# FORS 6094 Statistical Genetics for Forensic Scientists Spring 2018

Professor: David A. Gangitano, PhDOffice: CFS 221CTelephone: 936-294-4413e-mail: dag006@shsu.eduLecture hours: Tuesday & Thursday 2-2.50Classroom: CFS 102Math Lab hours: Wednesday 2.30-5.20Classroom: CFS 101Office hours: Tuesday & Thursday 3-4.30 hs. (other times by e-mailappointment)

#### Suggested textbooks

- 1) Interpreting DNA evidence. Statistical genetics for forensic scientists. Ian W. Evett and Bruce Weir. Sinauer Associates (1998)
- 2) Genetic Data Analysis II. Bruce Weir. Sinauer Associates (1996)
- 3) The Evaluation of Forensic DNA Evidence. National Research Council. National Academy Press (1996)

#### **Course description**

Since DNA profiles are regarded as being sufficiently distinctive to establish individuality, forensic arguments are going to assign probabilities on the basis of proportions of marker types in the population. For biological markers that are largely determined by inheritable units, this requires an understanding of Population Genetics

Population Genetics is concerned with understanding the mechanisms involved in the movement of genetic material through the space-time frame and the concepts related to evolution.

Statistical Genetics is the study of the applications of principles of statistics to problems in genetics. An introductory knowledge of the Probability Theory and Basic Statistics will be provided in this course.

The course will cover the following topics: Ideal Populations, Random Mating, Hardy Weinberg Equilibrium, Linkage Disequilibrium, Disturbing Forces, Inbreeding, Four-allele Descent Measurements, Product Rule, Independence Testing and Genetic Distance. Different types of population genetics software will be used to generate, analyze data and to compare different DNA databases (fragments and sequence) and to establish phylogenetic relationships and to calculate genetic distances.

An advanced knowledge of the scientific literature and the ability to integrate molecular biology into practical applications and research is required. During the course students will develop independent learning skills and improve their ability to present complex scientific information orally and written.

# **Course objectives**

- 1. Gain sufficient knowledge of the statistical and genetic issues to report DNA cases and to testify competently.
- 2. Understand basic concepts of statistics and probabilities and the principles of population genetics.
- 3. Familiarize with the laws and dynamics of genes in populations.
- 4. Understand the theory and application of genetic models.
- 5. Familiarize with the use of population genetics software and interpretation of results.

# Attendance policy

Attendance will be recorded in keeping with University policy. Students are expected to attend class. Class attendance requirements will be followed in accordance with Academic Policy Statement 800401. In accordance with university policy, students will not be penalized for absences of up to three hours as long as examinations and other assigned work have not been missed. If a student is absented it is their responsibility to obtain the class material and remain current with information distributed during class. Occasionally changes in schedule may be announced in class. These changes apply to all students, even those who were absent from class. One letter grade may, at the discretion of the instructor, be deducted from students' final grade if they miss more than four classes. There will be no distinctions between "excused" and "unexcused" absences. Students are expected to be on time to class. After the beginning of the class, late students may be counted as absent.

# **Grading Policy**

Final grades will be based upon the following scale: 90 plus average an "A"; 80 to 89 a "B"; 70 to 79 a "C"; and below 70 an "F". Students should not count on a curve of the final grade. The instructor reserves the right to modify the grading scheme to accommodate for a missed test or final examination in extenuating circumstances.

The instructor reserves the right to assign a final exam grade of 0% should she deem the absence was not properly handled or was unjustified. Appeals will be handled in accord with University Policy Statement 900823, Academic Grievance Procedures for Students.

### Make-up exams

If a student is absented from the mid-term exam he/she may not be given an opportunity to make up the mid-term exam, even if prior notice has been given the instructor. No make-ups will be given for the final exam unless arrangements have been made prior to the exam date. It is the student's responsibility to monitor the accuracy of the grades.

