UNIVERSITY OF THE FRASER VALLEY

ORIGINAL COURSE IMPLEMENTATION DATE: July 1994
REVISED COURSE IMPLEMENTATION DATE: January 2020
COURSE TO BE REVIEWED (six years after UEC approval)**:** January 2021
Course outline form version: 05/18/2018

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
(Transcripts only display 30 characters. Departments may recommend a short title if one is needed. If left blank, one will be assigned.)

Faculty: Faculty of Science | **Department (or program if no department):** Mathematics & Statistics

Calendar Description:

A course in mathematical statistics. Distributions of functions of random variables; transformations; beta, t, F, multivariate normal distributions; order statistics; convergence in distribution and probability; Law of Large Numbers; Central Limit Theorem; method of maximum likelihood; inference.

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):	
Pre/corequisites (if applicable, or NONE):	

Antirequisite Courses *(Cannot be taken for additional credit.)*
Former course code/number: **MATH 450**
Cross-listed with: **MATH 450**
Dual-listed with:
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 hours	50
Tutorials/workshops	
Supervised laboratory hours	
Experiential (field experience, practicum, internship, etc.)	
Supervised online activities	
Other contact hours:	
Total hours	**50**

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

Special Topics *(Double-click on boxes to select.)*
This course is offered with different topics:
☒ No ☐ Yes *(If yes, topic will be recorded when offered.)*

Independent Study
If offered as an Independent Study course, this course may be repeated for further credit: *(If yes, topic will be recorded.)*
☐ No ☐ Yes, repeat(s) ☐ Yes, no limit

Transfer Credit
Transfer credit already exists: *(See **bctransferguide.ca**.)*
☒ No ☐ Yes
Submit outline for (re)articulation:
☒ No ☐ Yes *(If yes, fill in transfer credit form.)*

Grading System
☒ Letter Grades ☐ Credit/No Credit

Maximum enrolment (for information only): 36

Expected Frequency of Course Offerings:
Every 3 to 4 years *(Every semester, Fall only, annually, etc.)*

Department / Program Head or Director: Cynthia Loten	**Date approved:**	April 2019
Faculty Council approval	**Date approved:**	May 3, 2019
Dean/Associate VP: Lucy Lee	**Date approved:**	May 3, 2019
Campus-Wide Consultation (CWC)	**Date of posting:**	June 21, 2019
Undergraduate Education Committee (UEC) approval	**Date of meeting:**	August 29, 2019

Learning Outcomes:

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

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

Prior Learning Assessment and Recognition (PLAR)

☒ Yes ☐ No, PLAR cannot be awarded for this course because

Typical Instructional Methods *(Guest lecturers, presentations, online instruction, field trips, etc.; may vary at department's discretion.)*

Lectures

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

Typical Text(s) and Resource Materials *(If more space is required, download Supplemental Texts and Resource Materials form.)*

	Author (surname, initials)	Title (article, book, journal, etc.)	Current ed.	Publisher	Year
1.	Hogg, R et al.	Introduction to Mathematical Statistics	☒	Pearson	2018
2.	Kalbfleisch, J	Probability and Statistical Inference Volume 2: Statistical Inference	☒	Springer-Verlag	2004
3.			☐		
4.			☐		
5.			☐		

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

Typical Evaluation Methods and Weighting

Final exam:	40%	Assignments:	20%	Field experience:	%	Portfolio:	%
Midterm exam:	40%	Project:	%	Practicum:	%	Other:	%
Quizzes/tests:	%	Lab work:	%	Shop work:	%	Total:	100%

Details (if necessary): Students must achieve at least 40% on the final exam in order to receive credit for this course

Typical 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. The method of Monte Carlo. Bootstrap procedures.
5. Sufficient statistics: 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.