INDEPENDENT SAMPLES T-TEST

0:00 / 7:35

1.0x

SPEAKER: MICHAEL J. MAHOMETA, Ph.D.

The t-distribution and its related tests can

be extended to include other situations.

We've only seen it used as a way to compare a single sample mean

to a comparison value - our Null Hypothesis value.

It turns out that we can also use the t-distibution

to compare two independent samples to one another,

Help

allowing us to ask some very interesting questions.

As a statical consultant I have a great job.

I get to work with all kinds of data and be exposed to research questions that

are outside my trained field of experimental psychology.

So, whenever I find an interesting study -

from a researcher at The University of Texas or elsewhere - I tend to save it.

I found this study several years ago, and it's

a great example of an interesting research

idea, and straight forward statical analysis.

It involves the use of visual imagery - imagining

pleasant scenes such as a beach or autumn leaves

- to help reduce the amount of perceived pain.

Now 32 voluntary patients in the hospital for elective survey

were randomly assigned to two groups: a control group that simply received

procedural information prior to their surgery,

and an experimental group that received procedural information

AND information on how to perform

Help

pleasant imagery to help

with pain reduction.

Perceived pain was measured on the day after surgery using a Visual Analog

Scale - a great way to get continuous self report data.

Subjects simply marked where they thought

their pain was on a horizontal line.

So let's answer our question: Will the group trained with pleasant imagery

report different postsurgical perceived pain from the control group?

Now because these two groups are independent

(they have completely separate participants in each),

and we want to compare the means of a continuous measure,

we turn to the independent samples t-test.

Now we'll have a few assumptions to contend with,

similar to the single sample t-test: We need a random sample

from the population; The subjects or observations within a group

are independent from one another; we have a NEW assumption

that the two groups must be independent

from one another;

and finally, the POPULATION distribution for the two groups

needs to be approximately normal.

On to our hypothesis test.

Help

Step one: Our Null and Alernative Hypothesis statements.

Our Null Hypothesis states that the there

will be no difference between the two groups.

Now some folks will write mu1 equal to m2 for the Null.

I try not to, but instead use mu1 minus mu2 equal to zero,

and I'll show you why in a little bit.

Our Alternative Hypothesis is that the two groups of participants will not

have equal means - this is a non-directional test (we don't know

what the imagery will do to the pain scale of the participants.)

Step two: We decide on an alpha level.

Typically 0.05 is the standard.

On to step three: We collect our data and run the analysis.

Here's the form of the independent samples t-test.

Now it looks pretty familiar, but let's break it down.

First the numerator.

There are two groupings here: one to represent our data,

and the other to represent the Null Hypothesis value.

Help

Now you see why I like the mu1 minus mu2 form of the Null Hypothesis

description.

If we want, we could actually hypothesis a base difference

between the groups, not just simply zero.

So, our numerator effectively compares our data

to some hypothesized comparison value.

In the case of the independent samples t-test,

our data is actually the difference between two independent sample means.

The denominator is familiar also - it's a measure of Standard Error.

But there's a twist - it's a Standard Error that's

based on the difference in the two sample means.

And here's how we calculate the "estimated Standard

Error of the difference in the sample

Help

means."

We need the Standard Deviation of both samples and the n of both.

So let's solve for t.

Here's data based on the mentioned study from the Applied Nursing Research

Journal.

We have a final mean pain score for the control group of 56.1

and the experimental group of 26.5.

The Standard Deviation of the two groups is 24.2 and 12.2 respectively.

And both groups have 16 participants each.

Making our substitutions, and solving for t, we get a t-statistic of 4.37.

Step four: We draw our conclusion.

Is this t-statistic one that indicates a difference between the two samples?

Now to answer that we again turn to our t-distribution,

and our degrees of freedom.

This version of the independent samples t-test -the unpooled independent

samples t-test - has THIS as the degrees of freedom calculation.

And that's ridiculous to calculate by hand.

Software automatically gives it to us.

And if we don't have software, we can us

Help

this simple rule

to come up with a conservative approximation

of the degrees of freedom.

In our example, the degrees of freedom is 22.20.

And, using a t-distribution with 22.20 degrees of freedom,

gives us a critical value of +/-2.07.

Since our t-statistic is outside this critical value,

and into the critical region, we Reject our Null Hypothesis -

the two groups of participants are not equal on their visual analog scale.

The experimental group had a lower perceived pain score than the control

group - indicating that using pleasant imagery

was effective at lowering perceived postoperative pain.

Another way to do this (not by hand) is using the t.test() function in R.

If we run this simulated data, we see that we have a two-tailed p-value

of less than 0.001 - and because that's lower than our alpha of 0.05,

we again Reject our Null Hypothesis.

And for an added visualization, we can use a graph to show this difference.

Help

1. An instructor for an animal learning course observes that some students are very comfortable working with rats during their animal training sessions. She suspects that these students may have experience with pets that gives them an advantage when training their rats. To test her hypothesis, she divides her students into two groups: those that currently have a pet at home, and those that don't. Below are the rats' performances for each group. Higher means indicate better performance.

Rats' scores for students with pets	**Rats' scores for students without pets**
n = 10	n = 15
mean = 78	mean = 66
sd = 12.56	sd = 12.04

Help

(1 point possible)

1a. What is the alternative hypothesis for this test?

- $\mu_{pet\ owners} > \mu_{no\ pets}$ ✔
- $\mu_{pet\ owners} \leq \mu_{no\ pets}$
- $\mu_{pet\ owners} \geq \mu_{no\ pets}$
- $\mu_{pet\ owners} = \mu_{no\ pets}$

Hide Answer

(3 points possible)

1b. Solve for each missing component of the t-test equation:

$$t = \frac{78 - A}{\sqrt{\frac{(12.56)^2}{B} + \frac{(C)^2}{15}}}$$

A=

Answer: 66

B=

Help

Answer: 10

C=

Answer: 12.04

Hide Answer

(1 point possible)

1c. What is the t-statistic?

- 3.76
- 0.99
- 2.38 ✓
- -1.79

Help

Hide Answer

(1 point possible)

1d. What is the t-critical value for this test, assuming df = $n_{smallest}$ - 1 and $\alpha = 0.05$?

- 1.065
- 1.833 ✓
- 2.262
- 3.023

Hide Answer

(1 point possible)

1e. What is the appropriate conclusion for this test?

- The sample size was too small to conduct a t-test, so we cannot draw a conclusion from these results.
- Having pets did not make a difference in how well students trained their rats.
- The rats of students with pets performed significantly better than the rats of the other students. ✔
- Students with pets at home were able to encourage their rats to perform better, probably because they had previously trained a dog.

Help

Hide Answer

(1 point possible)

1f. How would the p-value for this test be reported?

- $p > 0.05$
- $p < 0.025$
- $p < 0.05$ ✔
- $p > 0.025$

Hide Answer