

# An Excel<sup>®</sup> Companion for Business Statistics

Business Statistics		SALES PERIOD				
		1998	1999	2000	2001	2002
10						
11						
12						
13						
14						
15	Net Revenue					
16	Sales Revenue					
17	Other Revenue					
18	Other Income					
19	Total Net Revenue					
20						
21	Cost of Sales					
22	Manufacturing COGS					
23	Plant/Plant Costs Amortization					
24	Royalty Costs					
25	Total Cost of Sales					
26	Gross Margin					
27	Gross Margin %					
28						
29						

Other Expenses  
Allocated Overhead Costs  
SUMMARY CONSOLIDATED.PBL

David L. Eldredge



# AN EXCEL COMPANION FOR BUSINESS STATISTICS

**David L. Eldredge**  
Murray State University

▼  
SOUTH-WESTERN College Publishing  
*An International Thomson Publishing Company*

Team Director: David L. Shaut  
Acquisitions Editor: Charles E. McCormick, Jr.  
Production Editor: Deanna Quinn  
Marketing Manager: Joseph A. Sabatino  
Manufacturing Coordinator: Sue Kirven

Copyright © 1999  
by SOUTH-WESTERN COLLEGE PUBLISHING  
*An International Thomson Publishing Company*

ALL RIGHTS RESERVED

The text of this publication, or any part thereof, may not be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying, recording, storage in an information retrieval system, or otherwise, without prior written permission from the publisher.

ISBN: 0-538-89088-6 (package)

ISBN: 0-324-00771-X (book)

4 5 6 7 PN 4 3 2 1 0

Printed in the United States of America

ITP®

International Thomson Publishing

The ITP trademark is used under license.



---

# PREFACE

The computer software which is most commonly used for data analysis within business and industrial organizations is spreadsheet software. Current windows-based spreadsheet software comes with a number of built-in features for performing statistical analysis. Since the majority of the graduates of our business schools will use mainly spreadsheets for analysis in their subsequent careers, they will benefit from a familiarity with the use of these statistical features of spreadsheet software.

A few years ago, I concluded that if we as business statistics professors do not familiarize our students with these capabilities, they may never discover them. Accordingly, as an experiment in the Spring 1995 semester, I switched from the use of dedicated statistical software (e.g., Minitab, SPSS, SAS) to the use of spreadsheet software for my business statistics courses. The experiment was a success. I have used spreadsheet software as the sole software support for all the statistic courses I have taught since that time. Consequently, it pleases me to be able to share the results of some of my experiences through this manual with you.

**What Is The Purpose Of This Manual?** The title of this manual, *An Excel Companion for Business Statistics*, implies the three aspects of its purpose. First, it presents step-by-step instructions for using Excel for statistical analysis. The instructions are complimented by figures of computer screen captures. These show data input, menus, dialog boxes and statistical results. Second, it is designed to be used in conjunction with a textbook. For example, the manual does not include end-of-the-chapter exercises. Our intent is for you the student to work through a topic within this manual and then apply Excel to similar examples and exercises from your textbook. Third, it is focused on the area of business statistics. Although there are similarities in the application of statistical analysis to many areas, our orientation through examples is to the use of statistical analysis in business and industrial organizations.

**Which Textbooks Does It Support?** The manual has been designed to be used with most business statistics textbooks. This is possible for at least a couple of reasons. First, there is a large degree of consistency in many business statistics textbooks. The topics included and the organization of these topics is quite similar for many textbooks. Second, for those topics for which there is not consistency among textbooks, this manual uses a modular approach. As a result, it is relatively easy to identify the unit within this manual which corresponds to the topical coverage of a particular textbook.

**Do I Need This Manual If My Textbook Covers Excel?** A number of recently published business statistics textbooks incorporate the use of Excel within them. However, oftentimes the



instructions provided are not in sufficient detail for those persons who do not have a good knowledge of Excel. This manual presents detailed instructions and many figures showing the computer screen as the user will see it. It just isn't possible within the confines of a business statistics textbook to provide this level of detail which is needed by some users. If the specific instructions and visual guidance provided within this manual were added to the typical business statistics textbook, its length would become substantial if not prohibitive.

