

# Introduction

## How to use this document

This document is intended to introduce prospective researchers to MINITAB for Windows, which currently runs under Windows 98/ME/NT/2000/XP. Those who do not own a personal copy of MINITAB for Windows may access the software from various UITS Student Technology Centers at IU. Vendor-supplied documents are available for reference at the Swain Hall, BUS/SPEA and Education Libraries' Reserve Collections, IUPUI University Library, and at the UITS Center for Statistical and Mathematical Computing (Stat/Math Center). Faculty may arrange special introductory workshops for their classes in using MINITAB for Windows by contacting the UITS Stat/Math Center. If you want to buy a copy of MINITAB for Windows at an educational discount to install on IU owned PC's, contact the UITS Stat/Math Center.

## What is MINITAB?

MINITAB is a powerful, easy-to-use, statistical software package that provides a wide range of basic and advanced data analysis capabilities. MINITAB's straightforward command structure makes it accessible to users with a great variety of background and experience. MINITAB runs on PC and Macintosh computers, and most of the leading workstations, minicomputers and mainframe computers. While MINITAB differs across releases and computer platforms, the core of MINITAB -- the worksheet and commands -- is the same. Thus, if you know how to use one release of MINITAB on one platform, you can easily switch to another.

MINITAB for Windows provides a user interface that makes statistical analysis more intuitive for all levels of users. Pull-down menus and dialog boxes give you easy prompts every step of the way. You just double-click on the program icon, and off you go! MINITAB lets you spend more time exploring your data and less time telling the computer what you want it to do. Data may be entered into a spreadsheet like window. There is also the option of importing data directly from Lotus, Excel, Symphony, Quattro Pro, dBase, or ASCII files with MINITAB's importing/ exporting capability. With MINITAB's (Rel 10 and higher) Dynamic Data Exchange (DDE) you can enter your data into another spreadsheet program, such as Lotus, Excel or Quattro Pro, and MINITAB will receive it automatically. Or, you can enter data into MINITAB and send it simultaneously to another Windows program. MINITAB's graphics capability gives you unlimited possibilities to get the maximum visual impact. The macros let you create your own custom operations, designed specifically for your applications.

Some of the capabilities of MINITAB for Windows include:

- **General** : Windows menu interface, interactive command-line option, context-sensitive HELP, and powerful macro programming language.
- **Data and File Management** : Importing/Exporting, Dynamic Data Exchange, data editor, data manipulation (merge, stack, subset, sort, rank), merge worksheet, logical operators, arithmetic operators, matrix functions including transpose, inverse, eigenvalues, and eigenvectors.
- **Basic statistics** : descriptive statistics, confidence intervals, cross tabulations, correlation and covariance matrices, and test of homogeneity of variances.
- **Advanced statistics** : regression, ANOVA, MANOVA, cluster analysis, factor analysis, nonparametric procedures, time series analysis, simulations and distributions.
- **Graphics** : presentation-style graphics, ability to customize all attributes of every element in your graph, and ability to edit graphs. Plots and charts, 3D surface plot, scatterplot brushing.

## Hardware and software requirements

In order to install and run MINITAB for Windows, your machine should meet the following hardware and software requirements.

- Windows 98/NT/2000/ME/XP.
- 32MB RAM minimum.
- Personal computer with a Pentium I - 133 Mhz or higher processor.
- 35Mb hard drive space for installation.
- CD-ROM drive for installation.
- VGA or SVGA monitor, minimum 800 X 600 required. 1024 X 768 recommended.
- Mouse required for some capabilities.

## How to start a MINITAB session

Take the following steps to start a MINITAB session under Windows from UITS Student Technology Centers.

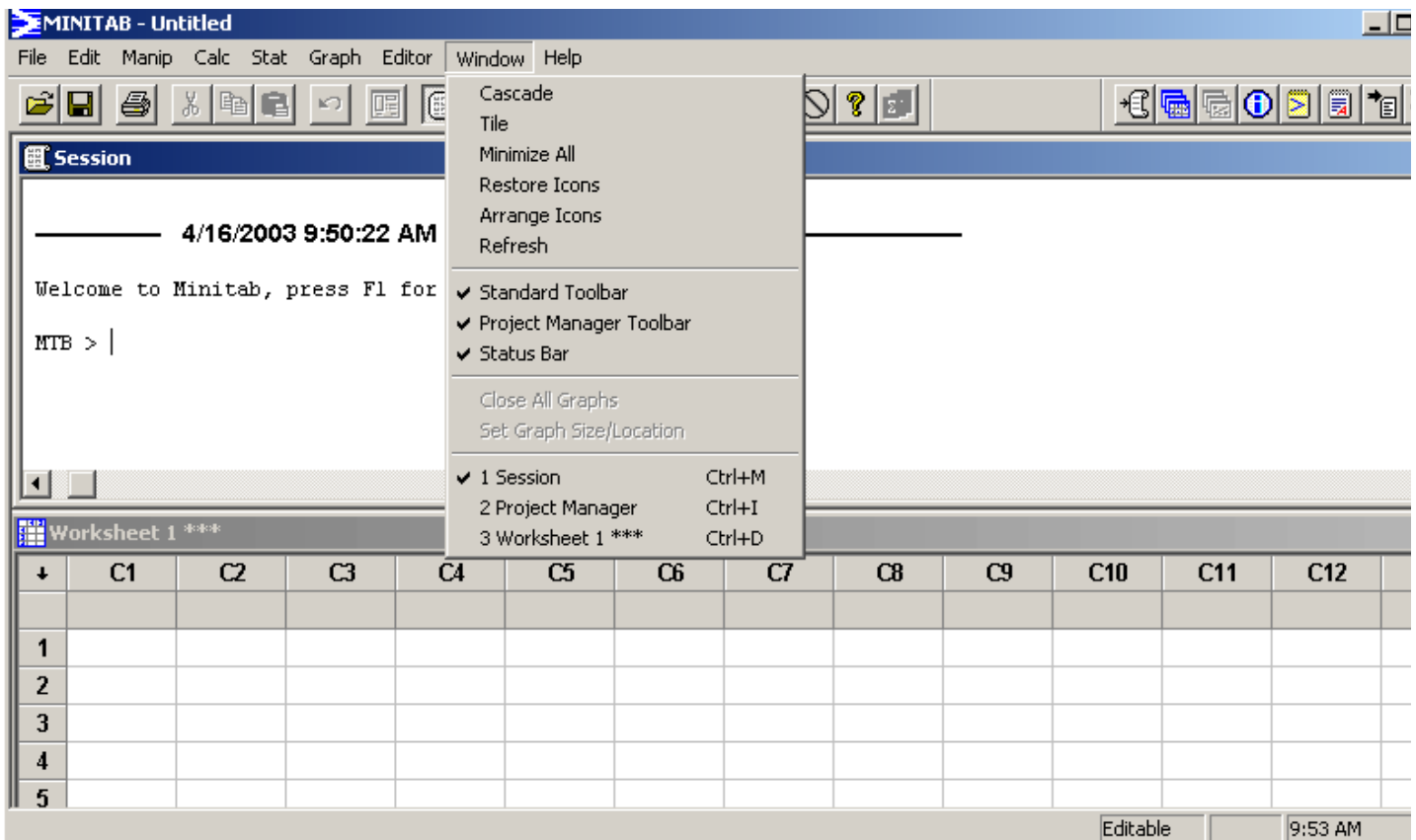
- Login an available Windows workstation.
- Click **Start** button -> **Program** -> **Statistics-Math** -> **MINITAB 13** -> **MINITAB**.

A **MINITAB** window will open showing the **MINITAB - Untitled** with a menu bar. Another two windows, **Session** and **Worksheet**, also appear within the larger window.

Now you are ready for MINITAB computing.

## Orientation

### The interface



There are five different window types in MINITAB for Windows accessible from the Main menu Window option.

