SPSS/Excel Workshop 3 – Summer Semester, 2010

In Assignment 3 of STATS 10x you ***may*** want to use Excel to perform some calculations in **Questions 1** and **2** such as:

- finding *P-values* and/or
- finding *t*-multipliers and/or
- checking your 'by-hand' calculations for hypothesis tests and confidence intervals about a single proportion and/or a difference between proportions

You ***must*** use SPSS to carry out hypothesis tests and confidence intervals for paired data and a difference between two means in **Questions 4** and **5** and to do an appropriate box plot(s) for the data set in **Question 4**.

The exercises that follow will help you with the computing skills you will need for Assignment 3.

Excel Basics

Finding a P-value *using Excel – Calculating* t *Probabilities*

In Assignment 3 of STATS 10x you ***may*** want to use Excel to perform some calculations in **Questions 1** and **2** such as finding *P-values*.

Question 1. [10 marks] [Chapter 9]	Question 2. [9 marks] [Chapter 9]
(a) Notes:	**(b) Notes:**
(ii) Once you have calculated your test statistic, it is necessary to use either a graphics calculator, SPSS, *Excel* or *t*-tables to determine the *P-value*.	**(ii)** At step 6 it is necessary to use either a graphics calculator, SPSS, *Excel* or *t*-tables to determine the *P-value*.

Example: This example is from the lecture workbook, Chapter 9, page 2. Find the *P-value* when the *t*-test statistic, t_0, = –1.25 and the degrees of freedom, *df*, = 49:

1. Click in cell A1.
2. Click the **Insert Function** button *fx* from beside the formula bar.
3. Choose **Statistical** from the **Or select a category** box in the **Insert Function** dialog box.

4. Choose **TDIST** from the **Select a function** box (Figure 1).

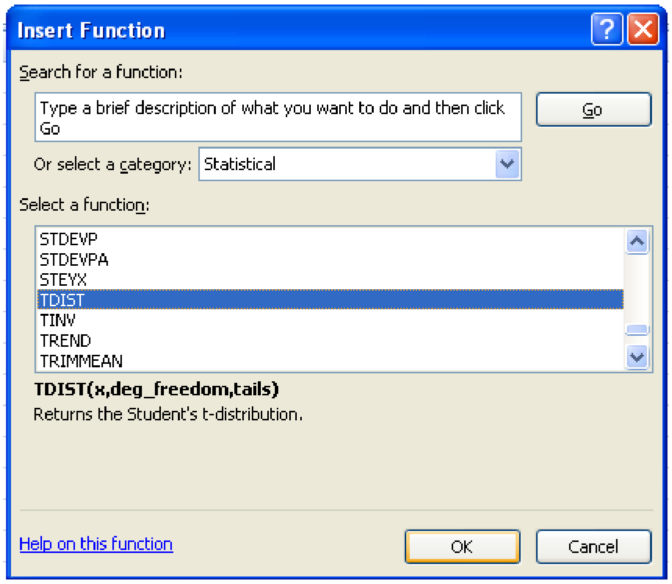


Figure 1

5. Click **OK**.

6. Fill the *t*-test statistic in the **X** dialog box.

Note: If your *t*-test statistic is negative, DON'T type the negative sign.

7. Type in the degrees of freedom ($n - 1$).

8. Enter 1 or 2 depending on whether the test is one-tailed or two-tailed (Figure 2).

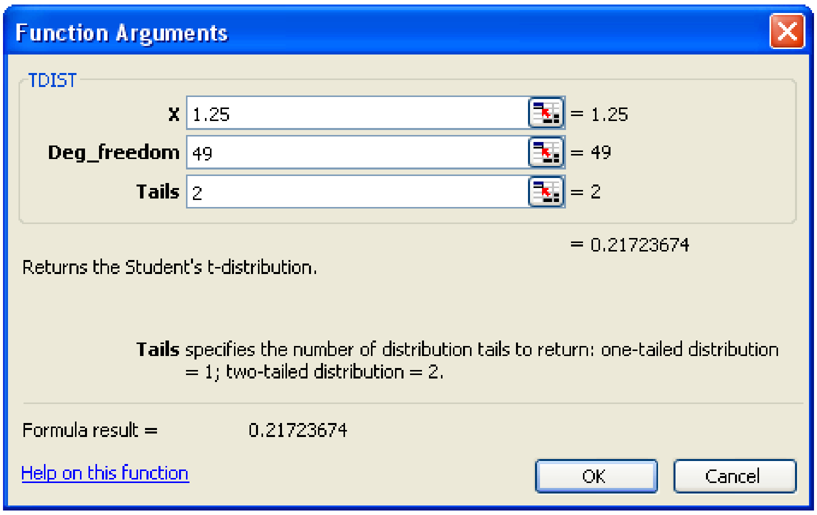


Figure 2

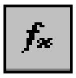
7. Click **OK**. (The value of 0.217237 should appear in cell A1.)

Finding a t-multipler using Excel – Calculating the Inverse of the Student t-distribution

In Assignment 3 of STATS 10x you ***may*** want to use Excel to perform some calculations in **Questions 1** and **2** such as finding *t*-multipliers.

Example: Find the *t*-multiplier for a 95% confidence interval with degrees of freedom, *df* = 30. (That is: $t_{30}(0.025)$, probability 0.025 and 30 degrees of freedom).

1. Click on cell A1.

2. Click the **Insert Function** button  from beside the formula bar.

3. Choose **Statistical** from the **Or select a category** box in the **Insert Function** dialog box.

4. Choose **TINV** from the **Select a function** box (Figure 3).

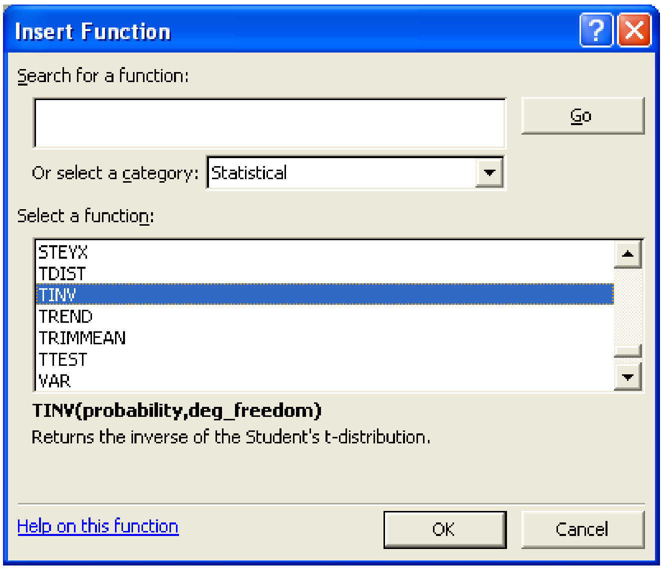


Figure 3

5. Click **OK**

6. Fill in the **TINV** dialog box (Figure 4).

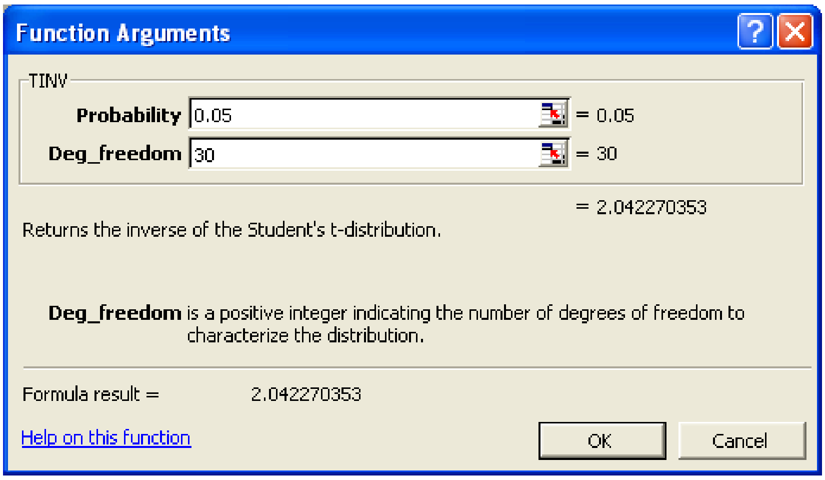


Figure 4

Note:

The *Excel* function **TINV** calculates the *t*-value for a 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

Downloading the Excel Test and Confidence Interval Calculators

In Assignment 3 of STATS 10x you ***may*** want to use the Excel *Test and Confidence Interval Calculators* to check your 'by-hand' calculations for hypothesis tests and confidence intervals about a single proportion and/or a difference between proportions in **Questions 1** and **2**. These are available to you in two places:

1. From Cecil (log in to Cecil in the usual way, click on **Assignment Resources** and look for **"Single/One proportion"** and **"Two proportions"**)
2. Go to Leila's Student Learning Centre STATS 10x webpage www.stat.auckland.ac.nz/~leila

> **Question 2. [9 marks] [Chapter 9]**
> **(b) Notes:**
> **(iii)** You can check your calculations by using the *Excel* spreadsheet on Cecil. Look under **Assignment Resources**.

Whichever way you do it, access **Single/One proportion.xls** and/or **Two proportions.xls** now.

Let's have a go at using these two documents!

On the following two pages are some questions from the **Worked Examples** document which you can find on Cecil.

We won't be doing the calculations by hand, although you are welcome to try later – in this workshop we'll use Excel to do them!

Question 13 [Chapter 9] (similar to Question 2, Assignment 3)

In 2001, the New Zealand Planning Institute (NZPI) conducted a random survey of its members. The NZPI survey included questions about job title, location and the types of organisations members worked for. 324 responses to these questions were received. Some of the information collected from the responses were:

– 78 responses were received from Senior Planners.
– 38 responses were received from Managers.
– 116 members were located in Auckland.
– 83 members were located in Wellington/Christchurch.
– Of those members who were located in Auckland, 68 were planners working for a Council.
– Of those members who were located in Wellington/Christchurch, 38 were planners working for a Council.

