MBG*4030 - Animal Breeding Methods and Applications

Winter 2026 Course Outline
Section: 01
Credits: 0.50

Land Acknowledgement: Guelph

The University of Guelph resides on the ancestral lands of the Attawandaron people and the treaty lands and territory of the Mississaugas of the Credit. We recognize the significance of the Dish with One Spoon Covenant to this land and offer respect to our Anishinaabe, Haudenosaunee and Métis neighbours. Today, this gathering place is home to many First Nations, Inuit, and Métis peoples and acknowledging them reminds us of our important connection to this land where we work and learn.

Calendar Description

Theoretical and scientific aspects of practical animal breeding programs which lead to genetic improvement of efficiency and profitability of animal production will be presented along with applications to livestock and poultry species. This course integrates quantitative genetics with concepts of statistics, economics, biology and biotechnology and expands into development of practical breeding plans.
Prerequisite(s): MBG*3060
Department(s): Department of Animal Biosciences

Course Description

This is a fourth-year undergraduate course for the study of methodology in animal breeding used for genetic improvement of livestock. This course covers the practical application of methods for genetic assessment of animals and breeding programs; the development of appropriate linear models for analysis of data; understanding genetic parameters; and the measurement of genetic change in the population. Genetic theory is reviewed as needed. The course involves statistical methods and computing (using R) to learn data analysis techniques in animal breeding.

The course is rounded off with a series of guest lectures from industry and not-for-profit organizations involved in national genetic evaluation and other applications of theory learned in the course.

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A pre-requisite of STAT*2040 is strongly encouraged for success in this course.

Lecture Schedule

MonWedFri 1:30pm-2:20pm in MCKN*115 (1/5 to 4/21)

Lab Schedule

Day	Time	Location
Lecture: Mo, We, Fr	1:30-2:20PM	MCKN 115

Day	Time	Location	Sections
We	2:30-4:20	ANNU 102	02
Fr	8:30-10:20	ANNU 102	01

Instructor Information

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Textbooks

Group	Title	Author	ISBN
Recommended	Linear Models for the Prediction of Animal Breeding Values	Mrode, R	Paperback: ISBN: 978-1-84593-981-6; 343 pages: Hardback: ISBN: 978-1-78064-391-5, 343 pages; ePDF: eISBN: 978-1-78064-390-8, 343 pages
Recommended	Understanding Animal Breeding	Bourdon, R.M.	ISBN-10 0130964492

Learning Resources

Required Resources

Notes, lecture slides, assignments, data sets, R scripts, etc. will be posted on CourseLink. Most of the assignments will require the use of free R software (see Links at CourseLink for download). Please see the Links section for additional materials. Students are advised to take their own notes during lectures. Course link (Website) (https://courselink.uoguelph.ca/)

Campus Resources

If you are concerned about any aspect of your academic program: Make an appointment with a Program Counsellor (https://www.uoguelph.ca/uaic/programcounsellors) in your degree program. If you are struggling to succeed academically: There are numerous academic resources offered by the Learning Commons (https://www.lib.uoguelph.ca/using-library/spaces/learning-commons) including, Supported Learning Groups for a variety of courses, workshops related to time management, taking multiple choice exams, and general study skills.

Cost of Textbooks and Learning Resources

Textbook / Learning Resource	Required / Recommended	Cost
Understanding Animal Breeding	Recommended	$117.09
Linear Models for the Prediction of Animal Breeding Values	Recommended	$33.09

Students are advised that prices are often determined by the publisher or bookstore and may be subject to change.

Course Learning Outcomes

1. Integrate quantitative genetics with statistics and biology to evaluate the breeding merit of animals.
2. Perform and understand simple data analyses for predicting breeding values of livestock.
3. Appreciate differences among livestock species and their production systems.
4. Integrate knowledge of genetic improvement techniques and evaluate how those techniques are applied to breeding programs in different species.
5. Discuss the relative merits of methods used to predict breeding values and select for multiple objectives.
6. Optimize selection and mating decisions for maximum genetic response in practical breeding schemes.
7. Assess the impact of new technologies and methods in reproduction and molecular genetics on breeding programs.

