17c_SPSS.pdf	Michael Hallstone, Ph.D. hallston@hawaii.edu

Lecture 17c: SPSS output for One Sample Hypothesis Test of Means (or t-tests)

The purpose of this lecture is to illustrate the SPSS output for one-sample hypothesis test of means (or one sample t-tests).

One sample hypothesis test of means or t-test of mean GPA

Below we will first deal with a hypothesized population GPA in step 1 is 3.0 in three forms.

You can test any of the following using the SPSS output below:

H_o: $\mu = 3.0$ $\quad$ H_1: $\mu \neq 3.0$

H_o: $\mu \geq 3.0$ $\quad$ H_1: $\mu < 3.0$

H_o: $\mu \leq 3.0$ $\quad$ H_1: $\mu > 3.0$

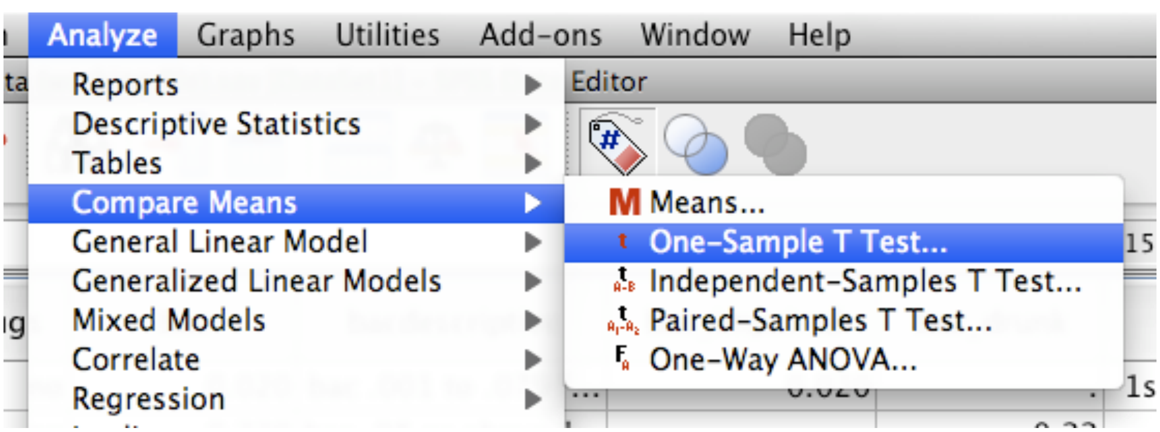
Doing the test using SPSS

To have SPSS perform this operation from the menus choose:

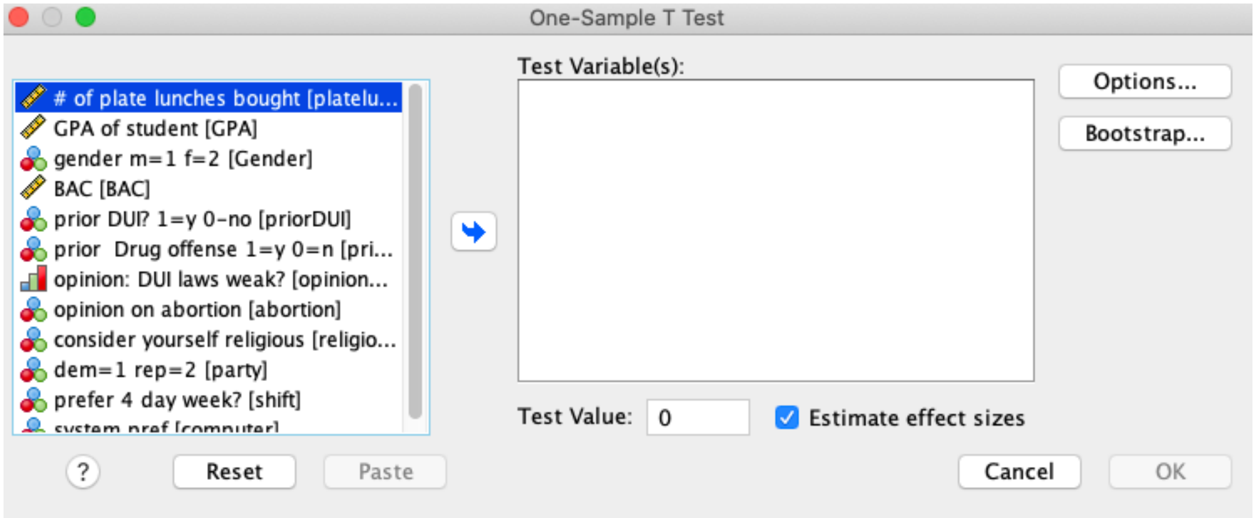
Analyze

Compare Means >

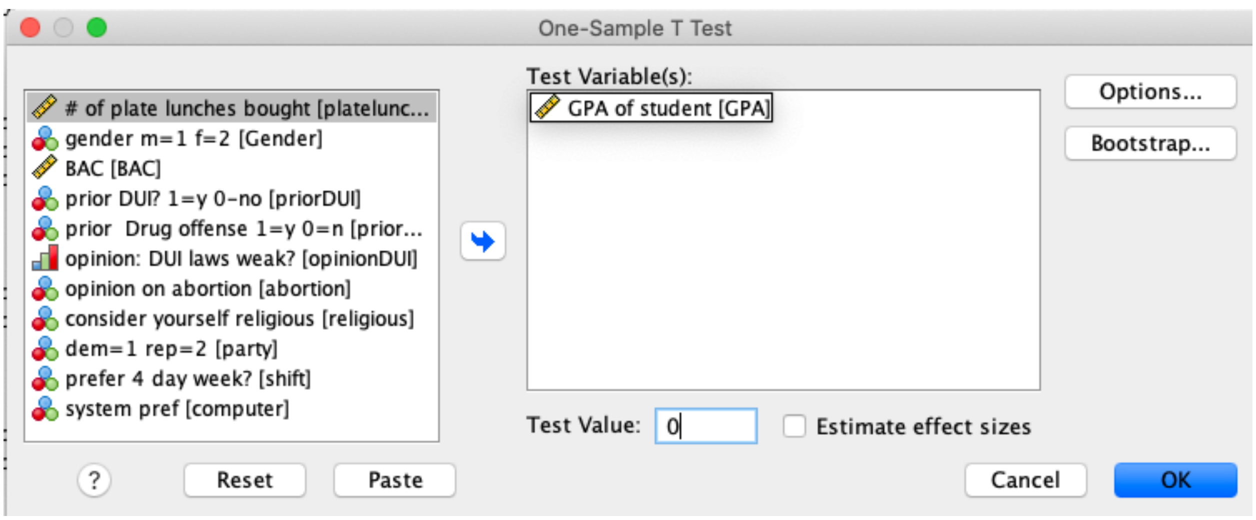
One Sample T-Test...



A window will pop up and you highlight and move your continuous variable over to the “Test Variables:” box with the arrow.



Then highlight GPA and move your variable with the arrow to “Test Variable(s) box. I will use GPA.