**Which Statistical Topics Are Supported By This Manual?** The topics within this manual include most of those you will find within your textbook. The manual covers (1) the charts, graphs and numerical measures of descriptive statistics, (2) discrete and continuous probability distributions, (3) sampling distributions, (4) the point estimates, confidence intervals and hypothesis testing of introductory inferential statistics, (5) hypothesis tests utilizing the chi-square statistic, (6) the multivariate analysis approaches of the analysis of variance, regression analysis and time series forecasting, and (7) quality control charts. Chapter topics found within business statistics textbooks which are not supported within this manual include (1) probability concepts, (2) nonparametric statistics other than the chi-square statistic, (3) index numbers and (4) decision analysis.

**Is Additional Software Required?** No. Our approach is to use only the inherent capabilities of Excel. That is, we rely totally on the computing, charting, statistical analysis tools, statistical functions and other features which are included within Excel as it is distributed to customers. We do not rely on add-ins, special macro functions, or special worksheets. All you need is Excel in order to construct all the worksheets within this manual.

**Which Versions of Excel Are Supported?** The manual supports the three most recent versions of Excel for IBM-compatible personal computers. Each of these versions is known by various names. The earliest of these three is usually called Excel 5.0 for Windows 3.1 or Excel 5. The version which followed it is known as Excel for Windows 95 Version 7.0, Excel 7.0 or Excel 7. Finally, the most recent version is named Excel 97 for Windows 95, Excel 8.0 or Excel 8. For simplicity and consistency, we will refer to these as *Excel 5*, *Excel 7* and *Excel 8* respectively within this manual. While these three versions are quite similar there are differences among them. This manual has been developed using Excel 7. However, we use boxed notes to draw your attention to any Excel 8 or Excel 5 differences which are important to our analyses. These will begin either with the words **Excel 8 Note** or **Excel 5 Note**.

**What Level of Excel Knowledge Is Required?** The primary purpose of this manual is to introduce you to the statistical capabilities of Excel. However, it is written assuming some readers will not have had prior experience with Windows and/or Excel. Accordingly, Chapter 1



includes a brief introduction to the Windows environment and an introduction to Excel. These sections are not a complete guide to either Windows or Excel. However, they present sufficient material for most persons to be able to begin using Excel for statistical analyses.

**Should I Just Use the Worksheets Given On the Diskette?** A diskette containing files of all the worksheets developed within this manual is included with it. However, if your objective is to learn to use Excel for solving statistical problems, you should follow the manual's instructions for developing the worksheets yourself. You will find this much more effective than just using worksheets developed by us. On the other hand, some of the worksheets require a considerable number of Excel operations to develop. Particular examples include the chi-square test of independence worksheet of Section 9.2 in Chapter 9 and the five quality control chart worksheets of Chapter 12. For such worksheets you may wish to forego the experience of developing them for the expedience of using those we have developed.

**Will The Worksheets I Develop Always Look Like Those Shown In the Manual?** As you work through the example analyses of this manual, you will develop your own Excel worksheets for performing the required computations and charting we demonstrate. Although your worksheets will generally resemble those given in the manual, you may detect differences. Some differences arise from additional editing and formatting which we have done in order to make the figures more understandable to the readers of this manual. In some instances we have enlarged charts and column widths, and others we have added borders to cells and used different font style such as italics or boldface. These sorts of cosmetic changes can be made by you but are not necessary for understanding the statistical analyses presented.

## Acknowledgements

I need to thank a number of persons for bringing this project to completion. First, is Glen Garrett our ever faithful ITP Sales Representative at Murray State University for a number of years. I am grateful for Glen's friendship and service, and for suggesting me for a similar project which proceeded this one. Second, I would like to thank Ken Black of the University of Houston—Clear Lake for accepting me for that prior project. Also, for the suggestions he made for its improvement. Some of them are also included in this manual.

This manual has benefited from others that came before it. In particular, my friend Mike Middleton's *Data Analysis Using Microsoft Excel 5.0*, Kenneth N. Berk and Patrick Carey's *Data Analysis with Microsoft Excel 5.0 for Windows*, and John L. Neufeld's *Learning Business Statistics with Microsoft Excel*.



