Analysis of Data
Applied Probability and Statistics
IE 300 Section B

Lectures: MWF 11-11:50am 2055 Sidney Lu ME Building
Labs/Discussions: T-Th 5:00-5:50pm, W-Th 12-12:50pm L416 DCL

Instructor: Prof. Carolyn Beck
                          1270A DCL (Office hours TBD)
                          beck3@illinois.edu

TAs: Shijie Sun, Sanyukta Parag Deshpande, Yilan Jiang (Office hours TBD)

Text: *Applied Statistics and Probability for Engineers*,
                          by Montgomery and Runger, Seventh, Sixth or Fifth 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

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

Midterms: Wednesday, October 16th and Friday, November 22nd, 11-11:50am

Final Exam: Wednesday, December 18th, 8-11am

Projects: To be completed in lab/discussion sections. Attendance will be mandatory in discussion sections and will count $\sim 15\%$ toward the total project grade.

Midterms

- There will be two in-class midterms.

- Makeup midterms will NOT be granted, except for verified cases of University team travel, illness or bereavement. Professor Beck must be notified IN ADVANCE if a midterm will be missed.

- Midterms will be closed book, closed lecture notes, closed homeworks, etc. A single page (8.5" x 11") of notes, written on both sides, will be allowed.

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:

- There will be approximately 8 short (10-15 min) quizzes throughout the semester during the lecture period; they will be announced in the preceding 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:
$$\left\{ \begin{array}{lll} \text{Homework} & -- & 15\% \\ \text{Quizzes} & -- & 10\% \\ \text{Midterms} & -- & 30\% \\ \text{3 Projects} & -- & 20\% \\ \text{Final} & -- & 25\% \end{array} \right.$$

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.