Quality Control II
Statistical Process Control and Reliability

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Abstract:
Welcome to the world of Quality Control - a journey into the heart of ensuring excellence in products and processes. This book delves into the fundamental principles, methodologies, and best practices that drive the pursuit of unparalleled quality across industries. Quality control is not just a process; it is a mindset that embodies the relentless pursuit of perfection. In today's competitive landscape. delivering high-quality products and services is no longer an option; it is a necessity. This book is designed to equip readers with a comprehensive understanding of quality control principles and how they can be applied to drive continuous improvement and achieve customer satisfaction. The primary aim of this book is to provide a valuable resource for students, professionals, and quality enthusiasts alike, seeking to deepen their knowledge and expertise in the realm of quality control. I hope this book inspires you to embrace the spirit of continuous improvement, to strive for excellence in all your endeavors, and to embrace the transformative power of quality control. Remember, quality control is not just a practice; it is a commitment to excellence - a commitment we make to ourselves, our customers, and the world at large.

Let the journey begin.

Keywords: central tendency, debugging phase, Parallel System, Statistical Process Control, wear-out phase

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STATISTICAL PROCESS CONTROL AND RELIABILITY

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LIST OF ABBREVIATIONS

SPC	Statistical Process Control	2
JUSE	Japanese Scientists and Engineers (JUSE)	3
Cp	Process Capability	29

PREFACE

Welcome to the world of Quality Control – a journey into the heart of ensuring excellence in products and processes. This book delves into the fundamental principles, methodologies and best practices that drive the pursuit of unparalleled quality across industries. Quality control is not just a process; it is a mindset that embodies the relentless pursuit of perfection. In today's competitive landscape, delivering high-quality products and services is no longer an option; it is a necessity. This book is designed to equip readers with a comprehensive understanding of quality control principles and how they can be applied to drive continuous improvement and achieve customer satisfaction. The primary aim of this book is to provide a valuable resource for students, professionals, and quality enthusiasts alike seeking to deepen their knowledge and expertise in the realm of quality control. I hope this book inspires you to embrace the spirit of continuous improvement, to strive for excellence in all your endeavors, and to embrace the transformative power of quality control. Remember, quality control is not just a practice; it is a commitment to excellence – a commitment we make to ourselves, our customers, and the world at large.

Let the journey begin.

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CHAPTER 1

FUNDAMENTALS OF STATISTICS PROCESS CONTROL

1.1 Introduction

Statistical Process Control (SPC) is a powerful method of quality control used in manufacturing and production industries **to monitor and control processes systematically**. It involves the application of statistical methods to **measure, analyse, and control the production process**, aiming to produce as much conforming products as possible with minimal rejected products or defects.

- The primary objective of SPC is to ensure that processes remain **stable, predictable, and capable of consistently meeting quality standards**. By using statistical tools and techniques, SPC helps identify variations and trends in process data, enabling businesses to take corrective actions and make data-driven decisions. Key tools used in SPC include **control charts**.

1.2 Statistics

Statistics is a study of the collection, organization, analysis, interpretation and presentation of data from the samples. **Statistical analysis** is the application of statistical data to determine probabilistic or statistical relationships in quantitative method. Basically, descriptive and inferential statistics are used to analyse data and draw conclusions to the population. Descriptive statistics (mean, standard deviation) that are applied to populations are called **parameters** as they represent the whole population. **Population** is group of data that includes all the data in the population. However, many researchers normally do not have access to the whole population because of limited resources such as time and financial. **A sample** is a set of data chosen from a population and subset of the population. Descriptive statistics of samples, such as the mean or standard deviation, are not called parameters but statistics. **A statistic** is a characteristic of a sample. A **parameter** is characteric of population.

CHAPTER 2

CONTROL CHARTS FOR VARIABLES

2.1 Introduction

Control charts for variables, also known as continuous data or quantitative data control charts, are powerful tools used in statistical process control (SPC) **to monitor and analyze the stability and variability of a process over time**. They are widely used in manufacturing and other industries to assess the performance of a process and detect any signs of instability or special causes of variation that may lead to defects or quality issues.

