Minitab

Supplement

By Matt Regan

Department of Statistics The University of Auckland

'2000 Matt Regan, Department of Statistics, The University of Auckland

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Introductory Exercises

Example:

The Cancer Data will be used to introduce the basics of MINITAB.

The MINITAB Environment

MINITAB	MINITAB Student - Untitled												
<u>F</u> ile <u>E</u> dit <u>M</u>	File Edit Manip Calc Stat Graph Editor Window Help												
	🗿 X 🖻 I	1 🗠 🗄											
E Session			Ì	<u> </u>									×
Workshe	Worksheet size: 5000 cells Menu Bar Tool Bar											•	
	Session Window												
•												2	ľ
Worksh	eet 1 ***												\mathbf{X}
	C1	C2	C3	C4	ය	C6	C7	C8	C9	C10	C11	C12	
1													-
2													-
3													-
4						Work	sheet						
						Win	dow						-
													-
- '													-
0													-
10													-
11													-
													┚
												<u> </u>	· ///
Current Work:	sheet: Workshee	et 1									Editable	13:20	
🄀 Start 🍃	§Start MINITAB Student - U 13:20												

Figure 1

Entering Data

1. To make a cell in the **Worksheet** active click in it with the **mouse** or move to it using the **arrow** keys.

Enter the names Stomach, Bronchus, Other, and Colon into the name cells. The name cells are found just below the column references C1, C2, C3Étc. Type what is needed to be typed then press Enter and the cell below becomes the active cell, or press any arrow key and the corresponding direction becomes the active cell. See Figure 2.

Worksheet 1 ***							
	C1	C2	ជ	C4			
Ļ	Stomach	Bronchus	Other	Colon			
1							



3. Enter the rest of the data as shown in Figure 3.

Workshe	Worksheet 1 ***								
	C1	C2	ជ	C4					
Ļ	Stomach	Bronchus	Other	Colon					
1	1.18	0.81	3	2.01					
2	-0.41	3.16	6	0.51					
3	-0.64	-0.22	10	1.07					
4	1.32	2.05	7	4.31					
5	1.39	1.90	6	1.00					
6	0.14	0.85	8	3.51					
7	2.29	0.27	5	3.00					
8	-0.10	0.73	4	1.79					
9	2.20	1.84	11	1.67					
10	*	3.86	9	2.16					



Editing Data

It the last entry of Stomach was found to be 3.83. Go to the cell (make it the active cell) by using the mouse or the arrow keys. Type in the correct value 3.83. It has now been changed. The Worksheet should now look like Figure 4.

Stor	nach
	1.18
	-0.41
	-0.64
	1.32
	1.39
	0.14
	2.29
	-0.10
	2.20
	3.83

Figure 4

Note: The asterisk (*) is MINITAB[©] missing value code.

It was discovered that the variable Other should not be there. Click in the name cell and hold the mouse button down, then drag the mouse down to row 10. The cells have now been highlighted. The Worksheet should look like Figure 5.

Worksheet 1 ***							
	C1	C2	ជ	C4			
Ļ	Stomach	Bronchus	Other	Colon			
1	1.18	0.81	3	2.01			
2	-0.41	3.16	6	0.51			
3	-0.64	-0.22	10	1.07			
4	1.32	2.05	7	4.31			
5	1.39	1.90	6	1.00			
6	0.14	0.85	8	3.51			
7	2.29	0.27	5	3.00			
8	-0.10	0.73	4	1.79			
9	2.20	1.84	11	1.67			
10	3.83	3.86	9	2.16			
11							

Figure 5

3. Click the Clear Cells button on the tool bar.

The cells should now be cleared.

4. Highlight the 11 cells of the Colon variable in the same manner describe above. On the menu bar choose Edit L Cut. Make the name cell of column C3 the active cell. Choose from the menu bar Edit L Paste. The Worksheet now appears like that in Figure 6.

🛗 Workshe	Worksheet 1 ***						
	C1	C2	ជ				
Ļ	Stomach	Bronchus	Colon				
1	1.18	0.81	2.01				
2	-0.41	3.16	0.51				
3	-0.64	-0.22	1.07				
4	1.32	2.05	4.31				
5	1.39	1.90	1.00				
6	0.14	0.85	3.51				
7	2.29	0.27	3.00				
8	-0.10	0.73	1.79				
9	2.20	1.84	1.67				
10	3.83	3.86	2.16				

Figure 6

Sorting Data

 From the menu bar choose Manip E Sort. In the Sort column(s) box type Stomach. Enter Stomach into the Store sorted column(s) in box, and enter Stomach into the first Sort by column box. Click OK.

Sort			×
C1 C2 C3	Stomach Bronchus Colon	Sort <u>c</u> olumn(s): Stomach	×
		Store sorted column(s) in:	
		Stomach	×
		Sort by column: Stomach	Descending
		So <u>r</u> t by column:	☐ D <u>e</u> scending
		Sor <u>t</u> by column:	Descending
	Select	Sort <u>by</u> column:	🗖 Descending
H	lelp	<u>0</u> K	Cancel

Figure 7

- 2. Repeat for the variables Bronchus and Colon.
- 3. The data should now appear as in Figure 8.

🗰 Workshe	🗰 Worksheet 1 ***						
	C1	C2	ជ				
Ļ	Stomach	Bronchus	Colon				
1	-0.64	-0.22	0.51				
2	-0.41	0.27	1.00				
3	-0.10	0.73	1.07				
4	0.14	0.81	1.67				
5	1.18	0.85	1.79				
6	1.32	1.84	2.01				
7	1.39	1.90	2.16				
8	2.20	2.05	3.00				
9	2.29	3.16	3.51				
10	3.83	3.86	4.31				



Summary Statistics

1. From the menu bar choose Stat Ł Basic Statistics Ł Display Descriptive Statistics. In the Variables box type Stomach-Colon. The window should appear as in Figure 9. Click OK.

Display Des	criptive Statistic	\$	×
C1 9 C2 E C3 0	itomach Fronchus Colon	<u>Variables:</u> Stomach-Colon	×.
Hel	Select P	<u>0</u> K	G <u>r</u> aphs Cancel

Figure 9

2. The summary statistics are outputted to the **Session** window, which can be seen below.

町 Session								
Descriptive Statistics								
Variable	N	Mean	Median	TrMean	StDev	SE Mean		
Stomach	10	1.120	1.250	1.001	1.410	0.446		
Bronchus	10	1.525	1.345	1.451	1.285	0.406		
Colon	10	2.103	1.900	2.026	1.191	0.377		
Variable	Minimum	Maximum	Q1	Q3				
Stomach	-0.640	3.830	-0.177	2.222				
Bronchus	-0.220	3.860	0.615	2.327				
Colon	0.510	4.310	1.052	3.128				

Figure 10

Stacking/Unstacking Variables

1. On the menu bar choose Manip E Stack/Unstack E Stack Columns. Enter Stomach-Colon into the Stack the following columns box. Store the stacked data in the variable values and Store subscripts in the variable factors. See Figure 11.

Stack Columns	×
C1 Stomach C2 Bronchus C3 Colon	Store the stacked data in: values
Select Help	Store <u>s</u> ubscripts in: factors (Optional)

Figure 11

2. Click OK. The stacked columns will appear in the Worksheet. See Figure 12.

C4	យ
values	factors
-0.41	1
-0.10	1
0.14	1
1.18	1
1.32	1
1.39	1
2.20	1
2.29	1
3.83	1
-0.22	2
0.27	2

Figure 12

3. If the data was given in the form seen in Figure 13. Then it would need to be unstacked.

Worksheet 1 ***			
	C4	C5-T	
Ļ	values	factors	
1	7	а	
2	8	С	
3	4	b	
4	2	а	
5	3	b	
6	6	С	
7	5	С	
8	7	Ь	
9	9	а	
10	1	С	
11	2	а	



4. From the menu bar choose Manip E Stack/Unstack E Unstack One Column. The Unstack One Column window appears. Enter values into the Unstack the data in box. Store the unstacked data in the variables a, b, and c. Type factors in the Using subscripts in box, so that the window will look like Figure 14.

