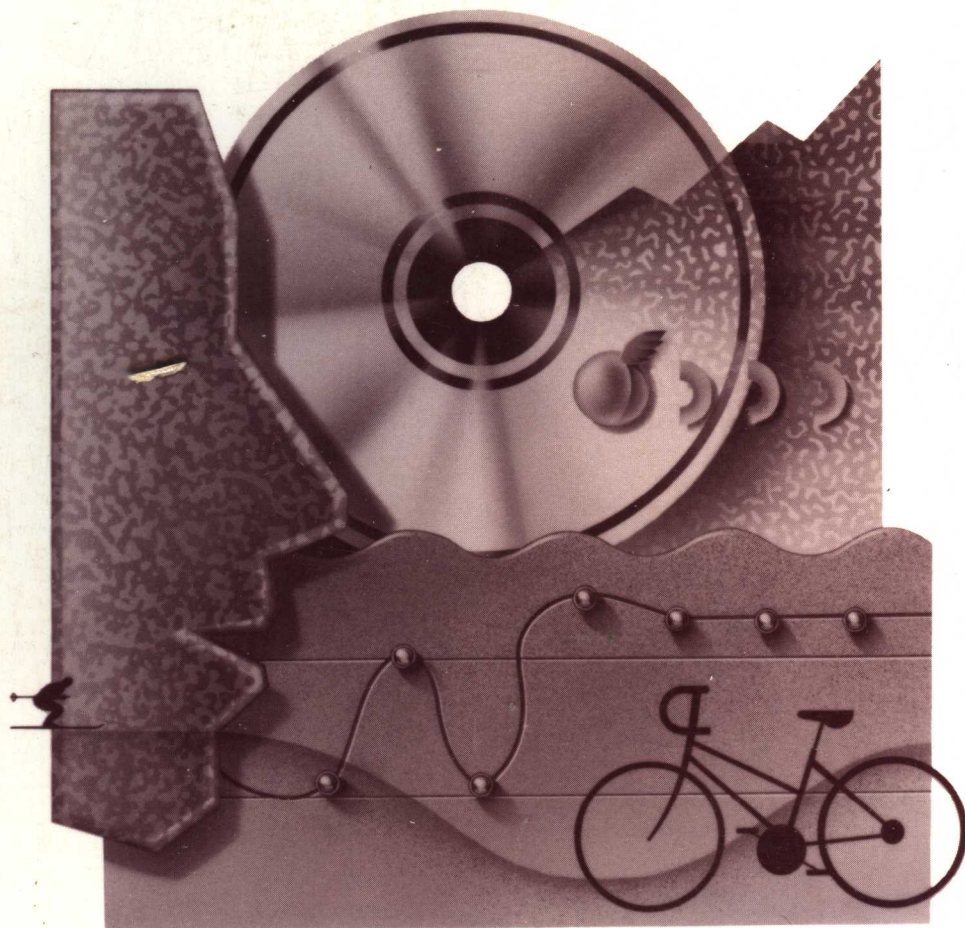


MINITAB® GUIDE  
FOR USE WITH

# APPLIED STATISTICS FOR BUSINESS AND ECONOMICS



ALLEN WEBSTER

PREPARED BY  
KILMAN SHIN

MINITAB® GUIDE  
FOR USE WITH

# APPLIED STATISTICS FOR BUSINESS AND ECONOMICS

○ ○ ○

ALLEN WEBSTER

*Prepared by*  
**Kilman Shin**  
*Ferris State University*

**IRWIN**

Homewood, IL 60430  
Boston, MA 02116

©Richard D. Irwin, Inc., 1992

*All rights reserved.* No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without the prior written permission of the publisher.

Minitab is a registered trademark of Minitab Inc.

*Printed in the United States of America.*

ISBN 0-256-10957-5

1 2 3 4 5 6 7 8 9 0 MG 8 7 6 5 4 3 2 1

## Minitab Guide

---

Dedicated to the People who have developed the Minitab System

Minitab is a registered trademark of Minitab Inc.

## Preface

This Minitab Guide explains the beginning steps to run Minitab software on personal computers (DOS version). This Guide may be useful to students who are taking statistics, business forecasting, econometrics, marketing research, economics, finance, and computer courses, and to any person who is doing statistical research.

This Guide consists of three parts:

In Part I (Chapters 1 - 8), the methods of typing the data and command files, and the operational steps are explained to run Minitab.

In Part II (Chapters 9 - 23), sample application files are shown using the data from Applied Statistics for Business and Economics, by Allen Webster, 1992 (Richard D. Irwin, Inc.). Statistical concepts, theory, formulas, interpretations of the data, calculation methods, and solutions are discussed in detail in the above textbook which also contains most statistical tables.

