Two Sample t Test: unequal variances

Theorem 1: Let $\bar{x}$ and $\bar{y}$ be the sample means and s_x and s_y be the sample standard deviations of two sets of data of size n_x and n_y respectively. If x and y are normal, or n_x and n_y are sufficiently large for the Central Limit Theorem to hold, then the random variable

$$t = \frac{(\bar{x} - \bar{y}) - (\mu_x - \mu_y)}{\sqrt{\frac{s_x^2}{n_x} + \frac{s_y^2}{n_y}}}$$

has distribution $T(m)$ where

$$m = \frac{\left(\frac{s_x^2}{n_x} + \frac{s_y^2}{n_y}\right)^2}{\frac{\left(\frac{s_x^2}{n_x}\right)^2}{n_x - 1} + \frac{\left(\frac{s_y^2}{n_y}\right)^2}{n_y - 1}}$$

Observation: The nearest integer to m can be used.

An alternative calculation (**Satterthwaite's correction**) of m (which has the same value) is as follows

$$m = \frac{(n_x - 1)(n_y - 1)}{(n_x - 1)c_y^2 + (n_y - 1)c_x^2}$$

where

$$c_x = \frac{\frac{s_x^2}{n_x}}{\frac{s_x^2}{n_x} + \frac{s_y^2}{n_y}} \quad c_y = \frac{\frac{s_y^2}{n_y}}{\frac{s_x^2}{n_x} + \frac{s_y^2}{n_y}} = 1 - c_x$$

Observation: This theorem can be used to test the difference between sample means even when the population variances are unknown and unequal. The resulting test, called, Welch's t-test, will have a lower number of degrees of freedom than $(n_x - 1) + (n_y - 1)$, which was sufficient for the case where the variances were equal. When n_x and n_y are approximately equal, then the degrees of freedom and the value of t in Theorem 1 are approximately the same as those in Theorem 1 of Two Sample t Test with Equal Variances.

Real Statistics Function: The Real Statistics Resource Pack provides the following supplemental function.

DF_POOLED(R1, R2) = degrees of freedom for the two sample t test for samples in ranges R1 and R2, especially when the two samples have unequal variances (i.e. m in Theorem 1).

Excel Function: Excel provides the function TTEST to handle the various two sample t-tests.

TTEST(R1, R2, *tails, type*) = p-value of the t-test for the difference between the means of two samples R1 and R2, where *tails* = 1 (one-tailed) or 2 (two-tailed) and *type* takes the values:

1. the samples have paired values from the same population
2. the samples are from populations with the same variance
3. the samples are from populations with different variances

These three types correspond to the Excel data analysis tools

- t-Test: Paired Two Sample for Mean
- t-Test: Two-Sample Assuming Equal Variance
- t-Test: Two-Sample Assuming Unequal Variance

Note that the type 3 TTEST uses the value of the degrees of freedom as indicated in Theorem 1 unrounded, while the associated data analysis tool rounds the degrees of freedom as indicated in the theorem to the nearest integer. We will explain the type 1 TTEST in Paired Sample t Test.

This function ignores all empty and non-numeric cells. The value of alpha is assumed to be .05.

Example 1: In Example 1 of Two Sample t Test with Equal Variances, we assumed that the population variances were equal since the sample variances were almost the same. We now repeat the analysis assuming that the variances are not necessarily equal.

We use the Excel formula TTEST(A4:A13,B4:B13,2,3). The first two parameters represent the data for each sample (without labels). The 3rd parameter indicates that we desire a two-tailed test and the 4th parameter indicates a type 3 test. Since

TTEST(A4:A13,B4:B13,2,3) = 0.043456 < .05 = α

we reject the null hypothesis. Note that if we use the type 2 test, TTEST(R1, R2, 2, 2) = 0.043053, the result won't be very different, thus confirming our assumption that the population variances are almost equal.

