ECE/CS 3530/3130: Engineering Probability and Statistics

Credits and Contact Hours: 3.0 Credit Hours
15 weeks: Three 50-minute lectures per week

Instructor's Name: Neal Patwari

Text Book(s) and/or Required Material:

- R.E. Walpole, R.H. Myers, S.L. Myers, and K.E. Ye, *Probability and Statistics for Engineers and Scientists*, Ninth Edition, Pearson, 2011

Catalog Description: An introduction to probability theory and statistics, with an emphasis on solving problems in electrical and computer engineering. Topics in probability include discrete and continuous random variables, probability distributions, sums and functions of random variables, the law of large numbers, and the central limit theorem. Topics in statistics include sample mean and variance, estimating distributions, correlation, regression, and hypothesis testing. Engineering applications include failure analysis, process control, communication systems, and speech recognition.

Prerequisites: C- or better in:

- MATH 1220: Calculus II; **or**
- MATH 1320: Engineering Calculus II

Designation: Required

Contribution of Course to Meeting the Requirements of ABET Criterion 5: This course is college-level mathematics (probability and statistics).

Specific Outcomes of Instruction: Students learn to do the following:

1. Count the number of elements of a set using combinations and permutations
2. Apply the discrete uniform probability law
3. Apply the law of total probability
4. Apply Bayes' Law
5. Define probability distributions and density functions
6. Use probability distributions and density functions such as uniform, Gaussian, multivariate Gaussian, exponential, gamma, Bernoulli, binomial, Poisson, Chi-square, student's distribution.
7. Calculation of the probability of a random variable being in a range.
8. Calculation of the mean, variance, moments, covariance, and correlation coefficient from a marginal or joint distribution function
9. Calculation of a marginal or conditional distribution function from a joint distribution function
10. Apply the central limit theorem
11. Calculate sample mean and variance
12. Calculate confidence intervals
13. Test hypotheses on the mean

14. Test hypotheses on the variance
15. Find linear regression coefficients

Relationship of the Course to the Program Outcomes:

(a) An ability to apply knowledge of mathematics, science, and engineering. Students apply probability and statistics to solve engineering problems throughout the course.

(b) An ability to design and conduct experiments, as well as to analyze and interpret data, and to debug and analyze software. One third of the course is devoted to hypothesis testing, including estimating the sample size needed for an experiment; how to formulate hypothesis tests on the mean or variance, for one or two samples; processing experimental data; rejecting or accepting the null hypothesis; and calculating the p-value from the experimental data.

(e) An ability to identify, formulate, and solve engineering problems. This course provides students with the ability to formulate the reliability of a system, and to design a system to improve reliability.

(k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice. Students write code for some homework problems, typically in Matlab or Python.

Topics Covered in the Course:

Basic probability, independence, conditional probability, Bayes' theorem, counting techniques (permutations and combinations), definition of random variable, continuous and discrete random variables, distributions and density functions, expectation, variance, covariance and correlation coefficient, particular distributions (uniform, Gaussian [1-dim and n-dim], exponential, Bernoulli, binomial, Chi-square, student's), Chebyshev's inequality, central limit theorem, sample mean and variance, confidence intervals, hypothesis testing, linear regression.