Psychology 312
Spring, 2015
Tentative Schedule of Activities

Date	Topic(s)	Assigned Activities
Wed 01/07	Course Introduction Administrative Details Overview of Multivariate Methods Mathematical Prerequisites Raw Scores, Deviation Scores, *Z*-scores The Algebra of Variances and Covariances Linear Transformations Linear Combinations Mean of a Linear Combination Variance of a Linear Combination Covariance of Two LCs Introduction to R Basic Computations and Linear Transformation in R Linear Combination in R Introduction to Matrix Algebra Types of Matrices Matrix Addition Transposition Scalar Multiples Scalar Products Matrix Multiplication	Install the latest version of *R* on your computer. Install the latest version of *RStudio* on your computer. When you receive an email from Piazza inviting you to join, please immediately join Piazza. Go to http://www.overleaf.com and register for the free account version of WriteLaTex. Read: Harlow, Chapters 1–2 [[LH01.pdf, LH02.pdf]] Rencher, Chapter 1 [[AR01.pdf]] Handout Chapter 3, The Scalar Algebra of Variances and Covariances, [[Covariances.pdf]] p. 31–51 Handout, Chapter 4, Introduction to Matrix Algebra p. 53–60 [[Matrix.pdf]] **Homework Assignment 1** Due 01/21
Wed 01/14	Introduction to Matrix Algebra (ctd) Linear Combinations Sets of Linear Combinations Extracting Rows and Columns Inverse of a Square Matrix Matrix Algebra and Matrix Manipulation in R Matrix Algebra of Sample Statistics Means Deviation Scores Sums of Squares Sums of Cross-Products	Read: Handout Chapter 4, Introduction to Matrix Algebra p. 57–75 ***R-intro*** Handout, p. 1–22

Wed 01/21	Matrix Algebra of Sample Statistics (ctd) Properties of the P and Q deviation score projector Variances and Covariances Covariance Matrices Diagonal Matrices and their Special Properties Roots and Powers of a Diagonal Matrix Correlation Matrices Eigenvalues and Eigenvectors Random Vectors and Random Matrices Matrix Expected Value Algebra Matrix Covariance Algebra for Sets of Linear Combinations Eigenvalues and Eigenvectors	**Homework Assignment 2.** Due Wednesday 02/04. Use R to do the computations for the last question. Download *R Utility Functions* and documentation from the R Code and Support Materials section of the website. Read: Handout Chapter 4, Introduction to Matrix Algebra p. 75-84 Rencher, Chapter 02 (Optional).
Wed 01/28	Random Vectors and Random Matrices Matrix Expected Value Algebra Matrix Covariance Algebra for Sets of Linear Combinations Eigenvalues and Eigenvectors Eckart-Young decomposition of a symmetric Matrix Symmetric Powers of a Symmetric Matrix Matrix Factorization and Random Number Generation Defining our own matrix functions Creating Data with Exact Attributes Creating Samples from a Population with Known Attributes	Read: **Homework Assignment 3**, Due Wednesday 02/11

Wed 02/04	Linear Regression Analysis Basics of Least Squares Linear Regression and Multiple Regression Algebra Introduction to the Geometry of Statistics Projection Operators Partial Covariance and Correlation Algebra Factor Analysis and Explanation of Variables in the "Partial Correlation Sense"	Read: Handout Chapter 5, The Algebra of Linear Regression and Partial Correlation. Gelman & Hill, Ch. 3 Gelman & Hill, Ch. 4 Weisberg, Ch. 1 Weisberg, Ch. 2 Wonnacott Ch 14 Wickens Ch 1–4 (Optional) Steiger(1994), pp. 201–207
Wed 02/11	The Determinant as Generalized Variance More Regression Algebra Multivariate Regression Systems with Latent Variables – Regression Component Analysis Principal Components as a Regression Component System. The "Fundamental Theorem of Factor Analysis" Multivariate Models as Data Constraints Spearman's Tetrad Criterion	Handout, *Exploratory Factor Analysis with R* Handout, *Algebra of Factor Analysis*

Wed 02/18	Practical Factor Analysis Principal Component Analysis with R and FactoMineR Exploratory Factor Analysis with R	Homework Assignment 4, Due Wednesday 02/25
Wed 02/25	The 3 Indeterminacies of Factor Analysis Simple Structure and Machine Rotation Orthogonal Rotation Oblique Transformation Bi-Factor Solutions – when "simple structure" fails Maximum Likelihood Estimation and Nonlinear Optimization in Factor Analysis Confirmatory Factor Analysis with R Path Diagrams and their Characteristics Confirmatory Factor Analysis as a Path Diagram Strict Confirmatory FA Jöreskog's "Exploratory-Confirmatory" Approach Advanced Routines for Quick Confirmatory Factor Analysis using the **sem** package	Homework Assignment 5 Due March 11 Handout, *Bifactor Rotation* Handout, *Advanced Exploratory Factor Analysis* Handout, *Confirmatory Factor Analysis with R* Handout, *Advanced Confirmatory Factor Analysis with R* Handout, *Path Diagrams*
Week 9		
	Spring Break – No Classes	

Week 10		
Wed 03/11	Structural Equation Modeling Algebraic Models The LISREL Model The RAM Model The Bentler-Weeks Model Structural Equation Modeling – The Wheaton Model Example	Jöreskog(1978), section on Confirmatory Factor Analysis, p. 454–457 Fox (2006) Handout, *Measures of Fit*
Week 11		
Wed 03/18	The RAM Model Practical Problems in CFA and Structural Equation Modeling Power Calculation Precision of Estimation Sample Size Estimation Handling iterative failure Canonical Correlation – Two-way simultaneous multiple regression	MacCallum, Browne, Sugawara (1996). Rencher, Chapter 11, *Canonical Correlation* Homework Assignment 6, Due April 01
Week 12		
Wed 03/25	Bias in Canonical Correlation – a demonstration Discriminant Analysis Stepwise Discriminant Analysis	Rencher, Chapter 8, *Discriminant Analysis*
Week 13		
Wed 04/01	Factorial ANOVA and the General Linear Model MANOVA	Homework Assignment 7, Due April 15 Reading TBA
Week 14		
Wed 04/08	Hotelling's T^2	