

5110/6830 Fall 2009
Take-home final assignment, due Dec. 10 at 12:25

Pick one of the projects below. This will be your assignment for the take-home final. You can work individually or in a group of up to 3 people. You are expected to:

1. email me before 8pm on Tuesday, December 1 to tell me what project and with whom you are planning to do;
2. Meet with me at least once either during class time on Dec. 3 or 8 or by appointment, so that we can discuss how your project is going;
3. Submit final report at 12:25 on Thursday, December 10;
4. You may be asked (in advance) to make a short presentation about your work on Dec. 10.

What I will look for in your project report:

1. Research the problem at hand well enough to allow you to build a meaningful model;
2. Build a model (it may discrete or continuous, as needed). If you need to ignore some things to make simplifications, state it. Explain the model the best you can, but the explanation does not need to be lengthy.
3. Analyze the model using methods similar to what did in class, analytically or numerically. Examples of possible questions to answer: What will be the long-term behavior of solutions? what if conditions (one of parameters) change suddenly? The questions that you will be answering depend on the particular situation you are trying to address. Use hand-drawn or printed-out figures as needed.
4. What conclusions can you derive from your findings?
5. As a minimum, you should build a model and analyze important features of its behavior. To do even better, introduce extra components to the model, e.g.: vaccination or other control strategy; search thorough parameter values to find other interesting phenomena; compare your results with actual data.
5. If you search for particular parameter values, or other facts, online or in literature, state them with references. (You don't necessarily need to give particular values to your parameters. You know from class that often the system can be analyzed for general parameter values, but sometimes you will need specifics, say, if you want to do simulations).
6. Hand-written report is fine.

Project suggestions.

They are all from de Vries et al. book that we used in class, chapter 9. I described the first few as I changed the formulation somewhat, the rest are straight from the book, scans linked below. It may be different for different people, but I think the disease projects (1-3) are slightly more challenging, but very rewarding.

1. HIV epidemic in Cuba (project 1 in dV)

Design a model that describes the epidemic spread of HIV in Cuba from 1986 to 2000. You will need to look into facts about HIV transmission. Try to introduce control mechanisms to lower the number of AIDS cases. How will you include them in your model? If you have time, read about Cuba's control strategy, include it in your model and compare the outcomes (an article about this particular epidemic is linked below, but you don't have to use it)

2. Yellow Fever in Senegal (project 4 in dV)

Yellow fever (YF) is a viral hemorrhagic fever transmitted by infected mosquitoes. YF is spread into human population in three stages:

- (jungle) YF is transmitted in rain forests from mosquitoes feeding on infected monkeys to humans who work in the forest;
- (intermediate) from infected humans to other humans (through mosquitoes) in rural villages;
- (urban) happens as soon as an infected individual enters urban areas. This can lead to an explosive epidemic.

The epidemic can be controlled by vaccination. The YF vaccine provides immunity within one week in 95% of those vaccinated.

Develop a model for the three stages. In particular, discuss the relative parameter values at different stages.

If you can, include vaccinations in your model. What happens if vaccinations are introduced before the urban stage is reached? How do you include it in your model? (There is some information about YF outbreak in Senegal in 2002 at www.who.int)

3. Cholera (project 5 in dV)

Large cholera outbreaks are usually related to contaminated water. The cholera virus is present in brackish water through algae blossom and through human feces. Only 10-20% of infected individuals suffer from severe symptoms. Many individuals do not show any symptoms at all, but their feces

are infectious.

Model the epidemic. What are the outcomes?

If you can, include the following WHO recommended control mechanisms:

- hygienic disposal of human feces;
- adequate supply of safe drinking water;
- good food hygiene and cooking;
- washing hands.

Which of the control mechanisms is most effective? (there is some information about cholera outbreak in South Africa in 2001-2002 at www.who.int)

4. Pupil control system (project 19 in dV)

(see book scan below)

5. Modeling of heart beats (project 20 in dV)

(see book scan below)

6. Bike-Run-Fun (project 25 in dV)

(see book scan below)