UNIVERSITY OF THE FRASER VALLEY

ORIGINAL COURSE IMPLEMENTATION DATE: July 1994
REVISED COURSE IMPLEMENTATION DATE: September 2023
COURSE TO BE REVIEWED (six years after UEC approval)**:** March 2029
Course outline form version: 09/08/2021

OFFICIAL UNDERGRADUATE COURSE OUTLINE FORM

Note: The University reserves the right to amend course outlines as needed without notice.

Course Code and Number: STAT 450	**Number of Credits:** 3 Course credit policy (105)
Course Full Title: Statistical Theory **Course Short Title:** Statistical Theory	
Faculty: Faculty of Science	**Department (or program if no department):** Mathematics & Statistics

Calendar Description:

The theory of probability and distributions includes an examination of the distribution of functions of random variables, moment generating functions, order statistics, sampling distributions, and the concepts of convergence in probability and convergence in distribution. Theory underlying applications such as estimation methods, complete and sufficient statistics, confidence intervals, and testing hypothesis is also considered.

Note: This course is offered as STAT 450 and MATH 450. Students may only take one of these for credit.

Prerequisites (or NONE):	MATH 370/STAT 370 or (MATH 270/STAT 270 and MATH 211).
Corequisites (if applicable, or NONE):	NONE
Pre/corequisites (if applicable, or NONE):	NONE

Antirequisite Courses *(Cannot be taken for additional credit.)*

Former course code/number:

Cross-listed with: **MATH 450**

Equivalent course(s): **MATH 450**

(If offered in the previous five years, antirequisite course(s) will be included in the calendar description as a note that students with credit for the antirequisite course(s) cannot take this course for further credit.)

Typical Structure of Instructional Hours

Lecture/seminar	50
Total hours	**50**

Scheduled Laboratory Hours

Labs to be scheduled independent of lecture hours: ☒ No ☐ Yes

Course Details

Special Topics course: **No**
(If yes, the course will be offered under different letter designations representing different topics.)

Directed Study course: **No**
(See policy 207 for more information.)

Grading System: **Letter grades**

Delivery Mode: **May be offered in multiple delivery modes**

Expected frequency: **Infrequent**

Maximum enrolment (for information only)**: 36**

Prior Learning Assessment and Recognition (PLAR)

PLAR is available for this course.

Transfer Credit *(See **bctransferguide.ca**.)*

Transfer credit already exists: **No**

Submit outline for (re)articulation: **No**
(If yes, fill in transfer credit form.)

Department approval	**Date of meeting:**	January 23, 2023
Faculty Council approval	**Date of meeting:**	March 3, 2023
Undergraduate Education Committee (UEC) approval	**Date of meeting:**	March 24, 2023

Learning Outcomes *(These should contribute to students' ability to meet program outcomes and thus Institutional Learning Outcomes.)*

Upon successful completion of this course, students will be able to:

1. Use transformations of discrete and continuous random variables to find the distributions of functions of several variables.
2. Use moment generating functions to find distributions of functions of several variables.
3. Derive the relationships between gamma and beta, normal, chi-squared and t, and chi-squared and F distributions.
4. Find the distributions of the maximum, minimum and the i-th order statistic of a random sample.
5. Derive and use the distributions of the sample mean and sample variance when the sample comes from a normal distribution.
6. Prove the convergence in distribution and in probability of some theoretical results.
7. Apply the Central Limit Theorem to problems involving sums of independent and identically distributed random variables.
8. Find unbiased estimators, consistent estimators, and estimators using the method of maximum likelihood and the method of moments.
9. Find the complete and sufficient statistic for an unknown parameter.
10. Derive the formulae for confidence intervals for means and for differences of means.
11. Determine the critical region, power function and p-value of a test of statistical hypotheses.

Recommended Evaluation Methods and Weighting *(Evaluation should align to learning outcomes.)*

Final exam:	40%	Quizzes/tests:	40%	Assignments:	20%
	%		%		%

Details:

Students must achieve at least 40% on the final exam in order to receive credit for this course.

NOTE: The following sections may vary by instructor. Please see course syllabus available from the instructor.

Texts and Resource Materials *(Include online resources and Indigenous knowledge sources. Open Educational Resources (OER) should be included whenever possible. If more space is required, use the Supplemental Texts and Resource Materials form.)*

	Type	Author or description	Title and publication/access details	Year
1.	Textbook	Hogg, R et al.	Introduction to Mathematical Statistics, Pearson.	2018
2.	Textbook	Kalbfleisch, J	Probability and Statistical Inference Volume 2: Statistical Inference, Spring-Verlag.	2004
3.	Textbook	Casella, G. and Berger, R. L.	Statistical Inference, Duxbury Press, 2e	2001
4.	Textbook	Wasserman, L.	All of Statistics: A Concise Course in Statistical Inference, Springer, 1e	2004
5.	Textbook	Wackerly, D et a.	Mathematical Statistics with Application, Duxbury Press, 7e	2007

Required Additional Supplies and Materials *(Software, hardware, tools, specialized clothing, etc.)*

Course Content and Topics

1. Brief review of probability and distributions: conditional probability, independence, Bayes' theorem, Chebyshev's inequality, joint, marginal and conditional distributions, conditional expectation, correlation coefficient and special distributions such as binomial, Poisson, gamma, chi-squared, normal and bivariate normal.

2. Distributions of functions of random variables: sampling theory, transformations of discrete random variables, transformations of continuous random variables, beta, t and F distributions, extensions of the change-of-variable technique, distributions of order statistics, the moment generating function technique, distributions of the sample mean and sample variance, expectations of functions of random variables and the multivariate normal distribution.

3. Limiting distributions: convergence in distribution, convergence in probability, limiting moment generating functions, the Law of Large Numbers and the Central Limit Theorem.

4. Introduction to statistical inference: point estimation, unbiased estimators, consistent estimators, method of maximum likelihood, invariance property, method of moments, confidence intervals for means, confidence intervals for differences of means, tests of statistical hypotheses, critical region, power function, p-value. Additional topics may include: The method of Monte Carlo, the bootstrap, and simulation.

5. Data Reduction Principles: unbiased minimum variance estimators, minimax principle, minimum mean-square-error estimators, sufficient statistics and their properties, completeness and uniqueness, the exponential class of probability density functions, minimal sufficient and ancillary statistics.