UNIVERSITY OF CALGARY

FACULTY OF SCIENCE
Department of Mathematics and Statistics

STAT 321	Introduction to Probability

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

Syllabus

Topics	**Number of hours**
Elements of probabilistic modeling. Set theory. Sample spaces, probabilities and conditional probabilities. Basic probability computation techniques**:** Counting methods, multiplication rule and the law of total probabilities, Bayes rule.	5
Discrete Random variables. Probability mass functions, probability computations involving a discrete random variable, expectation, variance, functions of a discrete random variable, common discrete distributions: Bernoulli, binomial, geometric, Poisson, negative binomial, moments and moment generating function.	8
Continuous random variables. Cumulative distribution function (c.d.f), probability density function (p.d.f), probability computations involving a continuous random variable, expectation and variance, functions of a continuous random variable, common continuous distributions: uniform, normal distribution, exponential, gamma, beta. Moment generating functions.	9
Multivariate random variables. Marginal distribution functions, joint distribution functions, conditional probability distributions, covariance and its properties, independence of random variables, functions of multivariate random variables, linear functions of random variables, conditional expectation	11
Central Limit Theorem. The statement and proof of central limit theorem. Applications to the analysis of the sample mean of independent and identically distributed random variables.	3
TOTAL HOURS	**36**

Course Outcomes

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

1. Define a random experiment; conceptualize its sample space, and the various events the random experiment could produce.

2. Apply various laws of probability to solve probability problems that are framed in both theoretical and applied contexts.

3. Read, replicate, and create mathematical proofs of probability theorems covered in the course.

4. Recognition of quantification of random events through the creation of a random variable; employment of probability foundations to design a probability model of a random variable.

5. Differentiation between discrete and continuous random variables, analysis of the random variable's properties through an examination of its distribution shape, its measure of centre (mean/expected value), and its measure of spread (variance or standard deviation).

6. Derivation of a moment generation function and subsequent employment of calculus methods to compute the moments of a random variable.

7. Differentiate between when to apply the various probability models covered in the course (Bernoulli, Binomial, Negative Binomial, Geometric, Hypergeometric, Poisson, Normal, Gamma and its special cases (Chi-square and Exponential)). In addition, demonstrate application of such probability models to compute probabilities.

8. Recognize the synergies between two random variables through the visualization of their joint probability distribution function and its employment to compute simultaneous probabilities and derive conditional distribution functions.

9. Distinguish between dependence and independence of a pair of random variables and compute the covariance between the random variables.

10. Statement and application of the Central Limit Theorem to both the sample mean and the sample proportion in order to consider the probable (and improbable) values of these statistics.

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