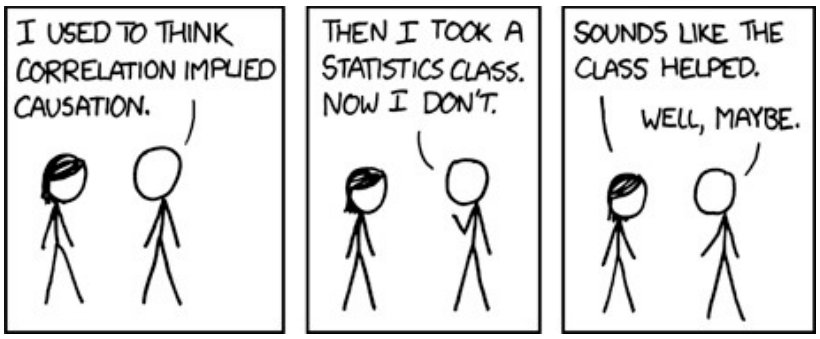
Biostatistics

BIOL 3112/5171

Course Syllabus

Winter 2023

"The acquisition of knowledge is hard. The world does not go out of its way to reveal its workings"
- Dr. Steven Pinker[1]



-XKCD https://xkcd.com/552

LAND ACKNOWLEDGEMENT

Lakehead University respectfully acknowledges its campuses are located on the traditional lands of Indigenous peoples.

Lakehead Thunder Bay is located on the traditional lands of the Fort William First Nation, Signatory to the Robinson Superior Treaty of 1850. Lakehead Orillia is located on the traditional territory of the Anishinaabeg. The Anishinaabeg include the Ojibwe, Odawa, and Pottawatomi nations, collectively known as the Three Fires Confederacy.

Lakehead University acknowledges the history that many nations hold in the areas around our campuses, and is committed to a relationship with First Nations, Métis, and Inuit peoples based on the principles of mutual trust, respect, reciprocity, and collaboration in the spirit of reconciliation.

WHAT ABOUT COVID?

We are still in the midst of a global pandemic. This means that we all need to be flexible as the term progresses in terms of safety precautions and possibly the how the class is delivered.

Currently, the university does not require vaccinations against Covid-19 or face coverings (masks). However, vaccination and/or face covering requirements may be reinstated with little

[1]Pinker is a contentious thinker. I agree with some of his views and disagree with others. Inclusion of this quote does not imply an endorsement of any of his other work/ideas/views beyond this quote.

notice. The university strongly encourages wearing face coverings (masks) where physical distancing is not possible.

Whether you wear a mask in class is your choice. I ask everyone to respect the choices of others. But remember that effective masking (i.e. properly fitted N-95s or similar) remain one of the most established and effective tools to limit the spread of airborne infectious disease.

Please keep these points in mind:

1) Currently, masks are strongly encouraged in class though the choice is up to you. It is your responsibility to be aware of any changes to the University's Covid-19/masking/vaccination requirements.
2) Check the D2L announcements page regularly, especially for changes to delivery. For example, if I or your GA develop Covid-19 symptoms then lectures or tutorials may be moved online.
3) **If you have Covid-19 symptoms, please do not come to class** (even if you have tested negative on a rapid-test or think it's 'just a cold'). Email me and your GA (if it's a tutorial) and let us know and we will sort something out. We record lectures so that if you have to miss one because of symptoms, you can catch up.

WHO WILL BE TEACHING AND HOW TO I CONTACT THEM?

Instructor:
Dr. Adam Algar (he/him)
aalgar@lakeheadu.ca
CB 4018 or Zoom

Office hours:
I don't have set office hours. If you want to meet, email me to make an appointment (in person or zoom), or you can stop in to my office and see if I'm free - if I'm busy then we can set up an appointment. **If this gets too chaotic I may set office hours later in the semester.**

Graduate Assistant:
Alex Ross
Office: BB1006 or Zoom
Phone: 807-343-8010 ext 8539
e-mail: aross10@lakeheadu.ca
Office hours: Wednesdays, 2:30-3:30

Access to BB1006 is through a classroom so either email Alex in advance to let him know you are coming and he'll meet you or call the number above.

