasing risk rate. In this thesis, under the assumption that the probability of failure is increasing, Weibull distribution was chosen as the mechanism of failure. In the case where the shock model has an increasing risk rate, using non-constant sampling intervals that become smaller and smaller over time is more economical than when the sampling intervals are constant.

In this treatise, for the first time in the statistical design of adaptive control charts, the statistical design of the single-variable control chart \bar{X} is discussed under the Weibull shock model. It is discussed under the Weibull shock model. In practice, using shock models that have more flexible risk rate functions. In the statistical design of control charts, consistency is closer to reality. In the continuation of the thesis, the economic statistical design of the univariate control chart \bar{X} under the Weibull shock model is discussed. Also, the economic and statistical economic consequences of a new control plan called \bar{X} control plan with variable sample size under the Weibull shock model with uneven sampling intervals $\bar{X} - VRS$, where the sample size is variable, are examined. In this connection, the cost model of Costa and Rahim (2001) has been used and the proposed control chart has been compared with control

charts with fixed parameters in statistical, economic and statistical-economic design.

Keywords: *economic-statistical design, statistical design, \bar{X} control chart, uneven sampling interval, Weibull shock model.*