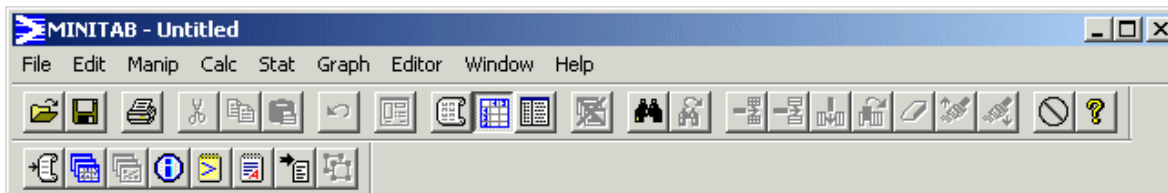
- **Session window:** The **Session** window displays the text output generated by your analyses and other work. It also contains a record of all the commands you have issued in the current session. You can

display the command language used to create the output, and type Session commands in at the active MTB> prompt. To enable Commands, choose **Enable commands** from **Editor** menu.

- **Project Manager windows:** The **Project Manager** contains folders that allow you to navigate, view, and manipulate various parts of your project.
- **Worksheet window:** The **Worksheet** window displays your data in a row-by-column format. You enter data from the keyboard or retrieve data into this window.
- **Help window:** The **Help** window contains information on using MINITAB.
- **Graph window:** The **Graph** window displays high-resolution graphs by MINITAB's **Graph** command. This window becomes available only after you generate graphical output.

## Menus

When you start a MINITAB session under Windows, the top strip of the window contains the main menus: **File, Edit, Manip, Calc, Stat, Graph, Editor, Window** and **Help**.



These menus contain MINITAB commands. To use a menu, click on it, drag the pointer to the item you want to select, and release the mouse button. When you choose items on a menu followed by an ellipsis (...), dialog boxes appear. When you select items followed by symbol >, submenus with more commands appear. If a menu command is dimmed, the item is currently unavailable. Sometimes whole menus are dimmed, indicating that all the commands in the menu are unavailable. The contents of the Editor menu changes depending on the active window. You may want to examine the commands available from each menu for further information.

## Help during MINITAB computing

Help is available at every step of MINITAB computing. Use the **Help** menu for help on any topic. Also context-sensitive help is available with each dialog box. If you don't understand what an item in a dialog box is for, click the ? button, or press **F1** for an explanation of the item.

# Getting Started

## Organizing your data for analysis

Suppose you have three test scores collected from a class of ten students (5 females, and 5 males) during a semester. The information you have for each student is: identification number, gender (1=female, 2=male), score for test one, test two and test three (the full data is collected toward the end of this section for you to enter into the Worksheet window). Your first task is to present the data in a form acceptable to MINITAB for processing. Before showing you how to enter the data, let us look at what MINITAB accepts as data.

MINITAB uses data organized in row and columns. The rows are **cases**, and the columns are **variables**. MINITAB automatically numbers columns in the worksheet as C1, C2, and so on. A MINITAB worksheet can contain up to 4000 columns, and as many rows as your worksheet size will allow. Minitab dynamically allocates memory to hold the data for the current worksheet. If the data in the current worksheet grows, Minitab will allocate more memory. If you ever run out of memory, Minitab will display error messages about insufficient memory or insufficient storage space. The messages will advise you on how to immediately increase available memory. If you receive memory error messages frequently, you can change your preferences for memory allocation, although there are advantages and disadvantages to doing this. To change your memory preferences, choose **Edit > Preferences > General > Select**.

A case contains information for one unit of analysis, e.g., a person, an animal, a product, etc... Variables are information collected for each case, such as name, score, age, etc... In the chart below, there are two cases and four variables. When data are arranged in rows and columns like this and stored in a file, it is called a **case-by variables** or **rectangular data file**.

variable  
↓

Name	Test1	Test2	Test3	
Tim	20	23	24	←case
Hans	21	26	28	

MINITAB handles three types of data: Numeric (numbers and \*), Text (characters that can consist of a mix of letters, numbers, spaces, and special characters) and Date/Time (dates, times or both). MINITAB determines the type of a variable based on the first row of the column. A numeric variable will only have numbers as values. Each text variable can have a maximum of 80 characters (letters, numbers, punctuation symbols, blanks). Upper and lower case character values in a variable are differentiated.

Text variables cannot be used in analysis in most of MINITAB procedures. If you want to use text data in a place where only numeric data are supported, you can use the **Code** command in the **Manip** menu to convert text values into numeric values.

The numbers stored in numeric variables can have up to 15 or 16 digits (depending on the number) without round-off error. You can use a negative (-) sign for negative numbers. MINITAB reads numbers with decimal points or exponential notation.

Even though MINITAB automatically assigns a column number for each variable in the worksheet, you may assign a unique name for each variable. A variable name (column name) can contain up to 31 characters, with no leading or trailing spaces, no single quotation marks (') and no octothorpes (#). A name cannot consist of a single asterisk (\*). A variable can be addressed with its column number or the name you assign to it.

Numeric missing value is flagged by a \* and by a blank for text (formerly called alpha) variable. Use the continuation symbol ampersand (&) at the end of any line to indicate that the command or data row continues on to the next line. MINITAB returns with the CONT> prompt. MINITAB ignores any statement you enter after the comment symbol (#). In a prompted session, MINITAB uses several different prompts to help you know what kind of input it expects (e.g., MTB>, SUBC>, DATA>, CONT>, Continue?).

With the above information in mind, let us get ready to enter our data mentioned in the above example. Even though it is not mandatory to assign a name for each variable to be entered into the worksheet, since MINITAB assigns column numbers (e.g., C1, C2, C3,..) as variable names, it is a good idea to name columns so that you won't forget what they contain. Before entering data into the worksheet, we suggest preparing a code book, as shown below, especially when dealing with several variables of varying types. A code book, however, is not mandatory for data analysis.

Column	var. name	type	length
C1	ID	numeric	2
C2	SEX	numeric	1
C3	TEST1	numeric	2
C4	TEST2	numeric	2
C5	TEST3	numeric	2

In our example, all variable types are numeric, and all but one variable, sex, take up two fields/spaces in their assigned columns.

The next task is to enter the data into the computer. There are several options for entering your data. You

may enter your data using a text editor or word processing packages (e.g., MS-Word, Word Perfect ). Files created using word processing software should be saved in text format before trying to read it into a MINITAB session. Data entered into spreadsheet packages (e.g., Excel, Lotus) can be read directly into a MINITAB session.

## Entering data into worksheet

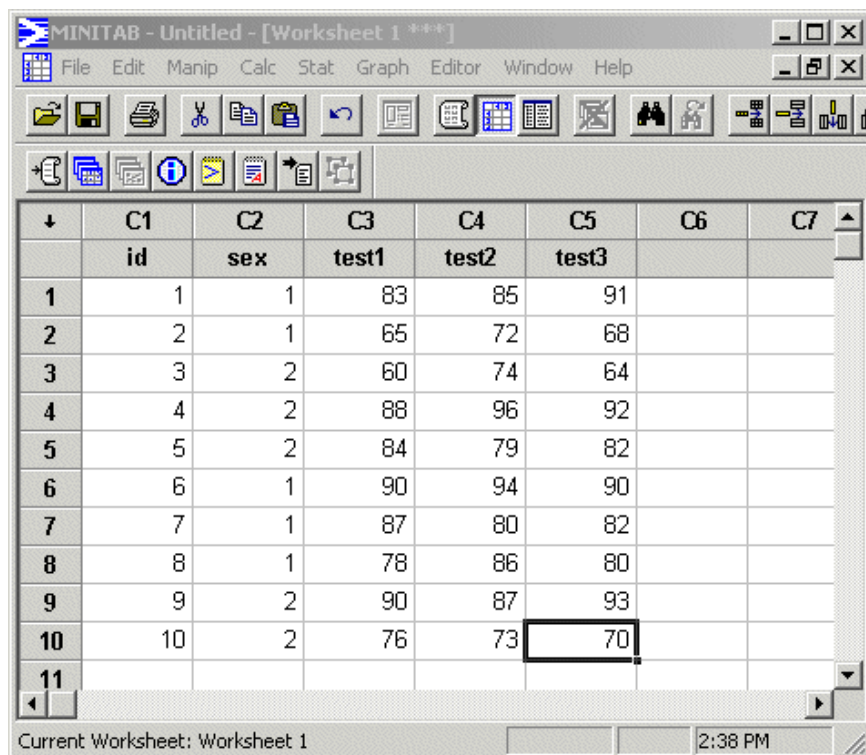
Now, let us enter the data into the worksheet. The first task is entering the variable names.