Example 2: We repeat the analysis from Example 1 but with different data for the new flavoring.

	A	B	C
3	New	Old	
4	20	12	
5	32	8	
6	2	6	
7	25	16	
8	5	12	
9	18	14	
10	21	10	
11	7	18	
12	28	4	
13	40	11	
14			
15	10	10	size
16	19.8	11.1	mean
17	150.6222	18.76667	variance

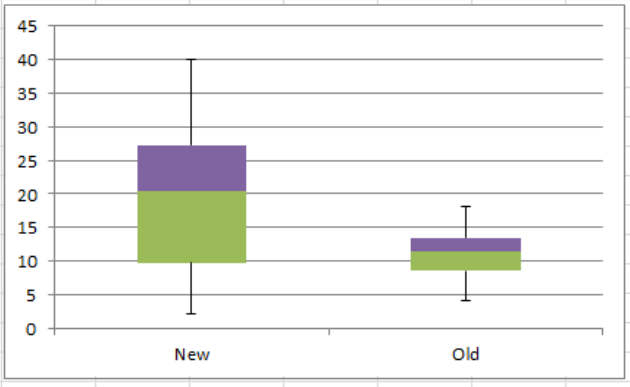

Figure 1 – Sample data and box plots for Example 2

Clearly, the sample variances are quite unequal. Using the T.TEST function with = 3 we get

T.TEST(A4:A13 ,B4:B13, 2, 3) = 0.05773 > .05 = α

and so this time we cannot reject the null hypothesis (for the two-tailed test). Note that if we had used the test with equal variances, namely T.TEST(A4:A13, B4:B13, 2, 2) = 0.048747 < .05 = α, then we would have rejected the null hypothesis.

We can also use Excel's **t-Test: Two-Sample Assuming Unequal Variances** data analysis tool to get the same result (see Figure 2).

	P	Q	R
35	t-Test: Two-Sample Assuming Unequal Variances		
36			
37		*New*	*Old*
38	Mean	19.8	11.1
39	Variance	150.6222	18.76667
40	Observations	10	10
41	Hypothesized Mean Difference	0	
42	df	11	
43	t Stat	2.113863	
44	P(T<=t) one-tail	0.029093	
45	t Critical one-tail	1.795885	
46	P(T<=t) two-tail	0.058186	
47	t Critical two-tail	2.200985	

Figure 2 – Data analysis for the data from Figure 1

Observation: Generally, even if one variance is up to 4 times the other, the equal variance assumption will give good results. This rule of thumb is clearly violated in Example 2, and so we need to use the t test with unequal population variances.

Real Statistics Data Analysis Tool: The Real Statistics Resource Pack provides a data analysis tool called **T Tests and Non-parametric Equivalents**, which combines the analyses for equal and unequal variances, as well as providing confidence intervals and the Cohen effect size. A second measure of effect size is also provided, which we will study in Dichotomous Variables and the t-test.

Example 3: Repeat Example 2 using the Real Statistics data analysis tool.

Enter **Ctrl-m** and select **T Tests and Non-parametric Equivalents** from the menu. Fill in the dialog box that appears as shown in Figure 3.

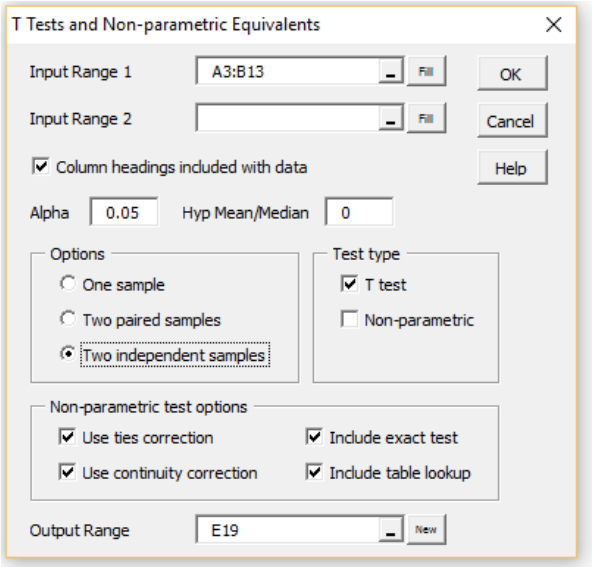

Figure 3 – Dialog box for T Test and Non-parametric Equivalents

Choose the **Two independent samples** and **T test** options and press **OK**. The output appears in Figure 4.

