Welcome to BIO 480

Introduction to Biological Modeling

http://faculty.unlv.edu/schulte/BIO480/

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Introduction to Biological Modeling

Course Syllabus Handouts

Sample Programs Berkeley Madonna Program

Lecture Notes

Course currently offered in Spring 2017. For information, email

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First Topic: Introduction to what a model is and why we use them

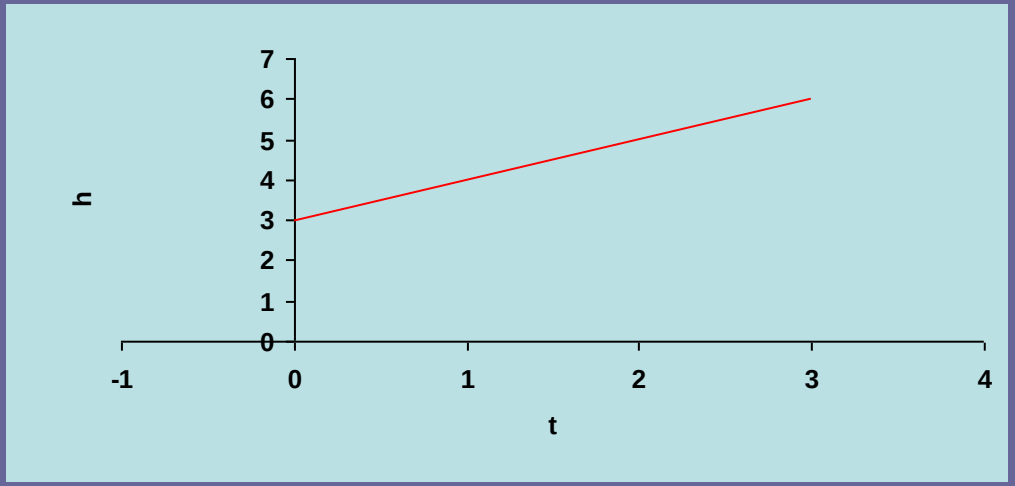
Not a math course, but:

- Use math in many models
- Models often described with equations
- Not solve equations
- Use computers for solutions

$$h = at + b$$

What effect does "a" have?

$$\frac{dh}{dt} = a$$



"a" is related to <u>growth rate</u>

Easy to see, but what about:

$$\frac{dh}{dt} = ah - bh^2$$

Computers will help us see this…

Not a computer programming class, but

- We will learn to write simple programs (…Why?)
- Not expected to already know how
- Our programs will be fairly simple, not fancy programs

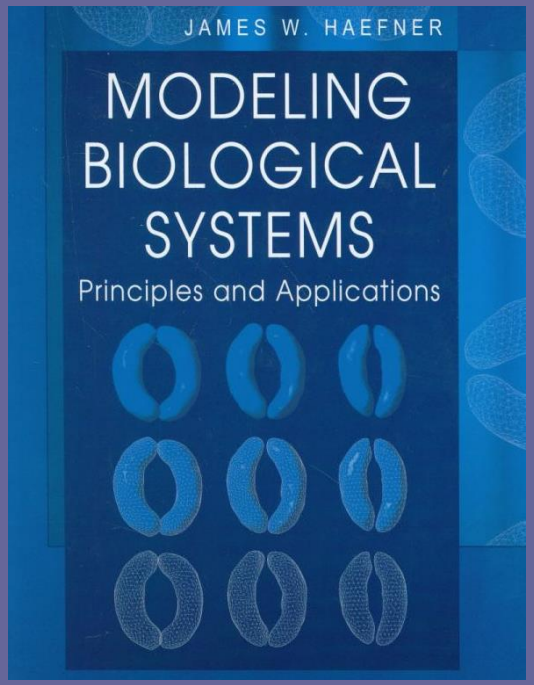
1) Request input
2) Make calculations
3) Display output

Course info

3 exams including final
(20, 20, 30%)
Project reports – 30%

Lab options:
Independent
Computer lab

Text: Haefner, James (2005)