Move the cursor to the cell immediately below the cell labeled C1 and type **id** and press TAB. Now the cursor moves to the cell below the cell labeled C2. Type in **sex** and press the TAB key. Type in the remaining three variables, **test1**, **test2** and **test3** under columns C3, C4, and C5.

Instead of using the TAB key for moving to the next cell, you could use the **ENTER** key. However, the **ENTER** key moves the cursor in the direction of the data entry arrow shown in the top left corner of the **Data** window. You can change the direction of this arrow by clicking on it.

The top row should have the above five variable names (below each column number). The next task is to enter the data points. Make sure the data entry arrow is pointing right. Move the cursor to the cell immediately below the variable **id**. Highlight 10 rows of the worksheet, beginning with the cell containing the cursor. To do so, press the **shift** key down, and use the **right arrow** key to move the cursor to column 5. Now, while continuing to hold the **shift** key down press the **down arrow** key until the cursor reaches 10th row. Now 10 rows and 5 columns are highlighted. You may also use the mouse to accomplish this task. Make sure that the selected columns are highlighted as you enter the data.

Enter the data as shown in the worksheet below, pressing the **ENTER** key after each value. Since the rows and columns are highlighted the cursor automatically moves to the second row when you are finished with the first row. If you don't highlight the worksheet, use an **arrow** key to move the pointer to the beginning of the second row after finishing the first row. If the **numlock** key is on, you can use the keypad to type in numbers.



The screenshot shows the Minitab interface with a worksheet titled 'Minitab - Untitled - [Worksheet 1 \*\*\*]'. The worksheet contains the following data:

	C1	C2	C3	C4	C5	C6	C7
	id	sex	test1	test2	test3		
1	1	1	83	85	91		
2	2	1	65	72	68		
3	3	2	60	74	64		
4	4	2	88	96	92		
5	5	2	84	79	82		
6	6	1	90	94	90		
7	7	1	87	80	82		
8	8	1	78	86	80		
9	9	2	90	87	93		
10	10	2	76	73	70		
11							

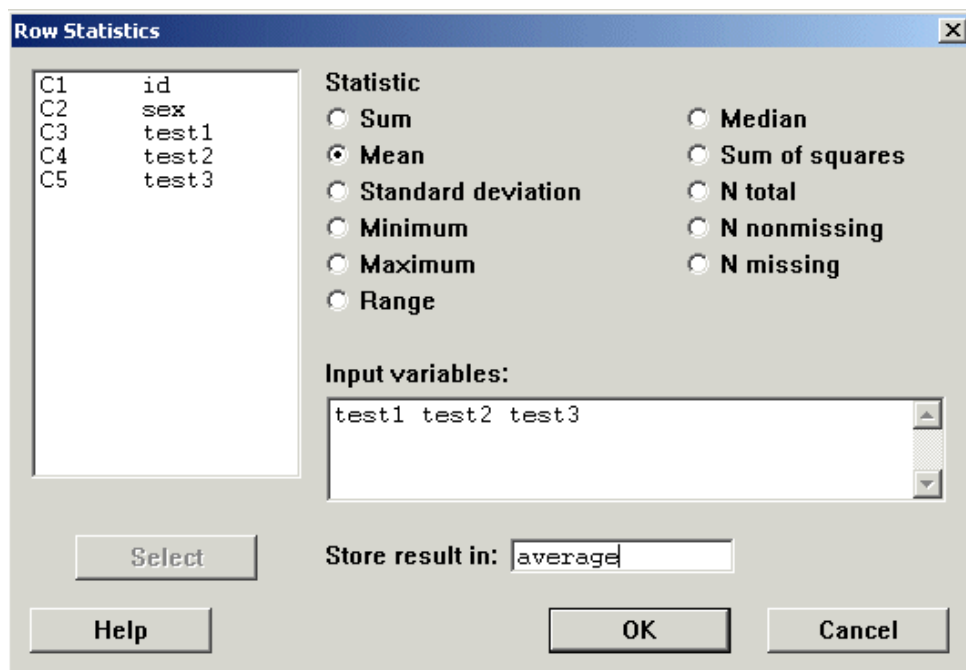
The status bar at the bottom indicates 'Current Worksheet: Worksheet 1' and the time is '2:38 PM'.

## Creating a new variable

Now that you have entered the data into the worksheet, save it on to a diskette on drive A (those who are

working from a personally owned PC may want to save it to a hard drive). Before saving it, let us create a new variable, **average**, to represent the mean score from the three tests for each student he/she took during the semester. (Note that creating the variable **average** is independent of saving the file.)

- From the **Calc** menu select **Row Statistics...**
- Select **Mean** from the options appearing in the dialog box.
- Click on the box below the **Input variables:**. Now the variables in your data set will appear in the box on the left of the dialog box.
- Type in **test1 test2 test3** (or select them from the variable list).
- Click on the box to the right of **Store result in:**.
- Type in **average**.



- click **OK**.

The variable **average** will appear in column 6 (the next empty column). Note that, instead of typing the variable names (**test1 test2 test3**) you could also type **C3-C5** in the Input variable box.

Now, suppose you want no decimal points for the new variable in column 6.

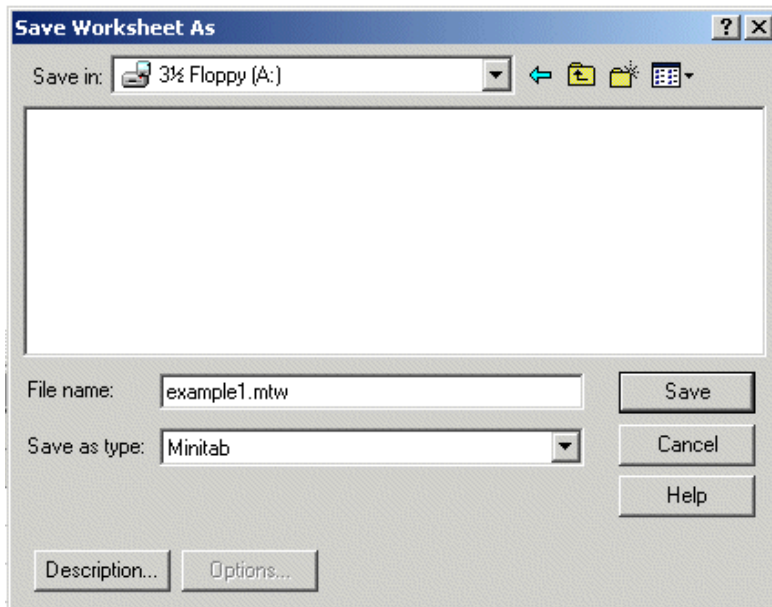
- Move the pointer to column 6, which is the variable named **average** and click on the the cell labeled C6 to highlight the variable column.
- Select **Format Column/Numeric** from **Editor menu**.
- Select **Fixed decimal width** and type **0** in the box right to it. (Note that this affects only the way the numbers are displayed in the data window, but not how the values are stored.)
- Click **OK**.

Now the variable average appears with whole numbers.

## Save the data file

Now to save the data (worksheet) file:

- Select **Save Current Worksheet As...** from the **File menu**. A dialog box appears.
- Type **a:\example1.mtw** as filename (specify appropriate pathname if you are using alternate location to store the file)



- Click **OK**.

The file will be saved on to the diskette in MINITAB format.

