Biology/Statistics 2244A

Statistics for Science

CALENDAR DESCRIPTION

An introductory course in the application of statistical methods, intended for students in departments other than Statistical and Actuarial Sciences, Applied Mathematics, Mathematics, or students in the Faculty of Engineering. Topics include sampling, confidence intervals, analysis of variance, regression and correlation. Cannot be taken for credit in any module in Statistics, Actuarial Science, or Financial Modelling.

Antirequisite(s): All other courses in Introductory Statistics (except Statistical Sciences 1023A/B, Statistical Sciences 1024A/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 2141A/B, Statistical Sciences 2143A/B, Statistical Sciences 2858A/B, Statistical Sciences 2037A/B if taken prior to Fall 2010, former Psychology 2885 (Brescia), former Statistical Sciences 2122A/B, former Social Work 2205.
Prerequisite(s): A full (1.0) mathematics course, or equivalent, numbered 1000 or above. Statistical Sciences 1024A/B can be used to meet 0.5 of the 1.0 mathematics course requirement.

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 you 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.

INSTRUCTOR DETAILS

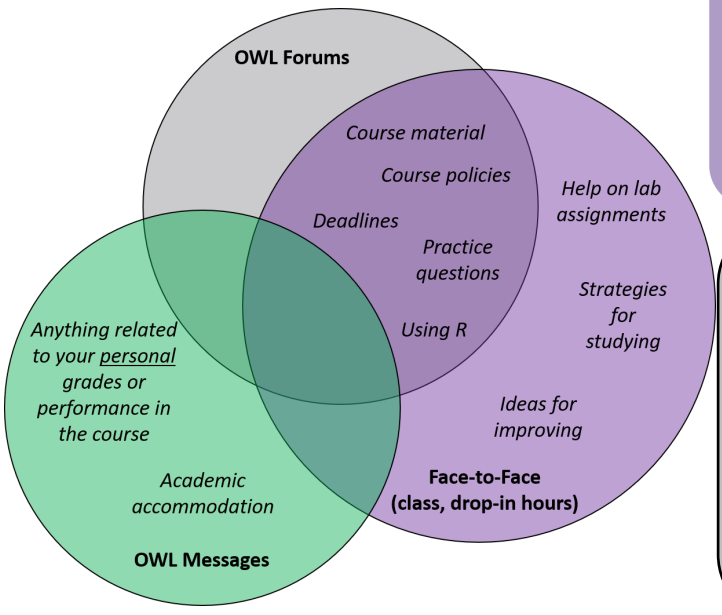
Name: Jennifer Peter

Departments:
Biology, *and*,
Statistical & Actuarial Sciences

Drop-in hours:
Mon 1:30–3:30 pm
Thurs 9:00—11:00 am
Both times in NCB 301L. No appointments needed...just 'drop-in'!

Contact: Please use "Messages" on our OWL site instead of email (my email is too similar to someone else's, which causes problems); send to ***Jennifer Peter.***

Have a question? *Find the best communication medium below:*



Fall 2019 lectures

001: Mon and Wed, 10:30–11:30 am, MC 110

002: Tues and Thurs, 4:30–5:30 pm, MC 110

See p.6 for lab sections

WHAT'S IN THIS SYLLABUS?

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COURSE MATERIALS

These materials are "required" in that each student needs *access* to them to be successful in the course. Whether that access is individual, shared by a group of individuals, or borrowed from the commons (e.g. computer labs, libraries, etc.) is up to you. In addition to these three main resources, we will occasionally use articles, videos, and applets available freely online to supplement your learning. ***If you discover any (open access) resources that are helpful to you for this course, I encourage you to share the details with the rest of the class!***

OWL Course Site:
Statistics 2244A 001 FW19 (owl.uwo.ca)

The OWL site is used **heavily**. It provides:

- Lecture slides (PDF format)
- Content for independent study (lecture videos, readings, etc.)
- Online Modules for learning to use the statistical software, R
- Lab Assignments (and related materials)
- Access to quizzes and other graded components
- Practice questions
- Communication tools

