Biology/Statistics 2244

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 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.

INSTRUCTOR DETAILS

Name: Jennifer Peter

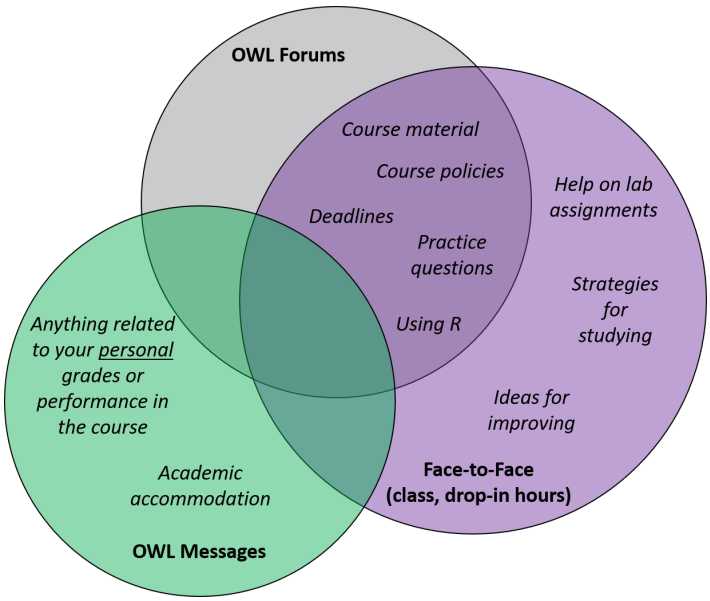
Departments: Biology *and* Statistical & Actuarial Sciences

Drop-in hours: Tues 2:00–4:00 pm, NCB 301L

'Drop-in hours' are open and collaborative around a large table ,with a smartboard on which we can create. No appointments needed...just 'drop-in'!

Contact: Please use the "Messages" tool on our OWL course site instead of email; send messages to ***Jennifer Peter.***

Note: what medium to use for communication depends on what you require; please consult this Venn diagram to identify the relevant method of communication.



Summer Evening 2019

Lectures:
Mon/Wed 6:30–8:30 pm
NCB 114

Labs: Thurs 6:30–9:30 pm
Section 002: HSB 13
Section 003: HSB 14

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 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:
Biology 2244B 002 SU19
Login with UWO ID and password at 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 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.

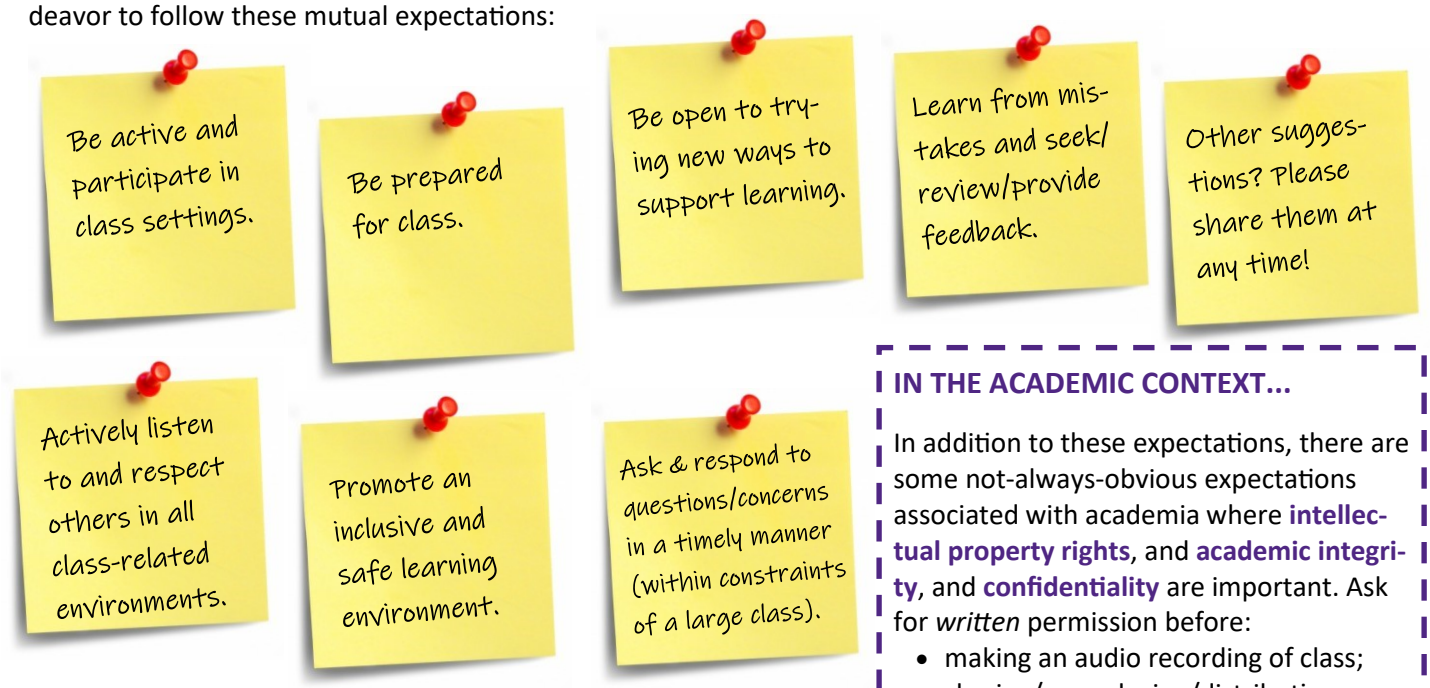
Textbook:

