Seminar 8
How to conduct and interpret the independent sample T-Test

Quantitative Research Methods
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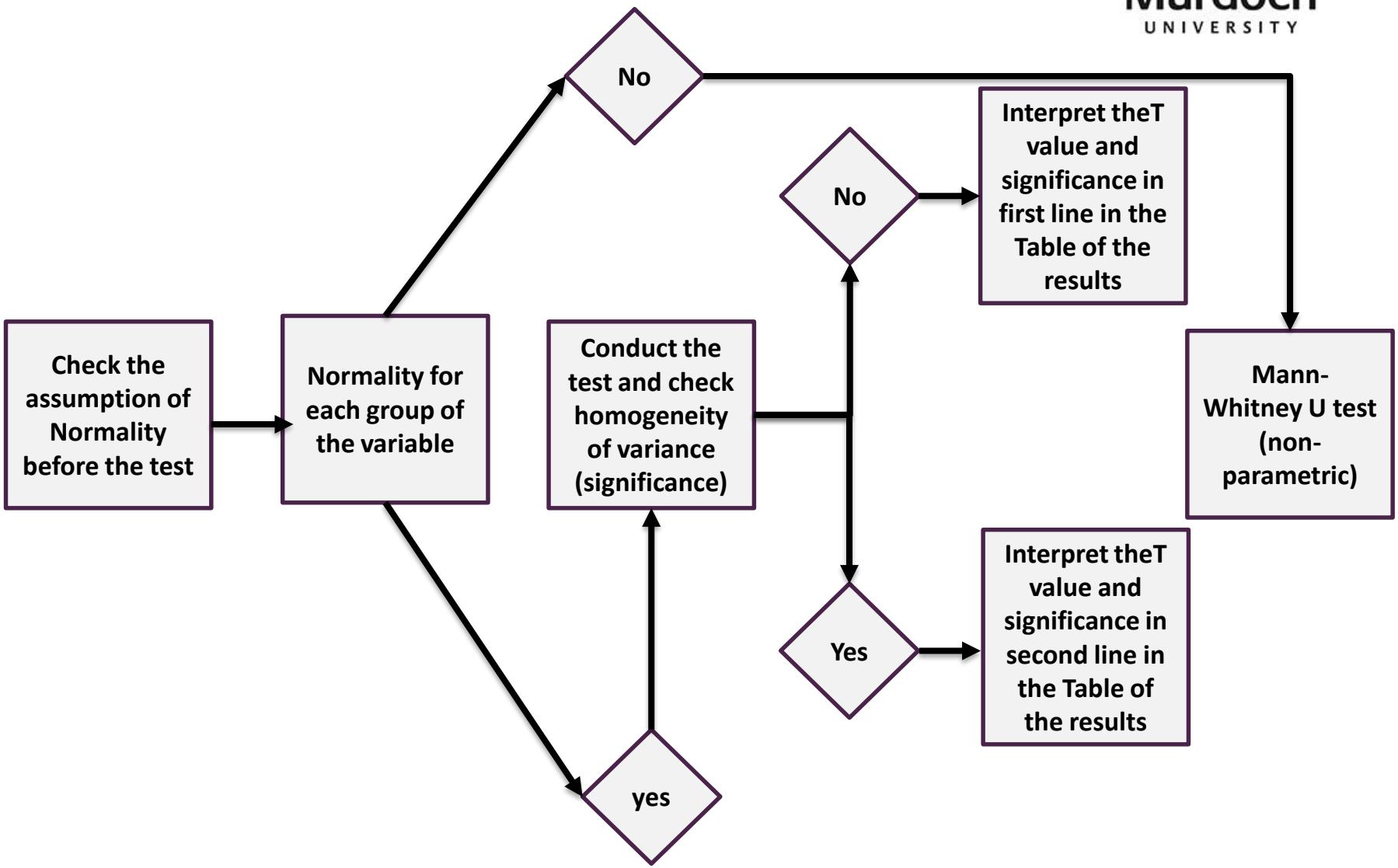
General assumptions of those techniques

