

Lakehead University

Biostatistics (Biology 3112, 5171), Winter 2021

Instructors:

Lecturer: **Dr. Michael Rennie**

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Office hour: Friday, 3:00-4:00 pm (personal zoom meeting room:

<https://lakeheadu.zoom.us/my/mrennie>)

TAs: **Alex Ross, Ryan Grow**

Office: CB 4030/ FB 1018

Phone: 807-343-8043 / 807-346-7979

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Office hours: Alex: Wednesday 2-3, Thursday 11-12 (e-mail for zoom link)

Text (recommended):

Experimental design and data analysis for biologists.

G. P. Quinn and M. J. Keough, 2002. Cambridge University Press. ISBN: 0 521 00976 6

Class Schedule:

LECTURES: Monday and Wednesday, 10:00 am to 11:30 am, online (see pages 7, 8 for dial-in information)

<https://lakeheadu.zoom.us/j/92676825501?pwd=S3lRTEhIT3B2bE9wRkFYb1lxSmJDQT09>

Meeting ID: 926 7682 5501

Passcode: 4n530d

TUTORIALS: Tuesdays 10:30 am to 12:30 pm, online (see pages 8, 9 for dial-in information)

<https://lakeheadu.zoom.us/j/98181669092?pwd=MXc2eUt3OHRXRW9nRjZxZEwZGgxQT09>

Meeting ID: 981 8166 9092

Passcode: 7y524b

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

Lecture (L) or Tutorial (T) #	Date	Topic	Recommended readings
L1	Jan 11	I'm a biologist/ecologist/ environmental scientist: what am I doing in a statistics class? <i>Introduction to R</i>	Chapter 1; Chapter 2 up to section 2.3 and 2.4.2; Chapter 3 up to section 3.7; Chapter 4, Chapter 19.
T-Intro	12	<i>Tutorial- getting comfortable with R¹</i>	

Lecture (L) or Tutorial (T) #	Date	Topic	Recommended readings
L2	13	Correlation, linear regression, model II regression	Chapter 3 to section 5.3.15; section 5.4, 5.7.
L3	18	Multiple regression (Assignment 1 posted)	Chapter 6 to section 6.1.5
T1	19	<i>Correlation, regression</i>	
L4	20	Single factor ANOVA, unplanned contrasts	Chapter 8 to section 8.1.5; section 8.3, 8.4
L5	25	Type I and II error rates; planned contrasts (Assignment 1 due)	Section 8.6, Chapter 3, especially section 3.2; Box 8.4 has a worked example
T2	26	<i>Single factor ANOVA</i>	
L6	27	Random effects	Section 8.2.1
L7	Feb 1	Experimental design (Assignment 2 posted)	Chapter 7 up to and including section 7.2
T3	2	<i>Estimating variance components</i>	
L8	3	Nested ANOVA	Chapter 9 to section 9.1.9
L9	8	Nested ANOVA, Randomized block design Practice midterm posted (Assignment 2 due)	Chapter 10 to section 10.10, 10.14
T4	9	<i>Nested ANOVA</i>	*grad students meet with Dr. Rennie about final projects
L10	10	Factorial ANOVA; Mixed effects models (the old way) Review practice midterm	Section 9.2, up to 9.26; 9.28; 9.2.11; 9.4, 9.5
	15-25	READING BREAK	*grad students submit 1-2 page proposal
MIDTERM	Mar 1	MIDTERM (Assignment 3 posted)	
T5	2	<i>Blocked design</i>	
L11	3	Unbalanced designs in ANOVA; appropriate Sums of Squares	Pages 242-244, section “Unequal sample sizes”

