Tutorial Concept Sheet
Psychology 2101

Two-Sample t-Test

The test statistic $t_{n_1+n_2-2} = \dfrac{M_1 - M_2}{\sqrt{\left(\dfrac{1}{n_1} + \dfrac{1}{n_2}\right)\hat{\sigma}^2}}$, with $\hat{\sigma}^2 = \dfrac{(n_1-1)s_1^2 + (n_2-1)s_2^2}{n_1 + n_2 - 2}$

Degrees of freedom $df = n_1 + n_2 - 2$

1-sided vs. 2-sided hypotheses

Computing critical values from the *t* distribution

Cohen's *d* for two independent groups

A confidence interval for $\mu_1 - \mu_2$

Assumptions of the 2-sample *t*

- Independence
- Normality
- Homogeneity of variances

Effect of violation of assumptions

Computing the *t*-statistic with R

Two-Sample Correlated Sample t-Test

The test statistic, given *n* pairs of observations, compute the difference scores D_i . Then

$$t_{n-1} = \frac{M_D}{s_D / \sqrt{n}}$$

This is the ordinary 1-sample *t* statistic computed on the difference scores.

A confidence interval for $\mu_1 - \mu_2$ may be calculated with the 1-sample procedure, since $\mu_D = \mu_1 - \mu_2$

Computing the *t*-statistic with R.

Correlation

Draw a scatterplot

What is *covariance?*

How does it relate to *correlation*?

Some key formulas

$$r_{x,y} = \frac{1}{n-1}\sum_{i=1}^{n} Zx_i Zy_i = \frac{s_{x,y}}{s_x s_y}$$

Interpreting a correlation

Judging a correlation from a scatterplot

Computing correlation and covariance with R.
Significance test for the null hypothesis $r_{x,y} = 0$

$$t_{n-2} = \sqrt{n-2}\,\frac{r}{\sqrt{1-r^2}}$$

Linear Regression

The scatterplot revisited
Notation for relating a point to a line
Predicted values and residuals

$$\hat{Y} = bX + a$$
$$Y = \hat{Y} + E$$
$$E = Y - \hat{Y}$$

The least squares criterion — minimize $\sum E_i^2$
The least squares solution

$$b = r_{y,x}\frac{s_y}{s_x} = \frac{s_{y,x}}{s_x^2}$$

Computing and plotting a regression line with R
The meaning of the *standard error of estimate*
    Calculating it
    Finding it in the R output
Computing a predicted value

Partial Correlation

Two approaches to computing partial correlation
    Computing the correlation between regression residuals
    Computing the partial correlation directly

Correlational Problems and Fallacies

Anscombe's Quartet
Spurious correlations produced by mixing populations
Correlation is not Causality
Perfect Correlation is Not Equivalence
Zero Correlation is Not Zero Relationship
Restriction of range problem
The third variable problem
Apples and oranges regression