20

t Test With independent Samples and Equal Sample Sizes

Learning Objectives:

- Understand the similar logic underlying various test statistics
- Determine the degrees of freedom
- Calculate a two-sample *t* test for independent samples and equal sample sizes
- Use a table to interpret the calculated *t*
- Report results in APA format

A Two-Sample Study

Now that you know how to calculate the standard error of the difference between the means, you are ready to calculate a two-sample *t* test. This time, however, we will calculate $\sigma_{M_1 - M_2}$ from raw data. Recall that calculating a $\sigma_{M_1 - M_2}$ first involves calculating the σ_M for each population. And calculating a σ_M for a population first involves calculating the σ_{est} for each population based on sample data. Therefore, this module will include a lot of calculations.

For our example, assume that we randomly select 18 depressed clients. We then randomly assign the clients to one of two treatment groups (two samples), giving us 9 clients in each group. We treat one group with antidepressant medication and the other group with counseling. After a predetermined period of treatment, we measure the clients' depression levels, using a test where lower scores indicate lower depression and higher scores indicate higher depression. Here are the individual and the mean depression scores for each group:

Medication	Counseling
32	43
40	31
21	39
17	36
40	46
26	35
19	32

Medication	Counseling
44	44
20	37
$\Sigma = 259$	$\Sigma = 343$
$M_{\text{med}} = \dfrac{259}{9} = 28.778$	$M_{\text{med}} = \dfrac{343}{9} = 38.111$

Clearly, clients treated with medication were less depressed after treatment than clients treated with counseling: The mean depression levels of the two samples were 28.778 and 38.111 points, respectively. That's a difference of 9.333 points. But that difference does not necessarily indicate that medication is more effective than counseling. Recall that even if the null hypothesis is true and medication really is no more effective than counseling, we still do not expect any given sample of clients treated with medication to have exactly the same depression level as any given sample of clients treated with counseling. Although there will be no difference over an infinite number of pairs of samples, for any given pair of samples, the participants who were treated with medication could experience either more or less depression relief than those who were treated with counseling.

Thus, the question in rejecting the null hypothesis is not whether or not the mean depression levels for the two samples in our study are different but how different they are. Is the difference in depression level between the samples after treatment *only a little* and, therefore, probably due to mere sampling error? Or is the difference in depression level between the samples after treatment *a lot* and, therefore, probably due to something other than mere sampling error—in this case, due to the difference in treatment?

Inferential Logic and the Two-Sample *t* Test

We need a statistic to compute the probability of our observing two sample means as different as ours. As discussed in Module 19, the statistic we use will scale the observed difference between our two sample means (numerator) against the average difference expected under the null hypothesis (denominator, which is the standard error of the difference between the means). That statistic is a two-sample *t* test.

The formula for a two-sample *t* test is

$$t_{\text{2-samp}} = \frac{(M_1 - M_2) - (\mu_1 - \mu_2)}{\sigma_{M_1 - M_2}}$$

Q: What do they call a two-sample t test in England?

A: t for two.

where

M_1 = mean of the first sample,

M_2 = mean of the second sample,

μ_1 = mean of the first population,

μ_2 = mean of the second population, and

$\sigma_{M_1 - M_2}$ = standard error of the difference between the means.

But wait! The two-sample *t* test looks a lot like the *z* score, the normal deviate *Z* test, and the one-sample *t* test we previously encountered, doesn't it? Yes, it does. That's because each

is an example of the prototype for any test of statistical significance. Recall that a *prototype* is a generic model. Here, again, is the prototype for any test of statistical significance:

$$\frac{\text{What did you get?} - \text{What did you expect?}}{\text{Standardized random error}}$$

When we studied *z* scores, the substitutions we made were as follows:

"What did you get?"	Raw score
"What did you expect?"	Sample mean
"Standardized random error"	Standard deviation

This gave us the formula

$$z\ \text{Score} = \frac{\text{Raw score} - \text{Sample mean}}{\text{Standard deviation}}$$

In symbols, this was

$$z\ \text{Score} = \frac{X - M}{s}$$

For the *normal deviate Z test* and for the *one-sample t test*, the substitutions we made were as follows:

