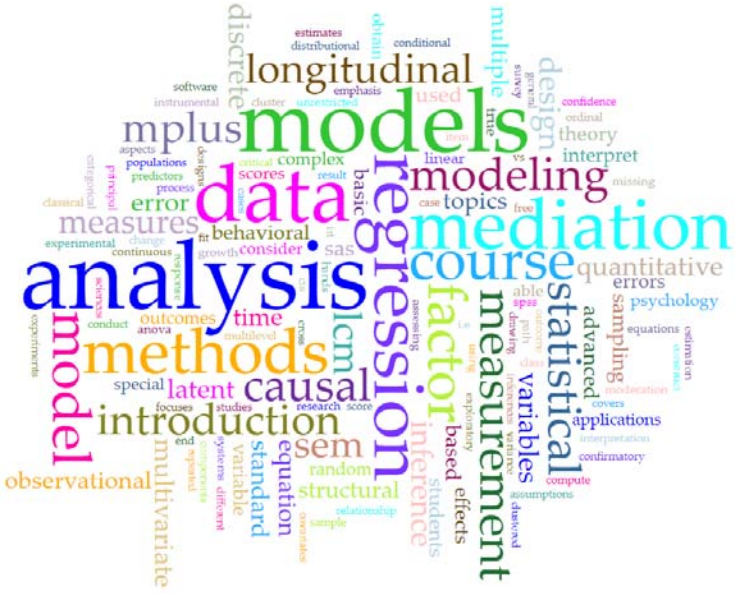
Quantitative Methods Courses

Department of Psychology
University of South Carolina



Master Schedule of Quantitative Courses

https://www.sc.edu/study/colleges_schools/artsandsciences/psychology/study/graduate/quantitative_psychology/index.php

FALL ODD	SPRING EVEN	FALL EVEN	SPRING ODD
PSYC 709: Basic Quantitative Methods in the Analysis of Behavioral Data I Dr. Shinkareva MW 10:30-11:45	PSYC 710: Basic Quantitative Methods in the Analysis of Behavioral Data II Dr. Maydeu-Olivares MW 10:30-11:45	PSYC 709: Basic Quantitative Methods in the Analysis of Behavioral Data I Dr. Shinkareva MW 10:30-11:45	PSYC 710: Basic Quantitative Methods in the Analysis of Behavioral Data II Dr. Maydeu-Olivares MW 10:30-11:45
PSYC 821 Theory of Psychological Measurement Dr. Maydeu-Olivares W 9:00-11:45	PSYC 824 Special Topics in Quantitative Psychology: Introduction to Causal Inference Dr. Shi T 12:30-3:15	PSYC 824 Special Topics in Quantitative Psychology: Structural Equation Modeling Dr. Maydeu-Olivares W 9:00-11:45	PSYC 825 Introduction to Statistical Mediation Analysis Dr. Fairchild T 12:30-3:15
PSYC 823 Multivariate Analysis of Behavioral Data Dr. Shinkareva M 1:00-3:45		PSYC 823 Multivariate Analysis of Behavioral Data Dr. Shinkareva M 1:00-3:45	PSYC 824 Special Topics in Quantitative Psychology: Longitudinal Structural Equation Modeling Or Analysis of Complex Survey Data Dr. Shi R 12:30-3:15

Title	**PSYC 709: Basic Quantitative Methods in the Analysis of Behavioral Data I**
Content	**Experimental design and Analysis of Variance (ANOVA)**
Current Instructor	Dr. Shinkareva (shinkareva@sc.edu)
Schedule	MW: 10:30-11:45, lab F 9-11 (Every Fall)
Software	R, SAS
Textbook	Example: Abdi, Edelman, Valentin, & Dowling (2009) Experimental Design & Analysis for Psychology. ISBN: 9780199299881

This is the first course in a two-semester statistical methods sequence. It is an introduction to research design and statistical analysis with emphasis on interpretation, statistical reasoning, and critical thinking about statistical information. As the result of having taken this course, students should (a) be familiar with the principles of research design and ANOVA methods, (b) understand applications of these methods in the literature, and (c) be able to conduct ANOVA with SAS and R statistical software.

