UBC MFRE | Master of Food and Resource Economics

FRE 521D: Data Analytics in Climate, Food and Environment

COURSE DESCRIPTION

This course provides an intensive exploration of advanced data analytics methods, specifically machine learning, SQL, and cloud-based data querying. With applications focused on climate, food, and environmental sectors, students will gain expertise in analyzing large datasets, managing and querying databases, and processing cloud-based data, all aimed at addressing real-world challenges in ESG assessment, sustainability, and data-driven decision-making.

COURSE DETAILS

Detail	Information
Instructor Name	Asif Ahmed Neloy
Lecture and Lab Location	MCML 154
Class Days	Monday and Wednesday, 5:30 PM to 7:00 PM
Email	asif.neloy@ubc.ca ; neloyn@myumanitoba.ca

Office Hours

- **Wednesday:** 4:00 PM to 5:00 PM (In-person, by appointment)
- **Thursday:** 11:00 AM to 12:15 PM (Virtual, by appointment)
- **Location: TBA**

TECHNICAL REQUIREMENTS

- **Python** (3.6 to 3.10): https://www.python.org/downloads/
- **Anaconda**: https://www.anaconda.com/products/distribution
- **Jupyter Notebook**: Installed via Anaconda (https://jupyter.org/install)
- **SQLite/SQL Server 2022 (Windows):**
  - SQLite: https://sqlite.org/download.html
  - SQL Server 2022: https://www.microsoft.com/en-ca/sql-server/sql-server-downloads
- **Tableau**: https://www.tableau.com/products/desktop/download

PREFERRED TEXTBOOK (NOT REQUIRED)

- **Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems**. *Author:* Aurélien Géron

LEARNING OUTCOMES AND APPLICATIONS

Machine Learning Fundamentals

Learning Outcomes:

- Attain a comprehensive understanding of machine learning terminology, data preprocessing techniques, and model-building strategies.
- Apply sophisticated machine learning approaches, including regression, classification, clustering, and ensemble models.
- Optimize predictive models through advanced techniques like regularization and data partitioning.
- Implement best practices in managing large-scale machine learning projects.

Applications:

- **Advanced ESG and Environmental Modeling:** Use machine learning to analyze multi-dimensional datasets for ESG risk assessment, predict environmental impacts, and forecast sustainability trends.

SQL -- Advanced Database Management

Learning Outcomes:

- Develop proficiency in relational database design, with an emphasis on optimization, indexing, and high-performance querying.
- Execute complex SQL queries, including advanced joins, recursive CTEs, and analytical functions, to extract meaningful insights.

Applications:

- **Dynamic ESG Metrics and Resource Data Analytics:** Use SQL to manage and analyze large datasets on ESG indicators and environmental metrics.

Data Access and Cloud-Based Querying Platforms (API Methods)

Learning Outcomes:

- Integrate data wrangling and visualization techniques in Python, including multi-source data fusion for comprehensive analysis.
- Evaluate and implement data retrieval from various formats (CSV, JSON, XML) using API methods.

Applications:

- **Automated Environmental Data Systems:** Develop workflows to retrieve, clean, and analyze real-time data from cloud and API sources.

ASSESSMENTS

Assignments (2)/Labs	Focus on SQL, machine learning, and data access using real-world datasets and detailed analysis.	30%
Group Project/Report (1)	Comprehensive data analysis project with end-to-end pipeline integration.	30%
Quizzes (3)	Spaced throughout the term, covering key topics in ML, SQL, and data access.	30%
Case Study/Reading (1)	Critical review and discussion of a sector-relevant case study.	5%
Participation	Active engagement in labs, discussions, and group project collaboration.	5%
Total		100%

COURSE POLICIES

Assignments:

- **Late Submissions:** Assignments must be submitted on time through the designated platform (e.g., Canvas). Late submissions will incur a **25% penalty per day** for up to three days. Assignments submitted more than two days late will receive a grade of zero unless prior arrangements are made and approved.