WHAT ARE THE EXPECTATIONS FOR COMMUNICATION?

What you can expect from me:
I try to be as accessible as possible for my students, given the need to balance teaching, research and other requirements of my role.

Meeting with me: I try to be available after class to answer questions. This time is probably best used for short discussions or questions about the course material. If you have a longer, or more in-depth question or point for discussion, email me for an appointment or set up one up at the end of class. I don't have regular office hours because my experience is that students rarely use them. You can also knock on my office door and see if I'm free – if I'm not, then we can set up

an appointment. I'm happy to meet in person or by zoom but if you're coming to my office, I respectfully ask that you wear a mask.

Email: I reliably check and reply to emails between 8:30am and 5:00pm on weekdays (excluding holidays). I do not reliably check or reply to emails in the evenings, on weekends, or on holidays. I do my best to reply to emails within two working days (i.e. excluding weekends and holidays), but it's not always possible. If you've emailed me about something and it has been more than two working days, please send me a polite email reminding me as sometimes an email slips down my inbox by accident. Please don't email me a reminder before two working days has passed. The implication of the above is that **if you email me the day before a due date, then chances are you won't get a reply before the deadline, so plan ahead**. The above also applies to emailing the GA. Obviously**, if something unforeseen happens that affects your ability to complete assignments, or a test, then email me as soon as you can (cc your GA if it's in relation to a tutorial).**

What I expect from you:
Other than verbal announcements in class, I will communicate with the class via the Announcements feature on the D2L site for the course. **It is your responsibility to check the D2L site regularly for announcements** especially regarding possible changes to delivery, scheduling, etc. I also expect that you to fully read the syllabus. Similarly, I also expect that you check your university email address regularly.

WHAT WILL I BE READING?

Experimental design and data analysis for biologists.
G. P. Quinn and M .J. Keough, 2002. Cambridge University Press. ISBN: 0 521 00976 6

I STRONGLY recommend getting the book and doing the readings. We can't cover all the necessary background and depth in class. Other biostatistics books (e.g. Biometry by Sokal & Rohlf) will include much of the same information though will take different approaches from Quinn and Keough, so we won't be using them directly but if you have access to them then you may find them helpful. Generic introductory stats books may also be useful.

A major portion of the course will be learning how to use R to carry out biostatistical analysis. I **strongly recommend** the **Introduction to R** 'book' by Venebles, Smith & the R Core Team. It's free!!! https://cran.r-project.org/doc/manuals/r-release/R-intro.htmla

There are many other free R resources online, and several intro to R books as well. If you're considering buying a book, I'm happy to discuss it with you.

HOW WILL I BE EVALUATED?

Discussion of ideas, concepts, and methods are a valuable part of learning stats and I encourage you to discuss topics with your peers, on the discussion board, and with your instructors. **However, all assessments must be completed individually**. **Late assignments will be penalized 10% per day, including weekends and holidays, unless you have a valid reason**

(e.g. family, medical) and request an extension. Normally the request for an extension should be made before the due date. I aim to ensure that all students can achieve their best possible results, so if you have particular circumstances affecting your assessments, please speak to me as soon as you can. **For students registered with Student Accessibility Services, you are welcome to speak with me but can also communicate via your accessibility advisor, who will inform me of any agreed accommodations. Please don't hesitate to feed back to me regarding accessibility and accommodations that are, or aren't, in place so that we can make adjustments.**

Assignments (Best 4 of 6) 4 x 15%
To be completed outside of class time. Answer a series of questions involving analysis of data and interpretation of statistical results. There are six assignments throughout the year and your 4 best marks will be retained

Engagement (5%)
Your engagement in class, tutorials, discussion boards/forums)

Tutorials
You do not have to submit work directly from the tutorials. However, without developing your R and practical analysis skills (planning, executing and interpreting statistical analysis) you will not be able to perform well on the other assessments.

