Excel

Supplement

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Contents

Introductory Exercises

Gross Domestic Product (GDP) is the total market value of goods and services produced in a country within a given period. The percentage growth of GDP is usually used as an important measurement of the economic growth of a country. Shown below is an estimate of percentage growth in GDP for 1998 and the forecast for 2000 for some South-East Asian and Pacific countries.

	A	B	C	D	E	F	G	H	I	J	K
1		Australia	China	Hong Kong	Japan	Malaysia	New Zealand	Philippines	Singapore	South Korea	Taiwan
2	1998	2.8	6.1	3.5	-2.3	-0.6	0.5	1.4	-0.5	-1.2	4.6
3	2000	2.5	7.4	5.3	1	2.1	1.8	3.6	3.1	7.1	4.9

Figure 1

Task 1 ENTERING INFORMATION

1. Type the data as in Figure 1.

Task 2 COPYING AND PASTING INFORMATION

2. Select cells from A1 to K3 and click **Copy** on the Standard toolbar.
3. Click **Sheet 2** on the Sheet tabs. (This is a new worksheet in the same workbook as the original worksheet. To go back the original worksheet, click **Sheet 1** on the Sheet tab.)
4. Click cell A1.
5. On the Menu bar, click **Edit ł Paste Special**.
6. Select the **Transpose** check box. (Figure 2)
7. Click **OK**. It will give the table as shown in Figure 3.

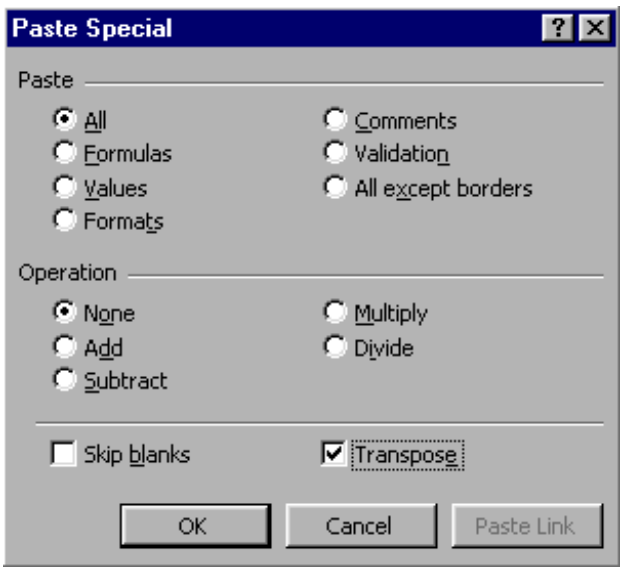


Figure 2

	A	B	C
1		1998	2000
2	Australia	2.8	2.5
3	China	6.1	7.4
4	Hong Kong	3.5	5.3
5	Japan	-2.3	1
6	Malaysia	-0.6	2.1
7	New Zealand	0.5	1.8
8	Philippines	1.4	3.6
9	Singapore	-0.5	3.1
10	South Korea	-1.2	7.1
11	Taiwan	4.6	4.9
12			
13			
14			
15			
16			
17			

Figure 3

Task 3 ENTERING FUNCTION

8. In cell A12, type **Total**.
9. In cell B12, type **=SUM(B2:B11)** and press Enter key on the keyboard.

Note: In *Excel*, a formula starts with an equal sign (=) and it will not be calculate until the Enter key has been pressed.

10. Select cell B12.

11. Click its **Fill Handle** (Figure 4) and hold down – do NOT release the mouse button.

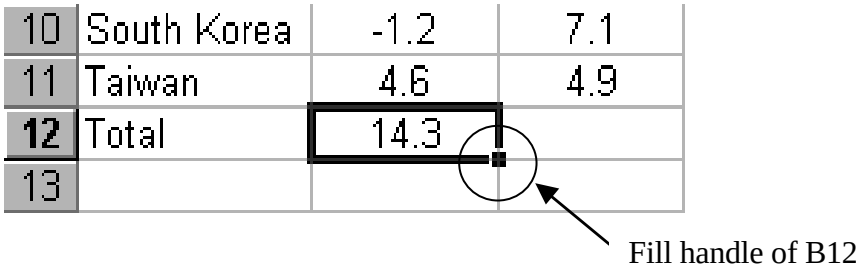


Figure 4

12. Drag the **Fill Handle** to the cell C12 and release the mouse button. Notice that the cell C12 contains the formula **=SUM(C2:C11)** now.

Note: This skill can also be used to fill in a series of numbers, dates, same content, or other items. Use **Office Assistance** or **Help** file to learn them.

13. In cell A13, type **Mean**.

14. In cell B13, type **AVERAGE(B2:B11)**.

15. In cell C13, use the skill described in step 11 and 12 to find the average GDP growth of all countries for year 2000.

Task 4 ENTERING FORMULA

16. In cell D1, type **Difference**.

17. In cell D2, type **=C2 – C3**.

18. Use the skill described in step 11 and 12 to find the difference in GDP growth between 1998 and 2000 for each country. The table should look like in Figure 5.

	A	B	C	D
1		1998	2000	Difference
2	Australia	2.8	2.5	-0.3
3	China	6.1	7.4	1.3
4	Hong Kong	3.5	5.3	1.8
5	Japan	-2.3	1	3.3
6	Malaysia	-0.6	2.1	2.7
7	New Zealand	0.5	1.8	1.3
8	Philippines	1.4	3.6	2.2
9	Singapore	-0.5	3.1	3.6
10	South Korea	-1.2	7.1	8.3
11	Taiwan	4.6	4.9	0.3
12	Total	14.3	38.8	
13	Mean	1.43	3.88	

Figure 5

Task 5 SORTING DATA

19. Select cells from A1 to D11.

20. On the Menu bar, click **Data Ł Sort**.

21. In **Sort** dialog box, click the arrow button and choose **Difference** from the list.

22. In **Sort By** box, choose **Descending**. (Figure 6)

23. Click **OK**. Now the table is arranged according to the difference of GDP growth in descending order and should look like in Figure 7.

Note: If the column specified in the **Sort By** box has duplicate items, the values can be sorted by specifying another column in the **Then By** boxes. In this example, China and New Zealand have the same difference of GDP growth. If after step 22, we set the first **Then By** box as **2000** and **Ascending**, then click **OK**. We will have table as in Figure 7 except that New Zealand is arranged before China.

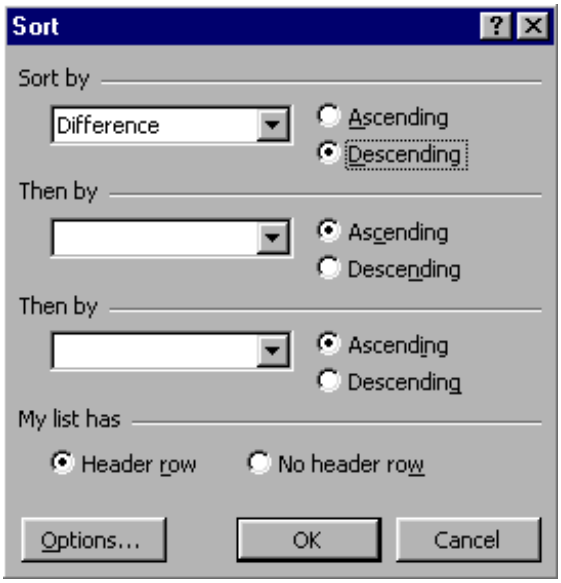


Figure 6

	A	B	C	D
1		1998	2000	Difference
2	South Korea	-1.2	7.1	8.3
3	Singapore	-0.5	3.1	3.6
4	Japan	-2.3	1	3.3
5	Malaysia	-0.6	2.1	2.7
6	Philippines	1.4	3.6	2.2
7	Hong Kong	3.5	5.3	1.8
8	China	6.1	7.4	1.3
9	New Zealand	0.5	1.8	1.3
10	Taiwan	4.6	4.9	0.3
11	Australia	2.8	2.5	-0.3
12	Total	14.3	38.8	
13	Mean	1.43	3.88	

Figure 7

Task 6 CREATING CELL NAMES:

Sometimes it is useful to refer to cells by a name like ‘sample_mean’ rather than a row column reference, eg like B24.

Naming One Cell:

Eg, name the cell B24 ‘sample_mean’.

1. Select the cell B24.

2. Move the cursor to the **Name Box** in the top left of your screen and click the mouse button when the cursor is over the box.

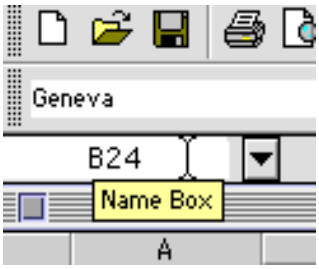


Figure 8

3. The **Name Box** should now be highlighted. Type **sample_mean**.

4. Press the Enter key. The **Name Box** should now contain **sample_mean** and will look like Figure 9 below.

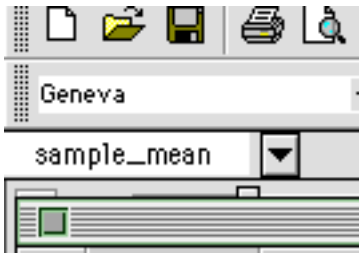


Figure 9

Naming More than One Cell:

Eg, naming cells B2:B4, ‘Bobs_age’, ‘Marys_age’, and ‘Jacks_age’, as these cells contain the age of the respective person.

1. Type the entries into cells A1:B4 and select cells A2:B4, as seen in Figure 10.

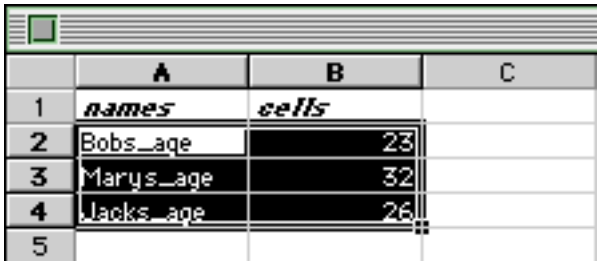


Figure 10

2. On the menu bar click **Insert ł Name ł Create…**

3. A dialog box is brought up, as in Figure 11. The names to be created are in the left column, select the **Left Column** check box.

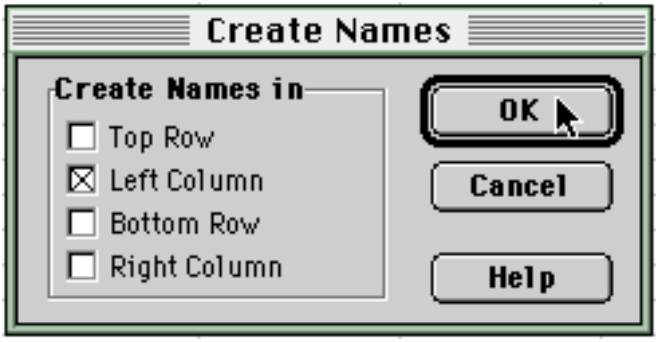


Figure 11

4. Click **OK**. The cells have now been named.

Example: Construct a dotplot for the Cancer Data.

1. Input the data into *Excel*. Notice that **1, 2,** and **3** in **Column A** represent **"Stomach", "Bronchus", "Colon"** respectively. (See Figure 1 on the right)
2. Highlight the cells A1:B30 and click **Chart Wizard.**
3. Choose **XY(Scatter)** in **Chart type** box and first option in Chart **sub-type** box.
4. Click **Next.** (See Figure 2 below)

	A	B
1	1	1.18
2	1	-0.41
3	1	-0.64
4	1	1.32
5	1	1.39
6	1	0.14
7	1	2.29
8	1	-0.1
9	1	2.2
10	1	3.83
11	2	0.81
12	2	3.16
13	2	-0.22
14	2	2.05
15	2	1.9
16	2	0.85
17	2	0.27
18	2	0.73
19	2	1.84
20	2	3.86
21	3	2.01
22	3	0.51
23	3	1.07
24	3	4.31
25	3	1
26	3	3.51
27	3	3
28	3	1.79
29	3	1.67
30	3	2.16

Figure 1

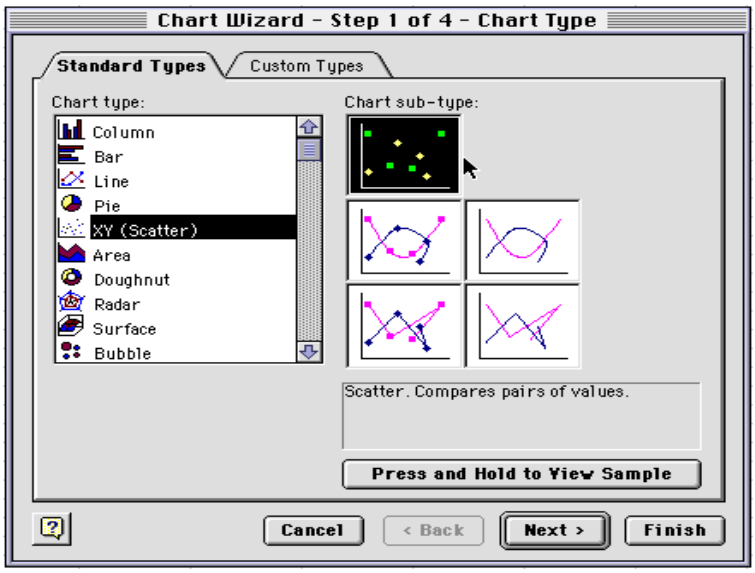


Figure 2

5. Click **Next.**

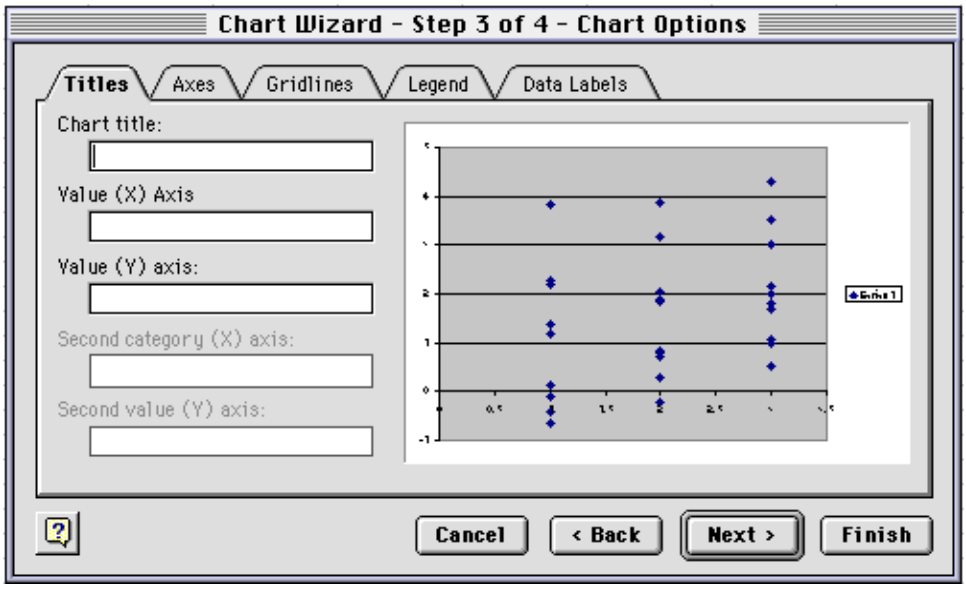


Figure 3

6 . Enter the titles in the **Chart Title**, **Value (X) Axis**, and **Value (Y) axis**. (Figure 3 on the right hand side).

