1 COURSE INFORMATION

Course Title	Course Code Number	Credit Value
Advanced Biometrics	FRST 430 / FRST 533C	3

PREREQUISITES

An introductory course in probability and statistics (e.g., FRST 231, BIOL 300, STAT 200, or equivalent) is essential to understanding the course content.

Additional for FRST 430: FRST 399 or equivalent. Restricted to students with 4th year standing or by permission of instructor.

COURSE DESCRIPTION

Data are all around us these days. We rely on data to make management decisions more than ever before. Yet, in order to do so, we need to understand what kind of data we are analyzing, the basic principles of modelling, the underlying model assumptions, and how to interpret model results. This course will give you the tools needed for analyzing and interpreting data from randomized experiments and observational studies using linear models. By the end of the term you will be familiar with basic linear modelling concepts and how data from either observational studies or randomized experiments drive the analysis methods and scope of inference.

2 CONTACT

Course Instructor	Contact Details	Office Location	Office Hours
Dr. Bianca Eskelson	**Course discussion board** (preferred) **Email:** bianca.eskelson@ubc.ca **Office Phone:** +1-604-827-0629 **Response time:** The TAs and I check the discussion board entries multiple times a day between 9:30 and 16:30. E-mail inquiries will be checked once every 48 hours.	FSC 2043	Mondays 13:00-14:00 Wednesdays 15:00-16:00 Or by appointment
Teaching Assistants			
Hsiao-Chi (Kiki) Lo Nat MacMillan Kate Peterson	TA's are available during Thursday lab sessions, monitor and respond to discussion board entries, and mark lab assignments. TA office hours will be scheduled before the midterm and final exams. Details will be posted on Canvas.		

COURSE COMMUNICATION

Students should strictly follow the course communication instructions outlined in the syllabus with regards to who they should contact for specific purposes. When you look for information related to the course, before contacting the instructor, please make sure to: 1) check the syllabus, and 2) the course Canvas page, where announcements are regularly posted and deadlines are included.

If you need to contact the instructor or teaching assistants, please follow this order: 1) ask questions directly during lab sessions or office hours; 2) post questions on the Canvas discussion boards; 3) e-mail the instructor to book a one-on-one appointment. Please contact the instructor via e-mail (bianca.eskelson@ubc.ca) rather than Canvas. If contacted via Canvas the response time will be longer than if contacted via e-mail.

The e-mail addresses of the teaching assistants are not provided to avoid that the same questions are sent to multiple people. Ideally, all questions are posted on the relevant discussion boards on Canvas.

3 COURSE STRUCTURE

LECTURES

Monday, Wednesday, Friday **12:00 to 13:00** **Location: FSC 1001**

During lecture, I annotate the course notes that you purchased from the bookstore. I typically start each lecture asking questions about material covered in previous lectures. I often start or end lectures with 'one-minute papers' or short 'quizzes' to assess student knowledge and to provide written feedback to students. These questions may also be shifted to be Canvas quizzes after lecture. During lectures, I appreciate when students ask clarifying questions and volunteer answers when questions are asked. Lectures may include in-class activities.

LABS SESSIONS AND ASSIGNMENTS

Ten lab assignments are designed to allow students to apply theoretical content learned in the course to data examples using the software R. Lab lectures (possibly pre-recorded) provide an overview of the lab assignments and what is expected for the lab report submission. Teaching Assistants and the instructor are available during scheduled lab sessions to answer questions that students may have.

Some components of the lab assignments may be submitted as Canvas quizzes, while other components will be uploaded to Canvas as part of a lab report. Detailed instructions are provided in the lab assignment instructions.

Graduate students (registered in FRST 533C) will submit their lab assignments in groups of 2 to 3 students. They are required to complete all work individually themselves and then meet to consolidate their assignments.

All assignments are **due at 10:00am on Thursdays**, see detailed schedule below.

Scheduled Lab section:

Thursday	**10:00 to 12:00**	**Location: FSC 1404 & 1406** (meet in 1406 at the beginning of the lab, then split up into both rooms after lab lecture; FSC 1220 can be used as 'overflow' room for laptop users)
October 10	10:00 to 12:00	**Location: ANGU 254** – Review session before midterm exam
December 6	10:00 to 12:00	**Location: IRC 3** – Review session for final exam

COURSE PARTICIPATION

Course participation grades are based on student participation during lectures, on the Canvas discussion boards (including introductions!), and the Canvas quiz sections that complement lectures (& guest lectures) and assignments. The discussion boards will thrive if you answer each other's questions!