(a) State the sampling situation for the difference between the proportion of NZPI senior planners and the proportion of NZPI members who are located in Auckland.

(b) **By hand**, test to see if there is a difference between the proportion of NZPI members who are senior planners and the proportion who are managers. Interpret your results.

1. Parameter = $p_S - p_M$, the difference in the true proportion of NZPI members who are senior planners and the true proportion who are managers.

2. H_0: $p_S - p_M = 0$

3. H_1: $p_S - p_M \neq 0$

4. Estimate $\hat{p}_S - \hat{p}_M$, the difference in the proportion of the sample that were senior planners and the proportion of the sample that were managers.

$$= \frac{78}{324} - \frac{38}{324} = 0.2407 - 0.1173 = 0.1234$$

5. Sampling situation (b): One sample of size n, several response categories.

$$\text{se}(\hat{p}_S - \hat{p}_M) = \sqrt{\frac{0.2407 + 0.1173 - 0.1234^2}{324}} = 0.032526$$

$$t_0 = \frac{0.1234 - 0}{0.032526} = 3.794, \qquad df = \infty \text{ (working with proportions)}$$

6. *P-value* = pr(T_∞ > 3.794) + pr(T_∞ < -3.794) = 2 x pr(T_∞ > 3.794) = 0.0001 (from Excel)

7. We have very strong evidence:
- against H_0 in favour of H_1.
- that the proportion of senior planners is not the same as the proportion of managers.

The observed difference, 0.1234, is a statistically significant result at the 5% level.

8. Use *estimate* ± *t* x se*(estimate)*, estimate = 0.1234, se(estimate) = 0.032526, $t = z = 1.96$

95% confidence interval is: $0.1234 \pm 1.96 \times 0.032526$
= (0.0596, 0.1872)

9 With 95% confidence, we estimate that the proportion of NZPI members who are senior planners is greater than the proportion who are managers by between 0.06 and 0.19.

Useful places to look for help by assignment question

Assignment question number	***Worked Examples*** question number	***Lecture Workbook*** page number
Q1		
Q2		
Q3		
Q4		
Q5		
Q6		
Q7		

Also, don't forget where else you can get assignment help! They are:

- Your **lecturer's office hours**! See Cecil for details – if they don't suit you, email or call them to book a time.
- **Statistics Assistance Area** – ask a tutor or your neighbour
- **Statistics Computer Lab** – ask a lab demonstrator or your neighbour
- The STATS 10x **forum**: www.stat.auckland.ac.nz/forum/10x

SPSS

In Assignment 3 of STATS 10x you ***must*** use SPSS to carry out hypothesis tests and confidence intervals for paired data and a difference between two means in **Questions 4** and **5** and to do an appropriate box plot(s) for the data set in **Question 4**. Instructions on the question sheet read:

Hypothesis tests in this assignment

- In questions 4 and 5:
  - You must follow steps 1, 2, 3, 7 and 9 in the "Step-by-Step Guide to Performing a *t*-test by Hand", Lecture Workbook, Chapter 9, page 9.
  - Replace steps 4 – 6 and 8 in the "Step-by-Step Guide to Performing a *t*-test by Hand" with the relevant computer output.

Computer use in this assignment

- Make sure you are prepared for questions 4 and 5 before you begin to use the computer.
- Hand in computer output for questions 4 and 5.
- Report *P-values* to 3 or 4 decimal places.
- When carrying out a two independent sample *t*-test using SPSS do not assume equal variances.

To save you typing time, all of the data files required for this workshop can be found on Leila's SLC STATS 10x website www.stat.auckland.ac.nz/~leila and also on Cecil in SPSS data file (.sav) format.

Paired Data Comparisons – finding the differences, plotting the data and carrying out a paired *t*-test for the *mean* difference and/or a sign test for the *median* difference

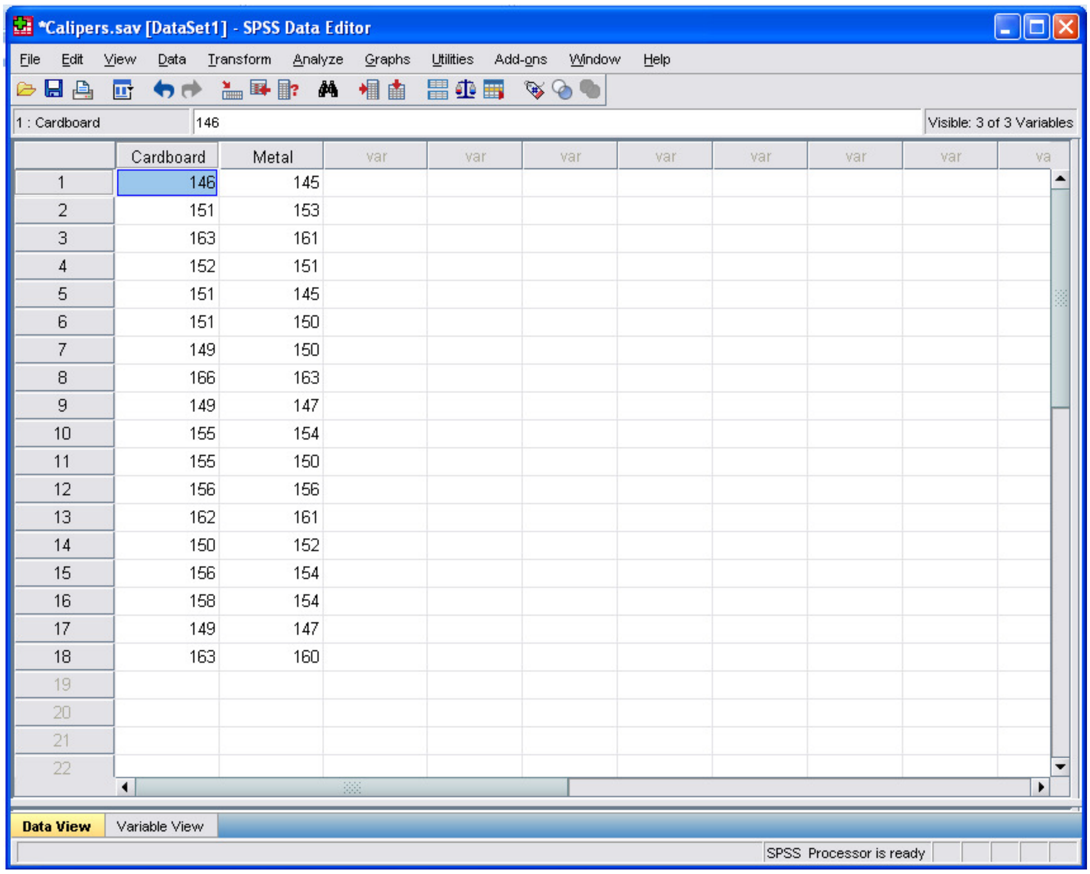
Paired *t*-test

What is the correct null hypothesis for this test?

Example: Conduct a paired data *t*-test for a mean difference of 0.

The head diameters of 18 N.Z. Airforce recruits were measured twice, once using cheap cardboard calipers and again using expensive and uncomfortable metal calipers.

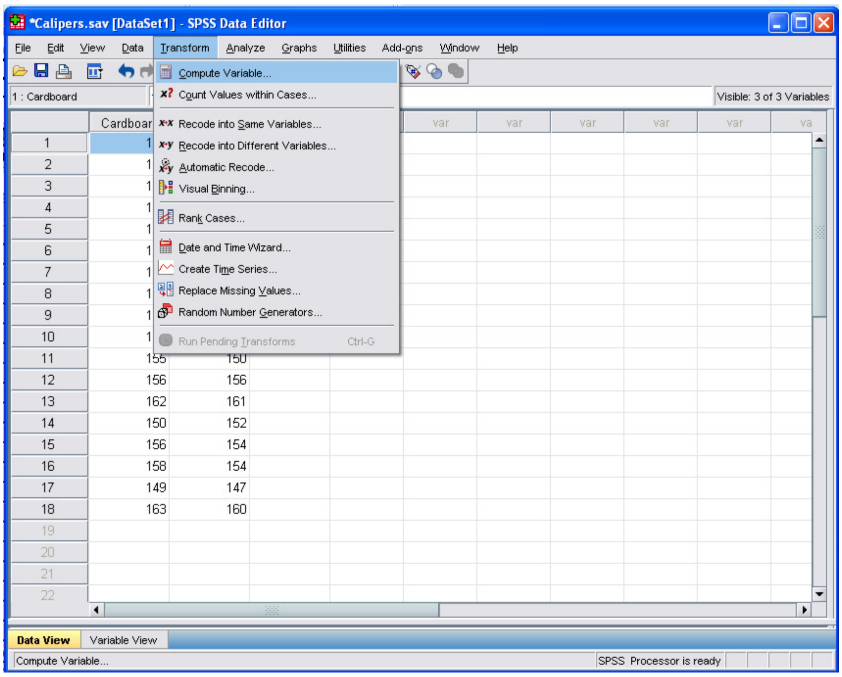
1. Firstly, enter the data into SPSS or open the Calipers.sav file.