Statistical Software:
R (www.r-project.org)

The **Lab Assignments** require using statistical software—specifically, R (and the highly recommended integrated development environment, R Studio available at www.rstudio.com)—to visualize and analyse data. Both software packages are free programs that can be downloaded to your personal computers and are available on campus GenLab computers. Instructions for downloading is on OWL under **Labs**

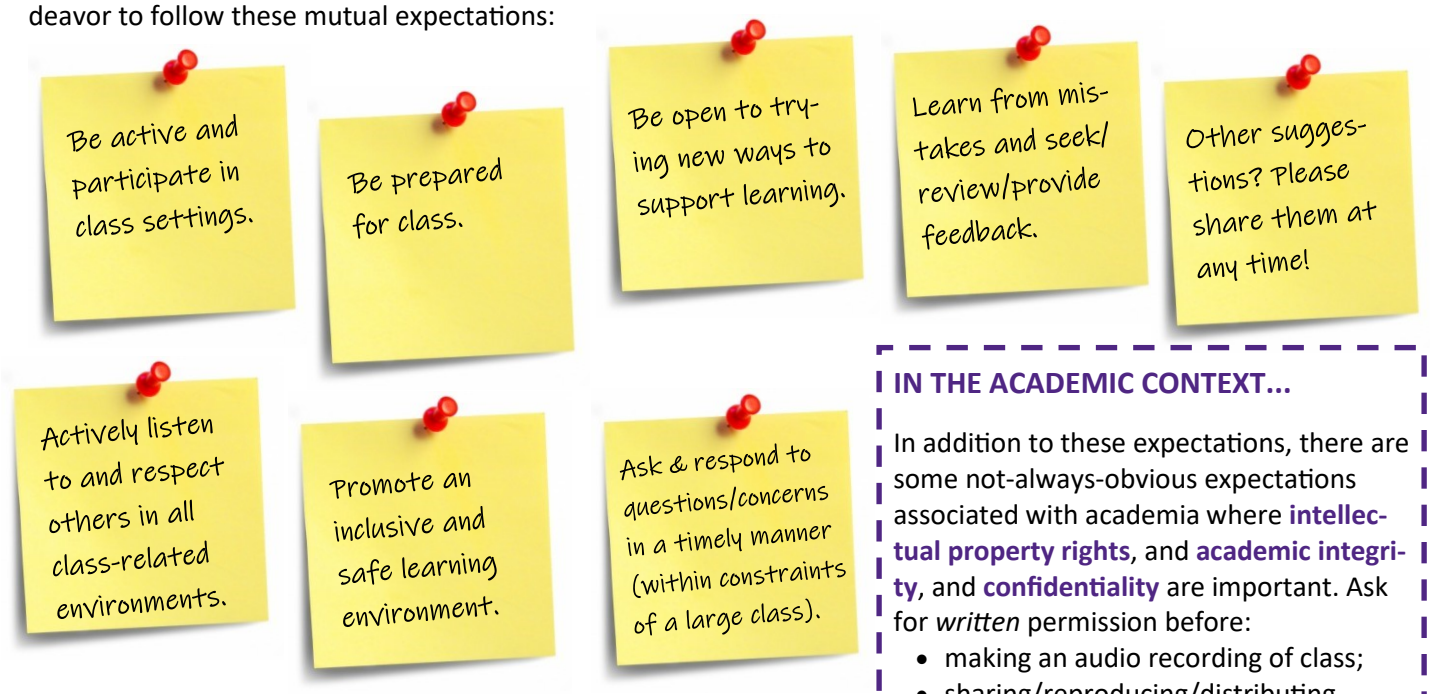
Textbook:

Baldi, B. and DS. Moore. 2018. *The Practice of Statistics in the Life Sciences.* 4th Edition, W.H. Freeman and Company.

You will be asked to read parts of the textbook as independent study. I promote the **SaplingPlus** version (i.e. 6-month subscription to online portal + ebook) because it is the cheapest option ($83.35 *through the UWO Bookstore; search* ***Stat 2244B***), has extra practice questions, and I have created topic-related modules within it.

