Conducting and Interpreting t-tests:

A non-random survey of UNT students was conducted in 2015. The resulting data were used to compare two groups by calculating the t statistic. The steps that were followed included:

1. Click Analyze
2. Click Compare Means
3. Independent Sample t test
4. Move Variable 13 (experiments w/ drugs) into the "Grouping Variable"
5. Click Define Groups and enter 1 for Group 1 and 2 for Group 2
6. Click Continue
7. Move V2 (marijuana should be legalized) to "Test Variables"
8. Click Okay

Example: IBM-SPSS Output

Group Statistics					
	V13 -Have you experimented with drugs during your time in college	N	Mean	Std. Deviation	Std. Error Mean
V2-Marijuana should be legalized	Yes	20	3.85	1.040	.233
	No	26	3.00	1.265	.248
V11-Approximetly how many traffic ticket/citations have you recieved since you started driving?	Yes	20	3.0500	4.65069	1.03993
	No	26	1.0000	1.26491	.24807

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
V2-Marijuana should be legalized	Equal variances assumed	1.565	.218	2.436	44	.019	.850	.349	.147	1.553
	Equal variances not assumed			2.500	43.770	.016	.850	.340	.165	1.535
V11-Approximetly how many traffic ticket/citations have you recieved since you started driving?	Equal variances assumed	6.208	.017	2.153	44	.037	2.05000	.95217	.13102	3.96898
	Equal variances not assumed			1.917	21.172	.069	2.05000	1.06911	-.17223	4.27223

Steps for Interpreting Output on Previous Slide:

1. The null hypothesis that will be tested using a t-test: UNT students who have experimented with drugs are no different from UNT students who have not experimented with drugs with regard to their belief that Marijuana should be legalized.

2. Column "N" (number of cases) tells us that there were 20 UNT students in the sample who reported "yes" they experimented with drugs and there were 26 UNT students who reported "no" they did not.

3. Column "Mean" tells us that, of the group that reported "yes", they scored an average of 3.85 on the variable "Marijuana should be legalized" (ranging from 1 strongly disagree to 5 strongly agree). The second group scored an average of 3.0 on the variable "Marijuana should be legalized."

Steps for Interpreting Output on Previous Slide:

4. The null hypothesis that we are testing: In the population of UNT students, there is no difference between those who did and those who did not experiment w/drugs with regard to their attitude toward legalizing Marijuana. To test the null hypothesis, we will look for any difference in our sample and then, assuming we find some difference (in this case one group scored 3.85 and the other 3.0), we will use SPSS to calculate the probability (i.e., chance) that the difference found is due to sampling error and not actually a real difference in the UNT student population. If the probability is extremely small, 5% (.05) or less, then we will reject the null hypothesis of no difference and assume that the difference found between the two sample groups is a real difference existing among the two groups in the whole population of UNT students.

Steps for Interpreting Output on Previous Slide:

5. Column "F" and Column "Sig." help us determine which of the reported t statistics to use for variable 2—"Marijuana should be legalized." That is, two t statistics have been calculated for variable 2 and provided in the output (2.436 and 2.500). The two t statistics are somewhat different because they use different measures of variability in their calculations. If Column "Sig" is greater than .05, we use the first t statistic (2.436). If Column "Sig" is equal to or less than .05 then we use the second t statistic (2.500). In this case, the number in the "Sig." column is .218. This is larger than .05. Therefore, we use the first t statistic provided (2.436).

Steps for Interpreting Output on Previous Slide:

6. Column "t" shows the actual t statistic calculated.

In our example, the first t statistic provided is 2.436.

Steps for Interpreting Output on Previous Slide:

7.   Column "Sig. (2-tailed)": the t statistic and the degrees of freedom (reported in the "t" column and the "df" column) have been used by SPSS to test the null hypothesis of no difference between the two groups. In other words, the probability (or chance) that the difference found is due to sampling error and not a real difference found in the population of UNT students.

In our example, for variable 2: "Marijuana should be legalized" the probability (or p value) that the difference found is due to sampling error is 3.9% (.039), or, less than a 5% chance. Therefore, we reject the null hypothesis of no difference and concluded that the difference found in our sample is a real difference existing among these two groups within the entire UNT population.

Steps for Interpreting Output on Previous Slide:

7. Looking for Substantive Differences: if the t statistic is found to be significant, then we will assume that the difference found in our sample is also a difference that exists in the whole population. The next question then becomes: is the difference found, a substantive (meaningful) difference? That is, is the difference large enough to be considered meaningful.