Lecture (L) or Tutorial (T) #	Date	Topic	Recommended readings
L12	Mar 8	Statistical power (Assignment 3 due)	Sections 5.6, 8.9, 9.2.13, 10.10
T6	9	<i>Factorial ANOVA, working with “real” data; midterm questions</i>	
L13	10	Multiple testing (Assignment 4 posted)	Section 3.4
L14	15	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
T7	16	<i>Power analyses, Multiple comparisons</i>	
L15	17	It's all just general linear modelling, man (this is where we blow your mind); dummy variables (Assignment 4 due)	Section 6.1.14
	<i>Mar 19</i>	<i>Final day to withdraw without penalty</i>	
L16	22	Tests of frequencies (Assignment 5 posted)	Chapter 14, to section 14.2.2
T8	23	<i>Comparing slopes, ANCOVA</i>	
L17	24	Non-parametric tests	Section 3.3.3, section 5.1.2, Section 8.5.2, 10.5
L18	29	Randomization- permutation tests (Assignment 5 due)	Section 3.3.2; readings as assigned
T9	30	<i>Non-parametric tests and tests of frequencies</i>	
L19	31	Randomization- bootstrapping tests (Assignment 6 posted)	
L20	Apr 5	Easter Monday- NO LECTURE	
T10	6	<i>Randomization</i>	<i>Frequency tests; Traditional non-parametric tests (posted online)</i>
L21	7	Generalized linear models*	Practice finals posted

Lecture (L) or Tutorial (T) #	Date	Topic	Recommended readings
L22	12	Mixed effects models* (the new way) AND/OR Model selection criteria* (a requiem for the p -value) (Assignment 6 due)	Chapter 13 to up to and including section 13.3; assigned reading
T11	13	<i>Data visualization?</i>	
L23	14	NO CLASS?	
24 hours to complete	20 April 2021	Final Exam – 20 April 2021 12:01 pm due 21 April 12:01 pm	Grad student final paper due Monday April 19, 5:00 pm

¹The 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 four out of six assignments, 15 points each [60%]
2. Term Test, February 22 [15%]
3. Final Exam [20%]
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 25%** 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 5%** 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. Stay tuned as I figure out how it works, but it will be 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).

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.

Lectures:

Michael Rennie is inviting you to a scheduled Zoom meeting.

Topic: Biostats lectures

Time: Jan 11, 2021 10:00 AM Eastern Time (US and Canada)

Every week on Mon, Wed, until Apr 12, 2021, 25 occurrence(s)

Jan 11, 2021 10:00 AM

Jan 13, 2021 10:00 AM

Jan 18, 2021 10:00 AM

Jan 20, 2021 10:00 AM

Jan 25, 2021 10:00 AM

Jan 27, 2021 10:00 AM

Feb 1, 2021 10:00 AM

Feb 3, 2021 10:00 AM

Feb 8, 2021 10:00 AM

Feb 10, 2021 10:00 AM

Feb 22, 2021 10:00 AM

Feb 24, 2021 10:00 AM

Mar 1, 2021 10:00 AM

Mar 3, 2021 10:00 AM

Mar 8, 2021 10:00 AM

Mar 10, 2021 10:00 AM

Mar 15, 2021 10:00 AM

Mar 17, 2021 10:00 AM

Mar 22, 2021 10:00 AM

Mar 24, 2021 10:00 AM

Mar 29, 2021 10:00 AM

Mar 31, 2021 10:00 AM

Apr 5, 2021 10:00 AM

Apr 7, 2021 10:00 AM

Apr 12, 2021 10:00 AM

Please download and import the following iCalendar (.ics) files to your calendar system.

Weekly: [https://lakeheadu.zoom.us/meeting/tJYrcO-](https://lakeheadu.zoom.us/meeting/tJYrcO-grD4vGtXsrqwORTweToVJZ1Vq2eZJ/ics?icsToken=98tyKuCqqDwsEtaQtRmGRowQBI_CM_zzpiVYjbdljw30FA9hVhTzAu10GIguJsmC)

[grD4vGtXsrqwORTweToVJZ1Vq2eZJ/ics?icsToken=98tyKuCqqDwsEtaQtRmGRowQBI_CM_zzpiVYjbdljw30FA9hVhTzAu10GIguJsmC](https://lakeheadu.zoom.us/meeting/tJYrcO-grD4vGtXsrqwORTweToVJZ1Vq2eZJ/ics?icsToken=98tyKuCqqDwsEtaQtRmGRowQBI_CM_zzpiVYjbdljw30FA9hVhTzAu10GIguJsmC)

