

Statistics and Experimental Design

ENCH 476 and 648G

Tuesdays & Thursdays, 11:00-12:15 pm

CHE 2108

Spring 2008

Instructor: Prof. Jeffery B. Klauda

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Office hours: Wednesday, 2-3pm or Friday, 10-11am; other times by appointment

Course Description

This course will focus on the use of statistics in data analysis and designing of experiments with special emphasis on applications to science/engineering problems. Probability distributions, confidence intervals, analysis of variance, factorial design, regression, and error analysis are some of the topics that will be covered. Class time will be devoted to a variety of activities, including lecture, individual or small group problem solving, and quizzes. Prerequisite: MATH 241.

Course Objectives for Students

- Understand the principles of statistics and apply this knowledge to engineering research and practice.
- Improve ones ability to properly interpret and analyze engineering data.
- Develop a working knowledge on designing research or process experiments in terms of data collection.
- Understand the ethical obligation of an engineer to use statistical principles in presenting data.
- Improve communication skills by classroom discussion, problem solving, and written assignments.
- *Graduate Students:* Directly apply statistical principles to their research.

Required Course Readings

Textbook

- D.C. Montgomery & G.C. Runger. (2007). *Applied Statistics and Probability for Engineers*. (4th Ed.). USA: Wiley. ISBN: 9780471745891

Handouts

- Propagation of error, non-linear regression, and case studies (given during semester)

Useful Websites

- www.stats.org
- www.stat.berkeley.edu/~stark/SticiGui/index.htm
- www.mathtools.net/Java/
- www.itl.nist.gov/div898/handbook/
- www.wiley.com/college/montgomery

Computer Software

Some homework problems will involve the use of data sets too large to solve by hand. This will require the use of software, such as Excel, Matlab, or Minitab. These and other programs are available at many campus computing centers (www.oit.umd.edu/projects/wheretogo/). The use of statistical software (Minitab, SAS, or SPSS) is strongly encouraged and will be demonstrated in the classroom. If you prefer to use your own computer instead of a campus computing center, Minitab is available at a discount rate for students. Visit: www.minitab.com/products/pricing/ACPRIORD.aspx

Lecture

The lecture time will consist of an overview of the topics given in the course calendar for that day. Students are expected to read the material to be covered that day before class. Many lecture periods will also consist of in-class problem solving in groups based on the lecture material. Therefore, **always bring your textbook and a calculator to class.**

Class Participation

Students will be expected to participate in class and during group problem solving activities. Solutions to these problems will be discussed and presented by students at the end of class. Everyone is expected throughout the semester to contribute to these discussions. Dr. Klauda will determine the grade for class participation based on the student's involvement.

Quizzes

Short quizzes, one or two problems, will be given throughout the semester. These will NOT be announced ahead of time and are open book/notes/calculator (another reason to bring a textbook/calculator to class). The grades will be scored as follows:

- 3 pts: correct solution with steps to reach that solution shown
- 2 pts: reasonable effort was made to solve the problem(s)
- 1 pt: little effort was made to solve the problem
- 0 pts: not turned in or left blank

The lowest grade on a quiz will not be counted in the final grade.

Homework

Homework problems will be assigned regularly and will be graded. These will consist of problems that only require pencil and paper to those that require software to analyze data sets. You are allowed to help each other on the homework problems but each person must turn in their own work. Homework that is copied from another student is in violation of the university's Code of Academic Integrity. Similarly, you are not allowed to use the publisher's solution manual or those from previous students.

Exams

There will be two midterm exams (**February 28 and April 8**) and a final exam (**May 15**). The midterm exams will only cover the material listed on the course calendar. The final is comprehensive but about half of the exam will be on problems related to the final third of the course. The exams for 476 and 648G will be different. All exams are *CLOSED* book, but one "cheat-sheet" (front/back) and a calculator are allowed for the midterms and two sheets for the final.

Term Projects

Term projects are **ONLY** required for those taking ENCH 648G. Graduate students are expected to work on a project that involves the statistical analysis and/or design of experiments related to their own research. A short 3-5 page, single spaced report not including graphs and tables will be turned in by the date and time of the final. The student will also present his/her work to class on May 13th.

Grading Summary

	ENCH 476	ENCH 648G
Homework	20%	20%
Exam 1	20%	15%
Exam 2	20%	15%
Final Exam	30%	25%
Class participation	5%	5%
Quizzes	5%	5%
Term Project	N/A	15%

Class Policies

Absences from class: If you must miss class for any reason, I strongly recommend that you ask a classmate for any notes, handouts, or announcements you may have missed. In addition, please notify me as far in advance as possible if you know that you are going to miss class for a university-approved reason, so that we can discuss any necessary arrangements. Please see the Undergraduate Catalog's description of university-approved reasons for absence (<http://www.umd.edu/catalog>).

Academic integrity: The University of Maryland, College Park has a nationally recognized Code of Academic Integrity, administered by the Student Honor Council. This code sets standards for academic integrity at Maryland for all undergraduate and graduate students. As a student you are responsible for upholding these standards for this course. It is very important for you to be aware of the definitions and consequences of cheating, fabrication, facilitation, and plagiarism. For more information on the Code of Academic Integrity or the Student Honor Council, please visit <http://www.shc.umd.edu>. Violations of the code will not be tolerated in this class.

