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Syllabus

ANSC 4240 – Mathematical Modeling of Biological
Systems
(Fall 2020)



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COURSE DETAILS

Course Title & Number:	ANSC 4240 – Mathematical Modeling of Biological Systems
Number of Credit Hours:	3.0
Class Times & Days of Week:	Thursday 2:30-5:15 pm
Location for classes/labs/tutorials:	WebEx Meetings
Pre-Requisites:	MATH 1500 or MATH 1520 or Equivalent or Consent of Instructor

Instructor Contact Information

Instructor(s) Name & Preferred Form of Address:	Marcos Cordeiro
Office Location:	232 Animal Science Building
Office Hours or Availability:	Generally, open door policy from 9:00 am to 4:00 pm but best to schedule an appointment by email
Office Phone No.	(204) 474-6112
Email:	Marcos.Cordeiro@umanitoba.ca All email communication must conform to the Communicating with Students university policy.
Contact:	Students are encouraged to contact the instructor in person, by phone or email during the time outlined above.

Course Description

Agricultural models are becoming increasingly important as tools for assessment of agro-ecosystems as they provide synthesis and quantification of the effects of varying management practices and climate on the agronomic, economic, and environmental performance of agricultural landscapes at varying temporal and spatial scales. In this course, students will create their own modeling workflow through hands on exercises aimed at addressing current challenges in agriculture.

Through lectures, assigned readings, seminars and modelling exercises, students will develop analysis that incorporate different aspects of modelling, from input data screening to model output uncertainty assessment. This course will make use of several freely available modelling packages developed by United States Department of Agriculture (USDA), Agriculture and Agri-Food Canada (AAFC), University of Saskatchewan, and University of Idaho, as well as open-source geographical information systems (GIS) packages such as QGIS. The R programming language will also be used for data acquisition, pre-processing and analyses. Open-source datasets used in this course may include climate (historical and climate

change projections), hydrometric (stream discharge), soils (Soil Landscapes of Canada), land use (Annual Crop Inventory from AAFC), statistical (Census of Agriculture), and remotely sensed (satellite imagery), data.

Course Goals

Through addressing real agricultural challenges in the Canadian context using modelling tools, students will learn (1) to work with a range of agricultural models, datasets, and pre-processing tools, and (2) to develop modelling workflows to address different agricultural issues.

Course Learning Objectives

At the end of the course, students will be able to:

1. Evaluate which modelling tools are appropriate for specific objectives;
2. Screen and curate input data from various sources;
3. Quality control and gap-fill datasets using statistical procedures;
4. Automate the pre-processing of large datasets for modelling exercises;
5. Develop custom workflows to address agricultural issues within a modelling framework;
6. Integrate a range of computer tools to support modelling exercises;
7. Assess model outputs and interpret its implications to the agriculture issue being addressed;

Textbook, Readings, and Course Materials

There are no required texts for the course. However, supplementary readings will be assigned according to the modelling problem being addressed by the students. The following are a few examples of reading materials:

1. Beven, K.J.. 2012. *Rainfall-Runoff Modelling: The Primer*. Wiley: West Sussex, UK.
2. Neitsch, S., et al.. 2011. SWAT2009 Theoretical Documentation. Texas Water Resources Institute Technical Report TR-406.
3. Global Strategy to improve Agricultural and Rural Statistics (GSARS). 2017. *Handbook on Remote Sensing for Agricultural Statistics*. GSARS Handbook: Rome.

These titles are available through the University of Manitoba Libraries or online (free of charge).

Using Copyrighted Material

Please respect copyright. For more information, see the University's Copyright Office website at <http://umanitoba.ca/copyright/> or contact um_copyright@umanitoba.ca.

Course Technology

Different modelling packages (e.g., Integrated Farm Systems Model- IFSM), GIS packages (e.g., QGIS) and programming language open-source software (e.g., R and R Studio) will be used in this course. Students should have administrative rights in the computers they will be using during the lectures in order to install different software packages.

Due to the COVID-19 pandemic and the measures adopted by UM to prevent its spread, lectures will take place online through Webex meetings. Student should refrain from behaviour that is distracting to other students.

