COURSE OUTLINE

THE UNIVERSITY OF BRITISH COLUMBIA

Department of Computer Science, Mathematics, Physics and Statistics
Okanagan Campus

DATA 311-101: MACHINE LEARNING

2022 Winter Term 1
SEPT. 6TH, 2022 – DEC. 8TH ,2022

INSTRUCTOR:

Name: Irene Vrbik (she/her)
Contact: *irene.vrbik@ubc.ca* (Preferred)
Office Location: SCI 104
Office Hours: Thursday 15:30 – 16:30 (hosted in SCI 104 and via Zoom)
Class Location: SCI 333

SCHEDULE:

Lecture: Wednesday and Friday
Hours: 2:00pm – 3:30pm

LABORATORY COORDINATOR/INSTRUCTOR/TA:

L01:	Name of TA: Livia Jonnatan	Monday	10:00am – 12:00pm
L02:	Name of TA: Jesse Ghashti	Monday	8:00am – 10:00am
L03:	Name of TA: Jesse Ghashti	Monday	4:00pm – 6:00pm
L04:	Name of TA: Livia Jonnatan	Friday	12:00pm – 2:00pm

All TA's can be contacted on Canvas.

TEXTBOOK AND OTHER REFERENCE MATERIAL:

Our primary source of reference will be:

→ **Title:** An Introduction to Statistical Learning with Applications in R, *Second Edition*
Title abbreviation: ISL
Authors: Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani
Download page: https://www.statlearning.com/ (free)

Some additional content will have coverage in:

→ **Title:** The Elements of Statistical Learning: data mining, inference, and prediction, 2nd edition
Title abbreviation: ESL
Authors: Hastie, Tibshirani, Friedman.
Download page: https://hastie.su.domains/ElemStatLearn/ (free)

Software:
Our course will exclusively be using R (https://cran.r-project.org/). I strongly recommend that you use RStudio (https://www.rstudio.com/products/rstudio/download/) for running R.

COURSE DESCRIPTION:

Course Website:
Course materials are available at https://canvas.ubc.ca.

Academic Calendar Entry:
Regression, classification, resampling, model selection and validation, fundamental properties of matrices, dimension reduction, tree-based methods, unsupervised learning.
Prerequisite: Either (a) STAT 230 or (b) a score more than 75% in one of APSC 254, BIOL 202, PSYO 373; and one of COSC 111, APSC 177.

Course Overview:
This course will introduce students to some popular machine learning techniques for making sense of complex datasets. Students will be applying these methods to datasets using R.

Learning Outcomes:
At the end of this course, you should be able to:

- build a model and validate it
- understand fundamental proofs for techniques that rely on matrix algebra
- compute linear regression and apply hypothesis testing
- perform logistic regression and discriminant analysis
- apply the K-fold cross-validation methods
- apply the LASSO and ridge regression methods
- apply bagging and boosting on tree-based methods
- apply some methods of unsupervised learning (e.g., principal components, or k-means clustering)
- manipulate data sets in R including applying the above methods

Course Objectives:
The course is designed to introduce students to classical machine learning methods for regression and classification with an emphasis on model validation (i.e., it is not enough to fit a model, students should be able to estimate how good the resulting model is). By taking this course, students will gain experience in applying machine learning algorithms in R and develop skills for effectively communicating a proper interpretation of the results.

Course Format:
Lectures will be given in-person with Zoom option. While Zoom sessions will be recorded and posted to

Canvas you are strongly encouraged to attend (either in-person or via Zoom) synchronously so that you may participate and ask questions. Slide decks will be posted to Canvas prior to our scheduled lecture time. Slides might be supplemented with handwritten material which I will upload to Canvas after lecture. Lectures may also include discussions which you will only gain access to by attending and/or reviewing zoom lectures. While statistical software (i.e., R code and output) will be discussed during lecture, practical skills and applications of topics are covered primarily in computer labs.

LATE POLICY:

- Assignments are to be submitted electronically through Canvas. Late assignments will have 10% deducted for each day (which includes weekends) beyond the due date. Assignments that are more than 2 days (i.e., 48 hours) overdue will not be accepted.
- Missed midterms will have their weight shifted to the final. **NO make-up tests will be provided**.

