

Course Outline: Winter 2020

General Information

Course Title: Animal Breeding Methods and Applications

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; the estimation of 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. 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 species. This course integrates quantitative genetics with concepts of statistics, economics, biology and biotechnology and expands into development of practical breeding plans. Prerequisite: MBG*3060 Quantitative Genetics

Credit Weight: 0.50

Academic Department (or campus): Department of Animal Biosciences

Campus: Guelph

Semester Offering: Winter semester 2020

Class Schedule and Location: Lectures Mo, We, Fri 11:30-12:20 in ANNU 102

Lab Section 01: Mo 14:30-16:20 in ANNU 102

Lab Section 02: Tu 14:30-16:20 in ANNU 102

Instructor Information

Instructor Name: Dr. Christine Baes

Instructor Email: cbaes@uoguelph.ca (please include "MBG*4030" in subject line, otherwise your mail will get lost and you won't receive a reply)

Office location and office hours: ANNU 124, Office hours by appointment only

GTA Information

GTA Name: Ryley Vanderhout

GTA Email: rvande02@uoguelph.ca (please include "MBG*4030" in subject line)

GTA office location and office hours: To be announced

Course Content

Specific 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.

Lecture Content:

The following is an approximate schedule of lecture topics. Guest lecturers will be announced.

| Lecture | Weekday | Date | Time | Topic |
|---------|------------------|----------------|-------|--|
| 1 | Monday | Jan. 06 | 11:30 | Genetics Overview |
| 2 | Wednesday | Jan. 08 | 11:30 | Matrix Algebra |
| 3 | Friday | Jan. 10 | 11:30 | Linear Models |
| 4 | Monday | Jan. 13 | 11:30 | ANOVA |
| 5 | Wednesday | Jan. 15 | 11:30 | Solving Mixed Models |
| 6 | Friday | Jan. 17 | 11:30 | Pedigrees and Relationships |
| 7 | Monday | Jan. 20 | 11:30 | Animal Models |
| 8 | Wednesday | Jan. 22 | 11:30 | Animal Models with BLUP |
| 9 | Friday | Jan. 24 | 11:30 | Variance Estimation |
| 10 | Monday | Jan. 27 | 11:30 | Genomics |
| 11 | Wednesday | Jan. 29 | 11:30 | Genomics (chips/sequence/diversity) |
| 12 | Friday | Jan. 31 | 11:30 | Sire Repeated Records |
| 13 | Monday | Feb. 03 | 11:30 | Maternal Models |
| 14 | Wednesday | Feb. 05 | 11:30 | Multiple-Trait Models (1) |
| 15 | Friday | Feb. 07 | 11:30 | Multiple-Trait Models (2) |
| 16 | Monday | Feb. 10 | 11:30 | Key Equation |
| 17 | Wednesday | Feb. 12 | 11:30 | Key Equation with Genomics |
| 18 | Friday | Feb. 14 | 11:30 | Breeding Strategies |
| | <i>Monday</i> | <i>Feb. 17</i> | | <i>Reading Week, no class</i> |
| | <i>Wednesday</i> | <i>Feb. 19</i> | | <i>Reading Week, no class</i> |
| | <i>Friday</i> | <i>Feb. 21</i> | | <i>Reading Week, no class</i> |
| 19 | Monday | Feb. 24 | 11:30 | Mid-term Review |
| 20 | Wednesday | Feb. 26 | 11:30 | Mid-term (in-class) |
| 21 | Friday | Feb. 28 | 11:30 | Multitrait selection (1) |
| 22 | Monday | Mar. 02 | 11:30 | Selection Index |
| 23 | Wednesday | Mar. 04 | 11:30 | Mating and Heterosis / Crossbreds |
| 24 | Friday | Mar. 06 | 11:30 | Economics of Breeding Value Estimation |
| 25 | Monday | Mar. 09 | 11:30 | Grad student/postdoc project presentations |
| 26 | Wednesday | Mar. 11 | 11:30 | Grad student/postdoc project presentations |
| 27 | Friday | Mar. 13 | 11:30 | Grad student/postdoc project presentations |
| 28 | Monday | Mar. 16 | 11:30 | Guest Lecture |
| 29 | Wednesday | Mar. 18 | 11:30 | Guest Lecture |
| 30 | Friday | Mar. 20 | 11:30 | Guest Lecture |

