

COURSE SYLLABUS

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| Instructors: | René Malenfant Myriam Barbeau Stephen Heard | Lecture: | T Th 10:00–11:20 AM (C104) |
| Email: | rene.malenfant@unb.ca mbarbeau@unb.ca sheard@unb.ca | Tutorial: | Th 11:30–12:50 PM (C104) |
| | | Office Hours: | TBA |

Course Description:

Introduces students who have previously taken a formal class in statistics to the practice and pitfalls of experimental design and data analysis in biology and forestry. It is intended for both graduate students and final year undergraduates (enrolled in an honours or senior research project). It will be jointly taught by faculty members from the Departments of Mathematics/Statistics, Biology and/or Forestry. Topics will be selected from sampling designs, experimental designs, parametric and non-parametric analysis, power analysis, and regression. The course will include discussion of examples in the literature. Students will also be analysing and interpreting data sets arising from their field of research.

Course Prerequisites:

STAT 2264 or equivalent.

Recommended Textbook:

Quinn, G. P. and M. J. Keough. 2002. *Experimental Design and Data Analysis for Biologists*. Cambridge University Press: Cambridge, UK.

Other Course Resources:

Kabacoff, R. 2015. *R in Action: Data Analysis and Graphics with R*, 2nd ed. Manning Publications: Shelter Island, NY. [On reserve at the Science & Forestry Library]

Underwood, A. J. 1997. *Experiments in Ecology: Their Logical Design and Interpretation Using Analysis of Variance*. Cambridge University Press: Cambridge, UK. [eBook available online through UNB Library]

Additional required readings will consist of journal articles, which are free of charge through UNB library subscriptions.

Library information:

UNB Libraries (www.lib.unb.ca) provides access to a vast collection of online and print resources. Use Research by Subject on the library website to find the best resources for this course.

Research help is available by phone, e-mail, chat, and in-person.

The libraries offer quiet and group study space. Book a Group Study Room online at http://www.lib.unb.ca/services/group_study.php

Online Materials:

Online course materials can be found in Desire2Learn (Brightspace), UNB's online Learning Management System. You can access it through the MyUNB portal for single login to all UNB services

(<https://my.unb.ca/Pages/default.aspx>) or directly by pasting lms.unb.ca into your browser address bar.

Grading Scale:

| Letter Grade | Percentage Grade | Grade Points |
|--------------|------------------|--------------|
| A+ | [93–100]% | 4.3 |
| A | [85–93]% | 4 |
| A– | [80–85]% | 3.7 |
| B+ | [75–80]% | 3.3 |
| B | [70–75]% | 3 |
| B– | [65–70]% | 2.7 |
| C+ | [60–65]% | 2.3 |
| C | [55–60]% | 2 |
| D | [50–55]% | 1 |
| F | [0–50]% | 0 |

Course Marking Scheme

| Item | Value | Date Due | Details |
|-------------------|-------------|-----------|---|
| Paper discussions | 15% | See below | Three discussions (5% each) |
| Assignments | 30% | See below | Three assignments (10% each) |
| Presentation | 15% | Dec. 6 | Oral presentation of one's term project |
| Final report | 40% | Dec. 18 | A brief manuscript based on your term project |
| Total: | 100% | | |

Paper discussions

Three lectures throughout the semester are dedicated to discussion of assigned readings. For each discussion, you must submit a point-form summary of the assigned reading, written in your own words. **The summary must not simply restate the abstract of the paper.** Each paper discussion will be graded based on the student's written summary (50%) as well as their spoken contributions to the paper discussion (50%). Note: Instructors will not lead or partake in the discussions... So, if you want a good grade, come prepared to chat!

Assignments

Assignments are designed for you to gain familiarity with statistical concepts and analyses discussed throughout the semester and which may be useful for your final project. All assignments are due at the *beginning* of lecture.

Final Project (Presentation & Report)

For the term project, you will individually analyse and interpret a dataset arising from your field of research. You first need to obtain the permission of René for your chosen dataset, by writing a proposal (approx. half of a page) indicating: (1) your research hypothesis, (2) a description of the dataset

you plan to use, and (3) the type(s) of analyses you plan to do. **You must submit this proposal by October 9th.** You are then required to prepare and present a written report and a 15-minute presentation on your term project.

Presentation:

You will present a 15-minute presentation on your project. You should budget 12 minutes for the presentation plus 3 minutes for questions. You should use visual aids (e.g., PowerPoint, blackboard, handouts, etc.). **If you use PowerPoint, please ensure that you have uploaded your presentation to D2L by 10:00 AM on Dec. 6.** You should treat your presentation as if it were a conference presentation: all of your analyses should be completed by this point; the talk is a chance to get feedback on your analyses before you submit the final report. It will be evaluated by the instructors and by other students. Remember that your talk is not a verbal rendition of a paper: it should stand alone and does not need to include all of your analyses. Pick the most important results that tell your story well.

Report

There is not a strict maximum or minimum length for the report; however, you must ensure that your report is **concise** and flows smoothly. Your aim is to present the material in such a way that the reader requires little effort to read through and understand your report. In previous years, reports have been *approximately 2000 words*, excluding reference section, tables and figures, and supplementary material. The report should be formatted similarly to a scientific manuscript, and must include the following parts:

1. Title page
2. Introduction: briefly giving background information and describing your research hypothesis
3. Methods with:
 - A complete description of the experimental or sampling design (i.e., you need to provide enough information so that we can evaluate the appropriateness of your analyses);
 - A description of statistical analyses. Your analyses should include—where appropriate—testing of assumptions, your chosen statistical test, multiple comparisons, power analyses, etc.
4. Results (incl. tables, figures, and written results)
5. Discussion with:
 - Interpretation of results
 - Brief discussion of future research that could next be done based on your present report
6. References: In addition to any literature cited, you must also properly reference R and any R packages that you use. You may choose any reference style you wish but **be consistent**.
7. Supplementary material (incl. a copy of the R script(s) used for your analyses, or printouts of statistical analyses if you used a statistical program other than R)

Marking scheme for the report:

- Writing style, clarity, and concision: 40 pts
- Content, data analysis, and effort: 60 pts

Course Policies:

1. Unless a student has prior approval from the instructor, there is a 20% penalty for each day an assignment or project is late.
2. Assignments (and the final project) are **individual work**, and collaboration among students should not exceed the kind of help you would expect from an instructor or a TA. For instance, helping another student by troubleshooting an analysis or by explaining concepts is okay, but directly giving/receiving answers or sharing script files (etc.) would obviously be forbidden. Any contributions from others must be clearly attributed, and the nature of any collaboration or assistance should be explained (e.g., in an Acknowledgements section).
3. Extra credit for additional work will not be granted.
4. R tutorials are optional but very highly recommended unless you are already proficient in R or another statistical software package. **Please install R and RStudio on your laptop and bring it to tutorials**; computers are not available in the tutorial room.
5. Cell phones are to be turned off during lectures and tutorials.
6. Please consult UNB's regulations regarding class attendance and decorum:
 - Attendance: <http://go.unb.ca/tls1viWva>
 - Decorum: <http://go.unb.ca/tlsmWzKLL>

Services for Students with Disabilities

If you are a student with a disability of any type (physical, mental, learning, medical, chronic health, sensory; visible or invisible) you are strongly encouraged to register with the UNBF Student Accessibility Centre (SAC) (<http://www.unb.ca/fredericton/student-services/academics/accessibility/>) so that you may receive appropriate services and accommodations. Once you are registered with SAC, the instructor will be notified via the UNBF SAC Accommodation Letter of your specific accommodations. If you would like to discuss your particular needs with the instructor, please book a time for a confidential appointment.

Class Recording and Copyright

Anyone who wishes to video or audio record lecture presentations or distribute course notes or other similar materials provided by instructors must obtain the instructor's written consent beforehand. Otherwise all such reproduction is an infringement of copyright and is absolutely prohibited and subject to academic penalties (see Academic Offences below). In the case of private use by students with documented disabilities, the instructor's consent will not be unreasonably withheld.

Weekly Schedule

Below is the intended schedule. It is subject to change in the event of extenuating circumstances, by mutual agreement, and/or to ensure better student learning. Students will be notified if and when changes are made. (Stay up-to-date via D2L Brightspace.)

| Date | Day | Topics | Items due |
|----------|-----|---|------------------|
| Sept. 6 | Th | Introductions (<i>Malenfant, Barbeau, Heard</i>) Philosophy of null-hypothesis statistical testing & <i>p</i> -values (<i>Heard</i>) | |
| Sept. 11 | T | Philosophy cont. (<i>Heard</i>) | |
| Sept. 13 | Th | Presenting statistical data (<i>Heard</i>) | |
| Sept. 18 | T | Basic principles of experimental design and sampling (<i>Heard</i>) | |
| Sept. 20 | Th | Discussion paper #1 (TBA) | Paper summary |
| Sept. 25 | T | Classical tests (<i>Malenfant</i>) | |
| Sept. 27 | Th | ANOVA (one-way, planned & unplanned comparisons, fixed and random factors, introduction to expected mean squares) (<i>Barbeau</i>) | |
| Oct. 2 | T | Factorial ANOVA (2-way and 3-way, interactions, variance components) (<i>Barbeau</i>) | Assignment #1 |
| Oct. 4 | Th | Factorial ANOVA continued (<i>Barbeau</i>) | |
| Oct. 9 | T | Assumptions (with a focus on independence of data) | Project proposal |
| Oct. 11 | Th | Nested ANOVA (<i>Barbeau</i>) | |
| Oct. 16 | T | Discussion paper #2 (TBA) | Paper summary |
| Oct. 18 | Th | Construction of any ANOVA from general principles (<i>Barbeau</i>) | |
| Oct. 23 | T | ANOVA (blocking, split plot, repeated measures) (<i>Barbeau</i>) | |
| Oct. 25 | Th | ANCOVA (<i>Malenfant</i>) | Assignment #2 |
| Oct. 30 | T | Multiple linear regression (<i>Malenfant</i>) | |
| Nov. 1 | Th | Likelihood; model selection (<i>Malenfant</i>) | |
| Nov. 6 | T | <i>Reading week – no class</i> | |
| Nov. 8 | Th | <i>Reading week – no class</i> | |
| Nov. 13 | T | Classical tests cont. (<i>Malenfant</i>) | |
| Nov. 15 | Th | Power analyses (<i>Malenfant</i>) | |
| Nov. 20 | T | Violated assumptions: dealing with “messy” data (<i>Heard</i>) | |
| Nov. 22 | Th | Violated assumptions cont. (<i>Heard</i>) | |
| Nov. 27 | T | Bayesian statistics (<i>Malenfant</i>) | |
| Nov. 29 | Th | Multivariate data analysis (<i>Malenfant</i>) | Assignment #3 |
| Dec. 4 | T | Discussion paper #3 (TBA) | Paper summary |
| Dec. 6 | Th | Student presentations | PowerPoint |

