Syllabus for IBS 593 Molecular Evolution
Revised: 22 June 2008

Course Description
The IBS 593 Molecular Evolution class is a required core course for Population Biology, Ecology and Evolution (PBEE) graduate students. This fast-paced, graduate level class explores the theory and applications of single locus population genetics, quantitative genetics and coalescent theory to understanding the patterns and processes acting on genetic variation in natural populations. The specific topics covered include:

- Genetic Variation in Natural Populations
- Genetic Drift
- Neutral Theory of Molecular Evolution
- Natural Selection
- Two-Locus Dynamics
- Nonrandom Mating
- Quantitative Genetics
- Coalescent Theory

The goal of this course is to combine theory with data in order to critically evaluate evolutionary processes at work in natural populations. This class also contains a short writing module and an examination of the role of strong inference in Population Biology. Student performance is evaluated through a combination of weekly homework assignments, formal written examinations, and by the student’s participation in class discussions which will focus on a critical reading of both the text and selected primary literature.

Course Directors
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Course Information
Course Type: Lecture
Building/Room: TBD
Meeting time: TBD
Maximum Enrollment: 15
Permission requirements: Non-PBEE graduate students need permission from instructors.
Course Objectives
Through this course, students are expected to learn the mathematical foundations of single-locus population genetics, quantitative genetics and coalescent theory. They further are expected to understand how this theoretical structure can be used to understand evolutionary processes. Modules on the application of strong inference in Population Biology and in writing will also be presented. Mastering the topics described below will provide a PBEE graduate student a minimum level of knowledge necessary to successfully pass the written and oral qualifying exams. The specific topics covered include:

Genetics Variation
Types of DNA sequence variation; definition of loci and alleles; genotype and allele frequencies; The Hardy-Weinberg law.

Genetic Drift
Sampling in finite populations; decay of heterozygosity; mutation and drift; The Neutral Theory of Molecular Evolution; the coalescent; effective size of a population; stationary distribution.

Natural Selection and Adaptation
Fundamental model; relative fitness; directional, balancing, underdominant selection; mutation-selection balance; genetic load; heterozygous effects of alleles; changing environments; selection and drift.

Two-Locus Dynamics
Linkage disequilibrium; two-locus selection; genetic draft

Nonrandom Mating
Generalized Hardy-Weinberg; identity by descent; inbreeding; evolution of selfing; subdivision

Quantitative Genetics
Correlation between relatives; response to selection; evolutionary quantitative genetics; dominance; intensity of selection

Coalescent Theory
Properties of samples from natural populations; gene genealogies, no recombination models, free recombination models

Blackboard
There will be a Blackboard site for the class.

Student Evaluation
Student performance is evaluated through a combination of homework assignments, formal written examinations, and by the student’s participation in class discussions which will focus on a critical reading of both the text and selected primary literature. The final grade is based on the following breakdown:

- Midterm exam 25%
- Final exam 25%
- Homework 30%
- Participation 20%

Credit Hours
This is a 4 credit hour class.

Required Textbooks
The following textbook is required for the class:


**Selected Primary Literature**

This is a sample listing of the primary literature for the class. They include:


Additional papers will be identified by the instructors.

**Additional Reading**

To complement material contained in the required textbooks, the following more specialized books will be reserved for students’ reading:

*The Darwinian Revolution*, by M. Ruse
*The Causes of Evolution*, 1932 J.B.S Haldane
*Genetics and Origin of Species*, T. Dobzhansky
*The Origins of Theoretical Population Genetics*, by W.B. Provine
*Evolutionary Genetics*, by J. Maynard Smith
*Mathematics of Heredity*, 1969, by G. Malecot
*Introduction to Quantitative Genetics*, by D.S. Falconer and T.F.C. Mackay.
*Quantitative Genetics*, by M. Lynch and B. Walsh
*Evolution and the Theory of Games*, by J. Maynard Smith
*The Evolution of Life Histories*, by S. Stearns

**Assignments**

For each topic, the reading assignments include the relevant chapters from the above books and a few key classic papers identified as conceptual or methodological breakthroughs. The homework assignments will consist of quantitative problem sets and may include application of computer programs.

**Class Calendar**

A detailed class calendar will be provided by the instructors.