Research Minute

Statistics 202 — Two-Variable Statistics. Student's T-Tests

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The purpose of most research is to understand the relationships between two phenomena. In many research designs, Phenomenon 1 is group membership (e.g., treatment vs. control; male vs. female; diagnosis present vs. absent), while Phenomenon 2 is a score or numeric measurement. A very common research question is: *Are there group (Phenom 1) differences in mean values of Phenom 2?* For example:

- Are there gender differences (*Phenom 1)* in patients' alcohol use? *(Phenom 2)* ?
- Compared to patients with uncontrolled hypertension, do patients with controlled hypertension *(Phenom 1)* have better knowledge about their disease (*Phenom 2)?*
- Do patients who receive home visits, compared to those who do not (Phenom 1), have fewer emergency room visits over a one year period (*Phenom 2)?*

In these questions—comparing group means— the appropriate statistical test is the **Student's T-Test,** also known as **Independent Samples T-test.**

Comparing Group Means with Student's T-tests

The Student's t-test compares two group means. For this test, the groups must be two different sets of people; no person can have membership in both groups. Also, because t-tests compare group *means* or averages, the outcome variable must be measured along a continuous numeric scale, such as BMI, A1c, or blood pressure.

Let's pose a research question: *Are there gender differences in BMI?*

In this question, Phenom 1 is gender; Phenom 2 is BMI.

A sample of 347 subjects is shown in the Table below. Women have 2.2 higher BMI than men, translating into about 12-15 pounds difference.

The **Student's t-test** uses group means and standard deviations to make a comparison between two groups.

To calculate ***t***, Mean 2 (x_2) is subtracted from Mean 1 (x_1), and divided by a measure of variation. By including variation in the denominator, the t-test accounts for the spread and overlap of datapoints in each group. Variation is determined by standard error, derived from the standard deviations (***s***) and sample sizes (***n***) of the two groups. Here is the formula for ***t***:

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

For this comparison, t = 2.60 and p=.010. Thus, the differences are statistically significant (because *p* is less than .05).

If you don't have statistical software, use this free t-test calculator.

http://graphpad.com/quickcalcs/ttest1/?Format=50

From a spreadsheet, you can cut and paste your actual data, choose "*unpaired t -test*" and push "*calculate now.*" Or, if you know the mean and standard deviation of each group (*Excel* can calculate these), you can enter that information and press "*calculate.*"

Research Question: Are there gender differences in BMI?

	Mean	Std Dev
Male n=145	31.44	7.08
Female n=202	33.62	8.94

Related Tests

ANOVA (Analysis of Variance) can assess group differences in more than two groups. It uses calculations similar to ***t*** to compare group means against the "Grand Mean," (the mean of all subjects in all groups).

Paired T-Tests are used to compare pre-test and post-test scores or measurements. Each individual must have two scores, from which the paired t-test creates a change score. Mean changes are then compared to 0 (no change). The online t-test calculator, mentioned to the left, has a Paired T-test option (see Step 3, last choice).

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Art by Brian Hischier