Course Syllabus

MATH 05.04 / BIOL 05: Fundamental Applied Mathematics for the Sciences

Instructors: Dan Rockmore &

Place: 105 Class of 1978 Life Sciences Center

Time: 1250-1355 hr, MWF; X-hour: 1320-1410 hr Tu

Textbook: Bodine, Erin N., Suzanne Lenhart, and Louis J. Gross. 2014. Mathematics for the Life Sciences. Princeton University Press, Princeton, NJ. (Links to an external site.)Links to an external site.

No Prerequisites

Mathematics is the language of science. However, mathematics preparation for most science students typically involves only the study of calculus at the university level. While many scientific problems involve calculus, two other areas of mathematics are equally (if not more) important: linear algebra and probability. For example, linear algebra is fundamental to stoichiometry and the conservation of matter in chemistry, hydrology and atmospheric dynamics in earth sciences, and cell growth and population dynamics in biology. Moreover, most features of the natural world are probabilistic and frequently best described by probability models, such as the firing of neurons in the brain or the timing of earthquakes. Both are also central to all problems in statistics. This course will explore the application of linear algebra and probability to problems across the physical, life and social sciences. We will cover the basics of solving linear algebra and probability problems as well as formulating simple models to describe and analyze natural phenomena from across the sciences.

Sequence of Study:

- Quantifying the world to test hypotheses
- Basic descriptive statistics
- Software for working with data
- Visualizing data
- Regression & correlation
- Exponential & logarithmic functions
- Regression on arithmetic and logarithmic scales
- Discrete difference equations
- Vector and matrix addition & subtraction
- Vector & matrix multiplication and "division"
- Determinants & the geometry of matrices
- Eigenvalue & eigenvectors
- The probability of an event

- Sampling with and without replacement
- Conditional & unconditional probabilities
- Bayes' theorem
- Bernoulli trials & binomial distributions
- Counting & Poisson distributions
- Normal distributions

Grading:

Grades in the class will be based on three exams given in the evening during the term and a final examination. Exams given during the term will cover the material through the previous Friday's material (inclusive), and the final examination will cover the entire course material. Exams will be mainly set problems and applications of mathematical techniques to new situations. Each examination during the term will be weighted as 20% of the final grade, and the final examination 40%.

Homework:

We will assign homework throughout the term to exercise students in the skills needed to address problems involving linear algebra and probability across the sciences. Homework assignments will be taken from the textbook and from additional problems and data sets we distribute. The homework is not graded. X-hours will be used to discuss the homework problems.

Software:

For this class you will need both Microsoft Excel and Mathworks Matlab. We will use both often.

You can download Matlab here. The instructions for installing Matlab on your computer can be found in the pdf file in the Files section of this Canvas Course. In there, you will find the software licence code you will have to enter to get Matlab to run.

Accommodations for students with disabilities:

We encourage students with disabilities, including "invisible" disabilities such as chronic diseases, learning disabilities, and psychiatric disabilities to approach us outside of class to discuss appropriate accommodations that might be helpful to them.

Religious Holidays:

Some students may wish to take part in religious observances that occur during this academic term. If you have a religious observance that conflicts with your participation in this course, please meet with us before the end of the second week of the term to discuss appropriate accommodations.

The Honor Principle:

Academic honesty is essential. The following is quoted directly from the Dartmouth College Student Handbook: "Fundamental to the principle of independent learning are the requirements of honesty and integrity in the performance of academic assignments, both in the classroom and outside. Dartmouth operates on the principle of academic honor, without proctoring of examinations. Students who submit work that is not their own or who commit other acts of academic dishonesty forfeit the opportunity to continue at Dartmouth." The complete text of the Academic Honor Principle is in the Student Handbook. Please read it carefully.

Any violations of the Honor Principle within the context of Math 5/Bio 5 will be referred to the Committee on Standards. All work on the term examinations and the final examination must be completed without reference to written materials other than those provided with the exam and must be completed without communication with anyone else (the only permissible exception is that students may request clarification of any exam question from the course instructors who are present expressly for that purpose). The answers that you provide must be entirely your own work.