EXPECTATIONS

To help maintain a safe, respectful, and productive community in which we—**students and teaching team alike**—can take risks in our learning/teaching, tackle challenging concepts, and ultimately grow as scientists, we should endeavor to follow these mutual expectations:



IN THE ACADEMIC CONTEXT...

In addition to these expectations, there are some not-always-obvious expectations associated with academia where **intellectual property rights**, and **academic integrity**, and **confidentiality** are important. Ask for *written* permission before:

- making an audio recording of class;
- sharing/reproducing/distributing course materials (for free or for profit)

R logo is © 2016 The R Foundation, used under CC-BY-SA 4.0 license (https://creativecommons.org/licenses/by-nc/4.0/).
SaplingPlus logo is © Macmillan Learning; used with permission.

EVALUATION SCHEME

The evaluation is set up to promote ***mastery of the material/skills*** by the end of the course, and to provide ***opportunities to learn from mistakes***. The course evaluation is divided into 'Fixed Distribution' and 'Flexible Distribution' segments; for more details on each component/item, see pages 5 and 6.

Fixed Distribution (35%)

Your final grade will be calculated using both Scheme 1 and Scheme 2. Your final course grade will use whichever scheme results in the highest grade for you as an individual.

Assessment	Scheme 1	Scheme 2
Clicker Participation	5%	0%
Quizzes	7%	7%
Activities	3%	3%
4 Lab Assignments	22% total	27% total
Highest lab	*8%*	*9%*
2nd highest labs	*6%*	*8%*
3rd & 4th highest labs	*4% each*	*5% each*

Flexible Distribution (63%)

Each of the following course items are *initially* weighted according to Scenario 1 ("S1") below. Your final grade will be calculated under all four scenarios. Your final course grade will use whichever scenario results in the highest grade for you as an individual.

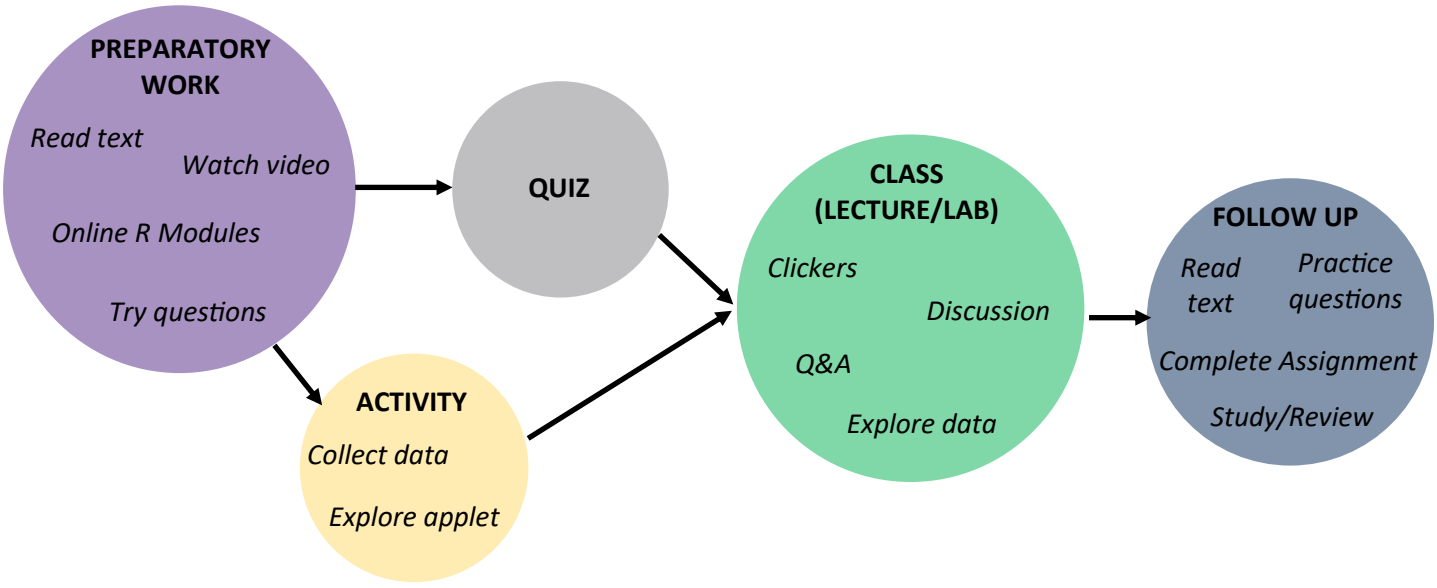
Assessment	S1	S2	S3	S4
Test 1	10%	0%	10%	0%
Test 2	13%	18%	0%	0%
Final Exam	40%	45%	53%	63%

