



# Course Outline

## Chapter 1: Descriptive Statistics and Graphical Analysis

- 1.1 Introduction**
  - 1.1.1 Learning Objectives
- 1.2 Types of Data**
  - 1.2.1 Basic Concepts
  - 1.2.2 Data Types
  - 1.2.3 Quiz: Types of Data
- 1.3 Using Graphs to Analyze Data**
  - 1.3.1 Basic Concepts
  - 1.3.2 Bar Charts and Pareto Charts
  - 1.3.3 Pie Charts
  - 1.3.4 Histograms
  - 1.3.5 Dotplots
  - 1.3.6 Individual Value Plots
  - 1.3.7 Boxplots
  - 1.3.8 Time Series Plots
  - 1.3.9 Quiz: Using Graphs to Analyze Data
  - 1.3.10 Minitab Tools: Bar Chart
  - 1.3.11 Minitab Tools: Pie Chart
  - 1.3.12 Minitab Tools: Histogram
  - 1.3.13 Minitab Tools: Dotplot
  - 1.3.14 Minitab Tools: Individual Value Plot
  - 1.3.15 Minitab Tools: Boxplot
  - 1.3.16 Minitab Tools: Times Series Plot
  - 1.3.17 Exercise: Graphical Analysis
- 1.4 Using Statistics to Analyze Data**
  - 1.4.1 Basic Concepts
  - 1.4.2 Mean and Median
  - 1.4.3 Range, Variance, and Standard Deviation
  - 1.4.4 Quiz: Using Statistics to Analyze Data
  - 1.4.5 Minitab Tools: Display Descriptive Statistics
  - 1.4.6 Exercise: Descriptive Statistics
- 1.5 Summary**
  - 1.5.1 Objectives Review

## Chapter 2: Statistical Inference

- 2.1 Introduction**
  - 2.1.1 Learning Objectives
- 2.2 Fundamentals of Statistical Inference**
  - 2.2.1 Basic Concepts
  - 2.2.2 Random Samples
  - 2.2.3 Quiz: Fundamentals of Statistical Inference

- 2.2.4 Minitab Tools: Random Sampling
- 2.3 Sampling Distributions**
  - 2.3.1 Basic Concepts
  - 2.3.2 Sampling Distribution of the Mean
  - 2.3.3 Quiz: Sampling Distributions
- 2.4 Normal Distribution**
  - 2.4.1 Basic Concepts
  - 2.4.2 Probabilities Associated with a Normal Distribution
  - 2.4.3 Probabilities Associated with the Sample Mean
  - 2.4.4 Quiz: Normal Distribution
  - 2.4.5 Minitab Tools: Cumulative Probabilities with a Normal Distribution
  - 2.4.6 Exercise: Probabilities and Normal Distributions
- 2.5 Summary**
  - 2.5.1 Objectives Review

## Chapter 3: Hypothesis Tests and Confidence Intervals

- 3.1 Introduction**
  - 3.1.1 Learning Objectives
- 3.2 Tests and Confidence Intervals**
  - 3.2.1 Confidence Intervals
  - 3.2.2 Hypothesis Testing
  - 3.2.3 Using Hypothesis Testing to Make Decisions
  - 3.2.4 Type I and Type II Errors and Power
  - 3.2.5 Quiz: Tests and Confidence Intervals
- 3.3 1-Sample t-Test**
  - 3.3.1 Basic Concepts
  - 3.3.2 Individual Value Plots
  - 3.3.3 1-Sample t-Test Results
  - 3.3.4 Assumptions
  - 3.3.5 Quiz: 1-Sample t-Test
  - 3.3.6 Minitab Tools: 1-Sample t-Test
  - 3.3.7 Exercise: 1-Sample t-Test
- 3.4 2 Variances Test**
  - 3.4.1 Basic Concepts
  - 3.4.2 Boxplots
  - 3.4.3 2 Variances Test Results
  - 3.4.4 Assumptions
  - 3.4.5 Quiz: 2 Variances Test
  - 3.4.6 Minitab Tools: 2 Variances Test
  - 3.4.7 Exercise: 2 Variances Test
- 3.5 2-Sample t-Test**



- 3.5.1 Basic Concepts
- 3.5.2 Individual Value Plot
- 3.5.3 2-Sample t-Test Results
- 3.5.4 Assumptions
- 3.5.5 Quiz: 2-Sample t-Test
- 3.5.6 Minitab Tools: 2-Sample t-Test
- 3.5.7 Exercise: 2-Sample t-Test

