Western Michigan University
IEE 2621 Probability for Engineers

Catalog description:

Introduction to probability emphasizing applications in engineering.
Use of discrete and continuous random variables common to engineering problems in engineering models.

Prerequisites & Corequisites:

MATH 2720 Minimum Grade of D with concurrency or
MATH 2720 Minimum Grade of D with concurrency
Credits: 2

Textbooks & Other Materials:

- o Probability and statistics for engineers, Richard L. Scheaffer Madhuri S. Mulekar and James T. McClave, Brooks/Cole,
- o Software: MINITAB Statistical Software, release 17, Minitab, Inc.
- o References: A first course in probability, Sheldon. Ross, Prentice Hall, 2010
- o Engineering Statistics, 5th edition, Douglas C. Montgomery, George C. Runger, and Norma F. Hubele, Wiley, 2011

Grading policy:

Workshops   10%
Project   10%
Homework   25%
Test   25%
Final exam   30%
Letter grades will be decided as follows: 90-100 A
85-90   BA
80-85   B
75-80   CB
70-75   C
65-70   DC
60-65   D
Below 60 E

Objectives: By the end of the semester the student should be able to:
To apply the basic rules and theorems of probability theory to engineering problems.
To appropriately choose, define and/or derive probability distributions for use in engineering models.
To develop functions of random variables that can be used in decision making.

Description of objectives

Objective 1
- 1.1 Understand and apply basic probability concepts, such as the definitions of an element, set, sample space, event, probability, and conditional probability.
- 1.2. Use counting rules and logic to assign probabilities to events.
- 1.3. Apply probability axioms and theorems, such as Bayes' Theorem, to determine probabilities that help to solve engineering problems
- 1.4. Determine whether two, or more events, are mutually exclusive or statistically independent.

Objective 2
- 2.1. Define a discrete random variable, and its associated p.m.f. and c.d.f.
- 2.2. Define a continuous random variable, and its associated p.d.f. and c.d.f.
- 2.3. Appropriately use named distributions, such as the Binomial and the Exponential, to model and solve engineering problems.
- 2.4. Determine the expectation and variance of a random variable from its distribution.

Objective 3
- 3.1 Derive a probability distribution for the function of a random variable, along with its associated expectation and variance.
- 3.2 Properly utilize joint distributions to solve engineering problems.
- 3.3 Define and interpret the covariance and the correlation coefficient associated with the joint distribution of two random variables.
- 3.4 Employ the conditional distributions and expectations of jointly distributed random variables to make engineering decisions.

Relationship of Course Objectives to Performance Criteria and Student Learning Outcomes:

Objectives	Performance criteria
To apply the basic rules and theorems of probability theory to engineering problems.	E2: Uses tools to optimize product designs and processes.
To appropriately choose, define and/or derive probability distributions for use in engineering models.	K1: Selects appropriate tools throughout the design process.
To develop functions of random variables that can be used in decision making.	A1: Applies appropriate statistical techniques.

Academic Integrity

"You are responsible for making yourself aware of and understanding the policies and procedures in the Undergraduate and Graduate Catalogs that pertain to Academic Honesty. These policies include cheating, fabrication, falsification and forgery, multiple submission, plagiarism, complicity and computer misuse. [The policies can be found at http://catalog.wmich.edu under Academic Policies, Student Rights and Responsibilities.] If there is reason to believe you have been involved in academic dishonesty, you will be referred to the Office of Student Conduct. You will be given the opportunity to review the charge(s). If you believe you are not responsible, you will have the opportunity for a hearing. You should consult with your instructor if you are uncertain about an issue of academic honesty prior to the submission of an assignment or test."

In addition, you are encouraged to review the materials at http://osc.wmich.edu and www.wmich.edu/registrar regarding the WMU Code of Honor and general academic policies on such issues as diversity, religious observance, student disabilities, etc.

General Policies

Workshops. The workshops will take place on the class dates indicated in the schedule. The workshop assignments are to be solved by the students during the class period and will be due at the end of the class, unless otherwise directed by the instructor or graduate assistant. All workshops have equal weight. You will receive

a score of zero for each workshop that you fail to turn in at the specified time. Most workshops will be completed in teams. Only one copy of the workshop should be handed in from each team, with all names appearing on at least the first page. You will be allowed to drop your lowest workshop grade (including a missed assignment).