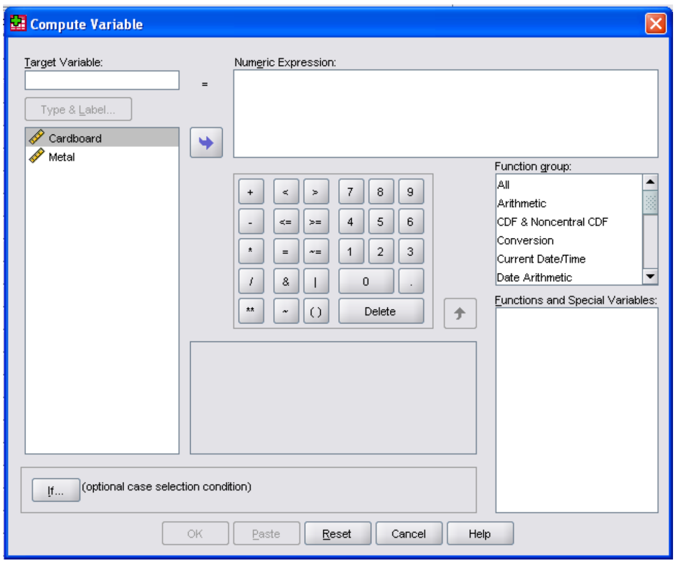
	Cardboard	Metal
1	146	145
2	151	153
3	163	161
4	152	151
5	151	145
6	151	150
7	149	150
8	166	163
9	149	147
10	155	154
11	155	150
12	156	156
13	162	161
14	150	152
15	156	154
16	158	154
17	149	147
18	163	160

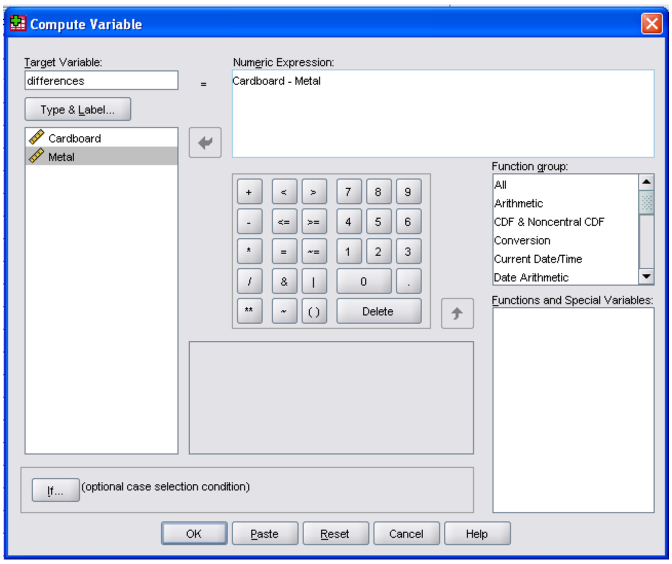
2. Secondly find the differences by:

   a. Choose the **Compute Variable** tool:
   Click **Transform** → **Compute Variable**

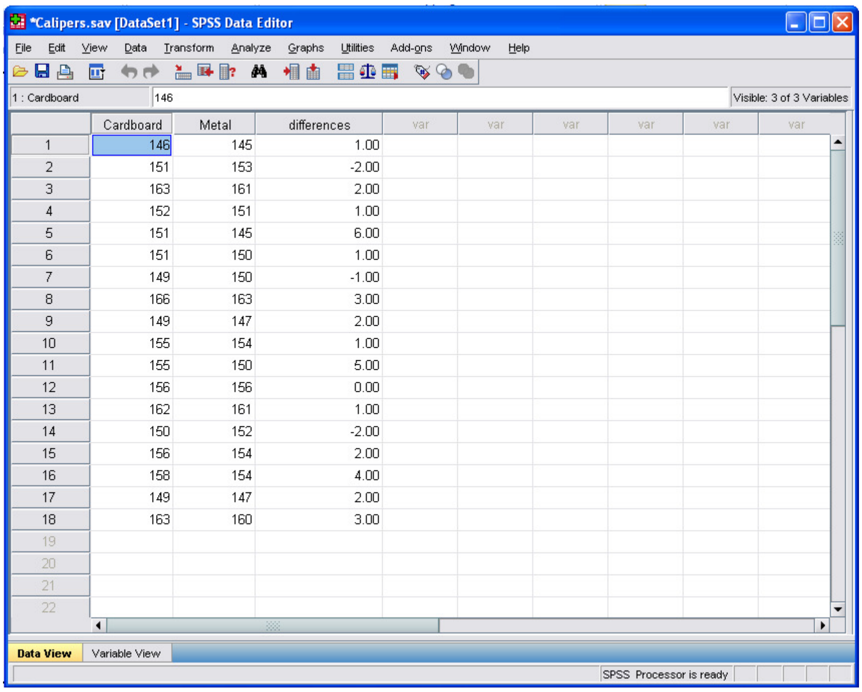


b. Get the **Compute Variable** tool to find the differences:
   i. Type "differences" into the **Target Variable** field.
   ii. Click **Cardboard**.
   iii. Click .
   iv. Click  (the subtraction button).
   v. Click **Metal**.
   vi. Click .
   vii. Click **OK**.



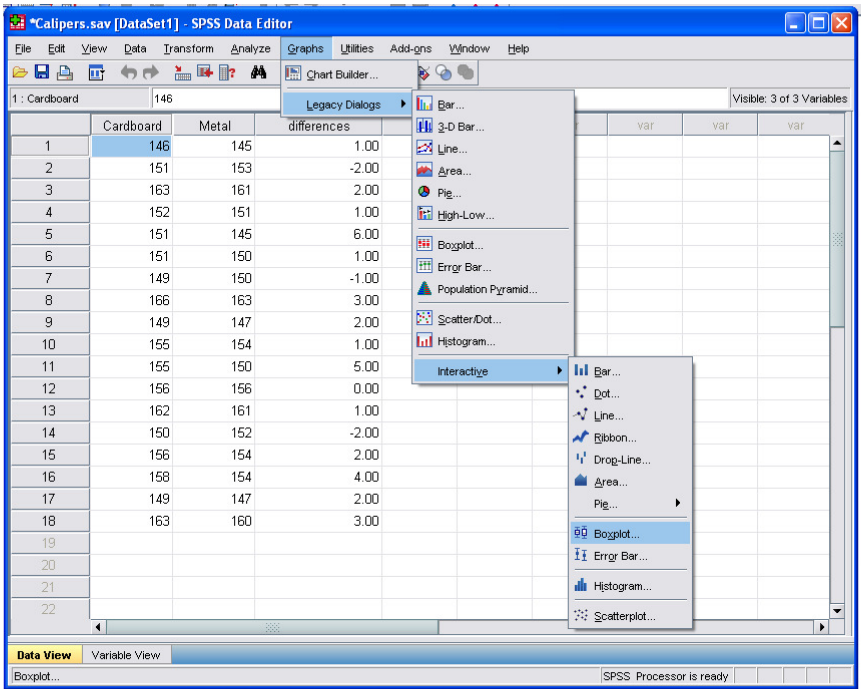


c. The differences will be computed and displayed in the **Data Editor**.

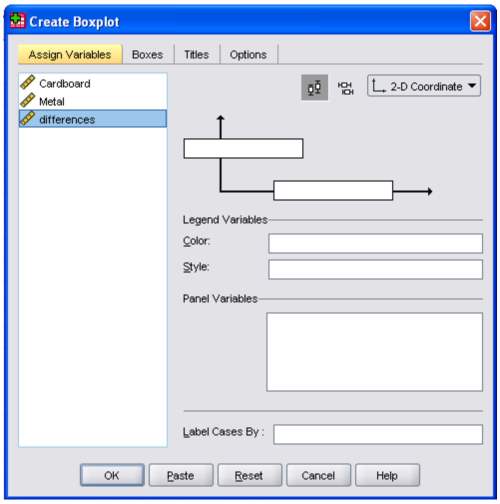


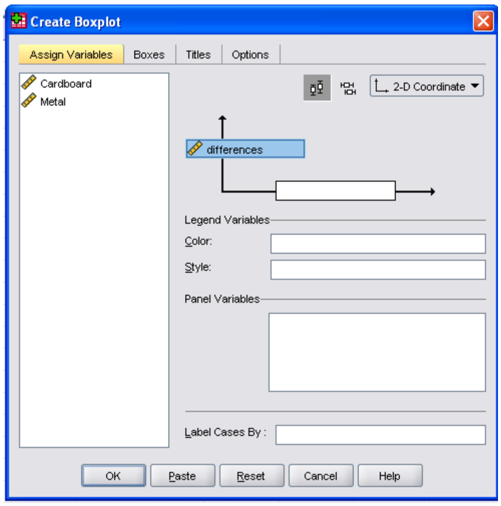
	Cardboard	Metal	differences
1	146	145	1.00
2	151	153	-2.00
3	163	161	2.00
4	152	151	1.00
5	151	145	6.00
6	151	150	1.00
7	149	150	-1.00
8	166	163	3.00
9	149	147	2.00
10	155	154	1.00
11	155	150	5.00
12	156	156	0.00
13	162	161	1.00
14	150	152	-2.00
15	156	154	2.00
16	158	154	4.00
17	149	147	2.00
18	163	160	3.00

3. Thirdly, plot the differences using a boxplot.
   a. Choose the **Boxplot** tool:
      Click **Graphs** → **Legacy Dialogs** → **Interactive** → **Boxplot**

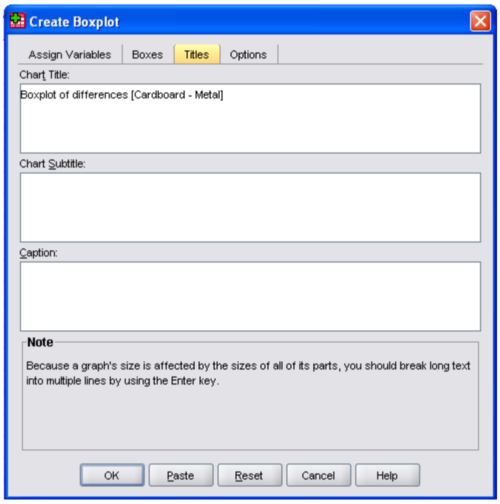


   b. Pick up "differences" and drop into the top white field.