- Level of measurement
  - Each of these approaches assumes that the dependent variable is measured at the interval or ratio level, that is, using a continuous scale rather than discrete categories.
- Independence of observations
  - each observation or measurement must not be influenced by any other observation or measurement. Violation of this assumption, according to Stevens (1996, p. 238), is very serious.
- Normal distribution
  - This should be conducted for the continues/interval variable for each of the groups.
- Homogeneity of variance
  - This means that the variability of scores for each of the groups is similar. This will be discussed when we deal with T-tests.

T-tests

- There are different types available in SPSS. We are going to cover two of them:
  - **independent-samples t-test**, used when you want to compare the mean scores of two different groups of people or conditions; and
  - **paired-samples t-test**, used when you want to compare the mean scores for the same group of people on two different occasions, or when you have matched pairs.
  - If you have more than two groups, or conditions, you will need to use analysis of variance instead (Session 10)

How to decide on independent sample T test



Independent-samples t-test

- Independent-samples t-test, used when you want to compare the mean scores of two different groups of people or conditions.
- Example
  - survey.sav data file.
  - Explores sex differences in self-esteem scores.
  - The two variables used are
    - SEX (with males coded as 1, and females coded as 2) and
    - TSLFEST, which is the total score that participants recorded on a ten-item self-esteem scale.
- Research Question
  - Is there a significant difference in the mean self-esteem scores for males and females?
- Non-parametric alternative: Mann-Whitney Test

Normality assessment

- Analyse-Descriptive Statistics-Explore.
- Move the variable “Sex” to the Factor list.
- Move the variable “TSLFEST” to the dependent list.
- Click on plots- de-select Stem-and-Leaf>> Select Histogram>>Select Normality plots with tests.
- Are both total self esteem for males and total self esteem for females normally distributed?

Normality results

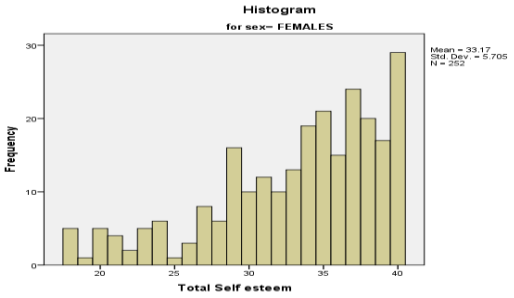
Descriptives

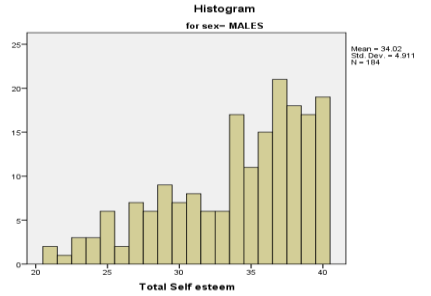
	sex			Statistic	Std. Error
Total Self esteem	MALES	Mean		34.02	.362
		95% Confidence Interval for Mean	Lower Bound	33.31	
			Upper Bound	34.74	
		5% Trimmed Mean		34.31	
		Median		35.00	
		Variance		24.120	
		Std. Deviation		4.911	
		Minimum		21	
		Maximum		40	
		Range		19	
		Interquartile Range		8	
		Skewness		-.758	.179
		Kurtosis		-.378	.356
	FEMALES	Mean		33.17	.359
		95% Confidence Interval for Mean	Lower Bound	32.47	
			Upper Bound	33.88	
		5% Trimmed Mean		33.57	
		Median		34.50	
		Variance		32.551	
		Std. Deviation		5.705	
		Minimum		18	
		Maximum		40	
		Range		22	
		Interquartile Range		8	
		Skewness		-.887	.153
		Kurtosis		.066	.306