Why is this so complicated!?

The success-based weighting of Lab Assignments and the Flexible Distribution is set up so you have multiple opportunities to receive feedback and demonstrate mastery. If you discover your understanding is not complete, and/or you perform below your desired level of success on a particular item of the Flexible Distribution, you still have future opportunities to regain some/all marks associated with those items. Because **all assessment items are cumulative**, the relative weighting of course material is (approximately) equivalent under each scenario.

HOW THIS COURSE WORKS

This course follows a *blended* learning approach (i.e. online + in-person delivery) that integrates five 'spheres' of engagement. While days/weeks vary, in general, you should expect the following framework:



LEARNING OUTCOMES (LOs)

This course is both introductory and comprehensive, conceptual and practical. At a fundamental level, the course is organized to ***demonstrate that statistics is a scientific discipline that can and should inform research at all stages***, from problem definition to interpretation and conclusion. To reinforce this overarching learning outcome, the course topics are organized around a "backbone" based on the PPDAC framework for scientific inquiry (MacKay and Oldford 2000).

More specifically, by the end of the course, you should be able to:

- A. Design sampling and study procedures to collect relevant data to address a research question.
  - A1. Distinguish among sampling and study designs.
  - A2. Identify issues associated with sampling and study design (e.g. bias, validity, confounding)
  - A3. Identify relevant inference procedures based on research question and variables.
- B. Create and interpret appropriate summaries of data.
  - B1. Select summaries based on research question and variables.
  - B2. Interpret summaries to identify and/or describe patterns, trends, and interesting features in data.
- C. Analyse data using inference procedures to address a research question.
  - C1. Select appropriate inference procedures to address a research question.
  - C2. Interpret and describe confidence intervals and hypothesis test results (and associated concepts).
  - C3. Evaluate the fit of models for common inference procedures.
  - C4. Identify situations and data that require alternative (i.e. not covered in this course) inference procedures.
- D. Use statistical software to explore, summarize, analyse, and interpret data.
  - D1. Use R to create and modify graphical and numerical summaries of data.
  - D2. Use R to conduct common inference procedures, including evaluating conditions for model fit.
  - D3. Interpret R output (including accompanying code) correctly.
- E. Communicate statistical concepts, analyses, and arguments in an accurate and scholarly manner.
  - E1. Apply vocabulary accurately to describe statistical concepts, procedures, and ideas.
  - E2. Apply conventional formats for reporting and interpreting results of statistical analyses in written/graphic form.
  - E3. Justify the choice of statistical procedures (e.g. selected study designs).
- F. Describe models and/or conceptual background for common inference procedures.
  - F1. Describe the models for common inference procedures.
  - F2. Describe sampling distributions (based on simple random samples) for commonly used statistics.
  - F3. Discuss and describe issues associated with inference (e.g. power, precision, Type I/II errors).

MacKay, R.J. and R.W. Oldford. 2000. Scientific method, statistical method, and the speed of light. Statistical Science 15(3): 254-278.

ASSESSMENT DESCRIPTIONS

CLICKER PARTICIPATION

WHY? Instant feedback on learning. Provoke discussion & engagement during class.