## Reading a data file in ASCII (text) format

In some situations, you may have created a data file using other software applications (e.g., Excel, Lotus, Quattro Pro), a data editor, or a word processor. In such a situation, you do not have to enter your data again into the Worksheet. You can import such files into MINITAB. Refer to the MINITAB Reference Manual for details on importing files created using spreadsheet software. In the example below, we are going to import an ASCII data file into MINITAB worksheet. MINITAB can read ASCII data in free-format (each value is separated by at least one space, or comma, without any blank cells, and no text variables), and fixed format (each value appears in the same place for every case). Text variables also can be imported using fixed format.

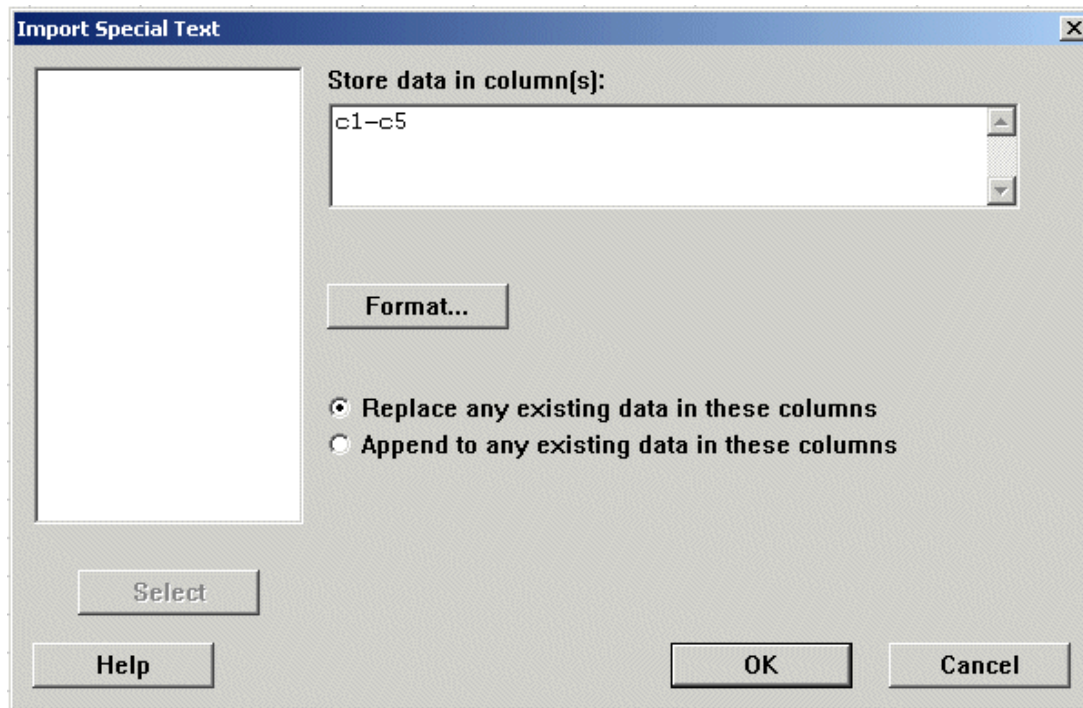
Suppose the data file we discussed above is stored on drive A as an ASCII file, examp1.dat, as follows:

```
01 1 83 85 91
02 1 65 72 68
03 2 60 74 64
04 2 88 96 92
05 2 84 79 82
06 1 90 94 90
07 1 87 80 82
08 1 78 86 80
09 2 90 87 93
10 2 76 73 70
```

To import the data into MINITAB:

- Select **New...** from the **File menu**, and choose **Minitab Worksheet** from appeared dialog box, then click **OK**.
- From the **File menu** select **Other Files/Import Special Text...**

A **Import Special Text** dialog box appears.



- Specify **C1-C5** as the columns to store the data.
- Click **OK**.

Another dialog box appears titled **Import Text from File**.

- Type **a:\example1.dat**. (You may use the mouse to select the file.)
- Click **OK**.

Now the data will appear in the worksheet. You may enter the labels for each variable immediately below the column number, as you did in the earlier example.

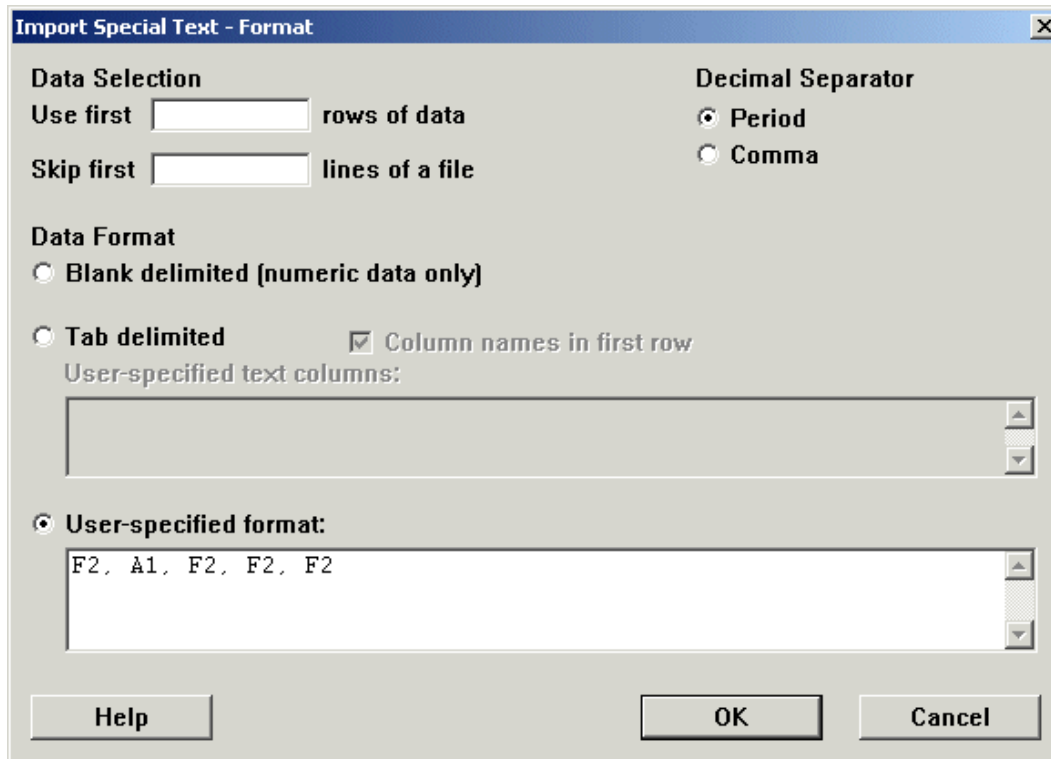
If the data you intend to import has more than 160 characters per row, then go to the Session window and type the command: **IW 512** before choosing **Import Special Text...** from the **File** menu.

If your data is entered without a blank space between the variables you may read it into MINITAB using fixed format style. To import ASCII data involving text variables use the fixed format. Suppose in the above ASCII data file, a:\example1.dat, the variable sex was given as a text variable (1=F, 2=M) as shown below.

```
01F838591
02F657268
03M607464
04M889692
05M847982
06F909490
07F878082
08F788680
09M908793
10M767370
```

To import the file:

- From the **File** menu select **Other Files/Import Special Text...**
- Specify **C1-C5** as the columns to store the data.
- Click **Format...**
- Click **User-specified format** from the dialog box titled **Import Special Text - Format**.
- Type in **F2,A1,F2,F2,F2** or **F2,A1,3F2**



- Click **OK**.

