

AM 1650: SYLLABUS 2007

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Requirement. Calculus. Basic multivariate calculus will also be needed – we will spend one or two sessions reviewing this part of mathematics before it is used.

Textbook: We will cover Chapter 1 up until (including) Chapter 10 of the textbook “Mathematical Statistics with Applications” (6th edition) by D.D. Wackerly, W. Mendenhall III, and R.L. Scheaffer.

Grades: There will be two in-class midterm exams and one final exam. The final grade will be: homework (20%), midterms (15%+15%), and final exam (50%).

Syllabus:

Part I: Probability.

- Basic concepts in probability:
 1. Sample space, sample points, probability, events, set notation.
 2. Calculate probability by counting.
 3. Conditional probability, independence.
 4. Bayes rules.
 5. Random variables.
- Discrete random variables.
 1. Definitions, discrete probability distribution.
 2. Expected values and variance.
 3. Special discrete random variables: binomial, geometric, Poisson, and so on.
 4. Moment generating functions.
- Continuous random variables.
 1. Definitions, cumulative distribution functions (cdf), density.
 2. Expected values and variance.
 3. Special continuous random variables: normal, exponential, uniform, and so on.

4. Moment generating function.
- Multivariate probability distributions.
 1. Review session on multivariate calculus.
 2. Joint distributions, marginal distributions, conditional distributions.
 3. Independence, correlations, covariance.
 4. Conditional expectation.
 - Functions of random variables: the method of distribution functions.
 - Law of Large Numbers (LLN) and Central Limit Theorem (CLT).

Part II: Statistics.

- Point estimation:
 1. Definitions, population parameter vs. estimate, unbiasedness, mean square error (MSE).
 2. Confidence interval, large sample approximation.
 3. Estimation for a single population.
 4. Estimation for two populations.
 5. Efficiency, consistency, minimal variance unbiased estimator (MVUE), sufficient statistics.
 6. Maximum likelihood estimate (MLE).
- Hypothesis testing:
 1. Type I error, Type II error, power.
 2. Some standard large sample hypothesis testing and P -value.
 3. Neyman-Pearson Lemma – the most powerful test.
 4. Likelihood ratio test.