NRES 776 Syllabus

Lisa Koetke & Sunny Tseng

Fall 2023

### Advanced statistical analyses for natural resource sciences

* **Lecture**: Tuesday and Thursday 12:30 - 13:20 pm
* **Lab**: Thursday 8:00 - 10:50 am
* **Location**: In person: 5-177 Lecture & 8-362 Lab; Virtual: [zoom link](https://unbc.zoom.us/j/64078816232?pwd=TytUa2pnR1AyTmFYd2p5TXcrajhuZz09)
* **Course website**: UNBC Moodle (everything is there!)

This course provides advanced, practical training in the analysis of quantitative data. The course focuses primarily on advanced univariate statistics that can be applied to both experimental and observational data. This focus includes a full exploration of generalized linear models, including linear, logistic, and mixed models. Students also receive instruction in the principles of experimental design, data management, and the review and reporting of statistical results. Labs focus on using R statistical software to manipulate, display, and analyze data.

### Instructors

| name | email | office | office hour |
| --- | --- | --- | --- |
| Lisa Koetke | [lisa.koetke@unbc.ca](mailto:lisa.koetke@unbc.ca) | 10-2086 | Tue. 13:30 - 14:30 |
| Sunny Tseng | [stseng@unbc.ca](mailto:stseng@unbc.ca) | <https://unbc.zoom.us/j/6088522970?pwd=cjJhOVRqMmk0bkJ1N2tJajJrTWNYdz09> | Tue. 13:30 - 14:30 |

### Schedules

#### Lecture schedule

Lecture content will introduce the principles of experimental design and discuss a variety of statistical methods used to analyze experimental and observational ecological data.

| Date | Lecture ID | Tentative topic | Instructor | Location |
| --- | --- | --- | --- | --- |
| Sept 7, Thu. | Lecture 1 | Course introduction | Sunny | Virtual |
| Sept 12, Tue. | Lecture 2 | Basic concepts of statistics in ecology | Sunny | Virtual |
| Sept 14, Thu. | Lecture 3 | Graphics and data visualization | Sunny | Virtual |
| Sept 19, Tue. | Lecture 4 | Descriptive statistics | Sunny | Virtual |
| Sept 21, Thu. | Lecture 5 | Probability and distributions | Sunny | Virtual |
| Sept 26, Tue. | Lecture 6 | Hypothesis testing | Sunny | Virtual |
| Sept 28, Thu. | Lecture 7 | Experimental design | Sunny | Virtual |
| Oct 3, Tue. | Lecture 8 | Test of difference in means | Lisa | In Person |
| Oct 5, Thu. | Lecture 9 | Comparing more than two means | Lisa | In Person |
| Oct 10, Tue. | Lecture 10 | Linear regressions | Lisa | In Person |
| Oct 12, Thu. | Lecture 11 | Linear regressions | Lisa | In Person |
| Oct 17, Tue. | Lecture 12 | Analyzing multiple factors | Lisa | In Person |
| Oct 19, Thu. | Lecture 13 | Multiple regression | Lisa | In Person |
| Oct 24, Tue. | Lecture 14 | Model selection | Lisa | In Person |
| Oct 26, Thu. | Lecture 15 | Model selection and model averaging | Lisa | In Person |
| Oct 31, Tue. | Lecture 16 | Generalized linear models | Sunny | Virtual |
| Nov 2, Thu. | Lecture 17 | Generalized linear models | Sunny | Virtual |
| Nov 7, Tue. | Lecture 18 | Generalized linear models | Sunny | Virtual |
| Nov 9, Thu. | Lecture 19 | Generalized linear models | Sunny | Virtual |
| Nov 14, Tue. | Lecture 20 | Mixed-effect models | Lisa | In Person |
| Nov 16, Thu. | Lecture 21 | Mixed-effect models | Lisa | In Person |
| Nov 21, Tue. | Lecture 22 | Multivariate analyses | Lisa | In Person |
| Nov 23, Thu. | Lecture 23 | Multivariate analyses | Lisa | In Person |
| Nov 28, Tue. | Lecture 24 | Project 2 presentation | Sunny & Lisa | In Person |
| Nov 30, Thu. | Lecture 25 | Project 2 presentation | Sunny & Lisa | In Person |
| Dec 5, Tue. | Lecture 26 | Project 2 presentation | Sunny & Lisa | In Person |