## Descriptive statistics

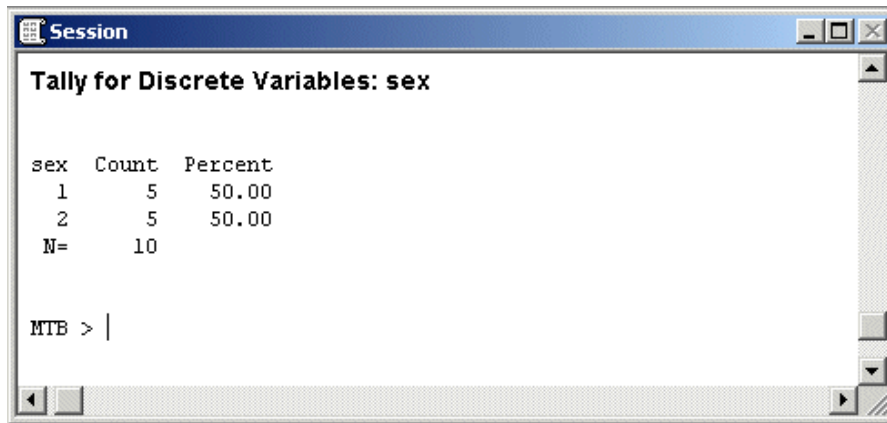
Now that we have data in the worksheet (here we are using the file where the variable `sex` is entered as a numeric variable), let us run a few descriptive statistics. (The worksheet will still be displayed in the Data window. If not, from the **File** menu select **Open Worksheet** and choose **examp1.mtw**; the file you saved earlier.)

Of the variables in our data set, `sex` is a categorical variable, and `test1`, `test2`, `test3`, and `average` are continuous variables. We will use the Tally (**Stat/Tables/Tally...**) command to obtain frequency counts for the variable `sex`, and Descriptive Statistics (**Stat/Basic Statistics/Descriptive Statistics...**) to obtain descriptive statistics (e.g., Mean, StDev, N).

## Tally

To run the Tally procedure:

- Select **Tables** from the **Stat** menu.
- Select **Tally...** from the **Tables** menu. A dialog box titled **Tally** appears.
- Highlight the variable `sex` from the box on the left.
- Click **Select**. The variable `sex` appears in the **Variables:** box.
- Select **Count**, and **Percents** from under the **Display** menu. (You may choose more options as necessary.)
- Click **OK**. The output appears as shown below.



**Tally for Discrete Variables: sex**

sex	Count	Percent
1	5	50.00
2	5	50.00
N=	10	

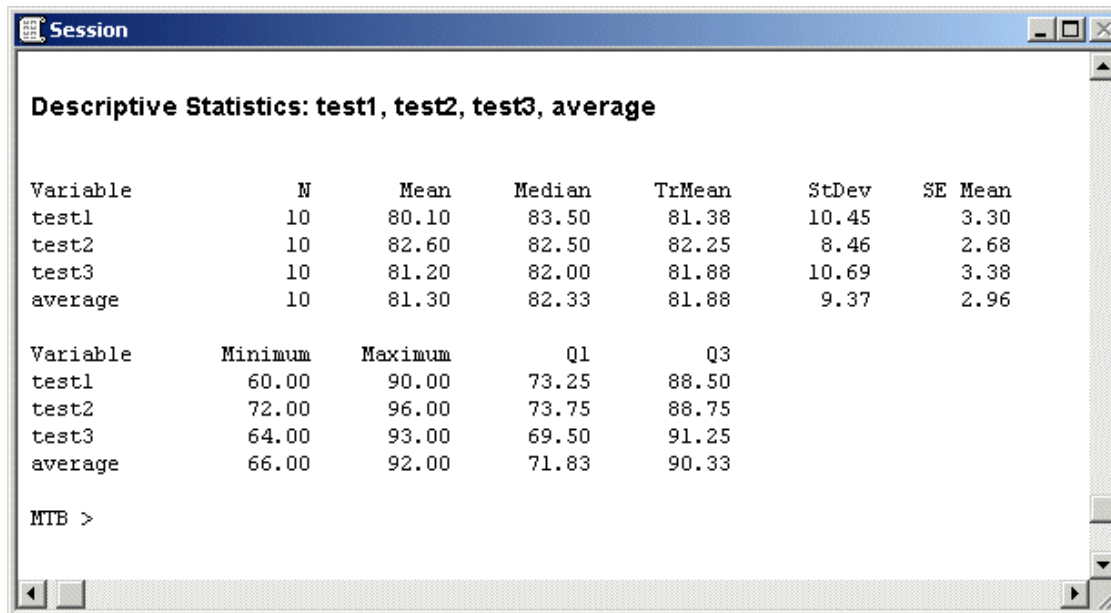
MTB > |

## Descriptive Statistics

To run the descriptive statistics:

- From the **Stat** menu select **Basic Statistics**. From **Basic Statistics** select **Display Descriptive Statistics**. Select **test1**, **test2**, **test3**, and **average** for variables. The variables appear in the box on the right.
- Click **OK**.

The output from the commands you just executed appears on the screen as shown below.



**Descriptive Statistics: test1, test2, test3, average**

Variable	N	Mean	Median	TrMean	StDev	SE Mean
test1	10	80.10	83.50	81.38	10.45	3.30
test2	10	82.60	82.50	82.25	8.46	2.68
test3	10	81.20	82.00	81.88	10.69	3.38
average	10	81.30	82.33	81.88	9.37	2.96

Variable	Minimum	Maximum	Q1	Q3
test1	60.00	90.00	73.25	88.50
test2	72.00	96.00	73.75	88.75
test3	64.00	93.00	69.50	91.25
average	66.00	92.00	71.83	90.33

MTB >

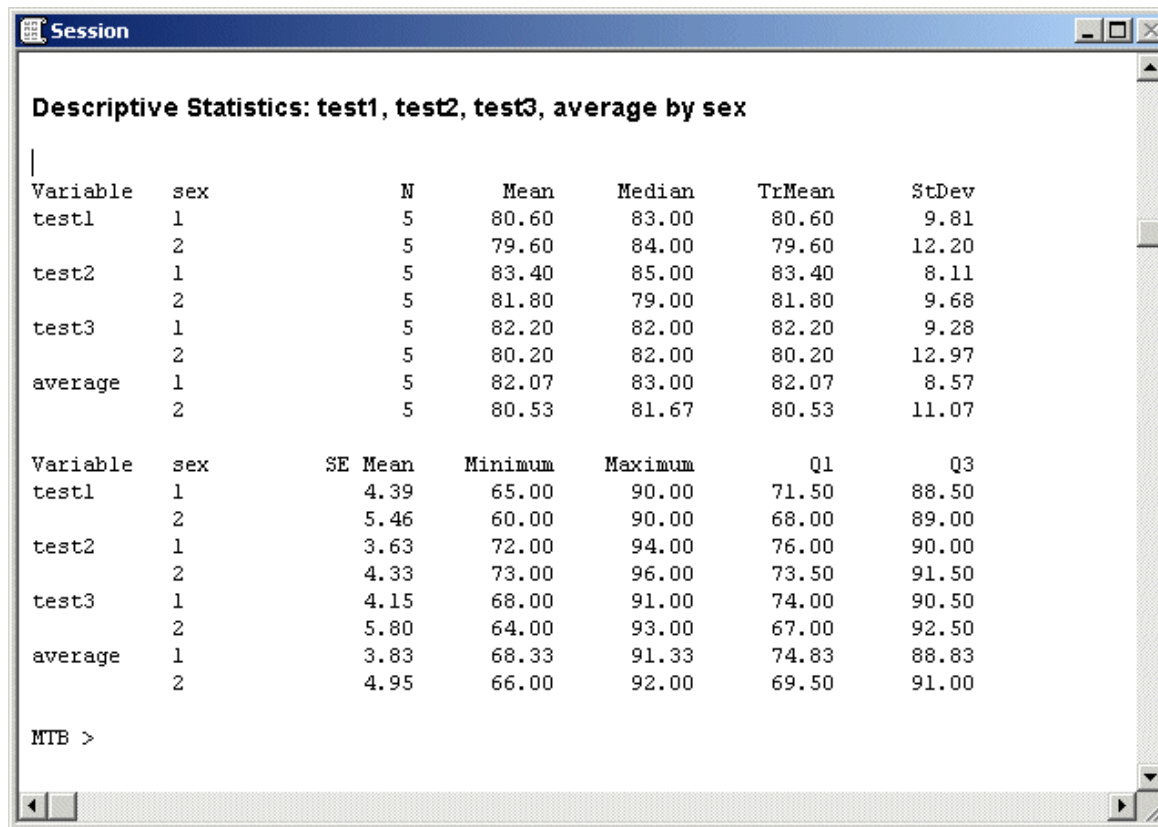
The number of decimal places in the output cannot be tailored through any menu options in MINITAB. However, you may edit the Session window. To edit the output select **Editor/Make Output Editable**.