Project. The project will be assigned on the date specified in the schedule. You will receive a score of zero if the project is not turned in at the beginning of the lecture on the day the project is due.

Homework. Homework will be posted on the course webpage. All the homework has equal weight, unless stated otherwise. Homework are to be turned in at the beginning of lecture on the day the homework is due. Late homework will not be accepted. You will receive a score of zero for each homework that you fail to turn in at the specified time. Grade appeals are considered within 7 days only. You will be allowed to drop your lowest homework grade (including a missed homework).

Test. The test will be administered during the lecture period on the days indicated in the schedule. You are responsible for the material up to the day of the test. During the test you are allowed to have a calculator and one 8" x 11" sheet of paper with anything you want written on the paper (you can use both sides of the sheet of paper).

Final exam. The day and time are listed in the schedule. The final exam is cumulative and you are responsible for the material up to the day of the exam. During the exam you are allowed to use a calculator, and two 8" x 11" sheets of paper with anything you want written on the paper (you can use both sides of the sheet of paper). You will have the entire class period to complete the final.

Class Policies

Attendance is mandatory. The student will receive a score of zero for any item not submitted because of absence. (This includes the assignments, tests, and the final exam.) Extreme circumstances will be considered on an individual basis, however, arrangements must be made prior to the due date, and supporting documentation is necessary. Personal or professional activities, e.g., part or full time jobs, travel, etc., **DO NOT** constitute an excuse for absences, lateness or a major circumstance for a make-up or substitution of an assessment activity. Students who anticipate the necessity of being absent from class due to the observation of a **major religious observance** must provide notice of the date(s) to the instructor, in writing, by the second class meeting.

Class participation is extremely important and expected. Discussion boards are very valuable to demonstrate your participation and ability to communicate with the whole class.

Every student, regardless of location/means that he/she uses to take the class, is responsible for all material discussed, distributed, or assigned in class, the syllabus or Blackboard.

The instructor responds through e-mail. However, please do not expect responses to same day or last minute electronic or voice-mails. Also if the instructor is out of town he/she will not be able to submit timely responses to electronic or voice-mails.

The use of cell phones, beepers and pagers in or during class is prohibited. Be sure all such devices are silenced upon entering the class. Always be on time to class. Please be courteous with respect to your fellow classmates and your instructor. Thank you!

Tentative schedule

Week	Topic	Topic description (pages)	Homework (HW) or Project (P)
1	Introduction Combination-analysis Probability	Syllabus Description Multiplication rule Permutation Combination Multinomial coefficients Sample space Event Equally likely events Complement, union, intersection distributive laws De Morgan's laws Definition of probability results following the definition Probabilities with equally likely outcomes	 P-HW1 posting
2	Probability Probability	Complementary events Additive rule Conditional probability Multiplicative rule Independence Total probability rul Baye's rule or theorem Workshop: Counting rules and probability laws to calculate probabilities	 P-HW1 due P-HW2 posting
3	Discrete distributions **P-Test**	Random variable Discrete vs. Continuous random variables Probability mass function Cumulative distribution function Expected value of a random variable Variance and standard deviation Results using expected value, variance Weeks 1 and 2	 P-HW2 due P-HW3 posting
4	Discrete distributions Discrete distributions	Bernoulli random variable Binomial distribution Poisson distribution Poisson vs Binomial Hypergeometric distribution Geometric distribution Negative binomial distribution	 P-HW3 due P-HW4 posting

Week	Topic	Topic description (pages)	Homework (HW) or Project (P)
5	Continuous distributions	Probability density function Cumulative distribution function Expected value Variance Results with expected value, variance	P-P posting
	Continuous distributions	Exponential distribution The Exponential and Poisson relationship	P-HW4 due
6	Multivariate distributions	Workshop: Probability distributions	
	Multivariate distributions	Joint probability mass function Marginal probability mass function Joint continuous function Marginal continuous function	P-HW5 posting
7	Multivariate distributions	Conditional distribution Independence	
	Multivariate distributions	Expected values Expected values for independent variables Covariance Correlation Mean and variance of a linear combination of random variables	P due P-HW5 due
8	**P-Final exam**		