	E	F	G	H	I	J	K	L	M	N
19	T Test: Two Independent Samples									
20										
21	SUMMARY			Hyp Mean	0					
22	*Groups*	*Count*	*Mean*	*Variance*	*Cohen d*					
23	New	10	19.8	150.6222						
24	Old	10	11.1	18.76667						
25	Pooled			84.69444	0.945348					
26										
27	T TEST: Equal Variances				Alpha	0.05				
28		*std err*	*t-stat*	*df*	*p-value*	*t-crit*	*lower*	*upper*	*sig*	*effect r*
29	One Tail	4.115688	2.113863	18	0.024373	1.734064			yes	0.445955
30	Two Tail	4.115688	2.113863	18	0.048747	2.100922	0.05326	17.34674	yes	0.445955
31										
32	T TEST: Unequal Variances				Alpha	0.05				
33		*std err*	*t-stat*	*df*	*p-value*	*t-crit*	*lower*	*upper*	*sig*	*effect r*
34	One Tail	4.115688	2.113863	11.20841	0.028865	1.795885			yes	0.533885
35	Two Tail	4.115688	2.113863	11.20841	0.05773	2.200985	-0.35857	17.75857	no	0.533885

Figure 4 – Real Statistics data analysis for data from Figure 1

We can see from Figure 4 that the degrees of freedom have been reduced from 18 to 11.208 under the assumption of unequal variances. We can get this same value by using the formula =DF_POOLED(A4:A13, B4:B13).

Observation: The input data for the two independent sample t test can have missing data, indicated by empty cells or cells with non-numeric data. Such cells will be ignored in the analysis.

56 Responses to *Two Sample t Test: unequal variances*

Eric *says:*
March 23, 2016 at 1:05 am

Hi Charles,

With unequal variances, which degree of freedom is reported in the text describing the results ? The adjusted Welch df or the "natural" df (n1+n2-2) ?

Example : (t(df?)=2.78; p=0,004)

Can't find an answer on this on the web or in textbooks…

Thanx in advance for considering this,

Eric

Reply

Charles *says:*
March 23, 2016 at 7:58 am

Hi Eric,
As explained on the referenced webpage, the adjusted Welch df is reported.
Charles

Reply

Ravi *says:*
March 22, 2016 at 3:21 am

Hi Charles,

great and very helpful website!
I just have a small question: I calculated the total bacterial numbers in the blood of 20 boys at three different time points i.e., at age 1 yr, 3 yr and 5 yr. I am confused which type of t-test should I use to calculate the statistical difference between the different time points?

Many thanks in advance.

Ravi

Reply

Charles *says:*
March 22, 2016 at 8:41 am

Hi Ravi,

The t test can only be used with pairs and not triplets. Thus you would have to perform up to three paired t tests: 1 yr – 3 yr, 1 yr – 5 yr, 3 yr – 5 yr. With three tests, there is more chance for experimentwise error, and so if you usually use alpha = .05, you would have to reduce the value of alpha say to .05/3 = .0667.

The usual approach in this case, is to start by using a different test, namely Repeated Measures ANOVA. This will test whether there is a significant difference between all three times. If there is, then there are follow up tests to pinpoint where the differences lie.

I suggest that you look at the ANOVA and Repeated Measures ANOVA part of the website.