I would like to acknowledge the input from a number of “Business Stat” students at Murray State University. Their observations and recommendations in response to their use of the prior manual have been useful in a number of instances.

My thanks also goes to the project team at South-Western College Publishing under the direction of Acquisitions editor Charles McCormick, Jr. Their assistance has been helpful in the completion of this project.

Finally, your use of this manual may result in comments, criticisms and suggestions for improving it. I would greatly appreciate hearing of these from you.

*David L. Eldredge  
Dept. of Computer Science and Information Systems  
Murray State University  
P.O. Box 9  
Murray, Kentucky 42071-0009*

*Dave.Eldredge@Murraystate.Edu*

*To my wife Judy, and to all my family for their love and support through the years.*

---

# BRIEF CONTENTS

	<b>Preface</b>	<b>ix</b>	
<b>Chapter 1.</b>	<b>Introduction to Statistics with Excel</b>	<b>1</b>	
<b>Chapter 2.</b>	<b>Descriptive Graphs and Charts</b>	<b>25</b>	
<b>Chapter 3.</b>	<b>Descriptive Numerical Measures</b>	<b>47</b>	
<b>Chapter 4.</b>	<b>Probability and Sampling Distributions</b>	<b>67</b>	
<b>Chapter 5.</b>	<b>Statistical Inference for Population Means</b>	<b>91</b>	
<b>Chapter 6.</b>	<b>Statistical Inference for Population Proportions</b>	<b>127</b>	
<b>Chapter 7.</b>	<b>Statistical Inference for Population Variances</b>	<b>141</b>	
<b>Chapter 8.</b>	<b>Analysis of Variance</b>	<b>153</b>	
<b>Chapter 9.</b>	<b>Applications of the Chi-Square Statistic</b>	<b>165</b>	
<b>Chapter 10.</b>	<b>Regression Analysis</b>	<b>187</b>	
<b>Chapter 11.</b>	<b>Time Series Forecasting</b>	<b>209</b>	
<b>Chapter 12.</b>	<b>Statistical Quality Control Charts</b>	<b>223</b>	
<b>Appendix A.</b>	<b>Excel Data Analysis Tools</b>	<b>243</b>	
<b>Appendix B.</b>	<b>Excel Statistical Functions</b>	<b>248</b>	
<b>Appendix C.</b>	<b>Excel 8 (97) Chart Wizard</b>	<b>257</b>	
	<b>Index</b>	<b>263</b>	



---

# CONTENTS

## PREFACE ix

## CHAPTER 1. INTRODUCTION TO STATISTICS WITH EXCEL 1

- 1.1 Using Windows 2
- 1.2 Using Excel 4
  - 1.2.1 The Excel Window 4
  - 1.2.2 Excel Dialog Boxes 7
  - 1.2.3 Excel Basic Tasks 10
- 1.3 Using Help 13
- 1.4 Using Excel's Statistical Analysis Features 15
  - 1.4.1 Data Analysis Tools 15
  - 1.4.2 Statistical Functions 17
  - 1.4.3 Other Statistical Features 18
- 1.5 Using Good Worksheet Practices 19
- 1.6 Using This Manual with Your Textbook 21

## CHAPTER 2. DESCRIPTIVE GRAPHS AND CHARTS 25

- 2.1 The HISTOGRAM Analysis Tool 26
  - 2.1.1 Frequency Distribution 26
  - 2.1.2 Histogram 30
  - 2.1.3 Ogive 32
- 2.2 The CHART WIZARD 33
  - 2.2.1 Frequency Polygon 33
  - 2.2.2 Bar/Column Chart 37
  - 2.2.3 Pie Chart 42
  - 2.2.4 Scatter Diagram 42



