EDMS 646: General Linear Models I
Topics List

1. Student’s t, F, and chi-squared distributions: characteristics, uses, and relations to each other and the normal distribution
2. Statistical inferences for variances
3. Correlations
   a. concept
   b. different types
   c. characteristics
   d. interpretation
   e. statistical inference
   f. assumptions
   g. Fishers $r$-to-$z$ transformation
4. Graphical representation of univariate and bivariate relations
   a. kernel densities
   b. Q-Q plots
   c. histograms
   d. scatterplots
   e. scatterplot matrix
5. General linear models that include simple and multiple regression models, analysis of variance designs and models, analysis of covariance, repeated measures analysis of variance, and split-plot model
   a. model equations
   b. purposes
   c. research questions
   d. statistical inferences for parameter estimates (hypotheses testing) including model comparison $\Delta F$ test
   e. point and interval estimation including predicted values
   f. evaluation of model fit including standard error of estimate, $R^2$, $R$
   g. interpretation of coefficients
   h. effect sizes including standardized coefficients and squared part correlations
   i. power analysis
   j. assumptions and methods to formally and casually test assumptions
   k. impact of assumption violations
   l. model diagnostics and influential statistics including multicollinearity
6. Factors that influence power
7. Multiple comparisons procedure: methods, purpose, characteristics
8. Statistical control
9. Differences between- and within-subjects design
10. Main effects and interaction effects: testing, interpretation, and statistical inferences
11. Test of simple effects
12. Decomposition of total variance
13. Fixed, random, and mixed effects: hypotheses and statistical testing
14. Dummy coding and its effect on parameter interpretation
15. Transformation of variables
1. Moderator analysis
   a. definition
   b. nature
   c. modeling
   d. statistical testing
   e. interpretation of moderating effects

2. Path analysis
   a. concepts
   b. exogenous and endogenous variables
   c. decomposition of effects in path analysis
   d. statistical inferences via SEM fit statistics

3. Mediator analysis
   a. definition
   b. nature
   c. modeling
   d. statistical testing
   e. interpretation of mediating effects

4. Estimation
   a. ordinary least squares
   b. weighted least squares estimation
   c. maximum likelihood estimation

5. Generalized linear models that include regression models for dichotomous, polytomous, and count outcomes
   a. model equations including link and variance functions
   b. purposes
   c. research questions
   d. statistical inferences for parameter estimates (hypotheses testing) including model comparison likelihood ratio test and information criteria
   e. point and interval estimation including predicted values
   f. evaluation of model fit including classification tables, odds ratio, cross-validation
   g. interpretation of coefficients
   h. coding schemes: dummy coding, effect coding and interpretation of parameter estimates
   i. effect sizes including standardized coefficients and squared part correlations
   j. power analysis
   k. assumptions and methods to formally and informally test assumptions
   l. impact of assumption violations

6. Nonlinear regression models—including nonlinear least squares estimation

7. Polynomial regression models

8. Missing data analysis
   a. mechanisms
   b. approaches—including multiple imputation
c. limitations

9. Parametric and nonparametric bootstrapping
   a. purposes
   b. implementation
   c. interpretation of results including point estimates and bootstrap confidence intervals
1. Measurement, scaling, and test theory
   a. Definition of measurement, scaling, and test theory
   b. Stevens’ levels of measurement and their statistical implications
   c. Thurstone's law of comparative judgment
   d. Thurstonian methods of scaling stimuli
2. Test construction
   a. Item analysis
   b. Basic achievement test construction
   c. Criterion vs. norm-referenced score interpretation
3. Classical test theory overview
   a. Variance and covariance of random variables and their composites
   b. Assumptions
4. Reliability
   a. Definition
   b. Estimation methods
   c. Factors that affect reliability estimates
5. Validity
   a. Definition of validity
   b. Alternative types of validity evidence
   c. The multi-trait multi-method approach to validity
   d. Factorial validity
   e. The unitary view of validity
6. Introduction to item response theory
   a. Overview of item response theory applications
   b. Item response theory compared to classical test theory
7. Introduction to test equating
   a. Overview of test equating methods
8. Introduction to test bias and differential item functioning (DIF)
   a. Overview of methods to detect DIF
9. Setting standards and developing test score cutoffs
   a. Overview of standard setting methods
10. Developing and using test norms
EDMS 647: Causal Inference and Evaluation Methods
Topics List

1. Rubin’s Causal Model and other causal frameworks  
   a. Definition of key concepts in symbols and equations
2. Threats to validity  
   a. The central threats to validity of inference as defined by Shadish, Cook, and Campbell  
   b. Approaches that one can use to minimize those threats
   Advantages and disadvantages  
   b. Describe and use best practices in analyzing data from randomized experimental designs to result in unbiased estimates and with maximum precision.
4. Natural experiments  
   a. Identify natural experiments and know when they are appropriate to use to result in unbiased causal inference  
   b. Suggest best practices in analyzing data from natural experiments to result in unbiased estimates and with maximum precision, including necessary assumptions for causal inference
5. Quasi-experiments  
   a. Identify quasi-experiments and know when they are appropriate to use to result in unbiased causal inference  
   b. Use best practices in analyzing data from quasi-experiments to result in unbiased estimates and with maximum precision, including necessary assumptions for causal inference
6. Evaluation Standards  
   a. Description of the Evaluation Standards
7. Design or critique an evaluation based on Stufflebeam’s CIPP model
8. Evaluation methods  
   a. Describe best practices for uses of questionnaires, structured interviews, and focus groups in the context of program evaluation.