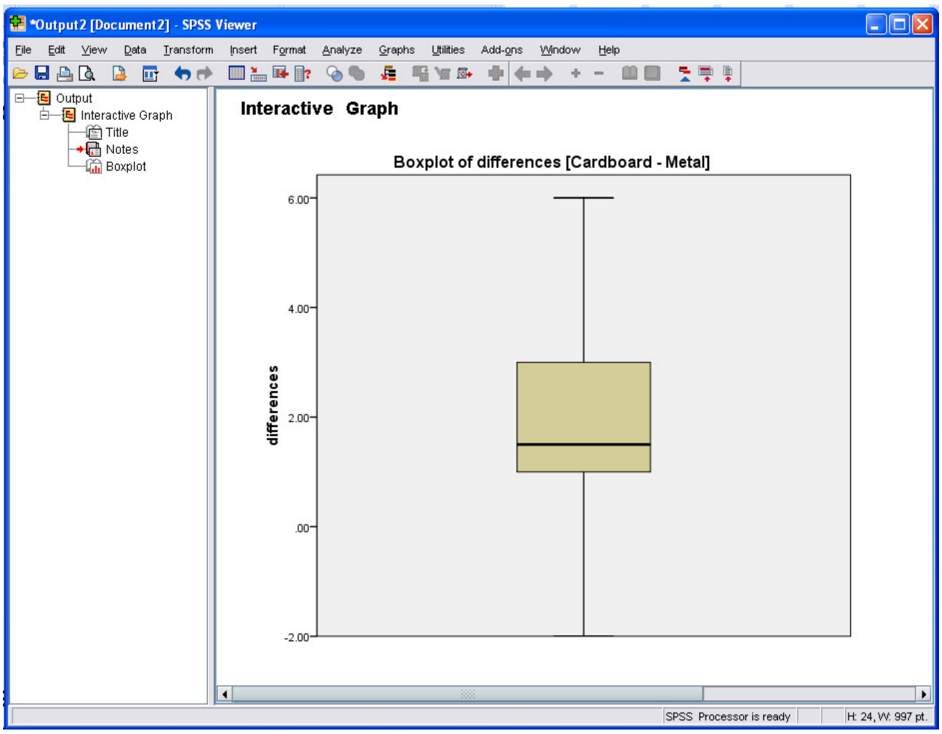




c. Do a title for the plot by clicking on the **Title** tab and type something meaningful into the **Chart Title** field.

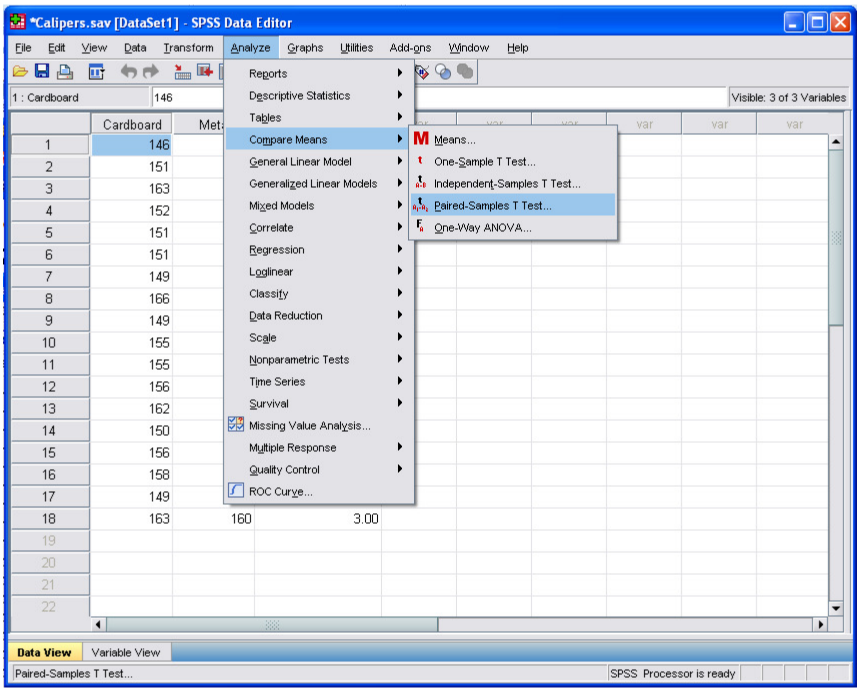


d. Click **OK**. The boxplot will appear in the **Output** window.



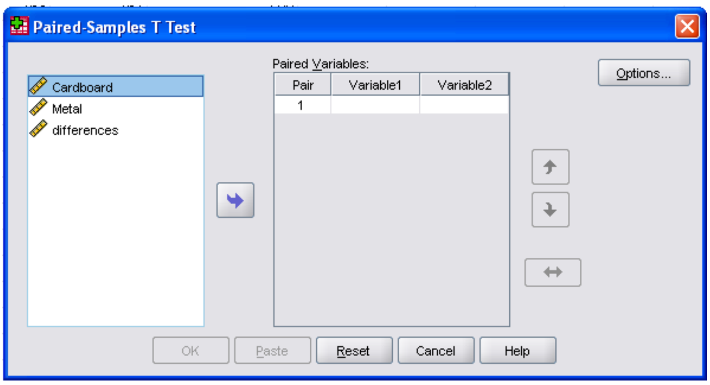
4. Fourthly, carry out the paired *t*-test.

a. Choose the analysis tool: **Paired-Samples T Test**.
Click **Analyze** → **Compare Means** → **Paired-Samples T Test**.

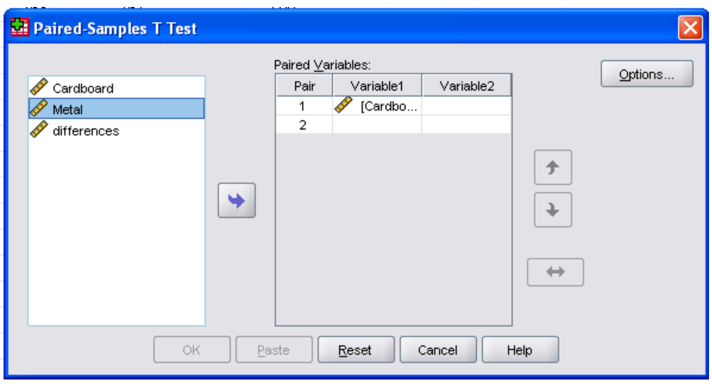


b. Select the variables of interest.

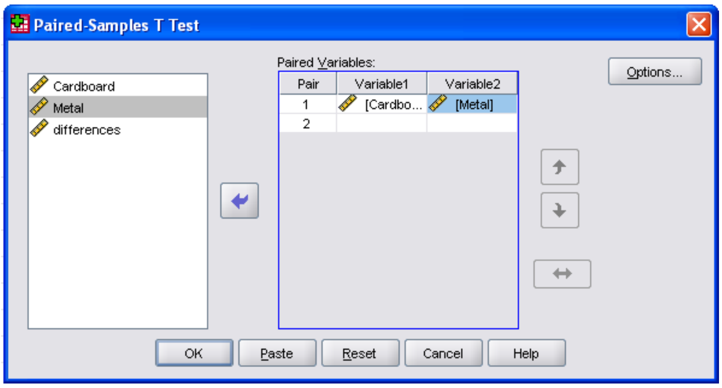
i. **Cardboard** is highlighted. Click .



ii. Click on **Metal**.

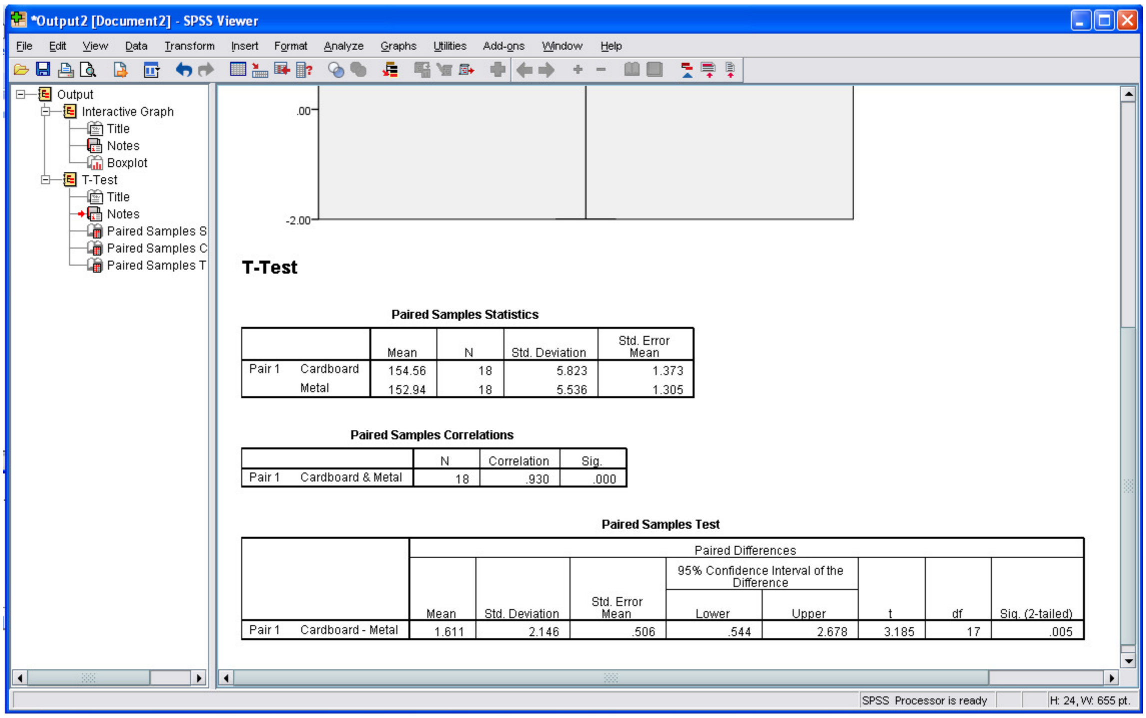


iii. Click .



iv. Click **OK**.