### 3.6 Paired t-Test

- 3.6.1 Basic Concepts
- 3.6.2 Individual Value Plots
- 3.6.3 Paired t-Test Results
- 3.6.4 Assumptions
- 3.6.5 Quiz: Paired t-Test
- 3.6.6 Minitab Tools: Paired t-Test
- 3.6.7 Exercise: Paired t-Test

### 3.7 1 Proportion Test

- 3.7.1 Basic Concepts
- 3.7.2 1 Proportion Test Results
- 3.7.3 Assumptions
- 3.7.4 Quiz: 1 Proportion Test
- 3.7.5 Minitab Tools: 1 Proportion Test
- 3.7.6 Exercise: 1 Proportion Test

### 3.8 2 Proportions Test

- 3.8.1 Basic Concepts
- 3.8.2 2 Proportions Test Results
- 3.8.3 Assumptions
- 3.8.4 Quiz: 2 Proportions Test
- 3.8.5 Minitab Tools: 2 Proportions Test
- 3.8.6 Exercise: 2 Proportions Test

### 3.9 Chi-Square Test

- 3.9.1 Basic Concepts
- 3.9.2 Chi-Square Test Results
- 3.9.3 Assumptions
- 3.9.4 Quiz: Chi-Square Test
- 3.9.5 Minitab Tools: Chi-Square Test
- 3.9.6 Exercise: Chi-Square Test

### 3.10 Summary

- 3.10.1 Objectives Review

## Chapter 4: Control Charts

### 4.1 Introduction

- 4.1.1 Learning Objectives

### 4.2 Statistical Process Control

- 4.2.1 Basic Concepts
- 4.2.2 Patterns in Control Charts

- 4.2.3 Quiz: Statistical Process Control

### 4.3 Control Charts for Variables Data in Subgroups

- 4.3.1 Basic Concepts
- 4.3.2 R Charts
- 4.3.3 S Charts
- 4.3.4 Xbar Charts
- 4.3.5 Quiz: Control Charts for Variables Data in Subgroups
- 4.3.6 Minitab Tools: Xbar-R Chart
- 4.3.7 Exercise: Xbar-R Chart

### 4.4 Control Charts for Individual Observations

- 4.4.1 Basic Concepts
- 4.4.2 Moving Range Charts
- 4.4.3 Individuals Charts
- 4.4.4 Quiz: Control Charts for Individual Observations
- 4.4.5 Minitab Tools: I-MR Chart
- 4.4.6 Exercise: I-MR Chart

### 4.5 Control Charts for Attribute Data

- 4.5.1 Basic Concepts
- 4.5.2 NP and P Charts
- 4.5.3 C and U Charts
- 4.5.4 Quiz: Control Charts for Attributes Data
- 4.5.5 Minitab Tools: P Chart
- 4.5.6 Exercise: P Chart

### 4.6 Summary

- 4.6.1 Objectives Review

## Chapter 5: Process Capability

### 5.1 Introduction

- 5.1.1 Learning Objectives

### 5.2 Process Capability for Normal Data

- 5.2.1 Basic Concepts
- 5.2.2 Assumptions
- 5.2.3 Testing for Normality
- 5.2.4 Quiz: Process Capability for Normal Data
- 5.2.5 Minitab Tools: Normality Test
- 5.2.6 Exercise: Assumptions for Process Capability

### 5.3 Capability Indices

- 5.3.1 Potential Capability: Cp and Cpk
- 5.3.2 Process Performance: Pp and Ppk
- 5.3.3 Sigma Level
- 5.3.4 Quiz: Capability Indices
- 5.3.5 Minitab Tools: Cp and Pp
- 5.3.6 Minitab Tools: Sigma Level
- 5.3.7 Exercise: Process Capability for Normal Data

### 5.4 Process Capability for Nonnormal Data



- 5.4.1 Transformations and Alternate Distributions
- 5.4.2 Box-Cox Transformation
- 5.4.3 Johnson Transformation
- 5.4.4 Alternate Distributions
- 5.4.5 Quiz: Process Capability for Nonnormal Data
  
