



## Calculus Based Statistics – STAT 206

University Studies Program

### Course Outline

COURSE IMPLEMENTATION DATE: Pre 1998  
OUTLINE EFFECTIVE DATE: January 2019  
COURSE OUTLINE REVIEW DATE: September 2024

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#### GENERAL COURSE DESCRIPTION:

This course is intended for students who are pursuing Engineering or a Bachelor of Science degree. Topics include probability theory, random variables, expected values, variance, moments, probability distributions (binomial, hypergeometric, Poisson, normal, geometric, negative binomial and gamma), estimation (properties of estimators, method of maximum likelihood and method of moments), hypothesis testing (type I and II errors, and generalized likelihood ratio tests), distributions ( $\chi^2$ ,  $t$  and  $F$ ) and their tests, goodness of fit and contingency tables, regression and ANOVA.

Statistics are used to analyze data throughout the sciences, including Biology, Chemistry, Commerce, Computer Science, Engineering, Geology, Mathematics, Medicine and Physics.

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**Program Information:** This course can be used to satisfy the requirements of an Associate of Science degree at College of the Rockies.

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**Delivery:** This course is delivered face-to-face.

**COTR Credits:** 3

**Hours for this course:** 45 hours

#### Typical Structure of Instructional Hours:

Instructional Activity	Duration
Lecture Hours	45
Seminars / Tutorials	
Laboratory / Studio Hours	
Practicum / Field Experience Hours	
Other Contact Hours	
<b>Total</b>	45

#### Practicum Hours (if applicable):

Type of Practicum	Duration
On-the-job Experience	N/A
Formal Work Experience	N/A
Other	N/A
<b>Total</b>	

**Course Outline Author or Contact:**

Andrea Hyde, Instructor

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Signature

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**APPROVAL SIGNATURES:**

Department Head  
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Department Head Signature

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Dean Signature

EDCO

Valid from: January 2019 – September 2024

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Education Council Approval Date

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**COURSE PREREQUISITES AND TRANSFER CREDIT:**

**Prerequisites:** MATH 104 or MATH 114 may be taken concurrently

**Corequisites:** None

**Flexible Assessment (FA):**

Credit can be awarded for this course through FA  Yes  No

Learners may request formal recognition for flexible assessment at the College of the Rockies through one or more of the following processes: External Evaluation, Worksite Assessment, Demonstration, Standardized Test, Self-assessment, Interview, Products/Portfolio, or Challenge Exam. Contact an Education Advisor for more information.

**Transfer Credit:** For transfer information within British Columbia, Alberta, and other institutions, please visit <http://www.cotr.bc.ca/Transfer>.

Students should also contact an academic advisor at the institution where they want transfer credit.

**Prior Course Number:** N/A

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## Textbooks and Required Resources:

Textbook selection varies by instructor and may change from year to year. At the Course Outline Effective Date the following textbooks were in use:

Larsen, Richard J., and Morris, L. Marx, *An Introduction to Mathematical Statistics and its' Applications* 5<sup>th</sup> edition

Please see the instructor's syllabus or check COTR's online text calculator

<http://go.cotr.bc.ca/tuition/tCalc.asp> for a complete list of the currently required textbooks.

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## LEARNING OUTCOMES:

Because statistics are used in any field where data must be analyzed, this course is appropriate for many careers, including Biology, Chemistry, Commerce, Computer Science, Engineering, Geology, Mathematics, Medicine and Physics.

At the completion of STAT 206, a successful student will be able to

- understand the fundamentals of probability including the axioms, discrete and continuous probability distributions, and conditional and combinatorial probability;
- work with random variables including their expected values, variance, higher moments and moment generation functions;
- work with special probability distributions including the binomial, hypergeometric, poisson, normal, geometric, negative binomial and gamma distributions, and recognize when they are appropriate;
- understand desirable properties for estimators, including unbiasedness, efficiency, consistency and sufficiency;
- use the methods of maximum likelihood and moments to find estimators and determine if they have the desired properties;
- understand the concept of an hypothesis test and type I and type II errors;
- understand how to generate hypothesis tests using generalized likelihood ratio tests;
- understand the normal distribution including estimators for the mean and variance, central limit theorem and the  $\chi^2$ ,  $t$ -, and  $F$ - distributions;
- perform relevant two sample tests;
- perform goodness of fit tests;
- use linear regression including least squares fits, covariance and correlation, and the appropriate hypothesis tests; and
- do ANOVA.

