

## EMSE 171/271 – Data Analysis for Engineers and Scientists

### Instructor Information:

Dr. S. Brent Morris - Assoc. Professorial Lecturer  
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Office Hours: *By appointment*

### Course Description:

A detailed statistical review is provided in the first four lectures. Topics that will be discussed include point estimation, confidence intervals, hypothesis testing and goodness-of-fit testing. These methods perform statistical inference in a single dimension (also known as univariate data analysis).

Discussion of multivariate data analysis requires the introduction of matrices and vectors. One class will review rules of matrix-vector algebra and provides intuitive geographical interpretations of these operations. Multivariate data analysis will be introduced by first discussing the classical Hotelling  $T^2$  hypothesis test, which is a natural extension of the univariate  $T$  test. Next, we introduce regression analysis (in matrix-vector format), principal component analysis and analysis of variance (ANOVA). The introduction of these topics will be cursory and their application will be facilitated by the use of the MINITAB software program. Discussion of these multivariate techniques will concentrate on intuition, not a rigorous derivation of their methodologies.

### Prerequisite Requirement:

ApSc 115: Engineering Analysis III (or any other undergraduate Applied Statistics course from a physical or natural sciences program).

### Course Objectives:

Each student should: (1) Get a solid refresher on classical statistical inference techniques, (2) become familiar with matrix-vector operations, (3) get an intuitive feel for a variety of multivariate analysis methods (4) be able to execute the statistical analyses discussed using Microsoft EXCEL and MINITAB, (5) clearly and concisely present the insights obtained from the statistical analysis in a report.



**Method of Instruction:**

Homework discussion followed by a one hour and 15 minutes lecture, a 15 minute break and a 45 minute lecture. We shall use Microsoft Excel and Minitab to perform statistical analysis during the class sessions and the homework. During Class Sessions the only software programs that should be open on your desktop are either Adobe Acrobat (for viewing the notes) or Microsoft Excel or MINITAB for statistical analysis. During the class sessions (except for the break of course) a student is not to check his e-mail, the internet and should not engage in instant messaging sessions. Basically, your attention should be directed towards the class material.

Homework: Homework will have to be completed prior to the next class for discussion. Please send your electronic solutions to the [bmorris@scottishrite.org](mailto:bmorris@scottishrite.org) e-mail address ONE WEEK after it has been assigned. If a hardcopy is required for a homework problem it needs to be handed in at the beginning of the class session and not during. Electronic solutions of the homework will be provided. Homework will be graded on effort.

Reading Assignments: Lecture notes and recommended chapters for reading will be assigned prior to class as indicated in the outline.

**Method of Evaluation:**

FINAL GRADE CALCULATION:

15% Homework

35% Exam 1 (Open lecture notes only)

30% Exam 2 (Open lecture notes only)

20% Multivariate Data Analysis + Report

**Required Software and Recommended Text:**

Required Software: MINITAB and Microsoft EXCEL.

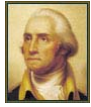
To obtain a valid license for MINITAB for the duration of the semester please check:

<http://www.minitab.com/education/semesterrental/default.aspx>

**Recommended Text Books:**

"Analyzing Multivariate Data" by Lattin, Carroll and Green, Duxbury Press

"Probability and Statistics for Engineering and The Sciences" by Jay L. Devore, Duxbury Press.



**Lead Professor:**

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- Electronic copies of the lecture notes can be downloaded from Prof. van Dorp's Faculty web-page at: <http://www.seas.gwu.edu/~dorpjr/EMSE271/Intro.html>
- Please send me an introductory e-mail with subject **"EMSE 171/271 Spring 2011"** so I can create an E-mail Class List. Electronic solutions to the homework will be distributed via this E-mail Class List.

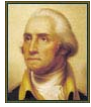
**Academic Integrity:**

THE ACADEMIC INTEGRITY CODE WAS DEVELOPED  
BY THE STUDENTS AND THE FACULTY OF GW WORKING  
TOGETHER IN 1995. BY ATTENDING GW EACH STUDENT  
IS PART OF THIS TRADITION.