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|----|------------|------------|------------|----------------------------|
| 31 | Monday | Mar. 23 | 11:30 | Guest Lecture |
| 32 | Wednesday | Mar. 25 | 11:30 | Guest Lecture |
| 33 | Friday | Mar. 27 | 11:30 | Guest Lecture |
| 34 | Monday | Mar. 30 | 11:30 | Guest Lecture (no joke...) |
| 35 | Wednesday | Apr. 01 | 11:30 | Ethics |
| 36 | Friday | Apr. 03 | 11:30 | Final Review |
| | <i>TBA</i> | <i>TBA</i> | <i>TBA</i> | <i>FINAL EXAM</i> |

Lab Content:

The following is a schedule of lab topics.

| Lab | Weekday | Date | Time | Topic |
|---|---------|---------|------------|--|
| 0 | Monday | Jan. 06 | S01: 14:30 | Introduction to R |
| | Tuesday | Jan. 07 | S02: 14:30 | |
| 1 | Monday | Jan. 13 | S01: 14:30 | Matrix algebra |
| | Tuesday | Jan. 14 | S02: 14:30 | |
| 2 | Monday | Jan. 20 | S01: 14:30 | Data Exploration, Linear Models, ANOVA |
| | Tuesday | Jan. 21 | S02: 14:30 | |
| 3 | Monday | Jan. 27 | S01: 14:30 | Inbreeding, Relationship matrices, Animal Model, BLUP Breeding Values, Mixed Model Equations |
| | Tuesday | Jan. 28 | S02: 14:30 | |
| 4 | Monday | Feb. 03 | S01: 14:30 | Sire Model, Repeated Records Model |
| | Tuesday | Feb. 04 | S02: 14:30 | |
| 5 | Monday | Feb. 10 | S01: 14:30 | Maternal Effects Model |
| | Tuesday | Feb. 11 | S02: 14:30 | |
| <i>READING WEEK (Yes, you should read during this week... and not go on vacation... unless you read there...)</i> | | | | |
| 6 | Monday | Feb. 24 | S01: 14:30 | Markers / Genomics |
| | Tuesday | Feb. 25 | S02: 14:30 | |
| 7 | Monday | Mar. 02 | S01: 14:30 | Key Equation, Selection |
| | Tuesday | Mar. 03 | S02: 14:30 | |
| 8 | Monday | Mar. 09 | S01: 14:30 | Multiple Trait Selection, Aggregate Genotypes, Selection Index |
| | Tuesday | Mar. 10 | S02: 14:30 | |
| 9 | Monday | Mar. 16 | S01: 14:30 | Heterosis and Crossbreeding |
| | Tuesday | Mar. 17 | S02: 14:30 | |
| 10 | Monday | Mar. 23 | S01: 14:30 | Ethics |
| | Tuesday | Mar. 24 | S02: 14:30 | |
| - | Monday | Mar. 30 | S01: 14:30 | Lab Binders Due, Open Study / Question Period |
| | Tuesday | Mar. 31 | S02: 14:30 | |

Course Assignments and Tests:

| Assignment or Test | Due Date | Contribution to Final Mark (%) | Learning Outcomes Assessed |
|--------------------|--|--------------------------------|----------------------------|
| Lab Assignments | Weekly (before each lab) | 40 | 1-9 |
| Midterm | February 26 th (in-class) | 20 | 1-5 |
| Lab Binder | March 30/31 for sections 1 & 2, respectively | 10 | 1-9 |
| Final Exam | TBA | 30 | 1-9 |

Additional Notes:

Lab Assignments:

- Lab assignments contribute 40% 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 before the next lab; you should be able to complete your lab assignment within the allotted lab period. **Late assignments will be not be accepted.**
- Marked assignments will be returned and discussed during labs the following week. 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.
- If you miss more than one assignment for a **valid** reason your mark will be re-weighted on the basis of those that were handed in. Otherwise, missed assignments will receive a grade of 0.