**CHAPTER 3. DESCRIPTIVE NUMERICAL MEASURES 47****3.1 The DESCRIPTIVE STATISTICS Analysis Tool 48**

3.1.1 Measures of Central Location 52

3.1.2 Measures of Variability 52

3.1.3 Measures of Shape 52

3.1.4 Other Descriptive Measures 52

**3.2 The RANK AND PERCENTILE Analysis Tool 53****3.3 Descriptive Statistical Functions 54**

3.3.1 Population Variance 55

3.3.2 Population Standard Deviation 56

3.3.3 Mean Absolute Deviation 56

3.3.4 Z Score 57

**3.4 Combinations of Statistical Functions 58**

3.4.1 Coefficient of Variation 59

3.4.2 Interquartile Range 60

3.4.3 Pearson's Coefficient of Skewness 62

3.4.4 Box Plot 63

**3.5 Measures of Association Between Two Variables 63**

3.5.1 The COVARIANCE Analysis Tool 64

3.5.2 The CORRELATION Analysis Tool 66

**CHAPTER 4. PROBABILITY AND SAMPLING DISTRIBUTIONS 67****4.1 Discrete Probability Distributions 68**

4.1.1 Binomial Distribution 68

4.1.2 Poisson Distribution 71

4.1.3 Hypergeometric Distribution 75

**4.2 Continuous Probability Distributions 76**

4.2.1 Normal Distribution 76

4.2.2 Exponential Distribution 79

4.2.3 Uniform Distribution 82

**4.3 Sampling Distributions 83**

4.3.1 Sample Mean 83

4.3.2 Sample Proportion 86



<b>CHAPTER 5. STATISTICAL INFERENCE</b>	
<b>FOR POPULATION MEANS</b>	<b>91</b>
<b>5.1 One Population Mean</b>	<b>93</b>
5.1.1 Point Estimate and Confidence Interval—Normal Distribution	94
5.1.2 Hypothesis Test—Normal Distribution	96
5.1.3 Point Estimate and Confidence Interval—t Distribution	99
5.1.4 Hypothesis Test—t Distribution	101
5.1.5 Determining the Necessary Sample Size	104
<b>5.2 The t-TEST: TWO-SAMPLE</b>	
<b>ASSUMING UNEQUAL VARIANCE Analysis Tool</b>	<b>106</b>
5.2.1 Hypothesis Test for Two Population Means	
with Independent Samples	107
5.2.2 Point Estimate and Confidence Interval	
for Two Population Means	111
5.2.3 Statistical Inference for One Population Mean	112
<b>5.3 Two Additional Analysis Tools for Two Independent Samples</b>	<b>117</b>
5.3.1 The t-TEST: TWO-SAMPLE	
<b>ASSUMING EQUAL VARIANCE Analysis Tool</b>	<b>118</b>
5.3.2 The z-TEST: TWO SAMPLE FOR MEANS Analysis Tool	118
<b>5.4 The t-TEST: PAIRED TWO SAMPLE</b>	
<b>FOR MEANS Analysis Tool</b>	<b>118</b>
5.4.1 Hypothesis Test for Two Population Means	
with Dependent Samples	119
5.4.2 Point Estimate and Confidence Interval	
for Two Population Means	122
5.4.3 Statistical Inference for One Population Mean	123
<b>CHAPTER 6. STATISTICAL INFERENCE</b>	
<b>FOR POPULATION PROPORTIONS</b>	<b>127</b>
<b>6.1 One Population Proportion</b>	<b>128</b>
6.1.1 Point Estimate and Confidence Interval	129
6.1.2 Hypothesis Test	130
6.1.3 Determining the Necessary Sample Size	133
<b>6.2 Two Population Proportions</b>	<b>135</b>
6.2.1 Point Estimate and Confidence Interval	136
6.2.2 Hypothesis Test	138