This is a judgement call. You must decide whether the difference is a meaningful difference.

Steps for Interpreting Output on Previous Slide:

In our example, we might conclude: There is a "large" difference between group 1 (those who have experimented with drugs) and group 2 (those who have not) with regard to legalizing marijuana use. Group 1 is much more likely to be in favor of legalizing marijuana than group 2. Group 1 scored an average of 3.82 (on an index ranging from 1 to 5 with 5 being strongly agree) as compared to an average of 3.00 by group 2. Thus, group 1 scored almost 20% higher on the index.

On the other hand…

Steps for Interpreting Output on Previous Slide:

On the other hand, instead of the previous conclusion, you could make the argument that the difference found is not really a meaningful one— 3.85 is not that different from 3.0. Neither group is against legalizing marijuana.

Whether you choose to make the first argument of "meaningfulness" or the second of "not really a meaningful difference" is a judgement call to be made by the researcher.

But, whichever conclusion you decide to draw, you must provide a sound rationale for your decision in order for your decision to be "acceptable" to other researchers.

Steps for Interpreting Output on Previous Slide:

8.   Presenting/publishing your research results: You might begin by providing a review of other studies that have looked at something similar and what they found. Once reviewing the literature on your topic, you can then discuss whether the results you found support (or don't support) this previous research.
        If your findings refute previous research, then you might provide some probable reasons why the relationship you found is different. For example, our explanation/rationale for our findings might be that: it is reasonable to expect that those who have had little or no exposure to drugs (e.g., did not experiment with drugs in college) do not support the legalization of marijuana because they believe drug use is dangerous, including the use of marijuana. On the other hand, those who have experimented with drugs have shown a tendency to be less fearful of the use of drugs and consequently are more open to legalizing marijuana. (by the way, I am not advocating the legalization of marijuana)

When to use a one-tailed vs two-tailed test

Researchers typically use the two-tailed test. However, in some cases the one-tailed test is most appropriate. In one such case, if previous research has shown clearly that there is only one direction in the relationship between two variables, then a one-tailed test should be used. For example, previous research may have shown that "education affects the amount of water people drink." As stated, this is a two-tailed test since no direction of affect is noted (i.e., no statement is made about whether education causes people to drink more or less water).

On the other hand, if we knew from previous research that those with more education drink more water, our research hypothesis would be: education causes people to drink more water. Testing this research hypothesis would require a one-tailed test since a direction has been established from previous research.

How to determine significance for a one-tailed test

The IBM-SPSS output typically assumes the researcher is conducting a two-tailed test (i.e., two-tailed research hypothesis). Therefore, the SPSS program automatically calculates the significance of the t statistic, assuming a two-tailed test (as shown in the previous example output)

IBM-SPSS does not provide the significance level for a one-tailed test. However, the significance level for a one-tailed test can be easily determined by dividing the p value of the two-tailed test by "2".

For example, see next slide.

How to determine significance for a one-tailed test

For example, our previous two-tailed test showed that the probability of obtaining the difference we found, when there is actually no difference, is approximately 2% (.019).

If we chose to conduct a one-tailed test, we would begin by dividing the p value of .019 by "2" which equals .0095. Using a one-tailed test, we would conclude that the probability of obtaining the difference we found, when there is actually no difference, is 9/1000. That is, if we took 1000 random samples only 9 of them would find the two groups to be this different, when there is actually no difference. Therefore, we would reject the null hypothesis.

How to determine significance for a one-tailed test

Here's another example: if we found the p value for a two-tailed test to be .07 and we had selected an alpha of .05, we would conclude that the null hypothesis cannot be rejected since .07 is NOT .05 or smaller. There is greater than a 5 percent (.05) probability that the difference we found was simply due to sampling error. Therefore, we would not reject the null hypothesis.

On the other hand, if previous research clearly showed that there is a direction to the effect, then we would state the research hypothesis as a "one-tailed" hypothesis and use a one-tailed t test.

How to determine significance for a one-tailed test

In our example, to conduct a one-tailed t test, we would divide the p value of our two-tailed t test (.07) by two, equaling a p value of .035. Consequently, by using a one-tailed test, we are now willing to conclude that the difference found between the two groups IS significant. That is, there is only a 3.5 percent probability that we would have found this large a difference (3.85 vs 3.00) when there was actually no difference between the two groups. Therefore, with a one-tailed test we will reject the null-hypothesis and accept the research hypothesis.

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(see you later)