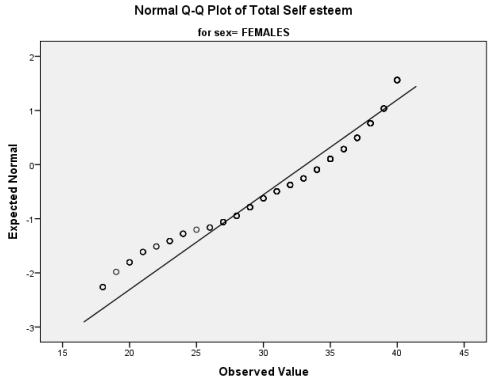
Tests of Normality

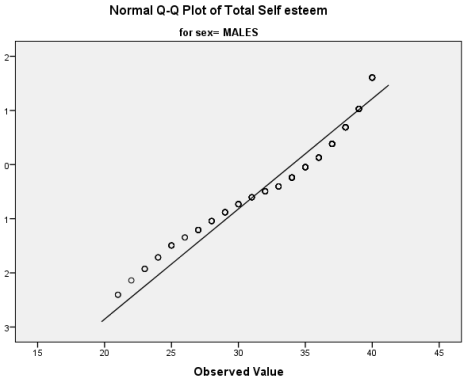
		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	sex	Statistic	df	Sig.	Statistic	df	Sig.
Total Self esteem	MALES	.146	184	.000	.916	184	.000
	FEMALES	.133	252	.000	.912	252	.000

