STAT 311: Elements of Statistical Methods

Instructor: Fritz Scholz

Textbook: An Introduction to Statistical Inference and Its Applications with R
by Michael Trosset, CRC Press.

Course Coverage: As the textbook title suggests, this course uses the free statistical platform R as the primary computing tool. The student's proficiency will grow from using R as an over-sized calculator to writing functions for performing basic analyses.
After some introductory examples mathematical preliminaries and notations are reviewed, including counting principles (combinations, permutations, product rule), functions, and limits. We introduce probability theory axiomatically, illustrated by simple examples, followed by basic consequences of the axioms, with equally likely outcomes used as initial applications. This is expanded by conditional probability, multiplication rule, independence and Bayes theorem. Discrete and continuous random variables are introduced together with their cumulative distribution function and density and the concept of their independence. Some special distributions are are covered, such as Bernoulli, Geometric, Binomial, Hypergeometric, Uniform, Normal, Chi-square, t- and F-distribution). Mean and variance of discrete and continuous random variable are defined and the rules governing them are given. The concept of population is contrasted with that of a sample. The empirical distribution and the the plug-in principle are used to provide sample estimates of various population attributes. As basic data exploration tools we introduce box plots, histograms, normal probability plots, and kernel density estimates. The effect of large sample sizes is discussed in the context of the law of large numbers and the central limit theorem. The concept of inference is introduced as the dual inverse of probability calculations, highlighting the three basic forms in the binomial setting: point estimation, testing hypotheses, and confidence sets. The one-sample location problem is examined from various perspectives, stretching from normal to nonparametric settings. This is followed by the two-sample and K-sample settings covering ANOVA concepts. Chi-square tests for goodness of fit and independence, simple linear regression and measures of association and correlation round out the course, time permitting.

Prerequisites: Mathematics maturity at the level indicated in the catalog. Calculus is not a necessary requirement but widens the student's perspective. The student should have familiarity with mathematical notation (functions, summation signs, set concepts) and algebraic manipulations.

Grade: The grade is based on the scores from homework, 2 quizzes, 1 midterm, and 1 final, with respective weighting of 20%, 20%, 20% and 40%.

Time & Place:
MWF2:30-3:20 GWN 301 and one of the following 6 sections:

AA Tth8:30-9:20 THO 235

AB Tth9:30-10:20 THO 135

AC Tth8:30-9:20 CMU B006

AD Tth9:30-10:20 CMU 230

AE Tth8:30-9:20 CMU 326

AF Tth9:30-10:20 CMU B006