#### Lab schedule

The labs will include a tutorial demonstrating code and techniques, practice exercises, and a discussion of the weeks’ readings. Labs will emphasize hands-on statistical analysis and interpretation of results from quantitative observations and manipulative experiments. Analysis will be done using R Statistical Software.

| Date | Lab ID | Tentative topic | Instructor | Location | Discussion | Note |
| --- | --- | --- | --- | --- | --- | --- |
| Sept 14, Thu. | Lab 1 | Intro to R | Sunny | Virtual | NA | NA |
| Sept 21, Thu. | Lab 2 | Data visualization | Sunny | Virtual | Presenting data graphically | Lab 1 due |
| Sept 28, Thu. | Lab 3 | Data summarizing | Sunny | Virtual | Presenting statistical results | Lab 2 due |
| Oct 5, Thu. | Lab 4 | Comparing two means | Lisa | In Person | Hypothesis testing | Lab 3 due |
| Oct. 12, Thu. | Lab 5 | Comparing more than two means | Lisa | In Person | Problems with p-values | Lab 4 due |
| Oct. 19, Thu. | Lab 6 | Project 1 presentation | Sunny | In Person | NA | Project 1 due |
| Oct. 26, Thu. | Lab 7 | Multiple regression | Lisa | In Person | Questionable research practices | Lab 5 due |
| Nov. 2, Thu. | Lab 8 | Model selection | Lisa | In Person | Model selection | Lab 7 due |
| Nov 9, Thu. | Lab 9 | Generalized linear models | Sunny | Virtual | Generalized linear models | Lab 8 due |
| Nov. 16, Thu. | Lab 10 | Generalized linear models | Sunny | Virtual | Generalized linear models | Lab 9 due |
| Nov. 23, Thu. | Lab 11 | Mixed-effect models | Lisa | In Person | Decolonizing quantitative research | Lab 10 due |
| Nov. 30, Thu. | Lab 12 | Multivariate analyses | Lisa | In Person | NA | Lab 11 due; Project 2 due |

### Assessments of learning

#### Grade distribution

| Letter | A+ | A | A- | B+ | B | B- | C+ | C | C- | D+ | D | D- | F |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Percent | 90.0 - 100.0 | 85.0 - 89.9 | 80.0 - 84.9 | 77.0 - 79.9 | 73.0 - 76.9 | 70.0 - 72.9 | 67.0 - 69.9 | 63.0 - 66.9 | 60.0 - 62.9 | 57.0 - 59.9 | 53.0 - 56.9 | 50.0 - 52.9 | <50.0 |

#### Lab assignments (50%)

* Due: every Thu. midnight
* Submission: a R file named as “NRES776\_*lastname*\_lab\_*X*.R”. Submit to course website.
* Description: For these assignments, you will analyze data sets using a variety of techniques learned in class. A demonstration of lab assignments will be included in the beginning of each lab. Students are encouraged to finish the lab during the course lab time.

#### Project 1 (15%)

* Due: Oct.19 at midnight
* Submission: oral presentation, a PDF file named as “NRES776\_*lastname*\_project\_1.pdf” submitted to course website.
* Description: Working with the instructor, students will develop an analysis strategy to examine data relevant to their research area. You will develop the project starting with a research question, data visualization, and list hypotheses. Making it as a research proposal that you are going to apply funding with. There will be a 5 mins presentation component as well as a 2-pages report.

