Lakehead University

Biostatistics (Biology 3112, 5171), Winter 2026

Instructors:
Lecturer: **Dr. Michael Rennie**
Office: CB 4050
Phone: 807-343-8010 x7860
e-mail: mrennie@lakeheadu.ca
Office hour: Tuesday, 11:30 am–12:30 pm (or by appointment)

TAs: **Graham Matheson**
Office: FB 1018
Phone: 807-343-8010 x7979
e-mail: gmatheso@lakeheadu.ca
Office hours: Friday, 10:30-11:30 (or by appointment)

Text (recommended):
Experimental design and data analysis for biologists, First Edition.
G. P. Quinn and M .J. Keough, 2002, First Edition. Cambridge University Press. ISBN: 0 521 00976 6
Please note we are NOT currently using the 2nd Edition of this textbook. A .pdf copy of the first edition is available on the course website at no cost to the student.

Class Schedule:

LECTURES: Monday and Wednesday, 10:00 am to 11:15 am, AT 1006

Zoom information (for Orillia graduate students only):
https://lakeheadu.zoom.us/j/94115846538?pwd=4RZlvn5X052wUtheFQR8kalQWe1ooq.1
Meeting ID: 941 1584 6538 Passcode: 557185

TUTORIALS: Fridays 8:30 am to 10:30 am, AT 3001

Zoom information (for Orillia graduate students only):
https://lakeheadu.zoom.us/j/94205622533?pwd=gJUN1OR41H0XIRyaYXLpufOIh0XSYG.1
Meeting ID: 942 0562 2533 Passcode: 590212

Note: Students enrolled in Thunder Bay are expected to show up to class IN PERSON unless otherwise arranged with the instructor in advance. Failure to do so will be considered when assigning participation marks (see below).

Lecture Schedule (tentative, will adjust topics as required):

Lecture (L) or Tutorial (T) #	**Date**	**Topic**	**Recommended readings**
L1	Jan 5	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	7	Correlation, linear (Model I) regression	Chapter 3 to section 5.3.14; section 5.4, 5.7.
T1 (TA: Abby Sim)	9	*Tutorial- getting comfortable with R[1], Correlation, Model I regression*	
L3	12	Model II regression, Multiple regression	Section 5.3.14, Chapter 6 to section 6.1.5
L4	14	Multiple regression (continued), Single factor ANOVA (Assignment 1 posted)	Chapter 8 to section 8.1.5; section 8.3, 8.4
T2 (TA: Abby Sim)	16	*Model II regression, Multiple regression*	
L5	19	Single factor ANOVA, unplanned contrasts	Chapter 8 to section 8.1.5; section 8.3, 8.4
L6	21	Type I and II error rates; planned contrasts; Model II ANOVA (Assignment 1 due) (Assignment 2 posted)	Section 8.6, Chapter 3, especially section 3.2; Box 8.4 has a worked example; Section 8.2.1
T3 (TA: Graham Matheson)	23	*Single factor ANOVA*	
L7	26	Experimental design	Chapter 7 up to and including section 7.2
L8	28	Nested ANOVA	Chapter 9 to section 9.1.9
T4	30	*Estimating variance components (Model II ANOVA)* (Assignment 2 due)	
L9	Feb 2	Nested ANOVA, Randomized block design **Practice midterm posted**	Chapter 10 to section 10.10, 10.14

Lecture (L) or Tutorial (T) #	**Date**	**Topic**	**Recommended readings**
L10	4	Factorial ANOVA; Mixed effects models (the old way)	Section 9.2, up to 9.26; 9.28; 9.2.11; 9.4, 9.5
T5	6	*Nested ANOVA; Blocked design*	***grad students meet with Dr. Rennie about final projects**
L11	9	Unbalanced designs in ANOVA; appropriate Sums of Squares Review practice midterm	Pages 242-244, section "Unequal sample sizes"
MIDTERM	**11**	**MIDTERM** (Assignment 3 posted)	***grad students submit 1-2 page project proposal**
T6	13	*Factorial ANOVA, working with "real" data*	
	16-20	**READING BREAK**	
L12	23	Statistical power	Sections 5.6, 8.9, 9.2.13, 10.10
L13	25	Multiple testing (Assignment 3 due) (Assignment 4 posted)	Section 3.4
T7	27	*Power analyses, Multiple comparisons*	
L14	March 2	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	4	It's all just general linear modelling, man (this is where we blow your mind); dummy variables (Assignment 4 due) (Assignment 5 posted)	Section 6.1.14
	March 6	*Final day to withdraw without penalty*	
T8	6	*Comparing slopes, ANCOVA*	
L16	9	Tests of frequencies	Chapter 14, to section 14.2.2

Lecture (L) or Tutorial (T) #	Date	Topic	Recommended readings
L17	11	Non-parametric tests (Assignment 5 due)	Section 3.3.3, section 5.1.2, Section 8.5.2, 10.5
T9	13	*Non-parametric tests and tests of frequencies*	
L18	16	Randomization- permutation tests	Section 3.3.2; readings as assigned
L19	18	Randomization- bootstrapping tests (Assignment 6 posted)	
T10	20	*Randomization*	
L20	23	General***ized*** linear models*	
L21	25	Mixed effects models* (the new way) **AND/OR** Model selection criteria* (a requiem for the *p*-value)	Chapter 13 to up to and including section 13.3; assigned reading
T11	27	TBD (Review?)	
L22	30	Data visualization *(Guest lecture, Dr. Cody Dey)* (Assignment 6 due)	Practice finals posted
L23	Apr 1	Data visualization *(Guest lecture, Dr. Cody Dey)*	
FINAL EXAM	**TBD**	**TBD**	**Grad student final paper due TBD**

[1]The tutorial this week will be, in part, self-directed; students are strongly encouraged to load R and Rstudio on their personal computers so they can work on assignments, etc. at home (Please make time to complete this task during the first week of classes). Students will go through the introductory R code presented in lecture on Jan 11th, on the machines in AT 3001 and at home using their personal computers.
*topics during the final 3 lectures and in the last tutorial may vary from this depending on student interests; can be customized if there are specific analyses that the class would like to address.