This course should help students

- use written and oral communication skills effectively, employing methods appropriate to message and context;
- think clearly and critically, fusing experience, knowledge and reasoning into considered judgment;
- identify, interpret and solve problems, effectively implementing and evaluating proposed strategies;
- develop organizational, problem solving, and critical thinking skills;
- learn to work both independently and in groups;

- learn to transfer knowledge to new contexts;
  - practice comprehending and interpreting abstract materials from text; and
  - develop an appreciation of the importance of persistence, a positive attitude and energy.
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## COURSE TOPICS:

1. Probability
  - a) Axioms
  - b) Discrete probability functions
  - c) Continuous probability functions
  - d) Conditional probability; independence
  - e) Combinatorial probability
2. Random variables
  - a) Densities; joint densities
  - b) Combining and transforming random variables
  - c) Conditional densities
  - d) Expected values: properties
  - e) Variance
  - f) Moments and moment generating functions
  - g) Chebyshev's inequality
3. Probability distributions
  - a) Binomial distribution
  - b) Hypergeometric distribution
  - c) Poisson distribution
  - d) Normal distribution
  - e) Geometric distribution
  - f) Negative binomial distribution
  - g) Gamma distribution
4. Estimation
  - a) Properties
    - i) Unbiasedness
    - ii) Efficiency; minimum variance estimators
    - iii) Consistency
    - iv) Sufficiency
  - b) Methods of finding estimators
    - i) Method of Maximum Likelihood
    - ii) Method of Moments
  - c) Interval estimation
5. Hypothesis testing
  - a) Errors: type I and type II errors
  - b) Generalized likelihood ratio tests
6. The normal distribution
  - a) Point estimates for  $\mu$  and  $\sigma^2$ .
  - b) Central limit theorem
  - c) The  $\chi^2$ ,  $t$  and  $F$ -distributions
  - d) One sample  $t$  test

7. Two sample tests
  - a) Testing  $H_0: \mu_X = \mu_Y$  (two sample  $t$ -test)
  - b) Testing  $H_0: \sigma_X = \sigma_Y$  ( $F$  test)
  - c) Testing  $H_0: p_X = p_Y$  (binomial data)
  - d) Confidence intervals
  
8. Goodness of fit
  - a) Multinomial distribution
  - b) goodness-of-fit tests
    - i) Parameters known
    - ii) Parameters unknown
  - c) contingency tables
  
9. Regression
  - a) Covariance and correlation
  - b) Least squares
  - c) Linear model
  - d) Bivariate normal
  
10. ANOVA
  - a) The  $F$ -test
  - b) Computational formulae
  - c) Orthogonal contrasts
  - d) Tukey's method

See instructor's syllabus for the detailed outline of weekly readings, activities and assignments.

**EVALUATION AND ASSESSMENT:**

Assignments	% Of Total Grade
Assignments	15%
Project	15%
Midterm Tests	30%
Final Exam	<u>40%</u>
Total	100%

Please see the instructor's syllabus for specific classroom policies related to this course, such as details of evaluation, penalties for late assignments and use of electronic aids.

**EXAM POLICY:**

Students must attend all required scheduled exams that make up a final grade at the appointed time and place.

Individual instructors may accommodate for illness or personal crisis. Additional accommodation will not be made unless a written request is sent to and approved by the appropriate Department Head prior to the scheduled exam.

Any student who misses a scheduled exam without approval will be given a grade of "0" for the exam.

## COURSE GRADE:

Course grades are assigned as follows:

Grade	A+	A	A-	B+	B	B-	C+	C	C-	D	F
Mark (Percent)	≥ 90	89-85	84-80	79-76	75-72	71-68	67-64	63-60	59-55	54-50	< 50

A grade of "D" grants credit, but may not be sufficient as a prerequisite for sequential courses.

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## ACADEMIC POLICIES:

See [www.cotr.bc.ca/policies](http://www.cotr.bc.ca/policies) for general college policies related to course activities, including grade appeals, cheating and plagiarism.

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## COURSE CHANGES:

Information contained in course outlines is correct at the time of publication. Content of the courses is revised on an ongoing basis to ensure relevance to changing educational, employment and marketing needs. The instructor will endeavour to provide notice of changes to students as soon as possible. The instructor reserves the right to add or delete material from courses.