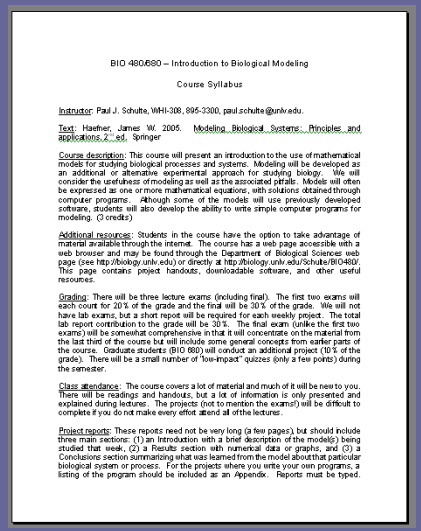
Class attendance – text readings and handouts, but a lot of info only presented and explained in lecture

Projects & project reports:

- Typed, often with graphs – learn to use Excel (see Graphing tutorial on course web page).
- Due end of week following project
- Late penalties
- Exams overlap with projects – good to keep up!!

Computer programming:

- Ok to work together, results and reports must be independent
- Don't copy & paste programs without understanding
- "Low impact" quizzes



BIO 480/680 – Introduction to Biological Modeling

Course Syllabus

Instructor: Paul J. Schulte, WHI-308, 895-3300, paul.schulte@unlv.edu.

Text: Haefner, James W. 2005. Modeling Biological Systems: Principles and applications, 2nd ed. Springer

Course description: This course will present an introduction to the use of mathematical models for studying biological processes and systems. Modeling will be developed as an additional or alternative experimental approach for studying biology. We will consider the usefulness of modeling as well as the associated pitfalls. Models will often be expressed as one or more mathematical equations, with solutions obtained through computer programs. Although some of the models will use previously developed software, students will also develop the ability to write simple computer programs for modeling. (3 credits)

Additional resources: Students in the course have the option to take advantage of material available through the internet. The course has a web page accessible with a web browser and may be found through the Department of Biological Sciences web page (see http://biology.unlv.edu) or directly at http://biology.unlv.edu/Schulte/BIO480/. This page contains project handouts, downloadable software, and other useful resources.

Grading: There will be three lecture exams (including final). The first two exams will each count for 20% of the grade and the final will be 30% of the grade. We will not have lab exams, but a short report will be required for each weekly project. The total lab report contribution to the grade will be 30%. The final exam (unlike the first two exams) will be somewhat comprehensive in that it will concentrate on the material from the last third of the course but will include some general concepts from earlier parts of the course. Graduate students (BIO 680) will conduct an additional project (10% of the grade). There will be a small number of "low-impact" quizzes (only a few points) during the semester.

Class attendance: The course covers a lot of material and much of it will be new to you. There will be readings and handouts, but a lot of information is only presented and explained during lectures. The projects (not to mention the exams!) will be difficult to complete if you do not make every effort attend all of the lectures.

Project reports: These reports need not be very long (a few pages), but should include three main sections: (1) an Introduction with a brief description of the model(s) being studied that week, (2) a Results section with numerical data or graphs, and (3) a Conclusions section summarizing what was learned from the model about that particular biological system or process. For the projects where you write your own programs, a listing of the program should be included as an Appendix. Reports must be typed.

Two initial questions :

1. What is a model ?
2. Why use a model ?

Consider two possible topics of interest:

1. Water flow thru plants cells – cells are not pipes, have obstructions
2. Fur on animals and temperature

Model

Questions

Experimental

Physical model (pipes with pins)

Mathematical model

How do obstructions affect flow ?

Find plants with different kinds of obstructions

Remove obstructions

Physical model

Mathematical model

What effect does fur have on temperature ?

Find animals with different amounts

Shave

All approaches have potential problems !!

Selected plants/animals vary in more ways than just the character we are studying

Manipulation may change more than just the character we are studying

Physical model may not match real system

Mathematical model may have wrong equation, leave out an important factor, or be solved incorrectly

Formal definition of a model

A model is…

an abstraction,
a simplification,
a representation
of a real system

Models are simplifications, but must include essential elements of the real system.