5. Lastly, view and interpret the results.



T-Test

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Cardboard	154.56	18	5.823	1.373
	Metal	152.94	18	5.536	1.305

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	Cardboard & Metal	18	.930	.000

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	Cardboard - Metal	1.611	2.146	.506	.544	2.678	3.185	17	.005

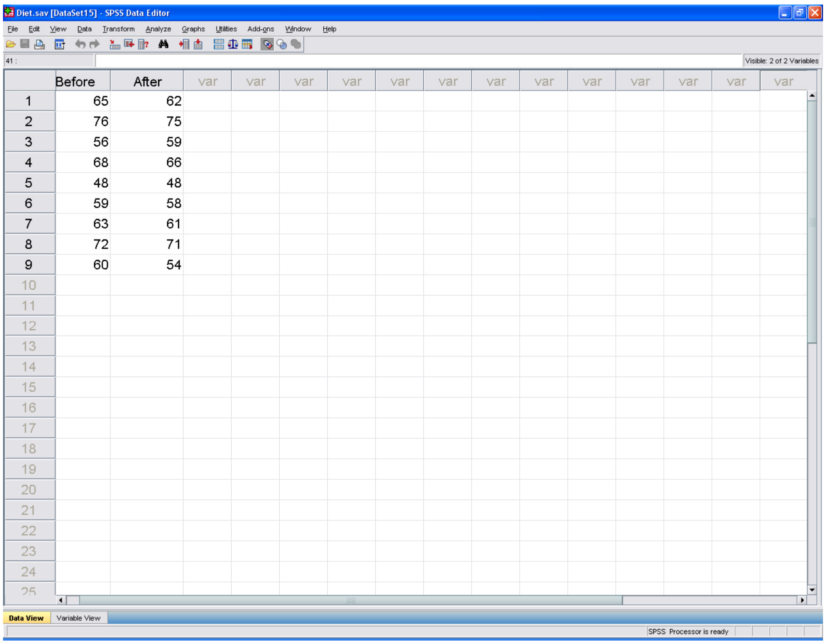
The Sign Test

What is the correct null hypothesis for this test?

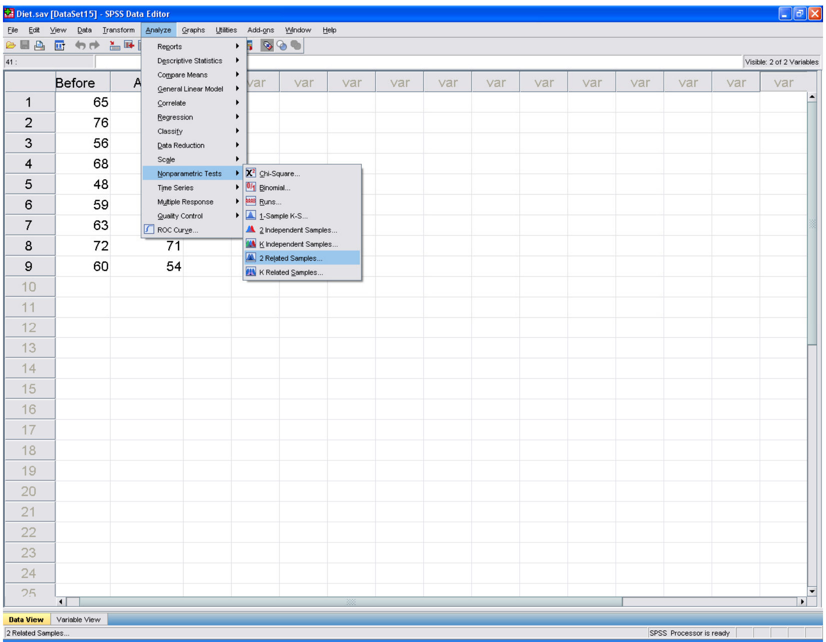
Example: Conduct a sign test for a median difference of 0.

A study was designed to determine the effectiveness of a new diet. Nine people took part in the study. The weight of each person was recorded and then after three months on the diet, their weights were again recorded.

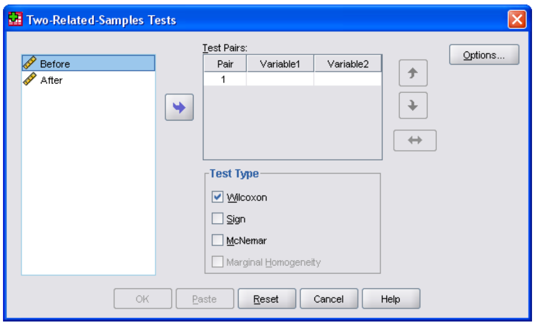
1. Enter the data into SPSS or open the Diet.sav file.



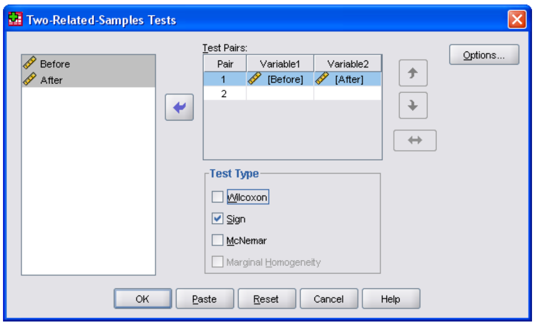
2. Choose the analysis tool: **2 Related Sample Nonparametric Test**. Click **Analyze** → **Nonparametric Tests** → **2 Related Samples**.



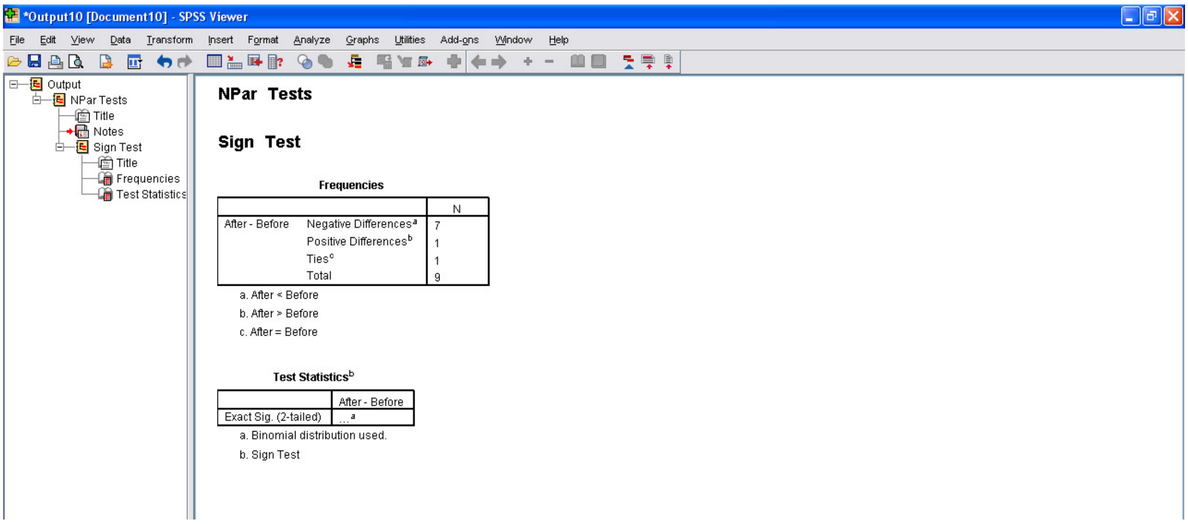
3. Select the relevant variables.
   Click **Before** and **After**.
   Click  .



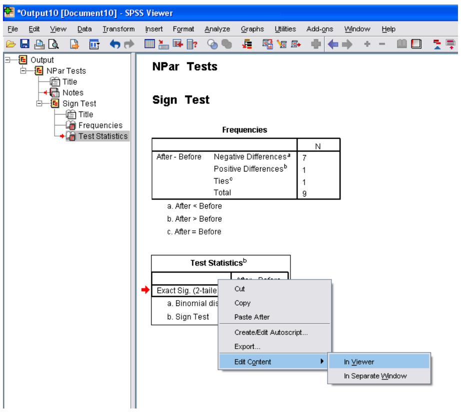
4. Choose the test type(s).
   Click the **Wilcoxon** box to unselect it. Click the **Sign** box.
   Click **OK**.



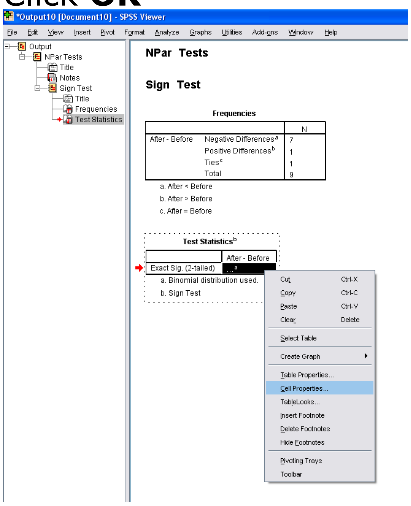
5. View the results.