"THE RIGHT ANSWER COMES FROM YOU"

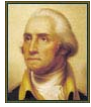
In-class exams will make use of lab computers or your laptop computers. The only software that is allowed to be open on your desktop during the exam is Adobe Acrobat, Microsoft Excel or MINITAB. The use of the internet, e-mail or instant messaging during the in-class exams shall be considered a violation of academic integrity. Cheating will not be tolerated, i.e. copying or looking on another student's paper during the midterm exam or the final exam, will not be tolerated. **No solutions from previous EMSE 171, 271** classes may be used. In the events of violations of academic integrity action will taken in accordance with the Academic Integrity Code. A copy of the Academic Integrity Code may be picked up at:

ACADEMIC INTEGRITY OFFICE  
THE GEORGE WASHINGTON UNIVERSITY  
609 22nd STREET, N.W. BLDG. AJ  
WASHINGTON D.C. 20052



## COURSE OUTLINE EMSE 171/271

Session	Date	Main Topic	Detailed Class Topic	Reading Assignments (LN = Lecture Notes)	Homework Assignments
1	1/13/2011	Stat Review - Univariate Analysis	Exploratory Data Analysis, Probability Calculus (Bayes Theory), Random Variables	LN Session 1	Homework Set 1
2	1/20/2011	Stat Review - Univariate Analysis	Distribution Theory, Calculating Probabilities, Sums of Random Variables	LN Session 2	Homework Set 2: Problems 1 - 4
3	1/27/2011	Stat Review - Univariate Analysis	Point Estimation, Estimator Distributions, Confidence Intervals, Hypothesis Testing	LN Session 3	Homework Set 2: Problem 5, Homework Set 3
4	2/3/2011	Stat Review - Univariate Analysis	Goodness-of-Fit, Method of Moments, Maximum Likelihood Estimation, Credibility Intervals	LN Session 4	Homework Set 4-1
5	2/10/2011	Review - Matrix Vector Algebra	Matrix Algebra, Coordinate Systems, Vector observations, Singular-Value Decomposition	LN Session 4 + Recomm. Chapter 1, 2 - AMD	Homework Set 4-2
6	2/17/2011	Multivariate Analysis	Multivariate Point Estimation, Matrix Determinant and Generalized Variance, Hotelling T2 Tests	LN Session 5 + Recomm. Chapter 1, 2 - AMD	Homework Set 5
7	2/24/2011	Multivariate Analysis	Overview Multivariate Analysis, Regression Analysis Matrix formulation	LN Session 9 + Recomm. Chapter 3 - AMD	
<b>8</b>	<b>3/3/2011</b>		<b>Exam 1 - Session 1 - Session 6</b>		
9	3/10/2011	Multivariate Analysis	Regression Analysis, Diagnostics and Forecasting	LN Session 10 + Recomm. Chapter 3 - AMD	Homework Set 6
	3/17/2011		SPRING BREAK		



**Syllabus: EMSE 171/271**

10	3/24/2011	Multivariate Analysis	Principal Component Analysis - Mechanics	LN Session 11 + Recomm. Chapter 5 - AMD	Homework Set 7
11	3/31/2011	Multivariate Analysis	Principal Component Analysis - Scree Plot, Kaiser Rule, Bartlett Test, Component interpretation	LN Session 11 + Recomm. Chapter 5 - AMD	Homework Set 8
12	4/7/2011	Multivariate Analysis	ANOVA - One Way ANOVA	LN Session 12	Homework Set 9
13	4/14/2011	Multivariate Analysis	ANOVA - Two way ANOVA, 2K Designs	LN Session 13	
14	4/21/2011		<b>Exam 2 - Session 7, Session 9 - Session 13</b>		
	4/28/2011		<b>Reading Days</b>		
15	5/5/2011		<b>Data Analysis Project is due</b>		

**THIS SCHEDULE IS SUBJECT TO CHANGE  
PLEASE CHECK SYLLABUS REGULARLY!**