The Single-Sample t test

This Tip Sheet provides an overview of how to perform the single-sample t test in Excel, which includes calculating the test statistic, finding the appropriate critical value for comparison, and finding the p-value of the computed t statistic. The formula for the single-sample t statistic is shown below.

$$t = \frac{\overline{\mathbf{X}} - \boldsymbol{m}_{HYP}}{S_{\frac{1}{x}}}$$

 \overline{X} is the mean of the sample, \mathbf{m}_{HYP} is the mean referenced under the null hypothesis, and $s_{\overline{x}}$ is the estimated standard error of the mean, the formula for which is shown below.

$$s_{\bar{x}} = \frac{s_x}{\sqrt{N}}$$

 s_x is the estimated standard deviation of the referenced population (calculated from the sample), and N is the size of the sample. The formula for s_x is shown below.

$$s_x = \sqrt{\frac{\sum (X - \overline{X})^2}{N - 1}}$$

The image below shows the expressions used to compute the estimated standard error and the t statistic. Note that the estimated population standard deviation is calculated with the function **STDEV** (for information on standard deviations see <u>Tip Sheet #6</u>). Also, the calculated values in column C (each cell with an adjacent formula shown) are rounded in their visual display, but the non-rounded values are used in the formulas.

J	A	В	С	D	
1	282	Sample Mean	280	=AVERAGE(A	A1:A16) 🗌 🗖
2	272	Sample Size	16		
3	287	Population Mean	290		
4	298	Estimated Population Standard Deviation	12.7	=STDEV(A1:A	×16)
5	297				
6	302	Estimated Standard Error of the Mean	3.17	=C4/SQRT(C2	?)
7	263	t	-3.10	=(C1-C3)/C6	×
8	283				
9	296				
10	274	These fictitious data represent fe	action th	nes for	
11	278	participants who have spent 30 h	ours play	/ing a	
12	268	new video game designed to incr	ease hun	nan	
13	267	processing speed. The population	n mean c	comes	
14	275	from an aggregate data set compi	led from	ı 🗌	
15	277	numerous studies that gathered re	eaction t	ime data.	
16	264	B	•		
17	Australia				
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Our next step is to find the critical value with which to compare our computed t statistic. First, click in a cell near your computed t statistic and select "Function" from the Insert menu (below left). Next select "Statistical" from the Function category list and then select "TINV" from the Function name list (below right). Click OK.

	Paste Function	? ×
Microsoft Excel - Book1	Function <u>c</u> ategory:	Function name:
Eile Edit View Insert Format Tools Data Window Help Maci Cells Image: Cells <	Most Recently Used All Financial Date & Time Math & Trig Statistical Lookup & Reference Database Text Logical Information	STDEVP STDEVPA STEYX TDIST TINV TREND TRIMMEAN TTEST VAR VAR VAR VAR VAR VAR VAR VAR
4 298 Estimated Population Standar	2	OK 💦 Cancel

When you see the dialogue box below, input your alpha level (we will use 0.05) into the "Probability" field and degrees of freedom in the "Deg_freedom" field. The degrees of freedom value for a single-sample t test is N - 1, where N is the size of the sample. Notice that Excel automatically assumes we want the two-tailed critical value. You can check to see that the critical value Excel returns is correct with a table in a statistics textbook. Click OK when you have entered the values.

Pro	bability .05	<u></u> = 0.05
Deg_fi	reedom 15	<u> </u>
		= 2,131450856
urns th	e inverse of the Student's t-distributi	= 2,131450856 ion.
urns th Deg_fi	e inverse of the Student's t-distributi reedom is a positive integer indicatir characterize the distributior	= 2.131450856 ion. ng the number of degrees of freedom to 1.

Your output should resemble the image below. Note that Excel returns a positive critical value. This is not a problem because we know that the negative critical value has the same magnitude because Student's t distribution is symmetrical.

J	A	В		С	D	
7	263		t	-3.10	=(C1-C3)/C6	
8	283					_
9	296		t critical, æ = .05	2.13	=TINV(0.05,15)	-
	> > Shee	t1 / Sheet2 / Sheet3 /	1.			

From our critical value we can see that we should reject our null hypothesis. However, it is also useful to know the two-tailed p-value associated with our computed t statistic. Following the steps for inserting TINV above, select a nearby cell and insert TDIST. You should see the dialogue box below. For "X," enter the **absolute value** of your computed t statistic (Excel will not handle a negative value), and input the degrees of freedom into the "Deg_freedom" field as done previously. In the "Tails" field, enter the number 2. When you have entered these values click OK.

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7	263			t	-3,10	=(C1-C3)/C6	
8	283						
9	296		· · · · ·				
10	274	X	3.10		<u> </u>		
11	278	Deg_freedom	15		15		
12	268	Taile	0		<u> </u>		
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15	277	Returns the Student	's t-distribution.				
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17		X	s the numeric value at	: which to eva	aluate the distribu	ition.	
18		l al				-	
10 ∢ ∢	▶ ► Sheet	Formula	a result =0.00731723		OK	Cancel	

Your worksheet should now resemble the one below. What do you conclude? Does the video game work or should the researcher look elsewhere for trying to improve processing speed? Do not forget that decreased reaction times denote increased processing speed!

Ľ.	A	В	С	D	
1	282	Sample Mean	280	=AVERAGE(A1:A16)	1
2	272	Sample Size	16		
3	287	Population Mean	290		
4	298	Estimated Population Standard Deviation	12.7	=STDEV(A1:A16)	
5	297	-			
6	302	Estimated Standard Error of the Mean	3.17	=C4/SQRT(C2)	7
7	263	t	-3.10	=(C1-C3)/C6	1
8	283				
9	296	t critical, œ = .05	2.13	=TINV(0.05,15)	
10	274	two-tailed p-value	0.0073	=TDIST(3.1,15,2)	
11	278				
12	268				
13	7,90				
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