Neuendorf

The t-test

The t-test or t statistic compares two means and tests whether they differ substantially--specifically, whether they represent means from different populations. The t statistic is part of a family of statistics called ANOVA (analysis of variance). The two means that are compared are typically for two different groups on a single dependent variable measured at the interval/ratio level. The "groups" constitute the two values of the other, categorical, binomial independent variable. For example, if we are examining the relationship of gender (IV) and movie attendance (DV), we could compare the mean number of movies attended last month for males and the mean number attended for females. The formula for the t statistic is as follows:

$$t = \frac{mean_1 - mean_2}{\sqrt{\frac{sd_1}{n_1} + \frac{sd_2}{n_2}}} \qquad df = n_1 + n_2 - 2$$

NOTE: The t may be positive or negative, depending on which mean is listed first. Use the absolute value of your own t when checking the table of "critical values."

Notice what components are in the formula: means, standard deviations, and n's. The fact that the difference in the two means is assessed *in light of the two groups' standard deviations* is integral to the notion of ANOVA.

Suppose we wish to test the hypothesis that males attend more movies than do females (a one-tailed H_t). Given:

$$mean_M = 5.7 \qquad sd_M = 2.5 \qquad n_M = 70$$
$$mean_F = 4.5 \qquad sd_F = 3.1 \qquad n_F = 60$$

$$t = \frac{5.7 - 4.5}{\sqrt{\frac{2.5^2}{70} + \frac{3.1^2}{60}}} \qquad df = 70 + 60 - 2 = 128$$

$$t = \frac{1.2}{\sqrt{.089 + .160}} = \frac{1.2}{.499} = 2.40$$

Checking the t-table for the significance of this t at df=120 (the next-lowest designation in the table), we find that the critical value of t at p = .05, one-tailed, is 1.658. Since our t of 2.40 <u>exceeds</u> this critical value in the table, our t is <u>statistically significant</u> at the .05 level. This means that we are 95% certain that gender and movie attendance are indeed related in the population. In terms of the specific H_t of the relationship between the two variables, we can say that we are 95% certain that males attend significantly more movies than do females in the population. We have taken a 5% risk of making a (Type I) error.

Thus, there is a 5% probability that gender and movie attendance are really <u>not</u> related in the population, and the relationship we found in the sample was not truly representative of the state of affairs in the population, but rather due to chance (e.g., the drawing of a "weird" sample).

$n_1 + n_2 - 2$

Percentage Points of Student's t Distribution[*]

df	Level of significance for one-tailed test					
	.10	.05	.025	.01	.005	.0005
	Level of significance for two-tailed test					
	.20	.10	.05	.02	.01	.001
1	3.078	6.314	12.706	31.821	63.657	636.619
2	1.886	2.920	4.303	6.965	9.925	31.598
3	1.638	2.353	3.182	4.541	5.841	12.941
4	1.533	2.132	2.776	3.747	4.604	8.610
5	1.476	2.015	2.571	3.365	4.032	6.859
6	1.440	1.943	2.447	3.143	3.707	5.959
7	1.415	1.895	2.365	2.998	3.499	5.405
8	1.397	1.860	2.306	2.896	3.355	5.041
9	1.383	1.833	2.262	2.821	3.250	4.781
10	1.372	1.812	2.228	2.764	3.169	4.587
11	1.363	1.796	2.201	2.718	3.106	4.437
12	1.356	1.782	2.179	2.681	3.055	4.318
13	1.350	1.771	2.160	2.650	3.012	4.221
14	1.345	1.761	2.145	2.624	2.977	4.140
15	1.341	1.753	2.131	2.602	2.947	4.073
16	1.337	1.746	2.120	2.583	2.921	4.015
17	1.333	1.740	2.110	2.567	2.898	3.965
18	1.330	1.734	2.101	2.552	2.878	3.922
19	1.328	1.729	2.093	2.539	2.861	3.883
20	1.325	1.725	2.086	2.528	2.845	3.850
21	1.323	1.721	2.080	2.518	2.831	3.819
22	1.321	1.717	2.074	2.508	2.819	3.792
23	1.319	1.714	2.069	2.500	2.807	3.767
24	1.318	1.711	2.064	2.492	2.797	3.745
25	1.316	1.708	2.060	2.485	2.787	3.725
26	1.315	1.706	2.056	2.479	2.779	3.707
27	1.314	1.703	2.052	2.473	2.771	3.690
28	1.313	1.701	2.048	2.467	2.763	3.674
29	1.311	1.699	2.045	2.462	2.756	3.659
30	1.310	1.697	2.042	2.457	2.750	3.646
40	1.303	1.684	2.021	2.423	2.704	3.551
60	1.296	1.671	2.000	2.390	2.660	3.460
120	1.289	1.658	1.980	2.358	2.617	3.373
∞	1.282	1.645	1.960	2.326	2.576	3.291

[*] Abridged from Table III of R. A. Fisher and F. Yates, *Statistical Tables for Biological, Agricultural, and Medical Research*, Longman Group, Ltd., London, 1973 (previously published by Oliver and Boyd, Edinburgh), by permission of the authors and publishers.