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 (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.

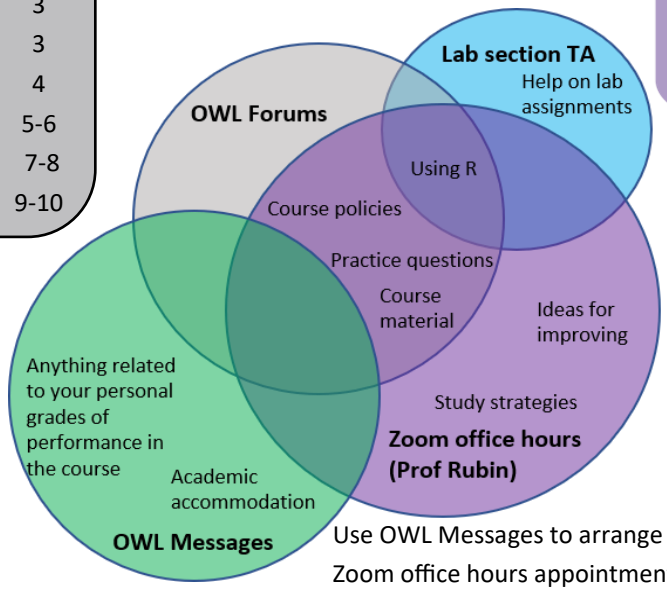
Unless you have either the requisites for this course or written special permission from your Dean to enroll in it, you may be removed from this course and it will be deleted from you record. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped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

WHAT'S IN THIS SYLLABUS?

INSTRUCTOR

Name: Ben Rubin
Contact: Please use "Messages" on our OWL site instead of email: send to ***Benjamin Rubin.*** If you encounter technical problems then use my email (brubin2@uwo.ca)

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



Use OWL Messages to arrange a Zoom office hours appointment.

Course format

Lecture content delivered asynchronously through OWL

Labs will include synchronous TA support

Hardware requirements

- Laptop or computer
- Stable internet connection
- Working microphone
- Working webcam

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:
Biology 2244A 003 FW20
(owl.uwo.ca)

The OWL site is the main source for course content, assignments, quizzes and communication.

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

Lab Assignments require using statistical software—specifically, R (and the highly recommended integrated development environment, R Studio available at www.rstudio.com)—to transform, visualize and analyse data. Both software packages are free programs and can be downloaded to your personal computer or accessed by creating a free *RStudio Cloud* account. Downloading instructions are 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 ($88.95) *through the UWO Bookstore; search* ***Stat 2244***), has extra practice questions, and topic-related modules within it.

Proctortrack BY VERIFICIENT

Term tests and the final exam will be administered using Proctortrack emote exam software. For more details, see the exams section of this outline (p. xx)

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:

- Be active and participate in class settings.
- Be prepared for class.
- Be open to trying new ways to support learning.
- Learn from mistakes and seek/review/provide feedback.
- Other suggestions? Please share them at any time!
- Actively listen to and respect others in all class-related environments.
- Promote an inclusive and safe learning environment.
- Ask & respond to questions/concerns in a timely manner (within constraints of a large class).

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 sharing/reproducing/distributing course materials (for free or for profit)

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 assessment item, see pages 5 and 6.

Assessments will use the following interfaces: Proctortrack, Gradescope, OWL quizzes, OWL assignments, and Turnitin.

Fixed Distribution (37%)

Your final grade will calculated using the following weighting.

Assessment	Weight
Quizzes	7%
Activities	3%
4 Lab Assignments	27% total
Highest lab	*9%*
2nd highest lab	*8%*
3rd & 4th highest labs	*5% each*

Flexible Distribution (63%)

Your final grade will automatically be calculated under all four scenarios (S1 to S4) Your final course grade will use whichever scenario results in the highest grade for you as an individual.