7 . Click **Finish**. Your plot should look like Figure 4 below.

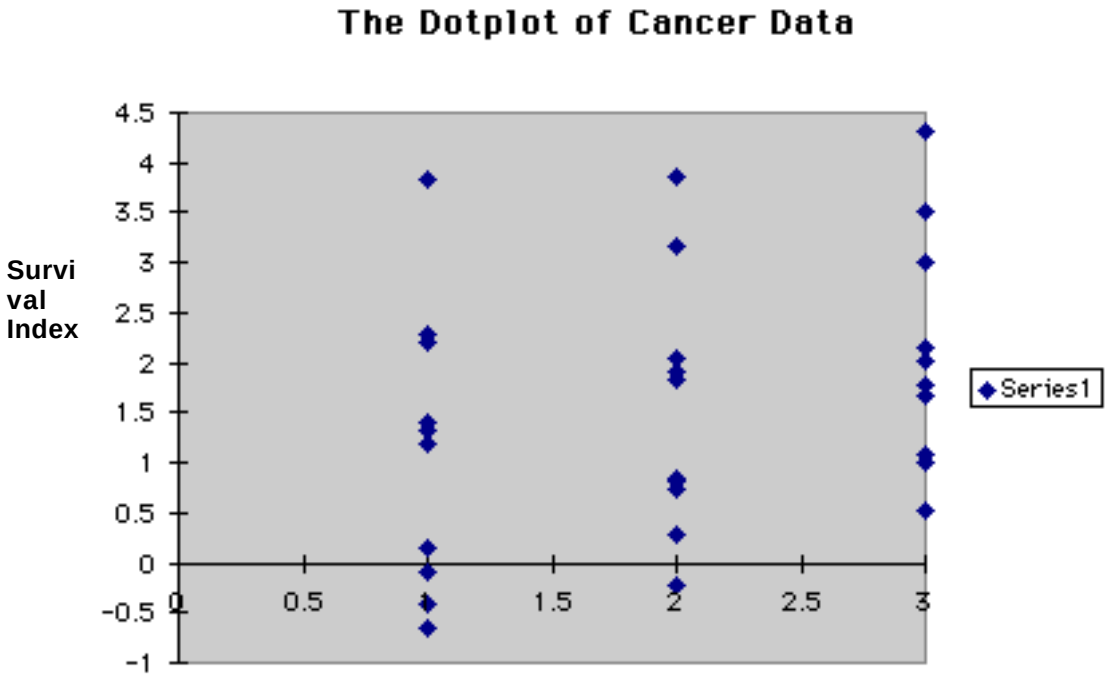


Figure 4

8 . By using textboxes and by double clicking each axis, it is possible to format the axes to produce a plot as in Figure 5 below.

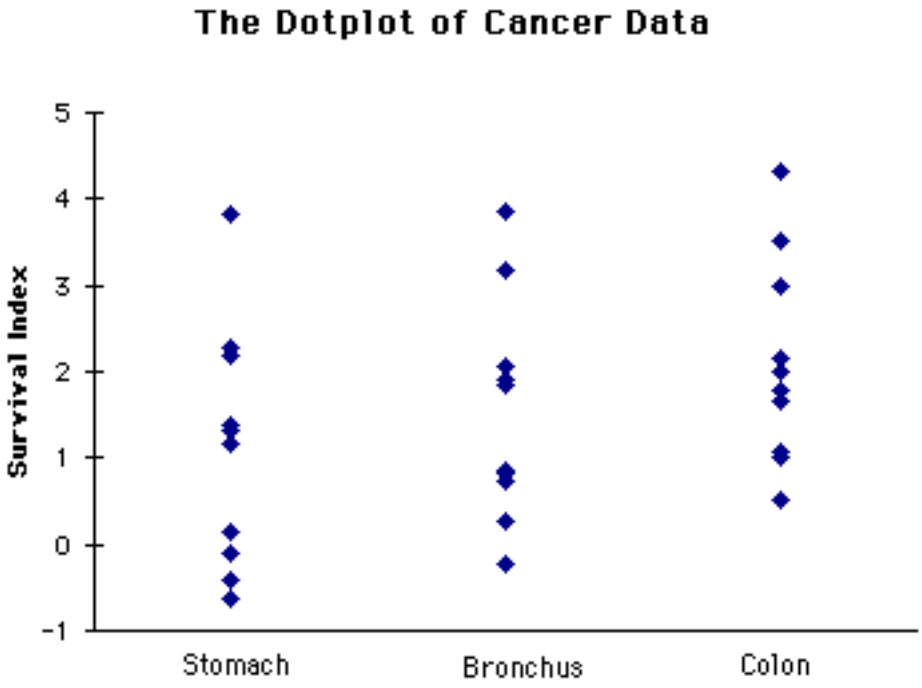


Figure 5

Calculating Binomial Probabilities

A. Individual probabilities: pr($X = x$)

Example: Find pr($X = 5$) where $X \sim$ Binomial(8, 0.6)

1. Click cell A1.
2. Click the **Paste Function** button  from the tool bar.
3. Choose **Statistical** from the **Function category** list box in the **Paste Function** dialog box.
4. Choose **BINOMDIST** from the **Function name** list box (Figure 1).

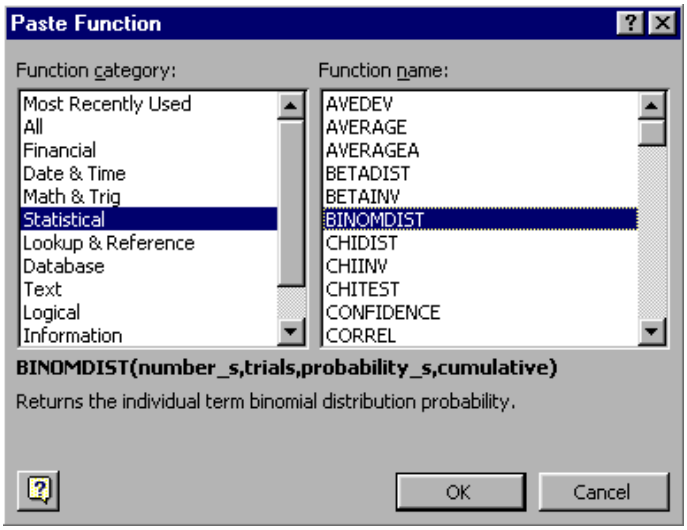


Figure 1

5. Click **OK**.
6. Fill in the **BINOMDIST** dialog box (Figure 2).

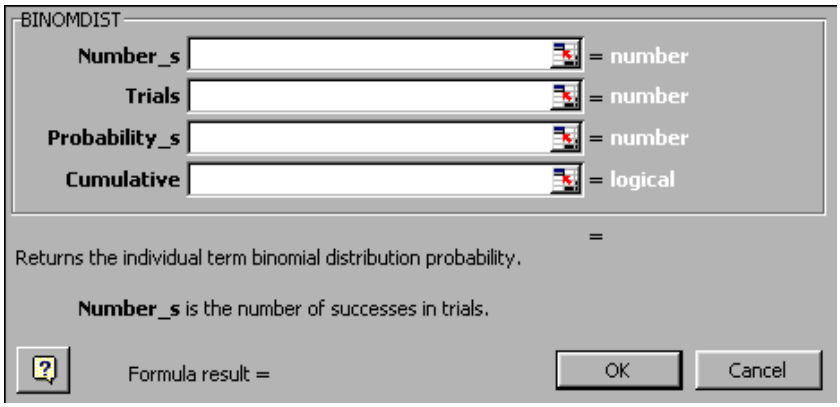


Figure 2

where:

Number_s is the number of successes in trials. It is equivalent to x in our manual. In this example, we put 5 in this box.

Trials is the number of trials. It is equivalent to n in our manual. In this example, we put 8 in this box.

Probability_s is the probability of success in each trial. It is equivalent to *p* in our manual. In this example, we put 0.6 in this box.

Cumulative indicates whether the number of successes is cumulative (TRUE or 1) or not(FALSE or 0). Since the individual probability is not cumulative, we put FALSE in this box.

7. Click **OK**. (The value of 0.279 should appear in cell A1).

B . Lower tail probabilities: pr($X \leq x$)

Example: Find pr($X \leq 3$) where $X \sim$ Binomial(8, 0.6)

1. Click cell B1.
2. Follow Steps 1 to 4 in A.
3. Set: **Number_s** = 3
Trials = 8
Probability_s = 0.6
4. The lower tail probability is cumulative, hence we set
Cumulative = TRUE.
5. Click **OK.** (The value of 0.174 should appear in cell B1).

C . Upper tail probabilities: pr($X \geq x$)

Example: Find pr($X \geq 3$) where $X \sim$ Binomial(8, 0.6)

Note: pr($X \geq 3$) = 1 – pr($X \leq 2$)

1. Evaluate pr($X \leq 2$) in cell C1 (use steps in B).
2. In cell C2, type: **=1 - C1**.
3. Press **Enter**. (The value of 0.950 should appear in cell C2).

D . pr($a \leq X \leq b$)

Example: Find pr($3 \leq X < 7$) where $X \sim$ Binomial(8, 0.6)

Note: pr($3 \leq X < 7$) = pr($3 \leq X \leq 6$) = pr($X \leq 6$) – pr($X \leq 2$)

1. Evaluate pr($X \leq 6$) in cell D1 (use steps in B).
2. Evaluate pr($X \leq 2$) in cell D2 (use steps in B).
3. In cell D3, type: **=D1 – D2**.
4. Press **Enter**. (The value of 0.844 should appear in cell D3).

Note:

Another way to calculate Binomial probabilities is to type the function "=BINOMDIST(x, n, p, c)" directly into the cell, where:

- x is the number of success in trials.
- n is the number of trials.
- p is the probability of success in each trial.
- c indicates whether the function is cumulative (TRUE or 1) or not cumulative(FALSE or 0).

For example:

To evaluate pr($X = 5$)	In cell A1, type: **=BINOMDIST(5, 8, 0.6, 0)**
To evaluate pr($X \leq 3$)	In cell B1, type: **=BINOMDIST(3, 8, 0.6, 1)**
To evaluate pr($X \geq 3$)	In cell C1, type: **=BINOMDIST(2, 8, 0.6, 1)** In cell C2, type: **=1 - C1**
To evaluate pr($3 \leq X \leq 6$)	In cell D1, type: **=BINOMDIST(6, 8, 0.6, 1)** In cell D2, type: **=BINOMDIST(2, 8, 0.6, 1)** In cell D3, type: **=D1 - D2**

	A	B	C	D
1	= BINOMDIST(5, 8, 0.6, 0)	= BINOMDIST(3, 8, 0.6, 1)	= BINOMDIST(2, 8, 0.6, 1)	= BINOMDIST(6, 8, 0.6, 1)
2			=1-C1	= BINOMDIST(2, 8, 0.6, 1)
3				=D1-D2

Figure 3

Calculating Poisson Probabilities

A. Individual probabilities: pr($X = x$)

Example: Find pr($X = 5$) where $X \sim$ Poisson($\lambda = 3$)

1. Click cell A1.
2. Click the **Paste Function** button  from the tool bar.
3. Choose **Statistical** from the **Function category** list box in the **Paste Function** dialog box.
4. Choose **POISSON** from the **Function name** list box (Figure 1).