- 5.4.6 Minitab Tools: Box-Cox Transformation
- 5.4.7 Minitab Tools: Johnson Transformation
- 5.4.8 Minitab Tools: Capability Analysis with Johnson Transformation
- 5.4.9 Minitab Tools: Alternate Distributions
- 5.4.10 Minitab Tools: Capability Analysis with Alternate Distributions
- 5.4.11 Exercise: Process Capability with Data Transformations
- 5.4.12 Exercise: Process Capability with Alternate Distributions
  
- 5.5 Summary**
- 5.5.1 Objectives Review

## Chapter 6: Analysis of Variance (ANOVA)

- 6.1 Introduction**
- 6.1.1 Learning Objectives
  
- 6.2 Fundamentals of ANOVA**
- 6.2.1 Basic Concepts
- 6.2.2 Graphs and Summary Statistics
- 6.2.3 Quiz: Fundamentals of ANOVA
  
- 6.3 One-Way ANOVA**
- 6.3.1 Hypothesis Tests
- 6.3.2 F-Statistics and P-Values
- 6.3.3 Multiple Comparisons
- 6.3.4 Assumptions and Residual Plots
- 6.3.5 Quiz: One-Way ANOVA
- 6.3.6 Minitab Tools: One-Way ANOVA
- 6.3.7 Exercise: One-Way ANOVA
  
- 6.4 Two-Way ANOVA**
- 6.4.1 Basic Concepts
- 6.4.2 Graphs
- 6.4.3 Hypothesis Tests
- 6.4.4 F-Statistics and P-Values
- 6.4.5 Assumptions and Residual Plots
- 6.4.6 Quiz: Two-Way ANOVA
- 6.4.7 Minitab Tools: Two-Way ANOVA
- 6.4.8 Exercise: Two-Way ANOVA
  
- 6.5 Summary**
- 6.5.1 Summary of ANOVA

## Chapter 7: Correlation and Regression

- 7.1 Introduction**
- 7.1.1 Learning Objectives
  
- 7.2 Relationship Between Two Quantitative Variables**
- 7.2.1 Basic Concepts
- 7.2.2 Scatterplot
- 7.2.3 Correlation
- 7.2.4 Quiz: Relationship Between Two Quantitative Variables
- 7.2.5 Minitab Tools: Scatterplot
- 7.2.6 Minitab Tools: Correlation
- 7.2.7 Exercise: Scatterplots and Correlation
  
- 7.3 Simple Regression**
- 7.3.1 Basic Concepts
- 7.3.2 Regression
- 7.3.3 Hypothesis Tests and R<sup>2</sup>
- 7.3.4 Assumptions and Residual Plots
- 7.3.5 Quiz: Simple Regression
- 7.3.6 Minitab Tools: Simple Regression
- 7.3.7 Exercise: Simple Regression
  
- 7.4 Summary**
- 7.4.1 Objectives Review

## Chapter 8: Measurement Systems Analysis

- 8.1 Introduction**
- 8.1.1 Learning Objectives
  
- 8.2 Fundamentals of Measurement Systems Analysis**
- 8.2.1 Basic Concepts
- 8.2.2 Accuracy
- 8.2.3 Precision
- 8.2.4 Comparing Accuracy and Precision
- 8.2.5 Quiz: Fundamentals of Measurement Systems Analysis
  
- 8.3 Repeatability and Reproducibility**
- 8.3.1 Basic Concepts
- 8.3.2 Gage R&R Studies
- 8.3.3 Quiz: Repeatability and Reproducibility
  
- 8.4 Graphical Analysis of a Gage R&R Study**
- 8.4.1 Basic Concepts
- 8.4.2 Components of Variation
- 8.4.3 Xbar and R Charts
- 8.4.4 Interaction between Operator and Part
- 8.4.5 Comparative Plots
- 8.4.6 Gage Run Charts
- 8.4.7 Quiz: Graphical Analysis of a Gage R&R Study
- 8.4.8 Minitab Tools: Crossed Gage R&R Study
- 8.4.9 Minitab Tools: Gage Run Chart
- 8.4.10 Exercise: Graphical Analysis of a Gage R&R Study



