University of Puerto Rico. Mayagüez Campus
College of Engineering
Industrial Engineering Department

Course Syllabus

General Information

Course Number: ININ5559
Course Title: **Engineering Statistics**
Credit-Hours: Three

Course Description

Development of probability theory for scientific and engineering inference. Discrete and continuous random variables and distributions and their applications in engineering. Hypothesis testing and confidence intervals. Regression analysis. Applications to engineering problem solving.

Prerequisites

MATE 3032-INGE 3016 or Permission from the Department Chairperson

Textbook and References

- Douglas C. Montgomery, George C. Runger, and Norma F. Hubeke, 2010, 5th ed., **Engineering Statistics,** John Wiley and Sons, Inc.
- Douglas C. Montgomery and George C. Runger. 2013, 6th ed., Applied Statistics and Probability for Engineers, John Wiley and Sons, Inc.
- Ronald E. Walpole and Raymond H. Myers, 2011, Probability and Statistics for Engineers and Scientists, MacMillan Co., 9th. Ed.
- Ron S. Kenett and Shelemyahu Zacks, 2011, Modern Industrial Statistics: with applications in R, MINITAB and JMP, John Wiley and Sons, Inc.
- Lawrence L. Lapin. 1997, Modern Engineering Statistics. Duxbury Press. Belmont, CA.
- Jay L. Devore, 1995, Probability and Statistics for Engineers and the Sciences, Fourth Edition, Brooks/Cole Publishing Co.
- Stephen B. Vardeman, 1994, Statistics for Engineering Problem Solving, PWS Publishing Company, 1st Edition.
- Irwin Miller and John Freund, 1985, Probability and Statistics for Engineers, Prentice Hall, 3rd. Ed.
- William W. Hines and Douglas C. Montgomery, 1980, Probability and Statistics in Engineering and Management Science, John Wiley.

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Purpose

This course is designed for **non-IE engineering graduate students** who need to understand the basic theory of probability and statistics for explaining or modeling randomness in engineering problems. The purpose of the course is to teach engineering students (i) how to summarize and describe data; (ii) draw practical conclusions on the basis of engineering data; and (iii) the theoretical and applied background needed to understand and effectively use probability and statistical models. This course provides the statistical background needed in graduate courses such as ININ 5565: Measurement and Prediction of Product Reliability, ININ 6005: Experimental Statistics, ININ 6010: Multiple Regression Analysis, ININ 6026: Systems Simulation, ININ 6036: an Introduction to Time Series Analysis, and ININ 6078: Quality Control Systems.

Course Goals

After completing the course, the student should be able to:

- Interpret and understand the fundamental concepts of probability and statistics: random variables and their distributions, independent vs. dependent events, the central limit theorem, hypothesis testing, and confidence intervals.
- Recognize applications of specific distributions (binomial, Poisson, and normal) to engineering problems.
- Recognize and solve engineering problems involving hypothesis testing and construction of confidence intervals.
- Build empirical models using simple regression and use these models as approximations to mechanistic models in engineering.

Requirements

All students are expected to come to class on time, and prepared; do all assigned readings and related homework; actively participate in class discussions; and satisfy all assessment criteria to receive credit for the course.

Department and Campus Policies

Class attendance: Class attendance is compulsory. The University of Puerto Rico, Mayagüez Campus, reserves the right to deal at any time with individual cases of non-attendance. Professors are expected to record the absences of their students. Frequent absences affect the final grade, and may even result in total loss of credits. Arranging to make up work missed because of legitimate class absence is the responsibility of the student.

Absence from examinations: Students are required to attend all examinations. If a student is absent from an examination for a justifiable reason acceptable to the professor, he or she will be given a special examination. Otherwise, he or she will receive a grade of zero of "F" in the examination missed.

Final examinations: Final written examinations must be given in all courses unless, in the judgment of the Dean, the nature of the subject makes it impracticable. Final examinations scheduled by arrangements must be given during the examination period prescribed in the Academic Calendar, including Saturdays.

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Partial withdrawals: A student may withdraw from individual courses at any time during the term, but before the deadline established in the University Academic Calendar.

Complete withdrawals: A student may completely withdraw from the University of Puerto Rico, Mayagüez Campus, at any time up to the last day of classes.

Disabilities: All the reasonable accommodations according to the Americans with Disability Act (ADA) Law will be coordinated with the Dean of Students and in accordance with the particular needs of the student.

Ethics: Any academic fraud is subject to the disciplinary sanctions described in article 14 and 16 of the revised General Student Bylaws of the University of Puerto Rico contained in Certification 018-1997-98 of the Board of Trustees. The professor will follow the norms established in articles 1-5 of the Bylaws.

General Topics

Lecture	Topic	Reading
1-2-3	Introduction. The role of statistics in engineering. Data summary and presentation.	Chaps. 1 & 2
4-5	Random variables and probability distributions. Introduction; random variables; probability. Probability density function, mean and variance of a continuous random variable.	Secs. 3-1 to 3-4
6-7	Normal distribution. Probability plots.	Secs. 3-5 & 3-6
8-9	Probability mass function, mean and variance of a discrete random variable. Binomial distribution.	Secs. 3-7 & 3-8
10-11	Poisson process. Normal approximation to the binomial and Poisson distributions.	Secs. 3-9 & 3-10
12-14	Correlation and independence. Random samples, statistics, and the central limit theorem.	Secs. 3-11 & 3-13
15-17	Statistical inference. Point estimation. Hypothesis testing.	Secs. 4-1 to 4-3
18-21	Inference on the mean of a population.	Secs. 4-4 & 4-5
22	Inference on the variance of a normal population.	Sec. 4-6
23	Inference on a population proportion.	Sec. 4-7
24-25	Testing for goodness of fit	Sec. 4-10
26-28	Inference for a difference in means.	Secs. 5-1 to 5-3
29-30	The paired t-Test	Sec. 5-4
31	Inference on the variances of two normal populations	Sec. 5-5
32	Inference on two population proportions	Sec. 5-6
33	Introduction to ANOVA	Sec. 5-8
34-35	Empirical model building. Least square estimation.	Secs 6-1 & 6-2
36	Properties of the least square estimators and estimation of σ^2	Sec. 6-3
37-38	Hypothesis testing and confidence intervals in linear regression	Secs. 6-1 & 6-3
39-40	Prediction of new observations and assessing the adequacy of the regression model	Secs. 6-2 & 6-4
41-42	Using the computer for empirical model building.	Class notes

*All readings from Montgomery, Runger and Hubeke, 2010.