Expectations: I Expect You To

- a) Attend class on time so we start on time;

- b) Ask for help when you need assistance;
- c) Submit your own work for individual assignments and to work together in a team for group assigned projects;
- d) To act in a civil, respectful, and responsible manner toward all members of the U of M community. See [Respectful Work and Learning Environment Policy](#).

Class Communication:

Students are required to obtain and use your University of Manitoba email account for all communication between yourself and the university. All communication must comply with the Electronic Communication with Student Policy: http://umanitoba.ca/admin/governance/governing_documents/community/electronic_communication_with_students_policy.html;

Academic Integrity:

Each student in this course is expected to abide by the University of Manitoba [Academic Integrity principles](#). Always remember to reference the work of others that you have used. Also be advised that you are required to complete your assignments independently unless otherwise specified. If you are encouraged to work in a team, ensure that your project complies with the academic integrity regulations. You must do your own work during exams. Inappropriate collaborative behavior and violation of other Academic Integrity principles, will lead to the serious [disciplinary action](#). Visit the [Academic Calendar](#), [Student Advocacy](#), and [Academic Integrity](#) web pages for more information and support.

Refer to specific course requirements for academic integrity for individual and group work such as:

- I. Group projects are subject to the rules of academic dishonesty;
- II. Group members must ensure that a group project adheres to the principles of academic integrity;
- III. Students should also be made aware of any specific instructions concerning study groups and individual assignments;
- IV. The limits of collaboration on assignments should be defined as explicitly as possible; and
- V. All work should be completed independently unless otherwise specified.

Recording Class Lectures:

Cordeiro and the University of Manitoba hold copyright over the course materials, presentations and lectures which form part of this course. No audio or video recording of lectures or presentations is allowed in any format, openly or surreptitiously, in whole or in part without permission. Course materials (both paper and digital) are for the participant's private study and research.

Student Accessibility Services:

The University of Manitoba is committed to providing an accessible academic community. [Students Accessibility Services \(SAS\)](#) offers academic accommodation supports and services such as note-taking, interpreting, assistive technology and exam accommodations. Students who have, or think they may have, a disability (e.g. mental illness, learning, medical, hearing, injury-related, visual) are invited to contact SAS to arrange a confidential consultation.

Student Accessibility Services
520 University Centre
Phone: (204) 474-7423
Email: Student_accessibility@umanitoba.ca

Expectations: You Can Expect Me To

- a) To be available prior to and after the class time to discuss any questions or comments you may have;
- b) To provide feedback on assignments and exams.

CLASS SCHEDULE AND COURSE EVALUATION

This schedule is subject to change at the discretion of the instructor and/or based on the learning needs of the students but such changes are subject to [Section 2.8 of ROASS](#).

Item	Class Content & Teaching Strategies	Evaluation		
		Type of Assessment	Due Date	Value of Final Grade
Sep. 10	Introduction, Course Outline, Schedules. Lec. 01: Why to model?			
Sep. 17	Lec. 02: GIS tools and input data 1 – weather	Assignment 1 – Study area definition and data acquisition	Topic definition for modelling term presentation	
Sep. 24	Lec. 03: Input data 2 – weather (cont'd)	Assignment 2 – Data processing and gap filling	Assignment 1	10%
Oct. 1	Lec. 04: Input data 3 - physiography	Assignment 3 – Spatial properties of study area	Assignment 2	10%
Oct. 8	Lec. 05: Modelling approaches + Guest lecture	Assignment 4 – Estimating NH ₃ emissions using emission factors	Assignment 3	5%
Oct. 15	Lec. 06: Guest lecture	Tutorial – IFSM overview		
Oct. 22	Lec. 07: Agricultural models + Guest lecture	Assignment 5 – Watershed delineation	Assignment 4	10%
Oct. 29	Lec. 08: Model calibration and Validation	Assignment 6 – Model calibration and validation	Assignment 5	5%
Nov. 5	Lec. 08: Model assessment	Assignment 7 – Model assessment using graphical and statistical metrics	Assignment 6	10%
Nov. 12	No class - Fall Term Break			
Nov. 19	Lec. 09: Model uncertainty	Assignment 8 – Uncertainty of future climate ensembles	Assignment 7	10%
Nov. 26	Lec. 10: Scientific progress and biophysical modelling	Assignment 9 – Identifying gaps in model representation	Assignment 8	10%
Dec. 3	No class – preparation of term presentation		Assignment 9	5%
Dec. 11	Term assignment		Presentation	25%
				100%

Grading

Indicate your grading scale. A sample is given below that you can adjust to your course expectations.

