JAMES COOK UNIVERSITY SINGAPORE

t-tests

Learning Centre

Content

JAMES COOK UNIVERSITY SINGAPORE

1 ***T*-test**

What is a *t*-test?

2 **Types of *t*-tests**

Spoiler alert: There are 3!

3 **SPSS examples**

How to run *t*-tests on SPSS

4 **Reporting**

How to report results from SPSS output

What is a *t*-test?

A statistical analysis that tells us whether the difference between 2 groups happened by chance

Measured using mean scores of the 2 groups, standard deviations, and a number of data points (but SPSS does the calculations for us!)

Annotated by *t* statistics, which can be positive or negative

Types of *t*-tests

1

One sample *t*-test

2

Between subjects *t*-test

3

Within subjects *t*-test

1. One Sample *t*-test

A one sample *t*-test is used if we want to know whether a sample mean is different from a known population mean

Example

In my statistics class of 20 young adults, we could see that we were all quite tall. We then thought to ourselves: "Hmm, are we really taller than the average population?"

We then searched the Internet for census data on the height of young adults in Singapore, and at the same time measured the height of everyone in my class.

Are we really taller?

Location of SPSS Data Files

JAMES COOK UNIVERSITY SINGAPORE

Example SPSS data for practice are available on LearnJCU:

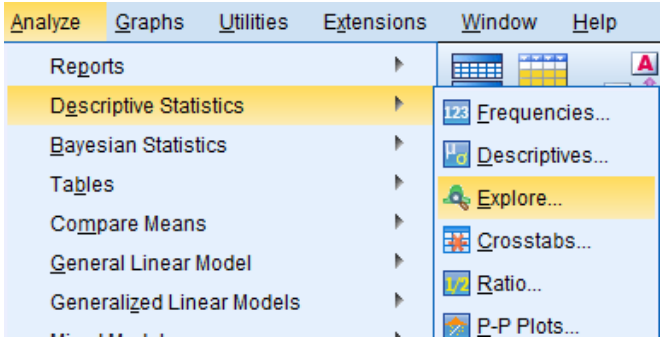
Log in to LearnJCU -> Organisations -> Learning Centre JCU Singapore -> Statistics Support -> Statistics Resources -> SPSS Data for Practice

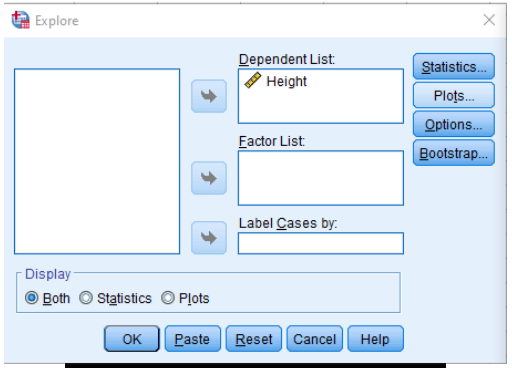
Assumptions Testing…

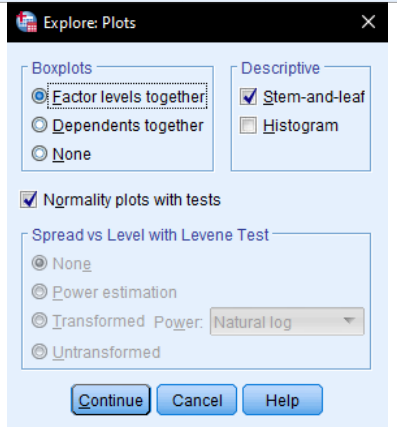
Before conducting the t-test, we need to first make sure that our data is normally distributed (assumption of normality)…

Assumptions Testing…

1. Analyze -> Explore
2. Move ‘Height’ to Dependent List
3. Click on ***Plots***, select ‘Normality plots with tests’
4. Continue, and OK







Assumptions Testing…

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Height	.124	20	.200*	.944	20	.282