Discussion Boards
These are not directly evaluated but contribute to the engagement mark. These are excellent opportunities to ask questions of your peers on R or other biostatical problems, and get feedback on ideas. All posts are expected to be respectful in line with the principles expected in an inclusive society (and outlined in the syllabus below)

UNDERGRADUATES ONLY

Midterm (15%)
You know what a midterm is by now!. A practice midterm will be circulated

Final Exam (20%)
A practice final will be circulated.

GRADUATE STUDENTS ONLY

Project Proposal (10%)
2 pages outlining your question, dataset and analysis

Final Project (25%)
Present your analysis in the form of a condensed scientific paper (Introduction, Methods, Results, Discussion, Appendices). More details in the early weeks of class. Length to be discussed with instructor.

WHAT WILL WE COVER?

The topics and timings below are a guide and are may (are likely to) change. However, due dates are unlikely to move but if they do they will never be moved earlier than noted below.

Lecture (L) or Tutorial (T) Number	**Date**	**Topic**	**Recommended readings in Quinn & Keough**
L1	Jan 9	I'm a biologist/ecologist/ environmental scientist: what am I doing in a statistics class? *Introduction to R*	Chapter 1; Chapter 2 up to section 2.3 and 2.4.2; Chapter 3 up to section 3.7; Chapter 4, Chapter 19.
L2	Jan 11	Correlation, linear regression	Chapter 3 to section 5.3.15; section 5.4, 5.7.
T-Intro	Jan 13	*Tutorial- getting comfortable with R*	
L3	Jan 16	Linear regression (continued), model II regression (Assignment 1 posted)	Chapter 3 to section 5.3.15; section 5.4, 5.7.
L4	Jan 18	Multiple regression	Chapter 6 to section 6.1.5
T1	Jan 20	*Correlation, regression*	
L5	Jan 23	Single factor ANOVA, unplanned contrasts;	Chapter 8 to section 8.1.5; section 8.3, 8.4
L6	Jan 25	Type I and II error rates; planned contrasts; Random effects (Assignment 1 due)	Section 8.6, Chapter 3, especially section 3.2; Box 8.4 has a worked example; Section 8.2.1
T2	Jan 27	*Single factor ANOVA*	
L7	Jan 30	Experimental design (Assignment 2 posted)	Chapter 7 up to and including section 7.2
L8	Feb 1	Nested ANOVA	Chapter 9 to section 9.1.9
T3	Feb 3	*Estimating variance components*	
L9	Feb 6	Nested ANOVA, Randomized block design	Chapter 10 to section 10.10, 10.14

Lecture (L) or Tutorial (T) Number	Date	Topic	Recommended readings in Quinn & Keough
		Practice midterm posted	
L10	Feb 8	Factorial ANOVA; Mixed effects models (the old way) (Assignment 3 posted) (Assignment 2 due)	Section 9.2, up to 9.26; 9.28; 9.2.11; 9.4, 9.5
T4	Feb 10	*Nested ANOVA*	**grad students meet with Dr. Algar about projects**
L11	Feb 13	Unbalanced designs in ANOVA; appropriate Sums of Squares Review practice midterm	Pages 242-244, section "Unequal sample sizes"
MIDTERM	**Feb 15**	**MIDTERM**	***grad students submit 1-2 page proposal**
T5	Feb 17	*Blocked design*	
	Feb 21-25	**READING BREAK**	
L12	Feb 27	Statistical power (Assignment 3 due)	Sections 5.6, 8.9, 9.2.13, 10.10
L13	Mar 1	Multiple testing (Assignment 4 posted)	Section 3.4
T6	Mar 3	*Factorial ANOVA, working with "real" data;*	
L14	Mar 6	Test for heterogeneity of slopes, Analysis of Covariance, comparisons of adjusted means	Chapter 12, to section 12.4; section 12.5, 12.6, 12.8
L15	Mar 8	General Linear Modelling (Assignment 4 due)	Section 6.1.14
T7	Mar 10	*Power analyses, Multiple comparisons*	
	Mar 10	**Final day to withdraw without penalty**	
L16	Mar 13	Tests of frequencies (Assignment 5 posted)	Chapter 14, to section 14.2.2
L17	Mar 15	Non-parametric tests	Section 3.3.3, section 5.1.2, Section 8.5.2, 10.5
T8	Mar 17	*Comparing slopes, ANCOVA*	