Letter Grade	Percentage out of 100	Final Grade Point
A+	90-100	4.5
A	80-89	4.0
B+	75-79	3.5
B	70-74	3.0
C+	65-69	2.5
C	60-64	2.0
D	50-59	1.0
F	Less than 50	0

Voluntary Withdrawal

The last day to drop the class and receive a 100% refund is September 22, 2020. The last day to withdraw with no refund is November 23, 2020. Any student dropping the course after the deadline will be assigned a final grade. Course withdrawals will be recorded on official transcripts. Refer to the Registrar's Office web page for more information.

Referencing Style

Assignments should use the APA reference style as outlined in the text: American Psychological Association. (2009). Publication manual of the American Psychological Association (6th ed.). Washington, DC: Author.

Assignment Feedback

Feedback on assignments, outlines, drafts, and analysis will be within a reasonable amount of time following submission.

Assignment Extension and Late Submission Policy

Extensions will be granted in special cases under instructor discretion.

UNIVERSITY SUPPORT OFFICES & POLICIES

Schedule "A"

Section (a) sample re: A list of academic supports available to Students, such as the Academic Learning Centre, Libraries, and other supports as may be appropriate:

Writing and Learning Support

The Academic Learning Centre (ALC) offers services that may be helpful to you throughout your academic program. Through the ALC, you can meet with a learning specialist to discuss concerns such as time management, learning strategies, and test-taking strategies. The ALC also offers peer supported study groups called Supplemental Instruction (SI) for certain courses that students have typically found difficult. In these study groups, students have opportunities to ask questions, compare notes, discuss content, solve practice problems, and develop new study strategies in a

group-learning format.

You can also meet one-to-one with a writing tutor who can give you feedback at any stage of the writing process, whether you are just beginning to work on a written assignment or already have a draft. If you are interested in meeting with a writing tutor, reserve your appointment two to three days in advance of the time you would like to meet. Also, plan to meet with a writing tutor a few days before your paper is due so that you have time to work with the tutor's feedback.

These Academic Learning Centre services are free for U of M students. For more information, please visit the Academic Learning Centre website at: <http://umanitoba.ca/student/academiclearning/>

You can also contact the Academic Learning Centre by calling 204-480-1481 or by visiting 205 Tier Building.

University of Manitoba Libraries (UML)

As the primary contact for all research needs, your liaison librarian can play a vital role when completing academic papers and assignments. Liaisons can answer questions about managing citations, or locating appropriate resources, and will address any other concerns you may have, regarding the research process. Liaisons can be contacted by email or phone, and are also available to meet with you in-person. A complete list of liaison librarians can be found by subject: <http://bit.ly/WcEbA1> or name: <http://bit.ly/1tJ0bB4>. In addition, general library assistance is provided in person at 19 University Libraries, located on both the Fort Garry and Bannatyne campuses, as well as in many Winnipeg hospitals. For a listing of all libraries, please consult the following: <http://bit.ly/1sXe6RA>. When working remotely, students can also receive help online, via the Ask-a-Librarian chat found on the Libraries' homepage: www.umanitoba.ca/libraries.

Section (b) sample: re: A statement regarding mental health that includes referral information:

For 24/7 mental health support, contact the Mobile Crisis Service at 204-940-1781.

Student Counselling Centre

Contact SCC if you are concerned about any aspect of your mental health, including anxiety, stress, or depression, or for help with relationships or other life concerns. SCC offers crisis services as well as individual, couple, and group counselling. *Student Counselling Centre:* <http://umanitoba.ca/student/counselling/index.html>

474 University Centre or S207 Medical Services
(204) 474-8592

Student Support Case Management

Contact the Student Support Case Management team if you are concerned about yourself or another student and don't know where to turn. SSCM helps connect students with on and off campus resources, provides safety planning, and offers other supports, including consultation, educational workshops, and referral to the STATIS threat assessment team.