"What did you get?"	Sample mean
"What did you expect?"	Population mean
"Standardized random error"	Standard error of the mean

This gave us the formula

$$Z_{\text{norm dev}}\ \text{or}\ t_{\text{1-samp}} = \frac{\text{Sample mean} - \text{Population mean}}{\text{Standard error of the mean}}$$

In symbols, this was

$$Z_{\text{norm dev}}\ \text{or}\ t_{\text{1-samp}} = \frac{M - \mu}{\sigma_M}$$

Well, now we have a *two-sample t test*. The substitutions we now make are as follows:

"What did you get?"	Difference between the two sample means
"What did you expect?"	Difference between the two population means
"Standardized random error"	Standard error of the difference between the means

This gives us the formula

$$t_{\text{2-samp}} = \frac{(\text{Difference between sample means}) - (\text{Difference between population means})}{\text{Standard error of the difference between the means}}$$

In symbols, this is

$$t_{2\text{-samp}} = \frac{(M_1 - M_2) - (\mu_1 - \mu_2)}{\sigma_{M_1 - M_2}}$$

Look again at the numerator of the formula. The second term, $\mu_1 - \mu_2$, is the expected difference between the population means. It is the expected difference in depression level between an infinite number of clients treated with medication and an infinite number of clients treated with counseling. Now recall that it is always the null hypothesis that we test. Under the null hypothesis, what do we expect that difference to be?

Yes, under the null hypothesis, the expected difference is 0. Therefore, the formula reduces to

$$t_{2\text{-samp}} = \frac{(M_1 - M_2) - 0}{\sigma_{M_1 - M_2}}$$

which further reduces to

$$t_{2\text{-samp}} = \frac{(M_1 - M_2)}{\sigma_{M_1 - M_2}}$$

Many sources show only the shortened formula above. However, to emphasize the similar logic underlying most inferential statistical tests, it is helpful to remember the fuller formula.

With the formula in hand, let's finally calculate our two-sample *t*. We want to determine whether the observed difference in depression level between the two samples was *a lot* (and therefore probably due to the difference in treatment between the samples) or *only a little* (and therefore probably due to mere sampling error).

✔ **CHECK YOURSELF!**

Compare a two-sample *t* test with a one-sample *t* test. When would you use each one?

Calculating a Two-Sample *t* Test

In our study, Sample 1 is the medication group, and Sample 2 is the counseling group. Therefore, the formula is

$$\begin{aligned} t_{2\text{-samp}} &= \frac{(M_1 - M_2) - (\mu_1 - \mu_2)}{\sigma_{M_1 - M_2}} \\ &= \frac{(M_1 - M_2) - 0}{\sigma_{M_1 - M_2}} \\ &= \frac{M_1 - M_2}{\sigma_{M_1 - M_2}} \\ &= \frac{28.778 - 38.111}{\text{Whoops! First, we need to calculate } \sigma_{M_1 - M_2}} \end{aligned}$$

In this module, we are restricting ourselves to studies in which sample sizes are equal and the samples are independent. Recall that when samples are independent and sample sizes are equal, the formula for $\sigma_{M_1 - M_2}$ is

$$\sigma_{M_1 - M_2} = \sqrt{\sigma_{M_1}^2 + \sigma_{M_2}^2}$$

where

σ_{M_1} = the standard error of the mean of the first population and

σ_{M_2} = the standard error of the mean of the second population.

But what *is* the σ_M for each population? Yes, unfortunately, we first have to compute each of those as well. Recall that the formula for σ_M is

$$\frac{\sigma}{\sqrt{n}} \quad \text{or} \quad \frac{\sigma_{\text{est}}}{\sqrt{n}}$$

where $\sigma_{\text{est}} = \sigma$ estimated from *s*.

Because we do not know the population standard deviation (σ) for either population, we have to use the second formula, which uses the *estimated* population standard deviation (σ_{est}) for each population.

But what *is* the estimated population standard deviation for each population? Yes, we estimate it from the sample data. That's where we must begin our calculations, so let's do that now.

Step 1: Find the two estimated population standard deviations.