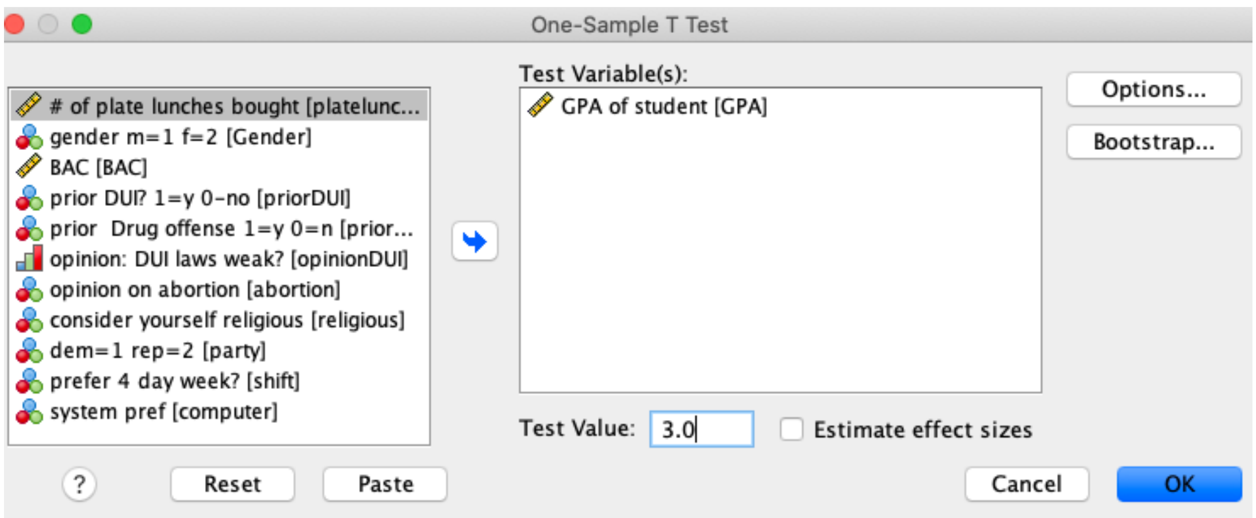


Then below there is a box that says "Test Value."

<u>You put the number of the hypothesized population mean in the "Test Value" box!</u> ***<u>You put the number that appears in Step 1! You put the number in the H_o and H_1!</u>***

Above in our step 1 we use H_o: $\mu = 3.0$ H_1: $\mu \neq 3.0$

so , we put "3.0" in the "Test Value" box. ***<u>Do not confuse this with "alpha" in step 2 which is typically .05! Do not put .05 in this box! You put the number that appears in your null and alternative hypothesis!</u>***



We do not use the "Estimate effect sizes" so I unchecked it in this example. It's not the end of the world if you did not do this. It will have no effect on your grade.

Push OK and you will see the following

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
GPA of student	10	2.8600	.88844	.28095

One-Sample Test

	Test Value = 3.0						
			Significance			95% Confidence Interval of the Difference	
	t	df	One-Sided p	Two-Sided p	Mean Difference	Lower	Upper
GPA of student	-.498	9	.315	.630	-.14000	-.7756	.4956

Test Ratio (TR) value in step 6 [SPSS calls it "t"]

Look in the lower box under "t" and you will see the TR which is -.498.

For our take home tests you do NOT have to show me the math by hand like above. Simply say "SPSS says TR= -.498" [Note the MINUS sign]

p-values

SPSS now reports two p-values.

P value for a two tailed test [SPSS calls it "two-sided"]

The output below can be used for the following two-tailed test: H_o: $\mu = 3.0$ H_1: $\mu \neq 3.0$

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
GPA of student	10	2.8600	.88844	.28095

One-Sample Test

	Test Value = 3.0						
			Significance			95% Confidence Interval of the Difference	
	t	df	One-Sided p	Two-Sided p	Mean Difference	Lower	Upper
GPA of student	-.498	9	.315	.630	-.14000	-.7756	.4956

Look at the bottom box. SPSS provides the two tailed p value in the box that says "Two-Sided p." Here p=0.630 or to turn this into a percentage we multiply by 100: 0.630 x 100= 63%

That means you if you reject the null you have to accept a 63% chance of being wrong. Thus we would not reject the null as our p value is greater than 5% [in step 2 on the tests we use this level of significance or "alpha"].

P-value plain English when we Fail to Reject null [FTR]:

In this case p=.63.