Short 'quizzes', discussion points, or 'one-minute papers' will be posted on Canvas throughout the term or answered during lectures. If these are posted on Canvas, students have 3 days to post responses after the questions have been posted. The Teaching Assistants and I will monitor and spot-check the responses, but we will not correct incorrect responses. Where applicable, correct answers will be posted three days after the questions were posted. Students are responsible to compare their own answers with posted solutions and ask for clarification on discussion boards, during lab sessions, or during office hours as needed.

The course participation grade ranges from 0 to 5 points. For example, if you never say anything in class, never post anything on the discussion board, and do not submit any of the Canvas or in class quizzes, you will receive 0 points.

IMPORTANT DATES

No classes: Monday, September 2; Monday, September 30; Monday, October 14; Monday, November 11, Wednesday, November 13

Friday, October 18, 2023: MIDTERM EXAM during class time, covering content up to and including assignment 4. **CLOSED BOOK EXAM – one page (letter size, back and front) 'cheat-sheet' allowed that will be submitted with midterm**; Location: **to be determined**

December 10 to 21: FINAL EXAM PERIOD. Date and time will be available by mid-October. The final exam is comprehensive = it covers everything covered in the course. **CLOSED BOOK EXAM – one page (letter size, back and front) 'cheat-sheet' allowed that will be submitted with final exam**; Students are responsible for attendance. Special arrangements will not be made except for documented medical or compassionate reasons.

4 LEARNING OUTCOMES

After taking this course students will:

1. be able to use simple linear and multiple linear regression to fit models using sample data;
2. be able to design and analyze lab and field experiments;
3. be able to interpret and evaluate results of model fitting and analysis of experiments;
4. be able to distinguish between observational studies and experiments and understand what this means for making inferences;
5. be aware of other analysis methods not explicitly covered in this course;
6. be able to implement and create R code for model fitting and analysis of experiments; and
7. be aware of other software packages that provide alternatives to R.

In order to meet these objectives, background theory and examples will be used. The free software environment for computing and graphics called "R" will be used in examples and to help in analyzing data in exercises. Recommended texts are also important, both to increase understanding while taking the course, and as a reference for future applied and research work.

5 LEARNING ACTIVITIES

Take notes during live lectures and lab lectures (often pre-recorded).

Perform assigned and suggested readings.

Actively participate in the course by answering and asking questions in the course online environment on Canvas. Ask questions on the Canvas discussion board as well as answer questions posted by fellow students.

Participate in one-minute papers, pair-share, and other in-class activities, some of which will be shifted to be online activities on Canvas.

6 ASSESSMENTS OF LEARNING

Assignments	20%
Participation	10%
Midterm	30%
Final Exam	40%

Policy on late submission of lab reports: I understand that there are crunch times with other courses throughout the term. Therefore, each student will receive a total of 6 late days that can be used flexibly throughout the term, with the restriction that a single assignment can only be late for a total of 3 days. This means students could, for example, submit 6 labs one day late, or 3 labs two days late, or 2 labs 3 days late. Once a student has used up their 6 late days, a reduction in grade by 10% per day will be assigned to late labs. Labs will not be accepted for marking once marked labs have been handed back to the class (typically within 3-4 business days after submission). All assignments in this course will be marked for spelling, punctuation, and grammar. All lab reports have to be submitted to complete the course even if the deadline has passed and they receive 0 points.

7 LEARNING MATERIALS

REQUIRED EQUIPMENT

A simple scientific calculator.

A ruler for creating a few graphs.

REQUIRED READING MATERIALS

Course notes: You must purchase the course notes package at the bookstore for around $25.00. You must have the course notes when you attend lectures so that you can take notes as I annotate the course notes during class.

Other required readings will be available on Canvas and through the Library Online Course Reserves (LOCR):

Ramsey, F.L. and D.W. Schafer. 2013. The statistical sleuth: a course in methods of data analysis. 3rd edition. Australia; Boston: Brooks/Cole, Cengage Learning.

