Guideline for Term Papers

AMATH 383 - Winter 2008

January 4, 2008

Course Projects

A major feature of this introductory mathematical modeling course is that use this skills that you will learn in this class to derive a mathematical model, and write a term paper on this model. These term papers are to be turned on **March 14, 2008 by 5pm**. Please do not worry about this project excessively. I understand that 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. This is critical as you will be working on this project for the majority of the quarter!

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 revelent 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.) **Wikipedia is not a valid source**.

The responsibility for finding a course project is yours, but I will be happy to give you feedback on ideas and some assistance in locating resources. There will be a handout posted to the course website that includes possible topics and references. The following are pointers on how the proposal and term paper for this project should be structured. Please see the me if you have additional questions.

Term Papers

The lengths of term-project papers may vary, but we are expecting that you will need 10-15 pages of double-spaced text to describe a meaningful project (not including figures and equations). In addition, there may be figures, data, and/or computer programs. This means that we are talking about a total length of 12 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. If you are reviewing a model by other scientist, explain why they are looking into the problem mentioned in the paper.

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. If you are reviewing a model by other scientist, it is critical that you explain not only the variables in their model, but how they arrived at the model.

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. Again, if you are reviewing someone else's model, you must be able to replicate their results on your own. If you are unable to, you can see me for additional methods of analysis.

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. If you are review someone else's model, what would you change about it? Are there any important effects that they've left out?

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.

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 (a markup language that is great for producing equations) are especially recommended. If you are interested in using LaTeX, and need help, let me know. I will keep the final copy of your project. Please be sure to Xerox your final project before turning it in.