In Part III (Chapter 24), some selected Minitab sample files are arranged in the alphabetical order.

Irwin's James Minatel, Development Editor, provided advise and most useful suggestions in developing the Guide. Irwin's Richard Hersher and Brian Murray made arrangements for the Guide. Allen Webster, author of the excellent applied statistics text, let me use all his textbook materials.

Bokman Shin and his family offered me seaside summer housing and various assistance while I was writing this Guide during the summer of 1991. Young Sook Chung provided very useful comments on many chapters.

This Guide is based on the copyrighted publications and software by Minitab Inc., which provided various assistance and cooperation. This book is dedicated to the people who have developed the Minitab system and those who work for the Minitab Corporation. I would like to acknowledge Thomas and Barbara Ryan, Brian Joiner, Beth Solt and Cathy Akritas of Minitab Corporation.

For more advanced applications, theories, methodology, various options, and sample input files, sample outputs, mathematical formulas, references, and interpretations, users are encouraged to read Minitab publications listed at the end of this Guide.

Kilman Shin  
October 15, 1991

# Table of Contents

## Part I. Operational Steps of Minitab

### Chapter 1. What Does Minitab Do? ...1

Minitab Programs	1
Differences between Mainframe and PC Minitab	1
Three Operational Steps of Minitab	1
Minitab Screen Structure	2
Minitab Menu System	4

### Chapter 2. What Do Minitab Input Files Look Like? ...11

Types of Minitab Input Files	11
Types of Commands	12
One-File Method	13
Two-File Method	18

### Chapter 3. Typing the Data and Command Files using a Text Editor (Word Processing Software) ...23

ASCII File and the System File	23
Typing an ASCII File	24
Explanations on Statements	25
Minitab Commands and User-Defined Words	27
Common Errors in Minitab Programming	29
To Save a File in the ASCII Format	29

### Chapter 4. Running Minitab with a Batch File ...31

Text Editor Method of Batch File Processing	31
Where Do You Want the Output? - Outfile - Execute	33
Two-File Batch Processing using Minitab Commands	37

**Chapter 5. Typing the Data and Command Files using Minitab ...39**

- Typing the Data Set using Minitab 39
- To Save the Data File in the ASCII Format 40
- To Save the Data File in the System Format 40
- To Retrieve the Portable and Lotus Files 41
- To Retrieve and Edit the Saved Files 42
- To Edit the Saved Data using Minitab Command 43
- To Insert One or More Lines 44
- To Make Corrections in the Column Data 44
- To Erase Columns and Constants 46
- To Select Specific Row Observations 46
- To Stack the Data Columns 46
- To Unstack the Data Columns 47
- Typing the Data using the Minitab Data Editor 47
- To Type the Data and Commands in One File  
    using the Journal Command 50
- To Type the Command and Data Files Separately using Minitab 52
- Lotus - Minitab Connection 53

**Chapter 6. Data Types and Read Format ...55**

- Free Format for the Numeric Data 55
- Free Format for Reading a Free Data File 55
- Fortran Format for Alpha Data 55
- Fortran Format for Reading an Alpha Data File 56
- Character-Numeric Data Value Conversion 56
- Numeric-Character Data Value Conversion 57
- Fortran Format for Reading Fixed Column Data 58
- Fortran Format to Read Two or More Data Lines per Observation 59
- NOBS - Number of Observations to Read 60
- Set Command to Read the Data in Order of Variables 60
- Set Command for Set Data File 60
- Set Command for Patterned Data Values 61
- Set Command with Fortran Format 62
- Fortran Format for Print Command 62
- Saving a Portable File 62
- Print and Write Format 63

**Chapter 7. Minitab Operation in Summary ...67**

- To Retrieve a Minitab System Data File 67
- To Retrieve an ASCII Data File 67
- To Execute a File 67
- To Save the Data Set in the Minitab Format 67

To Save the Data Set in the ASCII Format	67
To Type and Save the Command and Data Files Separately in the ASCII Format	68
To Print the Output	69
To Sort the Column Data	70
Mathematical Equations for the Column Data	70
Mathematical Equations for the Row Data	71
Minitab Columns, Constants, and Matrices	72
Coding the Data Values	72
Missing Values using the Code Command	74
To Erase Columns and Rows	75
To Replace Numbers	75
Saving, Retrieving, and Executing Minitab Files	75
Using the Alpha data	76
Selecting the Number of Observations	77
Function Keys for Special Uses	77

