STATISTICAL SCIENCE 2141 – Fall 2019
Applied Probability and Statistics for Engineers

Instructor:	Joseph Raaymakers, M.Sc.
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Office Hours:	Mondays, Wednesdays and Fridays, 10:00 AM-11:30 AM, WSC 107
Lecture Hours:	Mondays, Wednesdays and Fridays, 1:30 PM-2:30 PM, NSC 1
Tutorial Hours:	Wednesdays, 5:30 PM-6:30 PM, NSC 1

Prerequisite(s)
Applied Mathematics 1413, or 0.5 course from Calculus 1000A/B, or Calculus 1500A/B plus 0.5 course from either Calculus 1301A/B or Calculus 1501A/B.

Anti-requisite(s)
All other courses in Introductory Statistics (except Statistical Sciences 1023A/B, Statistical Sciences 1024A/B): Biology 2244A/B, Economics 2122A/B, Economics 2222A/B, Geography 2210A/B, Health Sciences 3801A/B,MOS 2242A/B, Psychology 2810, Psychology 2820E, Psychology 2830A/B, Psychology 2850A/B, Psychology 2851A/B, Social Work 2207A/B, Sociology 2205A/B, Statistical Sciences 2035, Statistical Sciences 2143A/B, Statistical Sciences 2244A/B, Statistical Sciences 2858A/B, Statistical Sciences 2037A/B if taken prior to Fall 2010.

Unless you have either the requisites for this course or written special permission from your Dean to enroll in it, you may be removed from this course and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped from a course for failing to have the necessary prerequisites.

Course Description
An introduction to statistics with emphasis on the applied probability models used in Electrical and Civil Engineering and elsewhere. Topics covered include samples, probability, probability distributions, estimation (including comparison of means), correlation and regression. Cannot be taken for credit in any 3-year or honors program or in any module in Statistics, Actuarial Science, or Financial Modelling.

Course Objectives
At the end of the course, students should be able to:
- state fundamental concepts of applied probability and statistics,
- see how the concepts are related and interact with each other,
- decide where and under what circumstances a given concept is applicable,
- combine the concepts to produce solutions for real-life problems,
- make appropriate inferences and decisions.

Textbook
- Probability and Statistics for Engineering and the Sciences, 9th ed., by Jay Devore

Reference Book
- Probability and Statistics for Engineers and Scientists, 4th ed., by Anthony Hayter.

Course Outline

Chapter	Topics
1 – Descriptive Statistics	Graphing Data, Sample Statistics: Mean, median, Variance, IQR, Percentiles, Outliers
2 – Probability Theory	Probabilities, Events, Union, Intersection, Conditional Probability, Bayes Rule
3/4 – Random Variables and Probability Distributions – Discrete and Continuous	Discrete and Continuous Random Variables, Expectation, Variance, Functions of Random Variables Discrete: Binomial, Poisson, Negative Binomial, Other Continuous: Uniform, Normal, Exponential, Gamma, Other
5 – Joint Probability Distributions and Random Samples	Joint Random Variables, Conditional Distributions, Expectation, Covariance, Correlation, Sampling Distributions, Central Limit Theorem
6 – Point Estimation	Point estimates and their properties, Construction of parameter estimates
7/8 – Inferences Based on a Single Sample	One Sample Hypothesis Testing and Confidence Intervals for Means (variance known and unknown), Other
9 – Inferences Based on Two Samples	Two Sample Hypothesis Testing and Confidence Intervals for Means (independent and paired samples), Other
12 – Simple Linear Regression and Correlation	Regression, Inferences About Slope, Prediction Intervals, Coefficient of Determination, Residual Analysis, Correlation Analysis
16 – Quality Control Methods	

Course OWL Web Page

Students should check OWL (http://owl.uwo.ca/portal) on a regular basis for news and updates.
This is the primary method by which information will be disseminated to all students in the class.
Students are responsible for checking OWL on a regular basis. The web page will contain:
1. A copy of this course outline
2. Updates and information about the course that you need to know
3. Daily class notes (which will be incomplete – to be filled in during the classes) and other things that are relevant to the course
4. Marks of quizzes and tests as they are marked

In-class Clickers

Your clicker use will be recorded in each lecture and will become part of your record. As such, your clicker record will be afforded the same degree of security, confidentiality and transparency that is customary for test marks, etc.

Clicker questions will be asked during most (but perhaps not all) lectures. You need only to answer 80% of the total clicker questions asked during the entire course to obtain a 5 (out of 5) on the clicker portion of your final mark. For any percentage (y) less than 80%, your clicker mark will decrease linearly using the formula:

$$\text{Clicker mark} = 6.25(y)$$

Examples: If you only answer 68% of all clicker questions, clicker mark $= 6.25(0.68) = 4.25$ (out of 5). If you only answer 44% of all clicker questions, clicker mark $= 6.25(0.44) = 2.75$.