a. Lilliefors Significance Correction





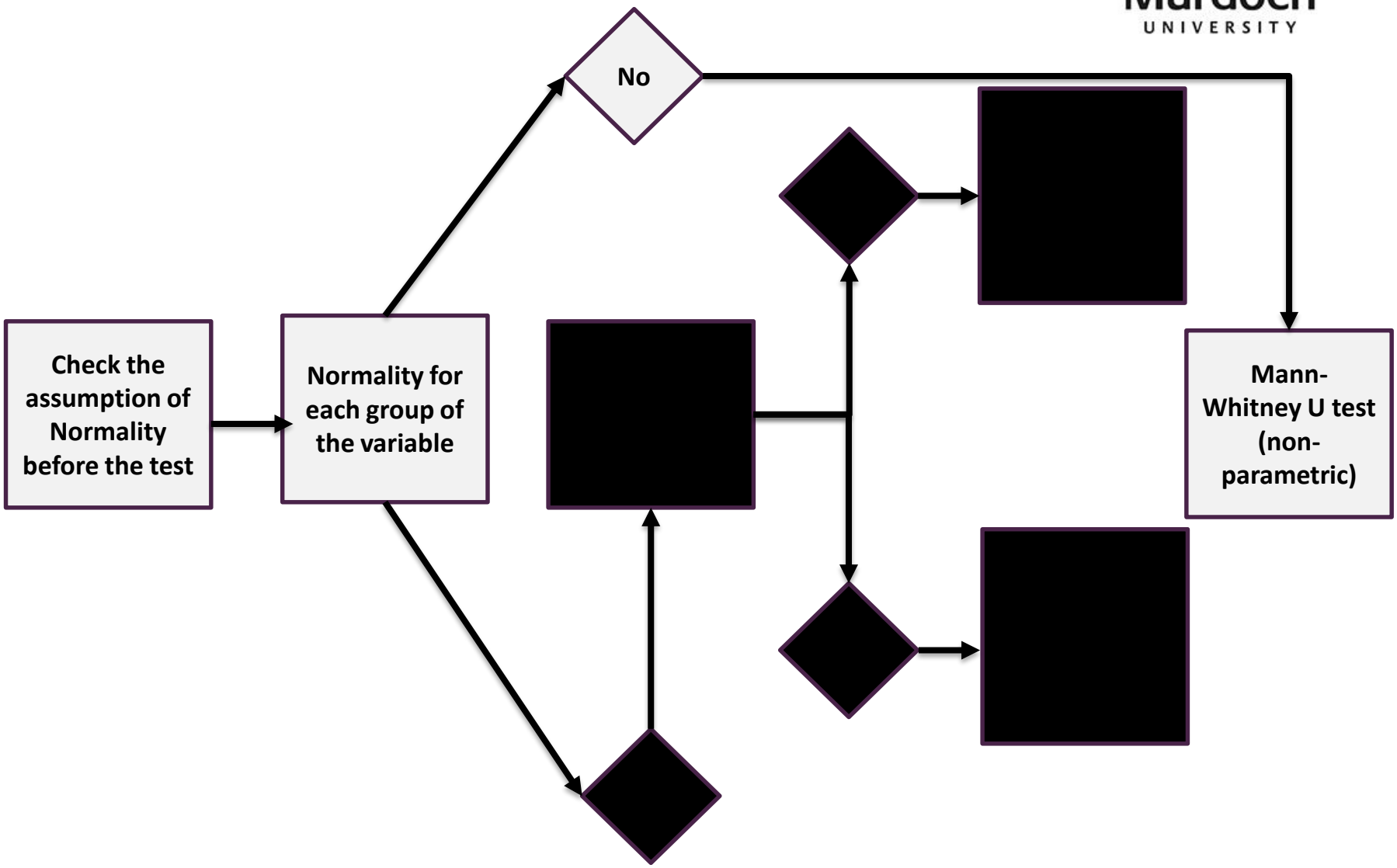




Criterion	Male	female
Skewness	-.758	-.887
KS, SW	< 0.05	< 0.05
Mean-median	Not large	A bit large
Histogram	Skewed	Skewed
Q-Q	Skewed	Skewed

Normality has been violated for both of them. Wee need to go for Mann-Whitney U test (Session 11).

How to decide on independent sample T test



T-test

For the sake of learning, let’s assume that the two variables were normally distributed.

We need to proceed with the procedure.

Procedure

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Procedure for independent-samples t-test

1. From the menu at the top of the screen click on: **Analyze**, then click on **Compare means**, then on **Independent Samples T-test**.
2. Move the dependent (continuous) variable (e.g. total self-esteem) into the area labelled **Test variable**.
3. Move the independent variable (categorical) variable (e.g. sex) into the section labelled **Grouping variable**.
4. Click on **Define groups** and type in the numbers used in the data set to code each group. In the current data file 1=males, 2=females; therefore, in the **Group 1** box, type 1; and in the **Group 2** box, type 2.
5. Click on **Continue** and then **OK**.

Interpretation of the results

Have a look at the mean and standard deviation for each of your groups.
Check the number of people in each group (N). Always check these values first. Do they seem right? Are the N values for males and females correct? Or are there a lot of missing data? If so, find out why. Perhaps you have entered the wrong code for males and females (0 and 1, rather than 1 and 2). Check with your codebook.

Group Statistics

	SEX	N	Mean	Std. Deviation	Std. Error Mean
Total self-esteem	MALES	184	34.02	4.91	.36
	FEMALES	252	33.17	5.71	.36

Interpretation of the results

Check Levene's test for equality of variances. This tests whether the variance (variation) of scores for the two groups (males and females) is the same.

* If your Sig. value is larger than .05 (e.g. .07, .10), you should use the *first line* in the table, which refers to **Equal variances assumed**.

* If the significance level of Levene's test is p=.05 or less (e.g. .01, .001), this means that the variances for the two groups (males/females) are not the same. Therefore your data violates the assumption of equal variance. In this case, you should use the information in the *second line* of the t-test table, which refers to **Equal variances not assumed**.

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
Total self-esteem	Equal variances assumed	3.506	.062	1.622	434	.105	.85	.52	-.18	1.87
	Equal variances not assumed			1.661	422.349	.098	.85	.51	-.16	1.85

Interpretation of the results

Assess significance of the difference

If the value in the **Sig. (2-tailed)** column is *equal or less* than .05 (e.g. .03,.01, .001), then there is a significant difference in the mean scores on your dependent variable for each of the two groups. If the value is *above* .05 (e.g. .06, .10), there is no significant difference between the two groups.