<b>CHAPTER 7. STATISTICAL INFERENCE</b>	
<b>FOR POPULATION VARIANCES</b>	<b>141</b>
<b>7.1 One Population Variance</b>	<b>142</b>
7.1.1 Point Estimate and Confidence Interval	142
7.1.2 Hypothesis Test	144
<b>7.2 The F-TEST: TWO-SAMPLE VARIANCES Analysis Tool</b>	<b>147</b>
7.2.1 Hypothesis Test for Two Population Variances	147
7.2.2 Point Estimate and Confidence Interval	151
<b>CHAPTER 8. ANALYSIS OF VARIANCE</b>	<b>153</b>
<b>8.1 The ANOVA: SINGLE FACTOR Analysis Tool</b>	<b>154</b>
<b>8.2 The ANOVA: TWO-FACTOR</b>	
<b>WITHOUT REPLICATION Analysis Tool</b>	<b>157</b>
<b>8.3 The ANOVA: TWO-FACTOR</b>	
<b>WITH REPLICATION Analysis Tool</b>	<b>160</b>
<b>CHAPTER 9. APPLICATIONS OF THE CHI-SQUARE STATISTIC</b>	<b>165</b>
<b>9.1 Goodness-of-Fit Test: Multinomial Distribution</b>	<b>166</b>
<b>9.2 Test of Independence: Contingency Tables</b>	<b>170</b>
<b>9.3 The PIVOT TABLE WIZARD</b>	<b>175</b>
9.3.1 One Variable Frequency Count	176
9.3.2 Two Variable Frequency Count	182
<b>CHAPTER 10. REGRESSION ANALYSIS</b>	<b>187</b>
<b>10.1 Simple Linear Regression with TRENDLINE</b>	<b>188</b>
<b>10.2 Simple Linear Regression with the REGRESSION Analysis Tool</b>	<b>194</b>
<b>10.3 Multiple Regression with the REGRESSION Analysis Tool</b>	<b>198</b>
<b>10.4 Simple Non-linear Regression Analysis</b>	<b>204</b>



<b>CHAPTER 11. TIME SERIES FORECASTING</b>	<b>209</b>
11.1 Identification of Appropriate Forecasting Methods	210
11.2 The MOVING AVERAGE Analysis Tool	212
11.3 The EXPONENTIAL SMOOTHING Analysis Tool	213
11.4 Linear Trend Projection with TRENDLINE	215
11.5 Non-linear Trend Projection with TRENDLINE	217
11.6 Choosing the Appropriate Forecasting Method	219
<b>CHAPTER 12. STATISTICAL QUALITY CONTROL CHARTS</b>	<b>223</b>
12.1 $\bar{x}$ Chart for Controlling Process Average	225
12.2 R Chart for Controlling Process Variability	233
12.3 p Chart for Controlling Proportion of Defective Items	235
12.4 np Chart for Controlling Number of Defective Items	238
12.5 c Chart for Controlling Number of Defects per Unit	240
<b>APPENDIX A. EXCEL DATA ANALYSIS TOOLS</b>	<b>243</b>
<b>APPENDIX B. EXCEL STATISTICAL FUNCTIONS</b>	<b>248</b>
<b>APPENDIX C. EXCEL 8 (97) CHART WIZARD</b>	<b>257</b>
<b>INDEX</b>	<b>263</b>



# **CHAPTER 1. INTRODUCTION TO STATISTICS WITH EXCEL**

## **1.1 Using Windows**

## **1.2 Using Excel**

### **1.2.1 The Excel Window**

### **1.2.2 Excel Dialog Boxes**

### **1.2.3 Excel Basic Tasks**

## **1.3 Using Help**

## **1.4 Using Excel's Statistical Analysis Features**

### **1.4.1 Data Analysis Tools**

### **1.4.2 Statistical Functions**

### **1.4.3 Other Statistical Features**

## **1.5 Using Good Worksheet Practices**

## **1.6 Using This Manual with Your Textbook**



The most powerful general-purpose managerial software available for data analysis in business and industry is spreadsheet software. Currently, the most widely used spreadsheet program is Microsoft Excel. Businesses and industries have used Excel throughout their organizations for their computational, charting and data management needs for years. Beyond these three uses, current versions of Excel include a number of features which provide the capability for easily conducting many statistical analyses. The purpose of this manual is to introduce you to these features which facilitate the computing and charting requirements of your study and use of statistics.

Versions of Excel are available for many types of computers under many operating systems. The Excel capabilities used in this manual are compatible with three versions: *Excel 7* and *Excel 8* (also called Excel 97) both under the Windows 95 operating system, and with *Excel 5* under the Windows 3.1 operating system (there wasn't an Excel 6). There are some differences between these three Excel versions. Our approach within this manual is to use Excel 7 and to draw your attention to any Excel 8 or Excel 5 differences which are important to our analyses. We will show these differences in the appropriate part of the manual within a boxed note. These boxes begin either with the words **Excel 8 Note** or **Excel 5 Note**.