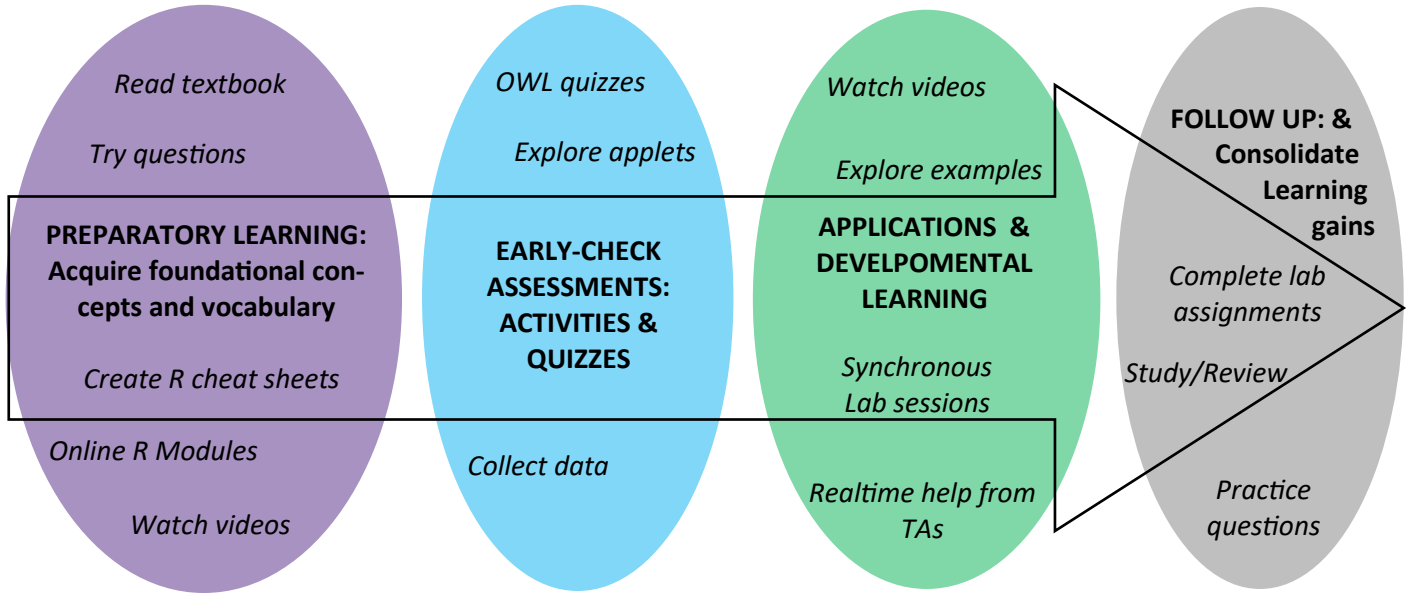
Assessment	S1	S2	S3	S4
Test 1	10%	0%	10%	0%
Test 2	13%	18%	0%	0%
Final Exam	40%	45%	53%	63%

Why is this so complicated!?

The success-based weighting of Lab Assignments and the Flexible Distribution are 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