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
Total self-esteem	Equal variances assumed	3.506	.062	1.622	434	.105	.85	.52	-.18	1.87
	Equal variances not assumed			1.661	422.349	.098	.85	.51	-.16	1.85

Interpretation of the results

Calculating the effect size for independent-samples t-test

Effect size statistics provide an indication of the **magnitude of the differences between your groups** (not just whether the difference could have occurred by chance).

Group Statistics

	SEX	N	Mean	Std. Deviation	Std. Error Mean
Total self-esteem	MALES	184	34.02	4.91	.36
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$$\text{Eta squared} = \frac{t^2}{t^2 + (N1 + N2 - 2)}$$

Independent Samples Test

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	Equal variances not assumed			1.661	422.349	.098	.85	.51	-.16	1.85

Reporting the results

An independent-samples t-test was conducted to compare the self-esteem scores for males and females. There was no significant difference in scores for males (M=34.02, SD=4.91) and females [M=33.17, SD=5.71); t(434)=1.62, p=.11]. The magnitude of the differences in the means was very small (eta squared=.006).

Group Statistics

	SEX	N	Mean	Std. Deviation	Std. Error Mean
Total self-esteem	MALES	184	34.02	4.91	.36
	FEMALES	252	33.17	5.71	.36

$$\text{Eta squared} = \frac{1.62^2}{1.62^2 + (184 + 252 - 2)}$$

$$\text{Eta squared} = .006$$

Independent Samples Test

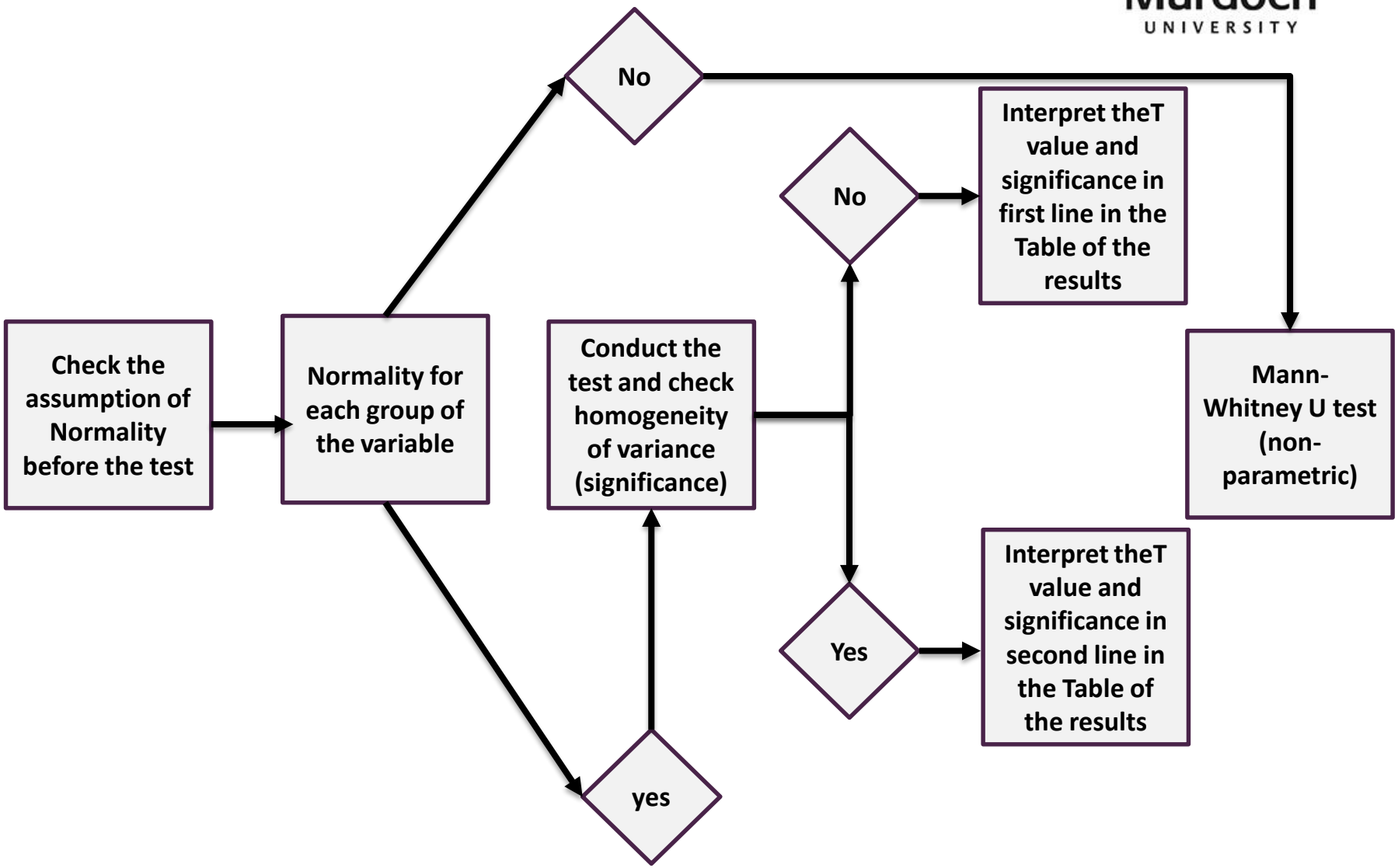
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Total self-esteem	Equal variances assumed	3.506	.062	1.622	434	.105	.85	.52	-.18	1.87
	Equal variances not assumed			1.661	422.349	.098	.85	.51	-.16	1.85

