Analysis of Data

Applied Probability and Statistics

IE 300

Lectures:	T-Th 3:30-4:50pm 103 Transportation Building
Labs/Discussions:	MW 5:00-5:50pm, M 12-12:50pm and T 12-12:50pm; L440 DCL
Instructor:	Prof. Carolyn Beck 1270A DCL beck3@illinois.edu
TAs:	Mozhde Bagheri Hosseini, Sanyukta Parag Deshpande, Yilan Jiang
Text:	*Applied Statistics and Probability for Engineers*, by Montgomery and Runger, Seventh Edition

Tentative Course Outline:

PART 1: Probability and Random Variables

Reading	Topics
Ch. 1	Introduction/Course overview
Ch. 2	Probability: sample spaces, events, addition and multiplication rules, conditional probability, independence, Bayes' Theorem, combinatorics
Ch. 3	Discrete Random Variables and Distributions: mass functions, cumulative distributions functions, mean and variance uniform, binomial and Poisson distributions
Ch. 4	Continuous Random Variables and Distributions: density functions, cumulative distribution functions, mean and variance uniform, normal, exponential, Erlang, Gamma (Weibull, lognormal and beta distributions), and normal approximation to binomial and Poisson distributions
Ch. 5	Joint Probability Distributions: multiple discrete and continuous random variables, covariance and correlation, bivariate normal distributions, linear combinations and general functions of random variables, moment generating functions
Ch. 6	Descriptive Statistics: sample and population means, sample and population variances, sample range, minimum and maximum. Frequency distributions and histograms, plots

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Course Outline: continued

PART 2: Sampling Distributions, Statistical Estimation and Hypothesis Tests

Reading	Topics
Ch. 7	Point Estimation and Sampling Distributions: methods of point estimation, sampling distributions of means and central limit theorem, general estimation concepts and error analyses
Ch. 8	Confidence Intervals: on mean of a normal distribution, variance known and unknown; on variance and standard deviation of a normal population; sample size, t-distribution, prediction and tolerance intervals
Ch. 9	Hypothesis Testing: one-sided and two-sided, p-values, tests on mean of a normal distribution, variance known and unknown tests on variance and standard deviation of a normal population Type II errors and choice of sample size, Tests on population proportion; goodness of fit measures
Ch. 10	Statistical Inference for Two Samples: for difference in means of normal distributions paired t-test; inference on variances and population proportions

PART 3: Linear Regression Models and Analysis of Variance

Reading	Topics
Ch. 11	Simple Linear Regression: empirical models, least squares estimators, hypothesis tests and ANOVA to test significance, confidence intervals, correlation
Ch. 12	Multiple Linear Regression: least squares, matrix methods, hypothesis tests, confidence intervals

Midterm: Thursday, October 12, 3:30-5:30 PM
Final Exam: Monday, December 11, 1:30-4:30pm

Homework:

- Homework will be assigned approximately every other week (posted on the Canvas course site).
- Homeworks should be submitted to the course Gradescope site.
- Late homeworks will receive a 10% deduction **for each day late**.
- Complete solutions will be made available and posted on the course Canvas web site; it is the responsibility of the individual student to read the homework solutions on their own to gain an understanding of missed problems. Any ensuing questions can be addressed in office hours!

Quizzes:

- Short (10-15 min) quizzes will be given roughly every Tuesday during lectures.
- Makeup quizzes will be granted ONLY for illness, or University team travel or similar; Professor Beck must be notified IN ADVANCE if a quiz will be missed.

Grading:

$$\begin{cases} \text{Homework} & -- & 15\% \\ \text{Quizzes} & -- & 15\% \\ \text{Midterm} & -- & 20\% \\ \text{3 Projects} & -- & 25\% \\ \text{Final} & -- & 25\% \end{cases}$$

COURSE GOALS:

I	Introductory probability and statistics fundamentals.
II	Data analysis utilizing basic probability and statistics measures.
III	Parameter estimation via point and interval estimators.
IV	Statistical hypothesis testing and confidence intervals.
V	Data-based modeling and model analysis utilizing regression methods.