ECE 413
Probability with Engineering Applications
Course Goals and Instructional Objectives

ECE 413 is a junior-level required course in both the EE and CompE curricula. The course introduces students to the theory of probability and its applications to engineering problems in the reliability of circuits and systems, and to statistical methods for hypothesis testing, decision-making under uncertainty, and parameter estimation. The goal is to provide the student with an adequate knowledge of probability and probabilistic reasoning in engineering analyses, and of statistical methods to enable the student to apply these techniques in advanced senior-level elective courses. The course serves as a prerequisite or co-requisite for advanced undergraduate-level technical electives in the areas of signal processing, computer networks, and communications such as

ECE 418 - Image and Video Processing
ECE 438 - Computer Communication Networks
ECE 459 - Communications I
ECE 461 - Communications II
ECE 463 - Digital Communications Laboratory

as well as numerous graduate courses.

Instructional Objectives

At the end of this course, the student will be able to apply the knowledge of probability and statistics gained in this course to several different types of problems in engineering.

1. Given a network of hosts that communicate with each other over links that are prone to failure, the student will be able to compute the probability that there exists a viable communication path between any two nodes in the network. The student will also be able to model failure modes for systems composed of several subsystems as a network problem, and to solve such problems. The student will be able to use Bayes' formula to identify the critical links and bottlenecks which are more likely to cause system failure.

2. The student will be able to formulate engineering decision-making problems as hypothesis testing schemes that compare likelihood ratios to thresholds. The student will be able to calculate the thresholds required to meet design specifications such as maximum false-alarm probabilities or detection probabilities in radar decision problems. The student will be able to design tests using Bayesian methods for the purpose of minimizing the average probability of error, or more generally, the average costs.

3. The student will be able to specify maximum-likelihood estimates for system parameters. The student will be able to estimate confidence intervals for parameters for any specified confidence level.

4. The student will be able to compute probability distributions for the parameters of various systems, to estimate average values and variances of these parameters, and to estimate the probabilities that various design specifications are met.

These objectives mainly address Program Outcomes (a), (l), (m), and (n), and to a lesser extent, (b), (c), and (e) as defined in the Program Educational Objectives and Program Outcomes formulated by the Department of Electrical and Computer Engineering.

This entire file is available at URL
http://www.ece.uiuc.edu/abet/coursegoals/413.pdf

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