The final exam is comprehensive but will concentrate on the material since the first exam. 10-2-03 - Topic Coverage for Exam I, Ma4261.

- multivariate calculations for general random variables - review of multiple integration
  - marginals, conditionals, independence
  - covariance, correlation
  - mgfs
  - best mean square prediction
- special distributions
  - binomial, multinomial, negative binomial
  - Poisson rvs and Poisson process
  - gamma (exponential and chi square too)
    - waiting times
    - squares of standard normals
  - the bivariate normal, prediction intervals
- transformations and sampling theory
  - direct calculation for discrete and continuous random variables
  - the transformation method for continuous random variables
    - Box-Muller
    - Student's (Gossett's) t- distribution definition and pdf
  - the mgf method
    - $\frac{\sqrt{n}(\bar{X}-\mu)}{\sigma} \sim N(0,1)$ if $X_1, \ldots, X_n$ are iid $N(\mu, \sigma^2)$
    - $\frac{(n-1)S^2}{\sigma^2} \sim \chi^2_{n-1}$.
    - $\frac{\sqrt{n}(\bar{X}-\mu)}{s} \sim t_{n-1}$ for a random sample from a normal population
  - application to confidence intervals
    - for the mean of a normal
    - for the variance of a normal

Main topics since the first exam -

- order statistics
  - joint density of all the order statistics
  - marginal density of a subset of order statistics
    * univariate marginals, the uniform distribution, probability transform, and the beta distributiuons
    * the multinomial heuristic
  - a distribution-free confidence interval for a population quantile
- limiting distributions
  - convergence in law (or distribution) - definitions and techniques
    * working directly with convergence of the cdf
    * using the moment generating function (proof of the central limit theorem)
  - convergence in probability - definitions and techniques
    * equivalence of convergence in probability to a constant c and convergence in law to the distribution with all mass at c - so the techniques from convergence in law can be used here too
    * Chebyshev's inequality
  - Slutsky's theorem: $A_n \xrightarrow{p} a, B_n \xrightarrow{p} b, X_n \xrightarrow{L} X$ implies $A_n X_n + B_n \xrightarrow{L} aX + b$; applications to large sample confidence intervals for means and proportions.
- estimation
  - methods of point estimation
    * Method of moments
    * Method of maximum likelihood
    * Bayes method
  - properties of estimators
    * unbiasedness
    * consistency
  - interval estimation:review one sample and introduce two sample confidence intervals
- hypothesis testing
  - Simple vs simple
    * type I and type II error: fix α and minimize β
    * Neyman-Pearson lemma and applications
  - Composite hypotheses
    * UMP tests and the Neyman-Pearson lemma for selected examples
    * non-existence of UMP tests generally (no proof): summary of important and useful "good" hypothesis tests; heuristics behind these tests
  - setting up hypotheses
  - reading and utilizing SAS output from proc ttest