> ❗ Life is good for only two things: discovering mathematics and teaching mathematics.
>
> —Simeon Poisson

	Medication			Counseling	
X	X − M	(X − M)²	X	X − M	(X − M)²
32	3.222	10.381	43	4.889	23.902
40	11.222	125.933	31	−7.111	50.566
21	−7.778	60.497	39	0.889	0.790
17	−11.778	138.721	36	−2.111	4.456
40	11.222	125.933	46	7.889	62.236
26	−2.778	7.717	35	−3.111	9.678
19	−9.778	95.609	32	−6.111	37.344
44	15.222	231.709	44	5.889	34.680
20	−8.778	77.053	37	−1.111	1.234
$\Sigma = 259$		$\Sigma = 873.553$	$\Sigma = 343$		$\Sigma = 224.886$

$$M_{\text{med}} = \frac{259}{9} = 28.778 \qquad\qquad M_{\text{couns}} = \frac{343}{9} = 38.111$$

First, we need the estimated population variances from each sample variance. Recall from Module 17 that sample variances tend to underestimate the true population variance. And recall that we correct for this bias by dividing the sum of squared deviations by $n - 1$ rather than by n.

The estimated population variances for the medication and counseling populations, using $n - 1$ in the denominator, are as follows:

$$\sigma^2_{\text{med, est}} = \frac{\sum(X - M)^2}{n - 1} \qquad\qquad \sigma^2_{\text{couns, est}} = \frac{\sum(X - M)^2}{n - 1}$$
$$= \frac{873.553}{8} \qquad\qquad\qquad = \frac{224.886}{8}$$
$$= 109.194 \qquad\qquad\qquad = 28.111$$

Recall that the standard deviation is the square root of the variance. Therefore, the estimated population standard deviations for the medication and counseling populations are as follows:

$$\sigma_{\text{med, est}} = \sqrt{\sigma^2} \qquad\qquad \sigma_{\text{couns, est}} = \sqrt{\sigma^2}$$
$$= \sqrt{109.194} \qquad\qquad\qquad = \sqrt{28.111}$$
$$= 10.450 \qquad\qquad\qquad = 5.302$$

Step 2: Find the two standard errors of the means.

Now that we have the two estimated population standard deviations, we can compute the two standard errors of the means:
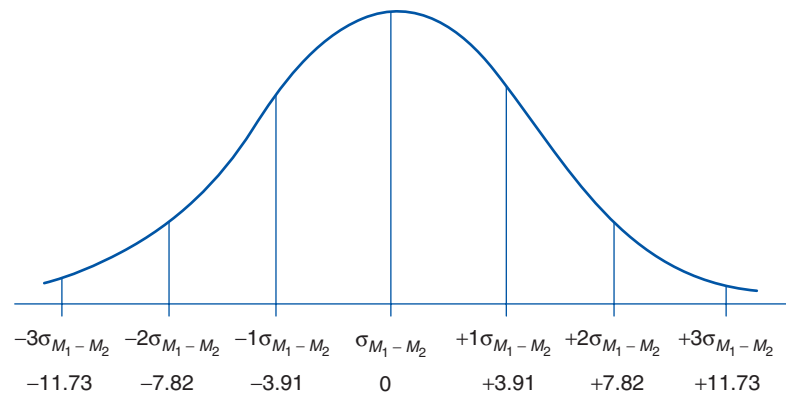
$$\sigma_{M_{\text{med}}} = \frac{\sigma_{\text{med, est}}}{\sqrt{n}} \qquad\qquad \sigma_{M_{\text{couns}}} = \frac{\sigma_{\text{couns, est}}}{\sqrt{n}}$$
$$= \frac{10.450}{\sqrt{9}} \qquad\qquad\qquad = \frac{5.302}{\sqrt{9}}$$
$$= \frac{10.450}{3} \qquad\qquad\qquad = \frac{5.302}{3}$$
$$= 3.483 \qquad\qquad\qquad = 1.767$$

Step 3: Find the standard error of the difference between the means.