Unstack One Column	×
C1 Stomach C2 Bronchus C3 Colon C4 values C5 factors	Unstack the data in: values Store the unstacked data in: a b c
Select	Using subscripts in: factors
Help	<u>O</u> K Cancel

Figure 14

5. The unstacked data will be displayed in the **Worksheet** as shown in Figure 15.

Worksheet 1 ***			
	C6	C7	C8
Ļ	а	b	С
1	7	4	8
2	2	3	6
3	9	7	5
4	2	4	1
5	7	9	5
6	3	1	6
7	9	8	4
8	3	7	5



Note: The **Calculator** is a very useful tool for calculations and data manipulation. It is found under the **Calc** menu. Use the Help file to find out more about it.

Using Excel Data in MINITAB

Example:

The Cancer Data is in an Excel Worksheet called cancer.xls. Use MINITAB to analyse it.

1. The Cancer Data can be seen below in Figure 1.

	A	В	С	D
1	Stomach	Bronchus	Colon	
2	1.18	0.81	2.01	
3	-0.41	3.16	0.51	
4	-0.64	-0.22	1.07	
5	1.32	2.05	4.31	
6	1.39	1.9	1	
7	0.14	0.85	3.51	
8	2.29	0.27	3	
9	-0.1	0.73	1.79	
10	2.2	1.84	1.67	
11	3.83	3.86	2.16	
12				



- 2. Open MINITAB.
- 3. Choose from the menu bar File Ł Open Worksheet. The Open Worksheet window pops up. Click on the arrow next to the Files of type box and select Excel (*.xls). Navigate to the directory that contains the sought after file. In this case it is called Data. This will not always be so. See Figure 2.

Open Works	heet	? ×
Look jn:	🔁 Data 📃	
Cancer.xls		
File <u>n</u> ame:	cancer.xls	<u>O</u> pen
Files of <u>type</u> :	Excel (*.xls)	Cancel
Description.	Options Preview	C Merge ⊙ Open

Figure 2

4. Click **Open**. The Cancer Data then appears in MINITAB as shown in Figure 3 below.

cancer.xls ***			
	C1	C2	ជ
Ļ	Stomach	Bronchus	Colon
1	1.18	0.81	2.01
2	-0.41	3.16	0.51
3	-0.64	-0.22	1.07
4	1.32	2.05	4.31
5	1.39	1.90	1.00
6	0.14	0.85	3.51
7	2.29	0.27	3.00
8	-0.10	0.73	1.79
9	2.20	1.84	1.67
10	3.83	3.86	2.16

Figure 3

5. Perform the required analysis.

Constructing a Stem-and-Leaf Plot

Example:

Construct a stem-and-leaf plot of the Traffic Death Rate Data. (Refer to Example 2.3.2 in your textbook.)

1. Enter the data, found in Table 2.3.1 of your textbook, into MINITAB. The first few rows should look like those in Figure 1.

Worksheet 4 ***			
	C1	C2	
Ļ	death rates		
1	17.4		
2	10.1		
3	13.1		
4	10.3		
5	10.5		
6	15.7		
7	20.1		



From the menu bar choose Graph L Stem-and-Leaf. Click in the Variables box, then select C1 death rates in the big box, and then click the Select button, so that the dialog box looks like Figure 2.

Stem-and-Leaf	×
C1 death rates	⊻ariables:
	'death rates'
	-
	□ By variable:
	☐ <u>T</u> rim outliers
Select	Increment:
Help	<u>O</u> K Cancel

Figure 2

3. Click OK. The stem-and-leaf plot appears in the Session window.

E Session	🗮 Session		
Characte	Character Stem-and-Leaf Display		
Stem-and Leaf Uni	-leaf of death ra Ν = 30 t = 1.0		
1	0 5		
1	0		
2	09		
9	1 0000011		
(7)	1 2222233		
14	1 4555		
10	1 77		
8	1 89		
6	2 0001		
2	2		
2	2 5		
1	2 6		

Figure 3

Constructing a Dot Plot

Example:

Construct a dot plot of the following data 3, 4, 4.5, 4.5, 6, 8. This example can be found on page 47 of your textbook.

1. Enter the data into MINITAB as seen in Figure 1 below.

Worksheet 1 ***			
	C1	C2	
Ļ	var1		
1	3.0		
2	4.0		
3	4.5		
4	4.5		
5	6.0		
6	8.0		
7			



From the menu bar choose Graph Ł Dotplot. The Dotplot dialog box appears. Click in the Variables box, select C1 var1 in the big box, and then click the Select button. Enter Example of a Dot Plot into the Title box (or any suitable title). The window should look like Figure 2.

Dotplot		×
	<u>V</u> ariables:	
	var1	<u>م</u>
	No grouping	
	○ <u>B</u> y variable:	
	C <u>E</u> ach column constitutes a group	
	Title: Example of a Dot Plot	
Select		
Help	<u>0</u> K	Cancel

Figure 2

3. Click OK. A window (see Figure 3) containing the Dot plot will appear.



Figure 3

Constructing a Box Plot

Example:

Produce a Box Plot of the SYSVOL data. (Refer to Section 2.4.4 in your textbook.)

1. Enter the data found in Table 2.1.1 of your textbook into MINITAB the first few rows should look like Figure 1 below

Worksheet 1 ***					
	C1	C2			
Ļ	sysvol				
1	36				
2	74				
3	52				
4	165				
5	47				
6	124				



2. From the menu bar choose Graph Ł Boxplot. The Boxplot window pops up. Click in the first cell of the Graph table under the Y column. Select C1 sysvol from the big box then click the Select button. The dialog box should then look like Figure 2 below.

Boxplot						×
C1 sysvol	<u>G</u> raph va	riables: Y (measur	ement)	vs X	(category)
	Graph	Y			х	<u> </u>
	1	sysvol				
	2					
	3					•
	<u>D</u> ata disp	ilay:				
	ltem	Display	▼ For	each	•	Group variable 🔺
	1	IQRange E	lox Grap	h		
	2	Outlier S	>> Grap	h		
	3					_
1			<u>E</u> dit A	ttribute	es	
Select	<u>A</u> nnotat	ion 🔻	Frame	▼		
Help	Option	IS		<u>(</u>	<u>0</u> K	Cancel

Figure 2

Click on the arrow next to Annotation, and Choose Title. The Title dialog box, shown in Figure 3, appears. In the first row of the Title table enter the title Box Plot of End-systolic Volume.





4. Click OK. Click OK again. A window appears that contains the Box Plot. See Figure 4.



Figure 4

Constructing a Histogram

Example:

Produce a Histogram of the Female Coyote Lengths Data. (Refer to Table 2.3.2 in your textbook)

1. Enter the data into MINITAB. The first few rows will look like Figure 1.

Worksheet 2 ***					
	C1	C2			
Ļ	female lengths				
1	93.0				
2	97.0				
3	92.0				
4	101.6				
5	93.0				
6	84.5				
7	102.5				



2. On the menu bar click Graph Ł Histogram. The Histogram window will appear. Click in the first cell in the Graph variables table. Select C1 female lengths in the big box, and then click the Select button.