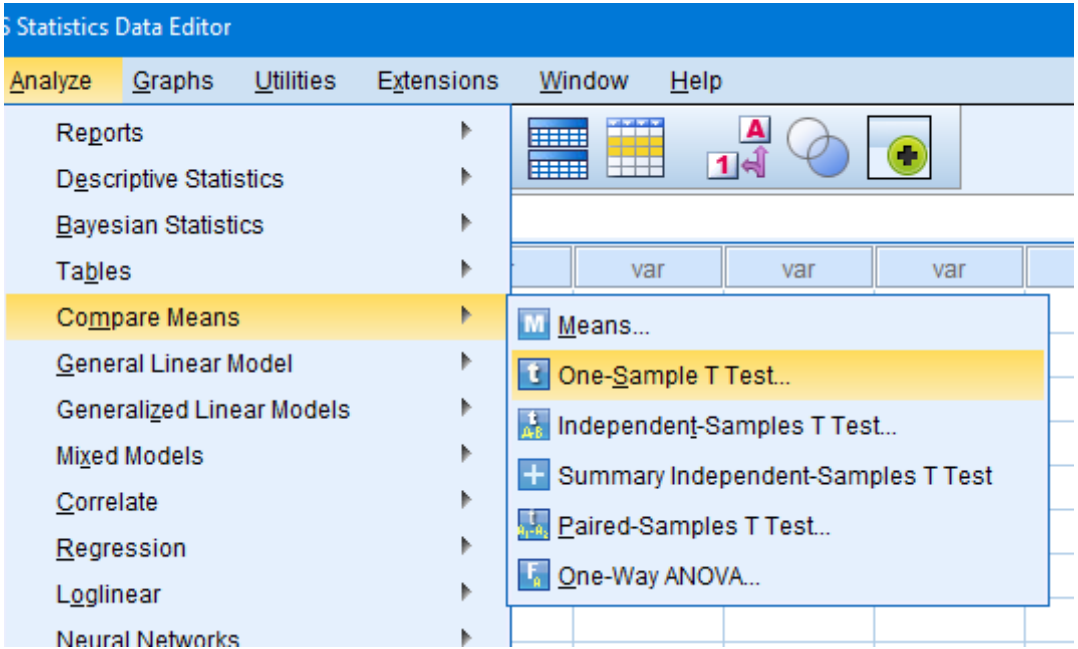
*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Since the Shapiro-Wilk *p* value is > .05, we conclude that assumption of normality is not violated

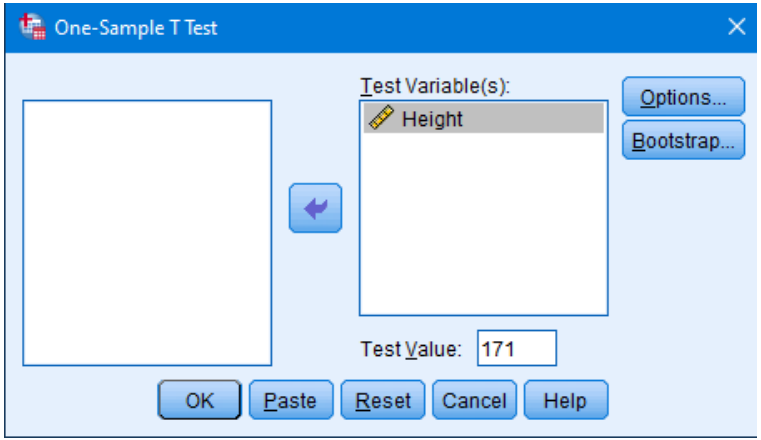
Onto SPSS!

Analyze -> Compare Means -> One-Sample T Test



Onto SPSS!

- Move ‘Height’ as the Test Variable
- Enter the ‘Test Value’, which is the census data we found on the Internet (171 cm.)
- OK!



Onto SPSS!

We get a *t* score of -.639. A negative *t* score in this case suggests that we are NOT taller than the known population mean, but is this statistically significant?