- **Substandard Format:** Assignments not following the required format (e.g., incomplete documentation, missing sections, or unprofessional presentation) will incur a penalty of **5% per formatting issue**, capped at 15%.

Participation

- Participation accounts for 5% of your overall grade and is evaluated based on the following rubric:

Criteria	Exceeds Expectations (5)	Meets Expectations (3-4)	Needs Improvement (1-2)	Unsatisfactory (0)
Class Engagement	Actively participates in all discussions and activities.	Participates occasionally but meaningfully in discussions.	Rarely participates or contributes to discussions.	No participation in discussions or activities.
Preparation for Class	Always prepared with relevant materials and assignments.	Usually prepared, occasionally misses minor details.	Often unprepared or missing key materials.	Consistently unprepared or absent.
Group Collaboration	Consistently supportive and engaged in group work.	Generally cooperative but may lack initiative.	Minimal effort or cooperation in group tasks.	Disruptive or fails to contribute to group work.

Group Presentations/Reports:

- **Grading Approach:**
  - **Group Grade:** A single grade is applied to all members of the group based on the quality of the presentation/report.
  - **Individual Adjustments:** Peer reviews will be conducted, and adjustments may be made based on individual contributions.

- **Rubrics:** Detailed rubrics for presentations and reports will be provided before the assignments. These rubrics will guide you in understanding expectations for structure, content, analysis, and delivery.

Plagiarism:

Plagiarism or any form of academic dishonesty will result in penalties as outlined below:

- **Serious Issues (e.g., copying entire sections, using unauthorized resources):** A **penalty of 50%** will be applied to the assessment, and the issue will be reported as per MFRE policies.
- **Minor Issues (e.g., improper citation, accidental paraphrasing errors):** A **penalty of 10-20%** will be applied to the assessment, depending on the extent of the issue.
- **Examples:**
  - **Serious:** Copying another student's work, using AI or external resources without acknowledgment, or submitting identical group responses without attribution.
  - **Minor:** Missing citation in one section or small paraphrasing errors in a non-critical part of the report.

COURSE SCHEDULE

Date	Topic	Notes
Week 1-3: Advanced Machine Learning Techniques		
January 6, 2025	Introduction to Data Analytics: Course Overview, Installing Prerequisites, and Basics of Machine Learning Terminology	
January 8, 2025	Machine Learning Basics: Data Engineering and Modeling	**Formation of groups for final project; Assignment 1 Released**
January 13, 2025	Supervised Modeling: Regression Techniques	
January 15, 2025	Supervised Methods: Classification Techniques	**Quiz 1**
January 20, 2025	Introduction to Unsupervised Modeling and Clustering	
January 22, 2025	Unsupervised Modeling: PCA and t-SNE	**Assignment 1 Deadline (Jan 25, 2025)**
January 27, 2025	Final Review of Machine Learning Models (Introduction to Imaging Datasets)	**Quiz 2; Final Project Released**
Week 3-5: Advanced SQL for Data Analytics		
January 29, 2025	SQL Basics: Queries, Joins, and Functions	**Assignment 2 Released**
February 3, 2025	Advanced SQL: Window Functions and Recursive Queries	**Quiz 3**
February 5, 2025	SQL for Time-Series Data and Optimization Techniques	**Assignment 2 Deadline**
Week 5-6: Data Access and Cloud Processing		
February 10, 2025	Data Wrangling in Python: ETL Pipelines	
February 12, 2025	Cloud Platforms: Big Data Handling and Serverless Architecture	**Final Project Submission**

MFRE PROGRAM - COURSE PROTOCOL POLICIES

Working with Others on an Assignment
You are encouraged to work with other students, but you must turn in your own individual assignment. If you have an answer that is too close to another student's answer, this will be considered academic dishonesty and this will be handled according to the MFRE and UBC policies.

Recordings
There is no required distribution of recordings of class. Recording will be provided based upon on the decision of the course instructor. Classes are designed as and are intended to be in-person.

Copyright
All materials of this course (course handouts, lecture slides, assessments, course readings, etc.) are the intellectual property of the 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 and could be subject to legal action. Further, audio or video recording of classes are not permitted without the prior consent of the instructor.