H	istogram							×
	C1	female len	_{gt} <u>G</u> raph va	riables:				
			Graph	×		_		
			1	'female l	en	gt>>		
			2					
			3			_		
			<u>D</u> ata disp	olay:				
			ltem	Display	-	For each	•	Group variables 🔺
			1	Bar		Graph		
			2					
			3					
]					<u>E</u> dit Attribut	es	
		Select	<u>A</u> nnotat	ion 💌	Ē	rame 🔻		
	He	elp	Option	IS			<u>o</u> ĸ	Cancel

Figure 2

3. Click on the arrow next to **Annotation**, and Choose **Title**. The **Title** dialog box, shown in Figure 3, appears. In the first row of the **Title** table enter the title **Histogram of Female Coyote Lengths**.



Figure 3

4. Click OK. Click OK again. A window like that in Figure 4 will pop up.



Figure 4

Constructing a Scatter Plot

Example:

Create a scatter plot of the Computer Timing Data. (Refer to Example 3.1.2 in your textbook.)

1. Enter the data into MINITAB, so that the first few rows will look like Figure 1.

🞬 Worksheet 1 ***					
	C1	C2			
Ļ	no terminals	time			
1	40	9.9			
2	50	17.8			
3	60	18.4			
4	45	16.5			
5	40	11.9			
6	10	5.5			
7	30	11.0			

Figure 1

From the menu bar choose Graph Ł Plot. The Plot dialog box appears. Click in the first cell in the Y column. Select C2 time in the big box, then click the Select button. Click in the first cell in the X column. In the big box select C1 no terminals, then Click the Select button. The window will look like Figure 2 below.

Plot								×
C1 no terminals	<u>G</u> raph va	riables:						
C2 time	Graph	Y			×	(
	1	time		'no t	er	minals'	11	
	2							
	3						-	
	<u>D</u> ata disp	lay:						
	ltem	Display	▼ Fe	or each	•	Group	variables	1
	1	Symbol	Gr	aph				
	2							
	3							-
			<u>E</u> di	t Attribut	es			
Select	<u>A</u> nnotat	ion 🔻	Era	ome 🔻				
Help	Option	IS			<u>0</u> K		Cancel	

Figure 3

Click on the arrow next to Annotation, and Choose Title. The Title dialog box, shown in Figure 3, appears. In the first row of the Title table enter the title Scatter Plot of Computer Timing Data.



Figure 3

4. Click OK. Click OK again. The window with the scatter plot pops up



Figure 4

Calculating Binomial Probabilities

Individual Probabilities: pr(X = x)

Example: Find pr(X = 5) where *X*~Binomial(11, 0.4)

- 1. On the menu bar click Calc **E** Probability Distributions **E** Binomial.
- 2. A dialog box, which can be seen in Figure 1 appears. Click on the circle next to **Probability**. The **Number of trials** is **11** and the **Probability of success** is **0.4**. The **Input constant** is **5**.

Binomial Distribution		×
	• Probability	
	○ <u>C</u> umulative probability	
	O Inverse cumulative probability	
	Number of trials: 11	
	Probability of success: 0.4	
	🔿 Input co <u>l</u> umn:	
	Optional s <u>t</u> orage:	
	Input constant: 5	
	Optional storage:	
Select		
Help	<u>O</u> K Cancel	



3. Click OK. The results appear in the Session window. See Figure 2.

🕮 Session
Worksheet size: 5000 cells
Probability Density Function
Binomial with $n = 11$ and $p = 0.400000$
x P(X = x) 5.00 0.2207



4. The result needed is 0.2207

Lower Tail Probabilities: $pr(X \le x)$

Example: Find $pr(X \le 4)$ where *X*~Binomial(11, 0.4)

 On the menu bar click Calc E Probability Distributions E Binomial. The Binomial Distribution dialog box appears, as shown in Figure 3. Ensure that the circle next to Cumulative probability is marked. The Number of trials is 11 and the Probability of success is 0.4. The Input constant is 4.

Binomial Distribution		X
	© Probability	
	• <u>C</u> umulative probability	
	C Inverse cumulative probability	
	Number of trials: 11	
	Probability of success: 0.4	
	🔿 Input column:	
	Optional s <u>t</u> orage:	
	Input constant: 4	
	Optional storage:	
Select	,	
Help	<u>O</u> K Cancel	



2. Click OK. The result appears in the Session window. See Figure 4.



Figure 4

3. The answer required is 0.5328.

Upper Tail Probabilities: $pr(X \ge x)$

Example: Find $pr(X \ge 7)$ where *X*~Binomial(11, 0.4).

Note: $pr(X \ge 7) = 1 - prX \le 6$

- 1. On the menu bar choose Calc Ł Probability Distributions Ł Binomial.
- The Binomial Distribution dialog box will appear. See Figure 5. Ensure that the circle next to Cumulative probability is marked. The Number of trials is 11 and the Probability of success is 0.4. The Input constant is 6 and the Optional storage is K1.

Binomial Distribution	E	<
	© Probability	
	Cumulative probability	
	C Inverse cumulative probability	
	Number of trials: 11	
	Probability of success: 0.4	
i	C Input column:	
	Optional s <u>t</u> orage:	
	Input co <u>n</u> stant: 6	
	Optional storage: K1	
Select		
нер		



3. Click OK. Enter var1 into the variable name cell as done in Figure 6 below.

Worksheet 1 ***					
	C1	C2			
Ļ	var1				
1					
2					
3					



4. From the menu bar choose Calc Ł Calculator. The Calculator dialog box pops up. Click in the Store result in variable box, then select C1 var1 in the big box next to it, and then click the Select button. Click in the Expression box and type 1– then select K1 and click the Select button. The dialog should then look like Figure 7.

Calculator						×
C1 var1 K1	<u>S</u> tore re <u>E</u> xpress	sult i ion:	n vari	able:	var	-1
						Eunctions:
	7 8	9	+	=	\diamond	All functions
	4 5	6	-	<	>	Absolute value
	1 2	3	*	<=	>=	Arcsine Arccosine
	0	•	1	A	nd	Arctangent Ceiling
			**	C)r	Cosine Current time 💌
Select			0	N	ot	Select
Help						<u>O</u> K Cancel



5. Click OK. The result will appear in the cell below var1, as seen in Figure 8.

Worksheet 1 ***				
	C1	C2		
Ļ	var1			
1	0.0993526			
2				
3				

Figure 8

Calculating Poisson Probabilities

Individual Probabilities: pr(X = x)

Example: Find pr(*X* = 5) where *X*~Poisson(6)

- 5. On the menu bar click Calc **E** Probability Distributions **E** Poisson.
- A dialog box, which can be seen in Figure 1 appears. Click on the circle next to Probability. The Mean is 6. The Input constant is 5.

Poisson Distribution	×			
	• Probability			
	C <u>C</u> umulative probability			
	C Inverse cumulative probability			
	<u>M</u> ean: 6			
	C Input column:			
	Optional storage:			
	© Input co <u>n</u> stant: 5			
Select	Optional sto <u>r</u> age:			
Help	<u>Q</u> K Cancel			



7. Click OK. The results appear in the Session window. See Figure 2.





8. The result needed is 0.1606

Lower Tail Probabilities: $pr(X \le x)$

Example: Find $pr(X \le 4)$ where *X*~Poisson(6)

4. On the menu bar click Calc L Probability Distributions L Poisson. The Poisson Distribution dialog box appears, as shown in Figure 3. Ensure that the circle next to Cumulative probability is marked. The Mean is 6. The Input constant is 4.

Poisson Distribution		×
	 Probability <u>C</u>umulative probability Inverse cumulative probability <u>M</u>ean: 6 	
	Input column: Optional storage: Input constant:	
Select Help	Optional sto <u>r</u> age: <u>O</u> KCance	:1



5. Click OK. The result appears in the Session window. See Figure 4.

E Session		
Cumulative D	vistrib	ution Function
Poisson with	mu =	6.00000
x 4.00	Ρ(X <= x) 0.2851



6. The answer required is 0.2851.

Upper Tail Probabilities: $pr(X \ge x)$

Example: Find $pr(X \ge 7)$ where *X*~Poisson(6).

