ASCI/AGRO 931
Population Genetics
Fall 2018
Animal Science A128

I. Instructors

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II. Scope of the Course

The first portion of the course will cover concepts in population genetics – the study of inherited variation and how it changes across time and space due to outside influence. Students will learn about forces at work in natural populations and the joint effect of these forces with artificial selection and planned mating systems in domestic species. Predictions of how selection, migration, mutation, and inbreeding affect the genetic makeup of populations are emphasized as well as the use of genetic data to understand the diversity within and relationships among groups of individuals.

The second portion of the course will cover concepts in quantitative genetics. Most students in the course are in the applied fields of animal and plant breeding or entomology and work most often with quantitative traits. Students are expected to apply the statistical concepts of variance, covariance, regression, and correlation to dissect the phenotypic value of an individual, predict response to selection for quantitative traits, analyze selection experiments, and describe the effects of breed/line crossing and inbreeding on population means and variance.

III. Relationship to Other Courses

Population Genetics 931 is cross-listed in the Departments of Animal Science and Agronomy and Horticulture. Several applied breeding courses build on the theoretical concepts of population and quantitative genetics to develop breeding strategies for plant and animal improvement. Students of quantitative genetics and plant and animal breeding will benefit from a strong background in population genetics. Those who work with natural populations will get the necessary principles to understand variation in these populations and to develop strategies to maintain this variation.

IV. Prerequisites

AGRO 315 and STAT 801 or equivalent, or permission of the instructors.

V. Texts and Other Readings

Required Text: DS Falconer & TFC Mackay. 1996. Introduction to Quantitative Genetics. Fourth Edition. Longman, NY.

The course will largely follow this text. Class periods will be used to supplement and explain concepts in the text and to introduce problems related to the textbook theory. To get the most out of the class, students should read/study the material for the next class period before class meets.

The topics covered each lecture period and the corresponding reading assignments will be announced daily/weekly. **You are expected to read the assignment in advance of the lecture**. Students should pay special attention to the problems that are presented in the text. Solutions and interpretations for these problems are presented at the end of the text. Studying these problems and solutions will give students an excellent understanding of population genetics. Handouts and supplemental readings/problems will be provided for some sections. All topics in the course outline may not be covered in equal depth during lectures. Students are still responsible for these sections. Usually these topics are ones that can be learned from reading the text and studying chapter problems.

Other helpful references:

R Halliburton. 2004. Introduction to Population Genetics. Pearson, NJ. *recommended

DL Hartl & AG Clark. 2006. Principles of Population Genetics. 4th ed. Sinauer, MA.

P Hedrick. 2009. Genetics of Populations. 4th ed. Jones and Bartlett Learning, MA.

M Lynch & B Walsh. 1998. Vol. 1: Genetics and analysis of quantitative traits. Sinauer, MA

Vol. 2 of this text is not in print, but chapters of it are available at http://nitro.biosci.arizona.edu/zbook/volume_2/vol2.html. Additional links to other population/quantitative genetics resources are available at the above site.

BS Weir. Genetic Data Analysis II. Methods for Discrete Population Genetic Data. Sinauer, MA.

VI. Learning Objectives:

At the completion of this course, students will be able to:

- distinguish, describe, compare, and analyze the mechanisms (mutation, drift, selection, migration, non-random mating) and their interactions that drive changes in allele frequency
- interpret data describing the magnitude and patterns of genetic diversity and differentiation in populations; assess population structure and gene flow
- identify problems affecting the longevity and diversity of populations; design experiments to collect and analyze data appropriate for guiding population management
- calculate coefficients of inbreeding and coancestry given mating history and pedigree data
- be able to dissect components of phenotypic value and phenotypic variance
- display knowledge of the theory and methods applied to quantitative trait loci mapping

VII. Assignments, Exams, and Grading Policy

1. **Problems.** The most effective method of mastering principles of population genetics is by working through problems. Therefore, problems are assigned to give students experience in applying population genetic principles to answer questions. These problem sets will be based upon material from the textbook, other reading, data sets distributed in class, and/or material from lecture. Problem sets will emphasize analysis and interpretation. Most problems will be graded, but some may be assigned and not graded. It is anticipated that up to 12 problem sets will be graded, ranging in value from 5-25 points per problem set.