Midterm:

- The midterm examination will contribute 20% to the final grade.
- The midterm examination will take place in class on Wednesday, February 27th
- You will receive one page with formulas you might need for the midterm
- If you miss the midterm for a valid reason, your final exam will be worth 50% of your final grade.

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 2nd / 3rd for sections 2 & 1, respectively.
- Grading of lab binders will be as follows:
 - Contents page (5 points)
 - Completeness / Uniformity (5 points)
 - Clarity / Neatness (5 points)
 - R scripts (10 points)
 - Discussions (20 points)
 - Overall impression (5 points)

Final Exam:

- The final exam is worth 30% of your final grade.
- The exam will cover both lab and lecture material, as well as any other material discussed.
- You will receive one page with formulas you might need for the midterm.
- You can use your own calculator.

Final examination date and time: TBA

Course Resources

Recommended Texts:

- Linear Models for the Prediction of Animal Breeding Values *Author:* Mrode, Raphael
- Understanding Animal Breeding *Author:* Bourdon, Richard M.

Communication:

All communication outside of class will be through CourseLink.

- News: important messages regarding the course will be posted in the News section on CourseLink. Please check this regularly.
- Discussion: Please use the Discussion option on CourseLink to ask question and discuss course content and assignments with the entire class. The instructor and GTA will monitor the online Discussion and answer questions there.
- Any emailed questions related to the course content will be copied to the CourseLink Discussion and answered there for the benefit of all students.

Other 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 Policies

Grading Policies:

- 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. 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.
- If you miss more than one assignment for a valid reason your mark will be re-weighted on the basis of those that were handed in. Otherwise, missed assignments will receive a grade of 0.

Course Policy on Group Work:

While you are encouraged to discuss the assignment problems with fellow students, each student must hand in an individual solution that is the result of his/her own efforts.

Course Policy regarding use of electronic devices and recording of lectures:

Electronic recording of lectures or labs is **not** permitted.

University Policies

Academic Consideration:

The University of Guelph is committed to supporting students in their learning experiences and responding to their individual needs and is aware that a variety of situations or events beyond the student's control may affect academic performance. Support is provided to accommodate academic needs in the face of personal difficulties or unforeseen events in the form of Academic Consideration.

Information on regulations and procedures for Academic Consideration, Appeals and Petitions, including categories, grounds, timelines and appeals can be found in [Section VIII \(Undergraduate Degree Regulations and Procedures\) of the Undergraduate Calendar](#).

Academic Misconduct:

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.

Detailed information regarding the Academic Misconduct policy is available in [Section VIII \(Undergraduate Degree Regulations and Procedures\) of the Undergraduate Calendar](#).

Accessibility:

The University of Guelph is committed to creating a barrier-free environment. Providing services for students is a shared responsibility among students, faculty and administrators. This relationship is based on respect of individual rights, the dignity of the individual and the University community's shared commitment to an open and supportive learning environment. Students requiring service or accommodation, whether due to an identified, ongoing disability or a short-term disability should contact the Student Accessibility Services (SAS), formerly Centre for Students with Disabilities (CSD), as soon as possible.

For more information, contact SAS at 519-824-4120 ext. 56208 or email sas@uoguelph.ca or visit the [Student Accessibility Services website \(http://www.uoguelph.ca/csd/\)](http://www.uoguelph.ca/csd/).

Course Evaluation Information:

End of semester course and instructor evaluations provide students the opportunity to have their comments and opinions used as an important component in the Faculty Tenure and Promotion process, and as valuable feedback to help instructors enhance the quality of their teaching effectiveness and course delivery.

While many course evaluations are conducted in class others are now conducted online. Please refer to the [Course and Instructor Evaluation Website](#) for more information.

Drop period:

The drop period for single semester courses starts at the beginning of the add period and extends to the Fortieth (40th) class day of the current semester (the last date to drop a single semester courses without academic penalty) which is listed in [Section III \(Schedule of Dates\) of the Undergraduate Calendar](#).

The drop period for two semester courses starts at the beginning of the add period in the first semester and extends to the last day of the add period in the second semester.

Information about Dropping Courses can be found in [Section VIII \(Undergraduate Degree Regulations and Procedures\) of the Undergraduate Calendar](#).