8. Accurately and effectively record and communicate scientific analyses in graphic and written form.
9. Have a command of basic terminology common in applied livestock genetics / genomics.

Tentative Schedule of Lectures

Week of	Topic	Activities	Due
1/5	Genetics Overview Matrix Algebra Linear Models Lab 0 (https://calendar.uoguelph.ca/syllabi/2026-winter/mbg-4030-01-mbg_4030_01/#topic-lab-0)		
1/12	ANOVA Solving Mixed Models Pedigree and Relationships Lab 1 (https://calendar.uoguelph.ca/syllabi/2026-winter/mbg-4030-01-mbg_4030_01/#topic-lab-1)		
1/19	Animal Models Animal Models with BLUP Variance Estimation Lab 2 (https://calendar.uoguelph.ca/syllabi/2026-winter/mbg-4030-01-mbg_4030_01/#topic-lab-2)		
1/26	Genomic Markers and Linage Disequilibrium Genomics (1) Genomics (2) Lab 3 (https://calendar.uoguelph.ca/syllabi/2026-winter/mbg-4030-01-mbg_4030_01/#topic-lab-3)		
2/2	Sire Models Repeated Records Models Maternal Models Lab 4 (https://calendar.uoguelph.ca/syllabi/2026-winter/mbg-4030-01-mbg_4030_01/#topic-lab-4)		
2/9	Multiple Traits (1) Mid Term Review Mid Term Lab 5 (https://calendar.uoguelph.ca/syllabi/2026-winter/mbg-4030-01-mbg_4030_01/#topic-lab-5)		
2/16		Winter Break	
2/18		Winter Break	
2/20		Winter Break	
2/23	Multi-trait selection (2) Key Equation Key Equation Including Genomics Lab 6 (https://calendar.uoguelph.ca/syllabi/2026-winter/mbg-4030-01-mbg_4030_01/#topic-lab-6)		

3/2	Mating and Heterosis (1) Mating and Heterosis (2) Ethics in Breeding Lab 7 (https://calendar.uoguelph.ca/syllabi/2026-winter/mbg-4030-01-mbg_4030_01/#topic-lab-7)	
3/9	Research Presentations (1) Research Presentations (2) Research Presentation (3) Lab 8 (https://calendar.uoguelph.ca/syllabi/2026-winter/mbg-4030-01-mbg_4030_01/#topic-lab-8)	
3/16	Guest Lecture 1 Guest Lecture 2 Guest Lecture 3 Lab 9 (https://calendar.uoguelph.ca/syllabi/2026-winter/mbg-4030-01-mbg_4030_01/#topic-lab-9)	
3/23	Guest Lecture 4 Guest Lecture 5 Lab 10 (https://calendar.uoguelph.ca/syllabi/2026-winter/mbg-4030-01-mbg_4030_01/#topic-lab-10)	
3/30	Guest Lecture 6 Guest Lecture 7 Final Review	
4/3		Holiday

Lab / Seminar Schedule

Lab 0

Introduction to R

Lab 1

Matrix Algebra

Lab 2

Data Exploration, Linear Models, ANOVA

Lab 3

Inbreeding, Relationship matrices

Lab 4

Animal Model, BLUP Breeding Values, Mixed Model Equations

Lab 5

Sire Model, Repeated Records Model, Maternal Effects Model

Lab 6

Markers / Genomics

Lab 7

Key Equation, Selection

Lab 8
Multiple Trait Selection, Aggregate Genotypes, Selection Index

Lab 9
Heterosis and Crossbreeding

Lab 10
Ethics

Open Study / Question Period

Assessment Breakdown

Description	Weighting (%)	Due Date
Lab Assignments	30%	Weekly
Midterm	20%	February 13th
Lab Binder	20%	April10th
Final Exam	30%	April 16th

