

Principles of Evolutionary Genetics

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Abstract

Many problems in modern biology are currently being addressed through the use of genetic information. However, appropriate use of genetic information requires an understanding of how it can be analyzed. This is particularly true in the fields of population genetics and evolutionary biology, where the phenomena of interest are generally unobservable and must be inferred from their influence on genetic patterns. This course will focus on the fundamental principles used in population genetics to analyze genetic data and to understand a variety of evolutionary processes.

General information

Course number Biology 588

Class time Monagle Residence Hall 3300 at 10:20–11:35 on Tuesday and Thursday.

Instructor Dr. Brook Milligan, 302 Foster Hall, 646-7980, brook@nmsu.edu. Office hours: Monday, Wednesday, Friday, 9:30–10:00 or by appointment.

Text The required text for this course is the following:

Readings Readings selected from the text and the primary literature will be used to supplement the material presented in class and in the text. In order to develop your research skills, it is your responsibility to look these up and download them. I suggest using the ISI Web of Science literature search engine, which is available from the NMSU library web page under “Articles, Books, Journals, etc.” link.

Problem sets A number of problems will be assigned throughout the semester. You are expected to have them completed by the class period *following* the assignment. I will ask individual students to present their answers to the problems. If you have difficulty with the problems, please see me. I strongly suggest that you work in groups (perhaps set up a problem session time on a regular basis).

Prerequisites Graduate standing and an interest in evolution and genetics. Please see the instructor if you do not have these.

Web resources I will make available to you on the World Wide Web (<http://web.nmsu.edu/~brook/courses/population-genetics/>) versions of various documents associated with the course. Whenever possible I will make available not only web-browsable versions, but also PostScript (*.ps) and Acrobat (*.pdf) versions. The latter may be more convenient for you to download and print, rather than view it online. These documents will include such things as the most recent version of the complete syllabus, the schedule, and other supplemental material.

Evaluation

The grade you receive in this course will result from your completion of homework problems (50%) and your participation in class (50%). Note that a number of class periods are denoted as discussions; these will involve you working with your peers to present papers to the class. As a consequence, it is especially important that you participate in these.

The final course grade will be determined based on the following absolute scale: A: 90–100%, B: 80–89%, C: 70–79%, D: 60–69%, F: 0–59%. In the case of S/U grading, the following scale will be used: S: 75–100%, U: 0–74%. Note that this means that you are not competing against anyone else in the course; you must only demonstrate that you know the material.

Grading policy

My grading policy is based on the opinion that a sound college education must be earned and active involvement in your education is the best means of succeeding. As a result, I will be grading you on your performance and ability to communicate clearly the concepts associated with this course. Your grades will represent your performance relative to what I consider to be a reasonable absolute standard; you will not be evaluated relative to your peers in the class. Thus, I regard the grades you receive as directly reflecting your personal effort and performance in this course. Remember, for each credit received for this course, I expect a minimum of three hours of effective involvement with the class each week. Beware of overloading your schedule.

Most importantly, I consider grades to be something you earn by your activities. During the upcoming semester you will be called upon to make many choices about how you spend your time and energy. Some of those choices may influence (either positively or negatively) your grade in this class. This is fine as long as you are aware at the outset that your choices may have direct consequences. In this regard, I share a philosophy espoused by Wiesenfeld (1996).

I am willing to provide you with learning opportunities and will gladly assist you to identify effective ways of improving your study habits or to understand the material. However, you must provide the initiative and keep me apprised of your status in the course. I cannot help you unless I am aware of problems you may be facing. Please let me know in advance if possible and do not let things slide too far.

Scholastic integrity

The progress of science, indeed of all human knowledge, depends entirely on our ability to trust the workings of others in order to extend their scholarship and creativity into new areas. In the absence of that trust, it is impossible to proceed. Consequently, scholastic integrity is one of the highest values upheld by the academic community. All of us must strive to maintain the highest standards in this area for all work associated with our academic activities, in the classroom, in the laboratory, and at home or with our peers.