PASSING CRITERIA:

In order to pass the course students MUST achieve a passing grade (at least 50%) on the final exam. Failure to satisfy this clause will result in a maximum grade of 45% for the course.

EXPECTATIONS:

Your responsibilities to this class and to your education as a whole, include attendance and participation. You have a responsibility to help create a classroom environment where all may learn. At the most basic level, you will respect your fellow class members and the instructor and treat them with the courtesy you hope to receive in return. Inappropriate classroom behaviour may include disruption of the classroom atmosphere (e.g., engaging in non-class activities, talking on a cell-phone), profanity in classroom discussion, use of abusive or disrespectful language toward the instructor, a student in the class, or about other individuals or groups. If you are attending lecture via Zoom, I trust that you will remain present and refrain from engaging in non-class activities. As standard in any zoom meeting, I ask that students' microphones will remain muted during lectures (unless addressing the class) to prevent any background noise distractions.

TENTATIVE COURSE SCHEDULE AND SUPPLEMENTARY (OPTIONAL) READINGS:

Below is a tentative outline for the course. These topics are subject to change depending upon how quickly we can cover the material.

Weeks	Topics	Optional Readings
1	Introduction, notation, terminology	ESL – Ch 1, Sec 2.1, 2.2
2	Simple regression, model assessment, non-linearity	ISL – Sec 3.1
3	Multiple linear regression, variable selection, categorical predictors, interactions	ISL – Sec 3.2
4	Classification via logistic regression	ISL – Sec 4.3
5	Discriminant analysis, distance measures	ISL – Sec 4.4
6	Unsupervised learning	ISL – Sec 12.4

7	Cross validation, bootstrap	ISL – Sec 5.1, 5.2
8	Tree based methods, tuning parameters	ISL – Sec 8.1, 8.2
9	Neural nets, shrinkage methods (LASSO and ridge regression)	ISL – Sec 10.1, 10.2
10	Dimensionality reduction via PCA, FA, NMF	ISL – Sec 12.2, ESL – Sec 14.7.1, 14.6
11	Unsupervised learning with mixture models	ESL – Sec 6.8
12	Carry over and course review	

Please note that lectures and labs will not be held on the following holidays:

- National Day for Truth and Reconciliation, Friday, 30 September 2022
- Thanksgiving Day Monday, 10 October 2022
- Remembrance Day. Friday, 11 November 2022
- Winter Session Term 1 midterm break November 7 to 11 (inclusive)

If you celebrate any other holidays that are not listed above, please feel free to contact me directly if you feel that they will potentially conflict with the outlined course structure. For other important UBCO related dates visit: http://www.calendar.ubc.ca/okanagan/academicyear.cfm

EVALUATION CRITERIA AND GRADING:

	Weight (in percent %)				
Grade Item	**Default**	**Alt 1**	**Alt 2**	**Alt 3**	**Alt 4**
Assignments	20	0	20	20	0
Midterm 1	20	0	0	20	20
Midterm 2	20	0	20	0	20
Final Exam	40	100	60	60	60

Final grades will be based on the evaluations listed above and the final grade will be assigned according to the standardized grading system outlined in the UBC Okanagan Calendar.

There will be two (2) synchronous midterms given during the term. Midterms will be held in class on Friday, October 14 and Friday, November 18. Midterms are not cumulative, in that second midterm will only cover the new material presented after the material covered on the first midterm.

LABORATORY/TUTORIAL MEETING TIMES:

LABORATORY SCHEDULE:

All students must be registered for a lab (held weekly unless otherwise specified). **Labs will begin on the week of September 12.** Please check your registration to determine your lab section and time. Zoom links to the virtual lab room can be found on Canvas.

LABORATORY FORMAT:

Labs are structured as walk-though tutorials which help to develop the practical skills of performing machine learning in R. You may work through the lab material on your own time and/or work through them during your scheduled lab. To ensure that TAs are not overloaded during a single lab, please do not attend labs for which you are not registered.