Note: $pr(X \ge 7) = 1 - prX \le 6$

- 6. On the menu bar choose Calc **L** Probability Distributions **L** Poisson.
- The Poisson Distribution dialog box will appear. See Figure 5. Ensure that the circle next to Cumulative probability is marked. The Mean is 6. The Input constant is 6 and the Optional storage is K1.

Poisson Distribution		×			
	C <u>P</u> robability				
	• <u>C</u> umulative probability				
	C Inverse cumulative probability				
	<u>M</u> ean: 6				
	C Input column:				
	Ontional storage:				
	Input constant: 6				
Select	Optional sto <u>r</u> age: K1				
Help	<u>O</u> K Cancel				



8. Click OK. Enter var1 into the variable name cell as done in Figure 6 below.

Worksheet 1 ***				
	C1	C2		
Ļ	var1			
1				
2				
3				

Figure 6

9. From the menu bar choose Calc Ł Calculator. The Calculator dialog box pops up. Click in the Store result in variable box, then select C1 var1 in the big box next to it, and then click the Select button. Click in the Expression box and type 1− then select K1 and click the Select button. The dialog should then look like Figure 7.

Calculator							×
C1 var1 K1	<u>S</u> tor <u>E</u> ×p	re re: ressi 1	sult i ion:	n vari	able:	va:	r1
							<u>F</u> unctions:
	7	8	9	+	=	\diamond	All functions
	4	5	6	-	<	>	Absolute value
	1	2	3	*	<=	>=	Arcsine Arccosine
		D	•	I	A	nd	Arctangent Ceiling
· I				**	0)r	Cosine Current time 💌
Select				0	N	lot	Select
Help							<u>O</u> K Cancel



10. Click OK. The result will appear in the cell below var1, as seen in Figure 8.

Worksheet 1 ***				
	C1	C2		
Ļ	var1			
1	0.393697			
2				

Figure 8

Calculating Normal Probabilities

Lower Tail Probabilities: $pr(X \le x)$

Example: Find $pr(X \le 4)$ where *X*~Normal(2, 1)

- 1. From the menu bar choose Calc **E** Probability Distributions **E** Normal.
- 2. The Normal Distribution dialog box appears. The circle next to Cumulative probability must be marked. The Mean is 2 and the Standard Deviation is 1. The Input constant is 4.

Normal Distribution		×			
	© <u>P</u> robability density				
	• <u>C</u> umulative probability				
	C Inverse cumulative probability				
	Mean: 2				
	Standard deviation: 1.0				
	O Input co <u>l</u> umn:				
	Optional storage:				
	© Input constant: 4				
	Optional storage:				
Select	,				
Help	<u>O</u> K Cancel				

Figure 1

3. Click OK. The result will be in the Session window shown below in Figure 2.

E Session
Worksheet size: 5000 cells
Cumulative Distribution Function
Normal with mean = 2.00000 and standard deviation = 1.00000
x P(X<=x) 4.0000 0.9772



4. The desired result is 0.9772

Upper Tail Probabilities: $pr(X \ge x)$

Example: Find $pr(X \ge 3)$ where *X*~Normal(2, 1)

- 1. From the menu bar choose Calc **E** Probability Distributions **E** Normal.
- A dialog box like the one below will appear. Mark the circle next to Cumulative probability. The Mean is 2 and the Standard deviation is 1. The Input constant is 3 and the Optional storage is K1.

Normal Distribution		X			
	© Probability density				
	• <u>C</u> umulative probability				
	O Inverse cumulative probability				
	<u>M</u> ean: 2				
	<u>Standard deviation:</u>	1.0			
	🔿 Input co <u>l</u> umn:				
	Optional storage:				
	Input constant:	3			
	Ontional storage'	V1			
Select	optional sto <u>r</u> age.	IVI			
Help		OK Cancel			



3. Type result in the cell just below C1 as in Figure 4.

Worksheet 1 ***				
	C1	C2		
Ļ	result			
1				
2				
3				



Click OK. Then on the menu bar click Calc ⊥ Calculator. Click in the Store result in variable box, then select C1 result in the big box next to it, and then click the Select button. Click in the Expression box and type 1– then select K1 and click the Select button. The dialog should then look like Figure 5.





5. Click OK. The answer will be displayed in the first column. See Figure 6.

Worksheet 1 ***			
	C1	C2	
Ļ	result		
1	0.158655		
2			



 $\operatorname{pr}(a \leq X \leq b)$

Example:

Find $pr(1 \le X \le 3)$ where *X*~Normal(2, 1).

Note: $pr(1 \le X \le 3) = pr(X \le 3) - pr(X \le 1)$

- 1. Find $pr(X \le 1)$, in the same manner as in that described above, and make the **Optional storage K1**. Find $pr(X \le 3)$ but in this case make the **Optional storage K2**.
- 2. As shown above, name a column result and the click on the menu bar Calc L Calculator.
- The Calculator window will pop up. Click in the Store result in variable box, then select
 C1 result in the big box and then click the Select button. Click in the Expression box, then select
 K2 in the big box and click the Select button. Type then select K1 in the big box click the Select button. The dialog box should look like Figure 7.

Calculator				
C1 result K1 K2	<u>Store result in variable:</u> result <u>Expression:</u> K2-K1			
	Eunctions:			
	7 8 9 + = <> All functions 💌			
	4 5 6 - < > Absolute value Antilog _ 1 2 3 * <= >= Arcsine Arccosine			
	0 . / And Arctangent Ceiling			
	T T Cosine Cosine Current time ▼			
Select	() Not Select			
Help	<u>O</u> K Cancel			



4. Click OK. The answer is shown in the cell below the column name result. See Figure 8.

Worksheet 1 ***			
	C1	C2	
Ļ	result		
1	0.682689		
2			

Figure 8
Calculating the Inverse of the Normal Distribution

Example:

Find *x* such that $pr(X \le x) = 0.25$ where *X*~Normal(2, 1).

- 1. From the menu bar choose Calc **L** Probability Distributions **L** Normal.
- The Normal Distribution dialog box pops up. Ensure that the circle next to Inverse cumulative probability is marked. The Mean is 2 and the Standard deviation is 1. The Input constant is 0.25.

Normal Distribution		×
	© Probability density	
	○ <u>C</u> umulative probabi	lity
		probability
	<u>M</u> ean: 2 <u>S</u> tandard deviation:	1.0
	Input column: Optional storage:	
	Input constant:	0.25
Select	Optional sto <u>r</u> age:	
Help		<u>O</u> K Cancel

Figure 9

3. Click OK. The answer is displayed in the Session window. See Figure 10.





4. The required answer is 1.3255.

Note: If the *x* is required for $pr(X \ge x) = 0.25$ then use (1 - 0.25) or 0.75.

Generating Random Samples

Example:

Generate a random sample of 20 values from X~Binomial(8, 0.6)

1. Enter the name **binomial sample** in the cell below **C1** as shown in Figure 1.

Worksheet 1 ***	
	C1
Ļ	binomial sample
1	



From the menu bar choose Calc Ł Random Data Ł Binomial. A dialog box appears. A sample of 20 values is needed, so therefore generate 20 rows of data. Click in the Store in column(s) box the select C1 binomial sample in the big box, and then click the Select button. The Number of trials is 8 and the Probability of success is 0.6

Binomial Distribution		x
	Generate 20	rows of data
	<u>S</u> tore in column(s):	
	'binomial sample'	A
	<u>N</u> umber of trials:	8
	Probability of success:	0.6
Select		
Help		<u>O</u> K Cancel

Figure 2

3. Click OK.

4. To obtain a random sample of 20 values from X~Poisson(2). Choose from the menu bar Calc L Random Data L Poisson, and fill in the dialog box as in Figure 3.

