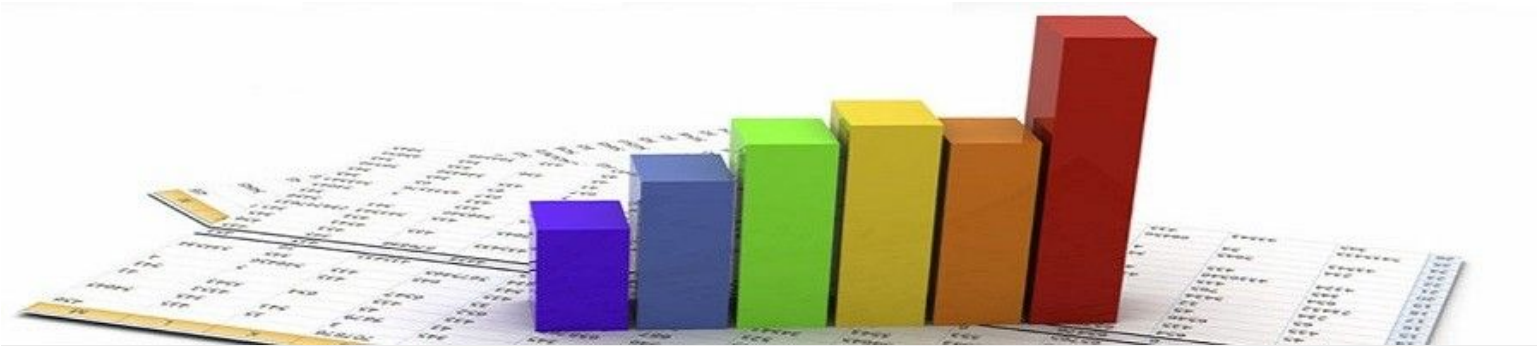
Statistics How To

Statistics for the rest of us!



ANCOVA: Analysis of Covariance

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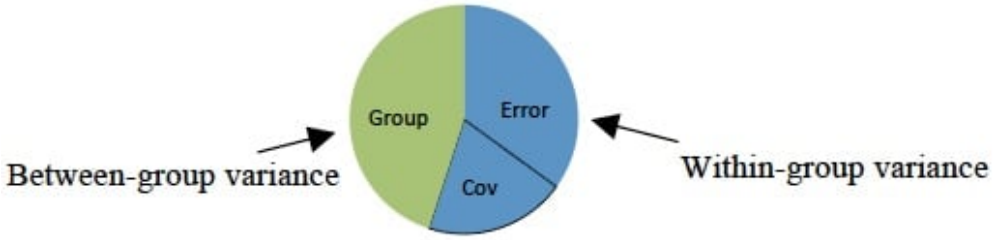
In order to follow this article, you may want to read these articles first:
Analysis of Variance (ANOVA)

Regression Analysis



What is ANCOVA?

ANCOVA is a blend of analysis of variance (ANOVA) and regression. It is similar to factorial ANOVA, in that it can tell you what additional information you can get by considering one independent variable (factor) at a time, without the influence of the others. It can be used as:

- An extension of multiple regression to compare multiple regression lines,
- An extension of analysis of variance.

Although ANCOVA is usually used when there are differences between your baseline groups (Senn, 1994; Overall, 1993), it can also be used in pretest/posttest analysis when regression to the mean affects your posttest measurement (Bonate, 2000). The technique is also common in non-experimental research (e.g. surveys) and for quasi-experiments (when study participants can't be assigned randomly). However, this particular application of ANCOVA is not always recommended (Vogt, 1999).

Extension of Multiple Regression

When used as an extension of multiple regression, ANCOVA can test all of the regression lines to see which have different Y intercepts as long as the slopes for all lines are equal.

Like regression analysis, ANCOVA enables you to look at how an independent variable acts on a dependent variable. ANCOVA **removes any effect of covariates**, which are variables you don't want to study. For example, you might want to study how different levels of teaching skills

affect student performance in math; It may not be possible to randomly assign students to classrooms. You'll need to account for systematic differences between the students in different classes (e.g. different initial levels of math skills between gifted and mainstream students).

Example

You might want to find out if a new drug works for depression. The study has three treatment groups and one control group. A regular ANOVA can tell you if the treatment works. ANCOVA can control for other factors that might influence the outcome. For example: family life, job status, or drug use.

Extension of ANOVA

As an extension of ANOVA, ANCOVA can be used in two ways (Leech et. al, 2005):

1. To control for covariates (typically continuous or variables on a particular scale) that aren't the main focus of your study.
2. To study combinations of categorical and continuous variables, or variables on a scale as predictors. In this case, the covariate is a variable of interest (as opposed to one you want to control for).

Within-Group Variance

ANCOVA can explain within-group variance. **It takes the unexplained variances from the ANOVA test and tries to explain them** with confounding variables (or other covariates). You can use multiple possible covariates. However, more you enter, the fewer degrees of freedom you'll have. Entering a weak covariate *isn't* a good idea as it will reduce the statistical power. The lower the power, the less likely you'll be able to rely on the results from your test. Strong covariates have the opposite effect: it can *increase* the power of your test.

Probability and Statistics Topic Indexes

Basic Statistics.
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Chi Square.
Online Tables (z-table, chi-square, t-dist etc.).
Regression Analysis / Linear Regression.
Non Normal Distributions.

General steps for ANCOVA

General steps are:

1. Run a regression between the independent and dependent variables.
2. Identify the residual values from the results.
3. Run an ANOVA on the residuals.

Assumptions for ANCOVA

Assumptions are basically the same as the ANOVA assumptions. Check that the following are true before running the test:

1. **Independent variables (minimum of two) should be categorical variables**.
2. **The dependent variable and covariate should be continuous variables** (measured on an interval scale or ratio scale.)
3. Make sure **observations are independent**. In other words, don't put people into more than one group.

Software can usually check the following assumptions.

1. **Normality**: the dependent variable should be roughly normal for each of category of independent variables.
2. Data should show **homogeneity of variance**.
3. **The covariate and dependent variable (at each level** of independent variable) should be **linearly related**.
4. Your data should be **homoscedastic** of Y for each value of X.
5. **The covariate and the independent variable shouldn't interact.** In other words, there should be homogeneity of regression slopes.

References and Further Reading

Bonate, P. (2000). Analysis of Pretest-Posttest Designs. CRC Press.
Horn, R. (n.d.). Understanding Analysis of Covariance. Retrieved October 26, 2017 from: http://oak.ucc.nau.edu/rh232/courses/eps625/
Leech, N. et. al (2005). SPSS for Intermediate Statistics: Use and Interpretation. Psychology Press.
Overall, J. (1993). Letter to the editor: The use of inadequate correlations for baseline imbalance remains a serious problem. J.Biopharm. Stat. 3, 271.
Senn, S. (1994). Testing for baseline balance in clinical trials. Statistics in Medicine. Volume 13, Issue 17.
Vogt, W. P. (1999). Dictionary of Statistics and Methodology: A Nontechnical Guide for the Social Sciences (2nd ed.). Thousand Oaks, CA: Sage Publications.

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