## Chapter 8. Interactive Method of Running Minitab ...79

Two-File Interactive Processing	79
One-file Journal Method of Interactive Processing	81

# Part II. Applications

## to Applied Statistics for Business and Economics

## Chapter 9. Describing the Data Sets... 83

Frequencies and Histograms (1)	83
Batch File Method	84
Interactive Method	91
Frequencies and Histograms (2) - in High Resolution Graph	93
Frequencies and Histograms (3)	94
High-Low-Close Chart	95
Exercises	96

## Chapter 10. Measures of Central Tendency and Dispersion ... 101

Descriptive Statistics (1)	101
Descriptive Statistics (2)	103
Average Growth Rate of GNP	108
Average Rate of Return on Investment	110
Exercises	112



## Chapter 11. Probability Distribution ... 115

Random Variable	115
Probability Distributions	115
Minitab Probability Calculations	116
Normal Distribution	117
Binomial Distribution	118
Poisson Distribution	120
t, F, $\chi^2$ (Chi-Square), and Exponential Distributions	121
Generating Critical t Values	125
Generating Critical $\chi^2$ Values	127
Generating Critical F Values (1)	129
Generating Critical F Values (2)	132
Random Numbers and Sampling Distribution	135
Exercises	136

## Chapter 12. Test for One Sample Mean: t - Test ... 139

Confidence Interval for the Mean	139
t - Test for One Sample Mean (1)	141
t - Test for One Sample Mean (2)	144
Normality Test for a Distribution	145
Exercises	149

## Chapter 13. Test for Two Sample Means: t - Test ... 151

Paired Samples	151
Two Independent Samples	151
t - Test for Paired Samples (1)	152
t - Test for Paired Samples (2)	153
t - Test for Paired Samples (3)	154
t - Test for Two Independent Samples (1)	155
t - Test for Two Independent Samples (2)	159
Exercises	160

## Chapter 14. Test for Three or More Sample Means: - Analysis of Variance ... 163

Types of ANOVA	163
Hypothesis Statements for ANOVA	163

One-way Analysis of Variance	165
One-Way Analysis of Variance - Scheffe, Tukey, and LSD Tests for Balanced Design	168
One-Way Analysis of Variance for Multiple Comparisons - Tukey, Fisher's LSD, Dunnet, and Hsu's MCB Tests	173
One Way Analysis of Variance - Scheffe, Tukey, and LSD Tests for Unbalanced Design	175
One-Way Analysis of Variance for Multiple Comparison - Tukey, Fisher's LSD, Dunnet, and Hsu's MCB Tests	176
Two-Way Analysis of Variance (without Replication)	176
Two-Way Analysis of Variance (with Replication)	180
Two-Factor Analysis of Variance for Unbalanced Design	184
Exercises	187
ANCOVA (Analysis of Covariance)	192
GLM (General Linear Models)	193
MANOVA (Multivariate Analysis of Variance)	194

## Chapter 15. Simple Regression and Correlation Analyses ...197

Regression and Correlation Coefficients	197
Significance Tests	198
Assumptions of OLS	199
Simple Regression Analysis	200
Predicting Future Values	203
Simple Regression and Correlation Analyses	204
Exercises	206

## Chapter 16. Multiple Regression and Correlation Analyses ...215

Multiple Regression Analysis	215
Tests for Simple and Partial Correlation Coefficients	219
Multiple Correlation Coefficient	221
Adjusted Correlation Coefficient	222
Partial Correlation Coefficient and t - Test	223
Tests for Regression Coefficients	224
The Problem of Multicollinearity	225
Standard Error of the Estimate	227
Exercises	228

## Chapter 17. Autoregression and Weighted Regression ...235

Problem of Serial Correlation	235
-------------------------------	-----

Autoregression Method	236
Exercise	241
Problem of Heteroscedasticity	242
White's Heteroscedasticity Test	243
Weighted Least Squares Regression	247
Exercises	251

**Chapter 18. Dummy Variable Models:**  
    **Probit, Logit, Logistic, Discriminant Models ...255**

Types of Measurement	255
Dummy Variable as Independent Variable	256
Concepts of Probit and Logit Models	260
Discriminant Models	263
Exercises	265

**Chapter 19. Nonlinear Equations:**  
    **Loglinear and Polynomial Equations ...273**

Linear Transformation and Linear Estimation	273
Nonlinear Equation and Nonlinear Least Squares Method	273
Logarithmic Linear Equations	274
Polynomial Equations	277
Exercises	279