Clicker participation only requires that you try; you do <u>not</u> have to get the questions correct to get this part of your course grade. Notice that you can miss up to 20% of the clicker questions (for any reason) without affecting your grade; this 'buffer' accounts for any technical problems that may arise as well as days on which you forgot your clicker or were late for class/left early. **Please note that no accommodation will be made for missed clicker participation or incorrectly programmed clicker IDs**.

Your clicker data will not be used for any non-academic or research purpose without your consent. For any research study in which you are invited to participate, you will be provided with a Letter of Information with an opportunity to give or withhold consent. Such research will not replace the usual end of term Course Evaluation given by the University.

<u>Quizzes</u>
There will be several multiple choice questions asked during tutorials that you will be required to answer using clickers. The following guidelines will apply:
- **Only 80% of the quiz questions will count toward your final mark.** (So you can miss 20% of the questions for any reason and you do not need any medical documentation. There are no makeup questions.)
- Each quiz question will be out of 5. You will receive full marks for each question you answer correctly and 1 out of 5 marks for each question you do not answer correctly. No marks will be given for questions you do not answer.
- You will be allowed to review your notes and collaborate with others in the class to come up with your answers.
- There will be a trial period to make sure that your clicker works.

<u>Midterm Exams</u> (1 hour each)
There will be 2 one-hour tests (consisting of short answer and multiple-choice questions) scheduled on the following dates:
1. Exam 1: **<u>Wednesday</u>**, **October 16, 2019, 5:30 pm to 6:30 pm** (Topics TBA)
2. Exam 2: **<u>Wednesday,</u> November 13, 2019, 5:30 pm to 6:30 pm** (Topics TBA)

If you have any conflict, you must check with your instructor as soon as possible (and prior to the exam). If you miss the test for a valid reason, you must provide documentation as to why you missed the test. There are no makeup tests. The weight of the missed test will be moved to the final exam.

<u>Final Exam</u>
The final exam will be a three-hour examination covering all material in the course, with emphasis on material covered since the midterm. The exam will consist of short answer and multiple-choice questions. It will be scheduled by the Registrar's office. Do not make travel arrangements until you know your exam schedule. Holding an airline ticket is not an acceptable reason to miss the final exam.

Cellular phones, iPods, and other similar technology are *not* permitted in the exam room. This means that cellular phones, iPods, Apple watches and other similar technology **cannot** be used as a timekeeper/clock, calculator or for any other purpose.

You will need a <u>non-programmable calculator</u> for all exams/in-class quizzes. It is the best practice to carry a non-programmable calculator with you all times during the term.

Evaluation

	Option 1	Option 2	Option 3
Clickers	5%	5%	5%
Quizzes	10%	10%	10%
Mid Term 1	17.5%	10%	20%
Mid Term 2	17.5%	20%	10%
Final Exam	50%	55%	55%

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** The marking scheme that gives the higher final mark will be the one used. This will be done automatically. No other marking schemes will be considered!

Policy on e-mail communication
You are welcome to communicate with your instructor by e-mail, but e-mail communication should only be used to provide them with information or to ask a question that requires a brief response. For more lengthy discussions and for discussions on lectures/course material please see your instructor during their scheduled office hours or by appointment. If you do e-mail them, please use your UWO account, as these are often the only emails read (as e-mails sent from other addresses often get spammed).

Attendance
The Department of Statistical and Actuarial Sciences views classroom attendance as a very important part of the learning process. You are expected to attend all classes. You are advised that excessive absenteeism may result in being debarred from the final examination.

Classroom Environment
The Department of Statistical and Actuarial Sciences has adopted a "Mutual Expectations" policy governing the classroom environment and all work submitted by students. [The full text of the policy can be found at https://www.uwo.ca/stats/undergraduate/mutual-expectations.html]. In summary, all interactions between students and faculty should be governed by the principles of **courtesy, respect and honesty.**

Students are encouraged to ask questions in the class. Cell phones should be turned off before class/during class and any unnecessarily loud talking among students is discouraged. The goal is to reduce any behaviour by students that may disrupt other students

Department Policy on Missed Course Requirements and Student Health and Wellness

If you are unable to meet a course requirement due to illness or other serious circumstances, you must seek approval for the absence as soon as possible and contact your instructor immediately. Approval can be granted either through a self-reporting of absence or via the Dean's Office/Academic Counselling unit of your Home Faculty. It is your responsibility to make alternative arrangements with your instructor once the accommodation has been approved and the instructor has been informed.

