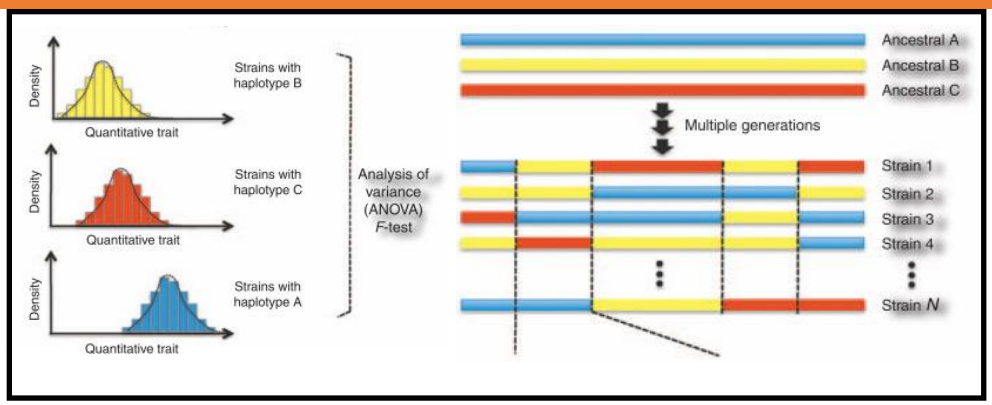
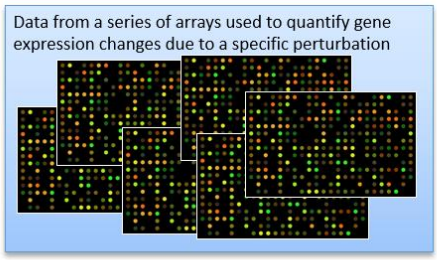
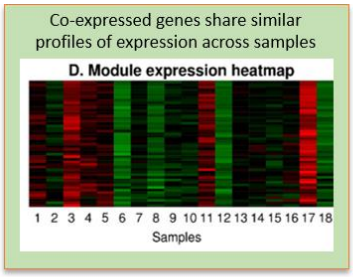
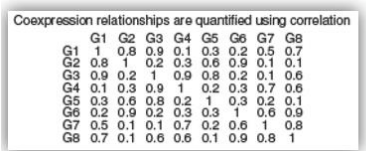
Fall 2024

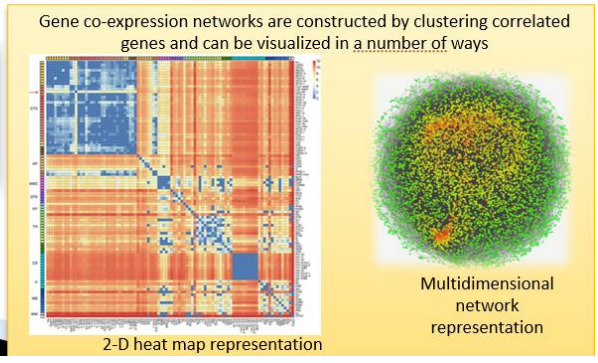


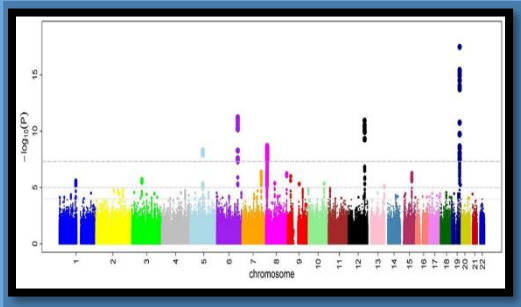
GENETIC ANALYSES OF COMPLEX TRAITS IN LIVESTOCK











Course

ANS 6387 / ANS 4383

Fall 2024— 3 Credits

Lecture

Online

Instructor

Dr. Raluca Mateescu

Office: Room ANS 231B,

Phone: (352) 392-2367

e-mail: raluca@ufl.edu

Course Objective

Comprehensive examination of principles of livestock inheritance, QTL mapping strategies and functional genomic approaches used for genomic selection and improvement programs in farm animals.

