MAE 108
Probability and Statistical Methods for Engineers (4 units)

Class/Laboratory Schedule: four hours of lecture, eight hours of outside preparation.
12 hours/week total

Course Coordinator(s): Janet Becker

Textbooks/Materials:

Catalog Description: Probability theory, conditional probability, Bayes theorem, random variables, densities, expected values, characteristic functions, central limit theorem. Engineering reliability, elements of estimation, random sampling, sampling distributions, hypothesis testing, confidence intervals. Curve fitting and data analysis.

Prerequisites: Math 18 or 20F

Course Type: Required

Performance Criteria:
Objective 1
1.1 Students will demonstrate understanding of the basic principles of probability theory. For example, using conditional probabilities to decompose a single event into multiple upstream events; or using Bayes theorem to invert conditional probabilities;

Objective 2
2.1. Students will learn to manipulate random variables as mathematical descriptors of events. For example, derive the probability density functions and probability mass functions of events described in words; or translate mathematically elementary manipulations of set theory learned in Objective 1.

Objective 3
3.1 Students will learn the methods of estimation of parameters, apply them to data drawn from real-life engineering examples, and exploit them for interval estimation. For example, they will be able to estimate mean and standard deviation using the method of moments; or derivation an confidence interval with a known variance with a given confidence.
Objective 4
4.1 Students will learn the mathematical basis of curve fitting for data drawn from real-life example. For example they will able to do a least-square linear fit to a set of data points.

Course Objectives:
(Numbers in parenthesis refer to MAE and AE Program Outcomes)

1. To teach students the mathematical basis to quantify uncertainties in problems in engineering. (1, 4, ME10)

2. To enable students to formulate and solve engineering problems which are not deterministic but instead have to be addressed using probabilistic and statistical tools. (1, 4)

3. To demonstrate the application of probability and statistics to the analysis of real-life engineering data. (1, 2, 6, ME8, ME9, ME10)

Course Topics:
1. Introduction to probability and statistics in engineering
2. Fundamentals of probability theory: sets, events, mathematical operations of sets
3. Mathematics of probability: addition and multiplication rules, conditional probability, total probability and Bayes’ theorems
4. Analytical models of random processes: random variables, probability density and distribution functions, expectation and moments of random variables
5. Useful probability distributions: Normal, Lognormal, Bernoulli, Binomial, Geometric, Poisson, Exponential and others
6. Multiple random variables, join probability density and distribution, covariance, correlation
7. Functions of Random Variables, moments, mean and variance, central limit theorem
8. Statistical inference from data: point estimation, sampling distributions, hypothesis testing, confidence intervals
9. Linear regression and correlation