

**Department:** Civil Engineering

**Course Number:** 453

**Course Title:** Probability and Statistical Analyses in Engineering Design

**Designation:** Required, Junior

**Catalog Description:** Introduction to probability, statistics, uncertainty, and reliability. Application of common continuous and discrete probability distributions. Design under uncertainty and elementary decision analysis. Simulation of random variables. Applications in natural and man-made materials, hydrologic and geological conditions and other natural processes, and engineering design. (3)

**Pre-Requisite:** Corequisite MATH 353

**Textbook and Required Material:** Hayter, Anthony J., 2002, *Probability and Statistics for Engineers and Scientists*, 2<sup>nd</sup> ed., Pacific Grove, CA: Duxbury (ISBN 0-534-38669-5). Also available for those students seeking additional assistance are the worked solutions of all odd-numbered problems, *Student Solutions Manual* (ISBN 0-534-39648-8). Datasets for examples and assignment problems available from the publisher's website ([www.duxbury.com](http://www.duxbury.com)).

**Course Objectives:** It is expected that a successful student in this course will have achieved...

- A thorough understanding of elementary concepts of probability and statistics; [maps to CE Outcomes a&b]
- An ability to understand and present inherently variable data appropriately and correctly; [maps to CE Outcomes b&g]
- An ability to apply the basic statistical concepts to practical applications involving water resources, geologic data, and other natural systems; [maps to CE Outcomes a,b&e]
- An ability to complete problems in statistical analyses including inference, analysis of variance, bivariate analyses, and non-parametric methods of analysis; [maps to CE Outcomes a&b]
- An ability to make and communicate practical conclusions based on statistical analyses of a variety of problems involving inherently variable data; and [maps to CE Outcomes b,c,e&g]
- An ability to take account of inherently variable conditions in making decisions or design choices. [maps to CE Outcomes c&e]

**Topics Covered** (and expected schedule, subject to revision):

1. Introduction to Probability Theory
2. Random Variables
3. Descriptive Statistics **EXAM 1: February 5, 2003**
4. Discrete Probability Distributions
5. Continuous Probability Distributions (including the normal distribution)
6. Statistical Estimation and Sampling
7. Inferences on a Population Mean **EXAM 2: March 5, 2003**
8. Comparing two Population Means
9. Goodness-of-Fit Tests Comparing Two Populations
10. Nonparametric Statistical Analyses **EXAM 3: April 11, 2003**
11. Linear Regression and Correlation
12. Introduction to Reliability and Decision Analysis

**FINAL EXAM: May 7, 2003, noon, 137 Anderson**

**Instructor:** Dr. Joel S. Kuszmaul, 118 D Carrier; kuszmaul@olemiss.edu; 915-7499  
Office hours: Tentatively, Monday 2-5pm, Thurs 1-3pm, and by appointment.

**Class/Laboratory Schedule:** Monday, Wednesday, & Friday 1:00 to 1:50 pm.  
Room 137 Anderson Hall/216 Old Chemistry (when advised)

**Professional Component:**

(Highlight those apply)

- differential and integral calculus
- probability
- statistics
- chemistry
- calculus-based physics
- structure
- water resources and environmental engineering
- geotechnical engineering
- transportation and construction management
- laboratory experiment
- critically analyze and interpret data
- design
- professional practice issues
- professional licensure and continuing education

**Outcomes:**

(Highlight those apply)

- (a) an ability to apply knowledge of mathematics, science, and engineering
- (b) an ability to design and conduct experiments, as well as to analyze and interpret data
- (c) an ability to design a system, component, or process to meet desired needs
- (d) an ability to function on multi-disciplinary teams
- (e) an ability to identify, formulate, and solve engineering problems
- (f) an understanding of professional and ethical responsibility
- (g) an ability to communicate effectively
- (h) the broad education necessary to understand the impact of engineering solutions in a global and societal context
- (i) a recognition of the need for, and an ability to engage in life-long learning
- (j) a knowledge of contemporary issues
- (k) an ability to use the techniques, skills and modern engineering tools necessary for engineering practice