WHAT? Multiple choice questions during class. **Students must attend their registered lecture section**.

HOW? iClicker app (free); account set-up information under **Administration** on OWL site.

GRADES. Awarded for participation (not correct answers). Full participation in each class is worth 1 point; you earn a proportional fraction of the point for a given class based on the number of clicker questions you answer during the class. The percentage of points you earn across the course puts you in one of 6 categories (see table) to determine your final grade.

% points earned	Grade /5%
0	0
0 < % < 20	1
20 ≤ % < 40	2
40 ≤ % < 60	3
60 ≤ % < 80	4
80 ≤ % ≤ 100	5

ACCOMMODATION? Built into the grading scheme (i.e. the 20% margins) and should cover occasional lapses in participation and/or technical problems. If you have circumstances that cause larger 'absences', please obtain relief/consideration from Academic Counseling.

QUIZZES

WHY? Feedback on independent learning/preparatory work. Accountability for class preparation.

WHAT? Multiple choice and/or numeric response questions. Not meant to reflect exam-style questions.

HOW? Quizzes & Activities tool on OWL site. Available for ~36 h before deadline; limited time for completion once started. One deadline for ALL students.

GRADES. Marked for correct answers. The percentage of quiz questions answered correctly across the entire term places you in one of 8 categories (see table) to determine your final grade.

% questions correct	Grade /7%
0	0
0 < % < 14	1
14 ≤ % < 28	2
28 ≤ % < 42	3
42 ≤ % < 56	4
56 ≤ % < 70	5
70 ≤ % < 85	6
85 ≤ % ≤ 100	7

ACCOMMODATION? Built into the grading scheme (i.e. the ~14% margins) and should cover occasional missed quizzes and/or technical problems. For more extenuating circumstances, please obtain relief/consideration from Academic Counseling.

ACTIVITIES

WHY? Collect data for use & discussion in class. Promote active learning of core concepts.

WHAT? Structure varies: instructions for each activity will be provided on OWL site. Often involves using an applet to collect some information/data.

HOW? Responses submitted via Quizzes & Activities tool on OWL site. Typically available for ~36 h before deadline (if not longer).

GRADES. Points are awarded for completion with plausible responses; instructions will specify exact requirements. The percentage of points collected (out of those offered) across the course places you in one of 4 categories (see table) to determine your final grade.

% points earned	Grade /3%
0	0
0 < % < 33	1
16 ≤ % < 67	2
67 ≤ % ≤ 100	3

ACCOMMODATION? Built into the grading scheme and should cover occasional missed activities and/or technical problems. For more extenuating circumstances, please obtain relief/consideration from Academic Counseling.

TESTS and FINAL EXAM

WHY? Assessment of understanding, application, and integration of course material.

WHAT? Multiple choice questions (unless stated otherwise); ~15-20 questions for Tests, ~45 questions for Final Exam.

HOW? Using Scantron sheets during an in-person test. Non-programmable calculators permitted.

GRADES. Your mark on the tests/exam is based on the number of correct answers submitted.

ACCOMMODATION? The Tests are part of the "Flexible Distribution" in course; weight from the Tests is automatically redistributed (see page 3). Students who miss the Final Exam must obtain relief/consideration from Academic Counseling. See information on Academic Policies under the *Policies and Supports* section (page 7).

LAB ASSIGNMENTS

WHY? Assessment of your application of course concepts in a authentic manner, including use of statistical software (R).

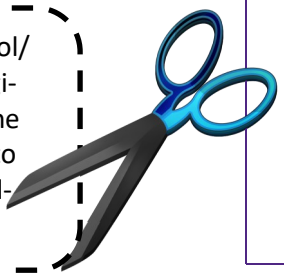
WHAT? 4 assignments, each composed of ~4 multiple part, short-answer questions requiring written responses (including graphs and R code). Assignments move progressively through the phases of the PPDAC framework (MacKay & Oldford 2000), and involve answering questions that relate to an overall research objective and set of research questions. Success on assignments will involve applying course concepts in a novel setting, and demonstrating appropriate use of R.