- Chapter 1 (p. 1-22)
- Display 2.12 (p. 48)
- Display 7.5 (p. 182)
- Chapter 8.4 (p. 216-218)
- Display 8.6 (p. 214)
- Research design 23.2-23.3.9 (p. 700-705)

Van Belle, G., L.D. Fisher, P.J. Heagerty, and T. Lumley. 2004. Biostatistics: a methodology for the health sciences (Vol. 519). John Wiley & Sons.

- Table 10.28 (p. 399)

Kutner, M.H., C.J. Nachtsheim, J. Neter, and W. Li. 2005. Applied linear statistical models, 5th edition. Boston: McGraw-Hill Irwin.

- Figure 1.9 (p. 16)
- Figure 16.4 (p. 691)
- Appendix B: Tables (p. 1316-1325)

Hothorn, T., and B.S. Everitt. 2014. A handbook of statistical analyses using R. 3rd edition. Boca Raton, FL: CRC Press.

- Chapter 1. (p. 1-23)

Plant, R.E. 2019. Spatial data analysis in ecology and agriculture using R. 2nd edition. CRC Press.

- Chapters 2 (p. 19-65), 4.2.1 (p. 105-108)

Venables, W.N., D.M. Smith, and R Development Core Team. 2023. An introduction to R. https://cran.r-project.org/doc/manuals/r-release/R-intro.pdf

RECOMMENDED REFERENCE MATERIALS

Hothorn, T., and B.S. Everitt. 2014. A handbook of statistical analyses using R. 3rd edition. Boca Raton, FL: CRC Press. [earlier editions available from UBC library (online copy).]

Kutner, M.H., C.J. Nachtsheim, J. Neter, and W. Li. 2005. Applied linear statistical models, 5th edition. Boston: McGraw-Hill Irwin. [Available from UBC library (hard copy only). NOTE: There are earlier editions (e.g., 1996) with a slightly different listing of authors that is also good.]

Lawson, J. 2015. Design and analysis of experiments with R. Boca Raton: CRC Press, Taylor & Francis Group. [Available from UBC library (hard copy only).]

Ramsey, F.L. and D.W. Schafer. 2013. The statistical sleuth: a course in methods of data analysis. 3rd edition. Australia; Boston: Brooks/Cole, Cengage Learning. [Available from UBC library (hard copy only).]

OTHER REFERENCE MATERIALS

FOR EXPERIMENTAL DESIGN ONLY:

The textbook 'A first course in design and analysis of experiments' by Gary Oehlert (2010), Professor at the University of Minnesota, USA, is very good and now available as downloadable pdf from: http://users.stat.umn.edu/~gary/Book.html This website has other materials that you may find useful.

Hicks, C.R. 1993. Fundamental concepts in the design of experiments, 4th edition. Saunders College Publishing, Toronto. [Available from UBC library (hard copy only); good text on experimental design.]

MAINLY FOR LINEAR REGRESSION ANALYSIS:

Faraway, J.J. 2015. Linear models with R. 2nd edition. Chapman and Hall/CRC. [Available from UBC library (online copy).]

Biometrics Pamphlets (http://biometrics.forestry.ubc.ca/ and then click on "links" to find the biometrics pamphlets by Ministry of Forests, Lands, and Natural Resources Operations [excellent with a variety of examples for each experiment]

Freese, F. 1967. Elementary statistical methods for foresters. [http://biometrics.forestry.ubc.ca/ and then click on "links" to find a .pdf copy of this simple textbook with good examples.]

Hurlbert, S.H. 1984. Pseudoreplication and the design of ecological field experiments. Ecological monographs, 54(2), 187-211. – Recommended reading for the graduate students in the course.