Lab sessions will be hosted by your TA online via zoom (links provided in Canvas). While they are primarily there to provide guidance on carrying out analyses in R, they additionally provide the opportunity to meet other students from class, ask questions and/or discuss concepts from lecture, and receive assistance on assignments. Thus, labs will act as additional "office hours" held by your TAs. While labs are not mandatory (i.e., attendance will not be taken) you are highly encouraged to attend. **Do not skip going through this material as lab content will be fair game for testing on midterms and the final exam.**

GRADING PRACTICES

Faculties, departments, and schools reserve the right to scale grades in order to maintain equity among sections and conformity to University, faculty, department, or school norms. Students should therefore note that an unofficial grade given by an instructor might be changed by the faculty, department, or school. Grades are not official until they appear on a student's academic record.
http://www.calendar.ubc.ca/okanagan/index.cfm?tree=3,41,90,1014

FINAL EXAMINATIONS

The examination period for W2022 is **Sunday December 11th, 2022, to Thursday December 22nd, 2022**. Except in the case of examination clashes and hardships (three or more formal examinations scheduled within a 24-hour period) or unforeseen events, students will be permitted to apply for out-of-time final examinations only if they are representing the University, the province, or the country in a competition or performance; serving in the Canadian military; observing a religious rite; working to support themselves or their family; or caring for a family member. Unforeseen events include (but may not be limited to) the following: ill health or other personal challenges that arise during a term and changes in the requirements of an ongoing job. Further information on **Academic Concession** can be found under **Policies and Regulation in the *Okanagan Academic Calendar*** http://www.calendar.ubc.ca/okanagan/index.cfm?tree=3,48,0,0

ACADEMIC INTEGRITY

The academic enterprise is founded on honesty, civility, and integrity. As members of this enterprise, all students are expected to know, understand, and follow the codes of conduct regarding academic integrity. At the most basic level, this means submitting only original work done by you and acknowledging all sources of information or ideas and attributing them to others as required. This also means you should not cheat, copy, or mislead others about what is your work. Violations of academic integrity (i.e., misconduct) lead to the breakdown of the academic enterprise, and therefore serious consequences arise and harsh sanctions are imposed. For example, incidences of plagiarism or cheating may result in a mark of zero on the assignment or

exam and more serious consequences may apply if the matter is referred to the President's Advisory Committee on Student Discipline. Careful records are kept in order to monitor and prevent recurrences.

A more detailed description of academic integrity, including the University's policies and procedures, may be found in the Academic Calendar at: http://okanagan.students.ubc.ca/calendar/index.cfm?tree=3,54,111,0.

COOPERATION VS. CHEATING

Working with others on assignments is a good way to learn the material and we encourage it. However, there are limits to the degree of cooperation that we will permit. Any level of cooperation beyond what is permitted is considered cheating.

When working on programming assignments, you must work only with others whose understanding of the material is approximately equal to yours. In this situation, working together to find a good approach for solving a programming problem is cooperation; listening while someone dictates a solution is cheating. You must limit collaboration to a high-level discussion of solution strategies, and stop short of actually writing down a group answer. Anything that you hand in, whether it is a written problem or a computer program, must be written by you, from scratch, in your own words. If you base your solution on any other written solution, you are cheating. If you provide your solution for others to use, you are also cheating.

COPYRIGHT DISCLAIMER

Diagrams and figures included in lecture presentations adhere to Copyright Guidelines for UBC Faculty, Staff and Students http://copyright.ubc.ca/requirements/copyright-guidelines/ and UBC Fair Dealing Requirements for Faculty and Staff http://copyright.ubc.ca/requirements/fair-dealing/. Some of these figures and images are subject to copyright and will not be posted to ***Canvas.*** All material uploaded to ***Canvas*** that contain diagrams and figures are used with permission of the publisher; are in the public domain; are licensed by Creative Commons; meet the permitted terms of use of UBC's library license agreements for electronic items; and/or adhere to the UBC Fair Dealing Requirements for Faculty and Staff. Access to the ***Canvas*** course site is limited to students currently registered in this course. Under no circumstance are students permitted to provide any other person with means to access this material. Anyone violating these restrictions may be subject to legal action. Permission to electronically record any course materials must be granted by the instructor. Distribution of this material to a third party is forbidden.