You should do all of your own work on all assignments, whether in or out of class. This does not preclude discussion of concepts and ideas with other students; indeed, such interaction is encouraged. However, it does mean that when the time comes to work on an assignment, you must present your own work. Please see the “Student Code of Conduct” in the current *Student Handbook* and pay particular attention to the sections that define Academic Misconduct and Plagiarism.

In the case of evidence of academic misconduct of any type, the instructor of this course will take appropriate action. At minimum all involved will receive no credit for the assignment in question. However, consequences may include immediate and outright failure of the entire course.

Student participation

I strongly encourage active student participation in class, and prefer to answer questions concerning the subject matter in class as they arise. There is no such thing as a “dumb question.” If something is not clear to you, others are certainly confused as well, so feel free to ask. I cannot always know what your background is, and may inadvertently use unfamiliar terminology. One of your biggest challenges in this course will be giving concrete meaning to the specialized and precise terminology encountered. In many ways you should treat this as a foreign language course, become actively involved, and participate.

If you feel uncomfortable asking questions in class, jot them in the margins of your notes and ask me immediately following class while your ideas are still fresh.

Courtesy

Please be courteous towards your fellow classmates. If you come to class, stay for the duration; if you must leave early, sit near an exit so that minimal disturbance results when you leave.

Disclaimer

The instructor reserves the right to modify this syllabus during the semester as considered necessary to achieve course objectives, enhance the quality of instruction, or to correct omissions or mistakes. Notification of changes will be made in class; however, the most up-to-date version will always be the one available on the world wide web. You are responsible for being aware of the contents of this syllabus.

Principles of Evolutionary Genetics: fall 2009 schedule

Class	Topics	Readings ^a	Problems ^b
1	Introduction: genome structure	1, Wasser et al. (2009)	
2	Quantifying genetic variation	2: I–III, V–VII	1, 6, 8
3	Hypothesis testing	2: IV	2
4	Discussion: individual identification	11: IIc, Brenner and Weir (2003), Eggert et al. (2003), Goodwin et al. (1999), Palsbøll et al. (2006)	
5	Life cycle and Hardy-Weinberg		
6	Natural selection	3: I	2, 11, 12
7	Estimating strength of selection	3: II	17
8	Inbreeding: deviation from Hardy Weinberg	5: I	1, 2
9	Pedigrees and identity by descent	5: Ifg, Jacquard (1975)	
10	Quantifying relatedness	Milligan (2003)	
11	Paternity	11: IIab, Diamond (1987), Foster et al. (1998), Foster et al. (1999)	
12	Inbreeding depression	5: II	9, 10
13	Discussion: inbreeding depression	Hedrick and Kalinowski (2000), Kalinowski et al. (1999), Kalinowski et al. (2000), Kärkkäinen et al. (1996), Keller and Waller (2002)	
14	Genetic drift and effective population size	6: I–II, Lande and Barrowclough (1987)	1, 2, 8, 12
15	Population structure	9: I–II	5, 7
16	Discussion: population subdivision	Clark et al. (2003), Hedrick et al. (2001), Gutiérrez-Espeleta et al. (2000), Maehr and Lacy (2002)	
17	Population assignment	11: II d	
18	Discussion: population assignment	Carmichael et al. (2001), Primmer et al. (2000), Wasser et al. (2008)	
19	Migration and gene flow	9: I	2
20	Discussion: landscape genetics	Manel et al. (2007), McRae and Beier (2007), Wang et al. (2009)	
21	Linkage disequilibrium	10: I, V	1, 2
22	International HapMap Project	Daly et al. (2001), Gabriel et al. (2002), The International HapMap Consortium (2007), Risch (2000)	
23	Heritability		
24	Quantitative trait loci	11: III	
25	Discussion: mapping quantitative traits	Hirschhorn et al. (2001), Liu et al. (2004), Sax (1923), Xu et al. (2002)	
26	Mutation and selection	7: I–II	2, 5, 7
27	Neutral theory	8: I	2, 3, 4, 7
28	Tests of neutrality	8: II	
29	Coalescence	8: III	12, 14

^aUnless noted otherwise, these readings are from the text (Hedrick, 2005).

^bAll problems are from the text chapters corresponding to each topic.

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