UNIVERSITY OF CALGARY

FACULTY OF SCIENCE
Department of Mathematics and Statistics

Statistics 323 (3 – 1T)	Introduction to Mathematical Statistics

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

Syllabus

Topics	**Number of hours**
Introduction to parameter estimation using an estimator/statistic: Properties of estimators/statistics, including unbiasedness, bias, and the mean square error of a statistic.	**4**
Confidence interval estimation: Pivotal quantities. Large sample confidence interval estimation of the population mean and proportion. Confidence interval estimation of the population variance, ratio of population variances, difference between population means, population proportions.	**6**
Functions of random variables: Change of variable and method of moment generating functions. Coverage to include both univariate and bivariate cases. Order statistics and their applicability to parameter estimation.	**6**
Distributions of Statistics: revisit the Central Limit Theorem. The derivation of the chi-square, t, and F distribution. Derivation of the distribution of the sample variance.	**4**
Efficacy of estimators/statistics: the relative efficiency, consistency. Methods of obtaining estimators/statistics including the method of moments and maximum likelihood estimation.	**4**
Hypothesis Testing: Developing formal hypothesis tests using discrete and continuous distribution theory. Type I and Type II errors. P-values. Applications to both single parameter and bi-parameter cases. Uniformly most powerful tests and the Neyman Pearson Lemma.	**6**
Simple Linear Regression Analysis: correlation, least-squares estimation, inference for estimated coefficients, coefficient of variation and analysis of variance. Derivation of the F-test. Model assessment and prediction of the response variable. Bivariate Normal Distribution.	**6**
TOTAL HOURS	**36**

Statistics 323: Introduction to Mathematical Statistics

Course Outcomes

By the end of this course, students will be able to

1. Identify a target population and its corresponding target parameter.

2. Apply the method of moments and maximum likelihood estimation to derive a statistic to estimate a target parameter.

3. Derive the probability distribution of a statistic and compute both its mean, is variance or standard deviation, and its bias.

4. Evaluate the large-sample merits of a statistic based on its (i) biased/unbiasedness and (ii) its consistency/lack of consistency, to determine its usefulness.

5. Read, replicate, and create mathematical proofs of statistical theorems covered in the course.

6. Recognize parameter estimation through the application of the pivotal quantity method to create a confidence interval for the unknown value of a population parameter. This is to include parametric estimation of the mean, proportion, variance, difference of two means, difference of two proportions, and ratio of variances.

7. Comprehend the scientific method of statistical hypothesis testing. This is to include the derivation of a statistical hypotheses, identification and subsequent application of a statistical test, to be encapsulated with the computation and interpretation of a P- value.

8. Conduct dual population comparisons through the application of both confidence intervals and hypothesis testing to compare (i) two population means and (ii) two population proportions. Such applications are expected to be done manually and with the assistance of R.

9. Model the existing synergy between two quantitative variables through the employment of least-squares estimation, resulting in the creation of a statistical model that predicts one variable based on the value of another.

10. Conduct a statistical hypothesis on the appropriate of the simple linear model with both the t-test and F-test. Awareness of the conditions of the linear model as well as diagnosis of their satisfaction. Confidence interval estimation of both the mean and an individual value of the response variable.

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