Contents:

1. Overview of experimental design
2. Looking at data
3. Probability and probability distributions
4. Fundamentals of statistical inference
5. ANOVA, one factor
6. ANOVA, assumptions
7. ANOVA, planned orthogonal comparisons
8. ANOVA, planned non-orthogonal comparisons
9. Post hoc analyses
10. ANOVA, two factors
11. Factorial designs and contrasts
12. ANOVA, repeated measures
13. Multi-factor repeated measures
14. Nested factorial designs

Title	**PSYC 710: Basic Quantitative Methods in the Analysis of Behavioral Data II**
Content	**Regression analysis**
Current Instructor	Dr. Maydeu-Olivares (amaydeu@mailbox.sc.edu)
Schedule	MW: 10:30-11:45, lab F 9-11 (Every Spring)
Software	SPSS, R, Mplus
Textbook(s)	Mendenhall, W. & Sincich, T. (2012). *A second course in Statistics. Regression Analysis* (7th ed). Upper Saddle River, NJ: Prentice Hall. Long, J.S. (1997). *Regression models for categorical and limited dependent variables*. Thousand Oaks, CA: Sage

This is the second course in a two-semester statistical methods sequence. This course is a lab-based, hands-on, no formula course in which students will learn all the intricacies of the regression model: predictors can be discrete or continuous, may interact with each other, and outcomes can be continuous, discrete, or counts. Relationships need not be linear, and may change over time as the result of an intervention (piecewise regression). We also consider the issue of causality, and how to proceed when model or distributional assumptions are violated. We use SPSS and R throughout the course, and we provide an introduction to Mplus, the software we use in more advanced courses.

Contents:

1. Simple linear regression
2. Multiple regression. Determining the relative importance of predictors
3. How to determine the impact of a block of variables in the model: Hierarchical regression
4. Regression with qualitative predictor variables
5. Polynomial and piecewise regression
6. Regression with interaction terms (moderation)
7. Multicollinearity
8. Variable screening methods: stepwise regression, all-possible-subsets regression, etc.
9. Outliers and influential observations
10. Regression pitfalls: heteroscedastic robust standard errors, bootstrapped standard errors, logarithmic transformations
11. Regression as a linear model
12. Discrete outcome variables: Multinomial logistic regression
13. Drawing causal inferences with observational data: instrumental variable regression
14. Count outcome variables: Poisson regression

Title	**PSYC 821: Psychological Measurement**
Content	**Measurement, factor analysis, and introduction to item response theory**
Current Instructor	Dr. Maydeu-Olivares (amaydeu@mailbox.sc.edu)
Schedule	W: 9:00-11:45 (Odd Fall)
Software	SPSS, Mplus, R
Textbook	None

This course is the first part of a two semester sequence (Structural equation modeling is the second part). The course is a lab-based, hands-on, no formula, course in which students will learn all the intricacies of psychological measurement. The course revolves around obtaining a confidence interval (CI) for the true measure of an individual's characteristic (e.g., weight, or satisfaction with life). Repeated measures are needed to do so, and we consider models for these measures: factor analysis models if the measures are continuous and ordinal factor analysis/IRT if the measures are discrete.