You may select a grouping variable to obtain separate analysis for individual groups. Suppose you want to obtain separate listing of the above analysis for males and females.

- From the **Stat** menu select **Basic Statistics**. From **Basic Statistics** select **Display Descriptive Statistics**. Select **test1**, **test2**, **test3**, and **average** for variables. The variables appear in the box on the right.
- Select **By variable:** and type in **sex** in the box.
- Click **OK**.

The output appears as shown below. Note that the amount of information provided by the Descriptive Statistics in the output cannot be tailored. However you can use the **Calc** menu to calculate a particular

statistic you want and write to a column.



**Descriptive Statistics: test1, test2, test3, average by sex**

Variable	sex	N	Mean	Median	TrMean	StDev
test1	1	5	80.60	83.00	80.60	9.81
	2	5	79.60	84.00	79.60	12.20
test2	1	5	83.40	85.00	83.40	8.11
	2	5	81.80	79.00	81.80	9.68
test3	1	5	82.20	82.00	82.20	9.28
	2	5	80.20	82.00	80.20	12.97
average	1	5	82.07	83.00	82.07	8.57
	2	5	80.53	81.67	80.53	11.07

Variable	sex	SE Mean	Minimum	Maximum	Q1	Q3
test1	1	4.39	65.00	90.00	71.50	88.50
	2	5.46	60.00	90.00	68.00	89.00
test2	1	3.63	72.00	94.00	76.00	90.00
	2	4.33	73.00	96.00	73.50	91.50
test3	1	4.15	68.00	91.00	74.00	90.50
	2	5.80	64.00	93.00	67.00	92.50
average	1	3.83	68.33	91.33	74.83	88.83
	2	4.95	66.00	92.00	69.50	91.00

MTB >

## Printing output

Once you are satisfied with your analysis you may want to obtain a hard copy of the output. You may print the entire output or selectively delete unwanted portion of the output before printing, or select the part you want and then print that part. You may also save the output file (**File/Save Session Window As...** from the Session window) into files on your A drive (or where directed) for later use.

To print the output from the Session window:

- Select **Print Session Window...** from the **File** Menu.
- Click **OK** at the print dialog box.

The contents of the window will now be printed.

## Data Analysis

So far what we did was to look at MINITAB to develop a basic idea on how the program works. The next step is to examine a few other data analysis techniques (e.g., correlation, regression, t-test, analysis of variance) which you might employ for your own data analysis. Note that only a limited number of procedures are discussed in this document for illustration. Refer to the documentation for further information.

## Downloading data

The data set we discussed in our earlier example was to get you started. Now we will examine another data set with more variables and cases, which is more appropriate for the kind of analysis techniques we are examining.

In this example, you will read an ASCII data file, **clas.dat**, created with a word processor and saved as a text

file, into the MINITAB session. The data collected is from 40 middle school students and has 28 variables. The first four variables (< b>id, **sex**, **exp**, **school**) are background variables. The variable **sex** has two levels (M=male, F=female). **Exp** (prior computer experience) has three levels (1=less than one year, 2=1-2 years, 3=more than 2 years), **scho ol** (type of school system) has three levels (1=rural school, 2=suburban school, 3=urban school). The next 20 variables (**comp1...comp10**, **math1...math10**) are Likert-type responses to a computer opinion survey, and mathematics anxiety survey. The last four variables (**mathscor**, **compscor**, **manx**, **canx**) are scores on the math test, computer test, math anxiety grouping, and computer opinion survey score. The variable **manx** is a dichotomous variable created from low (coded as 0) and high (coded as 1) mathematics anxiety score.

To obtain a copy of this data file:

- Using a web browser (Netscape, Internet Explorer, lynx, etc.) to go to the URL:  
<http://www.indiana.edu/~statmath/stat/minitab/clas1.dat>
- Save it to a file (for example, a:\clas1.dat).

Contact a STC consultant if you need assistance.

Let us assume that the data file, **clas1.dat**, is on drive A. The first task is to import the file stored in text format into MINITAB. Start your MINITAB session (if not already started) following the directions given earlier. At this point the fastest way to read this data into MINITAB is using the Session Window. From the sessions window, at the MTB> prompt, type:

```
read 'a:\clas1.dat' c1-c28;
format(f2.0,a1,22f1.0,2f2.0,f1.0,f2.0).
```

In the above command lines, the semicolon indicates that a subcommand will follow on the next line (the subcommand **format** indicates how the data file is to be read using the fortran format). If a line has to be continued with subsequent lines then use an ampersand (&) at the end of each line. When the job is executed, the data will appear in the worksheet filling 40 rows (cases) and 28 columns (variables). The columns will be numbered and no names will be assigned. You may type in names into the **Data** window, or use the **Session** window to assign names to the variables.

However, the above command lines can be saved into a text file that may be executed during a MINITAB session. Suppose the following MINITAB command lines are saved into a file, **clas1.mtb**, on your A drive. Note that we decided to name each variable for clarity sake.

```
read 'a:\clas1.dat' c1-c28;
format(f2.0,a1,22f1.0,2f2.0,f1.0,f2.0).
name c1 'id' c2 'sex' c3 'exp' c4 'school' c5 'comp1' c6 'comp2' c7 'comp3' &
c8 'comp4'
name c9 'comp5' c10 'comp6' c11 'comp7' c12 'comp8' c13 'comp9' c14 'comp10'
name c15 'math1' c16 'math2' c17 'math3' c18 'math4' c19 'math5' c20 'math6'
name c21 'math7' c22 'math8' c23 'math9' c24 'math10' c25 'mathscor'
name c26 'compscor' c27 'manx' c28 'canx'.
```

To execute the file, **clas1.mtb**, do the following:

- Select **File/Other Files/Run an Exec....** A dialog box titled **Run an Exec** appears. The default value for the number of execution will be given as 1. Do not change it.
- Click **Select File** button. Another dialog box with the same title appears.
- Type in **a:\clas1.mtb** in the box under **File Name**:
- Click **OK**.

The data will be read into the worksheet. Each variable will be assigned a name as directed. Now save the file by taking the following steps.

- Select **Save Current Worksheet As...** from the **File** menu. A dialog box appears.
- Type **a:\clas1.mtw** as filename (specify appropriate pathname if you are using an alternate location to store the file).
- Click **OK**.

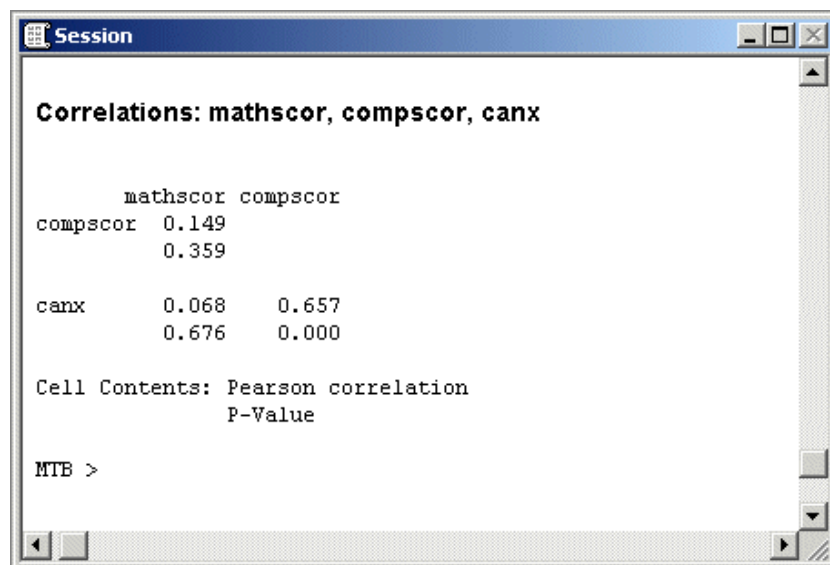
The copy of the file will now be saved on the diskette in MINITAB format. However, the data will still be displayed in the worksheet. Now you are ready for further analysis.