**Chapter 20. Chi-Square and Other Nonparametric Tests ...283**

Parametric Test	283
Nonparametric Test	283
Types of Parametric and Nonparametric Tests	283
Nonparametric Tests in Minitab	284
Chi-Square Test for the Goodness of Fit (1)	285
Chi-Square Test for the Goodness of Fit (2)	286
Chi-Square Test for Independence	290
Sign Test for Two Related Samples	291
Runs Test for Randomness	295
Mann-Whitney U Test for Two Independent Samples	298
Spearman Rank Correlation	302
Kruskal-Wallis Test for 3 or More Samples (1)	304
Kruskal-Wallis Test for 3 or More Samples (2)	307
Exercises	309

**Chapter 21. Time Series Analysis and Forecasting ... 315**

- Types of Statistical Data 315
- Forecasting Methods 316
- Methodology of Box-Jenkins ARIMA Models 321
- Moving Average Method 323
- Quarterly Moving Average Method 325
- 12-Month Moving Average and Seasonal Index 327
- Trend, Seasonal Index, and Cyclical Index 331
- ARIMA Model 336
- Exercises 341

**Chapter 22. Index Numbers ... 342**

- Laspeyres and Paasche Price Indexes 342
- Money Income, Real Income, and Growth Rate 343
- Exercises 345

**Chapter 23. Techniques of Quality Control ... 351**

- Quality Control Charts 351
- X-Bar Chart 352
- R-Chart 354
- P-Chart 355
- C-Chart 356
- Exercises 358

**Part III. Minitab Sample Files**

**Chapter 24. Minitab Sample Files (alphabetical order) ... 361**

**Appendix Notes**

- Note 1: One-File and Two-File Methods 407
- Note 2: Minitab Menu System 409

**Bibliography ... 413**

## Appendix Tables

Table 1. Critical  $t$  - Values ...415

Table 2. Critical  $\chi^2$  Values ....418

Table 3. Critical  $F$  Values ....421

Index ...429

## Part I. Operational Steps

### Chapter 1. What Does Minitab Do ?

#### **Minitab Programs**

The Minitab system is one of the most popular statistical packages, and widely used by students of introductory statistics. The advantage of Minitab software is the ease of interactive processing.

Minitab performs the following: histograms, stem-and-leaf charts, Box plots, descriptive statistics, probability density functions, correlation, multiple regression, stepwise regression, t-test, analysis of variance, principal component analysis, discriminant analysis, nonparametric statistics; time series analysis including ACF, PACF, CCF, and ARIMA models; matrix operation, and statistical process control (quality control) charts.

Minitab runs both in the interactive mode and in the batch mode. Minitab uses about 200 commands to do the above programs. The Minitab system accepts ASCII files as well as Minitab system files.

#### **Differences between Mainframe Minitab and PC Minitab**

This Guide starts with explanations on the operational steps of running Minitab on the PC-MS DOS personal computers. However, there is no difference between the mainframe Minitab and the PC Minitab as far as the file format is concerned. The major functional difference between the two versions is in the worksheet size. The mainframe Minitab can handle up to 1,000 columns (variables), but the PC version is limited to 100 columns and 100 constants.

A pull-down menu system is introduced in the PC Release 8.0 which comes in two versions, Minitab and Minitab Accelerated. The new release requires 1 MB of RAM, and DOS version 3.0 or later, and an AT computer with Intel 80286 or higher. A math coprocessor is not required but recommended. A mouse can be used.

#### **Three Operational Steps of Minitab**

There are three simple operational steps to run Minitab:

1. Type data and command files.
2. Submit to Minitab for Execution.
3. Get the output.

In step 3, if you get error messages, you would go back to step 1.

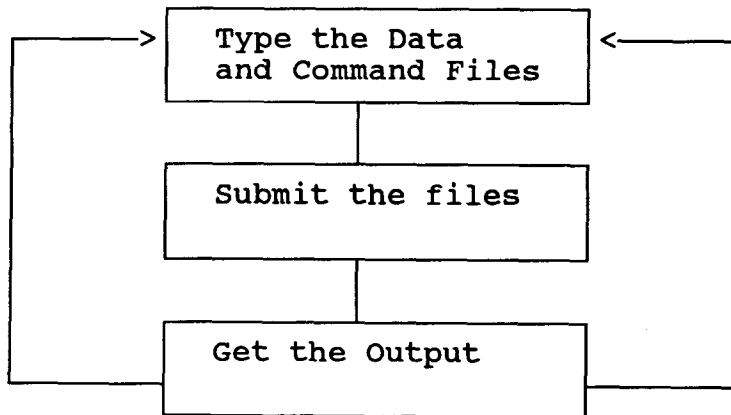


Figure 1-1. Three Operational Steps

### Minitab Screen Structure

The above three operational steps are carried out using the following screens of Minitab software.