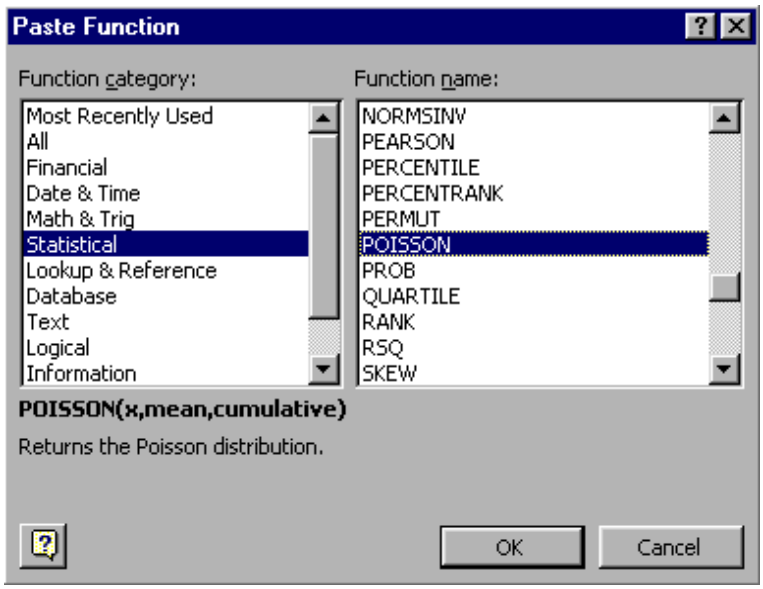


Figure 1

5. Click **OK**.
6. Fill in the **POISSON** dialog box (Figure 2).

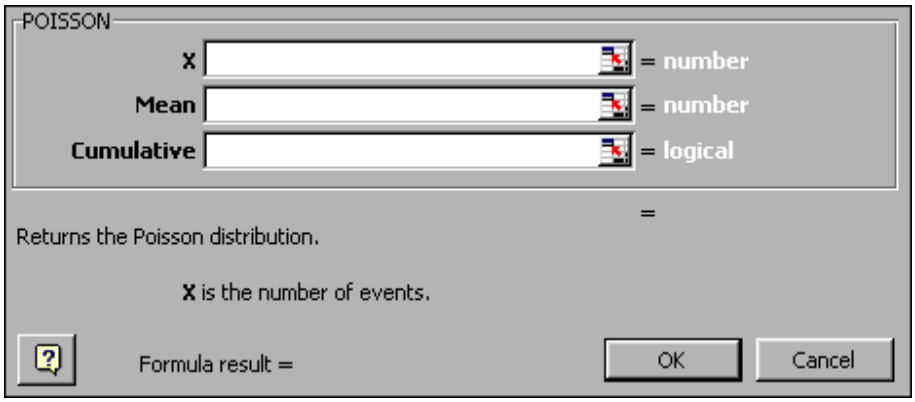


Figure 2

where:

X is the number of events. It is equivalent to *x* in our manual. In this example, we put 5 in this box.

Mean is the mean of the distribution. It is equivalent to λ in our manual. In this example, we put 3 in this box.

Cumulative indicates whether the Poisson probability is cumulative (TRUE or 1) or not(FALSE or 0). Since the individual probability is not cumulative, we put FALSE in this box.

7 . Click **OK**. (The value of 0.101 should appear in cell A1).

B . Lower tail probabilities: pr($X \leq x$)

Example: Find pr($X \leq 5$) where $X \sim$ Poisson($\lambda = 3$)

1. Click cell B1.
2. Follow Steps 1 to 4 in A.
3. Set: **X** = 5
Mean = 3
4. The lower tail probability is cumulative, hence we set
Cumulative = TRUE.
5. Click **OK.** (The value of 0.916 should appear in cell B1).

C . Upper tail probabilities: pr($X \geq x$)

Example: Find pr($X \geq 5$) where $X \sim$ Poisson($\lambda = 3$)

Note: pr($X \geq 5$) = 1 – pr($X \leq 4$)

1. Evaluate pr($X \leq 2$) in cell C1 (use steps in B).
2. In cell C2, type: **=1 - C1**.
3. Press **Enter**. (The value of 0.185 should appear in cell C2).

D . pr(a ≤ *X* ≤ b)

Example: Find pr(2 ≤ *X* < 9) where *X* ~ Poisson(λ = 3)

Note: pr(2 ≤ *X* < 9) = pr(2 ≤ *X* ≤ 8) = pr(*X* ≤ 8) – pr(*X* ≤ 1)

1. Evaluate pr(*X* ≤ 8) in cell D1 (use steps in B).
2. Evaluate pr(*X* ≤ 1) in cell D2 (use steps in B).
3. In cell D3, type: **=D1 – D2**.
4. Press **Enter**. (The value of 0.797 should appear in cell D3).

Note:

Another way to calculate Poisson probabilities is to type the function "=POISSON(*x*, λ, *c*)" directly into the cell, where:

x is the number of events.

λ is the mean of the distribution.

c indicates whether the function is cumulative (TRUE or 1) or not cumulative(FALSE or 0).

For example:

To evaluate pr(*X* = 5)	In cell A1, type: **=POISSON(5, 3, 0)**
To evaluate pr(*X* ≤ 5)	In cell B1, type: **=POISSON(5, 3, 1)**
To evaluate pr(*X* ≥ 5)	In cell C1, type: **=POISSON(4, 3, 1)** In cell C2, type: **=1 - C1**
To evaluate pr(2 ≤ *X* ≤ 8)	In cell D1, type: **=POISSON(8, 3, 1)** In cell D2, type: **=POISSON(1, 3, 1)** In cell D3, type: **=D1 - D2**

	A	B	C	D
1	=POISSON(5,3,0)	=POISSON(5,3,1)	=POISSON(4,3,1)	=POISSON(8,3,1)
2			=1-C1	=POISSON(1,3,1)
3				=D1-D2

Figure 3

Calculating Normal Probabilities

A. Lower tail probabilities: pr($X \leq x$)

Example: Find pr($X \leq 5$) where $X \sim$ Normal($\mu = 7$, $\sigma = 6$)

1. Click in cell A1.
2. Click the **Paste Function** button  from the tool bar.
3. Choose **Statistical** from the **Function category** list box in the **Paste Function** dialog box.
4. Choose **NORMDIST** from the **Function name** list box (Figure 1).

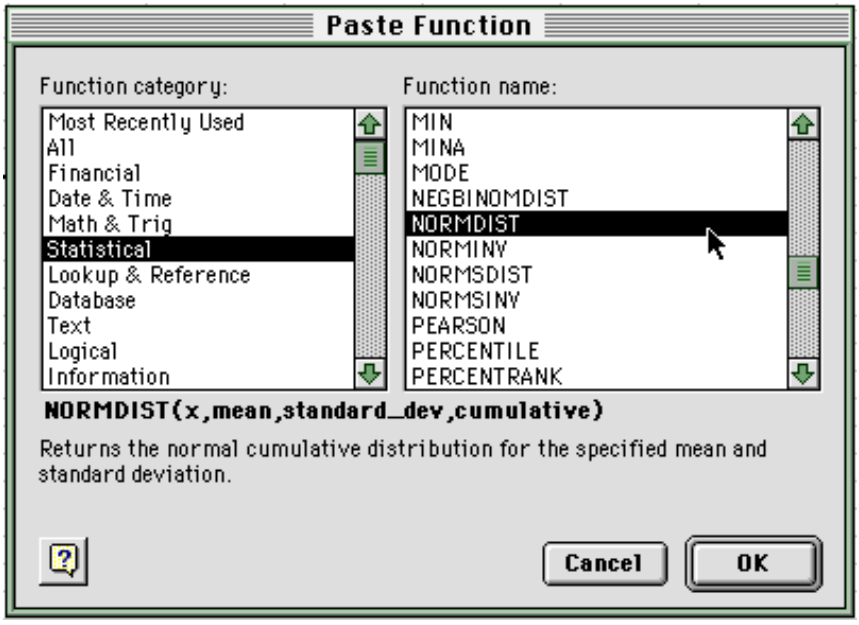


Figure 1

5. Click **OK**.
6. Fill in the **NORMDIST** dialog box (Figure 2).

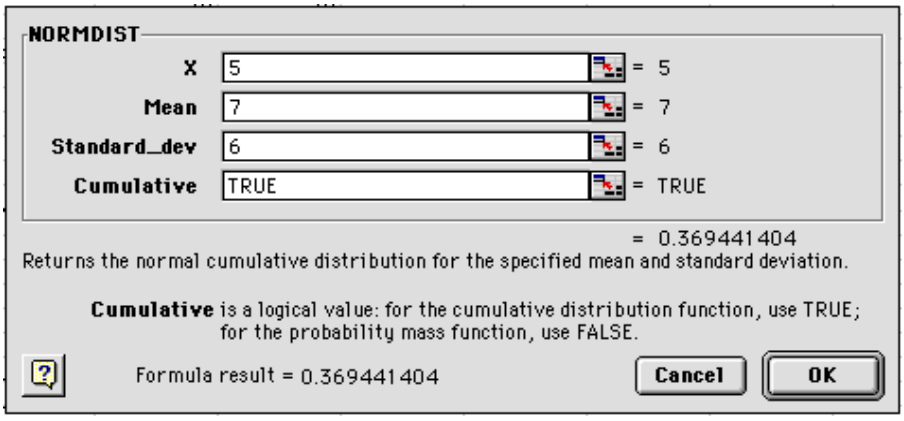


Figure 2

where:

X is the value for which we want the distribution. It is equivalent to *x* in our manual. In this example, we put 5 in this box.

Mean is the mean of the distribution. It is equivalent to μ in our manual. In this example, we put 7 in this box.

Standard_dev is the standard deviation of the distribution. It is equivalent to σ in our manual. In this example, we put 6 in this box.

Cumulative indicates whether we want it is cumulative distribution function(TRUE or 1) or probability mass function(FALSE or 0). We will always put TRUE or 1 in this box.

7. Click **OK**. (The value of 0.369 should appear in cell A1.)

B. Upper tail probabilities: pr($X \geq x$)

Example: Find pr($X \geq 9$) where $X \sim$ Normal($\mu = 7$, $\sigma = 6$)

Note: pr($X \geq 9$) = 1 – pr($X \leq 9$)

1. Evaluate pr($X \leq 9$) in cell B1 (use steps in section A. above.).

2. In cell B2, type: **=1 – B1**.

3. Press **Enter**. (The value of 0.369 should appear in cell B2.)

2. C. pr(a $\leq X \leq$ b)

Example: Find pr($5 \leq X \leq 11$) where $X \sim$ Normal($\mu = 7$, $\sigma = 6$)

Note: pr($5 \leq X \leq 11$) = pr($X \leq 11$) – pr($X \leq 5$)

1. Evaluate pr($X \leq 11$) in cell C1 (use steps in section A. above.).

2. Evaluate pr($X \leq 5$) in cell C2 (use steps in section A. above).

3. In cell C3, type: **=C1 – C2**.

4. Press **Enter**. (The value of 0.378 should appear in cell C3.)

Note:

Another way to calculate Normal probabilities is to type the function "=NORMDIST(x, μ, σ, c)" directly into a cell, where:

- x is the value for which we want the distribution.
- μ is the mean of the distribution.
- σ is the standard deviation of the distribution
- c is always set the value at 1.

For example:

To evaluate pr($X \leq 5$): In cell A1, type: **=NORMDIST(5, 7, 6, 1)**.

To evaluate pr($X \geq 9$): In cell B1, type: **=NORMDIST(9, 7, 6, 1)**
In cell B2, type: **1 – B1**.

To evaluate pr($5 \leq X \leq 11$): In cell C1, type: **=NORMDIST(11, 7, 6, 1)**.
In cell C2, type: **=NORMDIST(5, 7, 6, 1)**.
In cell C3, type: **C1 – C2**.

	A	B	C
1	=NORMDIST(5,7,6,1)	=NORMDIST(9,7,6,1)	=NORMDIST(11,7,6,1)
2		=1-B1	=NORMDIST(5,7,6,1)
3			=C1-C2

Figure 3

Calculating the Inverse of the Normal Distribution

Sometimes the x-value for a specified probability is required.

Example: What mark would a student have to get more than, in order to be in the top 25% of the class, if the mean mark was 65 out of 100 and the standard deviation is 9.

1. Click in cell A1.

2. Click the **Paste Function** button from the tool bar.

3. Choose **Statistical** from the **Function category** list box in the **Paste Function** dialog box.

4. Choose **NORMINV** from the **Function name** list box (Figure 4).

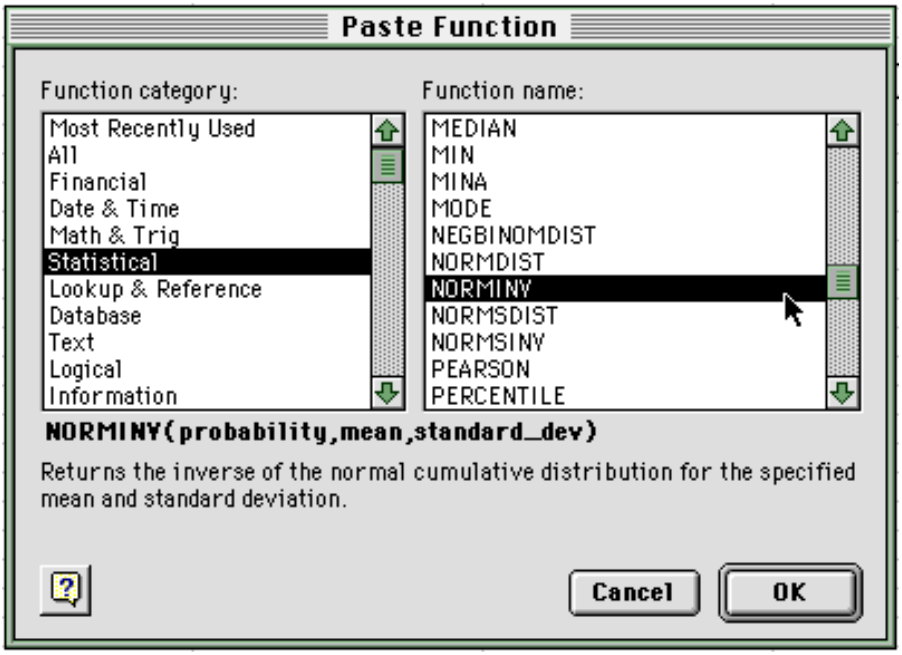


Figure 4

5. Click **OK**.

6. Fill in the **NORMINV** dialog box (Figure 5).

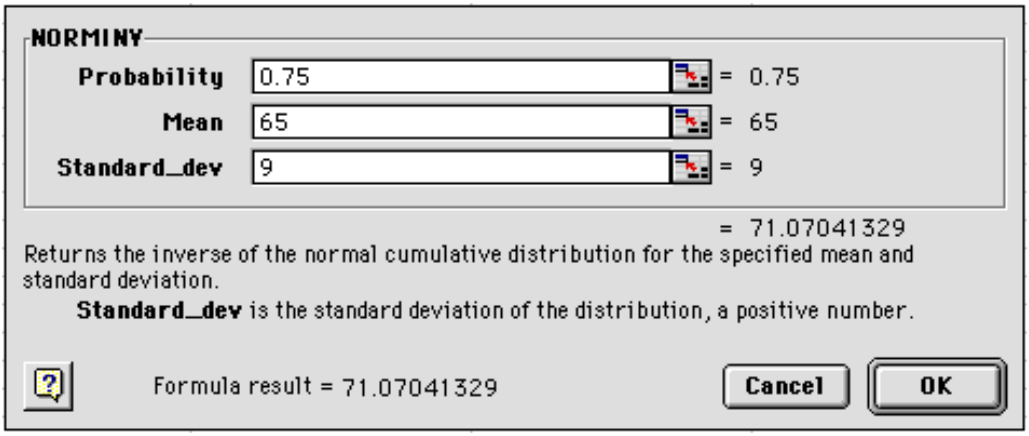


Figure 5

Note: the Excel function **NORMINV** determines the *x*-value for the probability that is to the left of the required *x*-value. In this example we want the *top* 25% therefore we use 1 - 0.25, or 0.75 for the probability. If instead we wanted the *bottom* 25% the probability is 0.25.

