COURSE SYLLABUS

General Information

Course Number: ININ 4010
Course Title: **Probability and Statistics for Engineers**
Credit-Hours: Three

Course Description

Descriptive statistics. Probability theory. Discrete and continuous random variables and distributions and their applications in engineering. Sample statistics and their distributions. Applications to engineering problems. Hypothesis testing and confidence intervals. Emphasis on the use of statistical computer packages and their use in engineering.

Prerequisites

MATE 3032 - Calculus II
INGE 3016- Algorithms and Computer Programming.

Textbook and References

- Walpole, R. E., and Myers, R. H., 2011, **Probability and Statistics for Engineers and Scientists**, 9th Edition.
- Montgomery, D. C., and Runger, G. C., 2011, Applied Statistics and Probability for Engineers, 5th Edition. John Wiley and Sons, Inc.
- Faber, H.F., 2012, Statistics and Probability Theory: In Pursuit of Engineering Decision Support, Springer Series in Topics in Safety, Risk, Reliability and Quality, Volume 48, Springer Netherlands. (Available online via UPRM library)
- Devore, J. L., 2011, Probability and Statistics for Engineers and the Sciences, 8th Edition, Cengage Learning.
- Montgomery, D.C., Runger, G.C., and Hubele, N., 2010, Engineering Statistics, 5th Edition, John Wiley and Sons, Inc.
- Navidi, W., 2010, Statistics for Engineers and Scientists, 3rd Edition, McGraw-Hill.
- Miller, I., and Freund, J., 2011, Probability and Statistics for Engineers, 9th Edition. Prentice Hall.

Purpose

This course is designed for engineering students who need to understand the basic theory of probability and statistics for explaining or modeling randomness in engineering problems. The purpose 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 is a requirement in the B.S. in IE and it is a prerequisite for the following required courses in the IE curriculum: ININ 4015 Engineering Economic

Analysis, ININ 4020 Applied Industrial Statistics, ININ 4021 Deterministic Models in Operations Research, ININ 4077 Work Systems Design, and ININ 4078 Statistical Quality Control.

Course Goals
After completing the course, the student should be able to:
- Interpret and understand the fundamental concepts of probability and statistics: descriptive statistics, sample space and events, random variables and their distributions, independent vs. dependent events, the central limit theorem, hypothesis testing, and confidence intervals.
- Recognize applications and develop skills to use distributions: geometric, binomial, Poisson, hyper geometric, normal, and exponential to engineering problems.
- Recognize when to use test of hypothesis to solve engineering problems.
- Use statistical software to perform data analysis and statistical plots, to identify probability distributions, to estimate parameters to test, and to present results.
- Present statistical analyses concisely, using appropriate statistical graphs, in written reports.

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.

Evaluation/Grade Reporting
Evaluation will be based on three exams, one small project, quizzes, reports, attendance, participation, and a final exam weighted as indicated below:
- Exam 1……………………………………..………….20%
- Exam 2…………………………………………….....20%
- Exam 3…………………………………………….....20%
- Final Exam…………………………………….………20%
- Quizzes, homework, reports………..……………15%
- Attendance………………………………….…………5%

Final grades will be assigned according to a standard scale:
- 0 – 59 → F; 60 – 69 → D; 70 – 79 → C; 80 – 89 → B; 90 – 100 → A

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. (Bulletin of Information Undergraduate Studies).

Absence from examinations: Students are required to attend all required 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. (Bulletin of Information Undergraduate Studies)

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. (See Bulletin of Information Undergraduate Studies).

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. (See Bulletin of Information Undergraduate Studies).

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. (See Bulletin of Information Undergraduate Studies).

Disabilities: After introducing and identifying himself/herself to the instructor and the institution as a student with disability, the student will receive reasonable accommodations in his/her courses and evaluations. For additional information, contact Services to Students with Disabilities at the office of the Dean of Students, 787 – 265 – 3862 ó 787 – 832 – 4040 exts. 3250, 3258.

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.

Sexual Harassment: Certification 130-2014-2015 states: Sexual harassment in the workplace and in the study environment is an illegal and discriminatory act and is against the best interests of the University of Puerto Rico. All persons who understand they have been subject to acts of sexual harassment at the University of Puerto Rico may file a complaint and request that the institution investigate, where necessary, and assume the corresponding action by the university authorities. If the complainant is a student, he or she must refer his or her complaint to the Office of the Student Ombudsperson or that of the Dean of Students.

