# 0 Tentative course outline

This course is a problem-oriented introduction to the basic concepts of probability and statistics, providing a foundation for applications and further study.

- **Weeks 1-2:** Introduction to probability theory
  - Experiments, events, sets, probabilities, random variables. Equally likely outcomes, counting techniques. Conditional probability. Independence. Bayes' theorem. (Sections: 2.1-2.5)
- **Weeks 3-5:** Random variables
  - Discrete random variables (1.5 weeks): Expected values, mean, variance, binomial distribution, Poisson distribution. Moment generating functions. (Sections: 3.1-3.6)
  - Continuous Random variables (1.5 weeks): Uniform, exponential, gamma, and normal distributions. Intuitive treatment of the Poisson process and development of the relationship with gamma distributions. (Sections: 4.1-4.4)
- **Weeks 6-7:** Multivariate distributions
  - Calculation of probability, covariance, correlation, marginals, conditions. Distributions of sums of random variables and sampling distributions. Central limit theorem. (Sections: 1.1, 1.3, 1.4, 5.1-5.7)
- **Week 8:** Catch-up, review, and midterm at the end of the week (Friday March 7).
- **Week 9:** Introduction to statistical estimation
  - Point and confidence interval estimation. Maximum likelihood, optimal, and unbiased estimators. Examples. (Sections 6.1, 6.2)
- **Weeks 10-12:** Large sample inference
  - Estimation (1.5 weeks): Types and comparison of estimators; sampling distributions for means/proportions, and their use in large sample estimation; sample size. (Sections 7.1, 7.2)
  - Hypothesis testing (1.5 weeks): Components of a test; signficance and power; p-values; large-sample tests for means and proportions (Sections: 8.1-8.4)
- **Week 13:** Small sample inference
  - t-distribution, with applications to small sample estimation and testing; $\chi^2$ and $F$ distributions, with applications to inference about variances (Sections: 7.3, 7.4, 8.3)
- **Weeks 14-16:** Regression and $\chi^2$ tests
  - Regression (1.5 weeks): Least squares, correlation coefficient, inference (Sections: 12.1-12.5)
  - $\chi^2$ tests: multinomial dsitributions, contingency tables, goodness-of-fit (Sections: 14.1-14.3)