7. Click **OK**. (The value of 71.0704 should appear in cell A1.)

Note:

The formula can be directly entered into the cell by typing "=NORMINV(p, μ, σ)", where:

p is the probability to the left of the x-value being calculated

μ is the mean of the distribution

σ is the standard deviation of the distribution

Note:

Excel has two other functions that work in the same manner as the functions explained above. These two functions are **NORMSDIST** and **NORMSINV**. These two functions calculate the value for a standard normal distribution, ie. $X \sim$ Normal(0, 1).

Generating Random Samples

Example:
Generate a random sample of 20 numbers that are Normally distributed with mean,μ=3, and standard deviation,σ=1.5.

1. Make A1 the active cell. On the menu bar Click **Edit ŁData Analysis**

2. The **Data Analysis** dialog box is brought up. Select **Random Number Generation** as shown in Figure 1 below. Click **OK**.

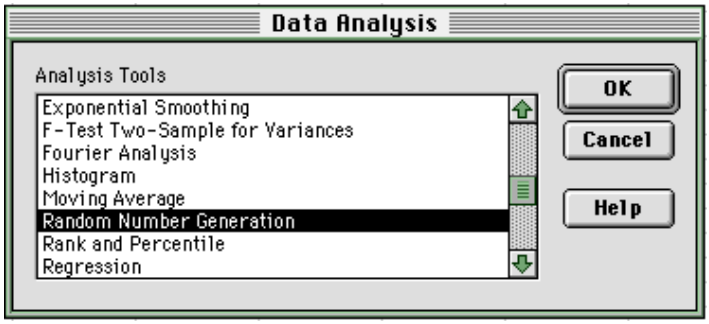


Figure 1

3. The **Random Number Generation** dialog box appears. The **Number of variables** is **1**. The **Number of random numbers** is **20**, and use your **ID number** as the **Random seed**. The **Distribution** is the **Normal** distribution with a **Mean** of **3** and **Standard deviation** of **1.5**. The **Output range** is **A1**.

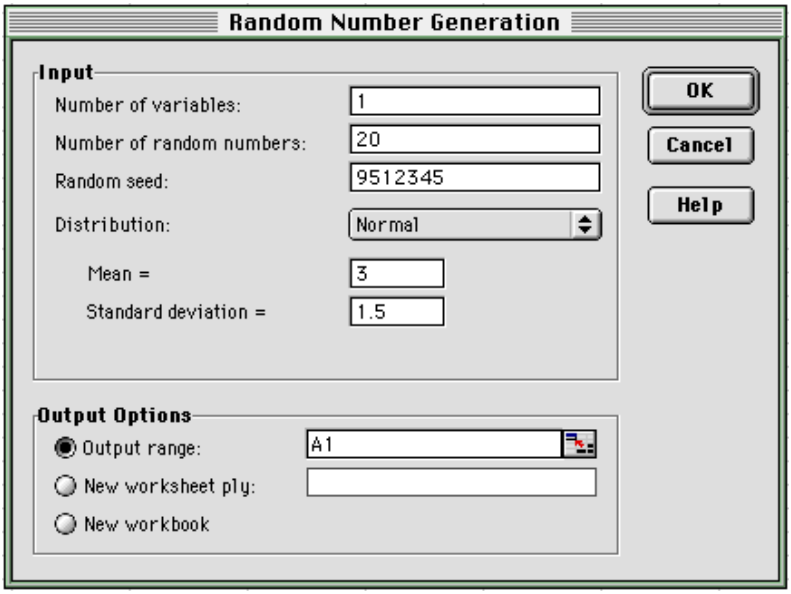


Figure 2

4. There should be 20 numbers in cells A1:A20. The same tool can be used to generate random samples from the Poisson and the Binomial distributions.

5. To generate 20 numbers from a Binomial distribution with 10 trials and a probability of success equal to 0.25, fill in the Random Number Generation dialog box as seen below in Figure 3.

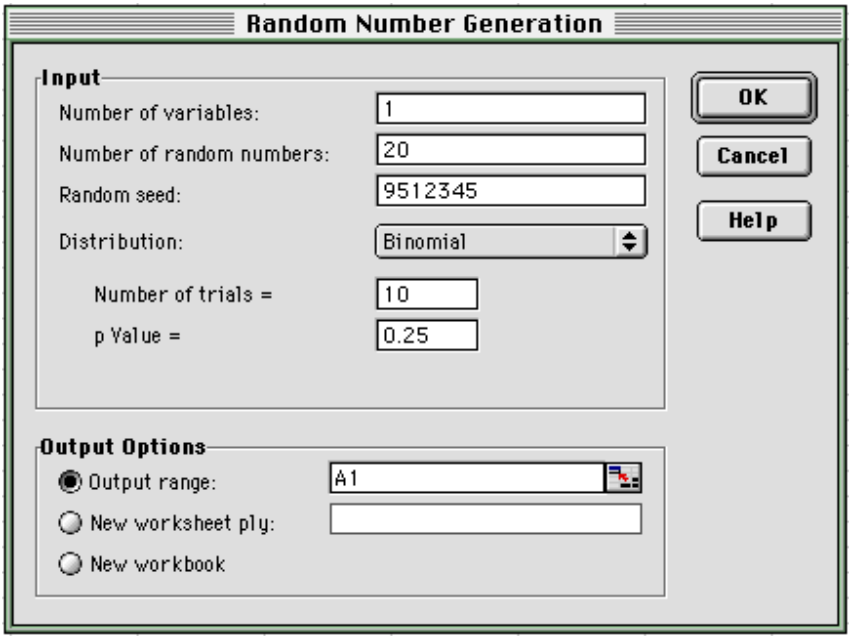


Figure 3

6. To generate 20 numbers that come from a Poisson distribution with lambda equal to 2, fill in the Random Number Generation dialog box as shown below.

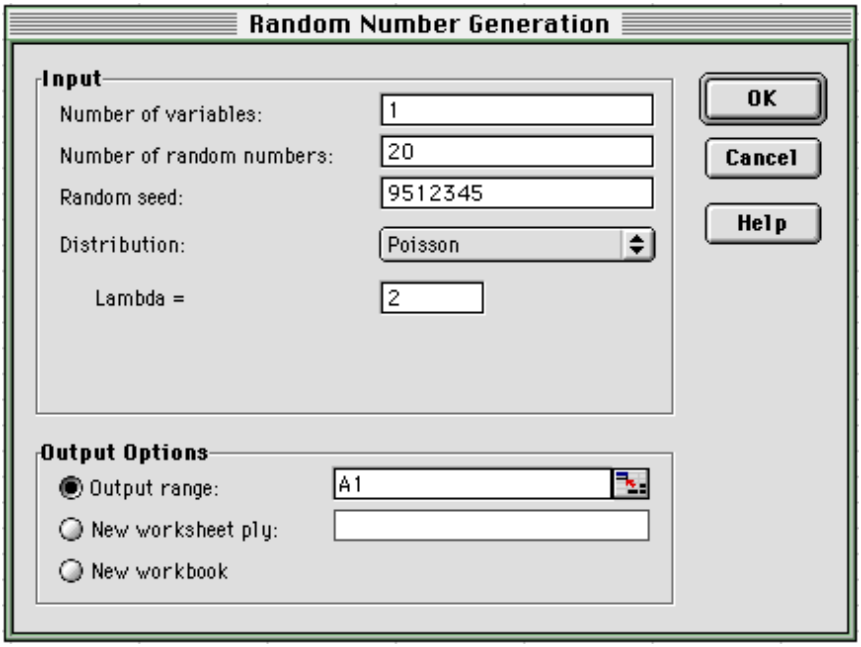


Figure 3

Example:
To investigate the distribution of the sample mean we will use *Excel* to simulate the rolling of a fair six-sided die. We will find the average (mean) outcome in a sample consisting of 4 throws. We will repeat this 300 times giving us 300 samples from which we will have 300 sample means. We will also use *Excel* to calculate some summary statistics and to construct a histogram of these 300 sample means.

1. Enter the headings shown below in Figure 1 into an *Excel* worksheet.

	A	B	C	D	E	F	G	H
1	Sample	Outcomes				Sample Means		
2	Number	1st Roll	2nd Roll	3rd Roll	4th Roll			

Figure 1

2. Enter **1** in cell A3 and **2** in cell A4. Highlight these two cells. Move the mouse cursor over the black box in the bottom right hand corner of the highlighted cells so that a black plus sign is seen, as shown in Figure 2. Hold the mouse buttom down and drag down to cell A302.

	A	B
1	Sample	
2	Number	1st Roll
3	1	
4	2	
5		

Figure 2

3. In cells A3:A302 should be the numbers 1-300.

4. In cell B3 enter the formula **=TRUNC(RAND()*6+1)**

5. In the same manner as Step 2 above, drag the formula in cell B3 across cells C3, D3 to E3. This can be seen in Figure 3.

	A	B	C	D	E
1	Sample	Outcomes			
2	Number	1st Roll	2nd Roll	3rd Roll	4th Roll
3	1	=TRUNC(RAND()*6+1)	=TRUNC(RAND()*6+1)	=TRUNC(RAND()*6+1)	=TRUNC(RAND()*6+1)

Figure 3

6. Enter the formula **=AVERAGE(B3:E3)** in cell G3. (See Figure 4.)

F	G
	Sample Means
	=AVERAGE(B3:E3)

Figure 4

7. Select cells B3:G3. Using the method in Step 2, drag the formulas in the selected cells down to row 302. The first few rows will look similar to the figure below. The values should be different due to the fact that a random number generator is being used.

	A	B	C	D	E	F	G	H
1	Sample	Outcomes					Sample Means	
2	Number	1st Roll	2nd Roll	3rd Roll	4th Roll			
3	1	6	1	4	5		4	
4	2	5	3	3	3		3.5	
5	3	2	6	2	6		4	
6	4	1	2	4	5		3	
7	5	4	5	3	5		4.25	
8	6	6	5	5	6		5.5	
9	7	3	4	1	2		2.5	
10	8	6	4	5	1		4	

Figure 5

8. Set up the heading in the cells shown below in figure 6.

	I	J	K	L	M
1	Mean	Frequency		Summary Statistics	
2				Mean	
3				Std Dev	
4					

Figure 6

9. In cell M2 enter the formula **=AVERAGE(G3:G302)** and in cell M3 enter the formula **=STDEV(G3:G302)** (Figure 7.)

	L	M
1	Summary Statistics	
2	Mean	=AVERAGE(G3:G302)
3	Std Dev	=STDEV(G3:G302)

Figure 7

10. Enter **1** and **1.25** in cells I2 and I3 respectively. Highlight cells I2and I3. In the same manner as that described in Step 2, drag the values down to cell I22, so that the worksheet looks like the figure below.

	I	J
1	Mean	Frequency
2	1	
3	1.25	
4	1.5	
5	1.75	
6	2	
7	2.25	
8	2.5	
9	2.75	
10	3	
11	3.25	
12	3.5	
13	3.75	
14	4	
15	4.25	
16	4.5	
17	4.75	
18	5	
19	5.25	
20	5.5	
21	5.75	
22	6	

Figure 8

11. Select cells J2:J22. Type **=FREQUENCY(G3:G302,I2:I22)** while the cells are still selected, but ***do not press the Enter key***. Then while holding down the **Shift** and the **Control** key, press the **Enter** key. The selected cells will now contain the counts (yours will be different) of the corresponding mean in column I, as seen in Figure 9.

	I	J
1	Mean	Frequency
2	1	0
3	1.25	0
4	1.5	2
5	1.75	10
6	2	4
7	2.25	13
8	2.5	17
9	2.75	24
10	3	36
11	3.25	33
12	3.5	34
13	3.75	38
14	4	26
15	4.25	20
16	4.5	24
17	4.75	7
18	5	6
19	5.25	5
20	5.5	0
21	5.75	1
22	6	0

Figure 9

12. Highlight cells J2:J22. Click the **Chart Wizard** button  . The **Chart Wizard** dialog box pops up. Choose the **Column Chart type** and the **Chart sub-type** indicated in the Figure 10 below. Click **Next**.