Assessment Details

Lab Activities

Lab Assignments **30%**
Lab Assignments:

- Lab assignments contribute 30% to the final grade.
- Assignments will be posted on CourseLink and discussed during labs. I expect students to make full use of lab time to learn methods and techniques needed in the assignments.
- You will have one week to work on the assignments and hand them in during the next lab.
- **Late assignments will not be accepted.**
- Marked assignments will be returned during labs the following week. Solutions and Grades will be posted on CourseLink.
- There will be 10 assignments. It is in your best interest to do them all, as they reinforce concepts introduced in class and are good practice for exams.
- Missed assignments will receive a grade of 0. If you miss more than one assignment for a valid reason (reasoning is at the instructors discretion) your mark will be re-weighted based on those that were handed in.

Course Learning Outcomes Assessed: 1, 2, 3, 4, 5, 6, 7, 8, 9

Lab Binders **20%**
Lab Binder:

- The lab binder will contribute 20% to the final grade.
- The lab binder is a collection of all lab exercises, including assignments, R scripts, answers, and summary / discussion pages for each lab.
- The lab binder is due on April 10th
- Grading of lab binders will be as follows:
  - Contents page (5 points)
  - Completeness / Uniformity (5 points)
  - Clarity / Structure (5 points)
  - R scripts (10 points)
  - Discussions (20 points)
  - Overall impression (5 points)

Course Learning Outcomes Assessed: 1, 2, 3, 4, 5, 6, 7, 8, 9

Exam

Midterm 20%

Midterm:

- The midterm examination will contribute 20% to the final grade.
- The midterm examination will take place in class on Friday, February 13th.
- You will receive one page with formulas you might need for the midterm.
- If you miss the midterm for a valid reason (at the instructors discretion), your final exam will be worth 50% of your final grade.

Course Learning Outcomes Assessed: 1, 2, 3, 4, 5

Final Exam 30%

For day and time see "Final Exam" section below.

Final Exam:

- The final exam is worth 30% of your final grade.
- Exams will cover both lab and lecture material.
- You will receive one page with formulas you might need for the final exam.
- You can use your own calculator.
- The exam will be held on April 16th from 11:30am-1:30pm.

Course Learning Outcomes Assessed: 1, 2, 3, 4, 5, 6, 7, 8, 9

Final Exam

Date: Apr 16

Time: Th 11:30am-1:30pm

Location: TBA *Please see Web Advisor closer to the date of scheduled final for location.*

To understand rules and regulations regarding Examinations students are encouraged to read Student's Responsibilities (https://calendar.uoguelph.ca/undergraduate-calendar/undergraduate-degree-regulations-procedures/examinations/)

If the student is unable to meet the final exam requirements due to medical, psychological or compassionate circumstances they are encouraged to review Student's Responsibilities in the Academic Consideration, Appeals and Petitions (https://calendar.uoguelph.ca/undergraduate-calendar/undergraduate-degree-regulations-procedures/academic-consideration-appeals-petitions/) section of the Academic Calendar.

Last Day to Drop Course

The final day to drop Winter 2026 courses without academic penalty is the last day of classes: April 06

After this date, a mark will be recorded, whether course work is completed or not (a zero is assigned for missed tests/assignments). This mark will show on the student's transcript and will be calculated into their average.

Course Grading Policies

Submission of Assignments

Assignments are to be submitted as described in the lab material which will be dispersed during the first lab. File naming and formatting will be described in detail, and assignments must follow the format documented or they may not be accepted.

Late Assignment

Late assignments will not be accepted and will result in a grade of zero.

Course Standard Statements

Course Policies

Students are expected to attend all lectures, labs and exams in person.