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 page 5.

Fixed Distribution (35%)

Each student's final grade will be calculated using both Scheme 1 and Scheme 2. Their final course grade will use whichever schemes results in the highest grade for that student.

Component	Scheme 1	Scheme 2
Clicker Participation	5%	0%
Quizzes	6%	6%
Activities	3%	3%
5 Lab Assignments	20% total	25% total
Highest lab	*6%*	*7%*
2nd & 3rd highest labs	*4% each*	*5% each*
4th & 5th highest labs	*3% each*	*4% each*

Flexible Distribution (65%)

Each of the following course items are *initially* weight according to Scenario 1 ("S1"). However, each student's grade will be calculated according to all five scenarios; whichever scenario results in the highest grade for that student will be used when calculating the final course grade.

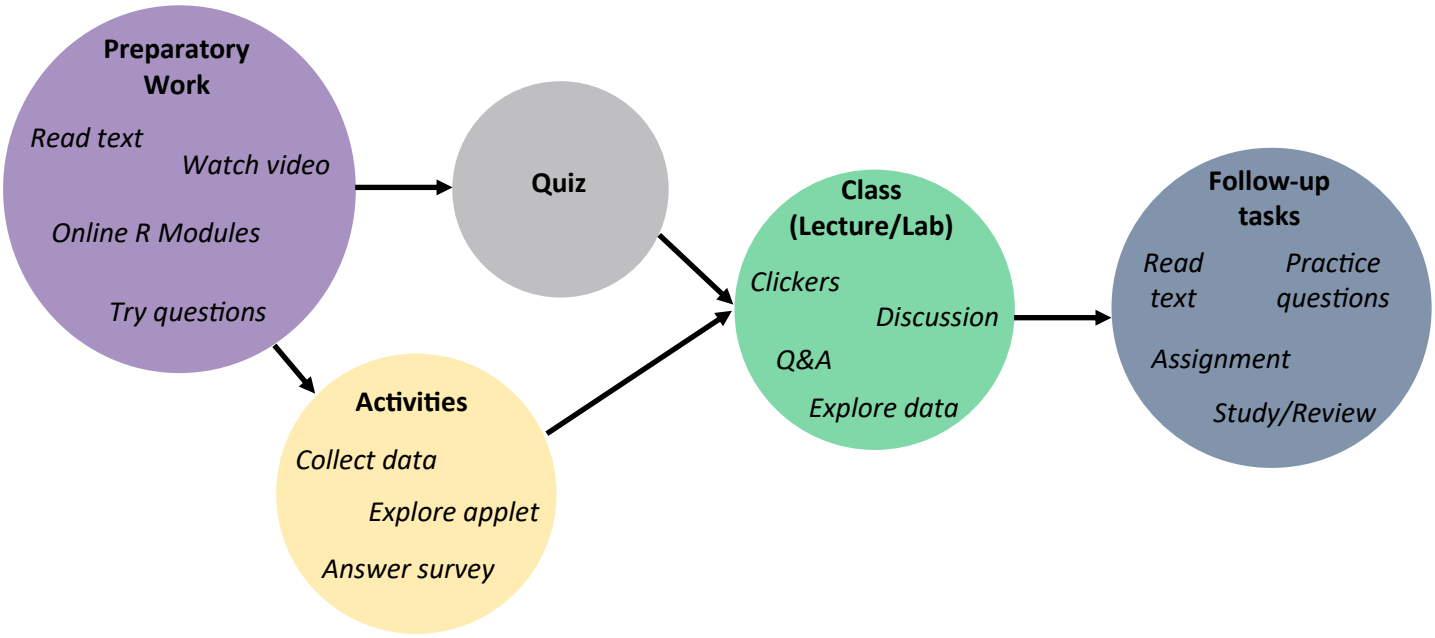
Item	S1	S2	S3	S4	S5
ICA 1	3%	0%	3%	0%	0%
ICA 2	3%	4.5%	0%	0%	0%
Test	15%	16.5%	15%	16.5%	0%
Final Exam	45%	45%	48%	49.5%	66%

