

PASW (SPSS)/Excel Workshop 3 – Semester Two, 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* <u>and/or</u>
- finding *t*-multipliers <u>and/or</u>
- checking your 'by-hand' calculations for hypothesis tests and confidence intervals about a single proportion and/or a difference between proportions

You <u>must</u> use PASW (SPSS) to draw the appropriate box plot(s) and to carry out hypothesis tests and calculate confidence intervals for the data sets in **Questions 4, 5** and **7**.

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)	At step 6 it is necessary to use either a graphics calculator, PASW (SPSS), <i>Excel</i> or <i>t</i> -tables to determine the <i>P</i> -value.	(ii)	At step 6 it is necessary to use either a graphics calculator, PASW (SPSS), Excel or <i>t</i> -tables to determine the <i>P</i> -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

 $f_{\mathbf{x}}$ 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).

l	nsert Function		? 🗙				
ŝ	earch for a function:						
	Type a brief description of what you want to do and then click Go						
	Or select a category: Statistical						
s	elect a functio <u>n</u> :						
	STDEVP STDEVPA STEYX		^				
	TDIST						
	TREND		-				
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	TDIST(x,deg_free Returns the Student's	lom,tails) t-distribution.					
E	elp on this function	ОК	Cancel				

Figure 1

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

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

- **7.** Type in the degrees of freedom (n 1).
- Enter 1 or 2 depending on whether the test is one-tailed or two-tailed (Figure 2).

Function Arguments									
TDIST									
x	1.25	1.25 = 1.25							
Deg_freedom	49	1 = 49							
Tails	2	1 = 2							
= 0.21723674 Returns the Student's t-distribution. Tails specifies the number of distribution tails to return: one-tailed distribution = 1; two-tailed distribution = 2.									
Formula result =	0.21723674								
Help on this function OK Cancel									

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 \underline{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 f_{*} 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).

Function Argum	ents	? 🔀					
TINV Probability Deg_freedom	0.05	1 = 0.05 1 = 30					
= 2.042270353 Returns the inverse of the Student's t-distribution.							
Deg_freedom is a positive integer indicating the number of degrees of freedom to characterize the distribution.							
Formula result = Help on this function	2.042270353	OK Cancel					



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 **Question 1** and/or **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.

$$\operatorname{se}(\hat{p}_{S} - \hat{p}_{M}) = \sqrt{\frac{0.2407 + 0.1173 - 0.1234^{2}}{324}} = 0.032526$$

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

- **6.** *P*-value = $pr(T_{\infty} > 3.794) + pr(T_{\infty} < -3.794) = 2 \times pr(T_{\infty} > 3.794) = 0.0001$ (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 $\pm t \times se(estimate)$, 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:

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



PASW (SPSS)

In Assignment 3 of STATS 10x you <u>must</u> use PASW (SPSS) to draw the appropriate box plot(s) and to carry out hypothesis tests and calculate confidence intervals for the data sets in **Questions 4, 5** and **7**. 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, page 9, Chapter 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, 5 and 7 before you begin to use the computer.
- Hand in computer output for questions 4, 5 and 7.
- Report *P-values* to 3 or 4 decimal places.
- When carrying out a two independent sample *t*-test using PASW (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 <u>www.stat.auckland.ac.nz/~leila</u> and also on Cecil in PASW (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 PASW (SPSS) or open the <u>Calipers.sav</u> file.

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- 2. Secondly find the differences by:
 - a. Choose the **Compute Variable** tool: Click **Transform** \rightarrow **Compute Variable**

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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**.

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

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Thirdly, plot the differences using a boxplot.
 a. Choose the **Explore** tool:

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b. Click on **differences** and then click on > to send it to the **Dependent List**.

Click on **Plots** (at the bottom) so **Statistics** aren't displayed.

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Click on **Plots** (at the right) and deselect **Stem-and-leaf** so only a boxplot is displayed. Click **Continue**.