Charles

Reply

Ravi *says:*
March 22, 2016 at 9:57 am

Dear Charles,
Thank you so much for your quick response. I got your point!
By the way, if I wish to compare the data of cell numbers only between two time points i.e., 1yr and 5 yr, which type of excel t-test shall then be appropriate?
Many thanks once again.
Ravi

Reply

Charles *says:*
March 22, 2016 at 11:57 am

Ravi,
In that case a paired t test is a good choice, assuming that each sample is at least reasonably symmetric.
Charles

Reply

Ravi *says:*
March 23, 2016 at 1:09 am

Dear Charles,
Thank you so much for your advices.
Ravi

Serna *says:*
March 17, 2016 at 3:48 am

Hello sir Charles!
I am one of those people who gets their brains crumpled like hell when it comes to statistics.
I just want to know if waht t test should I use to know if there is a significant difference between my experimental values and a fixed theoretical value.
for example, exptl values are 1, 2, 3 and my theoretical values are 2, 2, 2

Reply

Charles *says:*
March 17, 2016 at 7:52 am

Hello Serna,
If the theoretical values are all 2, then you would use the one sample t test with hypothetical mean of 2. See the webpage
One Sample t Test
Charles

Reply

Peaches *says:*
March 17, 2016 at 2:51 am

How would I write up the results of a Two-Sample Assuming Unequal Variances with the results with the mean (variable 1 -3.11; variable 2 – 3.04), variance 0.022 & 0.029,
observations 159 & 332, df 351, t Stat 4.53, P(T<=t) two-tail 8.15
I need to know how to write this information up in a detailed format.

Reply

Charles *says:*
March 17, 2016 at 8:17 am

I have not checked to see whether the t stat and df you calculated are correct, but T.DIST.2T(4.53,351) = 8.10E-06 and not the p-value you report (the E-06 part is important).

When you report your results, you need to relate the statistical results to the real-world problem you were studying. I will suppose, for illustrative purposes, that you are testing whether a particular training course is effective in reducing accidents. I will also suppose that the p-value is 8.10E-06, and so you have a significant result.

Using APA-like guidelines you would say something along the following lines:

On average participants achieved better test scores after the training course (M = -3.11, SE = 0.15, N = 159) than those who did not take the training course (M = -3.04, SE = 0.17, N = 332). The difference is significant t(351) = 4.53, p < .001 (two-tailed); this represents a xx-sized effect of d = xx. Note that I used the standard error instead of the variance. You should also report the effect size Charles

Reply

Peaches *says:*
March 17, 2016 at 3:43 pm

The variables are positive numbers. Would I use variance instead of standard error?

Thank you.

Reply

Charles *says:*
March 18, 2016 at 6:49 am

That the variables are positive numbers is not relevant, You can certainly use the variance, but generally the standard error is reported.
Charles

Reply

Andrea *says:*
March 8, 2016 at 9:58 pm

I am comparing three types of breathing during the shooting performance, but i have no the same number of people in each groups. So the situation seems like this:
A:1, 2, 3, 4, 5, 6, 7, 8, 9
B:1, 2, 3, 4, 5, 6, 7
C: 1, 2, 3, 4
Is it possible to evaluete it by t-test? What is the method???

Reply

Charles *says:*
March 9, 2016 at 8:27 am

Andrea,
You don't need to equal sample sizes to use the t test. But you are comparing more than 3 samples and so you need to use one-way Anova instead of the t test. See the following webpage: One-way ANOVA.
Charles

Reply

Cardre *says:*
February 22, 2016 at 9:12 am

Hi Guys,

I am doing research involving 65 samples at two different cycles, and seeing the impact these cycles (A & B) would have on the samples. Which t-test would be best to use and why?

Reply

Charles *says:*
February 22, 2016 at 9:47 am

Cardre,
You haven't provided enough information for me to respond. What do you mean by cycles?
Charles

Reply

Louis *says:*
February 26, 2016 at 12:29 am

if you have more than 30 samples you should not be using the t-test. Use the normal gaussian curve to calculate the information you need.