If I were to reject the null and conclude that the mean GPA of the population was NOT equal to 3.0, I would have to accept a 63% chance of error or of being wrong.

Since we used an alpha of .05 or 5 % in step 2, we FTR the null and the theory that the population GPA is equal to 3.0 "stands." [In step 7 we would say "There is insufficient evidence to reject the theory that the mean GPA of the population is equal to 3.0"]

P-value plain English when we reject the null:

Here we need to PRETEND the TR and p value were different. We will pretend it was 0.04 or 4%. Since 4% is less than our "alpha" in step 2 of .05 or 5% we would reject then null. On the test you would say

"I conclude that the mean GPA of the population is NOT equal to 3.0 with a 4% chance of being wrong."

You don't need to say this on the test but it's sort of like having 96% confidence in your decision to reject the null.

P value for a one tailed test [SPSS calls it "one-sided"]

SPSS reports only one 1-tailed p which is misleading as there are really two possible one tailed p values for these two possible tests:

H_o: $\mu \geq 3.0$ H_1: $\mu < 3.0$

H_o: $\mu \leq 3.0$ H_1: $\mu > 3.0$

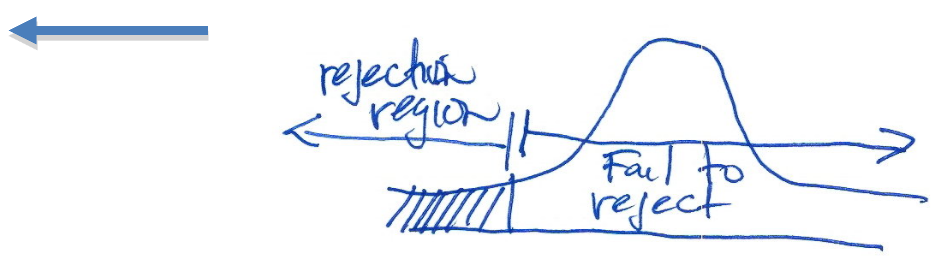
TR value falls in CORRECT tail

Here we need to pay attention to the sign of the TR. In this case our TR is negative.
Pretend we did this one: H_o: $\mu \geq 3.0$ H_1: $\mu < 3.0$.

[We are testing the theory that the mean GPA of the population is greater or equal to 3.0 or trying to prove the mean GPA of the population is less than 3.0

Divide the p-value by two and that is the one-tailed p-value *if the mathematical sign of the TR is in the correct tail!* If TR or t is positive it lands to the right of the mean, negative TRs are to the left. The TR must land in the appropriate tail.

The TR value needs to be NEGATIVE and our step 4/5 would look like



In this case the p-value is the total area under the curve from the TR all the way out through the left or negative side of the curve *regardless of whether or not the TR is negative or positive!*

If the TR value is in the "correct tail" the p value is half of the Two-sided p value or .630 divided by 2: p=.630 divided by 2 = .315 or 31.5%.

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
GPA of student	10	2.8600	.88844	.28095

One-Sample Test

	Test Value = 3.0						
			Significance			95% Confidence Interval of the Difference	
	t	df	One-Sided p	Two-Sided p	Mean Difference	Lower	Upper
GPA of student	-.498	9	.315	.630	-.14000	-.7756	.4956

Look at the box that says "One-Sided p" and low and behold p= value in plain English =0.315 or 31.5%.

P-value in plain English when we fail to reject null [FTR]:

So here we had this step 1: H_o: $\mu \geq 3.0$ H_1: $\mu < 3.0$

If I were to reject the null and conclude the mean GPA of the population was less than 3.0, I would have to accept a 31.5% chance of error or of being wrong.