Assignments: There will be six assignments that are to be completed outside of classes. These will all consist of independent analyses of data sets and a written report for grading. The four assignments in

which you do best will be counted in your final grade.

Tutorials: Each week there will be a two-hour tutorial in which you will get practice solving statistical problems using a computer and get comfortable using R. You are not required to submit anything for grading. These are also great opportunities to pick the brain of your TA, instructor, or peers on assignments.

Policy on late assignments or missed work: Failing to submit academic work on time is a serious matter. Students should arrange their schedules so that academic work is a top priority during the school year. *Because only four of the six graded assignments will count towards your final mark (see below), NO medical reasons for failing to submit an assignment on time will be accepted except under the most serious circumstances. A grade of 0 will be assigned to any late or missed assignments.* There is only one term test and only the most urgent medical matter will be accepted as a reason for missing the term test. The only acceptable document for medical emergencies is the 'Lakehead University Medical Certificate" and can be found here, along with instructions and requirements of such exemptions: https://www.lakeheadu.ca/current-students/examination/medical-notes.

Email: In order to receive important course communications, **it is absolutely necessary** that you monitor notices on the course website at least twice a week.

Grading (undergraduates):

1. Best 2/first 3 assignments, best 2/last 3 assignments, 12.5 points each [50%]

2. Term Test, February 11 [15%]

3. Final Exa, Date TBD [30%]

4. Student engagement (in class, in tutorials, participation on discussion forums, etc) [5%]

(Calculators- NOT phones with calculators, but old-school calculators with no additional functionality- are allowed for term test and final exam, but no other materials)

***Grading (graduate students):** *Graduate students will not write exams.* Assignments will be completed by graduate students, based on the same policy described above. In place of exams, graduate students will meet with the instructor to discuss an appropriate analysis for a dataset of their choosing, and will submit a report at the end of term describing the statistical approach. **A 1-2 page proposal** outlining the dataset and the planned analysis will be submitted around the time of the midterm, **worth 10% of the final grade**. The **final report will be worth the remaining 30%** of the final grade, and will loosely follow a typical scientific report (abstract, introduction, methods, results, discussion), but a heavy emphasis will be placed on the methodological choice of analysis selected in relation to the data set and experimental design, reporting of results and interpretation of the analysis. Appendices should be included to provide sufficient evidence that assumptions have been tested and have informed the analytical approach presented. Students are encouraged to use their own data for this assignment; if this is not possible, contact the instructor for alternatives. **The remaining 10%** of the course grade for grad students will be for **class participation, and they are expected to have a greater level of engagement than undergraduate students.**

Course web page: There will be a course web page through myCourseLink. It is a place to find lectures in .pdf format, R code, assignments, and discussion boards.

Discussion board and e-mail policy: Separate forums will be set up for the course in general, R-related questions and possibly additional forums for particular topic areas. Any questions regarding course organization, e.g., assignments, due dates etc. as well as questions regarding course content, e.g., statistical questions, should be posted to the appropriate forum. Students are invited to help answer questions posted to the discussion board as far as possible, particularly with regards to R-help (the best way to learn something yourself is to show someone else how to do it). Entries will be monitored by the course staff and annotated as necessary within two days from posting, and major issues will be addressed in class or during the tutorials. Please keep your questions and answers short and precise and be polite! Using the discussion board gives all students access to the same information. Therefore, the instructor will not answer individual emails about course organization or content, e.g., statistical questions. Students should only send emails to the instructor regarding personal issues that cannot be posted on the discussion board. Emails will usually be answered within two days (three days over weekend).

Use of AI or ChatGPT:
For coding help, yes (with some caveats), for writing assignments, no.

First, it's worth reiterating that all of the code you need for the assignments IS PROVIDED either in lecture or in tutorial solutions, so turning to ChatGPT shouldn't help all that much as it shouldn't be all that different from what I've given you already (e.g. it will produce example code that you need to edit to work for your data files… exactly what I'm doing by providing you with the lecture code).

Once you begin to learn a bit of R coding and can understand some basics, working with ChatGPT to help you build your code can sometimes be very helpful, especially once you get into more complicated statistical designs. However, it's worth remembering that whatever ChatGPT knows, it's on the internet already. So consider it as the thing that has read all the stack overflow posts for you, and is helping summarize them into something useful. That said, if you don't really understand some basics on how coding in R works, this likely won't help you very much. So maybe something you want to consider later on in the course or once you are done the course, but unlikely it will help you much during the course, since consulting ChatGPT isn't likely to give you any more information than what I am *as we are both providing you with example code.*

For help with R:
1. Begin by referring to the documents you have been provided with- the "getting started with R" lecture notes; "An introduction to R", by Venables, Smith and the R Development Core Team, available for download on the course website; other resources on the CRAN contributed documents (http://cran.r-project.org/other-docs.html); all of this stuff is free.
2. Search google with [R] in your search term; e.g. "[R] t-test". Sift through the search results till you find something helpful, most often on the first page or two.
3. Try "?topic" where "topic" is the function or issue you are having with, or help.search(topic) if it's not a function, but something else.
4. Post a question on the R-discussion forum on the course website. Wait for a student to post an answer (may be annotated by course staff within 2 days).

5. If still not answered, ask your TA in the tutorial session.
6. If STILL necessary, ask the instructor after class or during office hours.