Course Syllabus

Human Genetics 544: Basic Concepts in Population and Statistical Genetics

Fall 2023 Syllabus

Description: The course will cover concepts and analytic methods for studying variation in natural populations. The topics covered include the distribution of genetic variation, major forces of genetic stability and change, population genetics, quantitative genetics, and human populations. We introduce the basic models of population, quantitative, and statistical genetics with an emphasis on understanding the hypotheses, experiments, and discussion of contemporary scientific literature in the field. The focus is on human genetics research, however, much of the material is broadly useful and applies to natural populations of other species.

Course objectives:

Develop an understanding of basic concepts in population and statistical genetics.
Apply that knowledge to real-world situations and current research questions.
Acquire knowledge and confidence of recent population genetics research papers.
Be able to understand and give professional presentations on population genetics research.

Textbook and resources:

Human Population Genetics, John H. Relethford. 2012. PDF is available.
https://umich.instructure.com/courses/546806/files/25975146?wrap=1
Population simulation website: *Genetic Simulation On-Line,* Radford University, R. Sheehy.
https://sites.radford.edu/~rsheehy/Gen_flash/popgen/
All required papers will be available for download on the Canvas site.
All lecture Powerpoint slides will be available for download on the Canvas site.
A Word document template for paper discussion and analysis is available.
https://umich.instructure.com/courses/546806/files/25975198?wrap=1

Class location and time:

The class meets in-person in room Taubman 6370, Monday and Wednesday, 3PM - 4PM
The two Exams will be held during class time, with supplementary time available.

Schedule:

Topic 1. **Introduction to Population Genetics**
Textbook: Chapter 1: Genetic, Mathematical, and Anthropological Background

Monday August 28.
Lecture 1: "Genetics Review for Population Genetics
Paper 1: "Analysis of 6,515 exomes reveals the recent origin of most human protein-coding variants"
Paper 2: "A global reference for human genetic variation"

Wednesday August 30.
Lecture 2: "Quantitative Data in Population Genetics

Labor Day. Monday September 4. NO CLASS

Topic 2. **Hardy-Weinberg Equilibrium**
Textbook: Chapter 2: Hardy-Weinberg Equilibrium

Wednesday September 6.
Lecture 3: "Hardy-Weinberg Equilibrium
Paper: "Departure from Hardy Weinberg equilibrium and genotyping error"

Monday September 11.
Quiz #1
Group Presentation #1

NO Class 9/13

NO Class 9/18

Topic 3. **Inbreeding**
Textbook: Chapter 3: Inbreeding

Wednesday September 20.
Lecture 4: "Inbreeding
Paper: "The role of inbreeding in the extinction of a European royal dynasty

Monday September 25.
Quiz #2
Group Presentation 2

Topic 4. **Mutation**
Textbook: Chapter 4: Mutation

Wednesday September 27.
Lecture 5: Mutation
Supplemental Resource: Principal Component tutorial – YouTube. https://youtu.be/FgakZw6K1QQ
Paper: "Rapid evolution of the human mutation spectrum"

Monday October 2.
Quiz #3
Group Presentation 3

Topic 5. **Genetic Drift**
Textbook: Chapter 5: Genetic Drift

Wednesday October 4.
Lecture 6: "Genetic Drift
Paper: "Ancient genomes from Iceland reveal the making of a human population"

Monday October 9.
Quiz #4
Group Presentation 4

- **FIRST EXAM. Wednesday October 11**

- **Midterm break. Monday October 16. NO CLASS.**

Topic 6. **Natural Selection**
Textbook: Chapters 6 and 7: Models of Natural Selection and Natural Selection in Human Populations

Wednesday October 18.
Lecture 7: "Natural Selection and Human Populations"
Paper: "Multiple instances of ancient balancing selection shared between humans and chimpanzees"

Monday October 23.
Group Presentation 5

Topic 7. **Allele Flow and Population Structure, Part 1**
Textbook: Chapter 8: Gene Flow

Wednesday October 25
Lecture 8: "Allele Flow and Population Structure I"
Paper: "Genome-wide patterns of population structure and admixture in West Africans and African Americans"

Monday October 30.
Quiz #5
Group Presentation #6

Topic 8. **Allele Flow and Population Structure, Part 2**

Wednesday November 1.
Lecture 9: "Allele Flow and Population Structure II"
Paper: "Genome-wide Ancestry and Demographic History of African-Descendant Maroon Communities from French Guiana and Suriname"

Monday November 6.
Quiz #6
Group Presentation #7

Topic 9. **Human population history**
Textbook: Chapter 9: Human Population Structure and History

Wednesday November 8.
Lecture 10: "Human Population History"
Paper: "Genomic insights into the peopling of the Southwest Pacific"

Monday November 13.
Quiz #7
Group Presentation #8

Topic 10. **Complex trait analysis in human populations**

Wednesday November 15.
Lecture 11: "Complex trait analysis in human populations"
Paper: TBD

Monday November 20.
Quiz #8
Group Presentation #9

Thanksgiving break. November 22. NO CLASS

• SECOND EXAM. Monday November 27

Wednesday November 29
Final presentation: Assignment of final presentation papers and groups
Final presentation: Preparation discussions and questions

Monday December 4.

Group work-day

Wednesday December 6.

Final presentations and discussion

Grading:
Quizzes = 25%
Weekly Presentations = 15%
Exam 1 = 20%
Exam 2 = 20%
Final Presentation = 20%