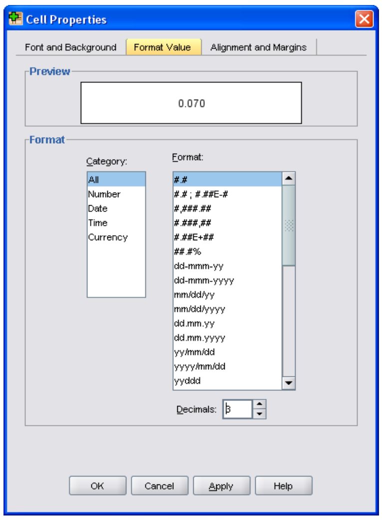


6. To view the *P-value*
   Place the cursor in the **Test Statistics** output
   Right click
   Select **Edit Content** → **In Viewer**

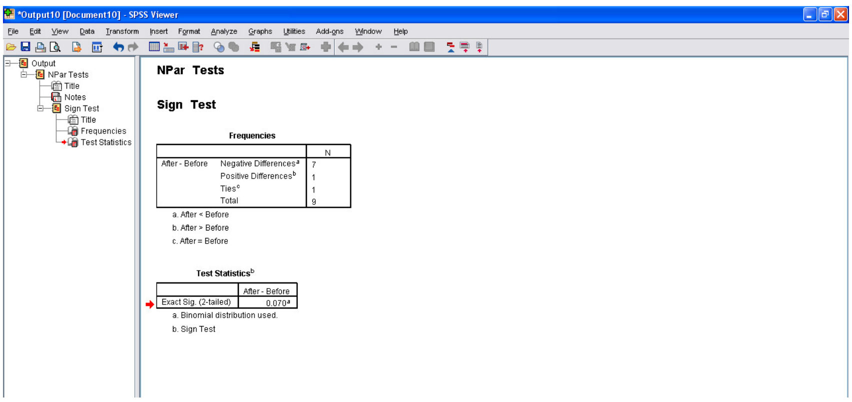


Place the cursor in the *P-value* cell
Right click
Select **Cell Properties**
Place the cursor in the *P-value* cell
Right click
Select **Cell Properties**
Select **Format Value**
Change the **Decimals** box to 3 or 4
Click **Apply**
Click **OK**





7. View and interpret the results.



Two Independent Samples – plotting the data and carrying out a two independent samples *t*-test

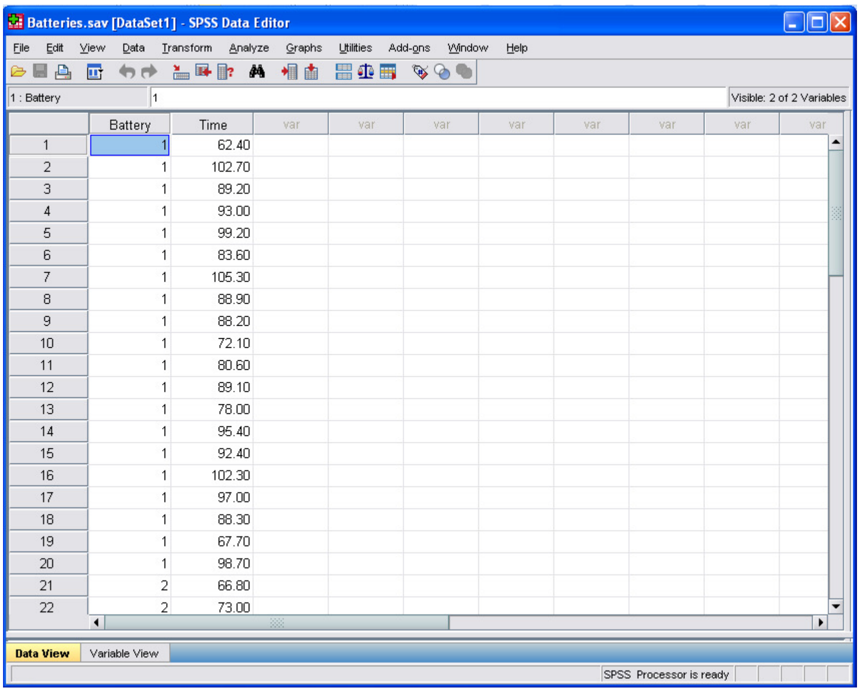
What is the correct null hypothesis for this test?

Example: Conduct a two independent samples *t*-test for no difference in the means.

A random sample of 40 cellphones of the same make and model were chosen. Half of the cellphones were randomly selected to have a nickel-cadmium battery put in them and the rest had a nickel-metal hydride battery. The talk time (in minutes) before the batteries needed to be recharged was recorded.

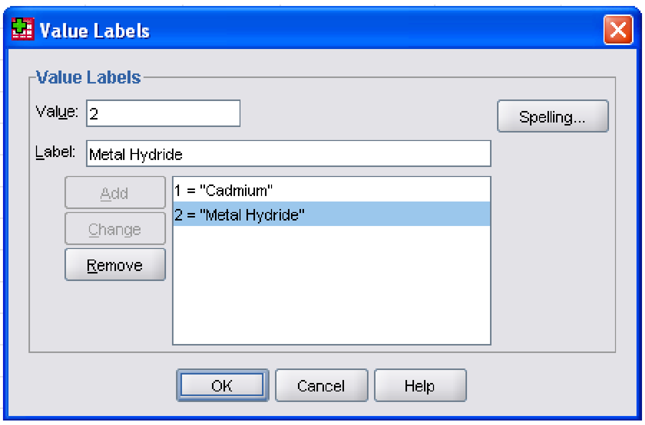
1. Enter the data into SPSS or open the Batteries.sav file.

   Use a value of **1** for **Nickel-cadmium** and **2** for **Nickel-metal hydride**.



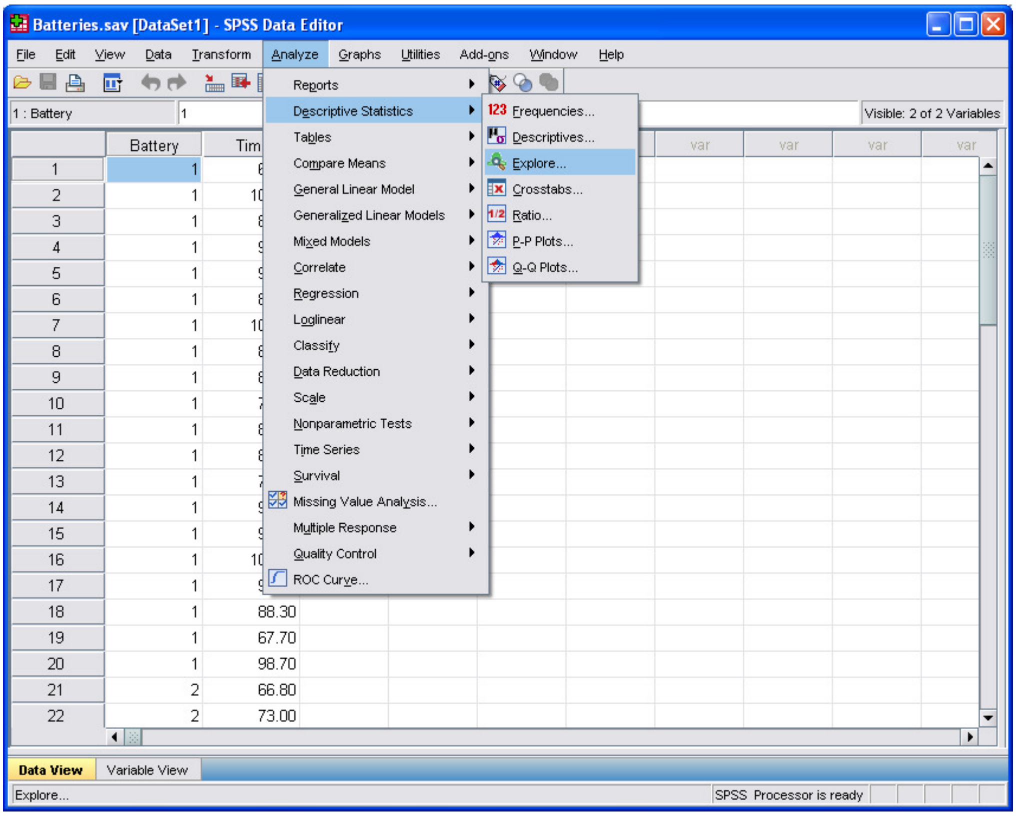
	Battery	Time
1	1	62.40
2	1	102.70
3	1	89.20
4	1	93.00
5	1	99.20
6	1	83.60
7	1	105.30
8	1	88.90
9	1	88.20
10	1	72.10
11	1	80.60
12	1	89.10
13	1	78.00
14	1	95.40
15	1	92.40
16	1	102.30
17	1	97.00
18	1	88.30
19	1	67.70
20	1	98.70
21	2	66.80
22	2	73.00

2. Assign labels.
   Label the values:
   Label **1** as **Cadmium** and **2** as **Metal**.



3. Plot the data using a boxplot.

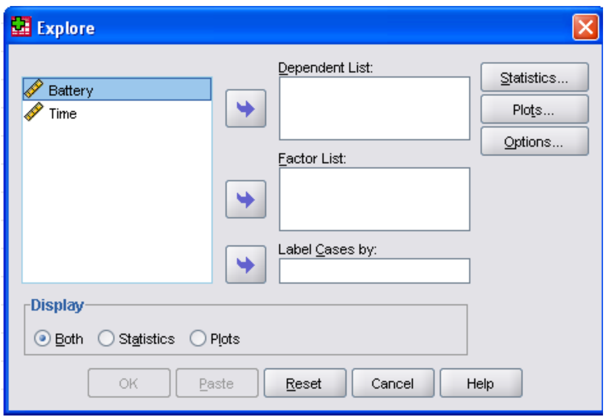
a. Choose the **Explore** tool:
Click **Analyze** → **Descriptive Statistics** → **Explore**

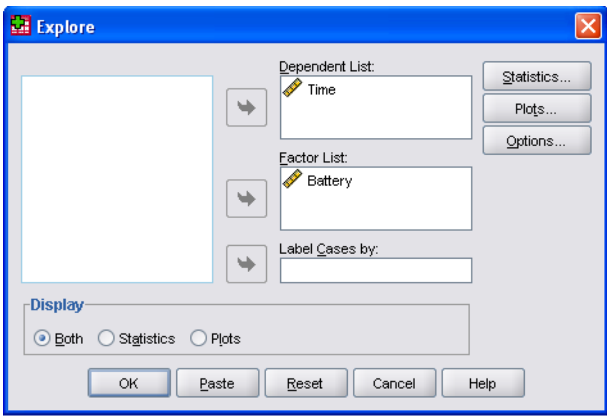


b. Assign the variables.