## Correlation analysis

A correlation analysis is performed to quantify the strength of association between two numeric variables. In the following task, we will perform Pearson correlation analysis. The variables used in the analysis are **mathscor**, **compscor**, and **canx**.

- Select **Stat/Basic Statistics/Correlation....** This opens the **Correlation** dialog box. The numeric variables in your data file appear on the source list in a box on the left side of the screen.
- Select **mathscor**, **compscor**, and **canx** from the list and click the **Select** button. The variables will be pasted into the selection box.
- Click **OK**.

A matrix as shown below appears on the screen.



MINITAB could be used to calculate Spearman's Rho (rank correlation coefficient) between pairs of non-missing data by ranking both columns (use **Manip/Rank**) and correlating the ranked data using **Stat/Basic Statistics/Correlation**. It is important to delete rows that contain missing values before ranking the data.

## Simple linear regression

A correlation coefficient tells you that some sort of relation exists between the variables, but does not tell you much more. For example, a correlation of 1.0 means that all points fall exactly on a straight line, but it says nothing about the form of the relation between the variables. When the observations are not perfectly correlated, many different lines may be drawn through the data. To select a line that describes the data, as close as possible to the points, you employ the Regression Analysis, which is based on the least-squares principle. In the following task, you will perform a simple regression analysis with **canx** as the dependent variable, and **compscor** as independent variable.

- Select **Stat/Regression/Regression....** The Regression dialog box appears.
- Choose **canx** as the response (dependent) variable.
- Choose **compscor** as the predictor (independent) variable.
- Click **OK**.

The output as shown below, will be displayed on the screen with regression statistics including slope, intercept, and squared multiple R. If you want to store additional regression information choose the

appropriate options from under **Storage**.

```

Session

Regression Analysis: canx versus compscor

The regression equation is
canx = 23.2 + 0.133 compscor

Predictor      Coef      SE Coef      T      P
Constant      23.194    1.315      17.63  0.000
compscor      0.13349   0.02483    5.38   0.000

S = 2.544      R-Sq = 43.2%   R-Sq(adj) = 41.7%

Analysis of Variance

Source          DF          SS          MS          F          P
Regression       1          186.92       186.92      28.89     0.000
Residual Error  38          245.85        6.47
Total           39          432.77

Unusual Observations

Obs   compscor   canx      Fit      SE Fit   Residual   St Resid
  6     44.0     24.000    29.067    0.433    -5.067     -2.02R
 26     80.0     29.000    33.873    0.837    -4.873     -2.03R
 39     85.0     40.000    34.540    0.948     5.460      2.31R

R denotes an observation with a large standardized residual

MTB > |

```

## T-test

T-test is a data analysis procedure to test the hypothesis that two population means are equal. MINITAB can compute independent (not related; 2-sample) and dependent (related; 1-sample) t-tests. For independent t-tests, you must have a grouping variable with exactly two values (e.g., male and female, pass and fail). The variable must be numeric. If a grouping variable has more than two categories then you can subset the two categories you want and create new columns with the selections to perform t-test with.

In the following task, we will perform an independent t-test. The dependent variable is **mathscor**, and the independent (grouping) variable is **manx**.

- Select **Stat/Basic Statistics/2-sample t....** A **2-Sample t** dialog box appears. **Samples in one column** is already selected for you. If not select it.
- Select or type in **mathscor** in the box right to **Samples:**
- Select or type in **manx** in the box right to **subscripts:**
- Click **OK**.

By default a 2-tail test will be performed unless you change it by clicking the arrow next to the **Alternate:** option and choosing another option. In our example we are assuming unequal variance.

The output given below will be displayed on the screen.

```

Session

Two-Sample T-Test and CI: mathscor, manx

Two-sample T for mathscor

manx      N      Mean    StDev   SE Mean
0         28     53.8    13.8    2.6
1         12     37.0    15.2    4.4

Difference = mu (0) - mu (1)
Estimate for difference: 16.75
95% CI for difference: (6.05, 27.45)
T-Test of difference = 0 (vs not =): T-Value = 3.28 P-Value = 0.004 DF = 19

MTB >

```

To do a t-test on paired data (related sample) store the difference between the two paired columns (using LET or SUBTRACT) in a third column and perform a 1-sample t-test T-TEST on that third column.

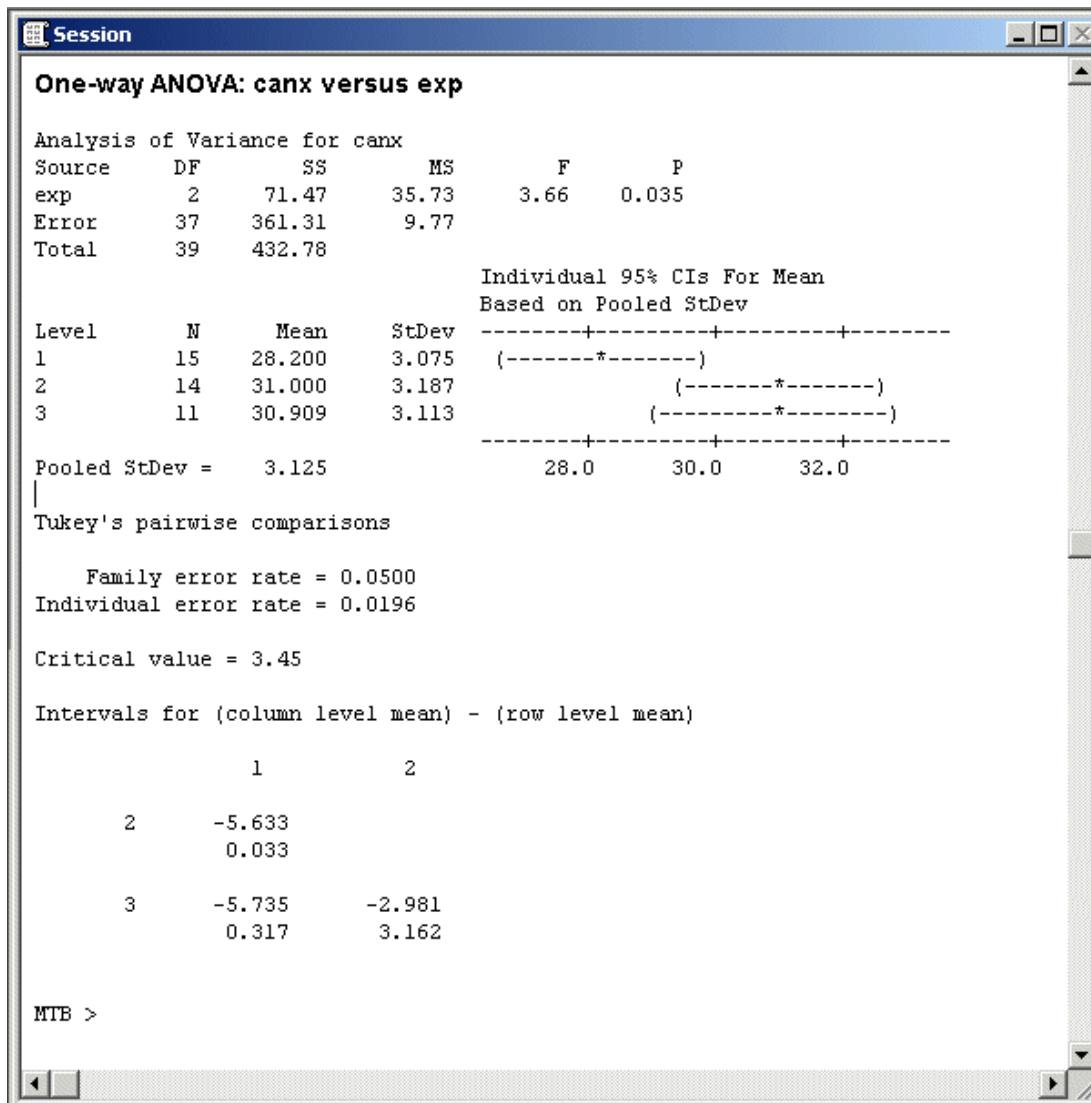
## Analysis of variance

The statistical technique used to test the null hypothesis that several population means are equal is called analysis of variance. It is called that because it examines the variability in the sample and, based on the variability, it determines whether there is a reason to believe the population means are not equal. The statistical test for the null hypothesis that all of the groups have the same mean in the population is based on computing the ratio of within and between group variability estimates, called F statistic. A significant F value only tells you that the population means are probably not all equal. It does not tell you which pairs of groups appear to have different means. To pinpoint exactly where the differences are, multiple comparisons may be performed.

