Marker-Assisted and Gene-Assisted Selection
Course Syllabus

Spring 2018

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Prerequisites: Genetic Prediction, Linear Models in Animal Breeding, and Year 1
prerequisites or equivalent
(equivalency granted via instructor's written/email approval)

Schedule and Credit

This on-line course will begin on Monday, January 8 and ends February 9 (with
additional time for the final exam). The content of the course is consistent with a
one-credit graduate level course.

Course Goal

The goal of this module is to extend the concepts learned in Linear Models in
Animal Breeding and Genetic Prediction to increase student understanding of
potential methods for incorporating genetic marker information into selection
decisions. This field is rapidly changing as new biotechnologies are developed
and as statistical methodologies follow to analyze the vast amounts of information
available from new DNA technologies related to livestock genomes.
Accordingly, a wide array of material will be covered with emphasis on
application of these technologies to real-world scenarios. Topics will include but
are not limited to recombination, single-gene tests, molecular breeding values,
suggested producer guidelines for use of the technologies, and incorporation of
genomic information into genetic prediction procedures.

Course Access

Access to course will be through Colorado State University's Canvas system:
http://info.canvas.colostate.edu/login.aspx

Lectures and material presented via:
- Adobe Presenter
- Camtasia produced mp4 files

Academic Integrity:

In this course students will be expected to abide by the honor code of Great Plains IDEA and Colorado State University as outlined below.

Colorado State University expects students to maintain standards of personal integrity that are in harmony with the educational goals of the institution; to observe national, state, and local laws, and University regulations; and to respect the rights, privileges, and property of other people (see Students' Responsibilities, Academic Integrity; http://catalog.colostate.edu/general-catalog/policies/students-responsibilities/#academic-integrity). The Great Plains IDEA (Ag*IDEA) integrity statement can be accessed at https://www.gpidea.org/student-handbook/grades-and-academic-integrity

We take academic integrity seriously. At a minimum, to achieve academic integrity no one will use another's work as his/her own. The CSU writing center defines plagiarism in this manner:

> Plagiarism is the unauthorized or unacknowledged use of another person's academic or scholarly work. Done on purpose, it is cheating. Done accidentally, it is no less serious. Regardless of how it occurs, plagiarism is a theft of intellectual property and a violation of an ironclad rule demanding "credit be given where credit is due."
> Source: (Writing Guides: Understanding Plagiarism. http://writing.colostate.edu/guides/researchsources/understandingplagiarism/plagiarismoverview.cfm. Accessed, January 15, 2009)

Course Outline:

I.   Introduction and Discussion of Course Goals

II.   Introduction
        a. Review of basic terminology and concepts
                i.   Direct Markers
                ii. Linked Markers
                iii. Gene/SNP "Chips"

        Upon completion of this lesson, learners will be able to:
            1. Understand the basic mechanisms behind QTLs, SNPs, and other genetic markers.

III.   Marker-Assisted Selection
        a. How do these technologies fit in to genetic improvement and selection?
                i.   Producers—what questions do you ask?
                ii. State of current commercial applications
        b. Recent history of commercial use
                i.   Parentage
                ii. Categorization
                iii. Molecular breeding values

Upon completion of this lesson, learners will be able to:
1. Recommend guidelines for use of marker technologies in a commercial and seedstock setting.
2. Intelligently discuss the history of commercial use of gene marker applications.
3. Relate current levels of knowledge to subsequent methodologies suggested for incorporating these markers into more traditional genetic evaluation procedures.
4. Understand the usefulness of gene marker technologies

IV. Use of genetic markers in breeding value prediction
   a. Defining the model.
   b. Linear models for inclusion of genetic markers.
   c. Alternative approaches for use of gene chip information
   d. EPD De-regression
   e. Selection index approaches
   f. Hybrid and super-hybrid models
   g. Sequencing information (DNA and RNA)
   h. Industry application
      i. What does the future hold?

Upon completion of this lesson, learners will be able to:
1. Define a model for use of genetic marker information
2. Appreciate the rapid evolution of statistical methodologies to evaluate these new sources of information
3. Understand the most recently suggested models for using marker information derived from "gene chips"

COURSE SCHEDULE

Course material will be made available on a weekly basis.   This pacing is intended to maintain course continuity by engaging all students in the same material at the same time.