This is our degrees of freedom, which is calculated by *n*-1 (20 people in my class minus 1 = 19)

p value is .53. Since this is greater than our alpha value of .5, we say that we fail to reject the null hypothesis. In other words, there is no difference between how tall we are, and the population

One-Sample Test

Test Value = 171

	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Height	-.639	19	.530	-1.000	-4.27	2.27

Write-up

An example write-up is available on:

JCUS Learning Centre website -> Statistics and Mathematics Support

Types of *t*-tests

1

One sample *t*-test

Between subjects *t*-test

2

3

Within subjects *t*-test

2. Between Subjects *t*-test

Also known as independent samples *t*-test, it is used to compare groups which are not related (i.e., independent)

Example

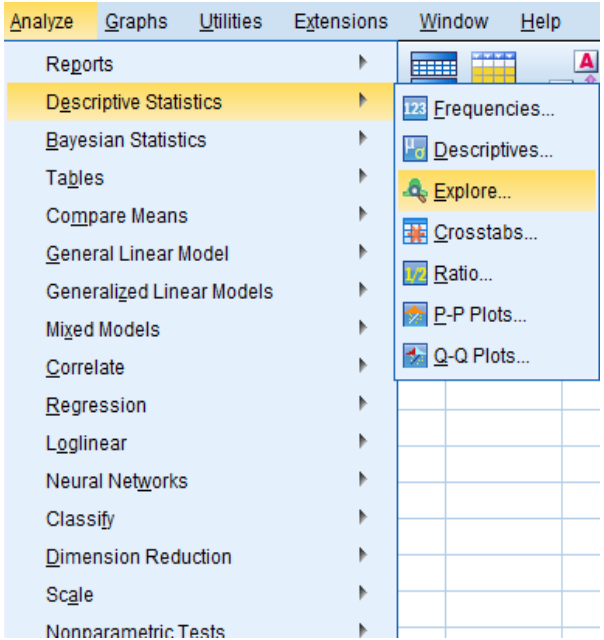
A researcher wanted to find out if there is a difference in time spent on social media between males and females. She hypothesised that females spend more time a day on social media, compared to males. The researcher collected data from 25 males and 25 females

Do females spend more time in a day on social media compared to males?

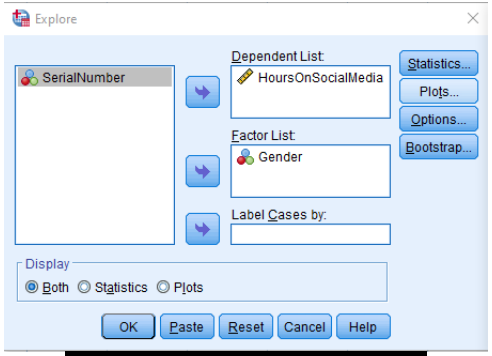
Assumptions Testing…

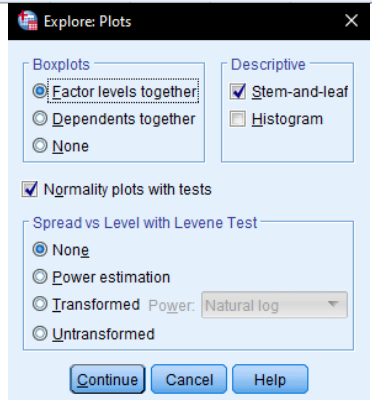
Before conducting the *t*-test, we need to first test the assumption of normality

Assumptions Testing…



1. Analyze -> Explore
2. Move ‘HoursOnSocialMedia’ to Dependent List, and ‘Gender’ to Factor List
3. Click on ***Plots***, select ‘Normality plots with tests’
4. Continue, and OK





Assumptions Testing…

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Gender	Statistic	df	Sig.	Statistic	df	Sig.
HoursOnSocialMedia	Female	.141	25	.200*	.965	25	.529
	Male	.193	25	.017	.946	25	.208

