



ANSC*6030 Modelling Metabolic Processes

Fall 2021

Section(s): C01

Department of Animal Biosciences

Credit Weight: 0.50

Version 1.00 - September 08, 2021

1 Course Details

1.1 Calendar Description

Building and testing of mathematical models of metabolic processes using continuous simulation software to assist in weekly assignments. Choice of model based on students' research interests (e.g. protein synthesis, nutrient uptake, rumen fermentation). Term project to reproduce model from scientific knowledge.

1.2 Course Description

The emphasis is really on teaching you to be able to build and test complex models of the systems you will study in your future research careers. All aspects of model development will be taught in lectures with weekly assignments on a common exemplary dynamic system. However, each of you will obtain independence in model construction and analysis with a term project to produce your own model from equations presented in the scientific literature. Once the basics of modelling have been taught, we will examine several different types of more advanced models considering such phenomena as distribution in space and chaos. The orientation of the models selected is towards an improvement in understanding of biological systems currently being studied by experimentation. A previous knowledge of animal biochemistry and physiology is required for the course.

You will learn the process of model development by conducting all the steps yourselves on a simple example model. The lectures will be used to discuss the results of the previous assignment(s) and introduce the methods for the subsequent piece of work.

Lectures will be pre-recorded and made available to students by Sunday evening for viewing

on Monday, weekly throughout the course. Students will be lead through a live discussion on course content during the second half of the scheduled time slot for this course (in person or virtual, based on mutual comfort level). 1on1 consultations will also be available weekly. Weekly assignments will involve short write-ups and overheads or data files on disk prepared for discussion of results in class.

1.3 Timetable

Monday 11:30-2:20, AD-S room - VIRTUAL

Timetable is subject to change. Please see WebAdvisor for the latest information.

COVID-19 Disclaimer: please be aware that the information on course delivery, accessibility and examinations presented in this outline were developed based on current University guidelines. However, due to the continuously evolving situation and resulting changes in public health recommendations, the format and delivery of this course may be revised with limited notice.

1.4 Final Exam

There is no final exam for this course. Final presentations for the course project will be scheduled during the exam period and final papers due a week later.

2 Instructional Support

2.1 Instructional Support Team

Instructor:	Jennifer Ellis Assistant Professor
Email:	jellis@uoguelph.ca
Telephone:	519-824-4120 56522
Office:	ANNU 234b
Office Hours:	Meetings by appointment, Thursdays 830-1130am

2.2 Teaching Assistants

Teaching Assistant (GTA):	Sarah Adams PhD Student
Email:	sadams05@uoguelph.ca
Office Hours:	Will lead weekly open/drop in course content discussion Mondays 1230-220 (in person or virtually)

3 Learning Resources

3.1 Additional Resources

Baldwin, R.L. 1995. Modeling Ruminant Digestion and Metabolism. Chapman & Hall, London, UK (Textbook)

QL 737.U5 B155

Close, C.M. and D.K. Frederick. 2002. Modeling and analysis of dynamic systems. 3rd ed. John Wiley & Sons, New York, USA (Textbook)

QA 402.C53 2002

France, J. and J.H.M. Thornley. 2007. Mathematical models in agriculture: quantitative methods for the plant, animal and ecological sciences. CABI Publ, Wallingford, UK (Textbook)

S 494.5.M3 F72 2007

Gentry, R.D. 1978. Introduction to calculus for the biological and health sciences. Addison-Wesley, Reading, USA (Textbook)

QH 323.5.G46 1978

Lassen, N.A. and W. Perl. 1979. Tracer kinetic methods in medical physiology. Raven Press, New York, USA (Textbook)

QP 43.L37

Shipley, R.A. and R.E. Clark. 1972. Tracer methods for in-vivo kinetics: theory and applications. Academic Press, New York, USA (Textbook)

QP 521.S47

3.2 Course Technology and Technical Support

Course Technologies and Technical Support

System and Software Requirements

This course will use a variety of technologies including;

- CourseLink (main classroom)
- Teams (via Office 365)

To help ensure you have the best learning experience possible, please review the list of system and software requirements.

<https://opened.uoguelph.ca/student-resources/system-and-software-requirements>

CourseLink System Requirements

You are responsible for ensuring that your computer system meets the necessary system requirements. Use the browser check tool to ensure your browser settings are compatible and up to date. (Results will be displayed in a new browser window).

<http://spaces.uoguelph.ca/ed/system-requirements/>
<https://courselink.uoguelph.ca/d2l/systemCheck>

3.2 Technical Support

CourseLink

This course is being offered using CourseLink (powered by D2L's Brightspace), the University of Guelph's online learning management system (LMS). By using this service, you agree to comply with the University of Guelph's Access and Privacy Guidelines. Please visit the D2L website to review the Brightspace privacy statement and Brightspace Learning Environment web accessibility standards.