Student Support Intake Assistant <http://umanitoba.ca/student/case-manager/index.html>

520 University Centre
(204) 474-7423

University Health Service

Contact UHS for any medical concerns, including mental health problems. UHS offers a full range of medical services to students, including psychiatric consultation.

University Health Service <http://umanitoba.ca/student/health/>

104 University Centre, Fort Garry Campus

(204) 474-8411 (Business hours or after hours/urgent calls)

Health and Wellness

Contact our Health and Wellness Educator if you are interested in information on a broad range of health topics, including physical and mental health concerns, alcohol and substance use harms, and sexual assault.

Health and Wellness Educator <http://umanitoba.ca/student/health-wellness/welcome.html>

Katie.Kutryk@umanitoba.ca

469 University Centre

(204) 295-9032

Live Well @ UofM

For comprehensive information about the full range of health and wellness resources available on campus, visit the Live Well @ UofM site:

<http://umanitoba.ca/student/livewell/index.html>

Section (c) sample: re: A notice with respect to copyright:

All students are required to respect copyright as per Canada's *Copyright Act*. Staff and students play a key role in the University's copyright compliance as we balance user rights for educational purposes with the rights of content creators from around the world. The Copyright Office provides copyright resources and support for all members of the University of Manitoba community. Visit <http://umanitoba.ca/copyright> for more information.

Section (d) sample: re: A statement directing the student to University and Unit policies, procedures, and supplemental information available on-line:

Your rights and responsibilities

As a student of the University of Manitoba you have rights and responsibilities. It is important for you to know what you can expect from the University as a student and to understand what the University expects from you. Become familiar with the policies and procedures of the University and the regulations that are specific to your faculty, college or school.

The [Academic Calendar](http://umanitoba.ca/student/records/academiccalendar.html) <http://umanitoba.ca/student/records/academiccalendar.html> is one important source of information. View the sections *University Policies and Procedures* and *General Academic Regulations*.

While all of the information contained in these two sections is important, the following information is highlighted.

- If you have questions about your grades, talk to your instructor. There is a process for

term work and final **grade appeals**. Note that you have the right to access your final examination scripts. See the Registrar's Office website for more information including appeal deadline dates and the appeal form <http://umanitoba.ca/registrar/>

- You are expected to view the General Academic Regulation section within the Academic Calendar and specifically read the **Academic Integrity** regulation. Consult the course syllabus or ask your instructor for additional information about demonstrating academic integrity in your academic work. Visit the Academic Integrity Site for tools and support <http://umanitoba.ca/academicintegrity/> View the **Student Academic Misconduct** procedure for more information.
- The University is committed to a respectful work and learning environment. You have the right to be treated with respect and you are expected conduct yourself in an appropriate respectful manner. Policies governing behavior include the:

Respectful Work and Learning Environment

http://umanitoba.ca/admin/governance/governing_documents/community/230.html

Student Discipline

http://umanitoba.ca/admin/governance/governing_documents/students/student_discipline.html and,

Violent or Threatening Behaviour

http://umanitoba.ca/admin/governance/governing_documents/community/669.html

- If you experience **Sexual Assault** or know a member of the University community who has, it is important to know there is a policy that provides information about the supports available to those who disclose and outlines a process for reporting. The **Sexual Assault** policy may be found at:
http://umanitoba.ca/admin/governance/governing_documents/community/230.html
More information and resources can be found by reviewing the Sexual Assault site <http://umanitoba.ca/student/sexual-assault/>
- For information about rights and responsibilities regarding **Intellectual Property** view the policy http://umanitoba.ca/admin/governance/media/Intellectual_Property_Policy_-_2013_10_01.pdf

For information on regulations that are specific to your academic program, read the section in the Academic Calendar and on the respective faculty/college/school web site

<http://umanitoba.ca/faculties/>

Contact an **Academic Advisor** within our faculty/college or school for questions about your academic program and regulations <http://umanitoba.ca/academic-advisors/>

Student Advocacy

Contact Student Advocacy if you want to know more about your rights and responsibilities as a student, have questions about policies and procedures, and/or want support in dealing with academic or discipline concerns.

<http://umanitoba.ca/student/advocacy/>

520 University Centre

204 474 7423

student_advocacy@umanitoba.ca