Another example

- survey.sav data file.
- Explores sex differences in total social desiarability.
- The two variables used are
  - SEX (with males coded as 1, and females coded as 2) and
  - Total social desiarability.

- Research Question
  - Is there a significant difference in the mean social desiarability scores for males and females?
- Non-parametric alternative: Mann-Whitney Test

How to decide on independent sample T test



Normality results

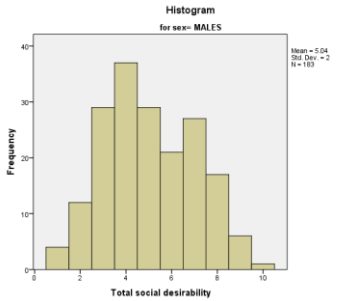
Descriptives

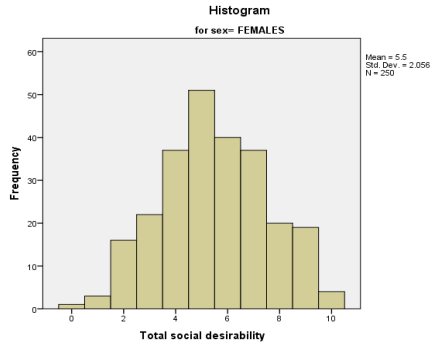
	sex			Statistic	Std. Error
Total social desirability	MALES	Mean		5.04	.148
		95% Confidence Interval for Mean	Lower Bound	4.75	
			Upper Bound	5.34	
		5% Trimmed Mean		5.02	
		Median		5.00	
		Variance		3.998	
		Std. Deviation		2.000	
		Minimum		1	
		Maximum		10	
		Range		9	
		Interquartile Range		3	
		Skewness		.181	.180
		Kurtosis		-.764	.357
	FEMALES	Mean		5.50	.130
		95% Confidence Interval for Mean	Lower Bound	5.24	
			Upper Bound	5.75	
		5% Trimmed Mean		5.50	
		Median		5.00	
		Variance		4.227	
		Std. Deviation		2.056	
		Minimum		0	
		Maximum		10	
		Range		10	
		Interquartile Range		3	
		Skewness		.016	.154
		Kurtosis		-.490	.307