Now that we have our two standard errors of the means, we can calculate the standard error of the difference between the means, which we need for the denominator of the two-sample *t*:

$$\sigma_{M_1 - M_2} = \sqrt{\sigma^2_{M_1} + \sigma^2_{M_2}}$$
$$= \sqrt{(3.483)^2 + (1.767)^2}$$
$$= \sqrt{12.131 + 3.122}$$
$$= \sqrt{15.253}$$
$$= 3.91$$

So the *value* of our standard error of the difference between the means (which is the standard deviation of the sampling distribution of differences between an infinite number of pairs of sample means) is 3.91. We can add that value to our diagram of the sampling distribution of the differences between the means (Figure 20.1).

The chart x-axis labels:

$-3\sigma_{M_1 - M_2}$ $-2\sigma_{M_1 - M_2}$ $-1\sigma_{M_1 - M_2}$ $\sigma_{M_1 - M_2}$ $+1\sigma_{M_1 - M_2}$ $+2\sigma_{M_1 - M_2}$ $+3\sigma_{M_1 - M_2}$

-11.73 -7.82 -3.91 0 $+3.91$ $+7.82$ $+11.73$

Figure 20.1   Sampling Distribution of the Difference Between the Means, Showing the Value of $\sigma_{M_1 - M_2}$

Step 4: Find *t*.

Now that we know the standard error of the difference between the means, we can finally calculate the two-sample *t* test:

$$
\begin{aligned}
t_{\text{2-samp}} &= \frac{(M_1 - M_2) - (\mu_1 - \mu_2)}{\sigma_{M_1 - M_2}} \\
&= \frac{(M_1 - M_2) - 0}{\sigma_{M_1 - M_2}} \\
&= \frac{M_1 - M_2}{\sigma_{M_1 - M_2}} \\
&= \frac{28.778 - 38.111}{3.91} \\
&= \frac{-9.333}{3.91} \\
&= -2.39
\end{aligned}
$$

We are finally done. The observed −9.333 points difference in depression level between clients treated with medication and clients treated with counseling is −2.39 of the σ_{M-M} error units. But what does that mean?

✔ CHECK YOURSELF!

List the steps for calculating a two-sample *t* test.

Interpreting a Two-Sample *t* Test

As usual, the question is whether the observed difference is *a lot*, and therefore probably due to the difference in treatment between the two samples, or whether it is *only a little*, and therefore probably due to mere sampling error. Let's see where our observed difference between the means falls within the sampling distribution of the differences between the means (Figure 20.2).
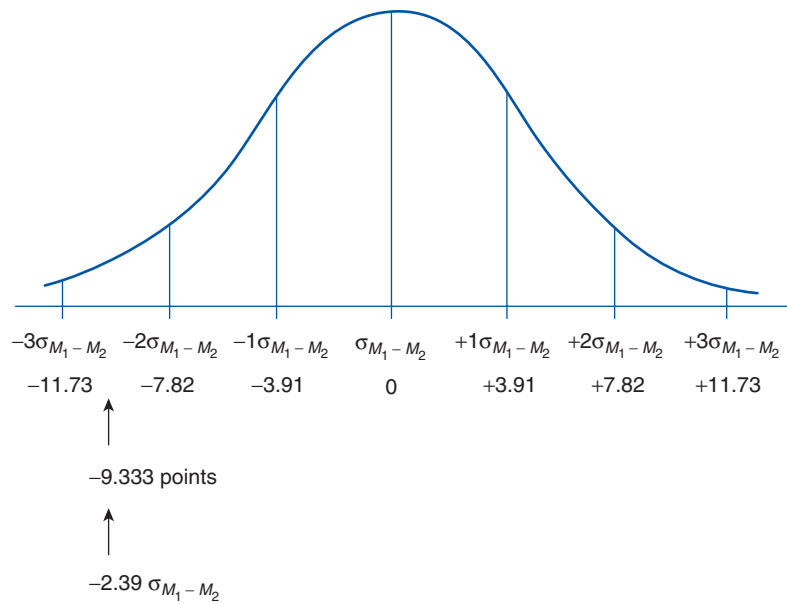
Figure 20.2   Sampling Distribution of the Difference Between the Means, Showing the Location of the Calculated *t*

Under the null hypothesis, the expected difference in depression level between clients given medication and those given counseling is 0—right in the middle of the distribution. From the diagram, we can see that the actual difference between the two samples is way down in the left tail of the distribution. It certainly does look like clients given medication were considerably less depressed than clients given counseling. But were they really less depressed, or is this just a random difference? What is the probability, if the null hypothesis is true and the two treatments really do not differ in effectiveness, that we would find this much difference in depression between the two differently treated samples?

