

تقييم كلية طب الكندي

ورشة عمل بعنوان

Statistical analysis in scientific research using SPSS

تقديم

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المكان: مختبر الحاسبات

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What is a t -test?

A statistical analysis that tells us whether the difference between 2 groups happened by chance

Measured using mean scores of the 2 groups, standard deviations, and a number of data points

Annotated by t statistics, which can be positive or negative

One sample t -test

A one sample t -test is used if we want to know whether a sample mean is different from a known population mean

In my statistics class of 20 young adults, we could see that we were all quite tall. We then thought to ourselves: “Hmm, are we really taller than the average population?”

We then searched the Internet for census data on the height of young adults in Singapore, and at the same time measured the height of everyone in my class.

Are we really taller?

Before conducting the t -test, we need to first make sure that our data is normally distributed (**assumption of normality**)...

Between subjects t -test

Also known as independent samples t -test, it is used to compare groups which are not related (i.e., independent)

A researcher wanted to find out if there is a difference in time spent on social media between males and females. She hypothesised that females spend more time a day on social media, compared to males. The researcher collected data from 25 males and 25 females

Do females spend more time in a day on social media compared to males?

Within Subjects t -test

Also known as paired samples t -test, it is used to compare groups which are related (e.g., same person; before and after a treatment)

A number of students failed their statistics module last semester. To help them, the Learning Advisors invited these students to attend remedial classes throughout the current semester.

To evaluate the effectiveness of the classes, the learning advisors analysed the overall grades of all students who attended the lessons, and compared them to their grades during the last semester.

Did the remedial classes improve students' grades?

When to use the independent samples t-test

The independent samples t-test is probably the single most widely used test in statistics.

It is used to **compare differences** between separate groups.

These groups are often composed by randomly assigning research participants to conditions.

For example, we may be interested in differences of emotional intelligence between males and females.

Example:

Suppose we put people on 2 diets: the pizza diet and the beer diet.

Participants are randomly assigned to either 1-week of eating exclusively pizza or 1-week of exclusively drinking beer.

At the end of the week, we measure weight gain by each participant.

Which diet causes more weight gain?

In other words, the null hypothesis is:

Ho: wt. gain pizza diet = wt. gain beer diet.

Why?

The null hypothesis is the opposite of what we hope to find.

In this case, our research hypothesis is that there ARE differences between the 2 diets.

Therefore, our null hypothesis is that there are NO differences between these 2 diets.

The first step in calculating the independent samples t-test is to calculate the **variance** and **mean** in each condition.

In the previous example, there are a total of 10 people, with 5 in each condition.

Since there are different people in each condition, these “samples” are “**independent**” of one another; **giving rise to the name of the test.**

	X₁ : Pizza	X₂ : Beer	<i>Column 3</i>	<i>Column 4</i>
	1	3	1	1
	2	4	0	0
	2	4	0	0
	2	4	0	0
	3	5	1	1
	2	4		
	$s_x^2 = \frac{\sum (x - \bar{x})^2}{n} =$		0.4	0.4

The formula for
the independent samples t-test is:

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{S_{x_1}^2}{n_1 - 1} + \frac{S_{x_2}^2}{n_2 - 1}}}$$

, $df = (n_1 - 1) + (n_2 - 1)$

From the calculations previously, we have everything that is needed to find the “t.”

$$t = \frac{2 - 4}{\sqrt{\frac{.4}{4} + \frac{.4}{4}}} \approx -4.47, \quad df = (5-1) + (5-1) = 8$$

After calculating the “t” value, we need to know if it is large enough to reject the null hypothesis.

The “t” is calculated under the assumption, called the **null hypothesis**,
that there are no differences between the pizza and beer diet.

If this were true, when we repeatedly sample 10 people from the population and put them in our 2 diets, most often we would calculate a “t” of “0.”

Look again at the formula for the “t”.

Most often the numerator ($X_1 - X_2$) will be “0,” because the **mean** of the two conditions should be the **same** under the null hypothesis.

That is, weight gain is the same under both the pizza and beer diet.

Sometimes the weight gain might be a bit higher under the pizza diet, leading to a positive “t” value.

In other samples of 10 people, weight gain might be a little higher under the beer diet, leading to a negative “t” value.