8 SCHEDULE OF TOPICS

Week	Week day	Dates	Computer Labs/Assignments/Exams
1	M W F	**Sept 2 - no class** Sept 4 - lecture Sept 6 - lecture	**Assigned readings:** Syllabus & Statistical Sleuth Chapter 1 (pp. 1-22) **Thursday, Sept 5, Computer lab -** Assignment 1: Review of statistics + introduction to R
2	M W F	Sept 9 - lecture Sept 11 - lecture Sept 13 - lecture	***Assignment 1 due Thursday 10:00am*** **Thursday, Sept 12, Computer lab -** Assignment 2: Simple linear regression (SLR) + scope of inference
3	M W F	Sept 16 - lecture Sept 18 - lecture Sept 20 - lecture	**Thursday, Sept 19, Computer lab -** Assignment 2 (cont'd): SLR in R
4	M W F	Sept 23 - lecture Sept 25 - lecture Sept 27 - lecture	***Assignment 2 due Thursday 10:00am*** **Thursday, Sept 26, Computer lab -** Assignment 3: Multiple linear regression (MLR)
5	M W F	**Sept 30 - no class** Oct 2 - lecture Oct 4 - lecture	***Assignment 3 due Friday*** **Thursday, Oct 3, Computer lab -** Assignment 4: MLR with Continuous and Class Variables
6	M W F	**Oct 7 - no class** Oct 9 - lecture Oct 11 - lecture	***Assignment 4 due Thursday 10:00am*** **Thursday, Oct 10, Review session – Location: ANGU 254**
7	M W F	Oct 14 - lecture Oct 16 - lecture **Oct 18 - MIDTERM**	**Thursday, Oct 17, Computer lab -** Assignment 5: MLR - Variable Selection and Model Building **MIDTERM EXAM: Friday, October 18, 12:00-13:00** **Location: DMP 110**
8	M W F	Oct 21 - lecture Oct 23 - lecture Oct 25 - lecture	***Assignment 5 due Thursday 10:00am*** **Thursday, Oct 24, Computer lab -** Assignment 6A: Completely Randomized Design (CRD), one fixed effect factor
9	M W F	Oct 28 - lecture Oct 30 - lecture Nov 1 - lecture	***Assignment 6 due Thursday 10:00am*** **Thursday, Oct 31, Computer lab -** Assignment 6B: Completely Randomized Design (CRD), two fixed effect factors
10	M W F	Nov 4 - lecture Nov 6 - lecture Nov 8 - lecture	***Assignment 7 due Thursday 10:00am*** **Thursday, Nov 7, Computer lab -** Assignment 7: Randomized Complete Block Design (RCB)
11	M W F	**Nov 11 - no class** **Nov 13 - no class** Nov 15 - lecture	**Thursday, Nov 14, Computer lab** - Assignment 7 (cont'd)
12	M W F	Nov 18 - lecture Nov 20 - lecture Nov 22 - lecture	***Assignment 8 due Thursday 10:00am*** **Thursday, Nov 21, Computer lab -** Assignment 8: Split-plot experiments
13	M W F	Nov 25 - lecture Nov 27 - lecture Nov 29 - guest lecture	***Assignment 9 due Thursday 10:00am*** **Thursday, Nov 28, Computer lab -** Assignment 9: Analysis of covariance Friday guest lecture: **"Statistical tools to aid in building extensions for individual tree growth and yield models"** ***Dr. Derek Sattler***, Forest Researcher, Carbon Accounting Team, Canadian Forest Service
14	M W F	Dec 2 – guest lecture Dec 4 - lecture Dec 6 - lecture	Monday guest lecture: **"The need for stand development modelling"** ***Eleanor McWilliams***, J&E McWilliams and Associates Ltd. ***Assignment 10 due Thursday 10:00am*** **Thursday, Dec 5, Review session – Location: IRC 3**
		December 10 to 21: Final Exam Period	**Final Exam: Date and location to be announced by mid-October**

9 UNIVERSITY POLICIES

CODE OF CONDUCT

UBC provides resources to support student learning and to maintain healthy lifestyles but recognizes that sometimes crises arise and so there are additional resources to access including those for survivors of sexual violence. UBC values respect for the person and ideas of all members of the academic community. Harassment and discrimination are not tolerated nor is suppression of academic freedom. UBC provides appropriate accommodation for students with disabilities and for religious observances. UBC values academic honesty and students are expected to acknowledge the ideas generated by others and to uphold the highest academic standards in all of their actions.

Details of the policies and how to access support are available on the UBC Senate website.

ACADEMIC INTEGRITY

Please learn about Academic Integrity for students at UBC and review this short blog on Academic integrity.

Note on generative AI tools: Students are permitted to use artificial intelligence tools, including generative AI, to gather information, and review concepts. However, students are ultimately accountable for the work they submit and need to generate their lab reports on their own. Any content generated or supported by an artificial intelligence tool must be cited appropriately using APA style. In addition, students need to explicitly outline why the generative AI toll was used and for what purpose and how it enhanced your assignment. Failure to include a proper referenece and description will be considered to be a breach of academic integrity and an academic misconduct. Use of AI tools is not permitted during midterm exams and finals exams in this course.