For further information, please consult the university's policy on academic consideration for student absences:
https://www.uwo.ca/univsec/pdf/academic_policies/appeals/Academic_Consideration_for_absences.pdf

For Final Exam: If you miss the Final Exam, please contact your faculty's Academic Counselling Office as soon as you are able to do so. They will assess your eligibility to write the Special Exam (the name given by the university to a makeup Final Exam).

You may also be eligible to write the Special Exam if you are in a "Multiple Exam Situation" (see http://www.registrar.uwo.ca/examinations/exam_schedule.html).

For Midterm Exam: The policy of the Department of Statistical and Actuarial Sciences is that there will be no make-up exams for a midterm missed due to illness. If your accommodation is approved, the weight of the missed midterm will be reassigned to the final exam. If your accommodation is not approved, then you will receive a mark of 0 for your midterm.

If you have any conflict that prevents you from writing a midterm, you must check with your instructor as soon as possible (and prior to the exam) so that alternate arrangements can be made.

For in-class clickers and quizzes: There are NO makeups for any of the clicker questions or quizzes, so if you miss 20% of the questions, they will be the ones that will not count towards your final mark. If you have already missed 20% of the questions, each additional question missed will count as a mark of ZERO. You do not need to get in contact with your Faculty or your instructor if you miss a question.

Academic Policy

The website for Registrarial Services is http://www.registrar.uwo.ca.

In accordance with policy, http://www.uwo.ca/its/identity/activatenonstudent.html, the centrally administered e-mail account provided to students will be considered the individual's official university e-mail address. It is the responsibility of the account holder to ensure that e-mail received from the University at his/her official university address is attended to in a timely manner.

Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, at this website: http://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf

Computer-marked, multiple-choice tests and exams may be subject to submission for similarity review by software that will check for unusual coincidences in answer patterns that may indicate cheating.

Support Services
Learning-skills counsellors at the Student Development Centre are ready to help you improve your learning skills. They offer presentations on strategies for improving time management, multiple-choice exam preparation/writing, textbook reading, and more. Individual support is offered throughout the Fall/Winter terms in the drop-in Learning Help Centre, and year-round through individual counselling: http://sdc.uwo.ca/.

Students who are in emotional/mental distress should refer to Mental Health@Western for a complete list of options about how to obtain help: https://www.uwo.ca/health/

Additional student-run support services are offered by the USC: https://westernusc.ca/your-services/.

Accessibility
Please contact the course instructor if you require lecture or printed material in an alternate format or if any other arrangements can make this course more accessible to you. You may also wish to contact Services for Students with Disabilities (SSD) at 661-2111 ext. 82147 if you have questions regarding accommodation.

The policy on Accommodation for Students with Disabilities can be found here:
https://www.uwo.ca/univsec/pdf/academic_policies/appeals/Academic%20Accommodation_disabilities.pdf

The policy on Accommodation for Religious Holidays can be found here:

http://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_religious.pdf

APPROXIMATE **Weekly Course Calendar**

Lectures – 2019	Section	
Sep 5 - 13	Descriptive stats, Probability theory (sections 1.1 - 1.4, 2.1 - 2.3)	
Sep 16 - 20	Probability theory (sections 2.3 – 2.5)	
Sep 23 - 27	Random variables, Discrete probability distributions (sections 3.1 - 3.5)	
Sep 30 - Oct 4	Random variables, Continuous probability distributions (sections 3.6, 4.1 – 4.3)	
Oct 7 - 11	Continuous probability distributions, Joint probability distributions (sections 4.3 – 4.4, 5.1)	
Midterm Exam 1 – <u>Wednesday</u>, Oct 16, 5:30- 6:30 pm (1 hour) – Chapters/Sections TBA		
Oct 14 - 18	Joint probability distributions, Conditional probability distributions, Statistics and sampling distributions, Central Limit Theorem, Point estimation (sections 5.2 – 5.5, 6.1)	
Oct 21 - 25	Point estimates and their properties, Construction of parameter estimates, Confidence intervals for a single sample (sections 6.1 – 6.2, 7.1)	
Oct 28 – Nov 1	Confidence intervals and hypothesis tests for a single sample (sections 7.2 – 7.3, 8.1)	
Midterm Exam 2 – <u>Wednesday</u>, Nov 13, 5:30- 6:30 pm (1 hour) – Chapters/Sections TBA		
Nov 11 - 15	Hypothesis tests for a single sample, Inferences for two samples (sections 8.1 - 8.3, 9.1)	
Nov 18 - 22	Inferences for two samples (sections 9.1 – 9.4)	
Nov 25 - 29	Simple linear regression and correlation (sections 12.1 – 12.4)	
Dec 2 - 4	Simple linear regression and correlation, Quality control methods (sections 12.4 – 12.5, 16.1 – 16.3)	
Final Exam – To be scheduled by the Registrar's office (3 hours)		