



# ANSC\*4040 Digital Technologies for Animal Production Systems

Fall 2022  
Section(s): C01

Department of Animal Biosciences  
Credit Weight: 0.50  
Version 2.00 - September 08, 2022

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## 1 Course Details

### 1.1 Calendar Description

Major topics and methods which fall within the scope of 'digital animal production' will be covered. Broad areas of focus include feed formulation, animal models and the application of machine learning within animal production systems.

**Pre-Requisites:** ANSC\*3120, STAT\*2040  
**Restrictions:** Registration in BSC.AGR, BSC.ABIO.

### 1.2 Course Description

Globally, animal production systems are rapidly digitalizing, capturing large volumes of data automatically, increasingly utilizing sensors to monitor individual animals, using machine learning algorithms to interpret sensor data and relying on complex computational/modelling systems for decision-making and problem solving on farm. This technical leap forward in animal production systems requires a strong data/computational skill-set in our graduates. Therefore, this course will introduce students to major topics and methods that fall within the scope of 'digital animal production'. Topics include data management and manipulation, predictive growth curves, feed formulation, and animal models, as well as introduce students to concepts in machine learning, sensors and precision nutrition as applied on farm. Students should leave the course with solid computational skills and an understanding of the application of digital tools (ie. sensors, models, etc.) used in animal production systems. Students will be evaluated via assignments, a written review paper and final presentation.

### 1.3 Timetable

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

Lectures: Two lectures per week (50 min each) - Monday & Wednesday at 1:30 pm

Labs: One lab per week (3 hrs each) - Friday at 2:30 pm

## 1.4 Final Exam

This course has no final exam. The final written paper is due on the 9th day of the examination period (Dec. 13, 2022).

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## 2 Instructional Support

### 2.1 Instructional Support Team

**Instructor:** Jennifer Ellis Assistant Professor, Animal Systems Modelling  
**Email:** jellis@uoguelph.ca  
**Telephone:** 1-519-824-4120 x 56522  
**Office:** 234b  
**Office Hours:** Office hours will be posted weekly as bookable 15 or 30 min slots.

**Instructor:** Dan Tulpan Assistant professor  
**Email:** dtulpan@uoguelph.ca  
**Telephone:** 1-519-824-4120 x52482  
**Office:** 127

### 2.2 Teaching Assistants

**Teaching Assistant (GTA):** Jihao You PhD Candidate  
**Email:** jyou03@uoguelph.ca  
**Office Hours:** Office hours will be posted weekly as bookable 15 or 30 min slots.

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## 3 Learning Resources

The instructors and TA will lecture (in person) in an interactive discussion-based manner, provide feedback to students on assignments, oversee/prepare applied learning exercises and mark assignments. Copies of the lectures will be provided as PDFs via CourseLink.

### 3.1 Required Resources

#### Course Website (Website)

Course material, news, announcements, and grades will be regularly posted to the ANSC\*4040 CourseLink site. You are responsible for checking the site regularly.

#### Course Materials (Other)

- Course notes will be used during the course (available in the course's webpage).
  - Additional, pertinent information, such as papers, chapters of books, etc. will be accordingly recommended and placed on the course's webpage.
  - Students are advised to take their own notes during lectures.
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## 4 Learning Outcomes

### 4.1 Course Learning Outcomes

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

1. Perform basic data manipulations common in animal science.
  2. Troubleshoot data calculation and coding problems.
  3. Apply statistical and computational methodologies to gain insight from real animal data.
  4. Interpret and judge the biological significance of mathematical equations & code
  5. Explain and discuss new and emerging digital tools, applications and developments in animal production.
  6. Communicate scientific content in numerical, written and oral form accurately and effectively.
  7. Use terminology common in digital animal production proficiently.
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## 5 Teaching and Learning Activities

### 5.1 Lecture

#### Week 1

**Topics:** (first lecture date: Mon Sept 12, 2022)

Lecture 1 - Course Introduction

#### Week 1

**Topics:** Lecture 2 - Introduction to Digital Animal Production

#### Week 2

**Topics:** Lectures 3 & 4 - There are no lectures in week 2. Instead, students have been offered online registration for the 'Modelling Nutrient Utilization in Farm Animals (ModNut)' conference being held in Sardinia this week. Assignment 1 is based off of conference presentations watched.

