# Math 4583
## Introduction to Mathematical Modeling
Fall 2014

**Instructor:** Dr. Birne Binegar, MS 430, 744-5793.

**Class Times:** MWF, 2:30–3:20, MS 514.

**Office Hours:** Tuesdays 10:15-11:15, Wednesdays and Fridays, 10:00–11:O0 , MS 430

**Course Objectives:** This course provides students with the opportunity to solve realistic mathematical problems *independently*, to discuss the solutions in front of the class, and to write technical reports describing their solutions. All of these skills will be required of you by any employer.

**Prerequisites:** Math 3013 (Linear Algebra) In addition, we require the ability to write clearly and correctly in English and some familiarity with the use of a word-processing system. But the most important prerequisite is enough mathematical experience and initiative to enable you to seek out and learn, on your own, whatever mathematical techniques are necessary to solve the particular problem you are working on. Common sense is indispensable!

**Course Format:** This is a seminar style course, not a lecture course. During the semester you will solve four mathematical problems which arose in different industrial settings. Your daily assignments will be to continue working on the solution to the current problem and to be able to present the progress you've made and the questions you have to the class at the next meeting. There will be no exams in this course. Your written work will consist of four technical reports describing each problem and its solution. The professor's role in the course is to moderate the discussions, to provide occasional hints, and to sometimes play the devil's advocate.

**Texts:** For each problem, a pamphlet containing the necessary background material and the statement of the problem will be photocopies and handed out to the class. These problems come from a collection entitled *Industry-Related Problems for Mathematics Students*, compiled by Jeanne Agnew, Marvin Keener, and others in the late 1970's and early 1980's . Through the Mathematical Association of America and the OSU Mathematics Department, these problems have been distributed to colleges and universities throughout the country. The unofficial text for the course is *Elements of Style*, by Strunk and White. This is a very short style manual that should be read **before** you begin writing your first report and then used as a reference on questions of grammar and style. Students may also find *Introduction to Technical Writing: Process & Practice*, by Lois Johnson Rew, to be a useful reference. You should buy a dictionary if you do not already own one. A thesaurus may also be useful. There is no mathematical text for this course, as you will be expected to find any necessary mathematical information on your own in the library.

**Grading:** Your grade in the course in the course will be the average of your grades on each of the four problems; but later problems may be weighted more heavily than earlier ones (to give credit for improvement). For each problem, half of your grade will be based on the mathematics of your problem solution, one fourth is based on the writing of your report, and one fourth is based on class participation.

A solution earning a mathematical grade of A is clear, complete, and correct. A solution earning a mathematical grade of B may contain small errors, omissions, or gaps in the derivation. A solution earning a mathematical grade of C may contain substantial errors, omissions, or gaps. In industry, errors cost employers time and money and are thus unacceptable. Being able to check your work is one of the mathematicians most valuable skills!

The clarity of the mathematical presentation in a report and the quality its writing are almost inseparable. Reports that are grammatically correct, well-organized, and easy to understand will earn a writing grade of A. Reports that are somewhat difficult to understand because of grammatical errors or lack of organization will earn writing grades of B. Those that are very difficult to understand, for any reasons, will earn writing grades no higher than C.

Your participation grade is based on attendance and on your contributions to the class discussions. Daily attendance without any participation will earn a grade of C. A grade of B will require some participation every day, even if this consists just of questions on your own work or comments on other people's work. A grade of A will be reserved for those who lead the discussions by introducing new ideas and approaches towards solving the problems.

**Report Format:** Your reports should be clear, correct, concise, and should contain the following components

(1) **Cover and Title Page.**
(2) **Abstract.** a one paragraph summary of the report's contents which introduces the subject matter and describes what the report accomplishes.
(3) **Table of Contents.**
(4) **Introduction.** This section should discuss the purpose of the report. It should include background information, it should state the problem, and it should describe the method of solution. Please do not simply rewrite the problem Introduction that appears in the handout. Indeed, it is not necessary to repeat information that can be so simply cited.
(5) **Sections.** Sections forming the body of the paper should be consecutively numbered. The first section(s) should contain preliminary mathematical material used to set up or solve the problem. Succeeding sections should discuss different aspects of the problem's solution. All notations and technical terms should be clearly defined, and assumptions should be clearly stated. Important facts or conclusions should be labeled as Lemmas, Theorems, Propositions, etc., and their statements should come **before** their proofs or derivations. Good mathematical writing, in general, should tell the reader where it is headed before it goes there!. Use displays for important equations and for equations which are too long to include in the text; everything else should be written in text, in full sentences. Use a consecutive numbering system for Theorems, Lemmas, displayed equations to which you later refer, etc.
(6) **Summary and Conclusions.** This section should summarize and criticize the results of the report. Include comments on how realistic or optimal your solution is, how the solution might be improved, other applications of the report, directions for future research, etc.
(7) **Acknowledgements.** This section, if necessary, consists of just a few sentences thanking individuals who helped you solve the problem.
(8) **References.** This is an alphabetical, consecutively-numbered list of all written sources, cited in the following format:

[1 ] Jeanne Agnew and Marvin S. Keener, eds., *Station Hydro-Turbine Optimization*, Industry-Related Problems for Mathematics Students No C-18.3, Oklahoma State University, 1980.
[2 ] Stanley I. Grossman, "Calculus," fourth edition, Harcourt Brace Jovanovich, San Diego, 1988.
[3 ] G. Strang, *Patterns in Linear Algebra*, Amer. Math. Monthly **96** (1989), 105-107.

Notice that the pamphlet containing the problem description [1] is listed here. Technical reports do not contain footnotes. A particular source is cited as [2, pp. 32-34] by including in square brackets the reference number, the page numbers if you wish, at the appropriate place in the text.

(9) **Appendices.** Any mathematical proofs, calculations, tables, etc., that are too long or would interrupt the flow of the report may be included in an Appendix.

**Computer Use:** Reports must be prepared on a computer with a word-processing system. You may choose either a technical system which can typeset mathematical symbols and equations or a non-technical

system which requires you to write mathematical symbols and equations by hand. The technical typesetting system TEXand its various implementations (e.g., LATEXand $\mathcal{A}\mathcal{M}\mathcal{S}$-TEX) have become the standard system for the international mathematical community. It is available on all the computers in the Mathematics Department. Many of the problems also require some computer programming. You may choose the language and the machine – I just care about the output. The Mathematics Department has a network of computer workstations, X-terminals and PC's equipped with various computer languages and programs for symbolic manipulation, text editing, etc. Due to the intensive computer use which accompanies this course, students are charged a computer use fee.

**Academic Honesty:** All written work must be your own – no discussions or collaborations on the written reports are permitted. You are not permitted to consult students who have solved any of these problems in this course in a previous semester, nor are you permitted to read their written solutions to the these problems. Otherwise, you may consult any written sources or any other person, as long as your sources are properly documented.

**General Advice:** Please try not to feel embarrassed about discussing your work in front of the class. Being able to discuss your progress, or lack thereof, in a clear and confident manner is an extremely valuable skill. Ideally, students who are having difficulty or working more slowly should speak first in each class period. That way, the students who are somewhat further along will be able to offer hints or advice. Hopefully, everyone will be able to state how far they have gotten during each class period but the actual solutions will be presented only when everyone has solved the problem.

You should certainly do the bulk of the work in solving each problem independently. However, you should feel free to discuss your progress with your classmates in between class periods. The feedback and support you thus gain can be quite helpful, especially since some of the problems are difficult. Working in complete isolation can be demoralizing and does not enhance your cooperative and collaborative skills, which are invaluable to any employer.

These problems come from the real world, not from a textbook. Thus some problems have several correct methods of solution, and others are open-ended so that there is no single correct solution. Some even contain errors. In these cases, as you would for an employer, you should point out the errors and do your best to correct them so that the problem can be solved.

I may occasionally extend a problem in class by asking for extra information or by posing further questions on the topic. This material should be included in your written solution, along with the answers to all questions posed in the problem description. Like an employer, I look for initiative and ingenuity – the best reports are not just limited to the information that was requested but contain additional material that, in your judgment, would be useful to the employer.

**Tentative Syllabus:** The following problems and the due dates for their reports are given below

| **Problem** | **Due Date** |
|---|---|
| Optimal Combination of Whole Life Insurance and Decreasing Term | September 15 |
| Determination of Magnetic Codes | October 13 |
| Satellite Communications Substem: A Reliability Analysis | November 10 |
| Moisture Content in the Lip of the Space Shuttle Door | December 5 |

**Attendance Policy:** Please notify me in advance of any unavoidable absences. Otherwise, absences and late reports will penalized you, as they would with any employer.

**Drop Policy:** The last day to drop the course with no record is Friday, September 2. The last day to drop the course with a grade of W is Friday, September 30. The first report will be returned before this date. The last day to drop the course with a grade of W or F is Friday, October 28. The second report will be returned before this date.