Poisson Distribution	×
	Generate 20 rows of data
	<u>S</u> tore in column(s):
	'poisson sample'
	<u>M</u> ean: 2
Select	
Help	<u>O</u> K Cancel

Figure 3

5. To obtain a random sample of 20 values from *X*~Normal(0, 1) i.e. Standard Normal. Choose from the menu bar **Calc** <code>L</code> **Random Data** <code>L</code> **Normal**, and fill in the dialog box as in Figure 4.

Normal Distribution		×
	Generate 20 rows of data	
	<u>Store in column(s):</u>	
	'normal sample'	4
	Mean: [0.0	
Select	Siandard deviation. J1.0	
Help	<u>0</u> K Ca	ncel

Figure 4

Calculating StudentÕt-Probabilities

Lower Tail Probabilities: $pr(T \le t)$

Example: Find $pr(T \le 4)$ where *T*~Student(33)

- 5. From the menu bar choose Calc rac Probability Distributions rate t.
- 6. The t-Distribution dialog box appears. The circle next to Cumulative probability must be marked. The Degrees of freedom is 33. The Input constant is 4.

t Distribution	E Contraction of the second	×
	C <u>P</u> robability density	
	Cumulative probability	
	Inverse cumulative probability	
	Degrees of freedom: 33	
	C Input column: Optional storage:	
	• Input co <u>n</u> stant: 4	
Select	Optional sto <u>r</u> age:	
Help	<u>O</u> K Cancel	



7. Click OK. The result will be in the Session window shown below in Figure 2.





8. The desired result is 0.9998

Upper Tail Probabilities: $pr(T \ge t)$

Example: Find $pr(T \ge 2)$ where *T*~Stutent(33)

- 3. From the menu bar choose Calc rac Probability Distributions rate t.
- 4. A dialog box like the one below will appear. Mark the circle next to **Cumulative probability**. The **Degrees of freedom** is **33**. The **Input constant** is **2** and the **Optional storage** is **K1**.

t Distribution		×
	 Probability density <u>C</u>umulative probability 	
	O Inverse cumulative probability	
	Degrees of freedom: 33	
	O Input column:	
	Optional storage:	
	Optional storage: K1	
Select		1
Help	<u> </u>	



4. Type **result** in the cell just below **C1** as in Figure 4.

Worksheet 1 ***		
	C1	C2
Ļ	result	
1		
2		
3		

Figure 4

6. Click OK. Then on the menu bar click Calc ⊥ Calculator. Click in the Store result in variable box, then select C1 result in the big box next to it, and then click the Select button. Click in the Expression box and type 1– then select K1 and click the Select button. The dialog should then look like Figure 5.





7. Click **OK**. The answer will be displayed in the first column. See Figure 6.

Worksheet 1 ***		
	C1	C2
Ļ	result	
1	0.0268931	
2		



$pr(a \le T \le b)$

Example: Find $pr(0 \le T \le 1)$ where *T*~Student(33).

Note: $pr(0 \le T \le 1) = pr(T \le 1) - pr(\mathcal{E} \ 0)$

- 4. Find $pr(T \le 0)$, in the same manner as in that described above, and make the **Optional storage K1**. Find $pr(T \le 1)$ but in this case make the **Optional storage K2**.
- 5. As shown above, name a column result and the click on the menu bar Calc L Calculator.
- 6. The Calculator window will pop up. Click in the Store result in variable box, then select
 C1 result in the big box and then click the Select button. Click in the Expression box, then select
 K2 in the big box and click the Select button. Type then select K1 in the big box click the Select button. The dialog box should look like Figure 7.

Calculator		X
C1 result <mark>K1</mark> K2	<u>Store result in variable:</u> result <u>Expression:</u> K2-K1	
	Eunctions:	
	7 8 9 + = <> All functions	
	$\begin{array}{c c c c c c c c c c c c c c c c c c c $	
	0 . / And Arctangent Ceiling	
	** Or Cosine Current time	-
Select	() Not Select	
Help	<u>O</u> K Cancel	

Figure 7

5. The answer is shown in the cell below the column name **result**. See Figure 8.

Worksheet 1 ***		
	C1	C2
Ļ	result	
1	0.337706	
2		

Figure 8

Calculating the Inverse of the Student *t*-Distribution

Example:

Find *t* such that $pr(T \le t) = 0.25$ where *T*~Student(33).

- 4. From the menu bar choose Calc rac Probability Distributions rate t.
- 5. The t Distribution dialog box pops up. Ensure that the circle next to Inverse cumulative probability is marked. The Degrees of fredom is 33. The Input constant is 0.25.

t Distribution		×
	© Probability density	
	© <u>C</u> umulative probability	
	Inverse cumulative probability	
	<u>D</u> egrees of freedom:	33
	© Input co <u>l</u> umn: Optional s <u>t</u> orage:	
	Input constant:	0.25
Select	Optional sto <u>r</u> age:	
Help		<u>O</u> K Cancel

Figure 9

6. Click OK. The answer is displayed in the Session window. See Figure 10.



Figure 10

4. The answer needed is -0.6820.

Note: If the *x* is required for $pr(T \ge t) = 0.25$ then use (1 - 0.25) or 0.75.

t-Test of a Mean

Example:

Perform a *t*-test on the Nitrate Ion Concentration Data to determine whether the concentration has changed from 0.492. (Refer to Example 10.1.1 in your textbook.)

1. Enter the data into MINITAB, as shown in Figure 1.

Worksheet 1 ***			
	C1		
Ť	concentration		
1	0.513		
2	0.524		
3	0.529		
4	0.481		
5	0.492		
6	0.499		
7	0.518		
8	0.490		
9	0.494		
10	0.501		



From the menu bar choose Stat E Basic Statistics E 1-Sample t. In the big box select
 C1 concentration, then click the Select button. Mark the circle next to Test mean, which is 0.492.

1-Sample t	×
	⊻ariables:
	concentration
	C <u>C</u> onfidence interval
	Level: 95.0
	est mean: 0.492 Alternative: not equal ▼
Select	G <u>r</u> aphs
Help	<u>O</u> K Cancel

3. Click OK. The results from the *t*-test appear in the Session window, which is shown in Figure 3 below.

E Session							
Worksheet	Worksheet size: 5000 cells						
T-Test of the Mean							
Test of mu	= 0.4	49200 vs m	u not = 0.	.49200			
Variable	Ν	Mean	StDev	SE Mean	т	Р	
concentr	10	0.50410	0.01600	0.00506	2.39	0.040	



4. The *P*-value is 0.04.

L

t-Test of Means for Two Independent Samples

Example:

Perform a *t*-test on the Urinary Androsterone Data. (Refer to Example 10.2.1 in your textbook.)

1. Enter the data into MINITAB. The first few rows will look like Figure 1 below.

Worksheet 1 ***				
	C1	C2		
Ļ	homosexual	heterosexual		
1	2.5	3.9		
2	1.6	4.0		
3	3.9	3.8		
4	3.4	3.9		
5	2.3	2.9		
6	1.6	3.2		
7	2.5	4.6		



2. On the menu bar click Stat Ł Basic Statistics Ł 2-Sample t. The 2-Sample t window pops up. Mark the circle next to Samples in different columns. Click in the First box. Select
C1 homosexual in the big box and click the Select button. Click in the Second box and do the same steps that were done for the First box, but select C2 heterosexual instead. The Alternative is not equal.