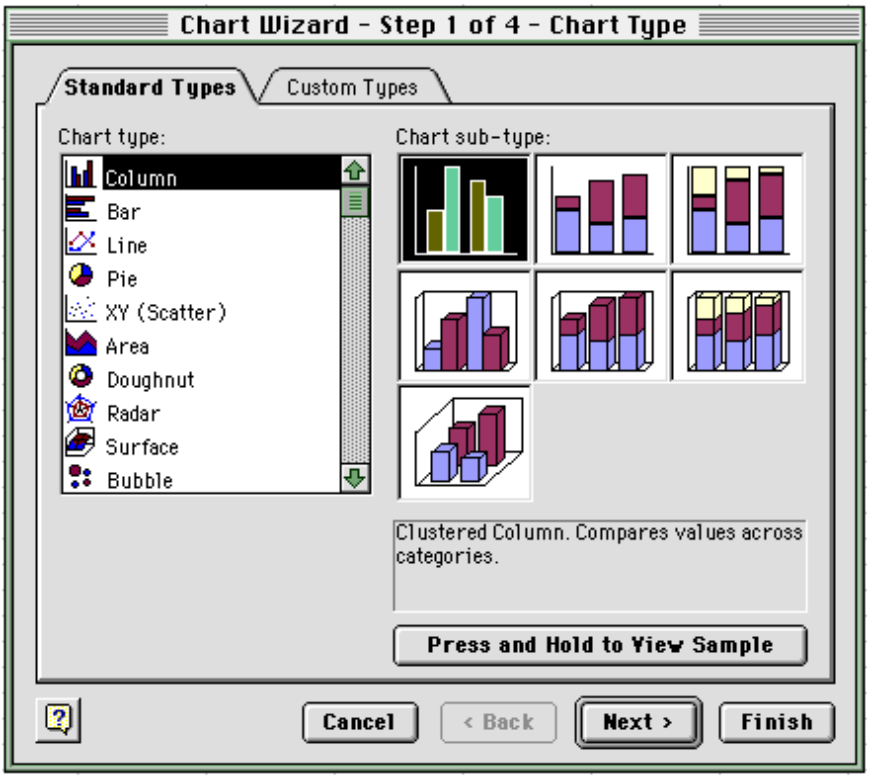


Figure 10

13. The next **Chart Wizard** dialog box appears. Click on the **Series** tab. In the **Category (X) axis labels** box type **=Sheet1!$I$2:$I$22** Click Next.

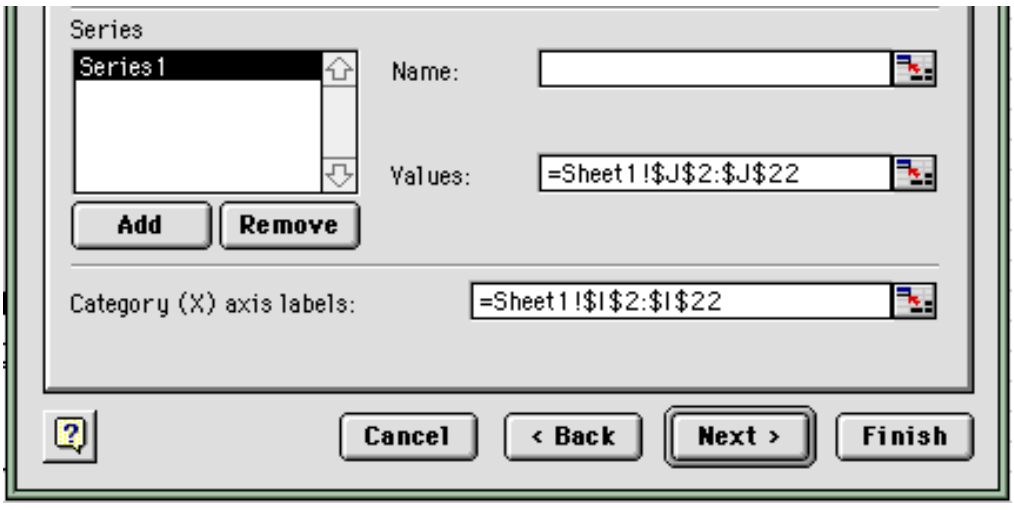


Figure 11

14. Another **Chart Wizard** dialog box is brought up (Figure 12). The **Chart title** is **Distribution of Sample Means**, the **Category (X) axis** is **Sample Mean**, and the **Value (Y) axis** is **frequency**. Remove the Gridlines and the Legend. Click **Next**.

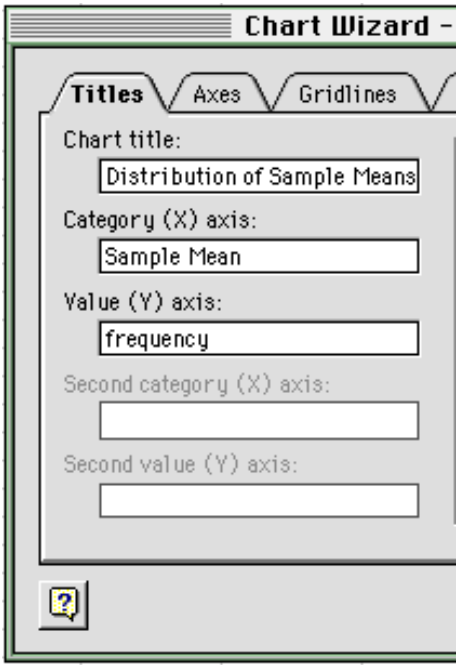


Figure 12

15. The last dialog box is shown. Ensure that the chart will be put on the current sheet. Then click **Finish**.

Calculating Student *t*-Probabilities

A. Upper tail probabilities: pr($T \geq t$)

Example: Find pr($T \geq 2$) where $T \sim$ Student($df = 9$)

1. Click in cell A1.
2. Click the **Paste Function** button  from the tool bar.
3. Choose **Statistical** from the **Function category** list box in the **Paste Function** dialog box.
4. Choose **TDIST** from the **Function name** list box (Figure 1).

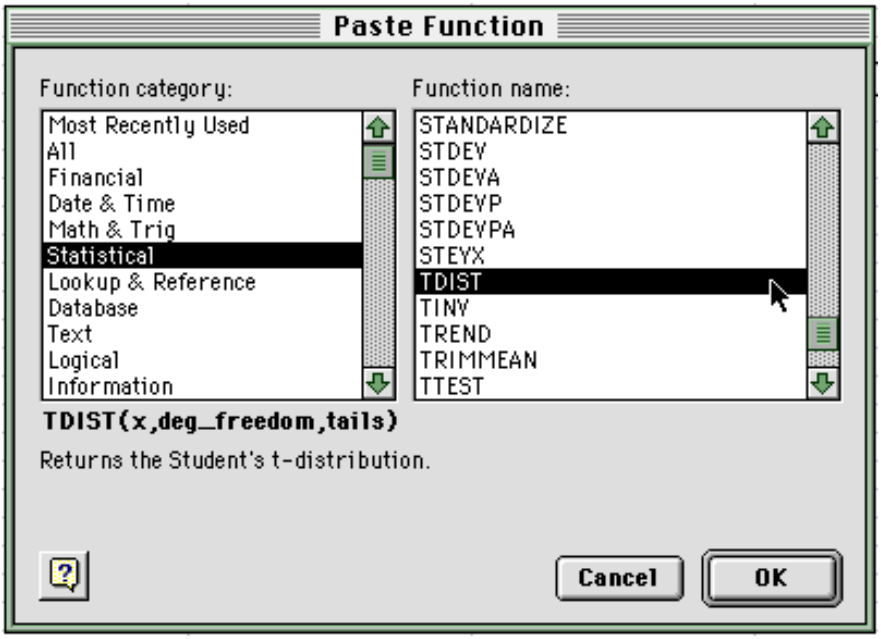


Figure 1

5. Click **OK**.
6. Fill in the **TDIST** dialog box (Figure 2).

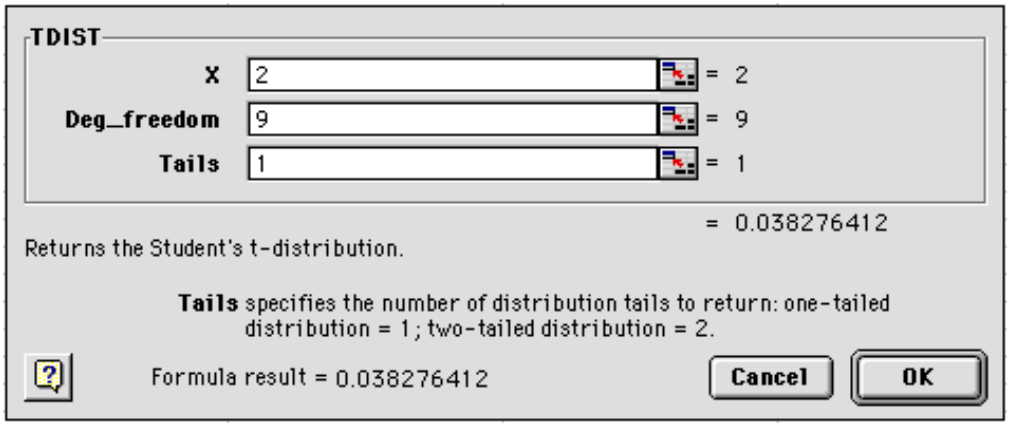


Figure 2

where:

X is the value for which we want the distribution. It is equivalent to *t* in our manual. In this example, we put 2 in this box.

Deg_freedom is the number of degrees of freedom. In this example, we put 29 in this box.

Tails is the number of tails required either 1 or 2. In this example, we put 1 in this box.

7. Click **OK**. (The value of 0.038 should appear in cell A1.)

B . Lower tail probabilities: pr($T \leq t$)

Example: Find pr($T \leq 1$) where $T \sim$ Student($df = 9$)

Note: pr($T \leq 1$) = 1 – pr($T \geq 1$)

1. Evaluate pr($T \geq 1$) in cell B1 (use steps in section A. above.).

2. In cell B2, type: **=1 – B1**.

3. Press **Enter**. (The value of 0.828 should appear in cell B2.)

3. C . pr(a $\leq T \leq$ b)

Example: Find pr($0 \leq T \leq 1$) where $T \sim$ Student($df = 9$)

Note: pr($0 \leq T \leq 1$) = pr($T \geq 0$) – pr($T \geq 1$)

1. Evaluate pr($T \geq 0$) in cell C1 (use steps in section A. above.).

2. Evaluate pr($T \geq 1$) in cell C2 (use steps in section A. above.).

3. In cell C3, type: **=C1 – C2**.

4. Press **Enter**. (The value of 0.328 should appear in cell C3.)

Note:

Another way to calculate Student *t*-probabilities is to type the function "=TDIST(*x*, *df*, *tails*)" directly into a cell, where:

x is the value for which we want the distribution.

df is the number of degrees of freedom of the distribution.

tails specifies whether one tail or two tails are to be calculated

For example:

To evaluate pr($X \leq 2$): In cell A1, type: **=TDIST(2, 9, 1)**.

To evaluate pr($X \geq 1$): In cell B1, type: **=TDIST(1, 9, 1)**
In cell B2, type: **1 – B1**.

To evaluate pr($0 \leq X \leq 1$): In cell C1, type: **=TDIST(0, 9, 1)**.
In cell C2, type: **=TDIST(1, 9, 1)**.
In cell C3, type: **C1 – C2**.

	A	B	C
1	=TDIST(2,9,1)	=TDIST(1,9,1)	=TDIST(0,9,1)
2		=1-B1	=TDIST(1,9,1)
3			=C1-C2

Figure 3

Calculating the Inverse of the Student *t*-distribution

Example: Find the *t*-value $t_{30}(0.025)$ ie. Probability 0.025 and 30 degrees of freedom for use in a 95% confidence interval as the *t*-multiplier.

1. Click on cell A1.
2. Click the **Paste Function** button from the tool bar.
3. Choose **Statistical** from the **Function category** list box in the **Paste Function** dialog box.
4. Choose **TINV** from the **Function name** list box (Figure 4).

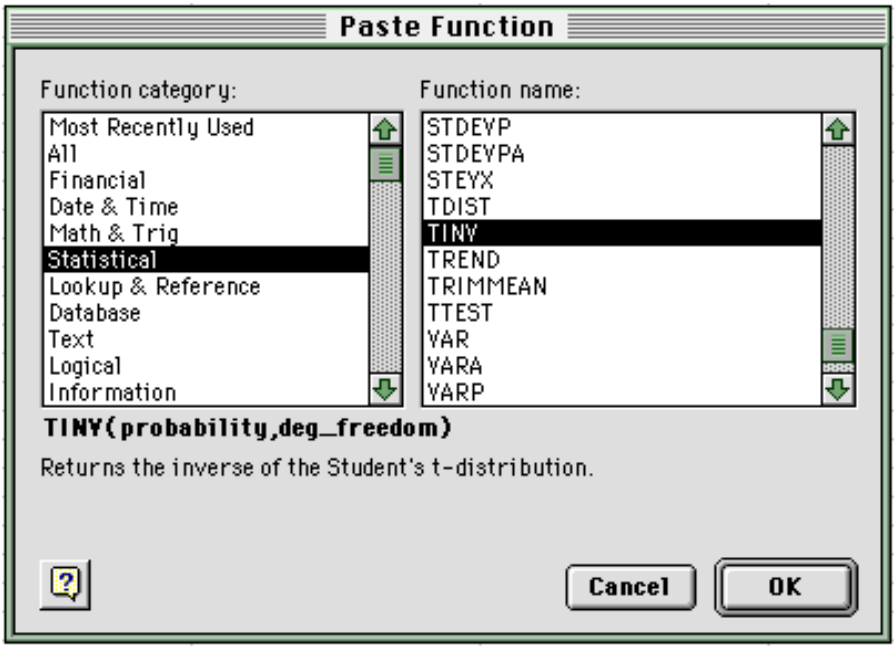


Figure 4

5. Click **OK**
6. Fill in the **TINV** dialog box (figure 5).

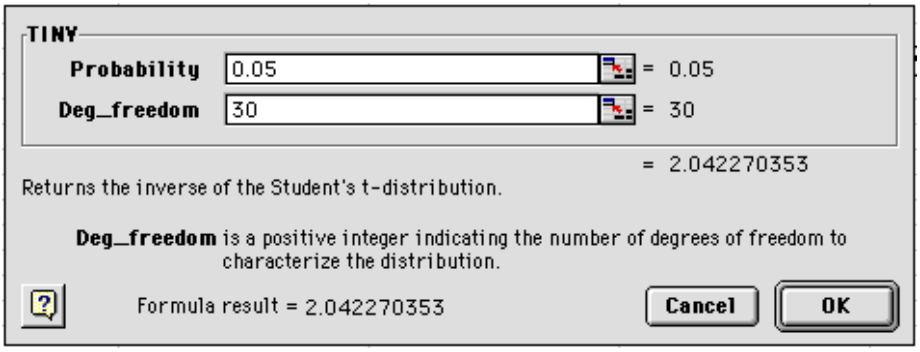


Figure 5

Note:

The *Excel* function **TINV** calculates the *t*-value for two–tailed *t*-distribution. So if we want to find the *t*-value whose probability to the right is 0.1, then in the **TINV** function the value for the probability is entered as 0.2, because of the two-tailed nature of the function.