Accommodations for students with disabilities: In order to receive accommodations, students with learning disabilities must provide a written request and documents from the University of Maryland Disability Support Services (<http://counseling.umd.edu/DSS>). Please submit any requests by **February 7**.

Cell phones: Please keep cell phones and other communicative devices silent and out of sight during class. Text messaging is not allowed during class and will be reflected in the class participation grade.

Inclement weather: In the event of inclement weather, I will comply with the University's decision regarding whether classes are going to be held or not. Any assignments due on the day of a cancellation will be due instead at the next class meeting.

Late Homework: These items are due at the designated time stated on each assignment. Email submissions will not be accepted, unless approved by myself. The penalty for lateness without a university-approved reason for absence on the due date is half credit up to a day late and no credit for two or more days.

Make-ups: Exams and quizzes may only be made up if you are absent for a documented, university-approved reason. If you miss class without a university-approved reason on a day that an exam or quiz takes place, you will not be able to make it up.

Religious observation: If you will miss class on the day of an exam or on the date that an assignment is due because of a religious observation that is not officially recognized by the university, you must contact me **at least 2 weeks before your anticipated absence** in order to discuss alternative dates for the exam or assignment.

Blackboard (www.elms.umd.edu): On Blackboard, I will post this syllabus, assignments, and any major changes to the course calendar. In addition, I may sometimes post handouts utilized in class and links to useful web sites. You will also be able to access your grades via Blackboard.

Course Calendar

Note: Students should read the chapter associated with the lecture PRIOR to class. Homework (HW) assignment dates are tentatively listed; due dates will be listed on the assignment.

Day	Date	Topic	Chapter/Section	HW
Tues	Jan 29	Overview of Syllabus Statistics in Engineering & Science	Ch. 1 and Ch. 2-1 to 2-2	
Thurs	Jan 31	Theory of Probability	Ch. 2-3 to 2-8	#1
Tues	Feb 5	Discrete Random Variables, Probability Distributions, and Mean and Variance	Ch. 3-1 to 3-4	
Thurs	Feb 7	Discrete Distributions	Ch. 3-5 to 3-7 & 3-9	#2
Tues	Feb 12	Continuous Random Variables, Probability Distributions, Mean and Variance, Normal Distribution	Ch. 4-1 to 4-6	
Thurs	Feb 14	Normal Distribution Distributions for Flaws and Lifetimes of Products	Ch. 4-6 to 4-8 & 4.10	#3
Tues	Feb 19	Joint Probability Distributions	Ch. 5-1 to 5-2	
Thurs	Feb 21	Covariance/Correlations Bivariate Normal Distribution	Ch. 5-3 to 5-5	#4
Tues	Feb 26	Propagation of Errors Data Description/Plots Exam Review	Handouts Ch. 6-1, 6-3 to 6-6	
Thurs	Feb 28	EXAM 1	Covered Material in Chapters 1-5	
Tues	Mar 4	Sample Distributions Point Estimation	Ch. 7	#5
Thurs	Mar 6	Confidence Intervals: Single Sample	Ch. 8-1 to 8-4	
Tues	Mar 11	Confidence Intervals: Single Sample	Ch. 8-5 to 8-7	#6
Thurs	Mar 13	Hypothesis Testing	Ch. 9-1 to 9-4	
Tues	Mar 18	<i>Spring Break ☺</i>		
Thurs	Mar 20			
Tues	Mar 25	Hypothesis Testing	Ch. 9-5 to 9-7	#7
Thurs	Mar 27	Statistical Inference: Two Samples	Ch. 10-1 to 10-4	
Tues	Apr 1	Statistical Inference: Two Samples	Ch. 10-5 to 10-7	#8
Thurs	Apr 3	Linear Regression Exam Review	Ch. 11-1 to 11-4	
Tues	Apr 8	EXAM 2	Covered Material in Chapters 6-10	
Thurs	Apr 10	Regression: Confidence Intervals, Prediction, Adequacy, & Correlation	Ch. 11-5 to 11-8	#9
Tues	Apr 15	Non-linear Regression	Ch. 11-9 & Handouts	
Thurs	Apr 17	Design of Single Factor Experiments	Ch. 13-1 to 13-2	#10
Tues	Apr 22	Design of Single Factor Experiments	Ch. 13-3 to 13-4	
Thurs	Apr 24	Design of Two-factor Experiments	Ch. 14-1 to 14-3	#11
Tues	Apr 29	Design of Multi-factor Experiments	Ch. 14-4 to 14-6	
Thurs	May 1	Multi-factor Experiments: Fractional Replication of 2^k Design & Response Surface Methods	Ch. 14-7 to 14-8	#12
Tues	May 6	Statistical Quality Control: Charts	Ch. 16-1 to 16-5	
Thurs	May 8	Statistical Quality Control: Process Capability, Classifying Products, Control Performance	Ch. 16-6 to 16-9	#13
Tues	May 13	Case Studies or Project Presentations Final Exam Review	Handouts	
Thurs	May 15	FINAL EXAM, 8:00-10:00am	All course material	