ANS 6387/4383—Genetic Analyses of Complex Traits In Livestock

Fall 2024

Instructor Dr. Raluca Mateescu
Office: 231B ANS; Phone: 392-2367; e-mail: raluca@ufl.edu

Student Hours: Open door and by appointment (contact Dr. Mateescu)

Course Description

Comprehensive examination of principles of livestock inheritance, QTL mapping strategies and functional genomic approaches used for genomic selection and improvement programs in farm animals.

Course Objectives

By the end of the semester, the student should be able to:

1. List and describe different molecular methods of genotyping and gene characterization;
2. Define the factors influencing linkage disequilibrium (LD) in livestock genomes and compare LD patterns between livestock and human genomes;
3. Identify and compare different designs for QTL detection in livestock and their implications for marker-assisted selection;
4. Assess the practical applications and challenges of transitioning from QTL to QTN in genetic research and breeding programs;
5. Critically evaluate the advancements, challenges, and future directions of genomic selection in livestock breeding;
6. Design breeding strategies that incorporate genetic and genomic information to enhance livestock performance and health;
7. Review real-world case studies of genomic selection and genetic improvement in various livestock industries.
8. Differentiate between genetic engineering, selective breeding, and natural selection, and understand their respective impacts on genetic variation;
9. Discuss the socio-economic and ethical implications of adopting genetic technologies in agriculture and food production

Attendance Policy

This course requires active participation, independently completed activities and online discussion with your peers. As such, skillful time management and good organization is imperative for success. University policies for class attendance and make-up exams, assignments and other work can be found HERE. It is your personal responsibility to obtain information presented in each module and to ensure that your assignments are completed before the due date. It is important to keep up and not fall behind. Get started on the first day of class – watch the lectures, do your homework on time, get help when you need it – and remember there is no substitute for **DAILY PREPARATION.**

Contacting the Instructor

The instructor will be available for students. Please make arrangements to visit at your convenience. If you call and I am not available, leave your name and telephone number or e-mail address and you will be contacted as soon as the message is received. **The best method to reach me is through e-mail.**

Text

No formal text is required. Students will be provided handouts, which are current and relevant to topics discussed in class. Optional references include:

- Lynch and Walsh, Genetics and Analysis of Quantitative Traits, Sinauer, 1998
- Cockett and Kole, Genome Mapping and Genomics in Domestic Animal, Springer, 2010

Students will be expected to read and discuss several journals articles from the following:

- Berry, D.P., J.F. Garcia, and D.J. Garrick. "Development and Implementation of Genomic Predictions in Beef Cattle." *Animal Frontiers* 6, no. 1 (2016): 32–38. https://doi.org/10.2527/af.2016-0005.
- Goddard, Michael E., and Ben J. Hayes. "Mapping Genes for Complex Traits in Domestic Animals and Their Use in Breeding Programmes." *Nature Reviews Genetics* 10, no. 6 (2009): 381–91. https://doi.org/10.1038/nrg2575.
- Haley, Chris. "Advances in Quantitative Trait Locus Mapping"
- Kemper, K. E., and M. E. Goddard. "Understanding and Predicting Complex Traits: Knowledge from Cattle." *Human Molecular Genetics* 21, no. R1 (2012): R45–51. https://doi.org/10.1093/hmg/dds332.
- Koning, D J de, J C M Dekkers, and C S Haley. "Designs for QTL detection in livestock and their implications for MAS"
- Meuwissen, Theo, Ben Hayes, and Mike Goddard. "Genomic Selection: A Paradigm Shift in Animal Breeding." *Animal Frontiers* 6, no. 1 (2016): 6–14. https://doi.org/10.2527/af.2016-0002.
- Platani, Maria, Owolabi Sokefun, Elias Bassil, and Yiorgos Apidianakis. "Genetic Engineering and Genome Editing in Plants, Animals and Humans: Facts and Myths." *Gene* 856 (2023): 147141. https://doi.org/10.1016/j.gene.2022.147141.
- Qanbari, Saber. "On the Extent of Linkage Disequilibrium in the Genome of Farm Animals." *Frontiers in Genetics* 10 (2020): 1304. https://doi.org/10.3389/fgene.2019.01304.
- Ron, M., and J. I. Weller. "From QTL to QTN Identification in Livestock – Winning by Points Rather than Knock-out: A Review." *Animal Genetics* 38, no. 5 (2007): 429–39. https://doi.org/10.1111/j.1365-2052.2007.01640.x.
- Tabor, Holly K., Neil J. Risch, and Richard M. Myers. "Candidate-Gene Approaches for Studying Complex Genetic Traits: Practical Considerations." *Nature Reviews Genetics* 3, no. 5 (2002): 391–97. https://doi.org/10.1038/nrg796.
- Van Eenennaam, Alison L., Kent A. Weigel, Amy E. Young, Matthew A. Cleveland, and Jack C.M. Dekkers. "Applied Animal Genomics: Results from the Field." *Annual Review of Animal Biosciences* 2, no. 1 (2014): 105–39. https://doi.org/10.1146/annurev-animal-022513-114119.
- Weller, J.I., E. Ezra, and M. Ron. "Invited Review: A Perspective on the Future of Genomic Selection in Dairy Cattle." *Journal of Dairy Science* 100, no. 11 (2017): 8633–44. https://doi.org/10.3168/jds.2017-12879.

