

MAST 232
Mathematics with Computer Algebra
Fall 2016

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Email: fred.szabo@concordia.ca
- Office Hours:** Fridays, 14:00–15:30 and by appointment.
- Text:** *Learning with Mathematica*, online lecture notes, by Fred E Szabo.
- Calculators:** All calculations in this course are carried out with *Mathematica*.
No calculators are required or allowed.
- Tests:** Tests, assignments and examinations will be interactive and use *Mathematica*.
Missed tests cannot be made up.
- Evaluations:** Evaluations are based on regular interactive participation throughout the term and, in addition, require the completion of a **project** and preparation of an associated *Mathematica* **slideshow**. Details, *Mathematica* templates, and a sample project and slideshow will be posted on Moodle and discussed in detail in the second half of the course.
- Grading Scheme:** The final grade will be based on online quizzes worth 30%, assignments worth 10%, a midterm examination worth 30%, reflections worth 10%, a *Mathematica* project worth 15%, and a slideshow based on the project worth 5%. *Students who miss the midterm examination may be permitted to rewrite the examination if they provide an appropriate medical certificate justifying their absence for medical reasons.*
- Note:** **Please note that there is no “100% final examination” in this course and no supplemental examination.**
- Requirements:** All activities throughout the course require a **laptop**, either your own or one of the University-owned laptops with *Mathematica* installed. These laptops can be borrowed from the Webster Library for the duration of the lectures, quizzes, and examinations, if needed. All work in this course requires a suitably fast Internet connection.

Preamble: Mast 232 is a foundation course designed to provide you with new tools for learning and excelling in your studies of mathematics and related subjects. As the course proceeds, you will have many opportunities to look at the mathematics you know from a new perspective and expand your knowledge in manageable steps, with the help of technology. I call it “*A New Kind of Learning.*”

The New Kind of Learning is built on the evolving pedagogical opportunities built into *Mathematica*, with particular emphasis on working with symbolic and numeric computations, discovering mathematical truths using *Mathematica* “manipulations,” minimizing the requirements for writing programming code by using free-form input, writing in the *Wolfram Alpha* language, employing the *Mathematica* predictive interface and suggestions bar, gaining conceptual insight through graphing and visualization, exploring computations and mathematical concepts using Boolean algebra, and exploiting other technological tools.

The course begins in earnest in Week 1 and you need to come prepared to learn, participate, and commit yourself to taking your knowledge to the next level. Your teaching assistants and I will do everything we can to make your learning experience relevant, enjoyable, and accessible. **So please come prepared: bring a laptop with *Mathematica* installed and activated.**

The following lecture numbers may not correspond exactly to the weeks of the course. Please consult the Moodle web page of the course to find out which lecture is offered in any particular week.

| Lectures | Topics |
|------------|--|
| Lecture 0 | Introduction to Mathematica |
| Lecture 1 | The Wolfram language and its options |
| Lecture 2 | Variables, functions, and manipulations |
| Lecture 3 | Tables, logic, and conceptual computations |
| Lecture 4 | Curves, surfaces, and visualizations |
| Lecture 5 | Power series and transcendental functions |
| Lecture 6 | Linear systems and their applications |
| Lecture 7 | Eigenvalues, singular values, and matrix decomposition |
| Lecture 8 | Derivatives, differentials, and applications |
| Lecture 9 | Integration and the fundamental theorem of calculus |
| Lecture 10 | Sets, probabilities, and statistical measures |

Assignments: Each lecture comes with an associated assignment of six routine uses of concepts or material covered in the lecture.

You should use the assignment template for the lecture as the workspace for using Mathematica to produce your answers. Even if some of the answers can be worked out easily without Mathematica, the point of posted problems is usually to discover how they can be solved with Mathematica. I am hoping that as you continue in the course, you will discover oodles of ways of using Mathematica and its off-shoot, Wolfram Alpha (accessible from inside Mathematica) to improve your performance in all of your courses, even if they are not in mathematics and statistics. You will receive a grade for completing and submitting an assignment. Solutions are posted after the due day of the assignment. If you require help or explanations, please contact your Teaching Assistant or your classmates. They will be delighted to collaborate with you to solve your problems. Some questions may have more than one correct answer. If your answers differ from the posted ones, please discuss them with your classmates or your TA.

Reflections: Ten minutes before the end of each lecture, you will be asked to use Mathematica to reflect on the lecture by answering two questions at some reasonable length:

- What did you learn today that you did not know already?
- How do you think you might be able to use what you have learned today in your future studies?

The purpose of these reflections is to provide you with a record of what you have learned and how you might be able to use this new knowledge elsewhere.

Please post your reflections in the appropriate drop box on the course website and e-mail a copy to yourself for future reference.

Quizzes: The two quizzes consist of five questions each, designed to test your specific knowledge of the course material covered in previous lectures. The dates of the quizzes are fixed and cannot be changed for any reason.

Midterm: The midterm consists of fifteen questions, designed to test your specific knowledge of the course material covered in previous lectures. The date of the midterm is also fixed and cannot be changed for any reason other than the usual documented medical emergencies. The midterm is an online in-class examination and must be completed during the allocated lecture hours.

Project: The course project is a really fun aspect of the course. It allows you to select a topic of personal interest and study it in depth. The project must be an individual effort and must be visibly different from any project of your peers. All work must be done with Mathematica, from beginning to end, and must reflect both your understanding and your enthusiasm for the topic, as well as your skill at using Mathematica to make the topic shine.

To help you get started, I will be posting projects from previous courses that will give you an idea of the flair, imagination and talent your fellow students displayed when they explored both basic and advanced ideas and techniques in mathematics and statistics by working on topics dear to their hearts. Let me emphasize that you will be rewarded for clarity, elegance, and your ability to illustrate the importance of your chosen topic.

In the second half of the course, I will be posting a list of topics from which you can choose yours. This does not preclude your proposing a different topic of personal interest. However, the mathematical content of the project should be within your reach. The mathematics should be something you can learn to understand in the available time and should be easy to describe and present in the allowed space.

Mathematica Slide Show: Mathematica has a wonderful tool called the “Slide Show” tool. You can convert any properly structured Mathematica notebook into a slide show and rework it as “an executive summary” of your project. You will find this a true challenge, if done properly, and it will teach you to think through your project topic at several levels of abstraction. I will spend quite some time with examples to make sure that you benefit from this challenge. Creating a slide show from the Mathematica notebook is not simply a “cut-and-paste” exercise. We’ll talk about it.

In Conclusion: This course is designed to provide an enjoyable and mathematically meaningful learning adventure. As such, your continued participation is essential. Therefore, there is no written final examination. Your participation and contribution throughout the term is what counts.

Disclaimer: This outline is subject to small changes if the delivery of the course material requires it.