Contents:

1. Data reduction is not measurement: principal components
2. Factor analysis 101: Exploratory (unrestricted) factor analysis using SPSS
3. Introduction to measurement: how to obtain error free measures
4. Confirmatory (restricted) factor analysis
5. Statistical theory for factor analysis: Robust standard errors, fit indices, modification indices
6. The new gold standard: unrestricted factor analysis with target rotation and correlated errors
7. Advanced models: second order and hierarchical factor models
8. Modeling response bias: random intercept factor analysis
9. What if you kept only the test score? Classical test theory
10. Model based and model free reliability estimates of test scores (factor scores, sum scores, z scores, etc.). Confidence intervals for true scores
11. What if the measures are discrete? Ordinal factor analysis
12. Introduction to item response theory (IRT): 2PL, graded, and nominal models
13. Assessing the precision of measurement in ordinal factor analysis and IRT
14. Measurement invariance: Factor analysis and ordinal factor analysis/IRT cases

Title	**PSYC 823: Multivariate Analysis of Behavioral Data**
Content	**Experimental design and Analysis of Variance (ANOVA)**
Current Instructor	Dr. Shinkareva (shinkareva@sc.edu)
Schedule	M: 1:00-3:45 (Every Fall)
Software	R, SAS
Textbook	Example: Tabachnick & Fidell, Using Multivariate Statistics

This hands-on course is an introduction to multivariate methods used in behavioral sciences, with an emphasis on interpretation, statistical reasoning and critical thinking about statistical information. Students will practice multivariate methods using the data and software of their choice. R and SAS will be used for in-class examples. As the result of taking this course, students should be able to (a) characterize and display multivariate data, (b) explain under what conditions different multivariate tests are used, (c) compute and interpret Multivariate Analysis of Variance applications, (d) compute and interpret Multivariate Multiple Regression applications, (e) compute and interpret Principal Components Analysis applications, (f) construct and interpret cluster analysis solutions, (g) construct and interpret Multidimensional Scaling solutions.

Contents:

1. Multivariate normal distribution
2. Multivariate tests
3. Multivariate regression
4. Multivariate analysis of variance
5. Classification
6. Principal components analysis
7. Canonical correlations
8. Cluster analysis
9. Multidimensional scaling

Title	**PSYC 824: Special Topics in Quantitative Psychology**
Content	**Structural equation modeling (SEM) of behavioral data**
Current Instructor	Dr. Maydeu-Olivares (amaydeu@mailbox.sc.edu)
Schedule	W: 9:00-11:45 (Even Fall)
Software	Mplus, R
Textbook	Geiser, C. (2013). *Data analysis with Mplus*. New York, NY: Guilford Press

This course is the second part of a two semester sequence (Psychological measurement is the first part). Psychological measurement is NOT a pre-requisite. Working knowledge of regression (PSYC 710 or equivalent) is required.

The course is a lab-based, hands-on, no formula, course in which students will learn the basics of modeling phenomena using systems of equations. A review of exploratory and confirmatory factor analysis (the contents of Psychological Measurement) will be included if needed.

Data can be clustered (i.e., multilevel data), or heterogenous (with known or unknown membership –multiple populations vs. mixtures), the measures can be observed without error (path analysis) or with error (classical SEM), and the systems of equations can have a restricted (confirmatory) or unrestricted (exploratory) measurement structure. Finally, we consider how to draw causal inferences in these complex models when the data is observational.
This course is an introduction to more advanced course offerings.
We use both Mplus and Lavaan (an R package).

Contents:

1. Regression in Mplus/Lavaan: observational residuals, robust standard errors, bootstrap
2. Introduction to moderation and mediation in Mplus/Lavaan
3. Statistical theory: goodness of fit, modification indices, etc.
4. Systems of equations without measurement error: Path analysis
5. Regression with measurement error in the predictors or outcomes: latent variable regression and general SEM.
6. Exploratory (unrestricted) SEM models
7. Random effects regression models for longitudinal data: introduction to latent growth models
8. Modeling multiple populations
9. Regression (and general SEM) with heterogenous populations: introduction to mixture modeling
10. Regression with nested (clustered) data: Multilevel vs. fixed effects regression
11. Drawing casual inferences in SEM models: instrumental variable methods

Title	**PSYC 824: Special Topics in Quantitative Psychology**
Content	**Longitudinal Structural Equation Modeling**
Current Instructor	Dr. Shi (shid@mailbox.sc.edu)
Schedule	R: 12:30 – 3:15 (Alt Odd Spring)
Software	Mplus, R
Textbook	Grimm, K. J., Ram, N., & Estabrook, R. (2017). *Growth Modeling: Structural Equation and Multilevel Modeling Approaches*. New York, NY: Guilford.