As with the *z* score, the normal deviate *Z* test, and the one-sample *t* test, we answer that question by looking up the critical value in a table. That table is the *t* table, just as it was for the one-sample test. Appendix C contains the *t* table. A portion of that table is reproduced as Table 20.1.

We enter the *t* table at the correct degrees of freedom (*df*). Recall that the *df* for a *t* test is $n - 1$ for each sample. For the one-sample *t* test, that was $n - 1$. But this is a two-sample

Table 20.1   A Portion of the *t* Table

	Level of Significance for One-Tailed Test (%)			
	5	2.5	1	.5
	Level of Significance for Two-Tailed Test (%)			
df	10	5	2	1
16	1.746	2.120	2.584	2.921
17	1.740	2.110	2.567	2.898
18	1.734	2.101	2.552	2.878

t test; that is, we have two groups. Thus, the *df* is $(n - 1) + (n - 1)$, which is $N - 2$ (i.e., here $N = 2n$). Our total sample size *for both samples added together* is $9 + 9 = 18$. Thus, the correct *df* is $18 - 2 = 16$.

As before, the *t* table lists the minimum value that our calculated *t* must have for us to reject the null hypothesis and conclude instead that the difference in means is probably due to the difference in treatment. That is, to reject the null hypothesis and thereby gain support for the research hypothesis, the value of the calculated *t* must meet or exceed the value of the tabled critical *t*.

✓ CHECK YOURSELF!

What do the entries in a *t* table tell you?

Recall that our hypothesis was directional: We had proposed that medication would result in *lower* depression levels than counseling would. Therefore, our hypothesis is *one-tailed*, and we must look in the one-tailed column of the table. Note that the figures in the table are absolute values. That is, they are the critical *t* values regardless of a positive or negative sign.

Assume that we were willing to make a Type 1 error 5% of the time. At $\alpha = .05$, can we reject the null hypothesis?

Yes, we can, because the calculated *t* of −2.39 meets or exceeds the one-tailed critical *t* of (−)1.746.

Now assume that we were willing to make a Type 1 error only 1% of the time. At $\alpha = .01$, can we reject the null hypothesis?

No, we cannot, because the calculated *t* of −2.39 does not meet or exceed the one-tailed critical *t* of (−)2.584.

The difference in participants' depression levels when given medication versus counseling was significant at the .05 error level. In a journal article, these results would be reported like this:

$$t(16) = -2.39, p < .05$$

This is read as follows: "*t* at 16 degrees of freedom is −2.39. There is less than a 5% chance that the difference in depression level is due to mere chance." Such a large observed difference in depression level is probably due to the difference in treatments.

PRACTICE

1. Assume that our research hypothesis for the above study is nondirectional. That is, while we believe that the type of treatment given will affect the level of depression, we have no idea which treatment—medication or counseling—will be more effective. Look up the critical *t* for this two-tailed hypothesis at both the .01 and .05 α levels. At which α level (if either) can we reject the null hypothesis?

2. A large furniture store stations salespeople near its entrance to greet customers and offer assistance in shopping. The salespeople, who work on a commission basis, tell the customers their name and hand them a business card. A psychologist thinks that the salespersons' intrusiveness might cause customers to buy less furniture rather than more furniture. She convinces the store's management to let her study the issue. Customers are

randomly selected to either receive or not receive a salesperson's offer of assistance immediately on entering the store. The amount of customers' purchases are then logged as they leave the store. Here are the data:

Amount of Purchase, in U.S. Dollars	
Immediate Assistance	*No Assistance Unless Requested*
0	761
2,274	0
0	2,592
0	0
0	1,037
362	0
855	84
0	0
0	672
1,273	0

a. What are the independent and dependent variables in this study?

b. State the null hypothesis and the directional (one-tailed) research hypothesis.

c. Calculate *t* and compare it with the tabled critical *t* at the .01 and .05 α levels. Can you reject the null hypothesis?