Why is this so complicated!?

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

HOW THIS COURSE WORKS

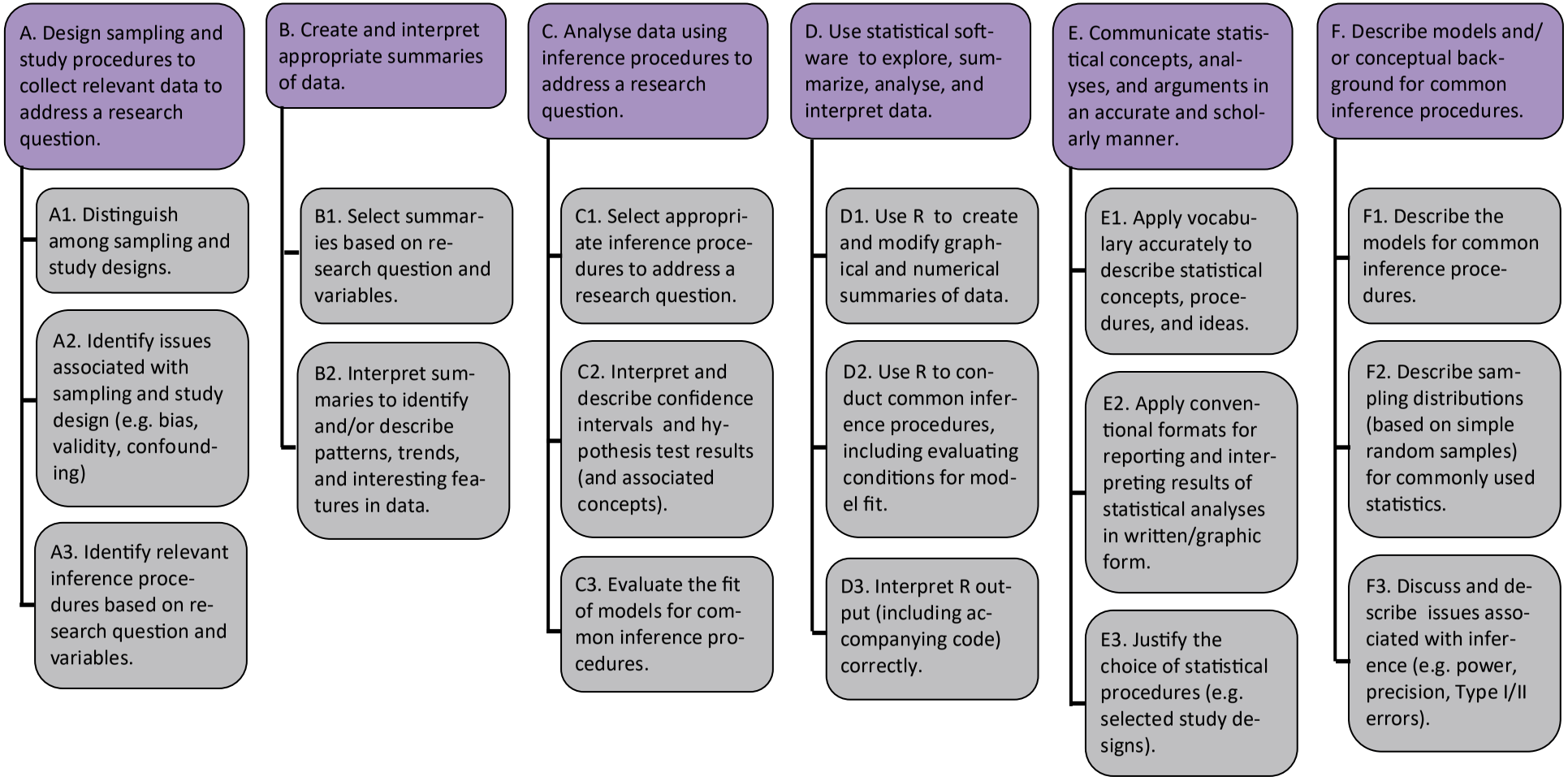
This course follows a *blended* learning approach (i.e. online + in-person delivery) that integrates five 'spheres' of engagement. While days/weeks vary, in general, you should expect the following framework:



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 conclusions. 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:



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.

WHAT? Multiple choice questions during class.

HOW? iClicker app (free); account set-up information under **iClicker** 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? It's 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 gaps in participation, please speak with Academic Counseling.

QUIZZES

WHY? Feedback on independent learning. Accountability for class preparation.

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

HOW? Quizzes tool on OWL site. Available for ~24 h before deadline; limited time for completion once started.

GRADES. Marked for correct answers. The percentage of quiz questions answered correctly across the entire term places you in one of 7 categories (see table) to determine your final grade.

% questions correct	Grade /6%
0	0
0 < % < 16	1
16 ≤ % < 33	2
33 ≤ % < 50	3
50 ≤ % < 66	4
66 ≤ % < 83	5
83 ≤ % ≤ 100	6

ACCOMMODATION? It's built into the grading scheme (i.e. the ~16% margins) and should cover occasional missed quizzes and/or technical problems. For more extenuating circumstances, please speak with Academic Counseling.

ACTIVITIES

WHY? Collect authentic data for use in class. Promote active learning of core concepts. Reflect on your learning.

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

HOW? Responses submitted via Quizzes tool on OWL site. Typically available for ~36 h before deadline.

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? It's built into the grading scheme and should cover occasional missed activities and/or technical problems. For more extenuating circumstances, please speak with Academic Counseling.

IN-CLASS ASSESSMENTS ("ICAs")

WHY? Low-weight assessment of understanding, application, and integration of course material.

WHAT? 5 multiple choice questions each; exam conditions scheduled during lab period. Calculators allowed.

HOW? Using IFAT scratch cards that allow up to 3 attempts per question to select correct answer.

GRADES. Marked for correct answers. Each question is worth 3 points; each 'attempt' (after the 1st) reduces points earned by 1 for each question.

ACCOMMODATION? Part of the "Flexible Distribution" in course (see page 3). Weight from missed ICA(s) is automatically redistributed (see page 3).

LAB ASSIGNMENTS

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

WHAT? 5 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).

HOW? To earn credit, assignments are submitted as a PDF file to **both** (1) "Assignments" on the OWL site and (2) Gradescope.

GRADES. Marked for correct/valid application of course concepts. Clarification on grading must be requested within one week of receiving assignment feedback.

DID YOU KNOW?

Lab Assignments are an ***essential course component***. That means—to pass Biology/Statistics 2244—you must:

- submit and receive a non-zero grade for **at least 3 of the 5** 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).