NETIQUETTE EXPECTATIONS

In taking this course, you agree to a 'social contract' for online peer-to-peer interactions. Neti-quette, or internet etiquette, is a set of guidelines for acting appropriately online. We are providing you with the following guidelines to empower you to successfully communicate in our online learning environment. Please click on the links above to understand what is being asked of you and how to hold up your end of the social contract.

We encourage you to….

- Be clear when expressing thoughts and information, remember that other users cannot not see your facial expressions or hear tone of voice. Thus, it is important to be weary of using humor and sarcasm.
- Remember that humans are on the other end of correspondence. Do not say anything that you would not say in person. Before you send something, ask yourself… how would I interpret this if I received it? Should I send it? Is the content better discussed over the phone, video chat, or in person?
- Respect other people's time. Make the subject line of a post specific to your message. Avoid tangents and stick to one subject per posting.

- Don't expect instant responses from peers or professors.
- Be forgiving and supportive of other learners.
- Understand that grammatical and spelling errors will happen and do not judge.
- Be sure to respond to your classmates' comments on your posts, just like you would in a face-to-face conversation.
- Remember everyone is from different cultures and may bring different perspectives. Em-brace diversity.
- Provide sincere and constructive comments of praise and feedback
- Respect the fact that everyone has different levels of technical competency and different learning styles
- Before entering a discussion, be sure to observe and review before leaping in to respond; avoid repetition. Also, take some time to consider your response to ensure it is well thought-out.
- Refer to your classmates' posts and comments when you contribute to the discussion to show that you acknowledge their thoughts.
- Do not use capital letters (this means someone is shouting). To emphasize a word, use asterisks in the following manner: *word*.
- Include your name at the end of each posting/comment.
- Cite all sources incorporated in posting using APA format and use a direct link when possible.
- Proofread all postings before submitting. Avoid using abbreviations and foul language; and be sure to use proper capitalization.
- Fundamentally, just as with your assignments or participation in other classes, remember that your posts and contributions in our online environment represent YOU. Be the best version of yourself in all ways possible. Go the extra mile to be a great contributor to the online environment.

(Source: Netiquette by Jaimie Hoffman is licensed under a Creative Commons Attribution-NonCom-mercial 4.0 International License.)

SUPPORT

Should any unfortunate and unforeseen conflicts arise your instructors are well prepared to connect you with the relevant support mechanisms at UBC. These support mechanisms provide conflict/dispute resolution guidance and respond to any dissonances in intercultural communication.

Here are some links:

- Early Alert is meant to provide support to any student, undergraduate or graduate, who might need assistance because of a temporary setback or an ongoing difficulty that puts their academic success at risk.
- The Faculty of Forestry Student Resources website, Indigenous resources, and the UBC Health and Wellbeing website.

Forestry undergraduate students, please contact: forestry.undergrad@ubc.ca

Forestry graduate students, please contact: erica.triggs@ubc.ca

Students from another faculty, please contact: forestry.undergrad@ubc.ca and you will be connected with the appropriate Student Services team across campus.

10 OTHER COURSE POLICIES

LEARNING ANALYTICS

This course will be using the learning technology Canvas (https://canvas.ubc.ca/courses/). Canvas captures data about your activity and provides information that can be used to improve the quality of teaching and learning. In this course, I plan to use analytics data to:

- View overall class progress
- Track participation in discussion forums to assess your participation in the course.

COPYRIGHT

All materials of this course (i.e., course handouts, lecture notes, lecture slides, course readings, course notes, course assignments and exams, pre-recorded lectures and tutorials, etc.) are the intellectual property of the Course Instructor or licensed to be used in this course by the copyright owner. Redistribution of these materials by any means without permission of the copyright holder(s) constitutes a breach of copyright and may lead to academic discipline.

The instructor is allowed by UBC policies to record live sessions within Canvas. Students are not allowed to redistribute those recordings or any other materials. Students are **NOT permitted to record any live or online sessions** (=no pictures, no video recordings, etc.) without the consent of the instructor and other participants.

11 ACKNOWLEDGEMENT

UBC's Point Grey Campus is located on the traditional, ancestral, and unceded territory of the xwməθkwəy̓əm (Musqueam) people. The land it is situated on has always been a place of learning for the Musqueam people, who for millennia have passed on their culture, history, and traditions from one generation to the next on this site.