Online Behaviour

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 username and password
- Recording lectures without the permission of the instructor

Technical Skills

As part of your learning experience, you are expected to use a variety of technologies for assignments, lectures, teamwork, and meetings. In order to be successful in this course you will need to have the following technical skills:

- Manage files and folders on your computer (e.g., save, name, copy, backup, rename, delete, and check properties);
- Install software, security, and virus protection;
- Use office applications (e.g., Word, PowerPoint, Excel, or similar) to create documents;
- Be comfortable uploading and downloading saved files;
- Communicate using email (e.g., create, receive, reply, print, send, download, and open attachments);
- Navigate the CourseLink learning environment and use the essential tools, such as Dropbox, Quizzes, Discussions, and Grades (the instructions for this are given in your course);
- Access, navigate, and search the Internet using a web browser (e.g., Firefox, Internet Explorer); and
- Perform online research using various search engines (e.g., Google) and library databases.

Course Technology and Technical Support

System and Software Requirements

This course will use a variety of technologies including;

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

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 (https://opened.uoguelph.ca/student-resources/system-and-software-requirements). Use the browser check (http://courselink.uoguelph.ca/d2l/tools/system_check/systemcheck.asp?ou=6605) tool to ensure your browser settings are compatible and up to date. (Results will be displayed in a new browser window).

Course Technologies

CourseLink

CourseLink (https://courselink.uoguelph.ca/) (powered by D2L's Brightspace) is the course website and will act as your classroom. It is recommended that you log in to your course website every day to check for announcements, access course materials, and review the weekly schedule and assignment requirements.

Technical Support

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

CourseLink Support

University of Guelph
Day Hall, Room 211
Email: courselink@uoguelph.ca
Tel: 519-824-4120 ext. 56939
Toll-Free (CAN/USA): 1-866-275-1478

Walk-In Hours (Eastern Time):
Monday thru Friday: 8:30 am–4:30 pm

Phone/Email 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 labs and lectures. 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 (https://www.uoguelph.ca/ccs/services/office365/teams)visit the CCS website for more information.

Standard Statements for Undergraduate Courses

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 discourages misconduct. 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.

The Academic Misconduct Policy (https://calendar.uoguelph.ca/undergraduate-calendar/undergraduate-degree-regulations-procedures/academic-misconduct/) is outlined in the Undergraduate Calendar.

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 10 days in advance, and no later than the first business day in November, March or July as appropriate for the semester. Similarly, new or changed accommodations for online quizzes, tests and exams must be approved at least a week ahead of time. For students at the Guelph campus, information can be found on the SAS website. (https://www.uoguelph.ca/sas)

Accommodation of Religious Obligations

If you are unable to meet an in-course requirement due to religious obligations, please email the course instructor within two weeks of the start of the semester to make alternate arrangements.

See the Academic calendar for information on regulations and procedures for Academic Accommodations of Religious Obligations (https://calendar.uoguelph.ca/undergraduate-calendar/undergraduate-degree-regulations-procedures/academic-accommodation-religious-obligations/).

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.

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 undergraduate students 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 the Undergraduate Calendar - Dropping Courses (https://calendar.uoguelph.ca/undergraduate-calendar/undergraduate-degree-regulations-procedures/dropping-courses/).

Email Communication

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

Health and Wellbeing

The University of Guelph provides a wide range of health and wellbeing services at the Vaccarino Centre for Student Wellness (https://wellness.uoguelph.ca/). If you are concerned about your mental health and not sure where to start, connect with a Student Wellness Navigator (https://wellness.uoguelph.ca/navigators) who can help develop a plan to manage and support your mental health or check out our mental wellbeing resources (https://wellness.uoguelph.ca/shine-this-year). The Student Wellness team are here to help and welcome the opportunity to connect with you.

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).

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.

Resources

The Academic Calendars (http://www.uoguelph.ca/registrar/calendars/?index) are the source of information about the University of Guelph's procedures, policies and regulations which apply to undergraduate, graduate and diploma programs.

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. See the Undergraduate Calendar for information on regulations and procedures for Academic Consideration. (https://calendar.uoguelph.ca/undergraduate-calendar/undergraduate-degree-regulations-procedures/academic-consideration-appeals-petitions/)