Hostigamiento Sexual: La Certificación 130-2014-2015, indica: El hostigamiento sexual en el empleo y en al ambiente de estudio es una práctica ilegal y discriminatoria, ajena a los mejores intereses de la Universidad de Puerto Rico. Toda persona que entienda ha sido objeto de actuaciones constitutiva de hostigamiento sexual en la Universidad de Puerto Rico podrá quejarse para que se investigue, de ser necesario, y se tome la correspondiente acción por parte de las autoridades universitarias. Si quien reclama fuera estudiante, deberá referir su queja a la Oficina de la Procuradora Estudiantil o al Decanato de Estudiantes.

Certification 36 (2018-2019): Discrimination by Sex and Gender on Modality of Sexual Violence:
"The University of Puerto Rico prohibits discrimination based on sex, sexual orientation, and gender identity in any of its forms, including that of sexual harassment. According to the Institutional Policy Against Sexual Harassment at the University of Puerto Rico, Certification Num. 130, 2014-2015 from the Board of Governors, any student subjected to acts constituting sexual harassment, may turn to the Office of the Student Ombudsperson, the Office of the Dean of Students, and/or the Coordinator of the Office of Compliance with Title IX for an orientation and/or formal complaint."

Certification 06-43 of the Academic Senate states, "The academic guidelines for offering online courses," defines: Traditional face-to-face courses are those that have less than 25% of the course's regular contact hours via the Internet. Therefore, a three-credit course will be considered "face to face" if, of the 45 hours of regular contact, 11 or less are taught via the Internet. According to certification 16-43 of the Academic Senate, a course may include up to 25% of its total contact hours via the Internet. The objective of this is so that all professors have this alternative in the case of any unscheduled eventuality.

Law 51: The Comprehensive Educational Services Act for People with disabilities states that after identifying with the instructor and the institution, the student with disabilities will receive reasonable accommodation in their courses and evaluations. For more information contact the Department of Counseling and Psychological services at the Office of the Dean of Students (Office DE 21) or call 787-265-3864 or 787-832-4040 x 3772, 2040 and 3864.

Campus Resources
General Library and University Computer Center is available to obtain professors reference materials.

General Topics

Lecture	Topic	Reading
1	Introduction to statistics and data analysis: Overview and Sampling Procedures. Discrete and Continuous Data.	Sec. 1.1, 1.2, 1.5
2-3	Using statistical software, the following topics are to be covered: descriptive statistics. Graphical representation of data. Measures of location (mean, median and percentiles) and variability (Lab).	Sec. 1.3, 1.4, 1.6
4-5	Sample spaces and events. Counting sample points, probability of events, additive rules	Sec. 2.1 to 2.5
6-8	Conditional probability, independence, product rule and Bayes theorem	Sec. 2.6 and 2.7
9	Discrete random variables. Probability distributions for discrete random variables. Cumulative distribution functions.	Sec. 3.1 to 3.2
10	Mean and Variance of discrete random variables.	Sec. 4.1(partially) and 4.2(partially)

11-13	Binomial and multinomial probability distribution The hypergeometric and geometric distributions. The Poisson probability distribution. (Problem Solving)	Ch. 5
14-16	Continuous random variables and probability density functions. Cumulative distribution functions. Mean and Variance of continuous random variables (Lab).	Sec. 3.3, 4.1, 4.2
17-19	The Continuous uniform distribution. The normal distribution. Exponential distribution (Class Activity: Dinamic).	Sec. 6.1 to 6.6
20	Probability Plots (Lab).	Sec. 8.8
21	Random sampling. Sampling distributions of means and Central Limit Theorem (Lab).	Sec. 8.1 to 8.4
22-23	Sampling distribution of S2, t-distribution, F-distribution	Sec. 8.5 to 8.7
24-25	Statistical inference, general concepts on point estimation and interval estimation. Interval estimation for population mean-single sample (Lab).	Sec. 9.1 to 9.5
26	Statistical hypothesis: general concepts. The use of P-value for decision making. Tests concerning a single mean	Sec. 10.1 to 10.4
27	Estimating the difference between two means. Tests on two means. Choice of sample size for testing means. Graphical methods	Sec. 9.8, 10.5 to 10.7
28	Paired observations	Sec. 9.9
29	Estimating a proportion. Tests on proportions for one- and two-samples	Sec. 9.10, 9.11, 10.8, 10.9
30	Estimating the variance of a normal population. One- and two-sample tests concerning variances. Hypothesis testing and confidence intervals using statistical software.	Sec. 9.12, 9.13, 10.10

*Each period corresponds to a 2 hour lecture.

*All readings from Walpole and Myers (2011)

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