Reply

Jaclyn *says:*
February 10, 2016 at 9:09 pm

Hi,
I have 2 questions:
1-why would I get 2 different T values when I run ttests in excel and spss?
2- I have a student who did a pre and post test but did not match up the ID number so correctly, what kind of ttest can she use, I am assuming can not used paired? Thanks

Reply

Charles *says:*
February 10, 2016 at 10:48 pm

Jaclyn,

1. You should get the same values. If you send me an Excel file with your data and results I will try to see what has happened.

2. The student will need to match up the ID numbers to be able to run any type of analysis.

Charles

Reply

Niez *says:*
December 14, 2015 at 2:50 pm

Hi,
I have a problem with my research. My lecturer told me to use both equal & unequal t-test but I don't understand what the difference equal & unequal t-test.

My research was about the efficiency between conventional and islamic banks from 2008 to 2015.the efficiency was measure by four (4) financial ratio.
1) return on asset between conventional & islamic bank
2) net profit margin between conventional & islamic bank
3) debt ratio between conventional & islamic bank.
4) earning per share between conventional & islamic bank.

It is logic to use both equal & unequal to run the data in excel & how?

Reply

Charles *says:*
December 14, 2015 at 5:14 pm

Hi,

In this situation, equal and unequal refers to variances of the two samples (actually the population, but the samples serve as surrogate for the population). You can calculate both versions (equal and unequal variances) of the t test using either Excel's data analysis tools or the Real Statistics data analysis tools. For more information, see the referenced webpage or the following webpage for more information about the equal variances version of the t test.
http://www.real-statistics.com/students-t-distribution/two-sample-t-test-equal-variances/

The t test is used to determine whether there is a significant difference in the means between two samples. This sounds like a reasonable test to use for the problems you have listed.

Charles

Reply

Athina Crilley *says:*
December 2, 2015 at 2:07 pm

Hello, I'm doing a t-test on part of a set of data using excel
1 mean is 1.6 with SD of 0.79, the other has a mean of 6.6 and a SD of 1.34. i've done the t test, selecting the first mean and SD as 'array 1' and the second lot as 'array 2'. it's a two-tailed test with unequal variance. I've got a p value of 0.48, which seems very high. have i done it correctly?

Reply

Charles *says:*

December 3, 2015 at 9:07 am

No, the arrays should contain the raw data, not the mean and standard deviation. You can perform the t test using TDIST or T.DIST using the means and standard deviations.
Charles

Reply

Yow *says:*
November 12, 2015 at 2:19 pm

Hello. Is this suitable if I have 10 respondents, which will be taking medication and be observed for their blood pressure for 10 days, to know if the medication is significant? or should I do one t-test for each of the respondent? Not really sure.
Sorry for the bad english.

Reply

Charles *says:*
November 12, 2015 at 7:11 pm

Unfortunately, I don't understand your question.
Charles

Reply

Learner *says:*
February 24, 2016 at 10:07 am

I guess, you want to study the effect of "medication" on "blood pressure" of patients (Is this medication significantly contributing for curing Blood pressure?). There might be two approaches:
1. You need to collect data from two group of BP – patients, namely treatment (Those who are taking medication) and control group (without medication). For keeping the effects of any other factor minimal, trails should be randomized.
2. Collect data measuring blood pressure of patients before and after taking medication. Again, keeping the effects of any other factor minimal, trails should be randomized.

So, finally you will have data of BP of two different groups. You can apply t-test. I believe for first case; you can apply independent sample t-test (with unequal variance) and for second case you can apply paired t-test.

If Professor approves the approach.