HOW? To earn credit, assignments are submitted as a PDF file to **both** (1) "Assignments (OWL Submissions)" on the OWL site and (2) Gradescope. The submission process will be discussed in the first lab session.

GRADES. Marked for correct/valid application of course concepts. Regrade requests must be made through Gradescope within one week of receiving graded assignment.

ACCOMMODATIONS? For any missed Lab Assignment, you must obtain relief/consideration from Academic Counseling, otherwise a grade of zero will be awarded. One missed ***and*** relieved assignment will be assigned a grade equal to the mean of the other non-relieved assignments, and will count as the lowest assignment weight (see page 3). If more than one lab assignments is missed ***with*** relief/consideration, a final course grade of *Incomplete* ("INC") will be issued, and the student will be required to make up the relieved assignment(s) in the next term of the course.

LAB EXEMPTION. If you previously took Biol/Stat 2244 **after Sept 2016**, you may be eligible for a lab exemption. More details on the OWL site under **Administration**. Decision to take the exemption is due before the deadline for Lab Assignment 1.



DID YOU KNOW?

Working with data in R (as assessed through Lab Assignments) is an ***essential requirement***. To pass 2244, you must:

- submit and receive a non-zero grade for **at least 3 of the 4** Assignments, **and**,
- **Earn a passing grade** for the lab assignments component of the course.

Otherwise, your final course grade will be recorded as 45% (or your calculated grade—whichever is lower).

Section	*Day*	*Time*	*Location*
003	Tues	6:30-9:30 pm	HSB-16
004	Tues	6:30-9:30 pm	HSB-14
005	Wed	6:30-9:30 pm	HSB-14
006	Wed	6:30-9:30 pm	NCB-105
007	Thurs	6:30-9:30 pm	HSB-16
008	Thurs	6:30-9:30 pm	HSB-14
009	Fri	11:30-2:30 pm	HSB-14
010	Tues	1:30-4:30 pm	HSB-16
011	Tues	1:30-4:30 pm	HSB-14
012	Thurs	1:30-4:30 pm	HSB-16
013	Thurs	1:30-4:30 pm	HSB-14
014	Tues	6:30-9:30 pm	NCB-105
015	Thurs	6:30-9:30 pm	NCB-105

COMMENTS ON 2244 GRADES AND EVALUATION

The assessment weights have been set to:

- recognize the workload of each component;
- highlight the relative importance to the learning outcomes for the course;
- acknowledge that mastery takes time.

The evaluation scheme is also set up with an awareness that we aren't 'perfect' every day, and some of our not-so-good days may coincide with a test or assignment deadline. The evaluation scheme, therefore, is set up to place higher value on your best work. Because this structure is already in place, I do **not** re-weight assessments, nor accept additional/revised work, to accommodate poor performance and/or non-relieved absences. For reference, I also do not 'bump' individual grades (e.g. to meet program cut-offs), nor force grades to follow a particular distribution (e.g. Normal curve).

MacKay, R.J. and R.W. Oldford. 2000. Scientific method, statistical method, and the speed of light. Statistical Science 15(3): 254-278.

POLICIES AND SUPPORTS

Looking for policies, support, or resources?

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

Submit your own work.

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.

Eyes on your own test.

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

Sick or unable to complete course requirements?

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. Approval can be granted either through a self-reporting of absence or via the Dean's Office/Academic Counselling unit of your Home Faculty. If you are a Science student, the Academic Counselling Office of the Faculty of Science is located in NCB 280, and can be contacted at scibmsac@uwo.ca. For further information, please consult the university's policy on academic consideration for student absences: https://tinyurl.com/AcademicConsiderations

DID YOU KNOW?

It is Faculty of Science policy that a student who chooses to write a test or exam deems themselves fit enough to do so, and the student must accept the mark obtained. Claims of medical, physical, or emotional distress after the fact will not be considered.

What's Gradescope?

This course will use **Gradescope**, an online collaborative grading and analytic platform. For information on their privacy policy, please visit their website.