3. The Shine Company, which manufactures cleaning supplies, wants to determine whether or not adding a fragrance to a window cleaner leads people to believe that it cleans better than an unscented product. The company randomly selects 24 participants for a pilot study. The company gives 12 participants the scented cleaner and the other 12 participants the unscented cleaner. After using the cleaners for a month, the participants rate how well they thought the cleaner worked. Higher scores indicate more effective cleaning. Here are the ratings:

Unscented	*Scented*
6	8
5	8
7	7
5	9
6	7
8	8
4	9
7	9
5	6
6	5
6	7
7	6

a. Is the research hypothesis in this study directional or nondirectional?

b. State the research hypothesis.

c. Calculate *t* and compare it with the tabled critical *t* at the .05 α level. Can you reject the null hypothesis?

4. Elena Martin is campaigning for the city council. She has two types of lawn signs to distribute: large ones and small ones. She wonders if the size of the sign affects residents' willingness to display the signs on their property. Early in the campaign, her staff obtain a list of homeowners in each of the city's 10 voting districts who are registered in her political party and presumably not averse to advertising their support for her. The staff randomly selects homeowners in each of the 10 districts, to some of whom they send large signs and to others, small signs. Two weeks later, staff members drive by each home to which they sent the signs to record whether or not the sign is being displayed. Here are the percentages of homes displaying the signs in each district:

Large Sign	Small Sign
34	41
41	44
30	36
32	38
28	29
31	47
40	49
27	39
36	43
22	37

a. Is the research hypothesis in this study directional or nondirectional?

b. State the research hypothesis.

c. Calculate *t* and compare it with the tabled critical *t* at the .01 α level. Can you reject the null hypothesis?

5. Carmine reads an article that says that male college students study less than female college students. Carmine wonders if this is really so. He asks 20 randomly selected students—10 males and 10 females—from his coed dorm to record their study times for a period of 4 weeks. Here are the students' average weekly study times, to the nearest half-hour:

Males	Females
13.5	15.5
6.5	10.0
8.0	10.5
14.5	7.0
12.5	13.0
16.0	12.5
12.0	11.0
9.5	8.5
7.0	8.0
11.5	13.0

a. Is the research hypothesis in this study directional or nondirectional?

b. State the research hypothesis.

c. Calculate *t* and compare it with the tabled critical *t* at the .05 α level. Can you reject the null hypothesis?

d. Do you think these samples are representative of all college males and females? To what populations can Carmine rightfully infer the results?

6. A cognitive psychologist is curious as to why women tend to physically turn a map's position to agree with the direction they are moving, while men tend to keep the map in its original position and mentally change orientations as they move. She wonders if there is a sex difference in ability to mentally rotate objects. She devises a computerized experiment in which she times correct responses to a mental visual rotation task at a given angle. Here are the times, in seconds, for 15 men and 15 women. Conduct a one-tailed *t* test at the .01 α level. Are men able to mentally rotate objects significantly faster than women?

Men	Women
0.25	0.29
0.27	0.30
0.23	0.25
0.24	0.23
0.22	0.22
0.28	0.26
0.23	0.33
0.22	0.27
0.24	0.29
0.28	0.26
0.22	0.29
0.21	0.27
0.23	0.22
0.23	0.29
0.20	0.25

7. A video arcade owner wonders if boys or girls spend more time playing video games once they enter the arcade. He records the playing time for 10 boys and 10 girls selected at random. No more than one person is selected from among a group of friends to minimize the effect of group behavior on individuals. Here are their times, in minutes. Conduct a two-tailed *t* test at the .01 α level. Do either boys or girls spend significantly more time playing the games, once they have entered the arcade?

Boys	Girls
124	64
36	22
39	105
48	19
40	32
79	43
63	24
143	33
36	98
22	30

8. An Internet provider wonders if its cable Internet customers are significantly more satisfied with one or the other of its two packages—free e-mail or free basic TV. The company surveys 12 customers currently receiving free e-mail with their cable Internet and 12 customers currently receiving free basic TV with their cable Internet. Satisfaction scores range from 1 to 10 based on answers to the survey questions. Here are the scores. Conduct a two-tailed *t* test at the .05 α level. Are customers significantly more satisfied with one package or the other?