Tutorial Schedule

The schedule is subject to change – watch for e-mails; announcements in class on days of the tutorial or via Desire2Learn).

| Week # | Date | Topic |
|--------|----------|---|
| 0 | Sept. 6 | No tutorial – René will be in the room to help make sure you have R and RStudio correctly installed on your laptop for next week; prepare for the first tutorial by following along with Ch. 1–3 of <i>R for Beginners</i> at: https://cran.r-project.org/doc/contrib/Paradis-rdebuts_en.pdf |
| 1 | Sept. 13 | Introduction to R; data manipulation |
| 2 | Sept. 20 | Figures and tables; RMarkdown |
| 3 | Sept. 27 | Probability distributions and <i>p</i> -values |
| 4 | Oct. 4 | ANOVA 1 – one-way ANOVAs; planned and unplanned comparisons |
| 5 | Oct. 11 | ANOVA 2 – factorial ANOVAs; interactions |
| 6 | Oct. 18 | ANOVA 3 – nested designs and split-unit designs |
| 7 | Oct. 25 | Correlation and simple linear regression; ANCOVA |
| 8 | Nov. 1 | Multiple linear regression; model selection |
| | Nov. 8 | <i>Reading week – no tutorial</i> |
| 9 | Nov. 15 | Classical tests; power analyses |
| 10 | Nov. 22 | Linear mixed-effects models in <i>lme()</i> |
| 11 | Nov. 29 | Generalized linear mixed-effects models in <i>MCMCglmm()</i> |
| | Dec. 6 | <i>Student presentations</i> |

Writing and Study Skills Support:

UNB's Student Services provides many coaching and mentoring services to assist with writing papers, effective study methods, and other skills development related to student success:

<http://www.unb.ca/fredericton/studentservices/academics/writing-centre/index.html>

Math Skills Support:

UNB's Math Learning Centre offers math help drop-in times and opportunity to book appointments:

<http://www.math.unb.ca/~mathhelp/>

Technical Support:

Information Technology Services (ITS) Help Desk can be reached by phone 457-2222 (Fredericton Campus) 657-2222 (Saint John Campus), email - its servicedesk@unb.ca, or visited in person at the Harriet Irving Library Learning Commons. <http://www.unb.ca/its/get-it-help.html>

Academic Advising:

For academic advising information and assistance, see: www.unb.ca/student-toolkit

Academic Offences

Academic offences include, but are not limited to, the following:

Plagiarism

Plagiarism includes:

1. quoting verbatim or almost verbatim from any source, regardless of format, without acknowledgement;
2. adopting someone else's line of thought, argument, arrangement, or supporting evidence (such as, statistics, bibliographies, etc.) without indicating such dependence;
3. submitting someone else's work, in whatever form (essay, film, workbook, artwork, computer materials, etc.) without acknowledgement;
4. knowingly representing as one's own work any idea of another.

NOTE: In courses which include group work, a penalty may be imposed on all members of the group unless an act of plagiarism is identified clearly with an individual student or students.

Examples of other academic offences include: cheating on exams, tests, assignments or reports; impersonating somebody at a test or exam; obtaining an exam, test or other course materials through theft, collusion, purchase or other improper manner, submitting course work that is identical or substantially similar to work that has been submitted for another course; and more as set out in the academic regulations found in the Undergraduate Calendar.

Penalties for plagiarism and other academic offences range from a minimum of F (zero) in the assignment, exam or test to a maximum of suspension or expulsion from the University, plus a notation of the academic offence on the student's transcript.

For more information, please see the Undergraduate Calendar, University Wide Academic Regulations, Regulation VIII.A, or visit: <http://go.unb.ca/tlsPb0XX5>. It is the student's responsibility to know the regulations.