Reply

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pi *says:*
October 24, 2015 at 5:28 pm

SIR.i am wondering could i compare t-test,welch and also mann whitney in term of mean.

as i am referring the journal article "should i use nonparametric method on two apparently non normal distribution"

some ppl said that this is no logic…however ,i do found some books to claim that under additional assumptions , mann whitney has the same distributons but shift of location occur,therefore we can use it to compare their means.

Reply

Charles *says:*
October 24, 2015 at 6:44 pm

Generally, if you can satisfy the assumptions for the t test, you should use the t test; otherwise provided the shapes of the two distribution are similar you should use Mann-Whitney. The loss in power of using Mann-Whitney is pretty small even when the assumptions for the t test are satisfied, and so when in doubt you might as well use Mann-Whitney.
Charles

Reply

Quinton *says:*
September 21, 2015 at 1:31 pm

Good Afternoon

I am trying to justify that the current method of sample taking is not representative. I have data from an online analyser that analyses the material/ore as it is produced. We then take a few grab samples for laboratory for analysis. I am not sure, but I think the two sample t-test would be the best fit for me. FYI I have done the F-test for the two samples and the null hypothesis that the variances for the two samples that are equal were not satisfied. I know want to perform the t-test to show that the sample means are not same, thus justifying that the grab samples is not sufficient and we need continuous online samplers. Am I on the right track? Please help

Reply

Charles *says:*
September 21, 2015 at 2:37 pm

If I am understanding correctly, you want to use the t-test for independent samples with unequal variances to test whether the two samples come from populations with the same mean. This seems like a reasonable approach to determine whether the grab samples are sufficient. Since you have already found a significant difference in the variances, you already have evidence that the grab samples are not sufficient.
Charles

Reply

Quinton *says:*
September 21, 2015 at 5:47 pm

Hi Charles, Thank you sooo so much for replying. To put some more clarity. I have more 40 000 data points that I have from an online analyser. This comes from one days production. Then I have a grab sample of 50 rocks (ore particles) that I re-analysed. I basically put it over the analyser 5 times so have 250 datapoints. If this sample was representative I assume that when plotting cumulative histograms of the two distribution (40 000 and 250 datapoints) should lay more or less on the same graph. Visually this is not the case. With my limited knowledge of inferential statistics the t-test with unequal variances seems to be the best option in comparing the two populations. Is this correct, since the population sizes are different. Is there another way that I can proof that the sample is not representative in a “fancy” way. Kind Regards

Reply

Charles *says:*
September 23, 2015 at 8:31 am

The t test is fancy enough. You can use the t test with unequal samples.

One caution: the 5 times that you have put each sample through the analyzer means that the sample of 250 datapoints are not independent, one of the assumptions for the t test. You might better averaging the 5 values for each rock to arrive at 50 data points, which you would compare with the 40,000 data points. Another, more complicated approach is to perform ANOVA with repeated measures.

Charles

Reply

IHateMath *says:*
September 15, 2015 at 5:33 am

Can you post the Unequal variance with a simpler examples?

Reply

Charles *says:*
September 15, 2015 at 8:46 am

Please explain more precisely what you are looking for since the example I gave is pretty simple.
Charles

Reply

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nanthinie *says:*
August 9, 2015 at 9:29 am

hi sir,

I'm doing 2 independent samples mean t-test with unequal variances to verify the comparison in the performance of the GDP Growth between 2 countries (Jordan & Morocco).. I'm not sure of which sign to use in Null Hypothesis and also in Alternative Hypothesis.. Is it = & ≠ or ≤ & > or ≥ & < ?

Reply

Charles *says:*
August 9, 2015 at 12:12 pm

It depends on whether you want to conduct a one-tail or a two-tail test. See Null and Alternative Hypothesis for more details.
Charles

Reply

Niklas Leuschner *says:*
July 15, 2015 at 4:11 pm

Hello, I am not sure what T-Test to use for one of my experiments. I am measuring if there is a significant difference in the abundance of a species in two different habitats.