Missing Classes/Labs
Students are expected to attend all classes, labs, or workshops. If you cannot make it to a class, lab, or workshop due to a medical or personal emergency, email your Instructor, your Course Assistant, and Olivier Ntwali, MFRE Program Coordinator ahead of time to let them know.

Respectfulness in the Classroom
Students are expected to be respectful of their colleagues at all times, including faculty, staff and peers. This means being attentive and conscious of words and actions and their impact on others, listening to people with an open mind, treating all MFRE community members equally and understanding diversity.

Respect for Equity, Diversity, and Inclusion
The MFRE Program strives to promote an intellectual community that is enhanced by diversity along various dimensions including status as a First Nation, Métis, Inuit, or Indigenous person, race, ethnicity, gender identity, sexual orientation, religion, political beliefs, social class, and/or disability. It is expected that all students and members of our community conduct themselves with empathy and respect for others.

Centre for Accessibility
The Centre for Accessibility (CfA) facilitates disability-related accommodations and programming initiatives designed to remove barriers for students with disabilities and ongoing medical conditions. If you are registered with the CfA and are eligible for exam accommodations, it is your responsibility to let Olivier Ntwali, Academic Program Coordinator, and each of your Course Instructors know. You should book your exam writing with the CFA using its exam reservation system: for midterm exams or quizzes, at least 7 days in advance; and final exams, 7 days before the start of the formal exam period.

MFRE PROGRAM - ACADEMIC HONESTY POLICIES

Plagiarism and Academic Dishonesty

Academic dishonesty and plagiarism are taken very seriously in the MFRE program. All incidences of plagiarism will be escalated to the MFRE Academic Director with penalties ranging from a mark of zero on the assignment, exam or course to being required to withdraw from the program. Note: If a student needs to extend his/her program due to a failed course or unsatisfactory progress, they will have to pay the full MFRE tuition fees for that term/s.

Academic misconduct that is subject to disciplinary measures includes, but is not limited, to the following:

- **Plagiarism**, which is intellectual theft, occurs where an individual submits or presents the oral or written work of another person as his or her own. Correct citations must be provided where applicable for all reports/assignments. In all MFRE courses, material will be submitted to a service which UBC subscribes to, called TurnItIn. This service checks textual material for originality. For more information, review the TurnItIn website.
- **Using Generative Artificial Intelligence (AI) tools** like ChatGPT, Bard, or other Generative AI models to generate content or conduct analysis for evaluations, without proper citation and or if asked not to use AI, is considered plagiarism and academic misconduct. If students use AI in their submissions, they must cite the AI generator using citations consistent with the UBC Academic Honesty Standards.
- **Cheating**, which may include, but is not limited to falsification of any material subject to academic evaluation, unauthorized collaborative work; or use of unauthorized means to complete an examination.
- **Working with Others on an Assignment** is encouraged, but you must turn in your own individual assignment. If you have an answer that is too close to another student's answer, this will be considered academic dishonesty and a grade of zero will be applied and the matter handled according to the MFRE and UBC policies.
- **Resubmission of Material**, submitting the same, or substantially the same, essay, presentation, or assignment more than once (whether the earlier submission was at this or another institution) unless prior approval has been obtained from the instructor(s) to whom the assignment is to be submitted.
- **Use of Academic Ghostwriting Services**, including hiring of writing or research services and submitting papers or assignments as his or her own.

Student Responsibility: Students are responsible for informing themselves of the guidelines of acceptable and non-acceptable conduct for examinations and graded assignments as presented via MFRE Code of Conduct; MFRE Turn it in, Course Syllabus, MFRE Instructors; Canvas and UBC academic misconduct policies.

Penalties for Academic Dishonesty: Penalties for academic dishonesty are applied at the discretion of the MFRE program. Incidences of academic misconduct may result in a mark of zero on the assignment, examination, or course, required withdrawal from the program, and/or the matter being is referred to UBC Graduate Studies.

LAND ACKNOWLEDGMENT

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.