The Hebrew University of Jerusalem

Syllabus

WORK SHOP POPULATION GENETICS - 71991

Last update 23-07-2020

HU Credits: 2

Degree/Cycle: 2nd degree (Master)

Responsible Department: Genetics & Breeding

Academic year: 0

Semester: 1st Semester

Teaching Languages: English

Campus: Rehovot

Course/Module Coordinator: Dr. Tamar Friedlander

Coordinator Email: tamar.friedlander@mail.huji.ac.il

Coordinator Office Hours: Please coordinate with me.

Teaching Staff:

Dr. Tamar Friedlander,
Mr. Harel Bacher

Course/Module description:
in this course the students will learn about the basic evolutionary processes in a population and will get familiarized with their mathematical description.

Course/Module aims:

Learning outcomes - On successful completion of this module, students should be able to:
The students will gain acquaintance with basic evolutionary processes and their mathematical description in a single locus: random mating, drift, mutation and natural selection.
The students will learn different examples to the occurrence of these processes in the lab and in natural populations and will apply the models they learned to different cases.

Attendance requirements(%):

Teaching arrangement and method of instruction: Lecture, tuition (partly in computer class) and home assignments.

Course/Module Content:
Introduction:
- *What are the evolutionary processes?*
- *Which questions are we asking and what kind of data do we have?*

History of evolutionary theory since Darwin.
review of probability: random variables, expectation, variance, Gaussian distribution.
Random mating in infinite population, Hardy-Weinberg equilibrium; when do we expect deviations from H-W? structured population.
Small population effect: drift.
What is the probability that a mutant fixes (neutrally)?
Effective size of population can differ from actual size: different numbers of males and females, variability in number of offspring, fluctuating population size: population bottlenecks decrease population variability (harmonic mean).

Fitness landscapes: different models, epistasis, experimental landscapes (examples).
Genotype-phenotype maps – examples (RNA secondary structure, etc.)
Definition of fitness, Fisher's theorem; 3 kinds of selection: directional, balancing (heterozygote advantage) & disruptive; discuss stability of each.
example of sickle-cell anemia.
Dynamics of fixation under selection.
Selection: mutation-selection balance.
How can polymorphism be maintained? Neutral evolution or changing environments or heterozygote advantage.
Fixation probability of a mutant: how it depends on its fitness advantage and the mutant frequency. Most mutations are lost due to stochastic effects even if they are beneficial. Can a deleterious mutation fix?
Experimental evolution – guest lecture
Linkage disequilibrium: definition, how it decays in time; model of 2 loci: one is selected and one is neutral – hitchhiking, selective sweeps.
Selfing vs. outcrossing, inbreeding depression. Self-incompatibility mechanisms in plants.
Differences in genetic architecture between selfers and outcrossers.

If time allows:
Open problems in evolutionary theory: the evolution of innovation.
How are new genes created? gene duplication, Ohno's model, evolution from random sequences, orphan genes.
Polyploidy, aneuploidy: mechanisms (allo-, auto-), how it affects adaptation.

Required Reading:
No obligatory reading.

Additional Reading Material:
The course is based on the book:
Population genetics / Gillespie, 2nd ed.

Course/Module evaluation:
End of year written/oral examination 0 %
Presentation 0 %
Participation in Tutorials 0 %
Project work 50 %
Assignments 50 %
Reports 0 %
Research project 0 %
Quizzes 0 %

Other 0 %

Additional information: