

Math 210 Project Guidelines
Spring 2007, Prof. Donnay

The goal of the project is for you to put your differential equations knowledge to use investigating a problem of interest to you.

The project will have two components: the **research**, in which you learn about your topic, and the **write up**, in which you describe what you have learned.

Length: your paper should be 10 – 15 pages long and should be type written. For the math equations, you can either leave blank lines and write them in by hand or you can use a computer system (such as Microsoft Equation: go to INSERT, OBJECT) to type the equations.

The project modules can serve as a guide to your work. You get to decide how closely you follow the module.

In doing the **research** (i.e. in figuring things out), use the techniques we have practiced during the term which include:

- figure out what variables and parameters you want to use and what they represent. Write down an exact statement of what each variable and parameter is representing.
- figure out what the units are for the variables and parameters.
- make up a simple example with numbers and units to help you understand what the variables and parameters mean.
- write out the equations you need for your model. Explain to yourself (and your partner) what the terms in the equations are representing. Check that the units of all the terms are make sense and are consistent.
- draw diagrams and graphs to clarify and help you understand the problems.

Label the diagrams/graphs.

- work out some problems/exercises.
- if the problem is very abstract with variables and parameters but no actual numbers, replace the parameters with some numbers. Then analyze the problem with the numbers.
- if the theory claims that for different parameter values, different behaviors occur, then take numbers that illustrate each of the different types of behaviors.
- use the computer to give you graphical/visual information about how the system is behaving.

Project Write up:

Target audience: Imagine that the person reading your paper is another student in our differential equations course. You want this person to be able to understand what you are describing. So your paper should include:

1. **Introduction** (Setting the stage) in which you describe in general terms:

- What your project is about
- Why the reader should care about this topic

2. **Main part of paper**: Describe what you have learned/discovered/figured out about your topic in such a way that the reader (your classmate) *can understand your reasoning*. Your mathematics should of course be correct. Components that can help the reader understand include:

- stating clearly what variables and parameters you use and what they represent.
- stating clearly what the units are for the variables and parameters.
- describing the model. What is the real world situation being studied? What are the important factors? What simplifying assumptions are being made? How does the real world problem get translated into a model; i.e. into equations.
- outlining the derivation of the equations and explaining what the various terms in the equations represent.
 - giving a simple example with numbers and units to illustrate what the variable and parameters mean.
 - drawing diagrams and graphs that clarify and help explain your problem. Be sure to include a description of what the diagram/graph is showing so the reader is not left wondering what is the point of the diagram/graph.
 - using tables to summarize your results.
 - working out problems/exercises. Be sure to state clearly what the problem is that you are working on and what the answer is that you get. Write out your work in such a way that *the reader can understand the reasoning behind your solution*.
 - using the language/terms we have learned in the course: example – “to solve this non-homogeneous linear equation we” or “we find the linear approximation at the equilibrium point”.
 - carrying out general, theoretical calculations.
 - plugging numerical values into the parameters and working out a problem using numbers rather than the more abstract parameters. State clearly the value of the parameters you are using.
 - breaking your report up into sub-sections as appropriate.
 - deciding how much detail to show in the calculations vs. giving results and drawing implications from the calculation.

Note that many of these approaches to help the reader understand the mathematics you are describing are the same techniques you would take yourself to help you understand and learn the mathematics as you were doing the research.

3. **Future Directions Section**: Include a section in which you mention some problems, questions, issues that this project has lead you to wonder about that you (or another researcher) might want to examine in the future. This can be short.

4. **“What to do when you do not know what to do” section**. This has been a theme of our course. In your write up, include a section in which you discuss what you have learned about this issue in doing the project.

5. **Teamwork Report**. Each person on the team should write a short (one paragraph) report describing what was the role of each member of the team, and how well (in your opinion) the different team members contributed to the project. As a measure of your opinion of people’s participation, state how you would distribute 20 reward points among the team members.

Resources:

You should consider using the computer programs from our CD, the TrueBasic programs for numerical integration and Mathematica. With Mathematica, you can graph functions and solve equations. Also Mathematica can numerically solve differential equations (even for systems of more than 2 equations). See the handout for an example of this.

Math 210 Project Rubric

Mathematics in the paper is correct.

Mathematics was clearly explained.

Linkages were made to the material we covered in class.

The paper was conscientiously written with attention given to good grammar, correct spelling, proper typesetting of equations, labeling figures.

Required sections were included:

Introduction

Main body of paper

Future Directions

“What to do when you do not know what to do”

Teamwork Report.