Problem sets are to be turned in ***at the beginning of class*** on the designated due date. Late assignments will be accepted no later than one class period after the original due date and will be penalized by 20% (maximum score 80% of total possible points).

2. **Journal Article Reviews (2).** A journal article will be assigned to the class that focuses upon theoretical and/or applied population genetics concepts. Each student will complete a review of the manuscript according to a rubric provided by the instructor. The student will be graded based upon completeness of his/her review and participation in a class discussion of the paper. **Tentative due dates are below.**

3. **Exams.** There will be three exams, including the final. Exams will emphasize interpretation of theory and analysis of problems. Exams may be given during the lecture period, take-home exams, or a combination thereof.

   Students are expected to be present to take the exam on the designated date. Make-up exams will not be given. If it is anticipated that a student will not be able to take an exam on the original exam date, arrangements with the instructor need to be made prior to the scheduled exam date. The instructor(s) will decide what constitutes a legitimate request for an alternate exam date for individual students and will make this decision on a case-by-case basis. **A tentative exam schedule is given below.**

4. **Points.**
   a. Problems 200
   b. Exams 300
   c. Journal Article Reviews 100
   TOTAL 600

5. **Final Grades.** The base minimum total points for each possible final grade are listed below. The instructors may assign a lower minimum for any of the grades.

Grade	Base Minimum		Grade	Base Minimum		Grade	Base Minimum
A	558		B-	480		D+	408
A-	540		C+	468		D	378
B+	528		C	438		D-	360
B	498		C-	420		F	< 360

VIII. Important dates *(dates, except for the final exam, are tentative and may be changed)*

Sept 17	Exam I	Nov 16	Review II due
Sept 24	Review I due	Dec 10	Final Exam 7:30-9:30 am
Nov 9	Exam II		

IX. Topics and Readings

Topics	Reading	Approximate no. periods
Genetic constitution of populations	Ch. 1	2
Allele and genotypic frequencies		
Hardy-Weinberg Equilibrium		
Linkage Disequilibrium		
Changes of allele frequency	Ch. 2	3
Migration		
Mutation		
Selection/Fitness		
Small populations – simplified conditions	Ch. 3	2
Idealized population		
Sampling/Drift		
Inbreeding		
Population Diversity/Relationships	supplemental material	4
F-statistics		
Cluster Analyses		
Measures of Diversity		
Non-nuclear DNA		
Small populations – less simple conditions	Ch. 4 + handouts	3
Effective population size		
Selection		
Small, pedigreed populations	Ch. 5	2
Inbreeding coefficient		
Coancestry		
Molecular Population Genetics	supplemental material	3
Neutral Theory	Ch. 4	
Selection		
Population values and means	Ch. 7	3
Mean, average effect & breeding value		
Dominance and interaction deviation		
Genetic components of variance	Ch. 8	2
Additive, dominance, and interaction		
Disequilibrium		
Environmental variation		
Resemblance between relatives	Ch. 9	2
Genetic covariance		
Environmental covariance		
Phenotypic covariance		
Heritability	Ch. 10	2
Estimation		
Precision of estimates		
Predicting response to selection	Ch. 11	1
The breeder's equation		
Variability in response		
Results of selection experiments	Ch. 12	2
Short-term responses		
Long-term responses		
Inbreeding and crossbreeding	Ch. 14	2
Inbreeding depression		

Heterosis		
Correlated traits	Ch. 19	3
Genetic and environmental correlations		
Correlated responses to selection		
G x E		
Quantitative trait loci	Ch. 21	3
Molecular markers	Suppl. Material	

X. Academic Dishonesty

Academic dishonesty can involve: cheating, fabrication or falsification of information, plagiarism - including copying of written materials or "cutting and pasting" from websites without proper referencing, destroying, defacing, stealing, or making inaccessible library or other academic resource material, complicity in the academic dishonesty of others, falsifying grade reports, or misrepresenting illness, injury, accident, etc. to avoid or delay an examination or the timely submission of academic work.

