Ph 129b
Probability and Statistics
OUTLINE

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1. Probability
   (a) Definition
   (b) Random Variables and Notation
   (c) Basic Properties
   (d) Statistical Independence
   (e) Expectation Values
   (f) Mean and Variance
   (g) Some Important Probability Distributions
   (h) Convergence
   (i) Characteristic Functions and the Central Limit Theorem
   (j) Laws of Large Numbers
   (k) Chebyshev's Inequality
   (l) The Exponential Family
   (m) Transformations
   (n) Propagation of Errors
2. Simulation
   (a) Getting a "Random Number"
   (b) Inverse Transform Method
   (c) Discrete Distribution
   (d) Composition Method
   (e) Acceptance-Rejection Method
   (f) Importance Sampling
3. Reverend Bayes and Professor Neyman
   (a) Statistics
   (b) Interpretive statistics
   (c) Descriptive statistics

(d) (optional) Fiducial statistics
(e) (optional) Objective Bayes

4. Point Estimation
   (a) Parametric Statistics
   (b) Efficiency, Consistency, Sufficiency, and Bias
   (c) Information
   (d) Rao-Cramer-Frechet Inequality
   (e) Least Squares Estimation
   (f) Maximum Likelihood Estimation
   (g) Substitution (Moment) Method
5. Interval Estimation
   (a) Neyman confidence intervals
   (b) Bayes intervals
   (c) Nuisance parameters
   (d) Pivotal statistics
   (e) Acceptance region method
   (f) Profile likelihood
   (g) Asymptotic intervals
6. Hypothesis Tests, Goodness of fit
   (a) The Simple Hypothesis Test, Likelihood ratio
   (b) Confidence level, P-value, and power
   (c) Compound hypotheses
   (d) Parametric and non-parametric tests
   (e) Common test statistics
   (f) Test validation
7. Density estimation [will probably get to somewhere here]
   (a) Empirical
   (b) Parametric
   (c) Histograms

(d) Smoothing, kernel estimation
(e) Bootstrap
(f) Jack-knife

8. Machine learning, multivariate optimization [optional]
   (a) Optimization Criteria
   (b) Training, Classifying, and Validating
   (c) Decision Trees
   (d) Neural Networks
   (e) Boosting, Bagging
   (f) Random Forest
   (g) Multiclass classifiers