7. Click **OK**. (The value 2.042 should appear in cell A1.)

Note:

The examples can be solved by directly typing the formula "=TINV(*p*, *df*)" into the cell, where:

p is the probability for the two-tailed distribution

df is the number of degrees of freedom for the distribution

t-Test of Means for Two Independent Samples

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

1. Enter the data into *Excel* as shown in Figure 1 below.

	A	B
1	heterosexual	homosexual
2	3.9	2.5
3	4	1.6
4	3.8	3.9
5	3.9	3.4
6	2.9	2.3
7	3.2	1.6
8	4.6	2.5
9	4.3	3.4
10	3.1	1.6
11	2.7	4.3
12	2.3	2
13		1.8
14		2.2
15		3.1
16		1.3

Figure 1

2. From the menu bar select **Tools ł Data Analysis...**

3. Select the **t-Test: Two-Sample Assuming Unequal Variances** from the **Analysis Tools** list box seen in Figure 2.

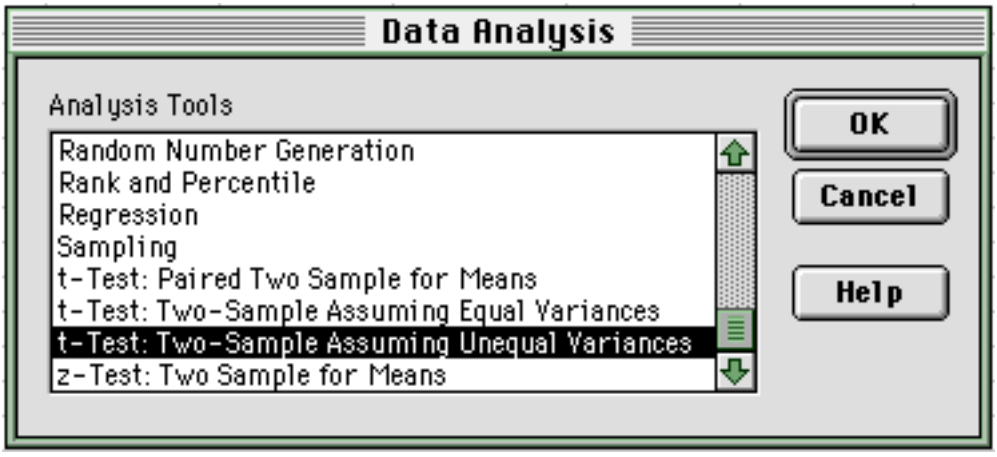


Figure 2

4. Click **OK**.

5. The dialog box below is brought up. In the **Variable 1 range** box enter **A1:A12**, and in the **Variable 2 range** box enter **B1:B16**. The **Hypothesized mean difference** is 0. Mark the **Labels** checkbox. And the **Output range** is **A20**.

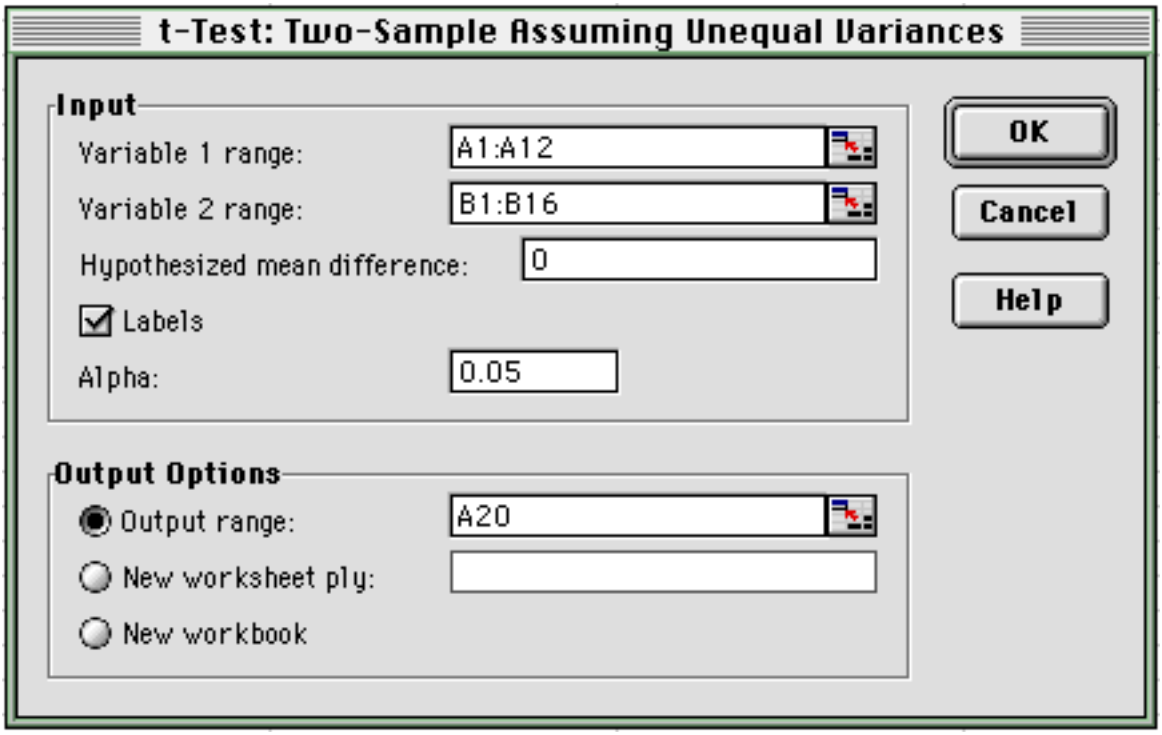


Figure 3

6. Click **OK**. The results will appear on the worksheet as in Figure 4.

	A	B	C
20	t-Test: Two-Sample Assuming Unequal Variances		
21			
22		*heterosexual*	*homosexual*
23	Mean	3.51818182	2.5
24	Variance	0.51963636	0.85142857
25	Observations	11	15
26	Hypothesized Mean Difference	0	
27	df	24	
28	t Stat	3.1572239	
29	P(T<=t) one-tail	0.00212947	
30	t Critical one-tail	1.71088232	
31	P(T<=t) two-tail	0.00425893	
32	t Critical two-tail	2.06389814	

Figure 4

t-Test of Means for Paired Data

Example:
Perform a *t*-test on the Airforce Headsizes Data. (Refer to Example 10.1.3 in your textbook.)

1. Enter the data seen in Figure 1 into *Excel*.

	A	B	C
1	recruit	cardboard	metal
2	1	146	145
3	2	151	153
4	3	163	161
5	4	152	151
6	5	151	145
7	6	151	150
8	7	149	150
9	8	166	163
10	9	149	147
11	10	155	154
12	11	155	150
13	12	156	156
14	13	162	161
15	14	150	152
16	15	156	154
17	16	158	154
18	17	149	147
19	18	163	160

Figure 1

2. From the menu bar select **Tools ł Data Analysis...**

3. The **Data Analysis** dialog box is brought up. From the **Analysis Tools** list box select **t-Test: Paired Two Sample for Means**.(See Figure 2). Click **OK**.

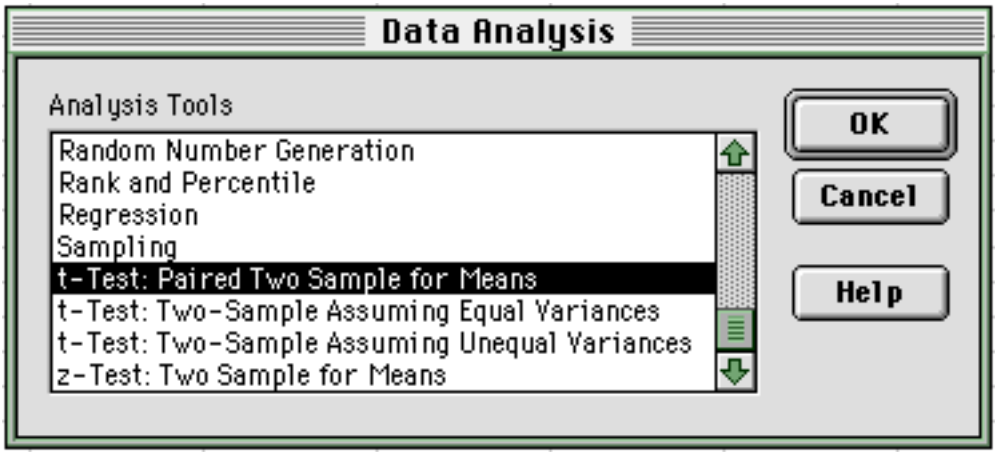


Figure 2

4. The following dialog box is shown (Figure 3). In the **Variable 1 range** box enter **B1:B19**, and in the **Variable 2 range** box enter **C1:C19**. Mark the **Labels** checkbox. The **Hypothesized mean difference** is 0. The **Output range** is **A23**.

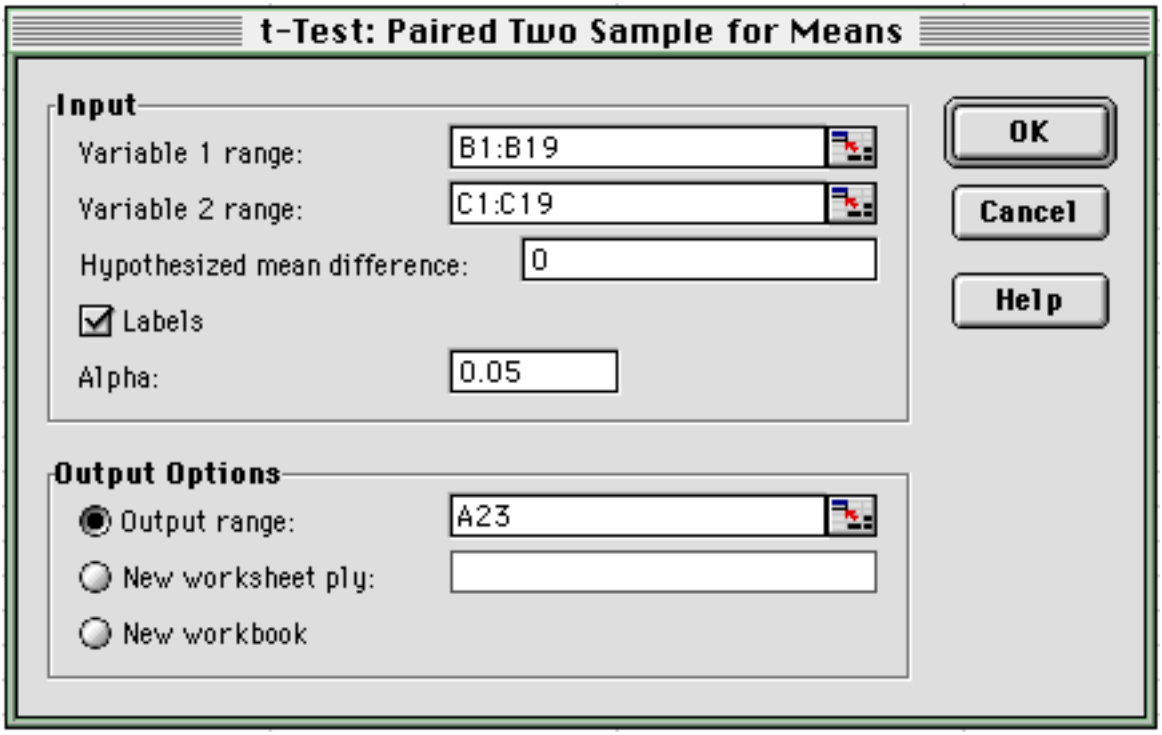


Figure 3

5. Click **OK**. The results will appear as in Figure 4 below.

	A	B	C
23	t-Test: Paired Two Sample for Means		
24			
25		*cardboard*	*metal*
26	Mean	154.555556	152.944444
27	Variance	33.9084967	30.6437908
28	Observations	18	18
29	Pearson Correlation	0.92985902	
30	Hypothesized Mean Difference	0	
31	df	17	
32	t Stat	3.1854219	
33	P(T<=t) one-tail	0.00270736	
34	t Critical one-tail	1.73960643	
35	P(T<=t) two-tail	0.00541472	
36	t Critical two-tail	2.10981852	

Figure 4

Example: Construct one-way ANOVA table for the Cancer Data.

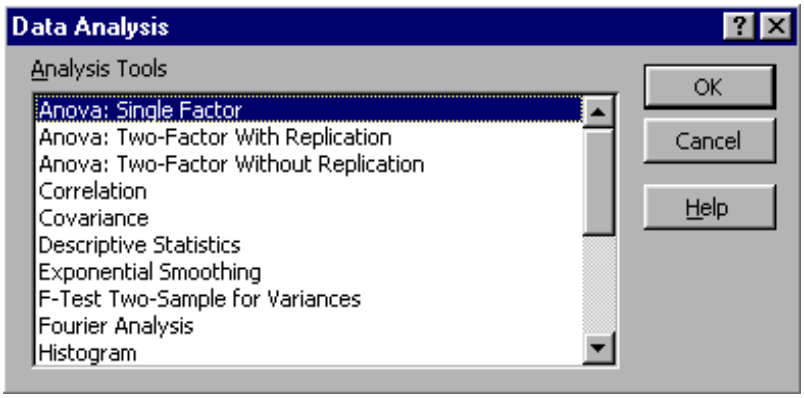
1. Enter the information as Figure 1 below.