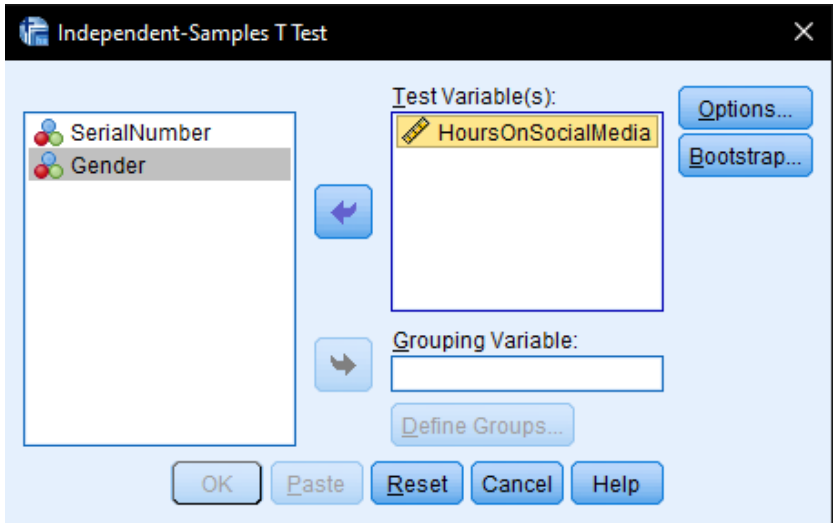
*. This is a lower bound of the true significance.

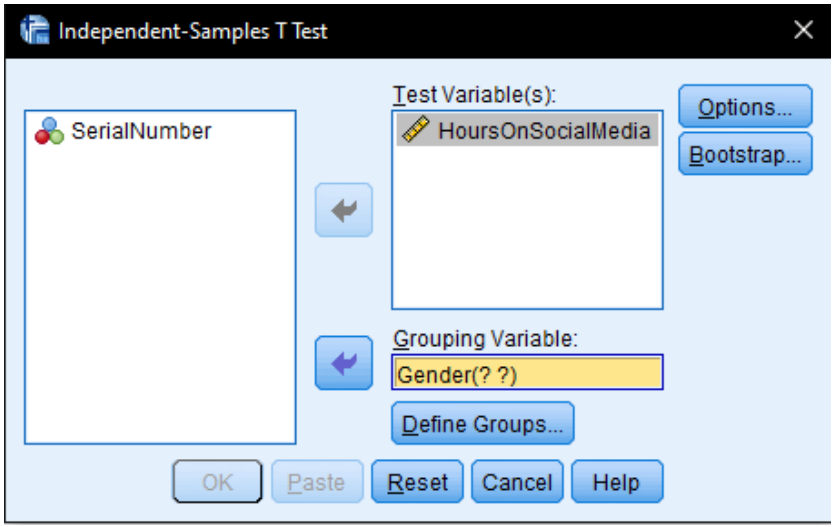
a. Lilliefors Significance Correction

Since the Shapiro-Wilk *p* values are both > .05, we conclude that assumption of normality is not violated

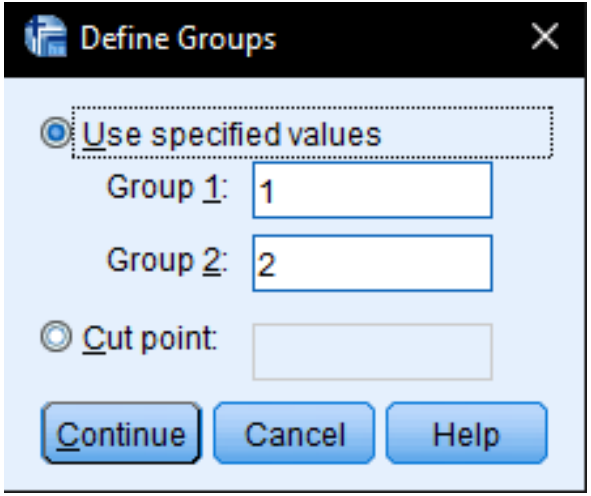
Onto SPSS!

- **Analyze -> Compare Means -> Independent Samples T Test**
- Move ‘HoursOnSocialMedia’ to the right column as the Test Variable
- Select ‘Gender’ as the Grouping Variable





Onto SPSS!



