

SPSS PC Version 10: T-Test - Differences between Means¹

It is possible to use inferential techniques for the comparison of two groups in terms of their means on some variable. The purpose of this process is to determine whether: 1) the differences you observe between the two *samples* represents a *real difference* between the *populations* from which the samples were drawn; *or* 2) the observed difference just happened by chance when, in reality, the two populations don't differ at all on the variable you are interested in. For example, we could use the "1995 National Survey of Family Growth" sample data to examine whether Hispanic women differ significantly from Non-Hispanic women in terms of their level of education.

Using SPSS to compare means from two independent samples:

- To conduct an independent samples t-test (the most common variety) choose *Analyze, Compare Means..., Independent-Samples T-Test*. A dialog box will pop up in which you will have to specify two things: the "test variable" and the "grouping variable."
- The "grouping variable" is the variable that defines the two groups that you want to compare. In our example, the grouping variable is *hispanic* since it distinguishes between Hispanic and Non-Hispanic women in the NSFG data. In addition to specifying this "grouping variable" you have to define the categories of that variable you want to compare in the dialog window that pops up when you select "Define Groups..." Here we want to compare those women with a value of 1 (=Hispanic) to those with a value of 2 (=Non-Hispanic) on the variable *hispanic*.
- The "Test variable(s)" are the variables on which you want to compare the two groups. In our example we want to see if the average education of Hispanic and non-Hispanic women are significantly different from one another, our "test variable" would be *educ* ("Education in years"). Note that you can specify multiple "Test variable(s)" on which to compare your groups.

T-TEST

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GROUPS=hispanic(1 2)
/MISSING=ANALYSIS
/VARIABLES=educ
/CRITERIA=CIN(.95) .
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- For our example we get the following output:

Group Statistics

	HISPANIC Whether R is Hispanic	N	Mean	Std. Deviation	Std. Error Mean
EDUC Education in Years	1.00 Hispanic	1553	11.1945	3.3282	8.445E-02
	2.00 Non-Hispanic	9294	12.9293	2.5853	2.682E-02

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
EDUC Education in Years	Equal variances assumed	128.742	.000	-23.402	10845	.000	-1.7348	7.413E-02	-1.8802	-1.5895
	Equal variances not assumed			-19.578	1877.567	.000	-1.7348	8.861E-02	-1.9086	-1.5611

¹Prepared by Kyle Crowder of the Sociology Department of Western Washington University, and modified by Patty Glynn, University of Washington. 11/15/2000

- The output from the t-test has two main components. The first box reports the mean values on the variable for the two different groups. Here we see that the 1,553 Hispanic women in the sample have a mean education of 11.19 years while the 9,294 non-Hispanic women have an average of 12.93 years of education. The question remains: Is this sample difference in educational attainment large enough to convince us that there is a real, statistically significant difference in educational attainment between the population of Hispanic women and the population of non-Hispanic women?
- The second box displays the results of the t-test that SPSS conducts to test whether or not the difference between the two sample means is significantly different from zero (null hypothesis that there is no real difference between the groups and any observed difference just occurred by chance). This second box contains the difference between the means (labeled "Mean Difference"; notice that $11.1945 - 12.9293 = -1.7348$), the standard error of the difference (labeled "Std. Error Dif."), and the t(obtained) (labeled "t") that results when the mean differences is divided by the standard error. This "t" tells you how far away from 0, in terms of the number of standard errors, the observed difference between the two sample means falls.
- Note that there are actually two sets of results: one labeled "Equal variances assumed" and the other labeled "Equal variances not assumed." In reality, there are two ways to calculate the standard error of the difference between means. Which of these is used depends on whether or not we can assume that the independent samples we are comparing are drawn from populations with an equal amount of variability on the variable we are interested in. You'll notice, however, that the calculation of the standard error when equal variances are *not* assumed actually yields a larger estimate of the standard error and is, therefore, a more conservative hypothesis test. You can determine which estimate is better by examining the Test for Equality of Variances. If this shows a significant value, then equal variances **cannot** be assumed. So, in this case, we must look at the lower numbers.
- You have two ways to use this information to assess your null hypothesis:
 - 1) You could figure out the critical-t, given your degrees of freedom and chosen alpha level, and compare this to your t(obtained). If "t" is more extreme than that critical-t, you can reject the null hypothesis. In our example, the t-critical for a two-tailed test with an alpha of .05 would be ± 1.96 . Since our obtained t (-19.578) is more extreme than this critical value, we can reject our null hypothesis in favor of the research hypothesis that there is a real difference between the population of Hispanic women and the population of non-Hispanic women in terms of their average level of education
 - 2) The same conclusion can be reached with less work by comparing your chosen alpha level with the SPSS-reported probability (p-value) associated with the obtained value of t. The column labeled "Sig. (2-tailed)" reports the probability of obtaining an observed mean difference of this extreme or more extreme if, in reality, the null hypothesis is true and there is no real difference between the populations from which the samples are drawn. If this p-value is *smaller* than your chosen alpha level you can reject the null hypothesis in favor of the research hypothesis that there is a real difference between the populations. In our example the p-value of .000 is much smaller than our chosen alpha level of .05, so we can conclude, once again, that the observed difference between the samples is statistically significant.