Guidelines for Term Papers

Course Projects

A major feature of this introductory mathematical modeling course is that students develop course projects and write term papers on those projects. These term papers are to be turned in on the last day of lectures, or electronically on or before that day. **No late submission is accepted.** The modeling projects and term papers may be done in groups of 1, 2, or 3 students. Please do not worry about this project excessively, but do start thinking about it from the very beginning. We know this is the first such experience for most of you.

The content of your project/term paper can be new and innovative research, or reviewing a few papers written by other scientists. A list of possible topics will be provied to you. You are strongly encouraged to pick one from the list, but this is not absolutely necessary. However, if you want to pick a topic on your own, you need the permission from the instructor ahead of time. The purpose of the project is that you learn to tackle a mathematical modeling problem with the following features:

(1) It should be a problem of interest to you.

(2) It should involve the mathematical techniques that you have studied in this class. It is also fine if it goes beyond what we have done in class and requires that you learn about some particular technique in greater depth.

(3) Since this course focuses on *mechanistic modeling*, it is not required to collect and/or analyzing any "real data". Comparing predictions from your mathematical model with real data would be nice, of course, but it is not essential. In any case, obtaining/collecting data itself should not be your main effort — that would be the task of a laboratory project.

(4) It is expected that you will have to use the library, physical or online, and identify relevent references in books and journals in order to do this project. Much useful information and data can also be found on the web. (But there is also a lot of nonsense out there. Remember that anyone can "publish" anything on the web and it is not subject to the same kind of editorial control as books or journals.)

The following are some pointers on how the proposal and term paper for this project should be structured. Please see the instructor or one of the TA's if you have additional questions.

Term Papers

The lengths of term-project papers may vary, but we are expecting that you will need 10 or 12 pages of double-spaced text to describe a meaningful project. In addition, there may

be figures, data, and/or computer programs. This means that we are talking about a total length of 15 to 20 pages.

The format of the paper will depend on what type of model you are looking at, but here are some key components that most papers should contain:

(1) Title and Abstract

This is a short overview of the paper, a miniature version of 100 words or so. Someone reading the abstract should get a good idea of what problem has been tackled, what types of techniques were used to solve it, and what sort of solution was found. Most professional papers start with an abstract. It is very valuable for the potential reader, to help decide whether the paper is of interest and, if so, to get an overview of the whole picture before starting to read the details.

(2) Problem description

Present the problem you are attempting to solve. Give some background. Explain why it is important or interesting. Outline the questions that you would like to answer.

(3) Simplifications

You will probably need to simplify the problem in order to obtain a model that is appropriate for this project. Explain the ways in which you simplified the original problem and outline the assumptions that underlie these simplifications. Justify the assumptions, if possible, or discuss the limitations that are imposed on your model by your assumptions and simplifications.

(4) Mathematical model

How did you turn the simplified problem into a mathematical model? Is there a standard mathematical paradigm that you are using, e.g., Newtonian mechanics, conservation of number of indivials, or linear programming? Or is it a problem of a different sort? How does it relate to standard problems? Define all of your variables, explain your notation, etc.

(5) Solution of the mathematical problem

What techniques did you use to solve the mathematical problem? Were you able to use standard techniques, e.g., the simplex method for linear programming and linear analysis for differential equations? Did you need to develop a new analytical method and/or algorithm to solve the problem? Did you use a technique from the literature that we haven't discussed in class? Explain in detail.

(6) Results and Discussion

What were your results from solving the mathematical problem? How are these results interpretable in terms of the original problem? Are the results reasonable? If not, what are the possible failings of the model that led to poor results? If your model

leads to a large problem that you cannot solve, try to formulate a smaller version that leads to reasonable results.

(7) Improvement

How can you improve the model or solution technique so as to yield better results? How easy or diffcult is it to implement these improvements.

(8) Conclusions

Summarize what you have done and what you have learned.

(9) References

This is extremely important! Please include a bibliography if you have used any references, e.g., books, journal articles, web pages. Put a citation in the paper if you refer to a reference. An example of reference, Taubes (2001), is given below.

Please type the paper. You can use any word processing system that you like, and write in mathematical equations if necessary. Typesetting systems such as LaTeX are especially recommended.

I will keep the final copy of your project. Please be sure to xerox your final copy before turning it in.

References

Taubes, C.H. (2001) *Modeling Differential Equations in Biology*. Prentice-Hall, Upper Saddle River.

