

Math 305 (16 students enrolled)
Spring 2018 Syllabus

Instructor: Gautier Picot
Office: PSB 320
Office Hours: M 1:30pm–2:30pm, T 10:30am–11:30pm, R 12:30pm–1:30pm, F 10:30am–11:30am and by appointment.
Email: gautier@math.hawaii.edu
Website: http://www.math.hawaii.edu/~gautier/305_spring18.html
Class Meeting: TR 09:00 a.m – 10:15 a.m in Keller 403
Lab Meeting (for Math 305L): TBA
Prerequisite: A grade of C or better in Math 216, 242 or 252A, or consent.

All major announcements will also be posted to the course website (e.g. exam dates).

Text: *Mathematical Models in Biology* by Logan and Wolesensky (2009).

Course Description: The course will cover basic techniques of probabilistic modeling. Models drawn from mathematical biology will be used as "case studies" to motivate and illustrate the mathematical methods as well as to introduce classical areas of mathematical biology such as population genetics and evolution. The class will present an introduction to probability theory and stochastic processes, with particular focus on Markov chains.

Approximate timeline:

- Week 1-Week 6: Chapter 5, sections 1-5. Introduction to modeling. Basic probability concepts, including conditional probability and independence. Introduction to population genetics and the Hardy-Weinberg Law. Continuous and discrete random variables. Joint probability distributions.
- Weeks 7-11: Chapter 5, section 6, Chapter 7, sections 1-4, and supplementary material. Covariance and correlation. Definition of a stochastic process, discrete time Markov chains. Simple random walks, random walks with absorbing states. Mathematical population genetics and evolution. Continuous time Markov chains, Poisson processes. Continuous time birth and death processes.
- Weeks 12 -16: Chapter 7, sections 5,6. Stochastic differential equations. Brownian motion and diffusion processes. Other topics as time allows.

Exams: There will be two in-class exams.

- First exam: Thursday, February 15th. Program: Chapter 5, sections 1-5.
- Second exam: March, March 22nd. Program: Chapter 5, section 6, Chapter 7, sections 1-4.

Calculators will not be allowed.

Homework: Three homeworks will be collected this semester:

- Hw1 will be assigned on Thursday January 25th and due on Thursday February 8th. Program: Chapters 5, sections 1-5.
- Hw2 will be assigned on Thursday March 1st and due on Thursday March 15th. Program: Chapter 7, sections 1-4.
- Hw3 will be assigned on Thursday April 12th and due on Thursday April 26th. Chapter 7, sections 1-4.

The homeworks will be due at the beginning of the class. Late work will not be accepted

For each section covered in class, a list of non mandatory suggested problems from the textbook will be posted on the course website, to help you study and get ready for the in-class and final exams. The in-class and final exams will most likely be based on those suggested problems.

Final Exam: There will be a cumulative final exam on **Thursday, May 10th from 9:45am to 11:45a.m.** By registering for this section, you are accepting the fact that you must be present during the scheduled final exam. Early exams will not be given.

Grading: Homework counts 20%, the worst in-class exam counts 20%, the best in-class exam count 25% and the final exam counts 35%. **The grades will NOT be curved.** Below is the grading system that will be used:

Letter Grade	Overall score (in %)
A+	95-100
A	92-94
A-	90-91
B+	85-89
B	82-84
B-	80-81
C+	75-79
C	67-74
D	50-66
F	0-49 or if the final exam is not taken

Optional Lab (Math 305L, 1 credit): It is open to students in Math 305. For students who receive the Certificate in Mathematical Biology, it is required. Others not interested in the Certificate are also welcome to take the lab. Students will learn to use Matlab (or a Matlab clone, such as Octave). For approximately two-thirds of the semester, students will work on weekly programming exercises. Students will be expected to download the program (Octave is free) and work on their own. Time in the Mathematics Department computer lab will be made available for students to work on their exercises and projects, but I will consult with them weekly, either in the lab or in my office. Around the middle of the semester students will choose a project, after which students will spend progressively more time working on their project. Part of the project will involve writing and running programs, and the lab will continue to be available for this purpose. The project will consist of choosing a model to study from a published research paper (or possibly an extension of a model in the textbook), simulating the model using Matlab (or Octave), and reproducing results from the paper. In addition, students will formulate a question that is not fully addressed in the paper, and modify the model to study it, or extend the analysis of the behavior of the model beyond that of the paper. A more open-ended project that requires formulation of a new model is also possible. Students will be required to turn in a written report on their project.

Collaboration: You are encouraged to study together, and to consult me as much as you want. Talking about mathematics with other people is one of the best ways to learn it. However, exams are individual activities, with no collaboration of any kind allowed. The departmental statement of academic expectations applies to all students and can be found on the Math Department web page: www.math.hawaii.edu under the tab Undergraduate.