2-Sample t		×
	C Samples in one column	
	Samples:]
	Subscripts:]
	Samples in <u>different columns</u>	
	First: homosexual	
	Second: heterosexual	
	Alternative: not equal	
	Confidence level: 95.0	
Select	🗖 Assume <u>e</u> qual variances	G <u>r</u> aphs
Help	<u>0</u> K	Cancel

Figure 2

3. Click OK. The answer, shown below in Figure 3, is outputted to the Session window.



4. The *P*-value is 0.0044.

Nonparametric Test for Two Independent Samples

Example:

Perform the Mann-Whitney test on the Urinary Androsterone Data. (Refer to Example 10.2.1 in your textbook.)

1. Enter the data into MINITAB. The first few rows are shown in Figure 1.

androsterone.MTW ***				
	C1	C2		
Ļ	homosexual	heterosexual		
1	2.5	3.9		
2	1.6	4.0		
3	3.9	3.8		
4	3.4	3.9		
5	2.3	2.9		
6	1.6	3.2		
7	2.5	4.6		

Figure 1

On the menu bar click Stat Ł Nonparametrics Ł Mann-Whitney. Click in the First sample box, then select C1 homosexual in the big box. Then click the Select Button. Do the same for the Second sample box, but choose C2 heterosexual instead. The Alternative is not equal.

Mann-Whitney	×
	First Sample: homosexual
	Second Sample: heterosexual
	Confidence level: 95.0
	Alternative: not equal
L	
Select	
Help	<u>O</u> K Cancel

Figure 2

3. Click **OK**. The results of the Mann-Whitney test are displayed in the **Session** window seen below in Figure 3.

🏾 Session
Mann-Whitney Confidence Interval and Test
mann-minutey connucled interval and read
homosexu N = 15 Median = 2.300
heterose N = 11 Median = 3.800
Point estimate for ETA1-ETA2 is -1.100
95.1 Percent CI for ETA1-ETA2 is (-1.800,-0.400)
W = 152.5
Test of ETA1 = ETA2 vs ETA1 not = ETA2 is significant at 0.0102
The test is significant at 0.0100 (adjusted for ties)

Figure 3

4. The *P*-value is 0.01.

t-Test of Means for Paired Data

Example:

Do a *t*-test on the Air Force Head Size Data. (Refer to Example 10.1.3 in your textbook.)

1. Enter the data into MINITAB. The first few rows are shown below in Figure 1.

Worksheet 1 ***				
	C1	C2		
Ļ	cardboard	metal		
1	146	145		
2	151	153		
3	163	161		
4	152	151		
5	151	145		
6	151	150		
7	149	150		



On the menu bar click Stat E Basic Statistics E Paired t. Click in the First sample box, then select C1 cardboard in the big box, and then click the Select button. Do the same for the Second sample, but select C2 metal instead.

Paired t		×
C1 cardboard	<u>F</u> irst sample:	cardboard
C2 metal	<u>S</u> econd sample:	metal
	Paired t evaluates minus the second	the first sample sample.
Select	<u>Gr</u> aphs	Options
Help	<u>O</u> K	Cancel

Figure 2

3. Click OK. The result is shown in the Session window, which can be seen in Figure 3.

🗮 Session						
Paired T-Test an	d Con	fidence Inte	erval			
Paired T for car	dboard	d - metal				
			~ . .	an w		
	N	Mean	StDev	SE Mean		
cardboar	18	154.56	5.82	1.37		
metal	18	152.94	5.54	1.30		
Difference	18	1.611	2.146	0.506		
95% CI for mean difference: (0.544, 2.678) T-Test of mean difference = 0 (vs not = 0): T-Value = 3.19 P-Value = 0.005						

Figure 3

4. The *P*-value is 0.005

Nonparametric Tests of One Sample

Example:

Use the Air force Head Size Data. (Refer to Example10.1.3 in your textbook.)

Sign Test

1. Enter the data into MINITAB. The first few rows are shown in Figure 1 below.

headsize.MTW ***					
	C1	C2			
Ļ	cardboard	metal			
1	146	145			
2	151	153			
3	163	161			
4	152	151			
5	151	145			
6	151	150			
7	149	150			



On the menu bar click Calc L Calculator. Click in the Store result in variable box and select
 C3 difference in the big box then click the Select button. Click in the Expression box. In the big box select C1 cardboard, then click the Select button, and then the minus button. Again in the big box select C2 metal, then Click the Select button. Click OK.

Calculator	×						
C1 cardboard C2 metal C3 difference	Store result in variable: difference Expression: Cardboard - metal						
	Functions: 7 8 9 + = \land <td< th=""></td<>						
	4 5 6 - > Ansolute Antilog 1 2 3 * <= >= Arcsine 0 . / And Ceiling Cosine . . .						
Select	() Not Select						
Help	<u>O</u> K Cancel						



3. From the menu bar choose Stat L Nonparametrics L 1-Sample Sign. Click in the Variables box. Then select C3 difference in the big box, and then Click the Select button. Ensure that the circle next to Test median is marked. The Test median is 0 and the Alternative is not equal.

1-Sample Sign	×
C1 cardboard C2 metal C3 difference	Yariables: difference Confidence interval Level: 95.0 ● Test median: 0.0 Alternative: not equal
Select Help	<u>O</u> K Cancel

Figure 3

4. Click **OK**. The results are printed out in the **Session** window as seen below

🕮 Session								
Sign Test for Median								
Sign test of	media	in = 0.	00000 v	ersus	not =	0.00	000	
differen	N 18	Below 3	Equal 1	Above 14	0.03	Р 127	Median 1.500	

Figure 4

5. The *P*-value is 0.0127.

Wilcoxon Signed-Rank Test

- 1. Repeat Steps 1 and 2 above for the same data.
- From the menu bar choose Stat L Nonparametrics L 1-Sample Wilcoxon. Click in the Variables box, then select C3 difference in the big box, and then click the Select button. Ensure that the circle next to Test median is marked. The Test median is 0 and the Alternative is not equal.

1-Sample Wilcoxon	×
C1 cardboard C2 metal C3 difference	Yariables: difference Confidence interval Level: 95.0 Confidence interval Level: 95.0 Confidence interval
Select Help	Anernative: not equal

Figure 5

3. Click OK. The results are outputted to the Session window, which is shown below.

f Session									
Wilcoxon Signed Rank Test									
Test of me	dian	= 0.000	000 versus	median no	t = 0.000000				
		N for	Hilgowon		Fatiwated				
		M TOT	WIICOXON		Estimated				
	N	Test	Statistic	P	Median				
differen	18	17	130.5	0.011	1.500				



4. The *P*-value is 0.011.

One-Way ANOVA Ñ F-Test

Example:

Perform an F-test on the Reading Methods Data. (Refer to Example 10.3.1 in your textbook.)

Worksheet 3 ***							
	C1	C2	ជ	C4			
Ļ	both	maponly	scanonly	neither			
1	0.1	1.0	1.0	-0.3			
2	3.2	-0.5	3.3	-1.3			
3	4.3	1.0	1.4	1.6			
4	-0.5	0.6	-0.9	-0.4			
5	1.9	0.6	1.0	-0.7			
6	3.3	1.0	0.0	0.6			
7	2.5	1.0	0.6	-1.8			

1. Enter the data into MINITAB. Shown in Figure 1 are the first few rows.



2. On the menu bar click on Stat Ł ANOVA Ł One-way (Unstacked). The One-way Analysis of Variance dialog box pops up. The option One-way (Unstacked) was chosen because the responses are in separate columns. Click in the Responses (in separate columns) box, then select in the big box, C1 both. Then click the Select button. Repeat this for the other three variables. The dialog box should then look like Figure 2 below.

