COURSE SYLLABUS

Department of Civil & Environmental Engineering
University of Maryland
Spring Semester 2004
ENCE 302 Probability and Statistics for Civil and Environmental Engineers

Instructor: Dr. Elise Miller-Hooks
Meeting Time: MWF 2:00-2:50
Meeting Place: EGR 0135

CONTACT INFORMATION

Office: 301-405-2046  1139 Engineering Laboratory Building
e-mail: elisemh@umd.edu
Office hours: M 1:00-2:00 and W 1:00-2:00 and 3:00-4:00

COURSE DESCRIPTION

Engineers must often make decisions based on incomplete, variable or uncertain information. Modern methods of design and analysis need to account for randomness in natural, engineered, and human systems. This course provides students with the fundamental skills and concepts of probability and statistics, including managing data, modeling variability and uncertainty, communicating about data and decisions, and supporting or defending a decision or judgment based on uncertain or incomplete data.

TEXTBOOK


RELATIONSHIP OF COURSE TO PROGRAM OBJECTIVES

In designing our upper-level curriculum to meet the demands that our graduates will face, the Department has found that a common foundation in probability and statistics is essential for mastering the tools of modern Civil Engineering practice and research. No matter what their specialty in Civil Engineering, students will use probability and statistics in their senior-level classes, where they will be expected to master (to name a few examples): flood frequency analysis (Water Resources), T-tests on laboratory results (Environmental), traffic simulation
(Transportation), project scheduling (Construction Management), interpreting soil samples (Geotechnical), and evaluating risk and reliability (Structures).

COURSE TOPICS

1. **Descriptive Statistics**
   - Methods of data presentation
   - Measures of central tendency
   - Measures of dispersion
   *Reading:* Chapters 1 and 2

2. **Uncertainty and Events**
   - Sample spaces and events
   - Mathematical rules and operations
   - Conditional probability and independence
   - Bayes’ theorem
   - Probability trees (*handout*)
   - Counting rules and combinations
   *Reading:* Chapter 3 and handout

3. **Discrete Random Variables**
   - Random variables
   - Discrete distributions: definitions and properties
   - Moments of distributions
   - Bernoulli trials
   - Binomial distribution
   - Geometric distribution
   - Hypergeometric distribution
   - Poisson distribution
   *Reading:* Chapter 4

4. **Continuous Random Variables**
   - Continuous random variables
   - Continuous distributions: definitions and properties
   - Uniform distribution
   - Exponential distribution
   - Normal distribution
   *Reading:* Chapter 5

5. **Multiple Random Variables**
   - Joint (bivariate or multivariate) distributions
   - Marginal distributions
   - Independence
   - Rules for moments
   - Covariance and correlation
Readings: Chapter 6

6. Sampling and Simulation
   Sampling distributions
   Central limit theorem (handout)
   Simulation
   Random number generation (handout)
   Reading: Chapter 7 and handouts

7. Estimation
   Properties of point estimators
   Method of moments
   Maximum likelihood estimation
   Reading: Chapter 8

8. Confidence Intervals
   Basic concepts and interpretation
   Confidence interval for population means
   Confidence interval for population variance
   Choosing the sample size
   Reading: Chapter 8

9. Hypothesis Testing
   Rationale and basic concepts
   Types of errors
   Sample population mean tests: large and small samples
   Testing of matched sample pairs
   Sample population variance tests
   Goodness of fit tests
   Reading: Chapter 9

10. Introduction to Linear Regression
    Basic concepts
    Assumptions and limitations
    Method of least squares
    Inferences concerning parameters
    Multiple and nonlinear regression (if time permits)
    Reading: Chapter 11
GRADING

<table>
<thead>
<tr>
<th>Quizzes related to individual homework assignments and readings (announced and unannounced)</th>
<th>Throughout semester</th>
<th>20%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Team assignment (performance and participation)</td>
<td>Multi-part assignment throughout semester</td>
<td>10%</td>
</tr>
<tr>
<td>Examination I</td>
<td>Monday, March 8</td>
<td>15%</td>
</tr>
<tr>
<td>Examination II</td>
<td>Monday, April 19</td>
<td>15%</td>
</tr>
<tr>
<td>Final Examination</td>
<td>Monday, May 17</td>
<td>30%</td>
</tr>
<tr>
<td>In class participation</td>
<td>Throughout semester</td>
<td>10%</td>
</tr>
</tbody>
</table>

NOTES

Examinations

Exam dates given above are tentative. Two exams will be given during the course. Makeup exams will not generally be given. Special extenuating circumstances which may cause a student to miss a scheduled exam will be evaluated on an individual basis. Any foreseeable conflicts in exam dates (e.g. a religious holiday) must be brought to the instructor’s attention within the first two weeks of the course.

Quizzes

Both announced and unannounced quizzes will be given during regular class time. Please be prepared to answer questions on material covered up to (and including) the previous class. Quizzes are structured to ensure that each student is completing the homework assignments and is participating in the in-class active learning sessions. Each student’s lowest quiz grade will be dropped.

Homework assignments

While individual homework assignments will not be graded, students who do not complete these assignments will have a very difficult time passing this course. Material for the quizzes will be taken almost entirely from the homework assignments, including assigned reading. Time to ask questions about the homework problems will be given at the beginning of every class by which the homework assignments are to be completed. If you cannot answer a particular question, you should be prepared with intelligent questions regarding the assignment.

Team assignment

Each student will be asked to join a team. Each member of the team will be given a particular role. The teams will meet with the organization that will provide a data set and problem statement. This organization will explain the importance of the data set, the problem to be addressed and will provide information about how and where the data was collected. Assignments that will involve this data will be given throughout the semester and intermediary feedback will be provided at key stages in solution development. Each team will complete a short report with conclusions and will be expected to give a short presentation on the team’s
findings. Representatives from the organization that has provided the data will be invited to attend the presentations and will be permitted to read the reports, should they desire.

**In-class participation**

I believe strongly that we learn best through active participation. Active learning activities will be an integral part of this course. There will be few opportunities for sleeping in the back row. To get something from each of these activities, one must complete the assigned readings and homework.