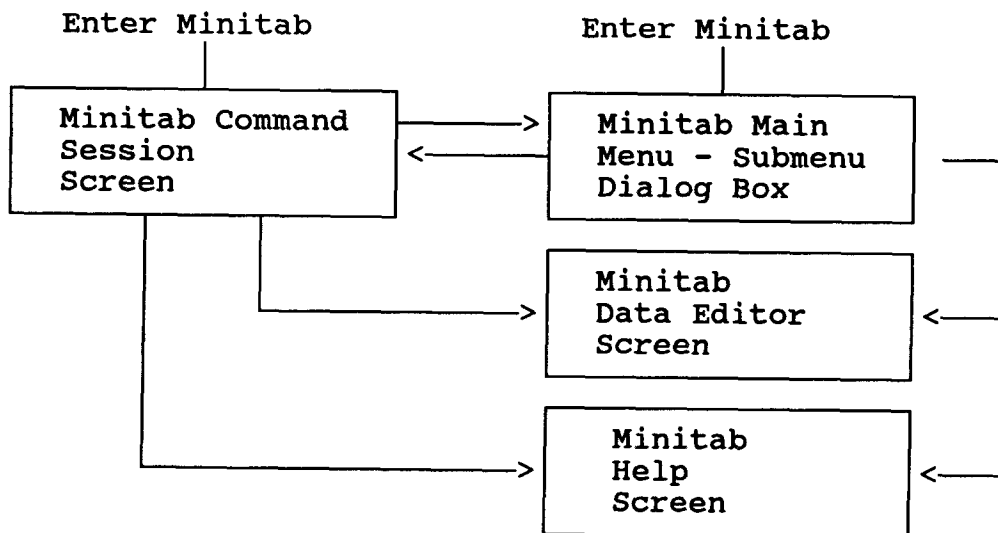


Figure 1-2. Minitab Window Structure

The above chart shows that you can enter Minitab either through the menu system or through the Command screen (session window). Minitab consists of 4 windows:

(1) The first is the Minitab Command screen (session window) where you can type the data and commands, and get the output. It is the headquarters of the Minitab software system.

(2) The second is the Minitab menu system. You have two options in running Minitab. You can type commands and the data in the Command Screen, and run Minitab. Or you can use the menu system in selecting the commands.

(3) The third is the Data Editor Screen where you can type only the data files. That is, you can type the data either in the Minitab Command screen or in the Data Editor screen.

(4) The third is the Minitab help screen (help window). At the command prompt, type Help followed by the concept you want to know, and you will get the explanations.

### **Minitab Command Screen (Session Window)**

You can type the data and command files in the Command Screen, and can submit to Minitab for execution. Or, you can use an external text editor or word processor to type the commands and the data, and retrieve the files in Minitab and execute them in the Command Screen.

Thus, you can run Minitab without Menu, Data Editor, and Help windows using only the Command screen. Thus, the command screen is the most important screen in Minitab.

### **Minitab Data Screen (Data Editor Window)**

Type a data file and save it. You can retrieve it into the Command screen and execute it. This screen is very similar to Lotus 1-2-3 spreadsheet program. You can switch back and forth between the Minitab Command screen and the Data Editor screen.

### **Minitab Help Screen (Help Window)**

At the Minitab command prompt, you can type Help followed the command name for which you need the help. If you want to know about regression analysis, ANOVA,



Set, and Read commands, for instance, type

MTB> Help regression

MTB> Help anova

MTB> Help read

MTB> Help set

The Help text will be displayed in the command screen instead of the Help window. For Minitab PC Version 8.0, Press F1 or Alt/H for Help, and you will get the Help window. Another new feature is: At the Minitab directory, type

C:\MINITAB>Minitab: - ?

...will print a Help message to the screen without running Minitab.

## Minitab Menu System

The Minitab menu system is introduced in Version 8.0. When you log on Minitab, you will see a bar menu on the top of the screen. Also, Minitab version 8.0 accepts the Mouse system.

### To Log on Minitab and to Exit

If Minitab is installed in drive C, at the Minitab directory, type

C:\MINITAB>Minitab

You will get the Minitab Logo, and a few seconds later, you will get the following Minitab Command (session window) screen with the Main Menus on the top of the screen:

### Command Screen (Session Window) with the Main Menu

```
File Edit Calc Stat Graph
Worksheet size: 16174 cells
```

F1=Help

```
MTB >
```