We begin below in **Section 1.1** with a brief overview of some WINDOWS features for those persons who are unfamiliar with Windows. In **Section 1.2** we introduce EXCEL and provide some initial instruction in its use for those who are unfamiliar with it. These first two sections are not meant to be a complete guide to either Windows or Excel. They merely present enough material to get you started. To become proficient you will need to refer to other books and resources. One of these further resources can be the extensive on-line HELP SYSTEM provided by Excel. An introduction to it is presented in **Section 1.3**. This is followed in **Section 1.4** by an introduction to the features of Excel which we use in this manual to facilitate statistical analyses. These include DATA ANALYSIS TOOLS, STATISTICAL FUNCTIONS, the CHART WIZARD, the TRENDLINE feature for charts and the PIVOT TABLE WIZARD. We continue in **Section 1.5** with a presentation of a number of worksheet practices which will help to make your statistical worksheets more effective for you and any others who might use them. Finally, **Section 1.6** discusses the use of this manual as a companion to your study of a business statistics textbook.

## 1.1 USING WINDOWS

---

The first thing you need to know about Windows is how to start (or launch) the software. For most computer systems, Windows will start automatically when you turn on the computer and the computer monitor. If the system you are using is set up differently you may have to start Windows from the DOS prompt (such as *C:\>*). If your system displays the DOS prompt, you should use the keyboard to type **Win** and then press the **Enter** key on the keyboard. The result should be the Windows screen called the Windows desktop.

Excel under both the Windows 95 and Windows 3.1 operating systems is designed to be used with a computer mouse. The movements of the mouse in your hand causes the movement of a mouse pointer



on the computer screen. The five mouse techniques you will be using to communicate with Excel are the following.

- **Point**—moving the mouse until the pointer is touching the element on the computer screen which you wish to select
- **Click**—quickly pressing and releasing the **left** mouse button
- **Double Click**—quickly pressing and releasing the **left** mouse button twice in rapid succession
- **Drag**—pressing and holding down the **left** mouse button while you move the mouse
- **Right Click**—quickly pressing and releasing the **right** mouse button once

After you have started Windows and understand the operation of the mouse, you are ready to start (or launch) Excel. In later chapters we will refer to these steps as the **Start-Up Procedure**. The steps for the Start-Up Procedure depend on whether you are using Windows 95 or Windows 3.1.

#### **START-UP PROCEDURE—WINDOWS 95**

1. Point and click the **Start** button in the lower left corner of your Windows screen. The *Windows 95 menu* will open.
2. Point to **Programs** on the menu and a second nested menu will appear to the right of the Windows 95 menu.
3. Point to **Office 95** (or **Office 97** for Excel 8) on the menu and a third menu will appear to the right. (this step may not be necessary for your computer system).
4. Point and click the selection **Microsoft Excel** and the Excel window will appear.