- Click on ***Define Groups***
- Since female is coded as ‘1’, and male as ‘2’, type in ‘1’ and ‘2’ under groups 1 and 2, respectively (you can switch them around if you wish)
- Click continue, and OK!

Onto SPSS!

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
HoursOnSocialMedia	Equal variances assumed	.792	.378	8.118	48	.000	1.3400	.1651	1.0081	1.6719
	Equal variances not assumed			8.118	46.321	.000	1.3400	.1651	1.0078	1.6722

This is to evaluate if the variances between 2 groups were significantly different from each other (Assumption test for homogeneity of Variance)

p-value was .378, which is larger than .05, indicating assumed equality of variances. Hence we focus on this row

t value = 8.12, *df* = 48, and *p* value <.001.

This means there was a significant difference on social media usage in a day between males and females

Group Statistics

	Gender	N	Mean	Std. Deviation	Std. Error Mean
HoursOnSocialMedia	Female	25	2.804	.6367	.1273
	Male	25	1.464	.5251	.1050

Females spent more time on social media per day compared to males (almost double the time!)

Write-up

An example write-up is available on:

JCUS Learning Centre website -> Statistics and Mathematics Support

Types of *t*-tests

1

One sample *t*-test

2

Between subjects
t -test

3

Within subjects
t-test

3. Within Subjects *t*-test

Also known as paired samples *t*-test, it is used to compare groups which are related (e.g., same person; before and after a treatment)

Example

A number of students failed their statistics module last semester. To help them, the Learning Advisors invited these students to attend remedial classes throughout the current semester.

To evaluate the effectiveness of the classes, the learning advisors analysed the overall grades of all students who attended the lessons, and compared them to their grades during the last semester.

Did the remedial classes improve students' grades?

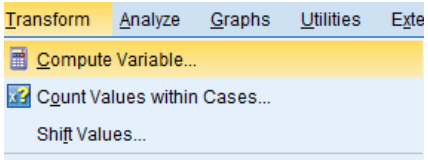
Assumptions Testing…

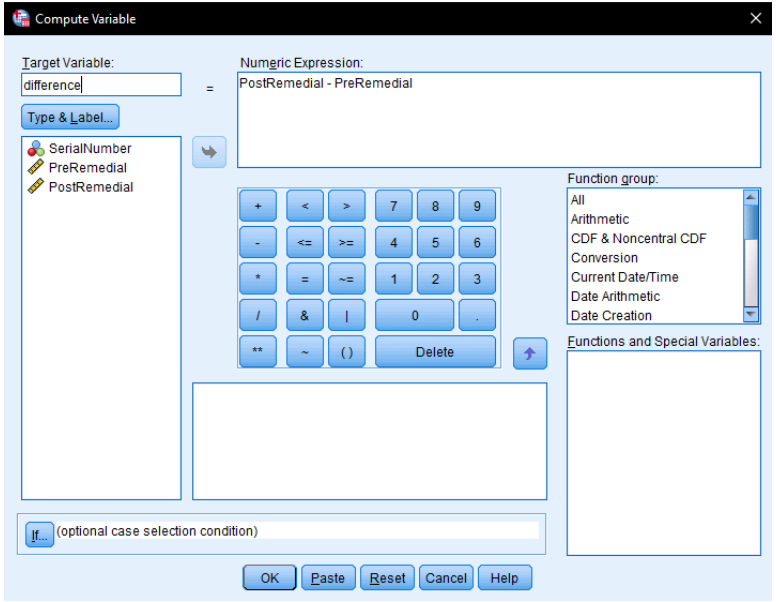
Before conducting the *t*-test, we need to first test the assumption of normality for 3 variables: pre-remedial, post-remedial, and also the difference score between the 2 variables

To calculate the difference, we use the *Compute Variable* function

Assumptions Testing…

1. Transform -> Compute Variable
2. Enter ‘difference’ as Target Variable
3. Select ‘PostRemedial’ and move it to Numeric Expression
4. Click the minus (-) in the numpad
5. Select ‘PreRemedial’ and move it to Numeric Expression
6. We are basically calculating the difference of before and after scores
7. OK



