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 Monday before the last day of lectures. 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. We know this is the first such experience for most of you. If you cannot come up with anything new or innovative, reviewing a few papers written by other scientists is acceptable.

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 and one that is fun to investigate.

(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) It would be nice (but not essential) if it required collecting and/or analyzing some "real data" in order to build and/or test the model.

(4) It is expected that you will have to use the library 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 responsibility for finding a course project is yours, but we will be happy to give you feedback on ideas and some assistance in locating resources. We will also help to match up people into groups if necessary, but it is best if you can do this on your own.

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 8 or 10 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 10 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) *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., linear programming or Newtonian mechanics? 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*

What were your results in solving the mathematical problem? How are these results interpretable in terms of the original problem? Are the results reasonable? If not, what are the 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 difficult is it to implement these improvements.

(8) *Conclusions*

Summarize what you have done and what you have learned.

(9) *References*

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 listed 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, troff, or lout are especially recommended.

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

References

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