Reply

Charles *says:*
July 15, 2015 at 4:15 pm

Niklas,
This seems like a good fit for a t test, but it depends on the nature of your data.
Charles

Reply

Dawn Wright *says:*
July 12, 2015 at 8:54 pm

Hi Charles,
I noticed the formula for the two sample, independent t-statistic calculates the absolute value [=(ABS(H5-H6-J3))/G16] . Other software packages I have used do not use the absolute value and thus can produce negative t-statistics. Is this something I am misunderstanding?
Thanks
dawn

Reply

Charles *says:*
July 16, 2015 at 7:01 am

Dawn,

The sign is not particularly important since it depends only on which of the means is subtracted from the other. The p-value is identical. I used the absolute value since Excel's two tailed formula — TDIST(t,df,2) or TDIST.2T(t,df) — requires a positive value for t.
Charles

Reply

Tripti Sharma *says:*
May 24, 2015 at 1:03 am

Hello Charles,
I would like to know whether I am using the right t test for my data.I have two data set of male life span with mean-31.15 and 19.05,variances -287.1 and 217.6,N1=79,N2=78.I am using two sample assuming equal variances.The other data set is the number of eggs laid having mean-36.59 and 15.1, variances-1130.399 and 238.32,N1=41,N2=10.For this data set, I am using two sample t test assuming equal variances .Which p value I should consider for my result -one tail or two tail. Am I using correct statistical analysis or not if not please suggest what I should use.
Tripti.

Reply

Charles *says:*
May 24, 2015 at 7:35 am

If you goal is to determine whether the two populations have the same mean, then the two sample t test assuming equal variances seems like a good choice provided the assumptions for the test are met (principally that the data is not highly skewed).

For the second example, I suggest that you use two sample t test assuming unequal variances.

Charles

Reply

Tanya *says:*
February 8, 2015 at 1:49 pm

May I ask what the formula for the df (degree of freedom)? I noticed that the value for the df is also different when I use t-test with unequal variances and equal variances.
thanks!

Reply

Charles *says:*
February 9, 2015 at 7:57 pm

Tanya,
The degrees of freedom for the unequal variances case is m in Theorem 1 on the referenced webpage.
Charles

Reply

Jam *says:*
September 27, 2014 at 4:08 pm

t-Test: Two-Sample Assuming Unequal Variances

CONTROLLED GROUP ——— – EXPERIMENTAL GROUP
Mean 0.205416667 ————- – 0.184527932
Variance 0.000385934————- 0.000686411
Observations 20————————- 19
Hypothesized Mean Difference———— 0

df –33
t Stat— 2.805852172
P(T<=t) one-tail– 0.004176129
t Critical one-tail– 1.692360258
P(T<=t) two-tail –0.008352257
t Critical two-tail– 2.034515287

Reply

Charles *says:*
September 27, 2014 at 6:35 pm

Jam,
Assuming that alpha = .05, since p-value (two-tailed) = 0.00835 < .05 = alpha, you reject that hypothesis that the two populations (from which the samples came) have the same mean. Charles

Reply

SAM *says:*
September 24, 2014 at 4:20 am

can you please help me in doing my research study i don't know how to solve the P-value. using T-test..
thank you! 🙂

Reply

Charles *says:*
September 25, 2014 at 11:47 am

You can calculate and interpret the p-value of the t test as described on the referenced page.
Charles

Reply

Olukayode Adedayo Babarinde *says:*
August 22, 2014 at 11:05 am

I want to know, i have samples from the same source. I have used two different methods to analyse them. I am trying to compare two different methods used to analyse the samples.
1. Can I use paired t-test?
2. Are the samples dependent or independent?
3. what do I do if the null hypothesis is rejected when t-calculated is greater than t-critical but p-value is greater than 0.05?
4. tell me which method to use.
thank you

Reply

Charles *says:*
August 23, 2014 at 7:04 am

1. It depends on what you mean by the samples are from the same source. If "source" means "population", then probably you shouldn't use the paired sample t test. But if "source" means the same "subjects" then the paired test is the one you should use. See http://www.real-statistics.com/students-t-distribution/paired-sample-t-test/ for more details.