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c. Click $\mathbf{OK}.$ The boxplot will appear in the \mathbf{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**.

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iv. Click OK.



5. Lastly, view and interpret the results.





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 PASW (SPSS) or open the <u>Diet.sav</u> file.



2. Choose the analysis tool: 2 Related Sample Nonparametric Test. Click Analyze \rightarrow Nonparametric Tests \rightarrow Legacy Dialogs \rightarrow 2 Related Samples.

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

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

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5. View and interpret the results.

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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 PASW (SPSS) or open the <u>Batteries.sav</u> file.

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

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2. Assign labels. Label the values:

Label 1 as Cadmium and 2 as Metal.

52	Valu	e Labels		
	-Value	Labels—		
	Val <u>u</u> e:	2		Spelling
	Label:	Metal Hydri	de	
		Add	1 = "Cadmium"	
		Change	2 = "Metal Hydride"	
		Remove		
			OK Cancel Help	



3. Plot the data using a boxplot.

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

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b. Assign the variables.

Quantitative (response) variable \rightarrow **Variable** box. Click **Time**. Click \blacktriangleright .

Qualitative variable (grouping factor) \rightarrow **Category Axis** box. Click **Battery**. Click \blacktriangleright .

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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 \rightarrow Compare Means \rightarrow Independent-Samples T Test.

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Time

OK

b. Select the variables of interest.



+

4

Grouping Variable

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Qualitative variable (grouping factor) \rightarrow **Grouping Variable** box. Click **Battery**. 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**.

🔛 Independent-Samples T Test	×
Define Groups	Options
Use specified values Group 1: 1 Group 2: 2 Qut point:	
Continue Cancel Help OK Paste Reset Cancel H	elp

d. View and interpret the results.

T-Test

	Group Statistics									
	Batterv	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 Varia		t-test for Equality of Means								
									95% Confidenc Differ	e Interval of the ence		
		F	Siq.	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 <u>ReadingMethods.sav</u> 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.

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6	3.3	2						
7	2.5	2						
8	3.6	2						
9	0.4	2						
10	2.3	2						
11	-1.4	2						
12	-0.7	2						
13	-0.1	2						
14	0.2	2						
15	0.4	2						
16	0.9	2						
	1							•

- 2. Plot the data using a boxplot.
 - a. Choose the **Boxplot** tool: Click **Graphs** → **Legacy Dialogs** → **Boxplot**

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11	-1.4	2		Histogram
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13	-0.1	2		
14	0.2	2		
15	0.4	2		
16	0.9	2		
	4			



b. Pick the appropriate plot.

Simple is selected by default. Click Define.

	-
Boxplot	Quantitative (response) variable \rightarrow Variable box. Click Increase in Reading Age [increase] . Click) .
Data in Chart Are Image: Summaries for groups of cases Summaries of separate variables Define Cancel Help	Qualitative variable (grouping factor) \rightarrow Category Axis box. Click Reading Method [method]. Click \blacktriangleright .
	Image: Simple Boxplot: Summaries for Groups of Cases Options Options Options Image: Options
OK Paste Reset Cancel Help	OK Paste Reset Cancel Help

c. Assign the variables.

d. View and interpret the boxplots.





- 5. Carry out the *F*-test.
 - a. Select the analysis tool: **One-Way ANOVA**. Click **Analyze** → **Compare Means** → **One-Way ANOVA**.

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One-Way ANG	OVA						SPSS Statistics Processor is ready

b. Select the relevant variables.

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

Qualitative variable (grouping factor) \rightarrow **Factor** box. Click **Reading Method [Method]**. Click \blacktriangleright .

📴 One-Way ANOVA	🛛 🗟 One-Way ANOVA 🛛 🔀
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3. Select the relevant output tables. Click **Post Hoc**.



Click the **Tukey** box.

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Click **Continue**.



Click Options.

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



4. View and interpret the results.

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