Example: INDEPENDENT SAMPLES (TWO-SAMPLE) T – TEST

The Health Survey for England 2000 (data courtesy UK Data Archive) recorded the number of cigarettes smoked on a weekday for smokers as a variable named *cigwday*. Non-smokers were given a missing value code that means they are automatically excluded from analyses of this variable.

Testing whether, on average, men and women aged between 16 and 21 smoke the same number of cigarettes on weekdays, the null and alternative hypotheses are:

Null (H_0): mean number of cigarettes smoked are the same for men and women

Alternative (H_1): mean number of cigarettes smoked differ between men and women

The two-sample t-test is potentially a good test to use here because:

(1) comparisons are being made between two independent samples (men vs women)

(2) the measurement being compared (number of cigarettes smoked per day) is quantitative

The output from SPSS is shown below. The first table summarises the sample data, while the second table provides the basis for conclusion about the population from which the samples were drawn:

T-Test

Group Statistics

	Sex	N	Mean	Std. Deviation	Std. Error Mean
Number cigarettes smoke on weekday	Men	87	11.5747	7.43911	.79756
	Women	80	10.5750	6.78378	.75845

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
Number cigarettes smoke on weekday	Equal variances assumed	1.056	.306	.905	165	.367	.99971	1.10489	-1.18182	3.18125
	Equal variances not assumed			.908	164.990	.365	.99971	1.10061	-1.17338	3.17281

The two sample t-test assumes that the variation in the dependent variable, number of cigarettes smoked in a weekday, is the same for men and women. The first set of circled results are the results of Levene's test, a test for equal variances. In this case, the P-value of 0.306 is greater than 0.05, showing that there is no statistically significant evidence that the variances are not equal. This means that it is reasonable to continue with the standard two-sample t-test, on the assumption that these variances are equal.

The second set of circled results give the output from the t-test: the test statistic, degrees of freedom and P-value. SPSS labels the P-value as 'sig.(2-tailed)'. To decide whether to reject the null hypothesis, check whether P is < 0.05.

Although our conclusion is based wholly on the P-value, the convention is to report the value of t and the degrees of freedom as well.

The hypothesis test allows you to say:
There is no statistically significant evidence that the mean number of cigarettes smoked differs between men and women (t= 0.905, df= 165, P = 0.367).

The confidence interval allows you to say:
We are 95% confident that the mean difference between men and women in the number of cigarettes smoked per week day is between –1.2 and +3.2 cigarettes per week day, where a – sign corresponds to women smoking more than men on average, and a + sign corresponds to men smoking more than women, on average.

In this example, the confidence interval includes 0, that is, no mean difference between men and women's average weekday consumption of cigarettes. This always happens when there is no statistically significant difference between the means.

Anything else?

The analysis is based on two assumptions:

(1) the variation in *cigwday* is the same for men and women
(2) the variable, *cigwday*, is Normally distributed for men and also for women

The first of these assumptions was checked above, using the Levene's test result produced by SPSS.

The second assumption also needs checking. Note that this is really two assumptions in one, that is, we need to assume that the number of cigarettes smoked by men and the number smoked by women are both Normally distributed. Checking this is an important step since the calculation of the P-value

and the confidence interval both depend on the assumptions listed above. If the data do not support the assumption, then the Mann-Whitney U test, a non-parametric method, will give more reliable results.