Week	Beginning Date	Activities	Assignments
Week One	January 9	**Review of Syllabus and Course Introduction** • online audio presentation **Basic Terminology** • Online audio presentation	Listen to the two **Audio-Presentations** related to this week's topics by Tuesday, January 16 Make a posting to the **Forum** by Friday, January 12 Complete **Quiz #1** by Tues., January 16
Week Two	January 16	**Approaches to Marker-Assisted Selection** • Perspective • Defining the Model	Listen to **Audio-Presentations** related to this week's topics by Mon., January 22 Make a posting to the **Forum** by Thursday., January 18 Complete **Quiz #2** by Tues., January 23

Week	Beginning Date	Activities	Assignments
Week Three	January 22	**Including SNP data in Genetic Evaluation Procedures** • online audio presentation	Listen to **Audio-Presentations** related to this week's topics by Mon., January 29 Make a posting to the **Forum** by Thursday, January 25 Complete **Quiz #3** by Tues., January 30
Week Four	January 29	**Including SNP data in Genetic Evaluation Procedures (cont.)** • online audio-visual presentations **Recent developments in application of SNP data, DNA and RNA Sequencing** • online audio-visual presentations	Listen to the **Audio-Presentations** related to this week's topic by Monday February 5 Make a posting to the **Forum** by Thursday, February 1 Complete **Quiz #4** by Tues., February 6
Week Five	February 5	**Industry application and background** • online audio presentation	Listen to the **Audio-Presentations** related to this week's topics by Friday February 9 Complete **Final Exam** by Friday, February 16

TEXTBOOK

No textbook is required for the course, although the following book is recommended as a useful reference:

> Mrode, R. A. 2005. Linear Models for the Prediction of Animal Breeding Values, 2nd Edition. CAB International, Wallingford, Oxfordshire, UK (ISBN 0 85199 000 2)

Appropriate refereed journal articles

TOOLS REQUIRED

You will need a current version of Flash Player installed on your computer to "see" the audio-presentations. You will also need Adobe Acrobat Reader to view Portable

Document Files (PDF) contained within the course. Finally, you will need to be able to create PDF files for homework assignments. This process can be accomplished within Microsoft Office software through the Print menu. If you choose a different software package to complete your homework assignment, you may need the full version of Adobe Acrobat to create a PDF of your work.

FORM OF ASSESSMENT

Students will be evaluated based on their performance on:

- Four equally weighted *on-line quizzes* (worth in total 40% of grade);
- *Forum* participation (4 postings, worth 20% of the total grade); and
- an on-line *final exam* at the end of the module (worth 40% of grade).

On-line quizzes. One hour will be allowed for each on-line quiz. These must be completed individually during the time period announced. These weekly quizzes will focus on material presented that week. You may use your class notes for these quizzes. Each on-line quiz is worth 10% of your grade.

Each weeks' quiz will be available by 6:00 p.m. Mountain Standard Time on Thursday. The quiz must be taken by 11:59 p.m. Mountain Standard Time on the subsequent Tuesday.

Forums. This assessment activity is designed to facilitate cross-institution interaction and to foster student help with the application of statistical tools.

Once each week students will be expected to contribute to class interactions in one of the following ways:
  1. Present a question for discussion on the "Forums";
  2. Contribute comments relative to the issues/questions being talked about on the Forums link (these questions might be introduced by the instructor or other students; or,

The deadline for weekly postings to the discussion board will be 11:59 pm Mountain Standard Time on Thursday of each week of the course.

Given the nature of the programs being used in this course, we fully expect that students will rely heavily on the suggestions of other students relative to the use of these tools.

Final exam. Two hours will be allowed for the final exam, which will be taken on-line. The exam must be completed individually during the time period announced. The final exam will cover material from the entire module. You may use your class notes for this exam.

The final exam will be available by 5:00 p.m. Mountain Standard Time on Friday, February 9. The final must be taken by 11:59 p.m. Mountain Standard Time on Friday, February 16.

GRADING

Your final grade will be determined by the number of credits (expressed as percentages) you earn over the five-week course.   You are assured of earning a final grade within a category shown below by earning the number of credits specified.

Credits	Grade category
90-100%	A
80-89%	B
70-79%	C
60-69%	D
< 60%	F

Plus (excluding A) and minus grades will be given within a passing grade category. Depending on overall performance of students in the course, there may be a curve applied to the percentages above.