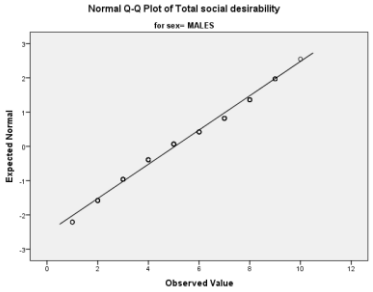
Tests of Normality

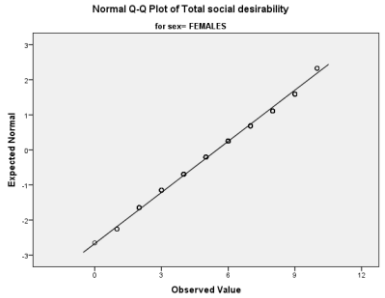
		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	sex	Statistic	df	Sig.	Statistic	df	Sig.
Total social desirability	MALES	.147	183	.000	.960	183	.000
	FEMALES	.115	250	.000	.973	250	.000

a. Lilliefors Significance Correction





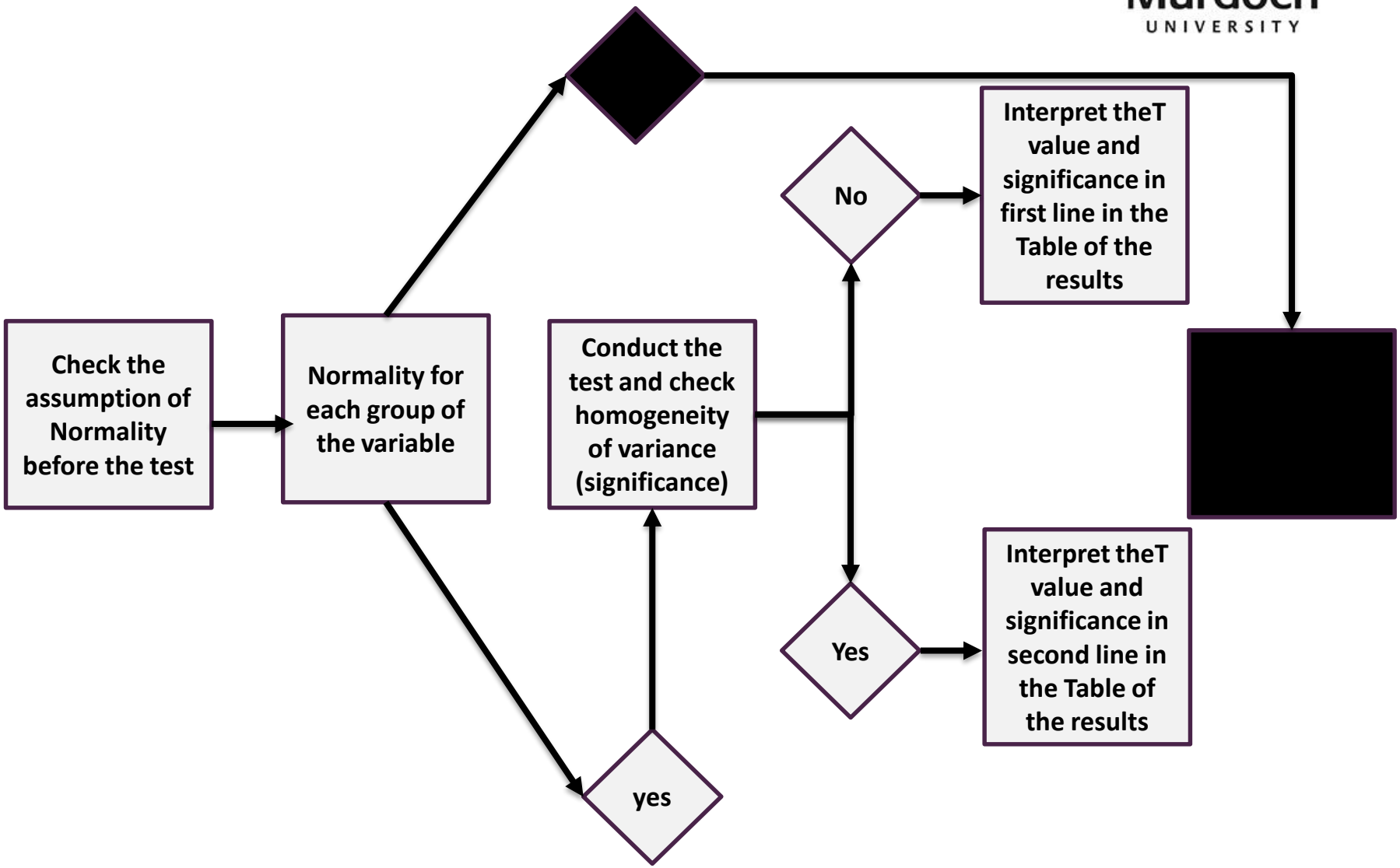




Criterion	Male	Female
Skewness	.181	.016
KS, SW	< 0.05	< 0.05
Mean-median	Not large	Not large
Histogram	Not heavily Skewed	Not heavily Skewed
Q-Q	Good	good

Normality has not been violated for both of them. Wee need to proceed with the test

How to decide on independent sample T test



Procedure

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2. Move the dependent (continuous) variable (Social desirability) into the area labelled **Test variable**.
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4. Click on **Define groups** and type in the numbers used in the data set to code each group. In the current data file 1=males, 2=females; therefore, in the **Group 1** box, type 1; and in the **Group 2** box, type 2.
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Interpretation of the results

Have a look at the mean and standard deviation for each of your groups.
Check the number of people in each group (N). Always check these values first. Do they seem right? Are the N values for males and females correct? Or are there a lot of missing data? If so, find out why. Perhaps you have entered the wrong code for males and females (0 and 1, rather than 1 and 2). Check with your codebook.

Group Statistics

	sex	N	Mean	Std. Deviation	Std. Error Mean
Total social desirability	MALES	183	5.04	2.000	.148
	FEMALES	250	5.50	2.056	.130