One-way Analysis of Variance 🛛 🗙							
C1 both C2 maponly C3 scanonly C4 neither	Responses (in separate columns):						
Select Help	<u>Gr</u> aphs <u>Q</u> K Cancel						

Figure 2

3. Click OK. In the Session window the answer will appear. See Figure 3.

Session								
One-way Analysis of Variance								
Analysis (of Var	iance						
Source	DF	SS	MS	F	Р			
Factor	3	27.06	9.02	4.45	0.008			
Error	46	93.35	2.03					
Total	49	120.41						
				Individus	al 95% CIs	For Mean		
				Based on	Pooled StD	ev		
Level	N	Mean	StDev	+	+	+	+	
both	22	1.459	1.544			(-*)	
maponly	12	1.233	1.441			(*)	
scanonly	7	0.914	1.302		(*)	
neither	9	-0.556	1.135	(*	-)		
				+	+	+	+	
Pooled St	Dev =	1.425		-1.0	0.0	1.0	2.0	

Figure 3

4. The *P*-value is 0.008.

Nonparametric One-Way ANOVA $\tilde{\mathsf{N}}\,$ Kruskal-Wallis Test

Example:

Perform a Kruskal-Wallis test on the Reading Methods Data. (Refer to Example 10.3.1 in your textbook.)

1. Enter the information into MINITAB, as shown in Figure 1. Only a few of the rows are shown here.

reading.	MTW ***					
	C1	C2-T				
Ļ	values	factor				
33	3.1	maponly				
34	2.6	maponly				
35	1.0	scanonly scanonly scanonly				
36	3.3					
37	1.4					
38	-0.9	scanonly				
39	1.0	scanonly				
40	0.0	scanonly				
41	0.6	scanonly				
42	-0.3	neither				
43	-1.3	neither				



 From the menu bar choose Stat L Nonparametric L Kruskal-Wallis. A dialog box appears. Click in the Response box, and the select C1 values in the big box. Click the Select button. Do the same for the Factor box, but select C2 factor instead.

Kruskal	-Wallis	×
C1 C2	values factor	Response: values
	Select Help	<u>OK</u> Cancel

Figure 2

3. Click OK. In the Session window, shown in Figure 3, will be displayed the results

	E Session							
	Kruskal-Wallis Test							
	Kruskal-Wa	llis	3 Test on val	ues				
	factor	Ν	Median	Ave Rank	Z			
	both	22	1.6000	29.8	1.84			
	maponly	12	1.0000	28.2	0.75			
	neither	9	-0.7000	11.6	-3.16			
	scanonly	7	1.0000	25.2	-0.06			
	Overall	50		25.5				
	H = 10.49	DF	= 3 P = 0.0	15				
	H = 10.52	DF	= 3 P = 0.0	15 (adjusted	for ties)			
1								

Figure 3

4. The *P*-value is 0.015.

Test of One Proportion

Example:

Test to see if the proportion is 0.2 for the ESP example. (Refer to Example 9.3.1 in your textbook.)

1. From the menu bar choose Stat Ł Basic Statistics Ł 1 Proportion. The 1 Proportion dialog box appears. Mark the circle next to Summarized data. The Number of trials is 60000, and the Number of successes is 12489. The window should then look like Figure 1.

1 Proportion			×
	© Samples in <u>c</u> olumns:		×
	Summarized <u>data</u> Number of <u>trials</u> : Number of <u>s</u> uccesses:	60000 12489	=
Select Help	<u>0</u>	к <u> </u>	O <u>p</u> tions Cancel



2. Click the **Options** button. Another window appears. The **Test proportion** is 0.2 and the **Alternative** is **greater than**. Mark the box next to **Use test and interval based on normal distribution**. Click **OK**. Refer to Figure 2.

1 Proportion - Options		×		
<u>C</u> onfidence level:	95.0			
<u>T</u> est proportion:	0.2			
<u>A</u> lternative: gr	eater than 💌			
☑ Use test and interval based on normal distribution				
Help	<u>0</u> K	Cancel		

Figure 2

3. Click OK again. The results are outputted in the Session window. See Figure 3.

```
        Session

        Test and Confidence Interval for One Proportion

        Test of p = 0.2 vs p > 0.2

        Sample X N Sample p 95.0 % CI Z-Value P-Value

        1
        12489 60000 0.208150 (0.204902, 0.211398)
```



4. The *P*-value is 0.000.

Test of Difference of Proportions from Two Independent Samples.

Example:

Carry out a test to determine if there is a difference in the proportions for the Playback Speed Data. (Refer to Example 9.3.4 in your textbook.)

 Choose from the menu bar Stat E Basic Statistics E 2 Proportions. Mark the circle next to Summarized Data. For the First sample the Trials are 74 and the Successes are 32. For the Second sample the Trials are 57 and the Successes are 15.

2 Proportions			×
	🔿 Samples in one c	olumn:	
	Sa <u>m</u> ples:		ĺ
	S <u>u</u> bscripts:		[
	C Samples in different	ent columns:	
	<u>F</u> irst:		1
	Second:		
	Summarized data	:	
		Trials:	Successes:
	F <u>i</u> rst sample:	74	32
	S <u>e</u> cond sample:	57	15
Select			O <u>p</u> tions
Help		<u>0</u> K	Cancel



2. Click the **Options** button. The **Test difference** is **0** and the **Alternative** is **not equal**. The **Options** window should now look like Figure 2. Click **OK**.

2 Proportions - Options
Confidence level: 95.0
Test difference: 0.0
Alternative: not equal
Use pooled estimate of p for test
Help <u>Q</u> K Cancel

3. Click OK again. The answer is displayed in the Session window. See Figure 3.

```
      Session

      Test and Confidence Interval for Two Proportions

      Sample
      X
      N
      Sample p

      1
      32
      74
      0.432432

      2
      15
      57
      0.263158

      Estimate for p(1)
      - p(2):
      0.169275

      95% CI for p(1)
      - p(2):
      (0.00862275, 0.329926)

      Test for p(1)
      - p(2)
      = 0 (vs not = 0):
      Z = 2.07
```

Figure 3

4. The *P*-value is 0.039.

One-Dimensional Tables

Example:

Determine if a certain die is symmetrical. (Refer to Example 11.1.1 in your textbook.)

1. Enter the information into MINITAB in the manner shown in Figure 1.

🗱 Worksheet 4 ***						
	C1	C2	C3	C4	C5	C6
Ļ	outcome	observed	expected	chi-square	cumprob	p-value
1	1	26	35			
2	2	40	35			
3	3	37	35			
4	4	26	35			
5	5	43	35			
6	6	38	35			



2. On the menu bar choose Calc Ł Calculator. The Calculator window pops up. Click in the Store result in variable box. In the big box select C4 chi-square, then click the Select button. In the Expression box type SUM((observed-expected)**2/expected). The window should look like Figure 2. Click OK.

Calcula	tor							×
C1 C2 C3 C4 C5 C6	outcome observed expected chi-square cumprob p-value	Store result in variable: 'chi-square' Expression: SUM((observed-expected)**2/expected)						
		ĺ.						<u>F</u> unctions:
		7	8	9	+	=	\diamond	All functions
		4	5	6	-	<	>	Absolute value
		1	2	3	*	<=	>=	Arcsine Arccosine
			0	•	1	A	nd	Arctangent Ceiling
1					**	C)r	Cosine Current time
	Select				0	N	ot	Select
F	lelp							<u>O</u> K Cancel

Figure 2

3. From the menu bar choose Calc L Probability Distributions L Chi-Square. The Chi-Square Distribution window appears. Mark the circle next to Cumulative probability. The Degrees of freedom is 5. Ensure that the circle next to Input column is marked. The Input column is Ôhi-squareÕ(include the single quote marks) and the Optional storage is cumprob. See Figure 3. Click OK.