Course Organization and Content

Course Organization

The course is organized in weekly **Modules**. You can access the Modules either through the Home Page (left panel, preferred mode of access), or through the Modules. Each weekly Module will open Monday 12:00 am and will close the following Sunday 11:59pm.

Videos

Short videos explaining certain concepts are pre-recorded. These concepts are important to be able to understand the articles and have meaningful discussions.

Discussions

Each weekly Module will have a discussion based on one article. The discussion will provide you with a prompt and are designed to encourage you to engage deeply with the article's content, reflect on its implications, and discuss practical applications and future research directions. To get the full points for the discussions, you need to post your original comment a few days before the due date to allow time for commentary and respond to others' posts at least 1-2 times using thoughtful statements or questions.

Quizzes

There will be a quiz in each Module. They will consist of short questions: multiple choice, true/false, fill in the blank or short answer. You will have a limited time to take it once you start the quiz (15 minutes) – so it is important that you study before you start to take the quiz. It is advised that you take these quizzes later in the week, after you completed participated in the discussion. Make sure you have a secure internet connection (if you lose the internet connection your quiz will end and you will not be allowed to take it again).

Grade Distribution

14 Quizzes (10 pts each)	140 points	33%
14 Article Discussions (20 pts each)	280 points	66%
Total	420 points	100%

Letter grades will be assigned based upon the following scale:

A 93-100%	**B- 80-82.9%**	**D+ 67-69.9%**
A- 90-92.9%	**C+ 77-79.9%**	**D 63-66.9%-**
B+ 87-89.9%	**C 73-76.9%**	**D- 60-62.9%-**
B 83-86.9%	**C- 70-72.9%**	**E 60% and Below**

The scale may be lowered but it will not be raised.