Lecture (L) or Tutorial (T) Number	Date	Topic	Recommended readings in Quinn & Keough
L18	Mar 20	Randomization- permutation tests (Assignment 5 due)	Section 3.3.2; readings as assigned
L19	Mar 22	Randomization- bootstrapping tests	
T9	Mar 24	*Non-parametric tests and tests of frequencies*	
L20	Mar 27	Generalized Linear Modelling	
L21	Mar 30	Data Visualization (tentative) (Assignment 6 posted)	TBD
T10	Mar 31	*Randomization (tentative)*	TBD Practice finals posted
L22	Apr 3	Mixed effects models (the new way) **AND/OR** Model selection criteria (tentative	
L23	Apr 5	TBD (Assignment 6 due)	
T11	Tuesday Apr 11	Assume attendance in tutorial mandatory for undergraduates	
		Final Exam Date is TBD	Grad student final paper due Tuesday April 18, 11:59 pm

WHAT ELSE DO I NEED TO KNOW?

Diversity, Equity & Inclusion
In this class I want us to:

- Develop an environment of mutual respect and safety in, and out of, the classroom and tutorial room for all participants, regardless of culture, ethnicity, gender identity, national origin, race, sex, sexual orientation, socio-economic status, religion, mental and physical ability, experience, or other aspects of identity or background.
- Foster an environment where the merit of ideas, hypotheses, and data are rigorously evaluated and challenged, but the merit of individuals is never in question.

You are expected to abide by the following principle in class, tutorials and online:

- Be respectful in all of your interactions

- Remember that others have different life experiences, perspectives, backgrounds, strengths, and challenges
- Challenge ideas, inferences, and evidence but not individuals
- Listen and learn. Do not dominate discussions.
- Be willing to change your mind if another argument, dataset, or set of evidence is stronger
- Racist, sexist, or other discriminatory behaviour will not be tolerated. Nor will harassment or bullying of any kind.

Throughout the course we will focus on a scientific approach based on the hypothetico-deductive method. This is just one way of knowing.

- There are other ways of knowing and learning about the world. Our focus on scientific method has no bearing on the value of other forms of knowing.

Science and the study of evolution have a history of discrimination and colonialism that still exists.

- The theory and empirical work that forms the basis of the course has been done overwhelmingly by white males of European descent.
- Some of these researchers had racist, sexist and other discriminatory views. And some of this research was used to strengthen and perpetuate hatred, racism, prejudice, sexism, colonialism and discriminatory world views.
- Discussion of these ideas, and researchers, is not meant – in any way – to indicate an acceptance of these views, or to excuse them.

I am still learning about diversity, equity and inclusion. and trying to improve.

- If I make mistakes, please draw these to my attention and feel free to discuss any concerns that you have with me.

Academic Integrity

I have no tolerance for academic dishonesty and breaches of Academic Integrity. To me, it is theft. Theft of the hard work, ideas, and achievements of others. If you obtain your degree through dishonesty you are stealing future jobs, academic spots and other opportunities from others who have earned them. Thus, a breach of Academic Integrity is a serious offence. **The principle of Academic Integrity, particularly of doing one's own work, documenting properly (including use of quotation marks, appropriate paraphrasing and referencing/citation), collaborating appropriately, and avoiding misrepresentation, is a core principle of university study. You must read the Student Code of Conduct – Academic Integrity** – for a full description of academic offences, procedures when Academic Integrity breaches are suspected and sanctions for breaches of Academic Integrity.

