STA213 **Fall 1999**

Introduction to Statistical Methods

1. Introduction of Probability with Axioms (chapter 1, 2)

- sample space
- some properties of probability
- conditional probability and Bayes theorem
- independence

2. Random Variables and Distributions (chapter 3)

- definition of random variables
- discrete and continuous distributions
- functions of random variables
- random vectors
- marginal and conditional distributions, independence
- transformation of random vectors
- order statistics

3. Expectation (chapter 4)

- moments (mean, variance, covariance, correlation,...)
- some properties of moments (inequalities)
- generating functions (pgf and mgf)

4. Special Distributions (chapter 5)

- discrete distributions (binomial, negative binomial, hypergeometric, Poisson, multinomial)
- continuous distributions (uniform, gamma, χ^2, exponential, beta, cauchy, normal, central limit theorem)

- 1-dimensional exponential family

5. Sampling Distributions (chapter 7)

- χ^2-, t-, F- distributions
- distribution of $(\bar{X}, S^2)$ in samples from Normal

6. Estimation (chapter 6)

1. Bayesian Estimation
    - prior, posterior, conjugate analysis
2. MLE
    - definition
    - properties (invariance, asymptotic normality)
3. Method of Moments
4. Unbiased Estimation (only basic notion)
    - MSE, UMVUE, Lehmann-Scheffe and Rao-Blackwell theorems
    - complete sufficient statistic
    - Cramer-Rao lower bound, Fisher Information
5. Sufficient Statistics

7. Confidence Interval (section 7.5)

- Bayesian credible sets
- basic notion of frequentist confidence interval

8. Testing (chapter 8)

1. Bayesian Testing : Bayes factor
2. Frequentist Testing
    - basic notion (type I, II errors, p-value, test function)
    - UMP test
    - Likelihood ratio test (χ^2 test)