

For your final project, you and your team will investigate a topic of your choosing. This can be on anything related to mathematical modeling and should be any combination of research into the topic, modeling of a real-world problem, and computation around the model. You will work in **groups of 2 or 3**. There are 3 “deliverables” to the final project, which have due dates posted on the tentative schedule on Canvas:

- (1) Submitting a proposal. (2) Submitting a final writeup. (3) Giving a presentation.

Proposal (2 pages)

The aim of the proposal is to show that you have a clearly defined goal in what you want to analyze and to discuss how you will go about it. Your proposal should be **2 pages** typed using a font size of 10-12 points. Use standard paper size (8.5 x 11) and exact one inch margins (top, bottom, left, and right). No information should appear in the margins. The **first page** of the proposal should include the following:

- Full statement of the problem to be investigated. This includes any constraints you may have to consider.
- Clear statement of what you expect to find from your study.
- Literature review: Cite a few references on where you got the idea and where any data came from.
- Concise description of what computation you will need to do for the project.
- Clear statement of why this problem is interesting to you and possibly other scientists.

The **second page** of the proposal should include the following:

- A clear description of each group members anticipated role on the project (how will the tasks be divided?).
- Brief idea of how long it will take you to complete the project.

References may be listed on a third page. Please submit the proposal via Gradescope in **pdf format only**. It should be uploaded once for the Group.

Final Project Paper (7-10 pages)

You will submit a paper/lab report with your findings. Your research is not expected to be original or novel. However, it is expected that you do a thorough literature review of the problem, discussing what has been done by others (clearly citing that work) and presenting some analysis of your study. Submission of your paper is representation that it is written in your own words and not copied from any source without direct citation. Your project should include the following:

- A brief abstract summarizing the results of your project (see below for more details).
- Clear statement of the problem and your modeling goals, including what aspect you have studied.
- Explanation of your assumptions and a rationale/justification for how they bear on the problem.
- Your model design and justification for type of model used or developed.
- Description of model testing, sensitivity analysis, or computation used, including error analysis, etc.
- Discussion of the strengths and weaknesses of your model or approach.
- Thorough literature review. This includes citing a few references of current or past research on the subject.
- Discussion on what applications this problem would be applicable to or why the analysis you chose provides insight into the specific research area.
- On a separate page (added as an appendix), a brief summary of each group member’s participation in the project.

Again, please submit the proposal via Gradescope in **pdf format only**. Code may be submitted separately if it helps, but a clear README must be provided to explain how to run the simulation. All files should be uploaded once for the Group.

Final Project Presentation (20 minutes)

You will give a 20 minute presentation during our scheduled Final Exam Period (announced in class) to me and your fellow classmates. This will be followed by a short question and answer period. This talk should summarize the analysis you have done in your paper. While the presentation does not have to be as detailed or as technical as your paper, it should give your audience a clear idea of what you have done and what you have found. It is highly recommended that you give a projector talk (see below for details), but “chalk-talks” will be allowed with permission. Each member of your group should be equally involved in the presentation.

Grading

10% of your final project grade is based on the proposal, and 10% is based on your final presentation. The remaining grade is based on the following rubric for the final paper:

- **Formatting (see below):** You will automatically lose 15% of the grade for breaking formatting rules (e.g. not adhering to the page limits).
- **Mathematics/Logic:** Points will be lost for math errors, etc.
- **Depth:** How much you investigated the problem and how much work you put in. Don't copy Wikipedia!
- **Written Presentation:** Good grammar and presentation are always important!
 - Conciseness and organization are extremely important.
 - Key statements should present major ideas and results.
 - Present a clear exposition of all variables, assumptions, and hypotheses.
 - Present an analysis of the problem, including the motivation or justification for the model that is used.
 - Include a design of the model.
 - Discuss how the model could be tested, including error analysis and sensitivity, if appropriate.
 - Discuss any apparent strengths or weaknesses in your model or approach.

Formatting

Both the proposal and final report must consist entirely of written text, and possibly figures, charts, or other written material. Both should be in electronic form (pdf only) and uploaded on Canvas on the due date. Hard-copy submissions will be seriously discouraged. The formatting guidelines are loosely based on the guidelines given for **The Mathematical Contest in Modeling (MCM)** competition, and are as follows:

- **Page Length:** Proposal - 2 pages; Final Project Paper - 7-10 pages (not including references or code).
- **Font:** 10-12 point font using standard paper size (8.5 x 11), single-spaced and exact one inch margins (top, bottom, left, and right). No information should appear in the margins. This does not apply to attached code.
- **Illustrations:** All illustrations must be of professional quality, though handwritten elements may be accepted. Illustrations must be numbered consecutively and cited in the text. Please make sure all figures are legible with large enough font and clearly labeled with a descriptive caption. It is allowed to put some more illustrations in the addendum.
- **Title:** Titles should be brief and appropriate and should specifically describe the content of the paper.
- **Abstract:** An abstract not exceeding 250 words that summarizes the principal techniques and conclusions of the projects must accompany the report. To write a good abstract, imagine that a reader will choose whether to read the body of the paper based on your summary. Your concise presentation in the abstract should inspire a reader to learn about the details of your work. Thus, an abstract should clearly describe your approach to the problem and, most prominently, your most important conclusions. Abstracts that are mere restatements of a Wikipedia intro, or are a cut-and-paste boilerplate from the Introduction are generally considered to be weak.
- **References:** You may use any inanimate source of data or materials: computers, software, references, web sites, books, etc. ALL SOURCES USED MUST BE CREDITED. Failure to credit a source will result in a significant penalty. References should be listed in either alphabetical order or order of citation at the end of the report. The following reference styles should be used:
 - Journal articles (titles of journals should be abbreviated in accordance with Mathematical Reviews; abbreviations are available at <http://www.ams.org/msnhtml/serials.pdf>):
 - [7] R. T. Rockafellar, Lagrange multipliers and optimality, SIAM Rev., 35 (1993), pp. 183-238
 - Books, pamphlets, research reports:
 - [2] B. Mandelbrot, Fractal: Form, Chance and Dimension, W. H. Freeman, San Francisco, CA, 1977.
- **Code:** Attach any code you used as an addendum, unless it is brief enough to be added to the content of the report. Proper documentation is expected.
- **Talk Presentation:** Please make sure your slides are legible, with figures clearly labeled. Brief and concise slides tend to be more informative than those filled with equations. Also, keep in mind that some colors might not appear as expected on the projector (Green=Bad). Please include references when appropriate.

While the following is not required, I recommend that you consider using **LaTeX** for your formatting. This allows you to automatically satisfy the formatting requirements without worrying and allows you to generate math equations

with ease. The learning curve is a little steep, but once you get the hang of it, you will have a valuable skillset at your disposal. The software is free and I have attached some templates for you to use for this project (both the proposal and final report can use the same template, though, you will not need all the content for the proposal). LaTeX also allows you to generate references fairly easy. If you have questions about this, I am happy to meet with you to discuss this further. Templates are provided in this module on Canvas.

For your presentation, you may also use the LaTeX package, Beamer. If you use the Beamer template, you may need some extra files to get it to work. Place them in the presentation directory or Latex distribution home folder. These are also provided in this module on Canvas.

Disclaimer: While Wikipedia can be used for basic information, please do not use this as a main source or copy any phrasing.