Use your UWO email.

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 man-

Missed the Final Exam? Heavy exam load?

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)

We use Turnitin.

All required papers may be subject to submission for textual similarity review to the commercial plagiarism detection software under license to the University for the detection of plagiarism. All papers submitted for such checking will be included as source documents in the reference database for the purpose of detecting plagiarism of papers subsequently submitted to the system. Use of the service is subject to the licensing agreement, currently between The University of Western Ontario and **Turnitin.com** (http://www.turnitin.com).

Respect one another.

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: http://www.uwo.ca/stats/undergraduate/mutual-expectations.html. In summary, the policy was developed under the premise that all interactions between students and faculty should be governed by the principles of courtesy, respect and honesty.

Clicker Responsibility. We subscribe to and use clicker software produced by iClicker (https://www.iclicker.com/) because it is the platform supported by Western's Technology Services (WTS) and is free to registered students. If using a clicker, you are responsible for bringing your own device for use as a clicker and setting up your iClicker account correctly. The instructor is not responsible (i.e. no academic relief/consideration will be made) for WiFi failure/inconsistencies; the grading scheme is set up to account for these issues.

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

Research. 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 Student Questionnaire given by the University.

Academic Integrity. Use of a clicker associated with an identity other than your own is an academic offense. Granting permission for someone else to submit answers on your behalf is an academic offence. In a test, lab, lecture, or tutorial, possession of a device associated with the identity of another student for the purpose of clicker participation, will be interpreted as intent to commit an academic offense and will be reported as such.

Senate definitions of grades

For your reference, the Senate definition for meaning of letter grades is:

Letter Grade	*Grade range (%)*	*Definition*
A+	90 – 100	One could scarcely expect better from a student at this level.
A	80 – 89	Superior work which is clearly above average.
B	70 – 79	Good work, meeting all requirements, and eminently satisfactory.
C	60 – 69	Competent work, meeting requirements.
D	50 – 59	Fair work, minimally acceptable.
F	Below 50	Fail.

Need an alternate format?

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

Need support with disabilities?

The policy on Accommodation for Students with Disabilities can be found here: www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_disabilities.pdf

Have a religious conflict?

The policy on Accommodation for Religious Holidays can be found here: http://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_religious.pdf

Help with learning strategies?

Learning-skills counsellors at the Student Development Centre (http://www.sdc.uwo.ca) 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.

In mental/emotional distress?

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

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

COURSE OUTLINE

This schedule is tentative; we occasionally get a little ahead/behind on course topics. Consequently, the timing of Activities and Quizzes will be adjusted to match our progression through the course (and occasionally, quizzes are added/removed). Importantly, the weeks for labs and the Assignment due dates may get bumped (to be later...never earlier) depending on our progression.

Lecture	Topic(s)	Graded components (Quizzes are due FIRST day of paired lectures)	Required 'Reading'
Sept 9 & 10	PPDAC: a scientific inquiry framework ("Problem")		
Sept 11 & 12	Sampling design considerations ("Plan") - part A *Independent Study:* Sampling Designs ("Plan")	Activity: Taking a sample	Ch 6, p146–155 plus videos on OWL
Labs	*None...don't stress. We'll get you ready in week 2.*		
Sept 16 & 17	Sampling design considerations ("Plan") - part B *Independent Study:* Study Designs ("Plan")	Quiz 1—Sampling	Ch 6, p141–144, p. 155-159 Ch 7, p168–178 plus videos on OWL
Sept 18 & 19	Study design considerations ("Plan") - part A	Quiz 2—Study design Activity: Practice lab assignment due Friday	
Labs	Introduction to lab component of 2244 *and* R Tutorial (importing data & using R script files)		
Sept 23 & 24	Study design considerations ("Plan") - part B *Independent Study:* Graphical & numerical summaries		Ch 1, p4–28 (except "Time Series") and Ch 2 (all sections)
Sept 25 & 26	Planning ahead: Sampling variability ("Plan")	Quiz 3—Online R Module 1	
Labs	*none*		
Sept 30 & Oct 1	Summarizing & Exploring Data ("Data") - part A	Quiz 4—Summarizing & Exploring Data	
Oct 2 & 3	Summarizing & Exploring Data ("Data") - part B		
Labs	Assignment 1 work/help period *and* R Tutorial (sub-setting and reporting code)		
Oct 7 & 8	Probability Models & Vocabulary (foundations)	**Planning a Study (Assignment 1) due Monday** Quiz 5 – Online R Module 2	Ch 9, p222–224 Note: Ch 10, p258–264 is not required, but should be for students interested in health-related fields
Oct 9 & 10	Probability models: Normal (foundations)	Quiz 6—Normal distributions	Ch 11, p271–278, p288–292
Labs	*none*		
Oct 14 & 15 Thanksgiving	*Independent Study:* Probability models: Binomial (foundations)	Quiz 7—Binomial distributions	Ch 12, p299–301
Oct 16 & 17	Sampling distributions (foundations)	Activity: Sampling distributions of sample means Quiz 8—Sampling distributions	Ch 13, p324–329
Labs	Assignment 2 work/help period *and* R tutorial (customizing figures)		