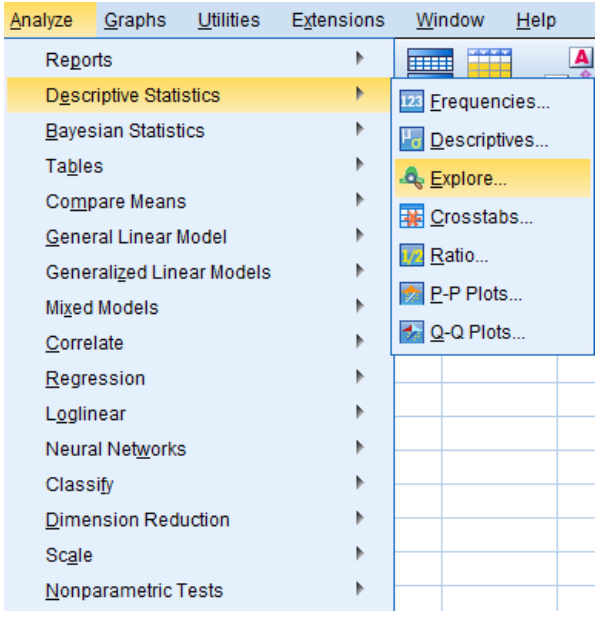


Assumptions Testing…

SerialNumber	PreRemedial	PostRemedial	difference
1	45	40	5.00
2	40	60	-20.00
3	48	55	-7.00
4	34	70	-36.00
5	47	69	-22.00
6	48	53	-5.00
7	49	54	-5.00
8	45	48	-3.00
9	40	55	-15.00
10	36	67	-31.00
11	37	49	-12.00
12	49	68	-19.00
13	45	69	-24.00
14	44	71	-27.00
15	46	51	-5.00
16	46	53	-7.00
17	39	40	-1.00
18	42	55	-13.00
19	44	60	-16.00
20	49	65	-16.00

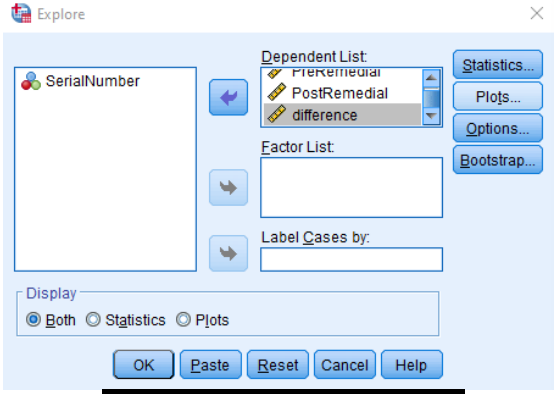
SPSS will create a new column

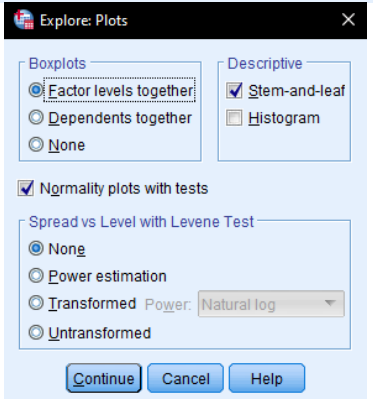
Assumptions Testing…



To conduct the normality tests:

1. Analyze -> Explore
2. Move ‘PreRemedial’, ‘PostRemedial’, and ‘difference’ to Dependent List
3. Click on ***Plots***, select ‘Normality plots with tests’
4. Continue, and OK





Assumptions Testing…

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
PreRemedial	.180	20	.087	.915	20	.081
PostRemedial	.156	20	.200*	.929	20	.151
difference	.142	20	.200*	.977	20	.894