2. This is related to the first question. You need to supply more information before I can answer this question.

3. I you are using a right-tailed test then it should never happen that t-calculated is greater than t-critical but p-value is greater than 0.05. If you are using a left-tailed test, then this just means that you can't reject the null hypothesis.

4. See my answer to your first question.

Charles

Reply

Donna *says:*
July 25, 2014 at 9:04 pm

Are you beginning with a significance level of 5% or 10% for your 2-tailed test?

What if the value you get is 0.03 for the t-test? For example
TTEST(A4:A13,B4:B13,2,2) =0.03
Do you reject the null hypothesis? What about the 2 tails?
Do large values have to be taken into consideration? What If I get 0.98?
Thank you for your help!

Reply

Charles *says:*
July 26, 2014 at 6:36 am

Donna,
The TTEST assumes that alpha = 5%.
If TTEST(A4:A13,B4:B13,2,2) = 0.03 then null hypothesis is rejected since .03 < .05. This is the two-tailed test (since the third argument is 2). If you want the one-tailed test you use the formula TTEST(A4:A13,B4:B13,1,2), which will have a value which is half of the two-tailed test, and so once again you would reject the null hypothesis (since .03/2 = .015 < .05). If you get a p-value = 0.98 you couldn't reject the null hypothesis since .98 > .05.
Charles

Reply

Ding *says:*
July 23, 2014 at 10:51 am

Sir,

I have several questions after reading your post.

1. Is there a scientific way (equation or theory) that clearly defines in which case variances of two data sets are equal or unequal?

2. I am not sure if I get your points, if two values obtained respectively from type 2 and type 3 (Excel t test) does not differ greatly, then it suggests equality of variance. If not, the opposite?

3. What does the considerable reduction of df mean in your example? Sorry I am not from background of mathematics. Can you explain to me in details.

4. I have two independent samples, n=6, to compare in excel t test. But I found no evidences to prove their variance equality. Can you suggest some ideas?

Thank you very much for your help. I look forward to your reply.

Have a good day.

Ding

Reply

Charles *says:*
July 24, 2014 at 6:20 pm

Ding,

1. There are a number of techniques for determining whether variances of two (or more) data sets are approximately equal, including graphical approaches and the commonly used Levene's test. See the webpage http://www.real-statistics.com/one-way-analysis-of-variance-anova/homogeneity-variances/ for more information.

2. No, even when the type 2 and type 3 p-values are very similar, the variances may be noticeably different. Generally the variances need to be very different before you will see any real difference between the type 2 and type 3 tests.

3. A smaller value of df changes the p-value. Obviously for the example I have given the smaller value of df doesn't change the p-value that much.

4. In this case, use the unequal variance test. With such a small sample, there is also risk that the normality assumption may not be satisfied, in which case you may want to use a non-parametric test such Mann-Whitney (see the webpage http://www.real-statistics.com/non-parametric-tests/mann-whitney-test/)

Charles

Reply

Colin *says:*
January 5, 2014 at 4:19 am

Sir
It seems (Sp)*sqrt(1/n1 + 1/n2) = sqrt((S1)^2/n1 + (S2)^2/n2). But I cannot prove it.
Sp means the square root of pool variance
sqrt() is the square root function in Excel

The package you provide uses "sqrt((S1)^2/n1 + (S2)^2/n2)" to calculate the stander error and t-value for both cases of "equal variance" and "unequal variance"

But I usually use "(Sp)*sqrt(1/n1 + 1/n2)" to calculate the stander error and t-value for "equal variance" and " sqrt((S1)^2/n1 + (S2)^2/n2) " to calculate the stander error and t-value for "unequal variance".

Reply