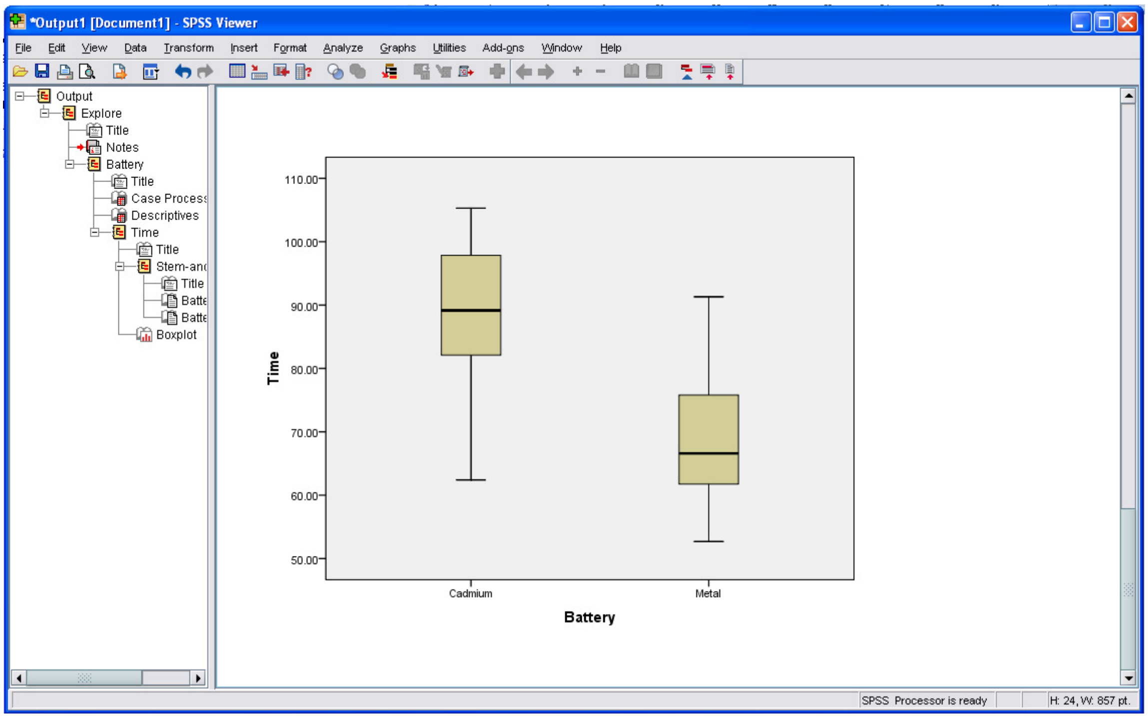
Quantitative (response) variable → **Variable** box.
Click **Time**.
Click .

Qualitative variable (grouping factor) → **Category Axis** box.
Click **Battery**.
Click .



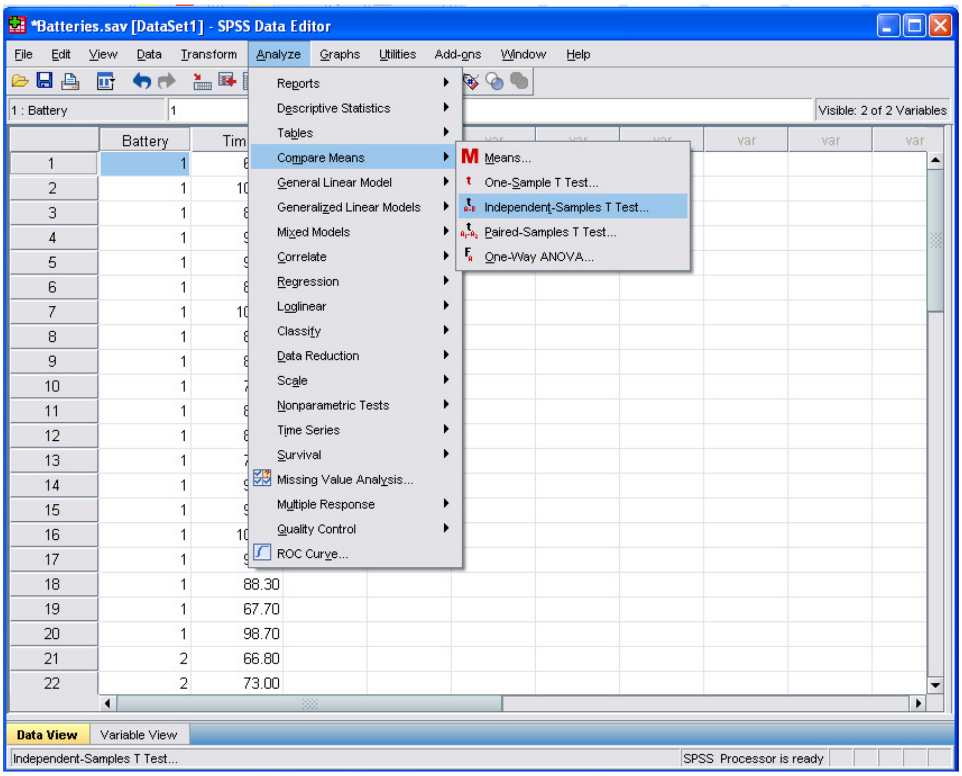


c. View and interpret the boxplots.



4. Carry out the two independent sample *t*-test.

a. Choose the analysis tool: **Independent-Samples T Test**.
Click **Analyze** → **Compare Means** → **Independent-Samples T Test**.

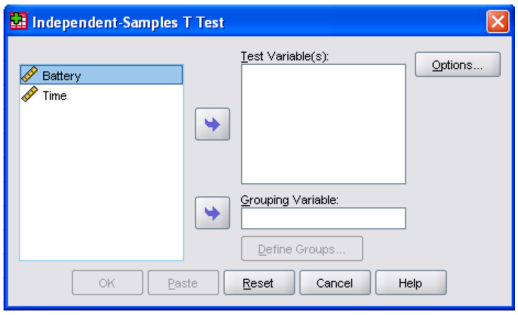


b. Select the variables of interest.

Quantitative variable (response) → **Test Variable(s)** box.

Click **Time**.

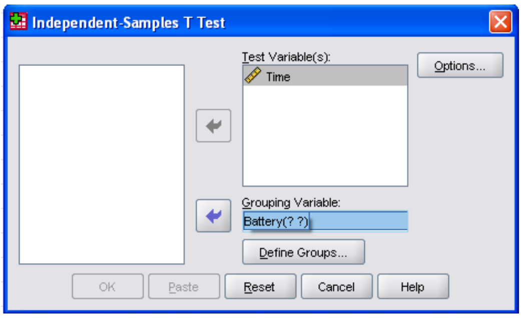
Click top .



Qualitative variable (grouping factor) → **Grouping Variable** box.

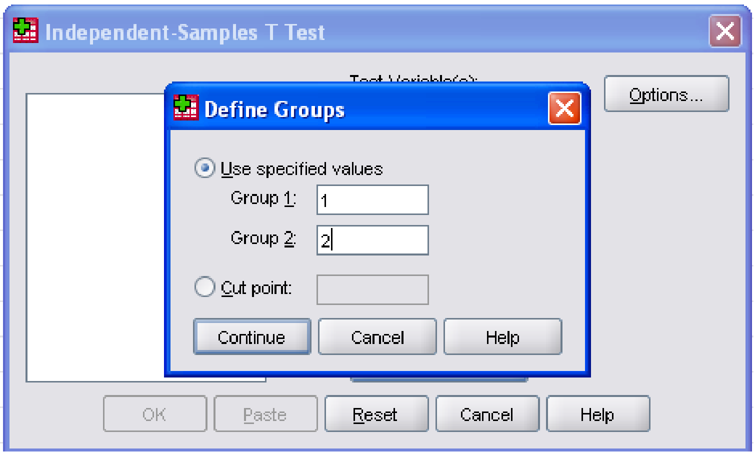
Click **Type**.

Click bottom .



c. Define the direction of the difference (mean 1 – mean 2 or mean 2 – mean 1).

Click **Define Groups**.
Type **1** in the **Group 1** box and type **2** in the **Group 2** box.
Click **Continue** and then **OK**.



d. View and interpret the results.

T-Test

Group Statistics

	Battery	N	Mean	Std. Deviation	Std. Error Mean
Time	Cadmium	20	88.7050	11.76066	2.62976
	Metal Hydride	20	69.1900	10.30528	2.30433

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means					95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Time	Equal variances assumed	.079	.780	5.581	38	.000	19.51500	3.49651	12.43668	26.59332
	Equal variances not assumed			5.581	37.356	.000	19.51500	3.49651	12.43267	26.59733

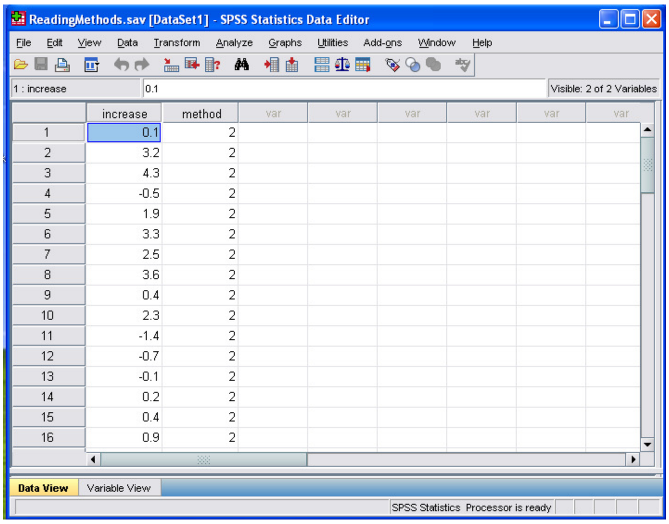
F-test for one-way ANOVA

What is the correct null hypothesis for this test?