The **important point**, however, is that under the null hypothesis we should expect that most “t” values that we compute are close to “0.”

The calculated t-value is 4.47 (notice, I’ve **eliminated the unnecessary “-” sign**), and the degrees of freedom are 8.

In the research question we did not specify which diet should cause more weight gain, therefore this t-test is a so-called **“2-tailed t.”**

In the **last step**, we need to find the critical value for a 2-tailed “t” with 8 degrees of freedom.

This is available from tables that are in the back of any Statistics textbook.

Look in the back for “Critical Values of the t-distribution,” or something similar.

The value you should find is:

$$\text{C.V.}_{t(8), 2\text{-tailed}} = 2.31.$$

The calculated t-value of 4.47 is larger in magnitude than the C.V. of 2.31, therefore we can reject the null hypothesis.

Even for a results section of journal article, this language is a bit too formal and general. It is more important to state the research result, namely:

Participants on the Beer diet ($M = 4.00$) gained significantly more weight than those on the Pizza diet ($M = 2.00$), $t(8) = 4.47$, $p < .05$ (two-tailed).

Repeat from previous slide:

Participants on the Beer diet ($M = 4.00$) gained significantly more weight than those on the Pizza diet ($M = 2.00$), $t(8) = 4.47$, $p < .05$ (two-tailed).

Making this conclusion requires inspection of the mean scores for each condition (Pizza and Beer).

	P						
one-tail	0.1	0.05	0.025	0.01	0.005	0.001	0.0005
two-tails	0.2	0.1	0.05	0.02	0.01	0.002	0.001
DF							
1	3.078	6.314	12.706	31.821	63.656	318.289	636.578
2	1.886	2.92	4.303	6.965	9.925	22.328	31.6
3	1.638	2.353	3.182	4.541	5.841	10.214	12.924
4	1.533	2.132	2.776	3.747	4.604	7.173	8.61
5	1.476	2.015	2.571	3.365	4.032	5.894	6.869
6	1.44	1.943	2.447	3.143	3.707	5.208	5.959
7	1.415	1.895	2.365	2.998	3.499	4.785	5.408
8	1.397	1.86	2.306	2.896	3.355	4.501	5.041
9	1.383	1.833	2.262	2.821	3.25	4.297	4.781
10	1.372	1.812	2.228	2.764	3.169	4.144	4.587
11	1.363	1.796	2.201	2.718	3.106	4.025	4.437
12	1.356	1.782	2.179	2.681	3.055	3.93	4.318
13	1.35	1.771	2.16	2.65	3.012	3.852	4.221
14	1.345	1.761	2.145	2.624	2.977	3.787	4.14
15	1.341	1.753	2.131	2.602	2.947	3.733	4.073
16	1.337	1.746	2.12	2.583	2.921	3.686	4.015
17	1.333	1.74	2.11	2.567	2.898	3.646	3.965
18	1.33	1.734	2.101	2.552	2.878	3.61	3.922
19	1.328	1.729	2.093	2.539	2.861	3.579	3.883
20	1.325	1.725	2.086	2.528	2.845	3.552	3.85
21	1.323	1.721	2.08	2.518	2.831	3.527	3.819
22	1.321	1.717	2.074	2.508	2.819	3.505	3.792
23	1.319	1.714	2.069	2.5	2.807	3.485	3.768
24	1.318	1.711	2.064	2.492	2.797	3.467	3.745
25	1.316	1.708	2.06	2.485	2.787	3.45	3.725
26	1.315	1.706	2.056	2.479	2.779	3.435	3.707
27	1.314	1.703	2.052	2.473	2.771	3.421	3.689
28	1.313	1.701	2.048	2.467	2.763	3.408	3.674
29	1.311	1.699	2.045	2.462	2.756	3.396	3.66
30	1.31	1.697	2.042	2.457	2.75	3.385	3.646
60	1.296	1.671	2	2.39	2.66	3.232	3.46
120	1.289	1.658	1.98	2.358	2.617	3.16	3.373
1000	1.282	1.646	1.962	2.33	2.581	3.098	3.3
Inf	1.282	1.645	1.96	2.326	2.576	3.091	3.291

THANK YOU