Interpretation of the results

Check Levene's test for equality of variances. This tests whether the variance (variation) of scores for the two groups (males and females) is the same.

* If your Sig. value is larger than .05 (e.g. .07, .10), you should use the *first line* in the table, which refers to **Equal variances assumed**.

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									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Total social desirability	Equal variances assumed	.047	.828	-2.288	431	.023	-.452	.198	-.841	-.064
	Equal variances not assumed			-2.297	398.328	.022	-.452	.197	-.839	-.065

Interpretation of the results

Assess significance of the difference

If the value in the **Sig. (2-tailed)** column is *equal or less* than .05 (e.g. .03,.01, .001), then there is a significant difference in the mean scores on your dependent variable for each of the two groups. If the value is *less than* .05 (e.g. .06, .10), there is a significant difference between the two groups.

Independent Samples Test

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	Equal variances not assumed			-2.297	398.328	.022	-.452	.197	-.839	-.065

Reporting the results

An independent-samples t-test was conducted to compare the social desiarability scores for males and females. There was a significant difference in scores for males (M=5.04, SD=2.00) and females [M=5.50, SD=2.056); t(434)=-2.288, p<.05]. The magnitude of the differences in the means was very small (eta squared=?).

$$\text{Eta squared} = \frac{t^2}{t^2 + (N1 + N2 - 2)}$$

Group Statistics

	sex	N	Mean	Std. Deviation	Std. Error Mean
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Independent Samples Test

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