Important Dates - Holidays

Labor Day	Sept 2
Homecoming	Oct 18-19
Veterans Day	Nov 11
Thanksgiving	Nov 25-30

ANS 6387/4383—Genetic Analyses of Complex Traits In Livestock

Fall 2024

Tentative Outline

Week	Module Start Day	Module	Readings	Videos
Week 1	Monday, August 26	Intro		Intro Lecture
		Basic Genetic Model for Quantitative Traits	Chapter 4: Intro, Quantitative Traits, Basic Genetic Model for Quantitative Traits, Heritability and Selection, Predicting rate of genetic change	Genetic Model and Heritability, EPD EBV Accuracy, Response to Selection
Week 2	*Monday, September 2*	*Labor Day*		
		Intro to Genomics	Chapter 17 Molecular Genetics Techniques + Chapter 15 Bioinformatics in Animal Genetics (Intro, Bioinformatics and animal genetics, Gene Expression, Gene Regulation, Epigenetics)	Intro to Genomics
Week 3	Monday, September 9	Linkage Disequilibrium (LD)	On the Extent of Linkage Disequilibrium in the Genome of Farm Animals	LD, LOD Scores, Gene Mapping, Recombination Frequency
Week 4	Monday, September 16	Candidate Gene Approach	Candidate-gene approaches for studying complex traits_Practical considerations	Candidate Genes - Advantages and Limitations, Candidate Genes vs QTL mapping
Week 5	Monday, September 23	QTL mapping	Advances in Quantitative Trait Locus Mapping	Association and Multiple Testing
Week 6	Monday, September 30	Advanced Strategies for QTL Detection and MAS in Livestock	Designs for QTL detection in livestock and their implications for MAS	MAS, Gene Introgression, Gene Editing, QTL mapping principles
Week 7	Monday, October 7	From QTL to QTN	From QTL to QTN identification in livestock – winning by points rather than knock-out: a review	SNPs vs Haplotyping, Mapping Populations, Fine Mapping
Week 8	Monday, October 14	Genetic Architecture and Prediction of Complex Traits	Understanding and predicting complex traits_knowledge from cattle.pdf	
Week 9	Monday, October 21	Genomic Selection	Genomic selection: A paradigm shift in animal breeding	
Week 10	*Monday, October 28*	*Thanksgiving*		
Week 11	Monday, November 4	Practical Applications and Outcomes of Genomic Selection	Applied Animal Genomics Results from the Field	
Week 12	Monday, November 11	Advances in Genomic Predictions for Beef Cattle	Development and implementation of genomic predictions in beef cattle.pdf	
Week 13	Monday, November 18	From QTL to Breeding Programs	Mapping genes for complex traits in domestic animals and their use in breeding programmes	
Week 14	Monday, November 25	The Future of Genomic Selection in Dairy Cattle	Invited review: A perspective on the future of genomic selection in dairy cattle	
Week 15	Monday, December 2	Genetic Engineering and Genome Editing	Genetic engineering and genome editing in plants, animals and humans: Facts and myths	

The instructor reserves the right to modify the syllabus during the semester with verbal or written announcements in class. It is the student's responsibility to stay informed of such announcements.

General information

Services for Students with Disabilities

Students with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565, www.dso.ufl.edu/drc/) by providing appropriate documentation. Once registered, students will receive an accommodation letter which must be presented to the instructor when requesting accommodation. Students with disabilities should follow this procedure as early as possible in the semester.

Grades and Grade Points

For information on current UF policies for assigning grade points, see https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx

Online course evaluation process

Students are expected to provide feedback on the quality of instruction in this course by completing online evaluations at https://evaluations.ufl.edu. Evaluations are typically open during the last two or three weeks of the semester, but students will be given specific times when they are open. Summary results of these assessments are available to students at https://evaluations.ufl.edu/results/.

Software Use

All faculty, staff and students of the university are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against university policies and rules, disciplinary action will be taken as appropriate

Academic Honesty

UF students are bound by The Honor Pledge which states, "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment." The Honor Code (https://www.dso.ufl.edu/sccr/process/student-conduct-honor-code/) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

Campus Helping Resources

Students experiencing crises or personal problems that interfere with their general well-being are encouraged to utilize the university's counseling resources. The Counseling & Wellness Center provides confidential counseling services at no cost for currently enrolled students. Resources are available on campus for students having personal problems or lacking clear career or academic goals, which interfere with their academic performance.

- University Counseling & Wellness Center, 3190 Radio Road, 352-392-1575, www.counseling.ufl.edu/cwc/
  Counseling Services, Groups and Workshops, Outreach and Consultation, Self-Help Library
  Wellness Coaching
- U Matter We Care, www.umatter.ufl.edu/
- Career Resource Center, First Floor JWRU, 392-1601, www.crc.ufl.edu/

Student Complaint Process

For information see https://www.dso.ufl.edu/documents/UF_Complaints_policy.pdf.