COURSE OUTLINE, continued.

Lecture	Topic(s)	Graded components	Required 'Reading'
Oct 21 & 22	Understanding confidence intervals (foundations)	**Summarizing & Exploring Data (Assignment 2) due Monday** Activity: Understanding confidence Quiz 9—Introduction to confidence intervals	Ch 14, p347–352
Oct 23 & 24	t confidence interval for the mean ("Analysis")	Quiz 10—t confidence intervals	Ch 15, p376–379 & Ch 17, p417–420
Labs	*none*		
Sat, Oct 26	***Test 1: 7:00–8:30 pm; see OWL Gradebook for your assigned room***		
Oct 28 & 29	Large sample confidence interval for the proportion ("Analysis")	Quiz 11—large sample confidence intervals	Ch 12, p308–309; Ch 13, p336–339; & Ch 19, p473–475
Oct 30 & 31	Understanding P-values (foundations)	Quiz 12—Introduction to hypothesis tests	Ch 14, p356–358
Labs	*none*		
Nov 4–10	***Reading week***		
Nov 11 & 12	Large sample test for the proportion ("Analysis")		
Nov 13 & 14	t-test for the mean ("Analysis")	Quiz 13—Online R modules 3 & 4	
Labs	none		
Sat, Nov 16	***Test 2: 10:00–12:00 noon; see OWL Gradebook for your assigned room***		
Nov 18 & 19	t procedures for difference between means ("Analysis") *Independent Study:* Large sample procedures for difference between proportions ("Analysis")	Quiz 14—t procedures for difference between means	Ch 18, p445–449 Ch 20, p495–500, p504–507
Nov 20 & 21	Uncertainties in hypothesis testing ("Analysis") *Independent Study*: Correlation ("Analysis")	Quiz 15—Online R modules 5 & 6	Ch 15: p383–395 Ch 3 (all sections)
Labs	*Assignment 3 work/help period and R tutorial (examples of conducting inference)*		
Nov 25 & 26	Linear Regression ("Analysis") - part A	**Analysing Data and Writing Conclusions (Assignment 3) due Monday** Quiz 16—Regression	Ch 4, p93–101, p107–115
Nov 27 & 28	Linear Regression ("Analysis") - part B	Quiz 17—Online R Modules 7 & 8	
Labs	*Assignment 4 work/help period*		
Dec 2 & 3	One-factor ANOVA & follow-up ("Analysis") - part A	Quiz 18—One-factor ANOVA	Ch 24, p605–611
Dec 4 & 5	One-factor ANOVA & follow-up ("Analysis") - part B	**Analysing Data and Writing Conclusions, part 2 (Assignment 4) due Thursday** Activity: Reflection	
Dec 8–19	***Final Exam Period (do not book travel during this time until exam schedule is finalized on October 4, 2019)***		