**Lab Activities Outline**

**Week 1, 9/1:** SPSS and R Setup

* Basic overview, file/data management

**Week 2, 9/8:** Preparing Data

* Importing data
* Descriptives
* Distribution visualization
* Working with different data formats: wide, long, tidy

**Week 3, 9/15:** Power Analysis and Protocol Preparation

* Power analysis (G\*Power) based on expected/meaningful effect size
  + 1 group, 1 variable (t-test) - d
  + 1 group, 2 variable (correlation) - r
  + 2 groups, 1 variable (independent samples t-test) – d (pooled sd)
  + >2 groups, 1 variable (anova) – eta2 or cohen f
  + 1 group, 2within X 2within (repeated measures anova)
  + 2 group, 2between X 2within (mixed anova)
* Example of correcting for multiple tests – Bonferroni correction for post-hoc pairwise comparisons in 2x2 anova

**Week 4, 9/22:** Visualizing data

* Plot means with error bars (bar, line plots)
* Scatter plots
* Approaches to depict variability (box plot, violin plot, 1D scatter and combinations)

**Week 5, 9/29:** Associations between variables, correlation and contingency coefficients

* 2 Continuous variables:
  + Pearson’s r
  + Nonparametric: spearman rho, kendall tau
* 2 Nominal variables:
  + Contingency coefficients or Cramer’s V
* 3 continuous variables – partial & semi-partial correlation
* Linearity violations can give the same correlation coefficient from different associations

**Week 6, 10/6:** Associations between variables, linear regression, logistic regression

* Linear regression with 1 or more predictors
  + Before fitting model emphasize on checking linearity assumption – use scatterplot
  + Create formula and estimate model
  + How to check linearity, homoscedasticity, normality, independence of residuals
* understand model R2, F-statistic, beta coefficients (standardized, unstandardized) and intercept
* F-statistic for model comparison – also AIC, BIC
* How to examine a quadratic/curvilinear relation
* Understand multi-collinearity and indicators (VIF)
* Logistic regression with dichotomous outcome variable
  + predicted values represent probability, coefficients are change in log(odds)
  + Effect size: Use odds ratio
  + Different assumptions, focus on extreme cases
* Notes on reporting, focus on effect sizes: delta R2, *f*2
* Link to robust regression options for e.g. outlier issues

**Week 7, 10/13:** Associations between variables, moderation and mediation

* Include an interaction term of 2 continuous predictors in regression model
  + Visualization (+/- 1 SD of 1 variable) and interpretation
  + Importance of centering for interpretation of main effects
  + Use *PROCESS* to test the same moderation model
    - Extra visualization, zone of significance
    - Interpreting main effects and interaction coefficients
* Mediation example 1 predictor, 1 mediator, 1 outcome
  + Examine X1->Y, X1->X2, X2->Y with regression models
  + Use *PROCESS to e*xamine *total effect, indirect effect, direct effect*
    - Interpretation of coefficients
    - Notes about causal interpretations, effect size
* Notes about more complex models: mediated moderation, moderated mediation

**Week 8, 10/20:** Comparing two groups

* Independent samples t-test, equal variance assumed or not
  + Same glm assumptions
  + Effect size Cohen d (pooled variance)
* Independent samples, nonparametric: Wilcoxon rank-sum W, Mann-Whitney U
  + Effect size use z-to-r (Field textbook)
  + Bootstrapped confidence intervals
* Dependent/paired samples t-test
  + Same glm assumptions
  + Effect size Cohen d (use difference between pairs)
* Dependent/matched groups: Wilcoxon signed rank test
  + Effect size use z-to-r (Field textbook)
* Save Kruskal-Wallis for three or more groups day
* Extra: equivalent t-test formulated as a regression model

**Week 9 is a Data Day**

**Week 10, 11/3:** Comparing 3 or more groups

* ANOVA (1 factor, 3 levels)
  + Same glm assumptions
  + Use aov() in R, 1-way anova in spss
  + Interpret SS between, SS within, F-stat
  + Effect size: R-squared/eta-squared, ω
  + Planned contrasts including linear and quadratic trend contrasts
* Factorial ANOVA
  + 2x2 (independent groups) example
  + Simple effects tests
* Non-parametric Kruskal Wallis H, Welch’s F
* ANCOVA
  + Example with 1 continuous covariate
* ANOVA formulated as a regression model (lm in R)
  + Dummy coding (same as before) and contrast coding examples
  + Robust regression for assumption violations

**Week 11, 11/10:** Repeated Measures and longitudinal designs

* 1 factor, 3 level repeated measures ANOVA same glm assumptions
* Within subject 2x2 design, repeated measures ANOVA
  + Effect size: R-squared/eta-squared, ω
* Formulate as regression model. Robust regression options for outlier issues.

**Week 12, 11/17:** Chi-squared test, loglinear analysis

* Chi squared for 1 frequency variable, two or more groups
  + Focus on formulating test as difference btw observed and expected
* Chi-squared independence test for two categorical variables, two or more groups
* Loglinear analysis for more than two groups
* Assumptions: independent groups, minimum expected count >=5
* Effect size: use odds ratio

**Week 13, 14: Thanksgiving and Data day**

**Week 15, 12/8:** Mixed Effects and trial-level data

* Multi-level model example: treatment effect with levels for students, class
* multi-level example: within-subject treatment, analysis of trial-level responses
* dichotomous outcome - mixed effects logistic regression example: yes/no choice with within-subject treatment, analyze trial-level responses
* effect size – pseudo R-squared (marginal, conditional)