**Week 3**

**Topics:** Lecture 5 - Feed Formulation Module - basic nutrient calculations (review)

**Week 3**

**Topics:** Lecture 6 - Feed Formulation Module - Principles of feed formulation - linear programming

**Week 4**

**Topics:** Lecture 7 - Feed Formulation module - advanced formulation

**Week 4**

**Topics:** Lecture 8 - Feed Formulation module - degradability of feedstuffs

**Week 5**

**Topics:** Lecture 9 - Empirical models in Animal Science - Animal growth & production curves

**Week 6**

**Topics:** Lecture 10 - Requirement models for Animal Nutrition

**Week 6**

**Topics:** Lecture 11 - Advanced Requirement Models for Animal Nutrition

**Week 7**

**Topics:** Lecture 12 - System level models - Inventory models

**Week 7**

**Topics:** Lecture 13 - System level models - whole farm models

**Week 8**

**Topics:** Lecture 14 - Response models - digestion kinetic models

**Week 8**

**Topics:** Lecture 15 - Response models - metabolism models

**Week 9**

**Topics:** Lecture 16 - Digitization - Machine learning in animal science (Instructor: Dan Tulpan)

**Week 9**

**Topics:** Lecture 17 - Digitization - Machine learning in animal science (Instructor: Dan Tulpan)

**Week 10**

**Topics:** Lecture 18 - Digitization - digital tools & on-farm sensors (Instructor: Dan Tulpan)

**Week 10**

**Topics:** Lecture 19 - Digitization - digital tools & on-farm sensors (Instructor: Dan Tulpan)

**Week 11**

**Topics:** Lecture 20 - Precision nutrition

**Week 11**

**Topics:** Lecture 21 - Precision nutrition

**Week 12**

**Topics:** Lecture 22 - Review and wrap-up

**Week 12**

**Topics:** Lecture 23 - Review and wrap-up

**5.2 Lab**

**Week 1**

**Topics:** (first Lab Date: Fri Sept 16th)

Lab 1 - Industry Guest Speaker - Digitization of Animal Production

Assignment 1 issued.

**Week 2**

**Topics:** This lab is a drop in session with the course TA, to review and discuss any problems with Assignment 1.

**Week 3**

**Topics:** Lab 3 - Feed Formulation problem - linear programming

Assignment 2 issued.

**Week 4**

**Topics:** Lab 5 - NIRS - Industry Guest Speaker

**Week 5**

**Topics:** Lab 5 - Fitting growth and production curves

Assignment 3 issued.

**Week 6**

**Topics:** Lab 6 - Models applied in industry - Industry Guest speaker

**Week 7**

**Topics:** Lab 7 - model creation and coding exercise

Assignment 4 issued.

**Week 8**

**Topics:** Lab 8 - System level models - Guest Speaker

**Week 9**

**Topics:** Lab 9 - machine learning exercise

Assignment 5 issued.

**Week 10**

**Topics:** Lab 10 - Farm visit (in person) - Elora Dairy

**Week 11**

**Topics:** Lab 11 - Precision Nutrition - Guest speaker

**Week 12**

**Topics:** Lab 12 - Final Presentations (students)

## 6 Assessments

### 6.1 Marking Schemes & Distributions

Assignment	Due Date	Weighting	Learning Ass
A1: ModNut presentation Q&A	Week 2	8%	1-4

A2: Feed formulation	Week 4	8%	1-4
A3: Growth curve fitting	Week 6	8%	1-4
A4: Model coding	Week 8	8%	1-4
A5: ML & sensors	Week 10	8%	1-4
Final Presentation - Review "Advances in..."	Week 12	20%	4
Final Paper - Review "Advances in..."	Week 14	30%	4
Participation (engagement in lab activities, questions asked, etc.)	Throughout	10%	6

## 6.2 Assessment Descriptions

### Assignments A1-A5 (5 assignments, 8% each)

The assignments are worth 8% each. Each assignment will encompass independent exercises based on the lecture and lab content. Focus is on ability to apply concepts learned in lecture and lab to solve applied problem exercises provided.

### Review Papers (30% of final grade)

Students will produce an 'Advances in...' review paper on a topic of their choice related to the course content.

### Final Presentation (20% of final grade)

Students will present their review findings to their classmates in a final presentation. Focus will be on reviewing their findings and 'forward thinking' - proposing how the technology might be further utilized in animal production systems.

