UNIVERSITY OF CALGARY

FACULTY OF SCIENCE
Department of Mathematics and Statistics

Statistics 421 H(3-0) Mathematical Statistics

(see Course Descriptions under the year applicable: http://www.ucalgary.ca/pubs/calendar/)

Syllabus

Topics	**Number of hours**
Review – Common univariate distributions; use of cdf, mgf, pdf; variable transformations (Jacobians, graphical domain transformation); distribution of order statistics.	2
Multivariate Normal Distribution (MVN) - Definition, mgf, joint marginals, and constant density contours; distributions of linear combinations of MVN random variables.	3
Limit Distributions - Concept of a degenerate distribution; convergence in distribution (use of the cdf, mgf); convergence in probability; proof of the CLT; use/proof of Slutsky's theorem.	5
Sufficiency and Completeness - Concept of a sufficient set of statistics, factorization theorem; Rao-Blackwell theorem; concept of a complete family of distributions; completeness and uniqueness (Lehmann-Scheffe theorem); minimal sufficient and ancillery statistics; completeness and independence (Basu's theorem); minimum variance unbiased estimation; Cramer-Rao inequality.	8
Exponential family of distributions	2
LR Tests - A review of the Neyman-Pearson lemma; the Likelihood Ratio test; power of a test, uniformly most powerful test; noncentral t, chi-square, and F distributions.	5
Normal Models - Cochran's theorem on quadratic forms (no proof); chi-square tests; analysis of variance.	5
Additional Topics - Selections from the following topics should constitute about 6-8 hours: sequential tests; general linear model; nonparametric tests (sign, Wilcoxon); Bayesian statistical inference. Topics should be selected in	6

accordance with class interests in mind, and emphasize applications.

TOTAL HOURS **36**

Course Outcomes:

The student successfully completing this course will be able to

1. derive distributions of functions of random variables by applying the change of variable technique, the cumulative distribution function technique, and the moment generating function technique;
2. define a random sample and statistics (including estimators and order statistics) and obtain their sampling distributions;
3. define the multivariate normal distribution and explain some of its applications;
4. use different modes of convergence (i.e., convergence in probability, convergence in distributions) and well-known asymptotic results (e.g., Weak Law of Large Numbers, Central Limit Theorem) to study large-sample properties of estimators (e.g., limiting and asymptotic distributions;
5. apply the concepts of sufficiency and completeness to derive minimum variance unbiased estimators;
6. define most powerful (MP), uniformly most powerful (UMP), and likelihood ratio tests and obtain them via, e.g., the Neyman-Pearson Theorem;
7. obtain and apply chi-square goodness-of-fit tests, analysis of variance, regression analysis, the chi-square test of independence, the sign test and some nonparametric tests;
8. define the prior and posterior distributions, a conjugate prior, and predictive distributions;
9. apply the statistical software R for carrying out probability and statistical calculations.

Date: September 2016 Creator:
ADL/DPMS
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