#### **START-UP PROCEDURE—WINDOWS 3.1**

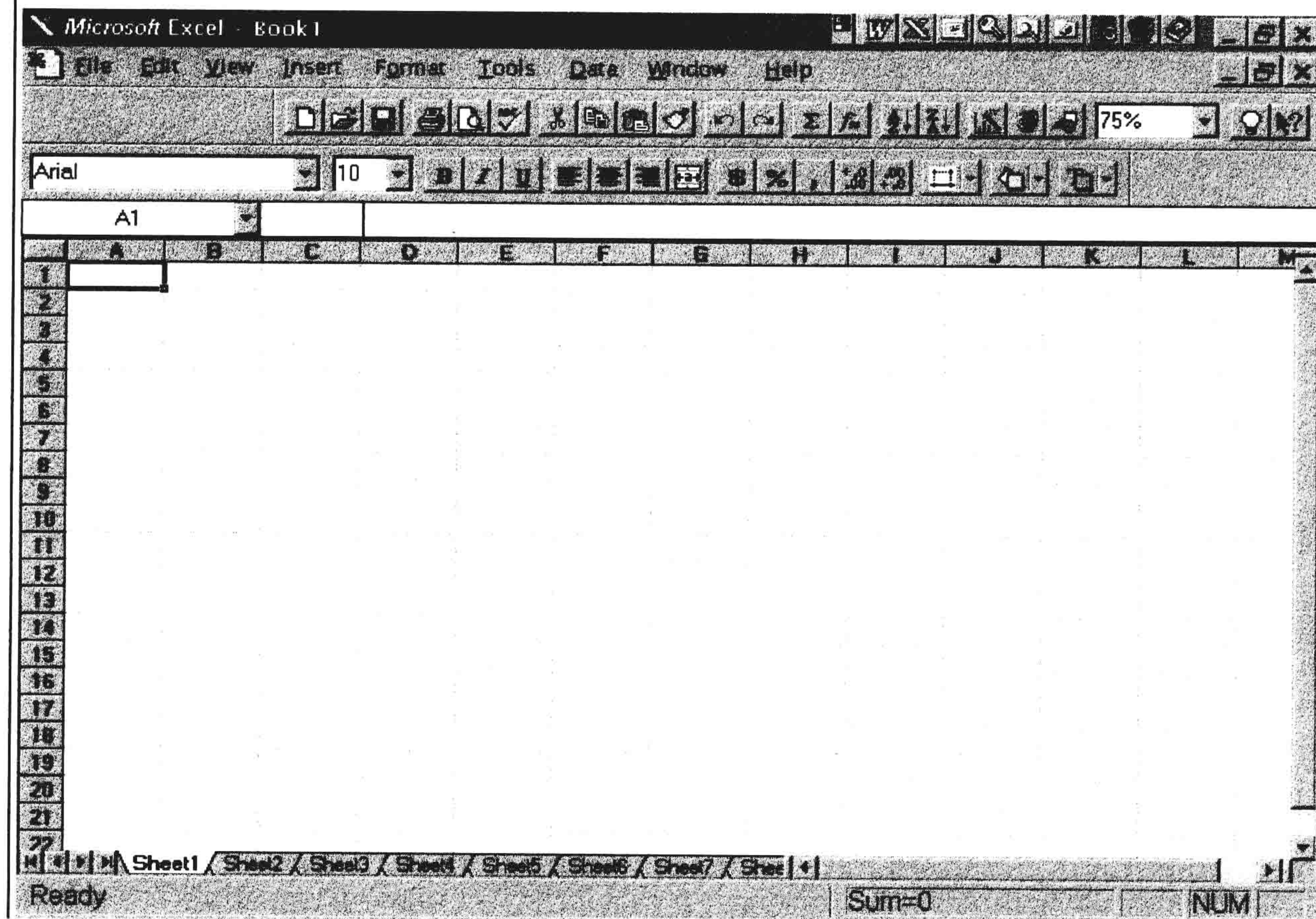
1. Start with the screen that is labeled **Program Manager** at the top.
2. Point and double click the selection **Microsoft Office** and a new window will open (this step may not be necessary for your computer system).
3. Point and double click the selection **Microsoft Excel** and the Excel window will appear.

Your resulting Excel window should be similar to that shown in Figure 1.1. If your window fills only a portion of the screen, you should change it to a full-screen presentation. To accomplish this click on the **Maximize Button** which is in the very top row called the Title Bar. It is the second button on the right for Windows 95 (see Figure 1.1) and is the first button on the right for Windows 3.1.

Although your window should generally resemble that of Figure 1.1, some of the details may differ. There are two primary reasons for these small differences. First, Excel allows modifications to be made to the appearance of its window. Second, there are some differences among the three versions of Excel. Figure 1.1 is for Excel 7.



Figure 1.1 Excel Window



## 1.2 USING EXCEL

We will introduce Excel by discussing three major topics within this section. They include first a description of the parts which make up the Excel window. Next we will discuss the use of dialog boxes for communicating with Excel and last how to perform a number of Excel basic tasks.

### 1.2.1 The Excel Window

If this is your first look at an Excel window such as Figure 1.1, you may feel a sense of panic! How can you ever come to grasp the use of such a complex appearing presentation?

Three thoughts may help you overcome your feeling of panic. First, Excel has many capabilities which you will never need to use. Second, it has more than one way to complete most actions. Consequently, it is not necessary for you to know everything about Excel in order to make effective