This course focuses on the application and interpretation of structural equation models fitted to longitudinal data (i.e., the repeated measurement of the same cases over time). At the end of this course, students will be able to develop a real understanding of the longitudinal SEM models and to be able to thoughtfully apply a variety of basic and advanced models to their own data.

Contents:

Introduction
1. Introduction to Longitudinal Data
2. Analyzing Longitudinal Data using Multilevel Regression
3. Review of SEM and Introduction to Mplus

Latent Growth Curve Models (LCM)
4. Unconditional Linear LCM
5. Nonlinear LCM
6. Conditional LCM with Time-Invariant Covariates
7. LCM with Time-varying Covariates & Multivariate LCM
8. Population Heterogeneity in LCM: Multiple-Group LCM
9. Population Heterogeneity in LCM: Growth Mixture Models
10. LCM with Non-normal/Discrete Data

Growth Models with Latent Entities
11. Longitudinal Measurement Models and Longitudinal Factorial Invariance
12. Second-Order LCM
13. Latent Transition Analysis

Cross-Lagged Models
14. Autoregressive Cross-lagged Panel Models
15. Longitudinal Mediation Models

Other Advanced Topics
16. Latent Change Score Models
17. Dynamic SEM for Intensive Longitudinal Data

Title	**PSYC 824: Special Topics in Quantitative Psychology**
Content	**Analysis of Complex Survey Data**
Current Instructor	Dr. Shi (shid@mailbox.sc.edu)
Schedule	R: 12:30 – 3:15 (Alt Odd Spring)
Software	Mplus, R, SPSS, SAS
Textbook(s)	Enders, C. K. (2010). *Applied Missing Data Analysis*. New York, NY: Guilford. Heeringa, S. G., West, B. T., & Berglund, P. A. (2017). *Applied Survey Data Analysis*. Chapman and Hall/CRC.

Probability-based designs and complex sampling strategies are often used in national or international sample surveys. In addition, missing data cannot be avoided in the process of data collection, especially for large-scale assessment following a longitudinal design. This course aims to address the above two practical issues in survey data analysis. The course will provide an introduction to the methods for handling sampling weights and dealing with missing data.

Contents:

Complex Sample Techniques

1. Review and Description of Existing National and International Surveys
2. Complex Sample Design (simple random sampling, stratified random sampling, cluster sampling, two-phase sampling)
3. Techniques for Design-based Estimation and Inference
4. Analysis Models for Complex Samples:
    - Linear Regression Models
    - Logistic Regression Models
    - Models for Ordinal Outcomes
    - Latent Variable Models

Missing Data Analysis

5. Introduction and Missing Data Mechanisms
6. Naïve Methods
7. EM-algorithm
8. Likelihood-based Methods
9. Bayesian Approach
10. Multiple Imputation Methods
11. Nonignorable Missingness Methods

Title	**PSYC 824: Special Topics in Quantitative Psychology**
Content	**Introduction to Causal Inference**
Current Instructor	Dr. Shi (shid@mailbox.sc.edu)
Schedule	T: 12:30 – 3:15 (Even Spring)
Software	R, SAS, Mplus
Textbook	Murnane, R. J., & Willett, J. B. (2010). *Methods matter: Improving causal inference in educational and social science research*. Oxford University Press.

The questions that motivate most studies in the health, social and behavioral sciences are not associational but causal in nature (Pearl 2009). For drawing causal conclusions, experiments (with randomization) have been considered the gold standard. Despite the advantages of true experimental designs, successful randomization of subjects to groups is not always possible. For example, it may be unethical to assign subjects to groups, or a factor of interest may be an immutable, naturally occurring phenomenon. In domains that are heavily reliant on observational data, statistical methods to enhance causal inference of observed relationships are paramount. This course focuses on causal inference for both experimental and observational studies, with an emphasis on observational studies.