- Variables in SPC refer to measurable data that can take any numeric value, such as dimensions, **weights, temperatures, cycle times, or other quantitative measurements**. Control charts for variables are designed to track the variability of these measurements and identify patterns or trends that may indicate deviations from the desired process performance.
- **Statistics** is a **group of tools** that allow us to analyze data, make summaries, **draw inferences and generalize from samples data**. A control chart is **a graphic** that illustrates whether processes are meeting their intended control limit and, if not, the degree by which they vary from those limit as shown in Figure 2.1.

CHAPTER 3

CONTROL CHARTS FOR ATTRIBUTES

3.1 Introduction

Attributes control charts are used to evaluate variation in a process where the measurement is an attribute--i.e. the variable can be measured on **a attributes scale** (e.g. **Defects and defectives**) such as **scratching, wrong operation manual and cabinet color difference**.

Attribute Charts deal with binomial and Poisson processes, not measurements. **A defect is an irregularity or problem**. **The larger unit may contain many defects**. A piece of glass (Defectives unit) may contain several bubbles or scratches (Defects) Defects are countable Example: Scratches, missing remote control, picture blur, color tone. **A defective is a unit** that, as a whole, is not acceptable or does not meet performance requirements. The selection of control chart is shown in Figure 3.1.

- **Defectives (unit) are monitored p and np charts**
- **Defects are monitored using c and u charts**

CHAPTER 4

RELIABILITY

4.1 Reliability

Reliability refers to the ability of a product **to consistently perform as expected over an extended period**. It can be formally defined as the probability that a product, equipment, or system will fulfill its intended function for a **specified duration under predetermined operating conditions**. Reliability emphasizes the quality of a product in the long run, indicating its reliability and **consistency over time**. A reliable product is one that continues to function properly and meet user requirements without unexpected failures or breakdowns. Given that individual units of a product may **fail at different points in time, reliability is assessed as a probability**. The higher the reliability, the more dependable and trustworthy the product is considered to be.

4.2 Factors associated with Reliability

Reliability involves **four important** aspects:

- **The numerical value:** It represents the **probability** that a product will perform **as intended within a specific timeframe**. It quantifies the probability of successful functioning. This numerical value indicates the level of confidence in the product's reliability.
- **Intended Function**: Product are designed for particular applications and are **expected to be able to perform** those intended applications.
- **Product life:** It refers to the **expected duration a product will remain functional** before becoming obsolete or non-operational. It is determined based on factors like usage, time, or a combination of both.
- **Environmental Conditions**: Environmental conditions **refer to the surroundings where a product operates or is stored, including indoor and outdoor settings**, as well as transportation and storage conditions. These factors can significantly impact product performance and longevity.

CHAPTER 5

ACCEPTANCE SAMPLING

5.1 Acceptance Sampling and Type of Defects

Acceptance sampling is used to **make judgement whether to accept or reject** a product or material using statistical sampling.

- Decision to accept or reject the lot is made by **identifying the number of defect items** in a sample based on size of lot. The lot is will be accepted if the number of defects is below the acceptance number.

Type of Defects:

- **Critical Defect**

  The Critical Defect is defect that relates **to safety** or **unsafe conditions** for end-users such as dangerous and could injure the customers. It is a severe issue that could potentially lead to accidents, injuries, or even loss of life if not addressed promptly. Examples of critical defects in various products could include faulty electrical wiring in appliances, brake failure in vehicles, or structural weaknesses in buildings.

- **Major Defect**

  The Major Defect is defect that relates to **result in failure of the unit for its intended purpose**, or reduced usability of the product unit such as malfunction. Major defects may lead to **malfunctions, frequent breakdowns, or compromised performance and causing inconvenience to customers**. Examples of major defects could be a non-functional touchscreen on a mobile phone or a leaking seal in a water bottle.

- **Minor Defect**

  A Minor defect is a discrepancy from the standards, but one **that is not likely to affect the usability of an object such as scratches and color differences**.

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