Join Zoom Meeting

<https://lakeheadu.zoom.us/j/92676825501?pwd=S3lRTEhIT3B2bE9wRkFYb1lxSmJDQT09>

Meeting ID: 926 7682 5501

Passcode: 4n530d

One tap mobile

+16473744685,,92676825501# Canada

+16475580588,,92676825501# Canada

Dial by your location

+1 647 374 4685 Canada

+1 647 558 0588 Canada
+1 778 907 2071 Canada
+1 204 272 7920 Canada
+1 438 809 7799 Canada
+1 587 328 1099 Canada
+1 301 715 8592 US (Washington D.C)
+1 312 626 6799 US (Chicago)
+1 646 876 9923 US (New York)
+1 669 900 6833 US (San Jose)
+1 253 215 8782 US (Tacoma)
+1 346 248 7799 US (Houston)
+1 408 638 0968 US (San Jose)
+61 8 7150 1149 Australia
+61 2 8015 6011 Australia
+61 3 7018 2005 Australia
+61 7 3185 3730 Australia
+61 8 6119 3900 Australia

Meeting ID: 926 7682 5501

Find your local number: <https://lakeheadu.zoom.us/j/92676825501>

Tutorials:

Michael Rennie is inviting you to a scheduled Zoom meeting.

Topic: Biostatistics Tutorials

Time: Jan 12, 2021 10:30 AM Eastern Time (US and Canada)

Every week on Tue, Fri, until Apr 13, 2021, 26 occurrence(s)

Jan 12, 2021 10:30 AM
Jan 15, 2021 10:30 AM
Jan 19, 2021 10:30 AM
Jan 22, 2021 10:30 AM
Jan 26, 2021 10:30 AM
Jan 29, 2021 10:30 AM
Feb 2, 2021 10:30 AM
Feb 5, 2021 10:30 AM
Feb 9, 2021 10:30 AM
Feb 12, 2021 10:30 AM
Feb 19, 2021 10:30 AM
Feb 23, 2021 10:30 AM
Feb 26, 2021 10:30 AM
Mar 2, 2021 10:30 AM
Mar 5, 2021 10:30 AM
Mar 9, 2021 10:30 AM
Mar 12, 2021 10:30 AM
Mar 16, 2021 10:30 AM
Mar 19, 2021 10:30 AM
Mar 23, 2021 10:30 AM

Mar 26, 2021 10:30 AM
Mar 30, 2021 10:30 AM
Apr 2, 2021 10:30 AM
Apr 6, 2021 10:30 AM
Apr 9, 2021 10:30 AM
Apr 13, 2021 10:30 AM

Please download and import the following iCalendar (.ics) files to your calendar system.

Weekly: https://lakeheadu.zoom.us/meeting/tJwsf-iuqDIqE9agJMyCkUf6pZ-vRLxevEbM/ics?icsToken=98tyKuCgrzMrHNKcsBCFR0w-BYqgd-7wplhfj_pcmzXIGgNYVwWgJtgPJIBTCN3G

Join Zoom Meeting

<https://lakeheadu.zoom.us/j/98181669092?pwd=MXc2eUt3OHRXRW9nRjZxZEdwZGgxQT09>

Meeting ID: 981 8166 9092

Passcode: 7y524b

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+16475580588,,98181669092# Canada

+17789072071,,98181669092# Canada

Dial by your location

+1 647 558 0588 Canada

+1 778 907 2071 Canada

+1 204 272 7920 Canada

+1 438 809 7799 Canada

+1 587 328 1099 Canada

+1 647 374 4685 Canada

+1 312 626 6799 US (Chicago)

+1 646 876 9923 US (New York)

+1 301 715 8592 US (Washington D.C)

+1 253 215 8782 US (Tacoma)

+1 346 248 7799 US (Houston)

+1 408 638 0968 US (San Jose)

+1 669 900 6833 US (San Jose)

+61 8 6119 3900 Australia

+61 8 7150 1149 Australia

+61 2 8015 6011 Australia

+61 3 7018 2005 Australia

+61 7 3185 3730 Australia

Meeting ID: 981 8166 9092

Find your local number: <https://lakeheadu.zoom.us/u/ab06G0pclQ>