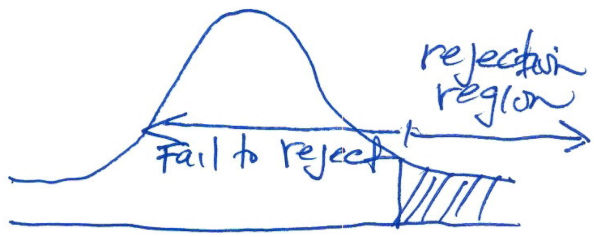
Since we used an alpha of .05 or 5 % in step 2, we FTR the null and the theory that the population GPA is greater than or equal to 3.0 "stands." [In step 7 we would say "There is insufficient evidence to reject the theory that the mean GPA of the population is greater than or equal to 3.0"]

TR falls in the WRONG tail

If testing the following:

H_o: $\mu \leq 3.0$ H_1: $\mu > 3.0$

So here we need a positive p value to reject the null.



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In this case the p-value is the total area under the curve from the TR all the way out through the right or positive side of the curve *regardless of whether or not the TR is negative or positive!*

Recall our TR= -.498 so our TR is in the WRONG tail. *The TR value needs to be NEGATIVE and ours is POSITIVE*

Thus in this case we would fail to reject the null but the p value is much higher. So our p value = 1 – one-sided p

=1 - 0.315= 0.685 or 68.5%

p value in plain English

If you were to reject the null and conclude the GPA of the population was GREATER THAN 3.0, you would have to accept a 68.5% chance of being wrong. (This amount of error is too high. Therefore you would fail to reject the theory in the null hypothesis.)

p-values when SPSS says p= <0.001

In rare cases you may see a “weird” very small p value like below.

H_o: $\mu = 1.0$ H_1: $\mu \neq 1.0$

H_o: $\mu \geq 1.0$ H_1: $\mu < 1.0$

H_o: $\mu \leq 1.0$ H_1: $\mu > 1.0$

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
GPA of student	10	2.8600	.88844	.28095

One-Sample Test

	Test Value = 1.0						
			Significance			95% Confidence Interval of the Difference	
	t	df	One-Sided p	Two-Sided p	Mean Difference	Lower	Upper
GPA of student	6.620	9	<.001	<.001	1.86000	1.2244	2.4956

p-value for two tailed tests [SPSS calls it “two-sided”]

The output above can be used for the following two-tailed test: H_o: $\mu = 1.0$ H_1: $\mu \neq 1.0$

It is just smaller than .001. Multiply that by 100 to get a percentage an p<0.1% which is much smaller than 5% error [in step 2 of the seven steps] so we would reject the null. Thus, I would conclude “The mean GPA of the population is not equal to 1.0 but there is a <u>less than</u> one-tenth of one percent chance of error or that I am wrong.

For One-Tailed Tests: [SPSS calls it “one-sided”]

All of the same TR in correct or incorrect tail rules above apply here to compute the p.

TR value falls in the correct tail

So here we had this step 1: H_o H_o: $\mu \leq 1.0$ H_1: $\mu > 1.0$

Here we needed a positive TR to reject null and we got it [TR=6.620].

P is exactly what you see in the “one-sided p” box. It is just smaller than .001. Multiply that by 100 to get a percentage an p<0.1% which is much smaller than 5% error [in step

2 of the seven steps] so we would reject the null.

Thus, I would conclude “The mean GPA of the population is greater than 1.0 but there is a less than one-tenth of one percent chance of error or that I am wrong.

TR falls in the wrong tail

So here we had this step 1: H_o: $\mu \geq 1.0$ H_1: $\mu < 1.0$

Here we needed a NEGATIVE TR to reject null and we got a POSITIVE [TR=6.620].

Thus, in this case we would fail to reject the null but the p value is much higher. So our p value = 1 – one-sided p

=1 - .001= 0.999 or 99.9. So here the p value is actually MORE than that!

p value in plain English

If you were to reject the null and conclude the mean GPA of the population was less than 1.0, you would have to accept MORE THAN a 99.9% chance of being wrong. (This amount of error is too high. Therefore you would fail to reject the theory in the null hypothesis.)