Book Review

Statistical Quality Control Using the SAS System By King, Dennis W.,
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This book was written for quality-control analysts in industry, and for students in statistics programs, or in programs for management or decision sciences, or in industrial or mechanical engineering programs. It is broadly applicable to a host of other fields as well, such as medical and laboratory sciences, and all types of service industries.

The reader is expected to have had a basic statistics course, and experience with the SAS system and the SAS DATA step. The book consists of eight chapters, three appendices, a list of references, and an extensive index. The many SAS procedures discussed in this book are contained in the SAS/QC, SAS/STAT, SAS/ETS, SAS/GRAPH, and SAS base products. One goal of this book is to demonstrate the broad applicability of SAS software as a tool for quality improvement. A second goal is to show how the SAS system can be used by employees at all levels of management and statistical expertise to analyze and present data collected on a process. The book consists of two sections. The first section consists of chapters 1-3, and requires a basic knowledge of statistics for interpretation of graphs and charts. It is intended for use by persons at all levels of an organization. The second section, chapters 4-8, presents detailed statistical methods of quality control, including theoretical aspects.

The first chapter presents an overview of statistical quality control, and relevant SAS software, including the SQC and ADX menu systems contained in the SAS/QC product. The second chapter presents a brief overview of data collection procedures, and use of the SAS system to enter data. The third chapter discusses basic methods of statistical process control (SPC),and demonstrates use of the SAS system to construct graphs and charts to display quality improvement information. This includes use of PROC PARETO to construct Pareto diagrams of nonconformity data, and PROC ISHIKAWA to construct Ishikawa cause and effect diagrams. It also includes programs for constructing defect concentration and scatter diagrams. The next three chapters (4-6) present advanced methods of SPC, which are based on statistical theory. The fourth chapter discusses the use of a variety of control charts. The use of PROC SHEWHART to create P, c, u, S, and X-bar Shewhart charts is first presented, along with a SAS program to calculate average run length (ARL). Next, the use of PROC CUSUM to construct cumulative sum (CUSUM), and fast initial response CUSUM control charts is presented. The use of PROC MACONTROL to construct exponentially weighted moving average control charts is next presented.

This is followed by a discussion of SPC for autocorrelated data based upon time series modeling. The last part of this chapter is devoted to the construction and use of specialized control charts, including control charts for short runs, and for laboratory QA/QC, as well as acceptance control charts and trend control charts. The fifth chapter covers the use of histograms and capability analysis for SPC. Three methods for constructing histograms are illustrated using PROC CAPABILITY. This is followed by a three-part section illustrating the use of PROC CAPABILITY for measuring process capability for normally distributed data. Part I presents a SAS program for analyzing sample data, and discusses methods for verifying that the data are normally distributed, using the printed output. Part II discusses how to estimate the process capability from the printed output. Part III demonstrates how to obtain

confidence intervals for the capability index. The next section presents methods for obtaining six different confidence or tolerance intervals for normally distributed data using PROC CAPABILITY.

This is followed by a section on obtaining capability indices for nonnormal data by calculating a generalized capability index. The final section of this chapter presents methods for performing reliability analyses using PROC CAPABILITY. The Weibull, lognormal, exponential, gamma and beta distributions can all be specified. Chapter six presents methods for improving processes by using statistically designed experiments, sometimes called Design of Experiments. In this chapter SAS/QC software is used to generate four types of experimental designs. These consist of factorial, fractional factorial, response surface and mixture designs. The author emphasizes that each experimental design requires a very specific method of analysis. The first example illustrates the use of the SAS/QC ADX menu system to design and analyze a factorial experiment. The second example illustrates the use of SAS/QC PROC FACTEX to generate a more complex factorial design, and uses SAS/STAT PROC GLM to perform an analysis of variance (ANOVA) on the measured data. The next section illustrates the use of PROC FACTEX and the ADX menu system to design various kinds of fractional factorial experiments. The use of the ADX system to analyze this type of experiment is also described.

The following sections illustrate the use of PROC FACTEX to construct factorial designs in blocks, orthogonal array designs using Taguchi methodology, and design and analysis of response surface designs. The last part of this chapter describes methods for generating and analyzing mixture designs. Chapter seven covers the design of acceptance sampling plans for attributes, and for variables, using SAS software, and describes their use. SAS code for producing a variety of sampling plans is presented, including those for Military Standards 105, 414 and 1235. Chapter eight covers the application of SAS base software, SAS/STAT, and SAS/QC for measurement quality control. The first example describes analysis of calibration data using least squares. This is followed by analysis of gage reproducibility and repeatability data using the GAGE application of SAS/QC software, as well as variance components methods.

The final section covers tolerance analysis, and includes two examples. Three appendices follow the body of the text. Appendix A contains 21 sets of data used in the examples discussed in the various chapters. Appendix B contains SAS code for two macros used in chapters seven and eight. Appendix C contains SAS code for generating the figures displayed in the text. A rather extensive list of references, and a comprehensive index complete the book. This is a well written book that presents many practical examples of the application the SAS system to meet the requirements of a wide variety of statistical quality control requirements. The examples are well chosen, and the SAS output is explained in detail. References to pertinent books and journal articles are included in each chapter. This is another fine example of the many books by SAS users covering the application of the SAS system to a variety of statistical problems. This book should be a useful guide to persons using the SAS system for statistical quality control.