<http://www.uoguelph.ca/web/privacy/> <https://www.d2l.com/legal/privacy/>
<https://www.d2l.com/accessibility/standards/>

Technical Support

If you need any assistance with the software tools or the CourseLink website, contact CourseLink Support.

Email: courselink@uoguelph.ca

Tel: 519-824-4120 ext. 56939 Toll-Free (CAN/USA): 1-866-275-1478

Support Hours (Eastern Time):

Monday thru Friday: 8:30 am–8:30 pm

Saturday: 10:00 am–4:00 pm

Sunday: 12:00 pm–6:00 pm

Teams (via Office 365)

Office 365 Teams is a collaboration service that provides shared conversation spaces to help teams coordinate and communicate information. This course will use Teams for one on one meetings with your Instructor/TA. It is recommended that you use the desktop version of Teams. As a student you are responsible for learning how to use Teams and it's features.

For Teams Support visit the CCS website for more information.

<https://www.uoguelph.ca/ccs/services/office365/teams>

4 Learning Outcomes

4.1 Course Learning Outcomes

By the end of this course, you should be able to:

1. Knowledgeably discuss simulation modelling of any nature
 2. Build and test complex mathematical models
 3. Use the simulation language ACSL
 4. Understand the processes of numerical and analytical integration
 5. Think of biological problems in terms of mathematical constructs
 6. More fully understand your area of experimental research, no matter the subject
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5 Teaching and Learning Activities

5.1 Lecture

Week 1

Topics: Introduction to modelling philosophies

Assignment 1 issued:

- define HPOC for 3 papers
- create comp1.csl in your SIGNAL directory

Week 2

Topics: Introduction to modelling procedure and ACSL using simple model as example – demonstrate ACSL coding for one pool

Assignment 2 issued:

- Solve the provided 1-compartment model analytically in excel and numerically using acsIX

Week 3

Topics: Introduction to modelling procedure and ACSL using simple model as example – demonstrate ACSL coding for two pool model

Assignment 3 Issued:

- Fitting analytical solutions with WolframAlpha and Excel Solver

Week 4

Topics: Model parameterization - reference state

Assignment 4 Issued:

- Three sentence summary of the use of an exponential equation you find in your research area
- write a model in acslX to reproduce the provided reference state model for milk synthesis and amino acid partitioning

Week 6

Topics: Isotope dilution models

Assignment 5 Issued:

- Use provided steady-state data to estimate glucose and lactate fluxes according to a 2-pool model, and reproduce the hot glucose and hot lactate infusion experiments using an m-file in acslX
- Produce a 3 sentence summary of a paper related to your research area that uses a dual-isotope method to estimate fluxes

Week 7

Topics: Model behaviour analysis

Assignment 6 Issued:

- Find 2-3 references that indicate what flux responses to PGOG should look like
- Do a behaviour analysis of the Cori cycle model built and parameterized last week
- Identify a problem in the model behaviour and fix it by modifying the flow diagram and/or equations

Week 8

Topics: Enzyme kinetics

Assignment 7 issued:

- Use your revised Cori cycle model to reproduce the OGTT experiment of Frayn (1996)
- Plot predicted time courses of concentrations and fluxes on top of observed
- Improve fits to observations by changing parameter values

Week 9

Topics: Project proposals - short oral presentation of what you propose to do for the term project which is to: reconstruct a mathematical model from a scientific paper or develop your own model, produce outputs, and simulate conditions of interest to test and critique model

(No assignment issued)

Week 10

Topics: Evaluating model goodness-of-fit

Assignment 8 Issued:

- determine goodness-of-fit of model to independent data set

Week 11

Topics: Distributed-in-space models

(No assignment issued)

Week 12

Topics: Chaotic models

(No assignment issued)

6 Assessments

Weekly Assignments:

Assignments will be issued on Monday during the recorded lecture, and are due the following Monday before the start of class (11:30 am). Assignments should be submitted via CourseLink Dropbox. Students may submit a draft of their assignment for high-level review/troubleshooting by Thursday at 11:59 pm via CourseLink Dropbox.

Participation:

Students will receive marks for participation via engagement in weekly discussions as well as engagement/questions asked during final presentations.

Final Project:

Students will utilize the skills developed through course content to build/test/modify/use a model from the literature.

Late assignments etc., without prior discussion with the instructor, will receive a grade of zero.

