STA 4702 – Multivariate Statistical Methods – Section 20468
STA 5701 – Applied Multivariate Methods – Section 22333
Spring 2019
MWF - 4th Period – FLG 0270

Instructor: Dr. Larry Winner

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Office Hours: Instructor: TBA TA: TBA (Will be posted on class webpage)

Course Objectives: STA 4702/5701 is an introductory course in statistics when responses are more than one characteristic or variable is observed on units (thus multivariate). We begin with a review of the relevant matrix theory/applications and common statistical distributions as well as the Multivariate Normal Distribution. Methods of inference regarding multivariate means will include: Hotelling's T^2, Multivariate Analysis of Variance (MANOVA), Multivariate Regression, and Repeated Measures (Growth Curves). Methods of inference regarding Covariance structure will include: Principal Components, Factor Analysis, and Canonical Correlation. Classification techniques will include: Discriminant Analysis and Cluster Analysis. Note that these methods (and the textbook) can be quite technical, and we will focus mostly on applications to various datasets to understand the methods.

Tentative Course Topics/Exam Schedule:

- Introduction to Multivariate Analysis (1.5 Lectures)
  - Applications (1.2)
  - Data organization (1.3)
  - Graphing (1.4)
  - Distance (1.5)
- Review of Matrix Algebra and Random Vectors/Matrices (1.5 Lectures)
  - Vectors: Addition, Length, Angle, Inner Product, Projection (2.2)
  - Matrices: Multiplication, Square Matrices, Orthogonal Matrices, Eigenvalues/Eigenvectors (2.2)
  - Positive Definite Matrices (2.3), Square Root Matrix (2.4)
  - Random Vectors and Matrices (2.5), Mean Vectors and Covariance Matrices (2.6)
- Geometry of the Sample and Random Sampling (1 Lecture)
  - **X** matrix, means vector, deviations, sample variance-covariance and correlation matrices (3.2)
  - Random sampling, Expectations of Sample mean vector and variance-covariance matrix (3.3)
  - Matrix form of Mean vector and variance-covariance and correlation matrices (3.5)
  - Linear Combinations of Random Variables (3.6)
- Probability and Sampling Distributions (1 Lecture)
  - Univariate: Normal, Student's t, χ^2, F (Supplementary Course Notes)
  - Multivariate Normal (4.2)
  - Sampling Distribution of Sample Mean Vector and variance-covariance matrix (4.4)
  - Large-Sample results for Sample Mean Vector and variance-covariance matrix (4.5)
- Inferences for a Population Mean Vector (3 Lectures)
  - Hypothesis test for a population mean (scalar or vector) – Hotelling's T^2 (5.2)

    - Confidence Regions and Simultaneous Comparisons of Individual Means (5.4)
    - Large Sample Inference for a Population Mean Vector (5.5)
- Comparing Several Population Mean Vectors (8 Lectures)
    - Repeated Measures on Subjects under 2 Different Conditions/Treatments (6.2)
    - Repeated Measures of Subjects with a single response and several Treatments (6.2)
    - Comparing Mean Vectors for 2 Populations (6.3)
    - Comparing Mean Vectors for $g \geq 2$ Populations (6.4)
    - Simultaneous Confidence Intervals for Treatment Means (6.5)
    - Test of Equality of Variance-Covariance Matrices (6.6)
    - 2-Way Multivariate Analysis of Variance (6.7)
    - Profile Analysis (6.8)
    - Repeated Measures and Growth Curves (6.9)
- Multivariate Linear Regression Model (5 Lectures)
    - Classical Univariate (Response) Multiple (Predictor) Linear Regression Model (7.1)
    - Least Squares Estimation (7.2)
    - Inferences for the Regression Model Parameters (7.3)
    - Inferences for the Estimated Regression Function (7.4)
    - Multivariate (Response) Multiple (Predictor) Regression (7.7)
- Principal Components (3 Lectures)
    - Population Principal Components (8.2)
    - Principal Components for Sample Covariance/Correlation Matrices (8.3)
    - Graphing Principal Components (8.4)
    - Large-Sample Inferences (8.5)
- Factor Analysis (3 Lectures)
    - Orthogonal Factor Model (9.2)
    - Methods of Estimation (9.3)
    - Factor Rotation (9.4)
- Canonical Correlation Analysis (2 Lectures)
    - Canonical Variates and Canonical Correlations (10.2)
    - Interpreting Population Canonical Variables (10.3)
    - Sample Canonical Variates and Canonical Correlations (10.4)
- Discriminant Analysis (4 Lectures)
    - Classifying 2 Populations (11.2)
    - Classifying with 2 Multivariate Normal Populations (11.3)
    - Evaluating Classification Functions (11.4)
    - Classifying More than 2 Populations (11.5)
- Cluster Analysis (3 Lectures)
    - Similarity Measures (12.2)
    - Hierarchical Methods (12.3)
    - Nonhierarchical Methods (12.4)

Tentative Exam \ Assignment Dates

- Exam 1 – February 8 Exam 2 – March 22 Exam 3 – May 2 10:00-12:00
- Assignment 1 – (Posted 1/14 – Due 2/1) Assignment 2 – (Assigned 2/8 – Due 2/22)
- Assignment 3 – (Posted 3/11 – Due 3/25) Assignment 4 – (Assigned 4/3 – Due 4/22)

Grading: Exams will count 28% each, and Homework Assignments will count 4% each to the Final total of 100%

Course Grade Cut-offs:

A	A-	B+	B	B-	C+	C	C-	D	E
90	87.5	85	80	75	70	65	60	50	

Attendance/Exam/Assignment Policies: While attendance is not taken, students are expected to attend lectures and participate in class. Make-up exams will only be considered with documented medical event or conference attendance (graduate students) and must be taken within 7 days of scheduled exam. Early exams will be given under no circumstances. Assignments are to be handed in during class on the date the assignment is due in paper format. Electronic submission of assignments will not be accepted. Turn off cell phones during classes. Students can bring 1 hand-written formula sheet (8.5"x11") to exams, and any calculator without internet access.

Academic Accommodations: If you have a documented disability and wish to discuss academic accommodations with me, please contact me as soon as possible.

Textbook: R.A. Johnson and D.W. Wichern (2007). *Applied Multivariate Statistical Analysis*, 6th Ed., Pearson Prentice-Hall, Upper Saddle River, NJ.

University Grading Points:

A	A-	B+	B	B-	C+	C	C-	D	E
4	3.67	3.33	3	2.67	2.33	2	1.67	1	0

Online Course Evaluations: The University has an online course evaluation system. Late in each semester (after final withdrawal date), students can go to the GATORRATER portal and evaluate courses. The website is located at: https://evaluations.ufl.edu/evals/Default.aspx.

University Policies:

Academic Dishonesty: All members of the University Community share the responsibility to challenge and make known acts of apparent academic dishonesty. Acts of academic dishonesty will not be tolerated and will be referred to the Student Honor Council.

Campus Resources:

Counseling and Wellness Center: http://www.counseling.ufl.edu/cwc/

Academic Resources: http://www.ufl.edu/academics/resources/

Disability Resource Center: https://www.dso.ufl.edu/drc/

Student Health Care Center: http://shcc.ufl.edu/