CS / HS 590 (3 credits)
Quantitative Genetics in Plant Breeding
2025 Fall Semester

I. Instructor

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Consultation hours: by appointment

II. Classroom and Time

Meeting Time: Tuesdays and Thursdays, 3:00 PM – 4:15 PM
Classroom: Williams Hall, Room 2112

III. Course Scope and Objectives

Quantitative traits—those influenced by multiple genes and environmental factors—are central to crop improvement, making quantitative genetics an essential component of modern plant breeding. CS 590: Quantitative Genetics in Plant Breeding is a graduate-level course focused on the application of quantitative genetic principles to practical breeding scenarios. It serves as an intermediate course, building on theoretical foundations from GN703: Population and Quantitative Genetics and preparing students for advanced analysis covered in CS-FOR-ANS 726: Advanced Topics in Quantitative Genetics and Breeding.

Course Objectives:

By the end of the course, students will be able to:
1. Understand and explain core concepts of population and quantitative genetics as they relate to breeding programs.
2. Apply quantitative genetic principles to evaluate and improve economically important traits in crop species.
3. Analyze plant breeding data—including multi-omic data—using statistical methods and software tools.

This course is particularly relevant for graduate students specializing in plant, or animal, breeding, as well as entomology, who aim to use quantitative methods to improve complex traits.

IV. Prerequisites

Students should have a foundational understanding of plant breeding, experimental design, and statistical analysis. The suggested prerequisites are listed below. Students are encouraged to contact Dr. Bandillo if they have any questions about the prerequisites or their readiness to take the course.

- CS 541 / HS 541 (Plant Breeding Methods) or equivalent
- GN703 Population and Quantitative Genetics or equivalent

V. Suggested References and Other Readings

Lecture slides and class notes will be available online through the course Blackboard site. No textbooks are required, though all suggested references are listed above. Class periods will be used to supplement and clarify concepts from the class notes and to introduce problems related to textbook theory. To maximize learning, students should review the material for the upcoming class period before each session.

The topics covered by each lecture period, along with the corresponding reading assignments, will be announced on a daily or weekly basis. Students are expected to complete the reading in advance of each lecture. Special attention should be given to the problems presented in the text, as working through these problems and reviewing the solutions will provide valuable insights into both theoretical and applied aspects of advanced genetics. Handouts and supplemental problems will be provided for certain sections.

While all topics in the course outline may not be covered in equal depth during lectures, students are still responsible for these sections. Typically, these topics can be learned through reading the text and studying the chapter problems.

1. Bernardo, R. (2020). *Breeding for Quantitative Traits in Plants* (3rd ed.). Stemma Press.
2. Falconer, S., & Mackey, T. (1996). *Introduction to Quantitative Genetics* (4th ed.). Longman, NY.
3. Walsh, B., & Lynch, M. (2018). *Evolution and Selection of Quantitative Traits*. Oxford University Press.
4. Isik, F., Holland, J., & Maltecca, J. (2017). *Genetic Data Analysis for Plant and Animal Breeding*. Springer International.

VI. Exams, Assignment, and Grading Policy

1. **Exams.** There will be three exams, including the final exam. Exams will emphasize interpretation of theory and analysis of problems. Exams may be given during the lecture period, or be take-home exams. **A tentative exam schedule is given below.**

Exam Schedule	Date
Exam 1	TBD
Exam 2	TBD
Final Exam	TBD

2. **Hands-on and/or Homework Problems.** One of the most effective method of mastering principles and theory of quantitative genetics is by doing problems. Therefore, problems are assigned to give students experience in applying genetic principles to problem solving. Most problems will be graded, but some may be assigned but not graded. Analysis and interpretation of data are emphasized in problems. It is anticipated that 6 problem sets, each worth 50 points, will be graded.

   Other chapters have the hands-on session to analyze simulated or real data sets. Each student will need to bring their laptop. Computer labs will usually include a short assignment to be completed and turned in the following session.

3. **Journal Review.** Each student must read one and write an extended abstract (maximum of 2 pages for each) of these papers. Papers must contain either theoretical work on quantitative genetics or analysis of experimental data to test quantitative genetic principles.

4. **Class Participation.** Class attendance and participation during class are important to good understanding of the material. At the end of the semester the instructor will give up to 50 points to each student for classroom participation.

5. **Points.**

Exams (3)	600
Problems (6)	300
Journal Review (1)	50
Class Participation	50
TOTAL	1000

6. **Final Grades.**

   The base minimum total points for each possible final grade are listed below. Dr. Bandillo may assign a lower minimum for any of the grades.

Points	Grade
970-1000	A+
940-969	A
900-939	A-
870-899	B+
840-869	B
800-939	B-
770-799	C+
740-769	C
700-739	C-
670-699	D+
640-669	D
600-639	D-
599 or less	F

VII. Tentative Schedules of Lectures

Please see the attached excel file for detailed lecture topics.

VIII. Class Policies and Other Information

Policies on Incomplete Grades and Late Assignments
Work missed due to excused absences can be made up by arrangement with the instructor. Late assignments will only be accepted with prior permission from the instructor. It is the student's responsibility to contact the instructor before the due date or as soon as possible after an emergency situation that results in missing an assignment.

Attendance Policy
Students are expected to attend all class sessions. They are responsible for the material covered, regardless of attendance. Please refer to the NC State Attendance Policy: REG-02-20-03.

Academic Integrity
Students are expected to uphold academic integrity in completing assignments and the midterm

project. By submitting your work, you affirm that you neither gave nor received unauthorized aid. Collaboration on assignments is only allowed when explicitly authorized by the instructor. Please refer to the NC State Academic Integrity Policy: POL-11-35-01.

Statement for Students with Disabilities
Reasonable accommodations will be provided for students with verifiable disabilities. To access these accommodations, students must register with Disability Services for Students at 1900 Student Health Center, Campus Box 7509, or by calling 515-7653. For more information on accommodations, please refer to the Academic Accommodations for Students with Disabilities Regulation: REG-02-20-01.

Laboratory Safety or Risk Assumption
None

Extra Expenses
None

Transportation
None