	A	B	C
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

4. Figure 1

2. From the Menu bar, select **Tool – Data Analysis**.

3. Choose **Anova: Single Factor** from the **Data Analysis** dialog box. (Figure 2)



5. Figure 2

4. Click **OK**.

5. In the **Input** box, we set:

Input Range:	A1:C11
Grouped By:	Columns
Label in First Row	√
Alpha:	0.05

6. In the **Output options**, choose **New Worksheet Ply**. The ANOVA table will be produced on a new worksheet. The **Anova: Single Factor** dialog box should look like Figure 3.

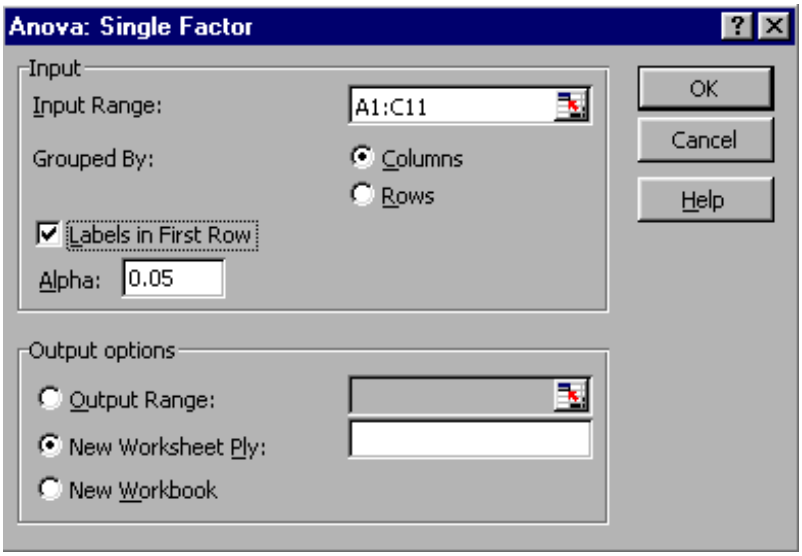


Figure 3

7. Click **OK**. The ANOVA table in Figure 4 should appear on a new worksheet.

	A	B	C	D	E	F	G
1	Anova: Single Factor						
2							
3	SUMMARY						
4	*Groups*	*Count*	*Sum*	*Average*	*Variance*		
5	Stomach	10	11.2	1.12	1.987022		
6	Bronchus	10	15.25	1.525	1.651094		
7	Colon	10	21.03	2.103	1.419312		
8							
9							
10	ANOVA						
11	*rce of Varia*	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
12	Between G	4.881327	2	2.440663	1.447769	0.25277	3.354131
13	Within Gro	45.51686	27	1.68581			
14							
15	Total	50.39819	29				

Figure 4

Chi-square Test

One-Dimensional Tables

Example: Perform a Chi-square test for goodness of fit on the Rolls of a Die Data. (Refer to example 11.1.1 in your textbook.)

1. Enter the data into *Excel* as done in Figure 1. Also enter the formula **=SUM(B2:B7)** into cell B8.

	A	B
1	outcome	count
2	1	26
3	2	40
4	3	37
5	4	26
6	5	43
7	6	38
8		=SUM(B2:B7)

Figure 1

2. Enter **expected** into cell C1. Then enter the formula **=$B$8/6** into cells C2:C7.

C
expected
=$B$8/6
=$B$8/6
=$B$8/6
=$B$8/6
=$B$8/6
=$B$8/6

Figure 2

3. In cell A10 type **=CHITEST(B2:B7,C2:C7)** as seen in Figure 3.

9	
10	=CHITEST(B2:B7,C2:C7)
11	

Figure 3

4. Once all the formulas have been entered, the *Excel* worksheet will look like the figure below. Cell A10 contains the *P-value* for the goodness of fit test.

	A	B	C
1	outcome	count	expected
2	1	26	35
3	2	40	35
4	3	37	35
5	4	26	35
6	5	43	35
7	6	38	35
8		210	
9			
10	0.18329453		

Figure 4

Two-Dimensional Tables

Example:
Perform a Chi-square test of homogeneity on the Phenotype Regional Data. The method described below can also be used to perform a test of independence. (Refer to example 11.2.2 in your textbook.)

	Phenotype				
Region	A	B	O	AB	Totals
Nithsdale	98	35	115	5	253
Cree	38	9	79	6	132
Rhinns	36	9	47	7	99
Totals	172	53	241	18	484

1. Enter the above data into *Excel* in the manner shown in the figure below.

	A	B	C	D	E	F
1	observed	A	B	O	AB	Totals
2	Nithsdale	98	35	115	5	253
3	Cree	38	9	79	6	132
4	Rhinns	36	9	47	7	99
5	Totals	172	53	241	18	484

Figure 5

2. In cells B8:E10, enter the formulas seen below.

7	expected	A	B	O	AB
8	Nithsdale	=($F$2*B5)/$F$5	=($F$2*C5)/$F$5	=($F$2*D5)/$F$5	=($F$2*E5)/$F$5
9	Cree	=($F$3*B$5)/$F$5	=($F$3*C$5)/$F$5	=($F$3*D$5)/$F$5	=($F$3*E$5)/$F$5
10	Rhinns	=($F$4*B$5)/$F$5	=($F$4*C$5)/$F$5	=($F$4*D$5)/$F$5	=($F$4*E$5)/$F$5

Figure 6

3. The results will then be displayed in the worksheet as shown in Figure 7.

7	expected	A	B	O	AB
8	Nithsdale	89.9091	27.7045	125.977	9.40909
9	Cree	46.9091	14.4545	65.7273	4.90909
10	Rhinns	35.1818	10.8409	49.2955	3.68182

Figure 7

4. Select cell A13. Then on the tool bar click the **Paste Function** button  . The **Paste Function** dialog box is brought up. Choose **Statistical** from the **Function category** box, and then choose **CHITEST** from the **Function name** box. Click **OK**.

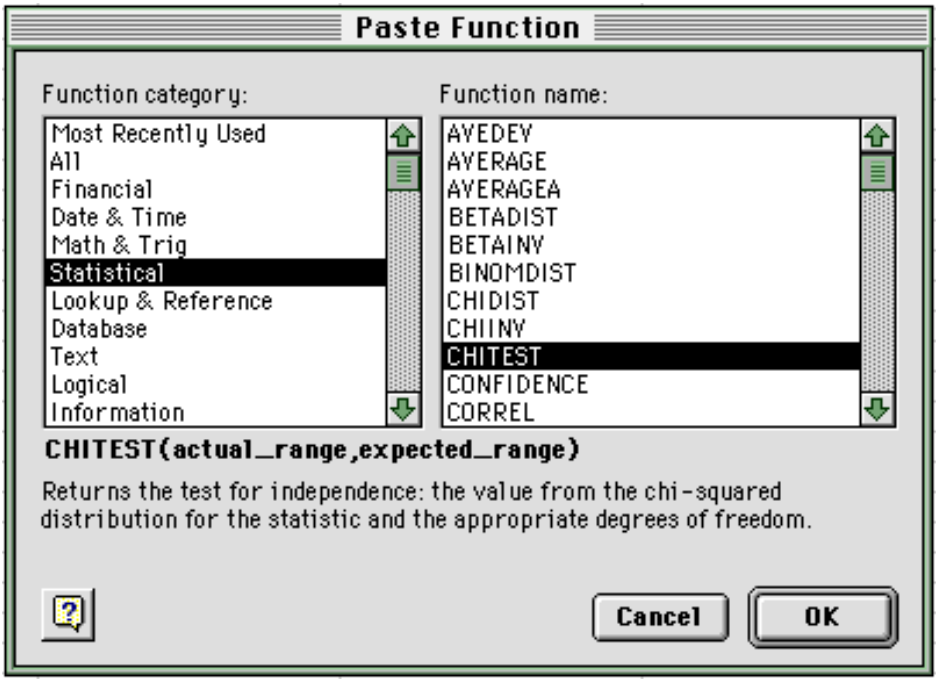


Figure 8

5. The **CHITEST** dialog box appears. The **Actual_range** is **B2:E4**, and the **Expected_range** is **B8:E10**. Click **OK**.

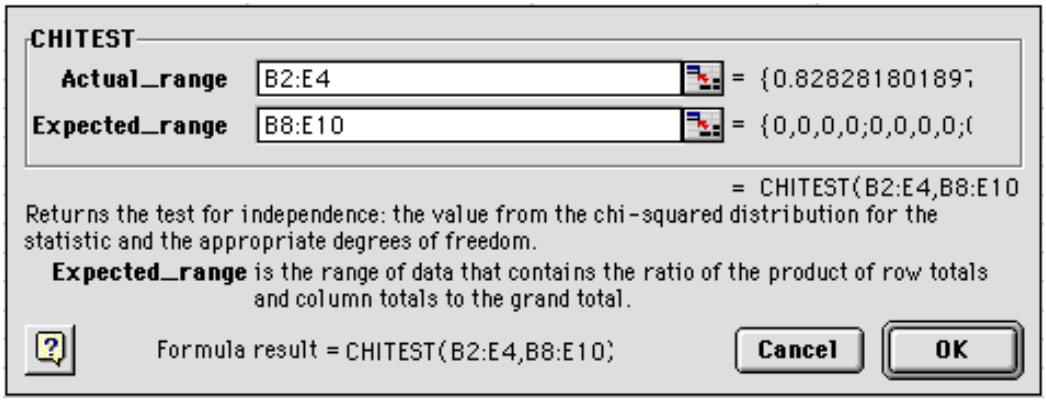


Figure 9

6. Finally the worksheet should look as in Figure 10. The *P-value* for the Chi-square test is found in cell A13 and the value is 0.015.

	A	B	C	D	E	F
1	observed	A	B	0	AB	Totals
2	Nithsdale	98	35	115	5	253
3	Cree	38	9	79	6	132
4	Rhinns	36	9	47	7	99
5	Totals	172	53	241	18	484
6						
7	expected	A	B	0	AB	
8	Nithsdale	89.9091	27.7045	125.977	9.40909	
9	Cree	46.9091	14.4545	65.7273	4.90909	
10	Rhinns	35.1818	10.8409	49.2955	3.68182	
11						
12						
13	0.0150207					

Figure 10

Simple Linear Regression

Example:
Perform simple linear regression on the Chernobyl Data. (Refer to example 3.1.1 in your textbook.)

1. Enter the Chernobyl data into *Excel* as seen in Figure 1.

	A	B
1	percent	radiation
2	2.2	23
3	2.4	20
4	1.9	22
5	3.9	29
6	3.6	32
7	2.6	21
8	0	16
9	4.2	37
10	5	44

Figure 1

2. From the menu bar choose **Tools** then the **Data Analysis** option.

3. The **Data Analysis** dialog box appears (See Figure 2). Select **Regression** and then click **OK**.

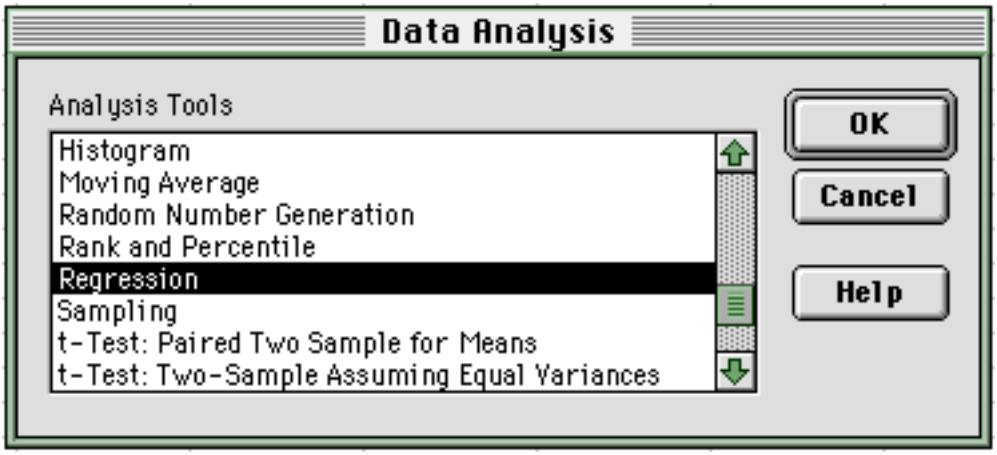


Figure 2

4. Fill in the **Regression** dialog box as shown in Figure 3 below. The **Input Y range** is **A1:A10**, and the **Input X range** is **B1:B10**. Mark the **Labels** checkbox. Mark the circle next to **New workbook** for the **Output Options**. Also mark the **Residual plots** checkbox.