ACCOMMODATIONS? For any missed Lab Assignment, you need to speak with Academic Counseling to request accommodation, otherwise a grade of zero (0) will be awarded. Up to two (2) missed ***and*** accommodation assignments will be assigned a mark equal to the mean of the other non-accommodated assignments, and will take on the lowest of the possible assignment weightings (i.e. Scheme 1: 3% or Scheme 2: 4%; see page 3). If more than two (2) lab assignments are missed with accommodation, a final course grade of *Incomplete* ("INC") will be submitted, and the student will be required to make up the assignments in the next term of the course.

LAB EXEMPTION FOR REPEATING STUDENTS. Students who previously took Biology/Statistics 2244 **after Sept 2014** may be eligible for a lab assignment exemption. Eligible students have the option of carrying their previous lab assignment grades to this term. This is an "**all or nothing"** exemption. Eligible students must indicate their acceptance of the exemption before the first lab assignment, otherwise, they will be marked on the assignments for this term. More details on the OWL site.

TEST and FINAL EXAM

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

WHAT? Multiple choice questions (unless otherwise specified); ~20 questions for Test, ~45 questions for Final Exam.

HOW? Using Scantron sheets that allow 1 attempt per question to select the correct answer. Calculators allowed.

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

ACCOMMODATION? The Test is part of the "Flexible Distribution" in course; weight from the Test is automatically redistributed (see page 3). Students who miss the Final Exam must speak with Academic Counseling to request academic accommodation. See information on Academic Policies under the *Policies and Supports* section (page 7).

COMMENTS ON 2244 GRADING

The assessment weightings have been set to:

- recognize the workload of each component;
- highlight the relative importance to the learning outcomes;
- 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 maybe 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 work to accommodate poor performance and/or unaccommodated absences. For reference, I also do not bump grades (e.g. to meet program cut-offs), nor force grades to follow a particular distribution (e.g. Normal curve).

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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 provide valid medical or supporting documentation to the Academic Counselling Office of your home faculty as soon as possible. If you are a Science student, the Academic Counselling Office of the Faculty of Science is located in NCB 240, and can be contacted at scibmsac@uwo.ca.

For further information, please consult the university's medical illness policy at http://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_medical.pdf

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.

POLICIES AND SUPPORTS, continued

Clicker Responsibility. We subscribe to and use clicker software produced by iClicker (https://www.iclicker.com/) because it is the company supported by Western's Technology Services (WTS) and is free to registered students. A student choosing to use a clicker will be responsible for (a) bringing their own device to use as a clicker, and (b) setting up their iClicker account correctly. Note that the course and instructor is not responsible (and therefore, no accommodation will be made) for WiFi failure.

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 in your absence is an academic offence. In a test, lab, lecture, or tutorial, possession of more than one clicker device, or one associated with the identity of another student, will be interpreted as intent to commit an academic offense and will be reported as such.

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.

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.

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

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

The course topics are organized around a "backbone" based on the Problem/Plan/Data/Analysis/Conclusion ("PPDAC") framework for scientific inquiry (MacKay and Oldford 2000). You will be responsible for covering certain topics on your own time (through textbook readings and/or posted video resources); these "Independent Study" topics have been strategically chosen based on previous student feedback and level of complexity.

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/activities are added/removed). Generally, I anticipate the Assignment duedates to remain as scheduled. The In-class Assessment and Test dates can be considered firm.