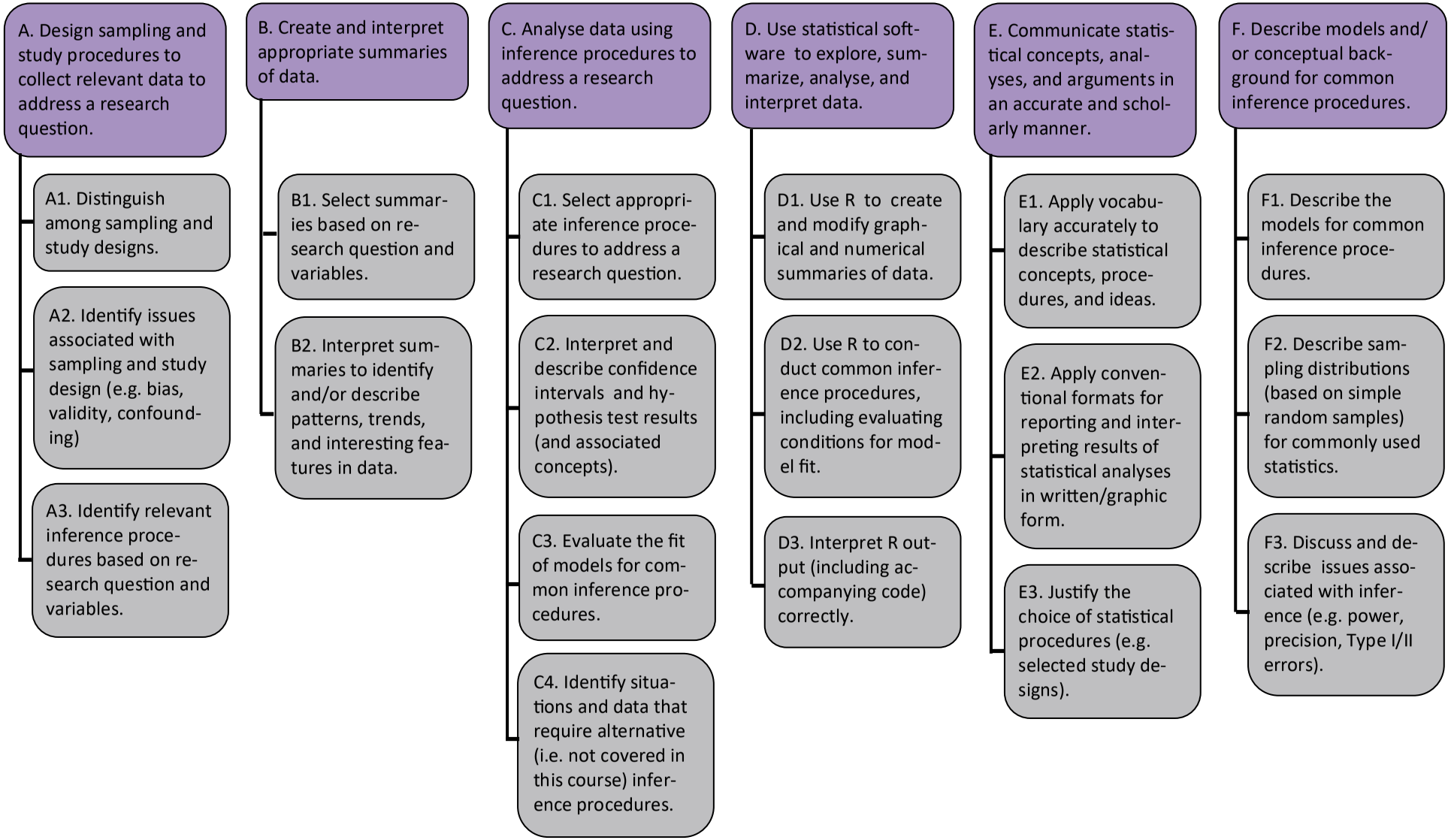
This course integrates four phases of learning. The basic framework will be applied to 16 lecture topics and 4 labs. Topics are highly sequential, so it is important to study them in the order presented and to attain a reasonable level of mastery of each before moving to the next. New material to be available on OWL twice or three times each week and to be successful in this course, it is highly recommended that you study often for short or moderate amounts of time. A detailed tentative schedule is presented on pages 9 & 10. Weekly emails will enumerate all upcoming events.



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:



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

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.

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.

% 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

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.

ACCOMMODATION? Built into the grading scheme (i.e. the 33% margins) and should cover occasional missed activities and/or technical problems. For more extenuating circumstances, please obtain relief/consideration from Academic Counseling.

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

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? Remotely, using Proctortrack software. 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" (see p.2); weight from the Tests is automatically redistributed (see p. 3) so no relief/consideration from counseling or Self-Reporting is necessary for missed **Tests.** Students who miss the **Final Exam** must obtain relief/consideration from Academic Counseling.

