| | |
|---|---|
| **ORIGINAL COURSE IMPLEMENTATION DATE:** | May 2005 |
| **REVISED COURSE IMPLEMENTATION DATE:** | September 2020 |
| **COURSE TO BE REVIEWED** (six years after UEC approval)**:** | January 2026 |

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 370

**Number of Credits:** 3 Course credit policy (105)

**Course Full Title:** Probability and Stochastic Processes

**Course Short Title:** Probability & Stochastic Proc.

*(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:**

Theory of probability and stochastic processes for science and mathematics students. Topics include probability space, conditional probability and independence, continuous and discrete random variables, jointly distributed random variables, expectation, conditional expectation and properties, simulating data from distributions, limit theorems, Markov chains and Poisson processes, and Markov Chains Monte Carlo (MCMC).

Note: This course is offered as STAT 370 and MATH 370. Students may only take one of these for credit.

| | |
|---|---|
| **Prerequisites (or NONE):** | 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:

Cross-listed with: **MATH 370**

Dual-listed with:

Equivalent course(s): **MATH 370**

*(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:**

Once per year *(Every semester, Fall only, annually, etc.)*

| | | |
|---|---|---|
| **Department / Program Head or Director:** Ian Affleck | **Date approved:** | August 28 2019 |
| **Faculty Council approval** | **Date approved:** | October 4, 2019 |
| **Dean/Associate VP:** Lucy Lee | **Date approved:** | October 4, 2019 |
| **Campus-Wide Consultation (CWC)** | **Date of posting:** | n/a |
| **Undergraduate Education Committee (UEC) approval** | **Date of meeting:** | January 31, 2020 |

**Learning Outcomes:**

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

1. construct an equally likely probability model and calculate the probability of an event by using counting techniques.
2. construct a probability model and investigate the properties of probability considering probability as a set function.
3. construct conditional probability models, investigate the independence of events, and use Bayes' formula.
4. formulate problems related to probability in real life using random variables and distributions of random variables.
5. investigate relationships between random variables that explain processes in applications.
6. calculate joint and conditional distributions, distributions of functions of random variables, and distributions of order statistics.
7. compute expectation, covariance, variance, correlation, conditional expectations and use properties of these quantities.
8. find moment generating functions and joint moment generating functions and use their properties.
9. apply the law of large numbers and some important inequalities such as Chebyshev's inequality.
10. simulate data from continuous and discrete distributions.
11. analyze and describe discrete-time random processes
12. derive limiting state probabilities for a finite Markov chain
13. evaluate stationary probabilities for Ergodic Markov chains

**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.)*

Classroom lectures. Evaluation includes assignments, tests, and a three-hour comprehensive examination. Students should feel comfortable in some programming environment, such as R or SAS

**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.)*

The text is chosen by a departmental curriculum committee. Recommended texts are:

| | Author (surname, initials) | Title (article, book, journal, etc.) | Current ed. | Publisher | Year |
|---|---|---|---|---|---|
| **1.** | Sheldon Ross | A First Course in Probability. 9th edition. | ☒ | Pearson | 2012 |
| **2.** | Sheldon Ross | Introduction to Probability Models. 10th edition | ☒ | Elsevier | 2010 |
| **3.** | | | ☐ | | |

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

**Typical Evaluation Methods and Weighting**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Final exam: | 45% | Assignments: | 20% | Field experience: | % | Portfolio: | % |
| Midterm exam: | 35% | Project: | % | Practicum: | % | Other: | % |
| Quizzes/tests: | % | Lab work: | % | Shop work: | % | Total: | 100% |

**Details (if necessary):**

The weighting of the components may vary amongst instructors and years. There have to be at least two tests. The final examination is comprehensive and worth 40 to 50%. Students must obtain at least 40% on the final exam to pass the course.

**Typical Course Content and Topics**

**Probability:** Equally likely probability models, counting methods, axioms of probability, probability space, probability as a continuous set function, conditional probabilities, Bayes' formula, independent events.

**Continuous and Discrete Random Variables:** Random variables, discrete random variables, important discrete random variables (uniform, Bernoulli, binomial, Poisson, geometric, negative binomial, hypergeometric), continuous random variables, important continuous random variables (uniform, exponential, gamma, chi square, normal, Cauchy, beta).

**Jointly Distributed Random Variables:** Joint distribution functions, independent random variables, sums of independent random variables, conditional distributions for discrete and continuous random variables, probability distributions of functions of random variables, order statistics, t and F distributions, bivariate normal distributions.

**Expectation and Properties:** Definition of expectation, covariance, variance, correlation, expectations and variances of important random variables, conditional expectations and properties thereof, moment generating functions and properties thereof, joint moment generating functions and properties thereof.

**Limit Theorems:** Chebyshev's inequality, weak law of large numbers, central limit theorem, strong law of large numbers.

**Markov Chains:** Chapman-Kolmogorov Equations, classification of states, limiting probabilities, time reversible Markov Chains, Markov Chain Monte Carlo Methods.

**Poisson Processes:** Counting processes, Interarrival and Waiting Time distributions, properties of Poisson Processes, Conditional distribution of the arrival times.