This syllabus is a general representation of the course as previously offered and is subject to change.

BIOL 301 - Biomathematics

General Course Syllabus (as of May 2019)

About the Course:

Course Description: Introduction to the uses of mathematics in the biological sciences and to the construction and analysis of models of biological processes.

The lectures cover basic mathematical models used in ecology and evolutionary biology. Topics include models of population growth, species interactions, demography, natural selection, and disease dynamics. The computer labs focus on learning to use a mathematical software package that aids in the solution of models of interest in biology.

Course Format: Lecture and Tutorial
Credits: 3
Co-requisites: One of BIOL 300 or STAT 200.

Course Learning Objectives:

By the end of this course, students will be able to:

- Gain an improved understanding of mathematical models as they are used in biology.
- Derive and interpret the results of models of population growth, species interactions, demography, natural selection, and disease dynamics.
- Determine the behaviour of a dynamical system using a combination of mathematical approaches and simulations.
- Gain an introductory understanding of matrix theory and probability theory.
- Use a mathematical software package to analyse and simulate equations describing biological phenomena.
- Practise translating a biological question into a mathematical model and analysing the equations using a student-developed model.

Textbooks and Additional Resources:

Textbook and Lecture Notes:

- A Biologist's Guide to Mathematical Modeling in Ecology and Evolution, Otto & Day (2007) Princeton University Press - available at the bookstore or order online.
- Lecture notes, Otto (2006) - Available at Copiesmart (in the Village, 5728 University Blvd) or the course website

Course Website:

- Homework assignments, answers to student questions, and a large portion of the lecture material will be posted on the class website: www.zoology.ubc.ca/~bio301/.

Additional References: On reserve at Woodward

- Population Biology. Hastings (1997)
- Theory of Population Genetics and Evolutionary Ecology. Roughgarden (1996)
- Theoretical Evolutionary Ecology. Bulmer (1994)
- Mathematical Models in Biology. Edelstein-Keshet (1988)

Evaluation:

Assessment	Weight
Homework	25%
Computer lab assignments/participation	10%
Midterm exam	20%
Course project	10%
Final exam	35%

Requirements: All students will be required to do weekly readings and homework assignments (due in class). In addition, there will be weekly computer labs (COPP 2008), where you will learn to use the software package *Mathematica* to help analyse models.

Schedule of Topics:

Unit	Topics
Part A: Introduction	**(1) Introduction** • Mathematical models in biology • Model construction • Example: Deriving the Hardy-Weinberg Law **(2) Mathematica Basics**
Part B: Models in One Variable	**Examples to be used:** • Population growth (no density dependence) • Population growth (with density dependence) • Selection at one genetic locus **(3) Discrete-time Formulations** **(4) Continuous-time Formulations** **(5) Preliminary Analyses** • Iterating recursions • Graphical analyses **(6) Analysing Linear Models in One-Variable**

<table>
<tr><td></td><td>(7) Analysing Non-Linear Models in One-Variable
Equilibrium states
Stability of equilibrium states
Background: Taylor Series
Global versus local solutions</td></tr>
<tr><td>Part C: Models in More than One Variable</td><td>Examples to be used:
Red blood cell production
Demographic models
Competition between two species
Spread of disease
(8) Formulating the Models
(9) Analysing Linear Models in More than One Variable
Background: Linear Algebra
(10) Analysing Non-Linear Models in More than One Variable
Equilibrium states
Stability of equilibrium states
Graphical methods</td></tr>
<tr><td>Part D: Probabilistic Models</td><td>Examples to be used:
Sex ratio among offspring
Fixation probability of a beneficial allele
Genetic drift
(11) Introduction to Probability Theory
(12) Discrete probability distributions
(13) Continuous probability distributions</td></tr>
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University Policies:

UBC provides resources to support student learning and to maintain healthy lifestyles but recognizes that sometimes crises arise and so there are additional resources to access including those for survivors of sexual violence.

UBC values respect for the person and ideas of all members of the academic community. Harassment and discrimination are not tolerated nor is suppression of academic freedom.

UBC provides appropriate accommodation for students with disabilities and for religious, spiritual and cultural observances.

UBC values academic honesty and students ae expected to acknowledge the ideas generated by others and to uphold the highest academic standards in all of their actions.

Details of the policies and how to access support are available on the UBC Senate website.