Link to the Student Code of Conduct and Policy on Academic Integrity:
https://www.lakeheadu.ca/students/student-life/student-conduct

I assume that you have completed Lakehead's online resource, AIM (Academic Integrity Matters course). If you have not, then you should complete it:
https://www.lakeheadu.ca/students/academic-success/student-success-centre/skills-for-success-seminars/thunder-bay/node/45182

Furthermore, by signing up for the course, you agree that**:**
Unless otherwise allowed by the course instructor, I must complete the assignments in this course without the assistance of anyone else. I further understand and agree that, if I violate either of this rule, or if I provide any false or misleading information about my completion of course assignments or exams, I may be prosecuted under the Lakehead University Student Code of Conduct – Academic Integrity, which requires students to act ethically and with integrity in academic matters and to demonstrate behaviours that support the University's academic values.

Accommodation and Accessibility
Lakehead University is committed to achieving full accessibility for persons with disabilities/medical conditions. Part of this commitment includes arranging academic accommodations for students with disabilities/medical conditions to ensure they have an equitable opportunity to participate in all of their academic activities. If you are a student with a disability/medical condition and think you may need accommodations, you are strongly encouraged to contact Student Accessibility Services (SAS) and register as early as possible. For more information, please email sas@lakeheadu.ca or visit https://www.lakeheadu.ca/faculty-and-staff/departments/services/sas

The Student Accessibility Services will get in touch with me about your accommodations. Thus there is no requirement that you speak to me about them directly, but you are welcome to do so if you wish, especially if you have any concerns about getting accommodations in place early. Also, please feel free feed back to me during the semester regarding accessibility and accommodations, either directly or through your Accessibility Advisor, so that we can make changes or adjustments that will improve accessibility and better implement accommodations.

Copyright Compliance
By taking the course you sign up to the following statement:
I understand and agree that all instructional, reference, and administrative materials to which I am given access in this course (the "course materials"), whether they consist of text, still or kinetic images, or sound, whether they are in digital or hard copy formats, and in whatever media they are offered, are protected in their entirety by copyright, and that to comply with this copyright and the law.
(a) I may access and download the course materials only for my own personal and non-commercial use for this course; and
(b) I am not permitted to download, copy, store (in any medium), forward or share, transmit, broadcast, show, post or play in public, adapt, or change in any way any text, image, or sound component of the course materials for any other purpose whatsoever except as expressly authorized, and only to the extent authorized, in writing, by the course instructor.
I further understand and agree that, if I infringe the copyright of the course materials in any way, I may be prosecuted under the Lakehead University Student Code of Conduct – Academic Integrity, which requires students to act ethically and with integrity in academic matters and to demonstrate behaviours that support the University's academic values.

Recording Lectures and Class Activities

In Evolutionary Concepts, BIO3671, and the associated lab instruction in the classroom will be recorded, where possible, for confidential access by students registered in the course but who are unable to attend class due to the pandemic or other necessity. To the greatest extent possible only the image and voice of the instructor will be recorded for this purpose but, due to class interaction, the images and voices of students present in the classroom may be incidentally recorded and, thus, be available for access by course students in remote locations. These recordings, however, are strictly confidential and may be used only by the instructor and students registered in the course and only for purposes related to the course. They may otherwise not be used or disclosed. Students in the classroom who are concerned about being recorded in this fashion may request the instructor to exclude them from the recording to the greatest degree possible on the understanding that total exclusion cannot be guaranteed. The recordings are made under the authority of sections 3 and 14 of The Lakehead University Act, 1965. Questions about the collection of the images and sounds in the recordings may be directed to the Chair of the Department of Biology, Lakehead University, 955 Oliver Rd, Thunder Bay, ON, P7B 5E1, +1 (807) 343-8010 ext 8460.