# Annotated outline of topics to be covered for each class meeting (15 weeks)

*Week 1 (January 17<sup>th</sup>)* Probability Theory: Probability and Laws of Probability. Bayes' Theorem

*Week 2 (January 23<sup>th</sup>)* Basic Statistics: Binomial Distribution. Poisson Distribution. Multinomial Distribution. Normal distribution.

Week 3 (January 30<sup>th</sup>)

Basic Statistics: Induction. Maximum Likelihood Ratio Estimation. Confidence Intervals. Bayesian Estimation. Testing Hypotheses.

Week 4 (February 6<sup>th</sup>) **Exam 1.** 

*Week 5 (February* 13<sup>th</sup>) Population Genetics: Ideal Populations. Notation. Random Mating (HWE test). Disturbing Forces.

#### AAFS meeting (February 19<sup>th</sup>-23<sup>rd</sup>)

*Week 6 (February 27<sup>th</sup>)* Population Genetics: Inbreeding. Inbreeding in Pedigrees. Inbreeding in Populations. Genotype Proportions in Inbred Populations. Drift & Mutation.

#### Week 7 (March 6<sup>th</sup>)

Population Genetics: Pairs of Loci. Linkage. Linkage Disequilibrium (LD test). Disequilibrium in Admixed Populations. Multi-locus Genotypic Proportions.

#### Spring Break (March 12<sup>th</sup>-16<sup>th</sup>)

*Week 8 (March* 20<sup>th</sup>) Statistical Genetics: Estimating Proportions. The Product Rule.

*Week 9 (March 27<sup>th</sup>)* Statistical Genetics: Effects of Subpopulation Data. Confidence Intervals.

Week 10 (April 3<sup>rd</sup>) **Exam 2** 

*Week 11 (April 10<sup>th</sup>)* Statistical Genetics: Independence Testing. Estimating Inbreeding Coefficients.

Week 12 (April 17<sup>th</sup>) Genetic Data Analysis I

Week 13 (April 24<sup>th</sup>) Genetic Data Analysis II

*Week 14 (May 1<sup>st</sup>)* Genetic Data Analysis III

Week 15 (May 8<sup>th</sup>) **Final Examination; 2PM** 

#### **Examinations and Assignments**

There will be one written final examination, in accordance with university policy. The final examination is *comprehensive* and may be based upon any information from anytime during the course. The written final examination will be composed of the analysis of a given population data and questions related to the comprehension of the results of the genetic analysis. The mid-term exams will be composed of mathematical exercises related to probabilities, statistics, population genetics and statistical genetics.

The mid-term exams will comprise 50% of the final grade and the remaining 50% will be based on the performance in the final examination.

	Number	Scope	Timeframe	Weight of Grade
Mid-term exams	2	Defined	Variable	50%

Final	1	Comprehensive	End of term	50%
Examination				

Material for the final exam and tests may come from class material, supplemental reading material or class discussion that was not covered in the reading material. *In other words, attendance and active participation in class is extremely important in order to complete the course successfully and receive a good grade.* 

No make-ups will be given for the final exam unless arrangements have been made prior to the exam date. It is the student's responsibility to monitor the accuracy of the grades.

Deadlines for assignments and other important announcements such as test times and locations will be announced either in class or by email. As a result, students *must* read their SHSU email in order to remain current.

Academic dishonesty http://www.shsu.edu/administrative/faculty/sectionb.html#dishonesty

Disabled student policy http://www.shsu.edu/~vaf\_www/aps/811006.html

# Services for disabled students

http://www.shsu.edu/~counsel/sswd.html

# Student absences on religious holy day policy

http://www.shsu.edu/catalog/scholasticrequirements.html#holyday

**Use of Cell & Smart Phones, PDA's & Similar Devices:** Engaging in voice communication using a cell phone or similar communication device during class is prohibited. Leaving the classroom to receive a phone call is prohibited, except with prior approval of the instructor for urgent communications. Device sound alerts should be turned off during class. Engaging in text communication during class is discouraged, although non-disruptive occasional use is permitted. Persistent or extended texting is, however, not allowed. Per University policy communication using any electronic device during an in-class examination is prohibited.

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