### Participation (10%)

Students will be evaluated on their participation and active engagement in lecture and lab content (via, e.g. questions asked, comments and thoughts shared, etc.).

## 7 Course Statements

### 7.1 Course Policy on e-mail



Email is used as an important source of updates about this course. All official email from the instructor will be sent to your University email account (@uoguelph.ca) - university policy prohibits us from responding to non-UofG emails with any course information. It is expected that you are checking your official email account on a frequent basis.

If you email a course instructor, please keep in mind that the instructors receive a lot of email each day. The instructors for this course are involved with other courses and research commitments, just as you are. In order to facilitate a response to your email, please consider the following guidelines: (1) Allow up to 24 to 48 hours for a response. Emails received outside of normal working hours will not be viewed until the next business day.

## 7.2 Course Policy on Technology

It is your responsibility to make sure you have access to a good internet connection and a suitable computer or electronic device along with a web camera, microphone and speakers/headphones. Your device needs to be capable of browsing and reviewing recorded or live video, audio and printed content from Courselink and across the internet. The University of Guelph's online Learning Management System (aka CourseLink) is integral to the delivery of this course. It is also your responsibility to ensure that you can access the course materials and complete online course requirements within the time allotted. If CourseLink is not accessible for a significant period of time (not including scheduled maintenance) deemed by the instructor to have had an impact on students' abilities to complete assignments, deadlines will be extended. In addition to accessing the Courselink website via a suitable web browser, additional software and applications may be used in the delivery of this course. These will include but not be limited to Zoom, Webex, MS Teams, MSOffice365 (Word, PowerPoint, Excel), Slido, email and a multi-purpose media player. The instructors will provide recommendations for software applications that are suitable for the purposes of the course but you will be ultimately responsible for finding, installing and maintaining any applications you use for this course. In any online sessions, you need to use technology to connect to course events as well as take notes and interact with the course material. This should be done in a way that respects your fellow students by not creating undue distractions (see below under Online Behaviour). Also, keep in mind that if your technology uses the University's network, the University's acceptable use policy also comes into play. [http://www.uoguelph.ca/cio/sites/uoguelph.ca.cio/files/CIO-ITSecurity-03.1.3-AUP-Approved\\_0.pdf](http://www.uoguelph.ca/cio/sites/uoguelph.ca.cio/files/CIO-ITSecurity-03.1.3-AUP-Approved_0.pdf)

## 7.3 Recording of Online Course Activities

Some learning activities in this course may be shifted from face-to-face instruction to remote online instruction. As a result of accessibility needs, learning activities may be recorded by the instructor or TAs and posted to CourseLink, Zoom, YouTube or another appropriate platform for grading and dissemination. As a result, individual students may be recorded during these sessions. By enrolling in this course, it is assumed that students agree to the possibility of being recorded during classes or other "live" course activities. If you prefer not to be distinguishable during a recording, you may:

1. Turn off your camera,
2. Mute your microphone (you should always mute your microphone when not participating

anyway),

3. Edit your identification in the online session or application (e.g. use your initials instead),
4. Use the chat function to pose questions (again with identifying information adjusted)

Students who express to the instructors or TAs that they, or a reference to their name or person, do not wish to be recorded may discuss possible alternatives or accommodations with the instructors or TAs.

## 7.4 Course Policy Regarding use of Electronic Devices and Recording of Lectures

In keeping with University policy, electronic recording of classes is expressly forbidden without consent of the individual instructor for that class. When recordings are permitted, they are solely for the use of the authorized student and may not be reproduced or transmitted to others, without the express written consent of the instructor. If the instructor provides a recording of the class or learning activity, these recordings are also solely for the use of the authorized student and may not be reproduced or transmitted to others, without the express written consent of the instructor. Please note that, if provided, these recordings are an optional additional tool for assisting with your learning and there is no guarantee a recording will be available for every online activity.

## 7.5 Online Behaviour – “Netiquette”

**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

## 7.6 Late Policy for Assignments

Assignments should be submitted via the CourseLink Drop Box.

If you choose to submit assignments to the Dropbox tool late, the full allocated mark will be reduced by 10% per day after the deadline for the submission of the assignment to a limit of six days at which time access to the Dropbox folder will be closed. 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 make a booking at least 14 days in advance, and no later than November 1 (fall), March 1 (winter) or July 1 (summer). Similarly, new or changed accommodations for online quizzes, tests and exams must be approved at least a week ahead of time.

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.

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