GRIEVANCES AND COMPLAINTS PROCEDURES

A student who has a complaint related to this course should follow the procedures summarized below:

- The student should attempt to resolve the matter with the instructor first. Students may talk first to someone other than the instructor if they do not feel, for whatever reason, that they can directly approach the instructor.
- If the complaint is not resolved to the student's satisfaction, the student should e-mail the Associate Head, Dr. Sylvie Desjardins at sylvie.desjardins@ubc.ca or the Department Head, Dr. John Braun at cmps.depthead@ubc.ca

STUDENT SERVICE RESOURCES

Disability Resource Centre

The Disability Resource Centre ensures educational equity for students with disabilities and chronic medical conditions. If you are disabled, have an injury or illness and require academic accommodations to meet the course objectives, please contact Earllene Roberts, the Diversity Advisor for the Disability Resource Centre located in the University Centre building (UNC 215).

UNC 215 250.807.9263
email: earllene.roberts@ubc.ca
Web: www.students.ok.ubc.ca/drc

Equity and Inclusion Office

Through leadership, vision, and collaborative action, the Equity & Inclusion Office (EIO) develops action strategies in support of efforts to embed equity and inclusion in the daily operations across the campus. The EIO provides education and training from cultivating respectful, inclusive spaces and communities to understanding unconscious/implicit bias and its operation within in campus environments. UBC Policy 3 prohibits discrimination and harassment on the basis of BC's Human Rights Code. If you require assistance related to an issue of equity, educational programs, discrimination or harassment please contact the EIO.

UNC 325H 250.807.9291
email: equity.ubco@ubc.ca
Web: www.equity.ok.ubc.ca

Office of the Ombudsperson for Students

The Office of the Ombudsperson for Students is an independent, confidential and impartial resource to ensure students are treated fairly. The Ombuds Office helps students navigate campus-related fairness concerns. They work with UBC community members individually and at the systemic level to ensure students are treated fairly and can learn, work and live in a fair, equitable and respectful environment. Ombuds helps students gain clarity on UBC policies and procedures, explore options, identify next steps, recommend resources, plan strategies and receive objective feedback to promote constructive problem solving. If you require assistance, please feel free to reach out for more information or to arrange an appointment.

UNC 328 250.807.9818
email: ombuds.office.ok@ubc.ca
Web: www.ombudsoffice.ubc.ca

Sexual Violence Prevention and Response Office (SVPRO)

A safe and confidential place for UBC students, staff and faculty who have experienced sexual violence regardless of when or where it took place. Just want to talk? We are here to listen and help you explore your options. We can help you find a safe place to stay, explain your reporting options (UBC or police), accompany you to the hospital, or support you with academic accommodations. You have the right to choose what happens next. We support your decision, whatever you decide.
Visit svpro.ok.ubc.ca or call us at 250-807-9640.

Independent Investigations Office (IIO)

If you or someone you know has experienced sexual assault or some other form of sexual misconduct by a UBC community member and you want the Independent Investigations Office (IIO) at UBC to

investigate, please contact the **IIO**. Investigations are conducted in a trauma informed, confidential and respectful manner in accordance with the principles of procedural fairness.

You can report your experience directly to the **IIO by** calling 604-827-2060.
Web: https://investigationsoffice.ubc.ca/
E-mail: director.of.investigations@ubc.ca

Student Learning Hub

The Student Learning Hub (LIB 237) is your go-to resource for free math, science, writing, and language learning support. The Hub welcomes undergraduate students from all disciplines and year levels to access a range of supports that include **tutoring in math, sciences, languages, and writing, as well as help with study skills and learning strategies**.
For more information, please visit the Hub's website (https://students.ok.ubc.ca/student-learning-hub/) or call 250-807-9185.

Student Wellness

At UBC Okanagan health services to students are provided by Student Wellness. Nurses, physicians and counsellors provide health care and counselling related to physical health, emotional/mental health and sexual/reproductive health concerns. As well, health promotion, education and research activities are provided to the campus community. If you require assistance with your health, please contact Student Wellness for more information or to book an appointment.

UNC 337 250.807.9270
email: healthwellness.okanagan@ubc.ca
Web: www.students.ok.ubc.ca/health-wellness

SAFEWALK

Don't want to walk alone at night? Not too sure how to get somewhere on campus? Call Safewalk at ***250-807-8076.***

For more information, see: www.security.ok.ubc.ca