Consequences of academic dishonesty in Animal Science courses, depending on the degree of severity as interpreted by an instructor, may range from a warning to assigning an F for the course. The instructor may also choose to assign a zero or partial credit for a specific assignment or examination in which dishonesty was involved. Before imposing an academic sanction the instructor shall first attempt to discuss the matter with the student. In all cases the instructor must document the instance(s) of student activity, which constitutes academic dishonesty. Documentation must be retained by the instructor for a minimum of one year and must be made available to appropriate department, college, and UNL authorities if cases of academic dishonesty result in disciplinary hearings and/or appeals at those levels. When an academic sanction is imposed that causes a student to receive a lowered course grade, the instructor shall file a written report outlining the facts of the case and of the academic sanction imposed against the student, to the Animal Science Department Head and the UNL Director of Student Judicial Affairs. The student shall be provided with a copy of this report. Further, the instructor may recommend the institution of CASNR or UNL disciplinary proceedings against the student for violation of the Student Code of Conduct if the instructor, in the exercise of his or her professional judgment, believes that such action is warranted.

If a student facing sanctions due to academic dishonesty in an Animal Science Department course wishes to appeal such a sanction, the following process must be followed. First the student must issue a written appeal to the chief instructor of the course. If resolution is not obtained, the student can appeal (in writing) to the Animal Science Department Head. The Department Head will refer the appeal to the Animal Science Curriculum Committee who will interview both the student and instructor, review all pertinent documentation, and issue a decision. If a member of the Animal Science Curriculum Committee is also an instructor of the course in which academic dishonesty has been reported, the Animal Science Department Head will temporarily appoint an alternative faculty member to the committee hearing the appeal. If a solution satisfactory to the student is not achieved at the department level, the student may then appeal through the CASNR Dean's office and the University Director of Student Judicial Affairs, in that order, and is subject to the processes and requirements of those offices.

XI. In the Event of an Emergency

Fire Alarm (or other evacuation): In the event of a fire alarm: Gather belongings (Purse, keys, cellphone, N-Card, etc.) and use the nearest exit to leave the building. Do not use the elevators. After exiting notify emergency personnel of the location of persons unable to exit the building. Do not return to building unless told to do so by emergency personnel.

Tornado Warning: When sirens sound, move to the lowest interior area of building or designated shelter**.** Stay away from windows and stay near an inside wall when possible.

Active Shooter:

Evacuate - If there is a safe escape path, leave belongings behind, keep hands visible and follow police officer instructions.

Hide out - If evacuation is impossible, secure yourself in your space by turning out lights, closing blinds and barricading doors.

Take action - As a last resort, and only when your life is in imminent danger, attempt to disrupt and/or incapacitate the active shooter.

UNL Alert: Notifications about serious incidents on campus are sent via text message, email, unl.edu website, and social media. For more information go to: http://unlalert.unl.edu.

Additional Emergency Procedures can be found at:
http://emergency.unl.edu/doc/Emergency_Procedures_Quicklist.pdf

XII. Special Needs

Students with disabilities are encouraged to contact the instructor for a confidential discussion of their individual needs for academic accommodation. It is the policy of the University of Nebraska-Lincoln to provide flexible and individualized accommodation to students with documented disabilities that may affect their ability to fully participate in course activities or to meet course requirements. To receive accommodation services, students must be registered with the Services for Students with Disabilities (SSD) Office, 132 Canfield Administration, 402-472-3787 voice or TTY.