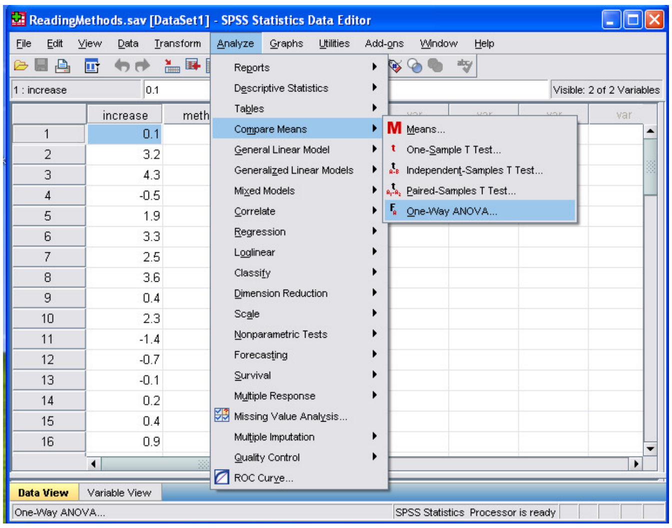
Example: Conduct a one-way ANOVA *F*-test for no difference in the groups' underlying means.

Fifty students learned about the reading methods of 'mapping' and 'scanning'. The method used and increase in reading age was recorded for each student.

1. Enter the data into SPSS or open the ReadingMethods.sav file.
   Use a value of **1** for **MapOnly**, **2** for **MapScan**, **3** for **Neither**, and **4** for **ScanOnly** for the **Method** variable (**Values** column in the **Variable View**).
   Label **Score** as **Increase in reading age** and **Method** as **Reading Method**.

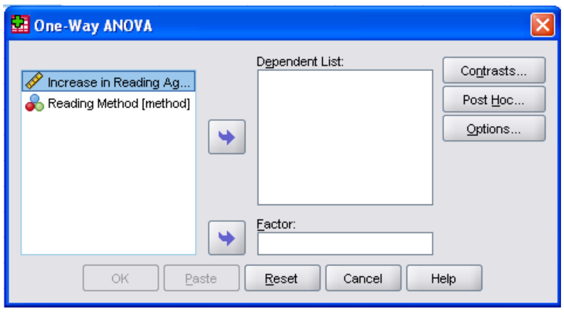


2. Select the analysis tool: **One-Way ANOVA**.
   Click **Analysis** → **Compare Means** → **One-Way ANOVA**.

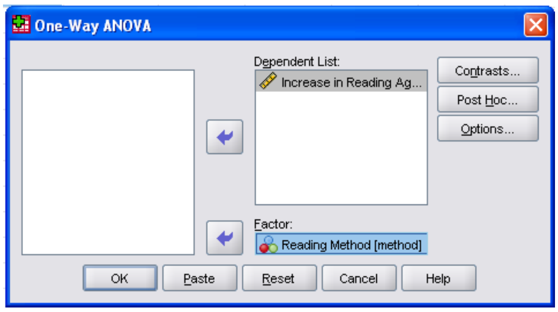


3. Select the relevant variables.

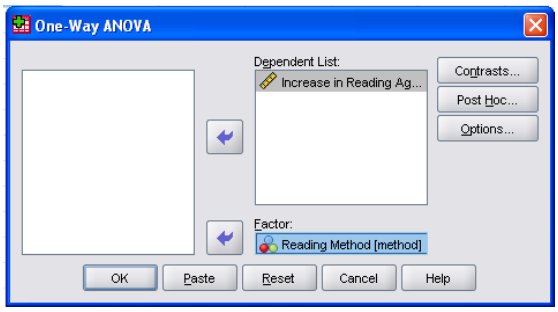
Quantitative (response) variable → **Dependent List** box.
Click **Increase in Reading Age [Score]**.
Click .



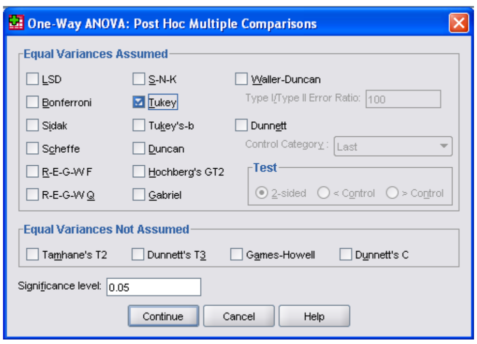
Qualitative variable (grouping factor) → **Factor** box.
Click **Reading Method [Method]**.
Click .



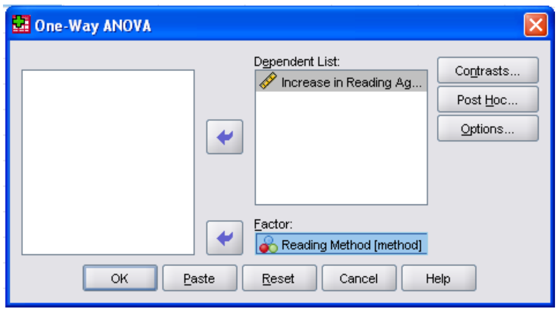
4. Select the relevant output tables.
Click **Post Hoc**.



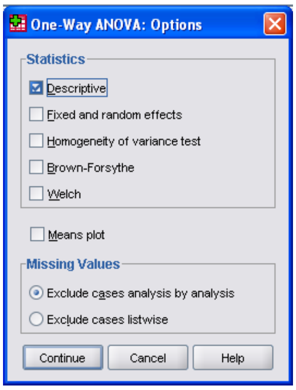
Click the **Tukey** box.
Click **Continue**.



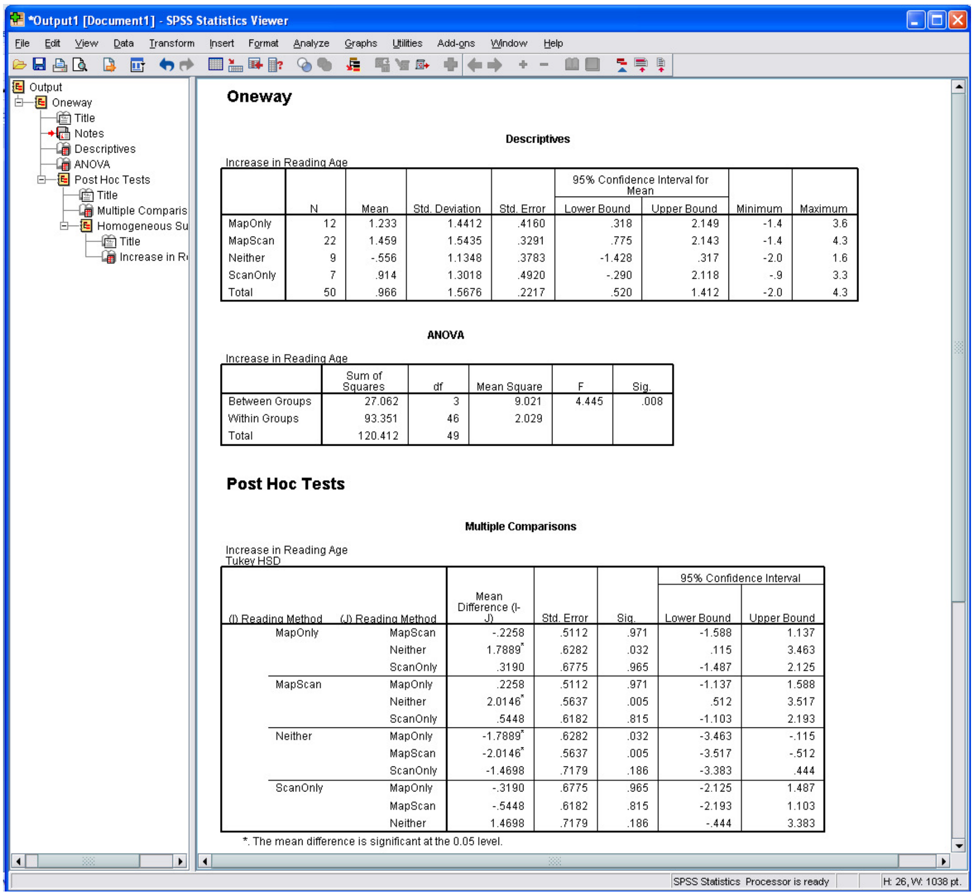
Click **Options**.



Click the **Descriptive** box.
Click **Continue** and then click **OK**.



5. View and interpret the results.



Oneway

Descriptives

Increase in Reading Age

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean Lower Bound	95% Confidence Interval for Mean Upper Bound	Minimum	Maximum
MapOnly	12	1.233	1.4412	.4160	.318	2.149	-1.4	3.6
MapScan	22	1.459	1.5435	.3291	.775	2.143	-1.4	4.3
Neither	9	-.556	1.1348	.3783	-1.428	.317	-2.0	1.6
ScanOnly	7	.914	1.3018	.4920	-.290	2.118	-.9	3.3
Total	50	.966	1.5676	.2217	.520	1.412	-2.0	4.3

ANOVA

Increase in Reading Age

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	27.062	3	9.021	4.445	.008
Within Groups	93.351	46	2.029		
Total	120.412	49			

Post Hoc Tests

Multiple Comparisons

Increase in Reading Age
Tukey HSD

(I) Reading Method	(J) Reading Method	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
MapOnly	MapScan	-.2258	.5112	.971	-1.588	1.137
	Neither	1.7889*	.6282	.032	.115	3.463
	ScanOnly	.3190	.6775	.965	-1.487	2.125
MapScan	MapOnly	.2258	.5112	.971	-1.137	1.588
	Neither	2.0146*	.5637	.005	.512	3.517
	ScanOnly	.5448	.6182	.815	-1.103	2.193
Neither	MapOnly	-1.7889*	.6282	.032	-3.463	-.115
	MapScan	-2.0146*	.5637	.005	-3.517	-.512
	ScanOnly	-1.4698	.7179	.186	-3.383	.444
ScanOnly	MapOnly	-.3190	.6775	.965	-2.125	1.487
	MapScan	-.5448	.6182	.815	-2.193	1.103
	Neither	1.4698	.7179	.186	-.444	3.383

*. The mean difference is significant at the 0.05 level.