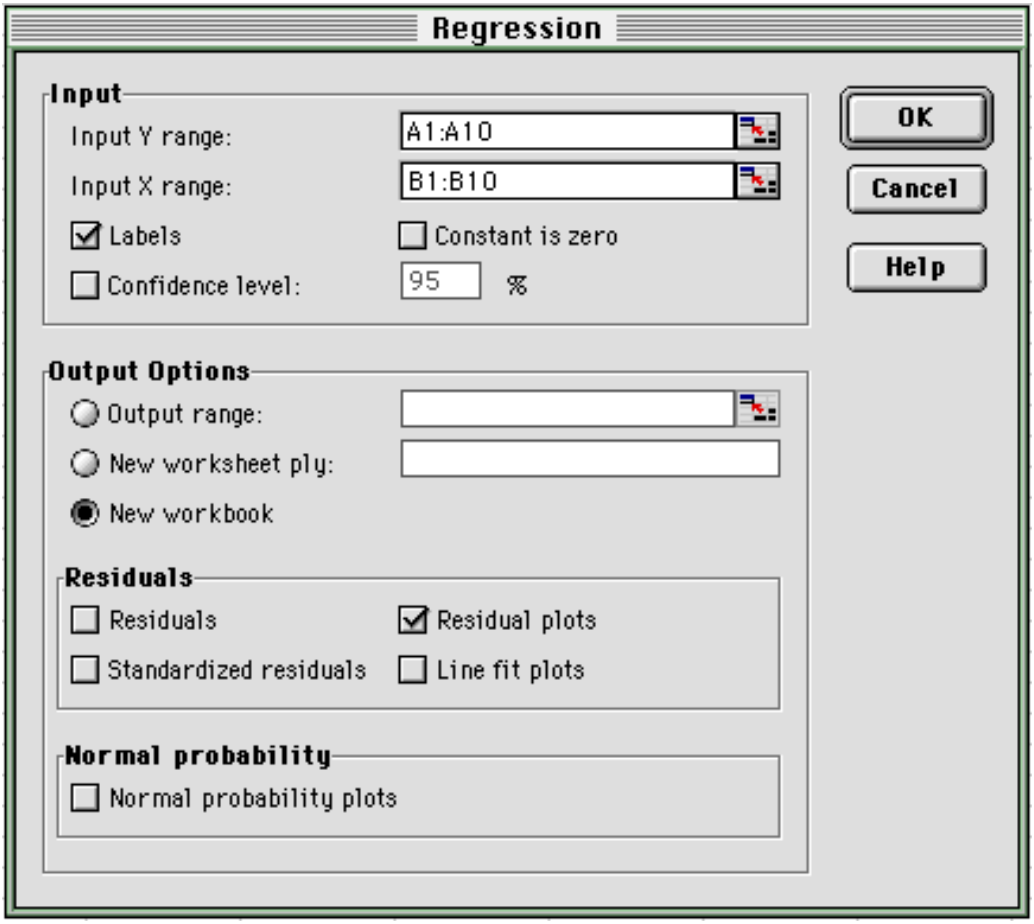


Figure 3

5. Click **OK**. The regression analysis tool produces the output seen below in Figure 4.

	A	B	C	D	E	F	G	H	I
1	SUMMARY OUTPUT								
2									
3	*Regression Statistics*								
4	Multiple R	0.91165222							
5	R Square	0.83110976							
6	Adjusted R Sq	0.80698259							
7	Standard Erro	0.65570289							
8	Observations	9							
9									
10	ANOVA								
11		*df*	*SS*	*MS*	*F*	*Significance F*			
12	Regression	1	14.810376	14.810376	34.4470379	0.00061847			
13	Residual	7	3.009624	0.42994629					
14	Total	8	17.82						
15									
16		*Coefficients*	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
17	Intercept	-1.1796123	0.72323094	-1.6310313	0.14690466	-2.8897805	0.5305559	-2.8897805	0.5305559
18	radiation	0.14924799	0.02542919	5.8691599	0.00061847	0.08911755	0.20937844	0.08911755	0.20937844

Figure 4

6. *Excel* also produces a Residual plot. This plot needs to be enlarged to look like the plot shown below in Figure 5.

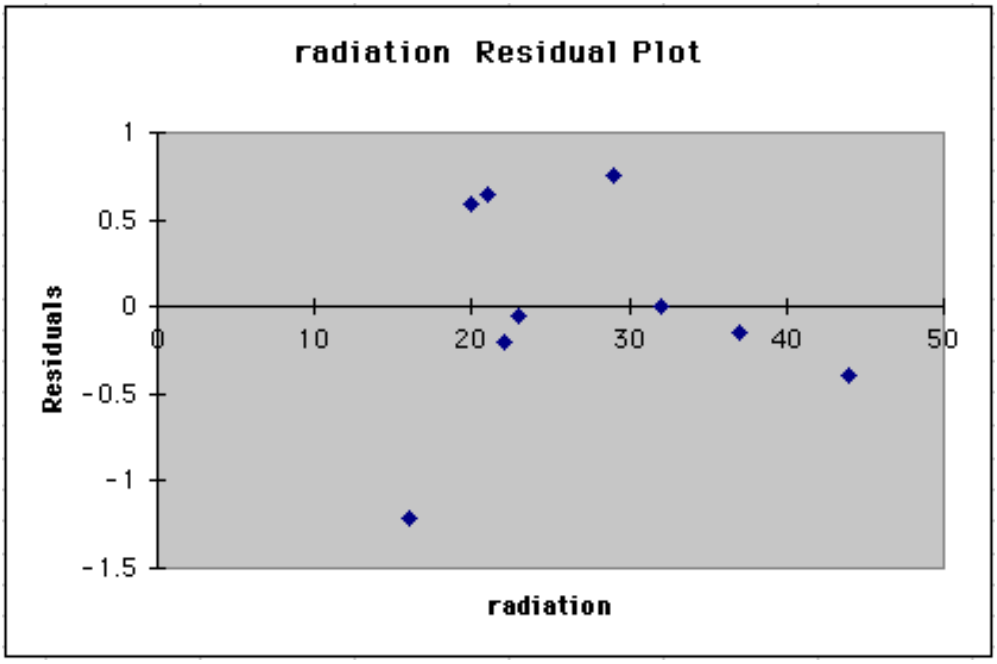


Figure 5

Note:

The Normal probability plots are not the plots we are looking for as they are not normal plots for the residuals. So we ignore this option.

Correlation

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

1. Enter the data into *Excel* as seen below in Figure 1.

	A	B
1	percent	radiation
2	2.2	23
3	2.4	20
4	1.9	22
5	3.9	29
6	3.6	32
7	2.6	21
8	0	16
9	4.2	37
10	5	44

Figure 1

2. From the menu bar select **Tools Ł Data Analysis...**

3. The **Data Analysis** dialog box is brought up. Select **Correlation** from the **Analysis Tools** list box seen in the figure below.

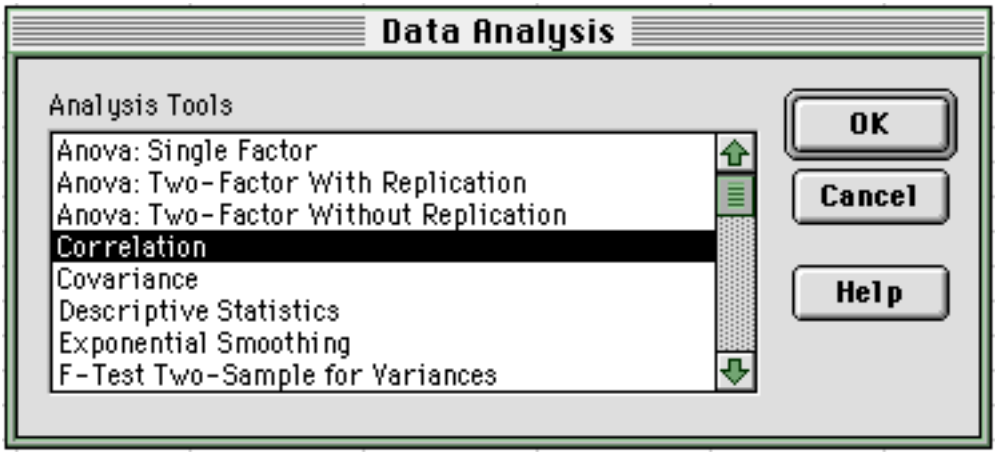


Figure 2

4. Click **OK**.

5. Then the **Correlation** dialog box is brought up. The **Input range** is **A1:B10**. Mark the check box for **Labels in the first row**, and ensure that the circle next to **Columns** is marked as well. The **Output range** is **A15**.

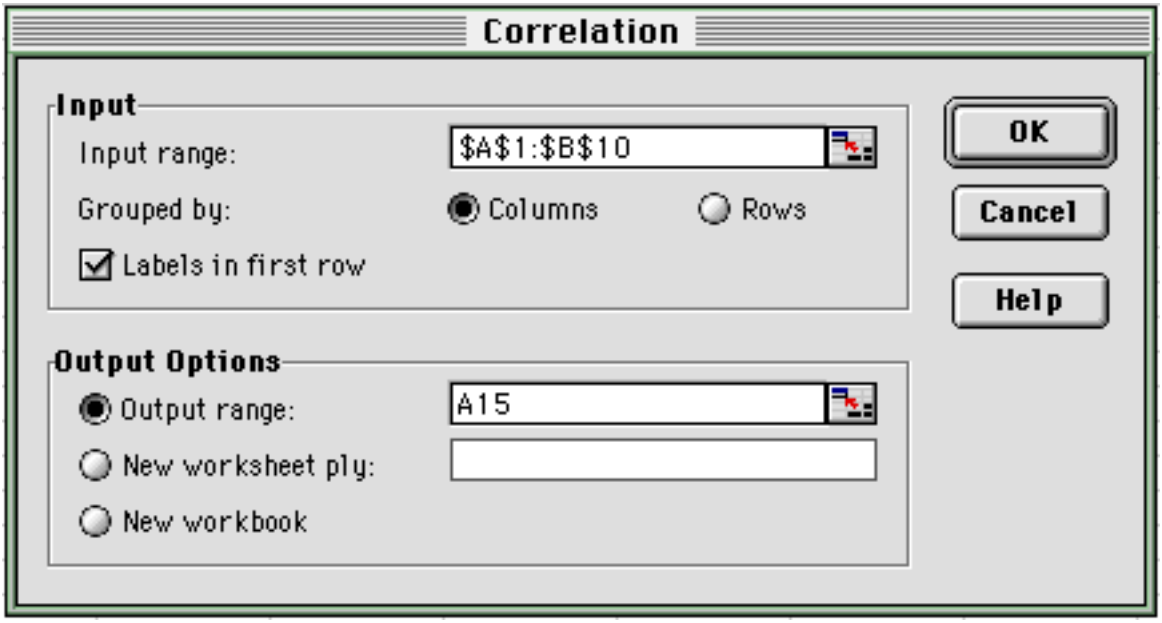


Figure 3

6. Click **OK**. The results that *Excel* outputs can be seen below in Figure 4.

		percent	*radiation*
15			
16	percent	1	
17	radiation	0.91165222	1

Figure 4

7. The sample correlation coefficient is contained in cell B17.

Copying and Pasting *Excel* into *Word*

It is useful to be able to include parts of a *Excel* spreadsheet or an *Excel* graph in a *Word* document as part of a report or assignment.

Example:
The *Excel* regression output and the graph below needs to be placed into a report.

	A	B	C	D	E	F	G
1	SUMMARY OUTPUT						
2							
3	*Regression Statistics*						
4	Multiple R	0.91165222					
5	R Square	0.83110976					
6	Adjusted R Sq	0.80698259					
7	Standard Erro	0.65570289					
8	Observations	9					
9							
10	ANOVA						
11		*df*	*SS*	*MS*	*F*	*Significance F*	
12	Regression	1	14.810376	14.810376	34.4470379	0.00061847	
13	Residual	7	3.009624	0.42994629			
14	Total	8	17.82				
15							
16		*Coefficients*	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
17	Intercept	-1.1796123	0.72323094	-1.6310313	0.14690466	-2.8897805	0.5305559
18	radiation	0.14924799	0.02542919	5.8691599	0.00061847	0.08911755	0.20937844
19							

Figure 1

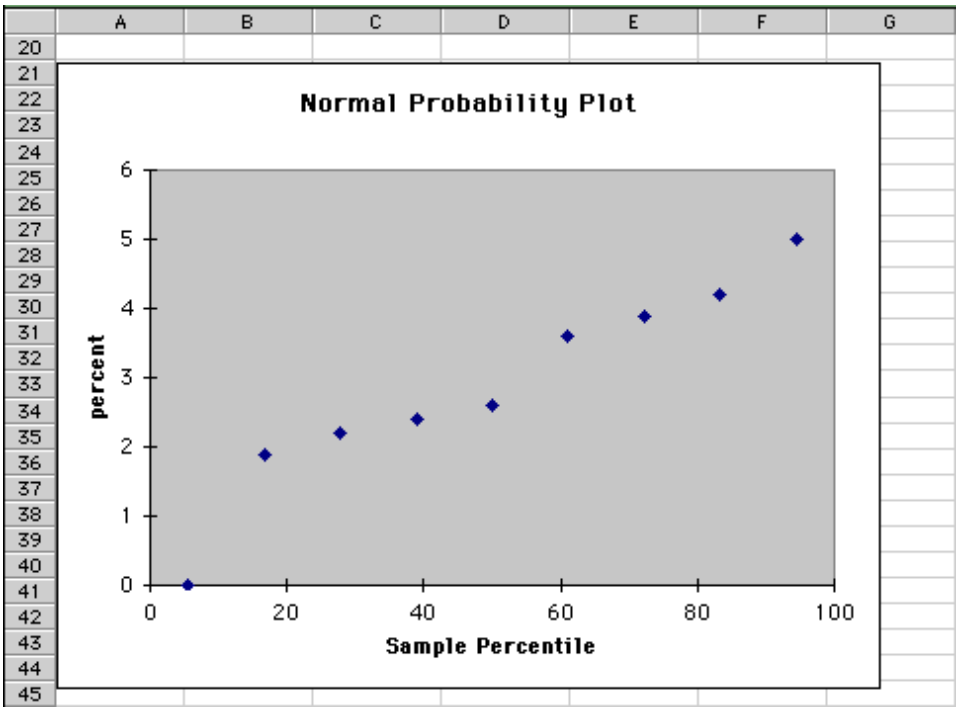


Figure 2

1. Select cells A1:G18. Click on the menu bar **Edit ł Copy**.

2. Then move over to *Word*. Place the blinking cursor at the spot that you wish the copied data to go. Click on the menu bar **Edit ł Paste.**

3. Once copied and pasted the regression output would look like the table below.

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.91165222
R Square	0.83110976
Adjusted R Square	0.80698259
Standard Error	0.65570289
Observations	9

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	14.810376	14.810376	34.4470379	0.00061847
Residual	7	3.009624	0.42994629		
Total	8	17.82			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	-1.1796123	0.72323094	-1.6310313	0.14690466	-2.8897805	0.5305559
radiation	0.14924799	0.02542919	5.8691599	0.00061847	0.08911755	0.20937844

4. Activate *Excel*. Click on the white part of the graph near the edge. Small black squares appear around the edge of the graph. Copy the graph using the method described in Step 1.

5. Activate *Word* and place the blinking cursor in the spot that you want put the graph. Paste the copied graph as in Step 2.

6. The graph will then appear in the *Word* document.