6.1 Marking Schemes & Distributions

Name	Scheme A (%)
Assignment 1	7
Assignment 2	7
Assignment 3	7
Assignment 4	7
Assignment 5	7
Assignment 6	7
Assignment 7	7
Assignment 8	7
Term Project (Oral Presentation)	15
Term Project (Written Report)	15

Name	Scheme A (%)
Participation in Discussion	14
Total	100

6.2 Assessment Details

Participation in Discussion (15%)

Due: on-going throughout the course

Learning Outcome: 1, 5, 6

Students will receive marks for participation via engagement in weekly discussions as well as engagement/questions asked during final presentations.

Term Project (oral presentation) (15%)

Date: Week 12

Learning Outcome: 1, 2, 3, 4, 5, 6

Term Project (written paper) (15%)

Date: Week 13

Learning Outcome: 1, 2, 3, 4, 5, 6

Assignment 1 (6.88%)

Due: Week 2

Assignment Topic: Intro to modelling

Assignment 2 (6.88%)

Due: Week 3

Assignment Topic: Analytical and numerical solutions (acslX and excel)

Assignment 3 (6.88%)

Date: Week 4

Assignment Topic: Fitting analytical solutions with WolframAlpha and Excel Solver

Assignment 4 (6.88%)

Date: Week 6

Assignment Topic: Build a model in acslX to reproduce the reference state model (milk synthesis and amino acid partitioning)

Assignment 5 (6.88%)

Date: Week 7

Assignment Topic: Isotope dilution model

Assignment 6 (6.88%)

Due: Week 8

Assignment Topic: Behaviour analysis

Assignment 7 (6.88%)

Due: Week 9

Assignment Topic: Enzyme kinetics

Assignment 8 (6.88%)

Due: Week 11

Assignment Topic: Model evaluation & goodness of fit

7 Course Statements

7.1 Netiquette Expectations

Inappropriate online behaviour will not be tolerated. Examples of inappropriate online behaviour include:

- Posting inflammatory messages about your instructor or fellow students
- Using obscene or offensive language online
- Copying or presenting someone else's work as your own
- Adapting information from the Internet without using proper citations or references
- Buying or selling term papers or assignments
- Posting or selling course materials to course notes websites
- Having someone else complete your quiz or completing a quiz for/with another student
- Stating false claims about lost quiz answers or other assignment submissions
- Threatening or harassing a student or instructor online

- Discriminating against fellow students, instructors and/or TAs
- Using the course website to promote profit-driven products or services
- Attempting to compromise the security or functionality of the learning management system
- Sharing your user name and password
- Recording lectures without the permission of the instructor

7.2 Dropbox Submissions

Assignments should be submitted electronically via the online **Dropbox** tool. When submitting your assignments using the **Dropbox** tool, do not leave the page until your assignment has successfully uploaded. To verify that your submission was complete, you can view the submission history immediately after the upload to see which files uploaded successfully. The system will also email you a receipt. Save this email receipt as proof of submission.

Be sure to keep a back-up copy of all of your assignments in the event that they are lost in transition. In order to avoid any last-minute computer problems, your instructor strongly recommend you save your assignments to a cloud-based file storage (e.g., OneDrive), or send to your email account, so that should something happen to your computer, the assignment could still be submitted on time or re-submitted.

It is your responsibility to submit your assignments on time as specified on the Schedule. Be sure to check the technical requirements and make sure you have the proper computer, that you have a supported browser, and that you have reliable Internet access. Remember that **technical difficulty is not an excuse not to turn in your assignment on time**. Don't wait until the last minute as you may get behind in your work.

If, for some reason, you have a technical difficulty when submitting your assignment electronically, please contact your instructor or CourseLink Support.

<http://spaces.uoguelph.ca/ed/contact-us/>

7.3 Late Policy

If you choose to submit assignments to the **Dropbox** tool late, without prior discussion with the instructor, will receive a grade of zero. Late Graded Homework Assignments will NOT be graded if they are submitted after the solutions have been posted to CourseLink.

Extensions will be considered for medical reasons or other extenuating circumstances. If you require an extension, discuss this with the instructor as soon as possible and well before the due date. Barring exceptional circumstances, extensions will not be granted once the due date has passed. These rules are not designed to be arbitrary, nor are they inflexible. They are designed to keep you organized, to ensure that all students have the same amount of time to work on assignments, and to help to return marked materials to you in the shortest possible time.

8 University Statements

8.1 Email Communication

As per university regulations, all students are required to check their e-mail account regularly: e-mail is the official route of communication between the University and its students.