#### Project 2 (20%)

* Due: Dec. 7 at midnight
* Submission: oral presentation during lecture times Nov. 28 to Dec. 5, a PDF file named as “NRES776\_*lastname*\_project\_2.pdf” submitted to course website.
* Description: Your second project will build off of Project 1. Using the same dataset, you will answer your research questions and test your hypotheses using methods learned in the second portion of the semester. This project will include a 5-minute presentation and a written report of your methods and results.

#### Discussion paper presentation (10%)

* Due: one of the lab session
* Submission: oral presentation
* Description: You will have 5 mins to present a discussion paper during the lab period and lead a 20 mins discussion based on the papers. You can sign up for the paper you would like to present. All students are expected to read the discussion paper before each lab and participate discussion. Guidelines on leading a discussion will be provided.

#### General participation (5%)

* Description: You will be evaluated by your involvement in course discussion, and providing feedback to other students’ presentation.

### Resources

#### Books

* Whitlock, MC and Schluter, D. 2015. The Analysis of Biological Data. 3rd Edition. Roberts and Company Publishers.
* Gotelli, N.J., and A.M. Ellison. 2013. A Primer of Ecological Statistics (2nd Edition). Sinauer Associates Inc., Sunderland, MA.
* Zuur, AF, Ieno, EN and Smith, GM. 2007. Analysing Ecological Data. Springer. eBook available through UNBC library: <http://prxy.lib.unbc.ca/login?url=https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=> 254638&site=ehost-live&scope=site

#### Online resources

* R for Data Science by Hadley Wickham and Garrett Grolemund at <http://r4ds.had.co.nz/>
* Foundations of Statistics with R by Darrin Speegle: <https://bookdown.org/speegled/foundations-ofstatistics/>
* Repository of Bookdowns on a variety of topics related to data analysis, R, and statistics: <https://bookdown.org/home/tags/statistics/>

### Territorial acknowledgement

UNBC is located on and serves diverse traditional territories that are home to numerous First Nations and other Aboriginal groups. The Prince George campus is situated on the traditional territory of the Lheidli T’enneh, part of the Dakelh (Carrier) First Nations. For further information about Territories on which UNBC campuses are located, please see: <https://www2.unbc.ca/indigenous-resource-dati/traditional-territory-acknowledgement>

### Access resource centre

The Access Resource Centre (ARC) provides services to students with documented health conditions and/or disabilities. The conditions can range from temporary to permanent and include but are not limited to:

* chronic health issues (e.g., Crohn’s, Diabetes, HIV, Lupus)
* hearing and visual impairments
* learning disabilities
* mental health challenges (e.g., anxiety disorder, borderline personality disorder, depression disorder)
* neurological disabilities (e.g., ADHD/ADD, Autism Spectrum Disorder, Epilepsy, Concussion, Migraines, Multiple Sclerosis)
* mobility and other physical disabilities.

ARC staff are available, by appointment, to meet with you to determine which academic accommodations can be put in place to support you in achieving their academic goals, provide referrals, and help advocate for you. Students who may have a need for academic accommodation are encouraged to contact ARC:

* Email at [arc@unbc.ca](mailto:arc@unbc.ca),
* Phone at 250-960-5682 (toll free 1-888-960-5682), or
* Stop by 5-157.

More details are available at the Access Resource Centre website.

### Academic dishonesty

Do NOT do Copying and Pasting! While it may seem a quick way to answer an exam or assignment question, this constitutes plagiarism – whether the text is from an online source (including AI systems like ChatGPT), another student’s assignment, or even another assignment of yours! Students who fail to put their answers into their own words will automatically receive 0% on the particular assignment/lab/exam in question. If the nature of the act is considered serious, recommendations for further disciplinary action will be forwarded to the Dean. Please ask the instructor for more information if you do not understand this prohibition. Note that ignorance of these policies will not be accepted as a defense. Students guilty of such activities may receive a zero on the particular assignment/exam/lab in question. If deemed sufficiently severe by the instructor, the offense could lead to sanctions that include reprimand, reduction of grade, or suspension. All matters of Academic Misconduct at UNBC require instructors to submit a formal report to the Chair and Office of Registrar, which will be placed in the student’s academic file.