- 8.5 Variation**
  - 8.5.1 Standard Deviation and Study Variation
  - 8.5.2 Tolerance
  - 8.5.3 Quiz: Variation
  - 8.5.4 Exercise: Numerical Analysis of a Gage R&R Study
- 8.6 ANOVA with a Gage R&R Study**
  - 8.6.1 Variance Components
  - 8.6.2 Analysis of Variance Tables
  - 8.6.3 Quiz: ANOVA with a Gage R&R Study
  - 8.6.4 Exercise: ANOVA Output for a Gage R&R Study
- 8.7 Gage Linearity and Bias Study**
  - 8.7.1 Basic Concepts
  - 8.7.2 Gage Linearity
  - 8.7.3 Gage Bias
  - 8.7.4 Quiz: Gage Linearity and Bias Study
  - 8.7.5 Minitab Tools: Gage Linearity and Bias Study
  - 8.7.6 Exercise: Gage Linearity and Bias Study
- 8.8 Attribute Agreement Analysis**
  - 8.8.1 Basic Concepts
  - 8.8.2 Binary Data
  - 8.8.3 Nominal Data
  - 8.8.4 Ordinal Data
  - 8.8.5 Quiz: Attribute Agreement Analysis
  - 8.8.6 Minitab Tools: Attribute Agreement Analysis with Binary Data
  - 8.8.7 Minitab Tools: Attribute Agreement Analysis with Nominal Data
  - 8.8.8 Minitab Tools: Attribute Agreement Analysis with Ordinal Data
  - 8.8.9 Exercise: Attribute Agreement Analysis
- 8.9 Summary**
  - 8.9.1 Objectives Review

- 9.2 Factorial Designs**
  - 9.2.1 Basic Concepts
  - 9.2.2 Creating Full Factorial Designs
  - 9.2.3 Analyzing Full Factorial Designs
  - 9.2.4 Quiz: Factorial Designs
  - 9.2.5 Minitab Tools: Create a Full Factorial Design
  - 9.2.6 Minitab Tools: Analyze a Full Factorial Design
  - 9.2.7 Exercise: Create a Full Factorial Design
  - 9.2.8 Exercise: Analyze a Full Factorial Design
- 9.3 Blocking and Incorporating Center Points**
  - 9.3.1 Blocking
  - 9.3.2 Center Points
  - 9.3.3 Analyzing Designs with Blocks and Center Points
  - 9.3.4 Quiz: Blocking and Incorporating Center Points
  - 9.3.5 Minitab Tools: Create a Factorial Design with Blocks and Center Points
  - 9.3.6 Minitab Tools: Analyze a Factorial Design with Blocks and Center Points
  - 9.3.7 Exercise: Create a Factorial Design with Blocks and Center Points
  - 9.3.8 Exercise: Analyze a Factorial Design with Blocks and Center Points
- 9.4 Fractional Factorial Designs**
  - 9.4.1 Basic Concepts
  - 9.4.2 Creating Fractional Factorial Designs
  - 9.4.3 Analyzing Fractional Factorial Designs
  - 9.4.4 Quiz: Fractional Factorial Designs
  - 9.4.5 Minitab Tools: Create a Fractional Factorial Design
  - 9.4.6 Minitab Tools: Analyze a Fractional Factorial Design
- 9.5 Response Optimization**
  - 9.5.1 Response Optimization
  - 9.5.2 Quiz: Response Optimization
  - 9.5.3 Minitab Tools: Response Optimization
  - 9.5.4 Exercise: Response Optimization
- 9.6 Summary**
  - 9.6.1 Objectives Review

## Chapter 9: Design of Experiments

- 9.1 Introduction**
  - 9.1.1 Learning Objectives

**Minitab** Our mission is to help people discover valuable insights in their data.

Minitab helps companies and institutions to spot trends, solve problems and discover valuable insights in data by delivering a comprehensive and best-in-class suite of data analysis and process improvement tools. Combined with unparalleled ease-of-use, Minitab makes it simpler than ever to get deep insights from data. Plus, a team of highly trained data analytic experts ensure that users get the most out of their analysis, enabling them to make better, faster and more accurate decisions.

For over 45 years, Minitab has helped organizations drive cost containment, enhance quality, boost customer satisfaction and increase effectiveness. Thousands of businesses and institutions worldwide use Minitab Statistical Software, Companion, and Quality Trainer to uncover flaws in their processes and improve them. In 2017, Minitab acquired Salford Systems, a leading provider of advanced analytics which delivers a suite of powerful data mining, predictive analytics and modeling capabilities. Unlock the value of your data with Minitab.

