

ANCOVA

- Measure one or more continuous variable for each experimental unit, along with the response variable
- Variation explained by continuous variable removed from residual
- Purpose
 - Test for difference between factor means, adjusted for effect of covariate
 - Also use to compare slopes for two or more regression lines

ANCOVA model

- ANOVA model with a covariate (12.1, p 343)
- If regression line is zero, equals ANOVA
- If ANOVA is zero, equals regression

Predicted values

- Predicted- based on mean value for treatment group and regression coefficient minus mean of X
- (see equation 12.1, page 343)
- Residuals- difference between predicted and Y

Assumptions

- Usual ANOVA assumptions
- Relationship between Y and X should be linear
- Covariate values should not depend on treatment groups
 - Avoid situations where covariate means differ greatly among treatment groups
 - Can check by running preliminary ANOVA with covariate as Y
 - Means that you should not start out with different covariate values at start of experiment
- Slopes should be homogeneous among groups

Testing for slope heterogeneity

- Include interaction in model
- If interaction is significant, slopes are heterogeneous
 - You can leave interaction in model
 - Differences among slopes may be of biological interest
- Plot slopes to determine whether they 'look' different before testing interaction

More complex designs

- Multiple covariates
 - Regression part of ancova becomes multiple regression
 - Check for collinearity problems
 - Check for homogeneity of slopes for each covariate separately
- Adding covariates to factorial model
- Nested designs with covariate

General issues

- Adding covariates can reduce unexplained variation and increase precision of group mean estimates
- ANCOVA tests null hypotheses about adjusted means and factor effects
- Homogeneity of slopes assumption should always be checked
- Covariates can be included in more complex models

Hints

- Specify model with interaction to test heterogeneity of slopes
- With more complex models, test main effects separately
- Use scatterplots to test assumptions