Free E-mail	Free Basic TV
6	7
7	10

(Continued)

Free E-mail	Free Basic TV
5	8
7	5
8	9
6	10
10	7
9	6
6	5
7	6
5	8
7	6

9. An employee benefits administrator wonders if the amount of the insurance co-pay affects the number of times employees visit a doctor per year. The company offers two plans. One plan has a higher visit co-pay in return for a larger cap on annual coverage. The other plan has a lower visit co-pay but with a lower cap on annual coverage. Here are the number of visits in a given year for 14 members under each plan. Conduct a two-tailed *t* test at the .05 α level. Does either plan result in significantly fewer visits?

Higher Co-Pays	Lower Co-Pays
1	1
0	3
4	0
1	5
2	3
3	4
1	4
0	3
0	5
1	2
0	0
2	2
4	4
0	1

10. A police agency is interested in reducing the speed of cars on a particular stretch of highway. Lore has it that a visible police car with radar is more effective in reducing speed than a warning sign saying that the area is monitored by radar. A police sergeant wonders if the lore is correct, so he tests each method on the same stretch of highway at the same time of day and on the same day of the week (two consecutive weeks) to ensure similar driving volume and conditions. He then records the number of miles per hour (mph) each speeder drives over the speed limit. Here are the data of the excess speed of the eight drivers caught speeding under each condition. Conduct a one-tailed *t* test at the .05 α level. Does the police car result in lower speeds than the warning sign?

Excess mph With Police Car	Excess mph With Warning Sign
12	18
7	12
6	9
10	15
4	7
13	19
11	18
6	12

Looking Ahead

As we saw in Module 17, the ability to reject the null hypothesis depends not only on how different the observed group means are but also on what level of Type 1 error you are willing to accept. In Module 23, we will look at this concept of error in more detail, just as we did in Module 18. As it turns out, dichotomous decisions (reject/do not reject) are less meaningful than reports of actual Type 1 error.

SPSS Connection

Download the file **data_depression relief due to med couns.sav** from www.sagepub.com/steinberg2e. These data are used in the textbook example.

Alternatively, manually enter the 18 scores from the depression example in Module 20 into the SPSS **Data View** spreadsheet. Data entry for a *t* test with equal sample sizes is not intuitively obvious. In the textbook, the data are set up as two groups of 9 clients. In SPSS, all 18 scores (9 + 9) are entered in a single column. Then their group membership (medication vs. counseling) is entered in the second column. Thus, enter the data as follows:

32	m
40	m
21	m
17	m
40	m
26	m
19	m
44	m
20	m
43	c
31	c
39	c
36	c
46	c
35	c
32	c
44	c
37	c

Click on the **Variable View** tab to define the variables. Name the first variable **deprscor**, set the decimals at **0**, and label the variable as **Depression Score**. Name the second variable **typtreat**, and label the variable as **Type of Treatment**. Label the value as follows: **c = counseling** and **m = medication**.

If the file is not already in **Data View**, click that tab in the lower left of the screen.

In the toolbar at the top of the screen, click on **Analyze**, then **Compare Means**, then **Independent-Samples T Test**. Highlight the variable **Depression Score** in the left window, and then click on the **arrow** before the **Test Variable** window to send the variable into that window. This is the study's dependent variable. Click on the variable **Type of Treatment** in the left window, and then click on the **arrow** before the **Grouping Variable** window to send the variable into that window. This is the study's independent variable. Click on **Define Groups** beneath the Grouping Variable window. Enter **m** for Group 1 and enter **c** for Group 2. Click **Continue** and then **OK**. This is what you will see.

T-Test

Group Statistics

Type of Treatment		N	Mean	Std. Deviation	Std. Error Mean
Depression Score	Medication	9	28.78	10.450	3.483
	Counseling	9	38.11	5.302	1.767

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
Depression Score	Equal variances assumed	8.727	.009	-2.390	16	.030	-9.333	3.906	-17.614	-1.053
	Equal variances not assumed			-2.390	11.863	.034	-9.333	3.906	-17.855	-.812

Visit the study site at www.sagepub.com/steinberg2e for practice quizzes and other study resources.