Chi-Square Distribution		×
C1 outcome C2 observed C3 expected C4 chi-square C5 cumprob C6 p-value	 Probability density Cumulative probability Inverse cumulative probability Degrees of freedom: 5 	
Select	Input column: 'chi-square' Optional storage: cumprob Input constant:	
Help	<u>O</u> K Cancel	

Figure 3

4. On the menu bar click Calc L Calculator. The Calculator window appears. Enter Ŷ-valueÕ (with single quotes) into the Store result in variable box, and in the Expression box type 1-cumprob.

Calculator	×				
C1 outcome C2 observed C3 expected C4 chi-square C5 cumprob C6 p-value	Store result in variable: ['p-value' Expression: 1-cumprob				
	Eunctions:				
	7 8 9 + = <> All functions 💌				
	4 5 6 - < > Absolute value ▲ Antilog ▲ Arcsine Arccosine				
	0 . / And Ceiling				
	or Cosine Current time				
Select	() Not Select				
Help	<u>O</u> K Cancel				

Figure 4

5. Click OK. The answer is displayed how it is displayed in Figure 5.

C4	CS	C6
chi-square	cumprob	p-value
7.54286	0.816705	0.183295



Two-Dimensional Tables

Example:

Perform a Chi-square test of homogeneity on the Blood Type Data. (Refer to Example 11.2.2 in your textbook.)

1. Enter the information in the same way as that shown in Figure 6.

🗱 bloodtype.MTW ***					
	C1	C2	ជ	C4	
Ļ	Α	В	0	AB	
1	98	35	115	5	
2	38	9	79	6	
3	36	9	47	7	



2. From the menu bar choose Stat Ł Tables Ł Chi-Square Test. The Chi-Square Test dialog box appears. Click in the Columns containing the table box. Enter A-AB. The dialog box should now look like Figure 7.

Chi-Squ	are Test		×
C1 C2 C3 C4	A B O AB	Columns containing the table:	A P
	Select Help	<u>O</u> K Cance	I

Figure 7

3. Click OK. The Session window now contains the results of the Chi-Square test. See Figure 8.

🗮 Session					
Chi-Squa	ire Test				
Freedor			1 1 1		
Expected	counts	are prin	ced perow	opserved	counts
	A	В	0	AB	Total
1	98	35	115	5	253
	89.91	27.70	125.98	9.41	
2	38	9	79	6	132
	46.91	14.45	65.73	4.91	
3	36	9	47	7	99
	35.18	10.84	49.30	3.68	
Total	172	53	241	18	484
Chi-Sq =	0.728	+ 1.921	+ 0.957	+ 2.066	+
	1.692	+ 2.058	+ 2.680	+ 0.242	+
	0.019	+ 0.313	+ 0.107	+ 2.990	= 15.774
DF = 6, H	-Value	= 0.015			
2 cells t	jith exp	pected com	unts less	than 5.0	

Figure 8

4. The *P*-value is 0.015.

Normality Test

Example:

Check the Nitrate Ion Concentration Data for normality using the Normality test. (Refer to Example 10.1.1 in your textbook.)

1. Enter the data, shown below in Figure 1, into MINITAB.

concentration.MTW ***			
	C1		
Ļ	concentration		
1	0.513		
2	0.524		
3	0.529		
4	0.481		
5	0.492		
6	0.499		
7	0.518		
8	0.490		
9	0.494		
10	0.501		



2. From the menu bar select Stat Ł Basic Statistics Ł Normality Test. Click in the Variable box, then select C1 concentration in the big box, and then click the Select button. Ensure that the circle next to Ryan-Joiner is marked. Enter the Title: Normal Plot and Normality Test for Concentration Data.

Normality Test	×
	Variable: concentration
	Reference probabilities:
	Tests for Normality
	C Anderson-Darling
	Ryan-Joiner (Similar to Shapiro-Wilk)
Select	C Kolmogorov-Smirnov
	Title: Normal Plot and Normality Test for Concent
Help	<u>O</u> K Cancel

Figure 2

3. Click OK. A window containing the Normal Plot and the Normality Test pops up.



Figure 3

4. The *P*-value is greater than 0.1.
Simple Linear Regression

Example:

Using the Chernobyl Data carry out simple linear regression. (Refer to Example 3.1.1 in your textbook.)

1. Enter the information, shown in Figure 1, into MINITAB.

🛗 chernobyl.MTW ***				
	C1	C2		
Ļ	radioactivity	death increase		
1	23	2.2		
2	20	2.4		
3	22	1.9		
4	29	3.9		
5	32	3.6		
6	21	2.6		
7	16	0.0		
8	37	4.2		
9	44	5.0		



2. On the menu bar choose Stat Ł Regression Ł Regression. The Regression dialog box appears. In the Response box enter **@eath increase**Q̃include the single quotes). Type radioactivity into the Predictors box.

Regressi	on			×
C1 C2	radioactivit death increa	R <u>e</u> sponse: Pred <u>i</u> ctors:	eath increase'	×
	Select		<u>G</u> raphs <u>R</u> esults	Options Storage
F	lelp		<u>0</u> K	Cancel

Figure 2

3. Click the **Graph** button. Another window will pop up. Ensure that the circle next to **Regular** is marked, as well as the squares next to **Normal plots of residuals** and **Residuals versus fits** are marked. Click **OK**.

Regression - Graphs		×
	Residuals for Plots: • <u>Regular</u> • <u>Standardized</u> Residual Plots • <u>Histogram of residuals</u> • Normal plot of residuals • Residuals versus fits • Residuals versus fits • Residuals versus the variables:	○ <u>D</u> eleted
Select Help	<u></u> K	Cancel

Figure 3

4. Click **OK**. The output is displayed in the **Session** window (See Figure 4). The two plots requested, the Normal plot and the Residual plot, are shown in Figures 5 and 6.

f Session						
Regression Analysis						
The regressio death increas	The regression equation is death increase = - 1.18 + 0.149 radioactivity					
Predictor	Coef	StDev	Т	Р		
Constant	-1.1796	0.7232	-1.63	0.147		
radioact	0.14925	0.02543	5.87	0.001		
S = 0.6557 R-Sq = 83.1% R-Sq(adj) = 80.7% Analysis of Variance						
Source	DF	SS	MS	F	Р	
Regression	1	14.810	14.810	34.45	0.001	
Residual Erro	r 7	3.010	0.430			
Total	8	17.820				
Unusual Obser Obs radioac 7 16.	vations t death in 0 0.000	Fi 1.20	t StDev 3 8 0.3	Fit Res 357 -	sidual -1.208	St Resid -2.20R
R denotes an observation with a large standardized residual						



Figure 5



Figure 6

Correlation

Example:

Determine the sample correlation coefficient of the Chernobyl Data. (Refer to Example 3.1.1 in your textbook.)

1. Enter the data, seen in Figure 1, into MINITAB.

🛗 chernobyl.MTW ***					
	C1	C2			
Ļ	radioactivity	death increase			
1	23	2.2			
2	20	2.4			
3	22	1.9			
4	29	3.9			
5	32	3.6			
6	21	2.6			
7	16	0.0			
8	37	4.2			
9	44	5.0			



2. On the menu bar choose Stat **E** Basic Statistics **E** Correlation. The Correlation window pops up. Click in the Variables box. Then select C1 radioactivity in the big box, and click the Select button. Do the same for C2 death increase, so that the dialog box looks like Figure 2.

Correlat	ion		×
C1 C2	radioactivit death increa	Yariables: radioactivity 'death increase'	1
1		☑ <u>D</u> isplay p-values	
	Select		
	Help	<u>O</u> K Cancel	

Figure 2

3. Click OK. The answer is outputted to the Session window, which can be seen in Figure 3.



Figure 3

4. The sample correlation coefficient is 0.912