In the following exercise you will perform a Oneway ANOVA with **canx** as the dependent variable and **exp** as the factor variable.

- Select **Stat/ANOVA/Oneway...**
- Select **canx** as the response variable.
- Select **exp** as the factor variable.
- Click **comparisons...** button.
- Select **Tukey's family error rate:**
- Click **OK.**
- Click **OK.**

The output given below will be displayed on the screen. The output shows that there is a significant difference among groups with different levels of computer experience at least at the .05 level. The multiple comparisons performed indicates that none of the differences are statistically significant at the .05 level. Examine the output and see the 3 intervals: (-5.633, 0.033), (-5.735, 0.317), and (.2981,3.162) all of which contains zero, and therefore none of them significant at the .05 level.



## Using MINITAB's Graph menu

MINITAB provides a wide selection of graphics for every stage of your project: exploration, research, and presentation.

### Plotting 2 variables using the Graph menu

Looking at plots is one of the best ways to examine relationships and patterns. For example, a scatterplot allows the visual representation of the relationship between variables diagram.

In the following task, you will plot variables **canx** (response variable) by **comp Scor** (predictor variable). We also fit a line to the data points on the scatterplot based on the least-squares principle.

- Select **Stat/Regression/Regression...**
- Select **canx** as response variable.
- Select **comp Scor** as predictor variable.
- Select **Fits** from under Storage.
- Click **OK**.
- Click **OK**.

As a result of the regression we have the fitted values of response variable, appeared on the column labeled **FITS1** in **Data** window.

- Select **Graph/Plot...**

A **Plot** dialog box appears. In the box below the **Graph Variables** box:

- Type **canx** as the Y variable.
- Type **comp Scor** as the X variable.
- Click the **Annotation** button and select **Title**.

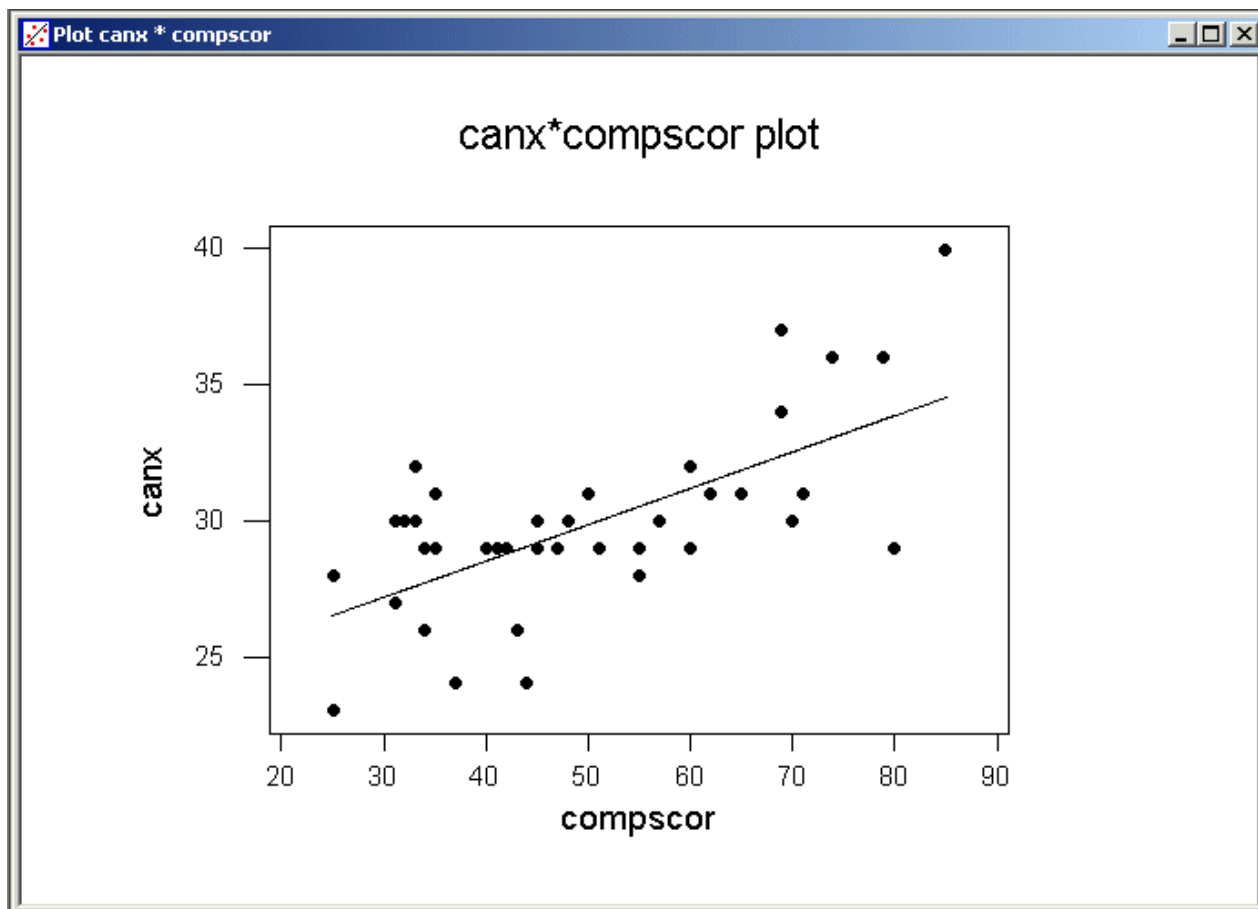
A Title dialog box appears.

- Type **canx \* comp Scor plot** as the title and click **OK**.
- Click the **Annotation** button again and select **Line**.

A line dialog box appears.

- In the box under **Points**, type **comp Scor fits1**
- Click **OK**.
- Click **OK**.

The plot with the best-fit line appears in a separate graph window as shown below.



The above plot can also be created using regression procedure without going into Graph menu. But, it lacks the flexibility to manipulate your plot diagram through the Graph menu. Do the following to plot a fitted regression line using the **Stat** menu.

- Select **Stat/Regression/Fitted Line Plot...**

A **Fitted Line Plot** dialog window appears.

- Select **canx** as response variable.

- Select **compscor** as predictor variable.
- Click **OK**.

The fitted regression line appears on the screen. You may use the %fitline macro to perform the same analysis. Refer to MINITAB Reference Manual for details.

To print the plot from the graph window:

- Select **File/Print Graph...**
- Click **OK**.

The plot will now be printed.

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## Further Help

The material covered in this document illustrates some of the basic features of MINITAB for Windows. Examining additional features of MINITAB for Windows is beyond the scope of this document. For further help refer to MINITAB for Windows documents. If you need assistance in using MINITAB for Windows contact UITS Stat/Math Center.

The basic documents for MINITAB for Windows are:

1. Meet MINITAB Release 13
2. MINITAB User's Guide 1: Data, Graphics, and Macros Release 13 for Windows, Windows 95, Windows NT
3. MINITAB User's Guide 2: Data Analysis and Quality Tools Release 13 for Windows, Windows 95, Windows NT

Documents may be purchased through IU Bookstore, or directly ordered from MINITAB Inc., 3081 Enterprise Drive, State College, PA. 16801-3008 (Phone: 800/448-3555, E-mail: [info@minitab.com](mailto:info@minitab.com), URL: <http://www.minitab.com>)

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