<b>Course assessment:</b>	Assignments	15 %
	Quizzes ( $\geq 7$ given, best 5 count 2 % each)	10 %
	Exams during semester (18 % each)	54 %
	Final examination	21 %

*Students must receive a score  $\geq 60\%$  on the writing assignment to pass the course*

**Exam dates as shown. The quizzes will not be announced in advance.** The quizzes will always be given during regular class time, but no make up quizzes will be given. To accommodate students who are prevented by illness (or family emergency) from attending class every day, only the best 5 quiz grades will be considered in course assessment. The quizzes will cover material recently presented in class or which was assigned as material to be read for that day of class. **Assignment deadlines** will typically be one week after an assignment is distributed (variations may arise as announced). Assignments are to be submitted at the beginning of the class in which they are due (or earlier to Dr Kuszmaul's office).

**Exams and assignment deadlines are not to be missed** (except, for the case of documented excuse, i.e. medical condition or family emergency). You must notify the instructor in advance of the exam. If you anticipate a conflict with an exam or an assignment deadline, please see the instructor as early as possible.

**Assessment guide:** course scores are expected to fall into the bounds A:90-100%, B:80-90%, C:70-80%, D:60-70%, F:<60%, but scores may be scaled (curved up) if appropriate, based on guidelines below:

*F:* Student has failed to meet objectives. Work of students in this category is characterized by incorrect, incomplete, or illogical responses. Students in this category often have trouble meeting deadlines or responding appropriately to the course and assignment requirements.

*D:* Student has minimally met objectives, but has submitted work that is substandard in one or more ways. Students in this category make excessive errors, do not fully justify assumptions or conclusions, and do not communicate their work properly.

*C:* Students has met objectives. Work of students in this category is usually correct and clear, but occasionally incorrect or incomplete. Conclusions based on analyses are usually correct, but with limited justification provided. Students must clearly communicate their work to receive (or surpass) this grade.

*B:* Student has fully met objectives, demonstrating a good command of the expected knowledge or skills. Work of students in this category rarely contains major errors. Conclusions based on analyses are correct and acceptably justified. Conclusions and analyses show a limited amount of creativity.

*A:* Student has fully met objectives, demonstrating an excellent command of the expected knowledge or skills. Work of students in this category is contains only minor errors or limitations. Conclusions based on analyses are correct and well justified. Conclusions and analyses are well communicated and demonstrate creative and practical solutions to problems.

*Note:* Student's participation in class, regular and successful completion of assignments, and improvement across the semester will be used to address borderline situations.

**Additional note on course expectations; Students are expected to:**

- Attend all lectures and be familiar with covered material.
- Complete the reading assignment in advance of lectures.
- Complete all assignments by due date and submit them in class. If you put off the assignments as long as possible, you will likely find the course more difficult than necessary. Spread the work over several days to increase the value of the lectures, to perform better on quizzes, and to take advantage of the scheduled office hours.
- Some of the assigned problems and examination questions will ask for simple answers to which a single number may fully answer the questions. Other problems will ask you to formulate an answer and provide a justification. Simply providing a numerical answer with

little or no justification will not be given full credit. During the semester, examples of this type of problem (and appropriate solutions) will be discussed during lecture.

- **COMPUTER-BASED CALCULATIONS:** Students are encouraged to make use of spreadsheet software to assist with arithmetic calculations, but should not use statistical functions of any software package until advised to do so. Students also find that the graphical capabilities available in spreadsheets may be helpful. You will need to obtain accounts to a computer running Excel.
- **ORIGINALITY REQUIREMENTS:** It must be your own thinking and reasoning presented in assignments and examinations. In the simplest cases, you will need to clearly indicate which statistical tables you use within your solution.

**Prepared by:** Joel Kuszmaul, Associate Professor, Geology & Geological Engineering

**Reviewed by:** Alex Cheng, Chair, Civil Engineering

**Date:** 8 January 2003