Date	Topics	Graded components	Required 'Reading'
Mon, June 17	PPDAC: a scientific inquiry framework ("Problem") Sampling considerations ("Plan") *Independent Study:* Sampling & Study Designs ("Plan")	Activity: Taking a sample (during first class)	Ch 6, p146-155 plus videos on OWL
Wed, June 19	Sampling considerations ("Plan"), cont'd. Study design considerations ("Plan")	Quiz 1—Sampling Quiz 2—Study design	Ch 6, p141-144, p. 155-159 Ch 7, p. 168-178 plus videos on OWL
Thurs, June 20	Introduction to lab curriculum Overview of Lab Assignment 1 ("Problem" & "Plan") Flowcharts for sampling & study design Introduction to R/R Studio, importing data	Activity: Practice lab assignment	
Mon, June 24	*Independent Study:* Graphical & numerical summaries Planning ahead: Sampling variability ("Plan") (50 min) Summarizing & Exploring Data ("Data")	Quiz 3—Summarizing & Exploring Data Activity: Data collection	Data: Ch 1, p. 4-28 (except "Time Series"), Ch 2 (all sections)
Wed, June 26	Summarizing & Exploring Data ("Data"), cont'd. Probability Models & Vocabulary (foundations)	Quiz 4—Online R Module 1 **Assignment 1 due Friday, June 28**	Ch 9, p. 222-224 Note: Ch 10, p. 258-264 is not required , but should be for students interested in health related fields
Thurs, June 27	Science Communication: Graphs ("Data") Overview of Assignment 2 ("Data") R: subsets, scripts, and reporting code	**In-class assessment 1** (6:30 pm in lab room)	
Mon, July 1 (CANADA DAY)	Probability models: Binomial (foundations) (Video Lecture) Probability models: Normal (foundations) (Video Lecture)	Quiz 5—Binomial distributions Quiz 6—Normal distributions Activity: Sampling distributions of sample means	Ch 12, p. 299-301 Ch 11, p. 270-278, p. 288-292
Wed, July 3	Sampling distributions (foundations) Understanding confidence intervals (foundations)	Quiz 7—Sampling distributions Quiz 8 – Online R Module 2 Activity: Understanding confidence	Ch 13, p. 324-329 Ch 14, p. 345-352
Thurs, July 4	Assignment 2 help/work period	**Assignment 2 due Friday, July 5**	

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

COURSE OUTLINE, continued.

Date	Topics	Graded components	Required 'Reading'
Mon, July 8	t confidence intervals for a mean ("Analysis") Large sample confidence intervals for a proportion ("Analysis")	Quiz 9—t confidence intervals Quiz 10—Large sample confidence intervals	Ch 15, p. 376-379 Ch 17, p. 417-420 Ch 13, p. 336-339 Ch 19, p. 473-475
Wed, July 10	Understanding P-values (foundations) Large sample test for a proportion ("Analysis")	Quiz 11— Introduction to hypothesis testing Quiz 12—Online R Modules 3 & 4	Ch 14, p. 356-358
Thurs, July 11	Science Communication: reporting confidence intervals ("Conclusion") Assignment 3 ("Analysis" & "Conclusion") work/help period	**Assignment 3 due Friday, July 12**	
Sat, July 13	**TEST (15%) - scheduled for 10:00 am**		
Mon, July 15	t-test for a mean ("Analysis") *(Potential) Independent Study:* Uncertainties in hypothesis testing (power, errors, effect size) ("Analysis")		Ch 15: p. 383-395
Wed, July 17	t-test for difference between means ("Analysis") *Independent Study*: Large sample test for difference in proportions ("Analysis")	Quiz 13—two sample test for diff in means Quiz 14—Online R Modules 5&6	Ch 18, p. 445-450 Ch 20, p. 495-500, p. 504-507
Thurs, July 18	Science Communication: reporting hypothesis tests ("Conclusion") Assignment 4 ("Analysis" & "Conclusion") work/help period	**In-class assessment 2** (6:30 pm in lab room) **Assignment 4 due Friday, July 19**	
Mon, July 22	*Independent Study*: Correlation ("Analysis") Regression (inference on slope) ("Analysis")	Quiz 15—Regression	Ch 3 (all sections) Ch 4, p. 93-101, p. 107-115
Wed, July 24	One-factor ANOVA and follow-up analyses ("Analysis") Inference beyond 2244 ("Analysis")	Quiz 16—ANOVA Quiz 17—Online R Modules 7 & 8	Ch 24, p. 605– 611
Thurs, July 25	Science Communication: discussing results ("Conclusion") Assignment 5 ("Analysis" & "Conclusion") work/help period	**Assignment 5 due Friday, July 26** Activity: Reflection	
July 29-30	**Final Exam (45%) during exam period (date/time set by Registrar)**		