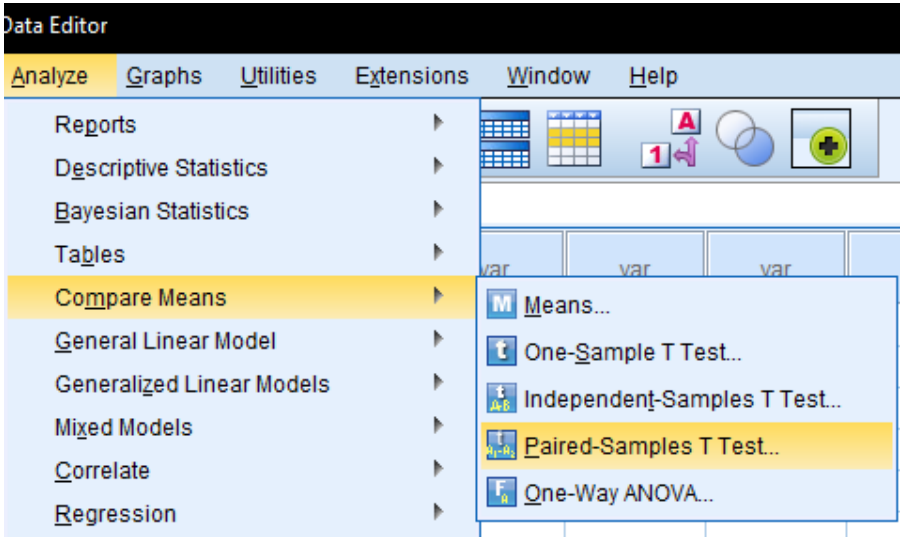
*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Since the Shapiro-Wilk *p* values are all > .05, we conclude that assumption of normality is not violated

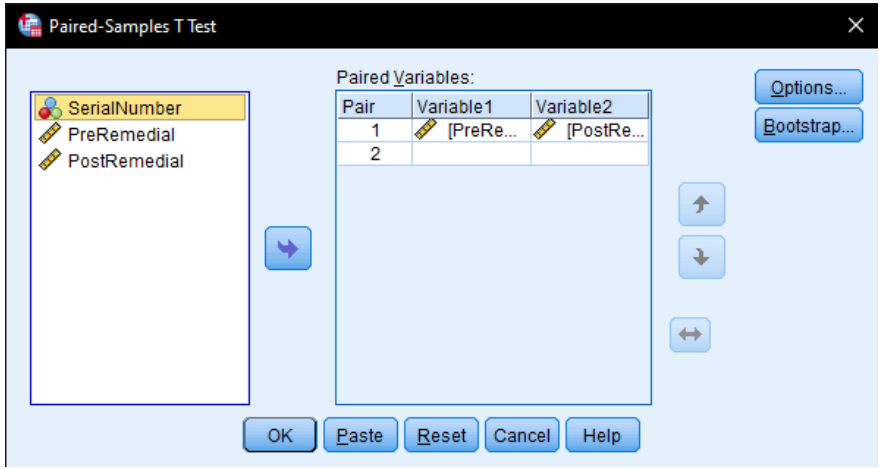
Onto SPSS!

Analyze -> Compare Means
-> Paired-Samples T Test



Onto SPSS!

- Select both ‘PreRemedial’ and ‘PostRemedial’ and move them over to the right column (you can hold the *ctrl* key to select multiple variables)
- OK!



Onto SPSS!

Looking at the output file, we get a t score = -5.834.

This is the degrees of freedom (*n* - number of pairs = 19)

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	PreRemedial - PostRemedial	-13.950	10.694	2.391	-18.955	-8.945	-5.834	19	.000

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	PreRemedial	43.65	20	4.580	1.024
	PostRemedial	57.60	20	9.627	2.153

We can say that, on average, students who underwent remedial classes improved their grades from 43.65 to 57.60 (check *p* value for statistical significance)

p-value < .001 (smaller than the critical alpha .05). We reject the null hypothesis. Therefore, we conclude that scores before and after remedial lessons were significantly different.

Write-up

JAMES COOK UNIVERSITY SINGAPORE

An example write-up can be found on:

JCUS Learning Centre website -> Statistics and Mathematics Support

JAMES COOK UNIVERSITY SINGAPORE

Questions?

learningcentre-singapore@jcu.edu.au