We use Proctortrack. Tests and examinations in this course will be conducted using the remote proctoring service, such as Proctortrack. By taking this course, you are consenting to the use of this software and acknowledge that you will be required to provide **personal information** (including some biometric data) and the session will be **recorded**. More information about this remote proctoring service is available in the Online Proctoring Guidelines at the following link:

https://www.uwo.ca/univsec/pdf/onlineproctorguidelines.pdf

Completion of this course will require you to have a reliable internet connection and a device that meets the technical requirements for this service. Information about the technical requirements are available at the following link:

https://www.proctortrack.com/tech-requirements/

LAB ASSIGNMENTS

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

WHAT? 4 assignments, each composed of ~4 multi-part, short-answer questions requiring written responses (including graphs and R code/output). 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 during the first in-lab session.

DID YOU KNOW?

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

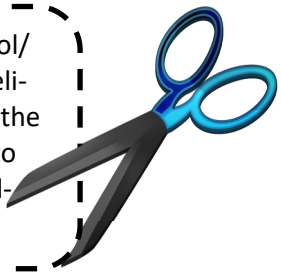
- submit and receive a non-zero grade for **at least 3 of the 4** Assignments, **and**,
- **Earn an overall passing grade** for the lab assignments component of the course.

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

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

ACCOMMODATIONS? For any missed Lab Assignment deadline, you must obtain relief/consideration from Academic Counseling or through Self-Reporting, otherwise a grade of zero will be awarded. Self-reporting for an Assignment results in either a deadline extension to 24 h after the 48-h self-report period ends, or, relieves the student from completing the Assignment (whichever is preferred). One missed ***and*** relieved assignment will be given a grade equal to the mean of the other non-relieved assignments, and assigned the lowest weight (see p. 3). If more than one assignment is missed ***with*** relief, a final course grade of *Incomplete* will be issued, and the student will be required to make up the relieved assignments in the future.

LAB EXEMPTION. If you previously took Biol/Stat 2244 **after August 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.



Section	*Day*	*Time*
003	Tues	6:30-9:30 pm
004	Tues	6:30-9:30 pm
005	Wed	6:30-9:30 pm
006	Wed	6:30-9:30 pm
007	Thurs	6:30-9:30 pm
008	Thurs	6:30-9:30 pm
009	Fri	11:30 am-2:30 pm
010	Tues	1:30-4:30 pm
011	Tues	1:30-4:30 pm
012	Thurs	1:30-4:30 pm
013	Thurs	1:30-4:30 pm
014	Tues	6:30-9:30 pm
015	Thurs	6:30-9:30 pm
016	Thurs	6:30-9:30 pm

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 develops over 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 scheme, therefore, places 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.

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.

Western's mixed model.

Western University is committed to a thriving campus as we deliver our courses in the mixed model of both virtual and face-to-face formats. We encourage you to check out the Digital Student Experience website to manage your academics

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.

Check OWL on the regular.

All course material will be posted to OWL: http://owl.uwo.ca.

It is your responsibility to check OWL (http://owl.uwo.ca) on a regular basis for news and updates.

For technical support with OWL, try the OWL Help page. Or, contact the WTS Helpdesk by phone at 519-661-3800 or ext. 83800.

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 manner.

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/

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).

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.

POLICIES AND SUPPORTS, continued

Accommodation Policies

Students with disabilities work with Accessible Education (formerly SSD) which provides recommendations for accommodation based on medical documentation or psychological and cognitive testing. The Academic Accommodation for Students with Disabilities policy can be found at:

https://www.uwo.ca/univsec/pdf/academic_policies/appeals/Academic Accommodation_disabilities.pdf

Academic Consideration for Student Absence

Students will have up to two (2) opportunities during the regular academic year to use an on-line portal to self-report an absence during the semester, provided the following conditions are met: the absence is no more than 48 hours in duration, and the assessment for which consideration is being sought is worth 30% or less of the student's final grade. Students are expected to contact their instructors within 24 hours of the end of the period of the self-reported absence, unless noted on the syllabus. Students are not able to use the self-reporting option in the following circumstances:

- for exams scheduled by the Office of the Registrar (e.g., December and April exams)
- absence of a duration greater than 48 hours,
- assessments worth more than 30% of the student's final grade,
- if a student has already used the self-reporting portal twice during the academic year

If the conditions for a Self-Reported Absence are *not* met, students will need to provide a Student Medical Certificate if the absence is medical, or provide appropriate documentation if there are compassionate grounds for the absence in question. Students are encouraged to contact their Faculty academic counselling office to obtain more information about the relevant documentation.

Students should also note that individual instructors are not permitted to receive documentation directly from a student, whether in support of an application for consideration on medical grounds, or for other reasons. **All documentation required for absences that are not covered by the Self-Reported Absence Policy must be submitted to the Academic Counselling office of a student's Home Faculty.**

For policy on Academic Consideration for Student Absences - Undergraduate Students in First Entry Programs, see:

https://www.uwo.ca/univsec/pdf/academic_policies/appeals/Academic_Consideration_for_absences.pdf

and for the Student Medical Certificate (SMC), see:

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

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.

Have a religious conflict?

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

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.

This schedule is tentative. The timing of Activities and Quizzes may be adjusted to (and occasionally, quizzes and/or activities are added/removed, and topics covered adjusted). Importantly, the weeks for labs and the Assignment due dates may get bumped (to be later...never earlier). **A weekly email to students (sent on Fridays typically) will provide details on upcoming deadlines, etc. to clarify/announce any adjustments to the course schedule.**

Monday	Tuesday	Wednesday	Thursday	Friday
		Sept 9	10	11
		T1: Introduction to Biol/Stats 2244		
			A1: Taking a sample	
Sept 14	15	16	17	18
T2: Sampling design				
		Q1: Sampling		A2: Practice lab assignment
Sept 21	22	23	24	25
T3: Study design				
Q2: Course outline		Q3: Study design		Q4: pre-lab1
Intro to lab at your assigned time				
Sept 28	29	30	Oct 1	2
T4: Sampling variability			T5: Data exploration & summary	
				Q5: pre-lab 2
Lab 1 at your assigned time				
Oct 5	6	7	8	9
T5: Data exploration & summary		T6: Probability distributions		
		Lab assignment 1 due		
Lab 2 at your assigned time				
Oct 12	13	14	15	16
Thanksgiving	T7: Normal distribution & binomial distribution			
		Q6: Normal distribution	Lab assignment 2 due	
Oct 19	20	21	22	23
T8: Sampling distributions			T9: Introduction to confidence intervals	
	A3: Sampling distributions		Q7: Proctortrack onbording quiz	Test 1: Sat, Oct 24 (T1 – T7)

Monday	Tuesday	Wednesday	Thursday	Friday
Oct 26	27	28	29	30
T9: Intro to conf. intervals				
T10: Confidence intervals for means and proportions				
A4: Understand-ing Confidence		Q8: Confidence intervals		
Nov 2	3	4	5	6
Reading week				
Nov 9	10	11	12	13
T11: Introduction to p vales				
		T12:Comparing proportions		
	Q9: Hypothesis tests			Test 2: Sat, Nov 14 (T1 – T10)
Nov 16	17	18	19	20
T12: Comparing proportions				
T13: Comparing two means				
		Q10: t procedures for means		Q11: pre-lab 3
Nov 23	24	25	26	27
T14: Uncertainties in hypothsis testing				
				Q12: pre-lab 4
Lab 3: Analyze				
Nov 30	Dec 1	2	3	4
T15: Linear regression				
				T16: ANOVA
		Q13: Regression		Lab assignment 3 due
Dec 7	8	9		
T16: Analysis of Variance				
Q14: ANOVA		Lab assignment 4 due		