Contents:

Introduction
1. The Potential Outcome Framework and Directed Acyclic Graphs
2. Randomized Experiments

Selection on Observable
3. Matching and Weighting
4. Propensity Score Methods

Cross-Sectional Research Designs
5. Instrumental Variables
6. The Regression Discontinuity Design

Longitudinal Designs
7. Difference-in-Differences
8. Fixed Effects and Random Effects Models
9. Comparative Interruptive Time Series Analysis and Synthetic Control Methods

Other Advanced Topics
10. Sensitivity Analysis
11. Causal Mechanisms: Causal Mediation Analysis
12. Beyond Means: Distributional Effects
13. Causal Inference with Time-varying Treatment
14. Causal Inference with Continuous Treatment
15. Applications of Machine Learning to Causal Inference

Title	**PSYC 824: Special Topics in Quantitative Psychology**
Content	**Quantitative Methods in the Analysis of fMRI Data**
Current Instructor	Dr. Shinkareva (shinkareva@sc.edu)
Schedule	Irregular
Software	MATLAB
Textbook	None

This course covers quantitative methods for analysis of fMRI data. Topics include statistical learning, multivariate pattern analyses, network analyses and coordinate-based meta analyses.

Contents (representative):

1. fMRI: strengths and limitations
2. Fundamentals of Statistical Learning
3. Multivariate Pattern Analyses (MVPA)
4. Reverse inference
5. Classifiers
6. Feature selection
7. Searchlight analyses
8. Multiple comparison correction
9. Representational Similarity Analyses
10. Functional connectivity analyses
11. Coordinate-based meta analyses

Title	**PSYC 825: Introduction to Statistical Mediation Analysis**
Content	**Mediation analysis and statistical methods for assessing mediating variables.**
Current Instructor	Dr. Fairchild (afairchi@mailbox.sc.edu)
Schedule	T: 12:30 – 3:15 (Odd Spring)
Software	Mplus
Textbook(s)	MacKinnon, D. P. (2008). *Introduction to Statistical Mediation Analysis*. Mahwah, NJ: Erlbaum. Geiser, C. (2013). *Data Analysis with Mplus*. New York, NY: Guilford Press.

This course is an elective, quantitative seminar that covers the substantive rationale for mediation analysis and presents statistical methods for assessing mediating variables. The course content reflects that mediation analysis may be applicable across many disciplines including psychology, sociology, and epidemiology. Statistical methods for assessing mediation are practiced in homework and integrated in an end of the semester class project. Mplus will be the primary software package used in the course. Upon successful completion of the class, students will be able to: (a) classify research scenarios in which mediation analysis would be appropriate; (b) describe detailed aspects of mediation analysis for basic mediation models; (c) identify key aspects of mediation in SEM, longitudinal data, categorical data, and multilevel data; (d) discern basic details of moderation analysis and conditional process models; (e) recognize limitations of causal inference from mediation models; (f) use Mplus to conduct mediation analyses for various types of data; and (g) interpret effects in a variety of different mediation models.

Contents:

Introduction
1. Introduction to Mediation Analysis
2. Using Mediation in Prevention & Intervention Work

Details on the Single Mediator Model
3. Basic Mediation Model Identification and Estimation
4. Assumptions of the Mediation Model
5. Causal Inference in the Mediation Model and Design Approaches to Mediation
6. Effect Size in Mediation

Multiple Mediator Models
7. Multiple Mediator Models
8. Serial Mediator Models

Advanced Topics in Mediation
9. Mediation in Path Analysis
10. Mediation Analysis with Longitudinal Data
11. Moderation and Conditional Process Models
12. Categorical Mediation Models and Mediation with Discrete Time Survival Outcomes
13. Power Analysis for Mediation Models