8.2 When You Cannot Meet a Course Requirement

When you find yourself unable to meet an in-course requirement because of illness or compassionate reasons please advise the course instructor (or designated person, such as a teaching assistant) in writing, with your name, id#, and e-mail contact. The grounds for Academic Consideration are detailed in the Undergraduate and Graduate Calendars.

Undergraduate Calendar - Academic Consideration and Appeals

<https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml>

Graduate Calendar - Grounds for Academic Consideration

<https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/index.shtml>

Associate Diploma Calendar - Academic Consideration, Appeals and Petitions

<https://www.uoguelph.ca/registrar/calendars/diploma/current/index.shtml>

8.3 Drop Date

Students will have until the last day of classes to drop courses without academic penalty. The deadline to drop two-semester courses will be the last day of classes in the second semester. This applies to all students (undergraduate, graduate and diploma) except for Doctor of Veterinary Medicine and Associate Diploma in Veterinary Technology (conventional and alternative delivery) students. The regulations and procedures for course registration are available in their respective Academic Calendars.

Undergraduate Calendar - Dropping Courses

<https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-drop.shtml>

Graduate Calendar - Registration Changes

<https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/genreg-reg-regchg.shtml>

Associate Diploma Calendar - Dropping Courses

<https://www.uoguelph.ca/registrar/calendars/diploma/current/c08/c08-drop.shtml>

8.4 Copies of Out-of-class Assignments

Keep paper and/or other reliable back-up copies of all out-of-class assignments: you may be asked to resubmit work at any time.

8.5 Accessibility

The University promotes the full participation of students who experience disabilities in their academic programs. To that end, the provision of academic accommodation is a shared responsibility between the University and the student.

When accommodations are needed, the student is required to first register with Student Accessibility Services (SAS). Documentation to substantiate the existence of a disability is required; however, interim accommodations may be possible while that process is underway.

Accommodations are available for both permanent and temporary disabilities. It should be noted that common illnesses such as a cold or the flu do not constitute a disability.

Use of the SAS Exam Centre requires students to book their exams at least 7 days in advance and not later than the 40th Class Day.

For Guelph students, information can be found on the SAS website

<https://www.uoguelph.ca/sas>

For Ridgetown students, information can be found on the Ridgetown SAS website

<https://www.ridgetownc.com/services/accessibilityservices.cfm>

8.6 Academic Integrity

The University of Guelph is committed to upholding the highest standards of academic integrity, and it is the responsibility of all members of the University community-faculty, staff, and students-to be aware of what constitutes academic misconduct and to do as much as possible to prevent academic offences from occurring. University of Guelph students have the responsibility of abiding by the University's policy on academic misconduct regardless of their location of study; faculty, staff, and students have the responsibility of supporting an environment that encourages academic integrity. Students need to remain aware that instructors have access to and the right to use electronic and other means of detection.

Please note: Whether or not a student intended to commit academic misconduct is not relevant for a finding of guilt. Hurried or careless submission of assignments does not excuse students from responsibility for verifying the academic integrity of their work before submitting it. Students who are in any doubt as to whether an action on their part could be construed as an academic offence should consult with a faculty member or faculty advisor.

Undergraduate Calendar - Academic Misconduct

<https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml>

Graduate Calendar - Academic Misconduct

<https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/index.shtml>

8.7 Recording of Materials

Presentations that are made in relation to course work - including lectures - cannot be recorded or copied without the permission of the presenter, whether the instructor, a student, or guest lecturer. Material recorded with permission is restricted to use for that course unless further permission is granted.

8.8 Resources

The Academic Calendars are the source of information about the University of Guelph's procedures, policies, and regulations that apply to undergraduate, graduate, and diploma programs.

Academic Calendars

<https://www.uoguelph.ca/academics/calendars>

8.9 Disclaimer

Please note that the ongoing COVID-19 pandemic may necessitate a revision of the format of course offerings, changes in classroom protocols, and academic schedules. Any such changes will be announced via CourseLink and/or class email.

This includes on-campus scheduling during the semester, mid-terms and final examination schedules. All University-wide decisions will be posted on the COVID-19 website (<https://news.uoguelph.ca/2019-novel-coronavirus-information/>) and circulated by email.

8.10 Illness

Medical notes will not normally be required for singular instances of academic consideration, although students may be required to provide supporting documentation for multiple missed assessments or when involving a large part of a course (e.g.. final exam or major assignment).

8.11 Covid-19 Safety Protocols

For information on current safety protocols, follow these links:

- <https://news.uoguelph.ca/return-to-campus/how-u-of-g-is-preparing-for-your-safe-return/>
- <https://news.uoguelph.ca/return-to-campus/spaces/#ClassroomSpaces>

Please note, these guidelines may be updated as required in response to evolving University, Public Health or government directives.
