Department of Mathematics & Statistics
Concordia University

MATH 618L
Topics in the Applications of Mathematics
Winter 2015

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Office Hours: By appointment and before and after the class.

Objectives: Mathematical modelling is a wide-open field. Almost any work in "applied mathematics" can be construed as mathematical modelling. It is therefore challenging for us to spend the next few months on aspects of mathematical modelling that are within your reach and provide a platform for future exploration as your careers unfold.

Process and plan of action:
We will begin the course by familiarizing ourselves with M*athematica* and *Wolfram Alpha*, the organizational and computational environments in which we will be working. **Please note that familiarity with *Mathematica* and/or *Wolfram Alpha* is not assumed.** I have written up a set of relevant and easy-to-follow *Mathematica* tutorials and will be posting them on our website when the course begins.
In the lectures that follow we will explore examples of mathematical modelling based on the questions listed below. We can add other questions if anyone has a particular interest in a topic not listed. Each of you will be working on a chosen project, either alone or as part of a team, toward an analytical report and a summarizing slide show. We will discuss the expected nature and details of the reports and the accompanying slide shows in class. In the case of a team project, the individual reports and slide shows can be components of a larger project.

Assessment: Assignment 1 (20%)
A **ten-slide** *Mathematica* slideshow on **mathematical modelling**
A **one-thousand-word** preliminary *Mathematica* report on mathematical modelling
Assignment 2 (20%)
A **ten-slide** *Mathematica* slideshow on **your chosen topic**
A **one-thousand-word** *Mathematica* report illustrating the mathematics behind your slide show
Assignment 3 (20%)

A **ten-slide** *Mathematica* slideshow on **a topic other than your own**
A **one-thousand-word** *Mathematica* report illustrating the mathematics behind your slide show
Assignment 4 (30%)
A **twenty-slide** *Mathematica* slideshow on **your completed project**
A **two-thousand-word** *Mathematica* report on your chosen topic, illustrated with solved problems.
Attendance and class participation (10%)

Assessment criteria:
Completeness (20%)
Accuracy (20%)
Mathematics (30%)
Clarity (20%)
Presentation (10%)

Laptops: Math 618 will be taught in the departmental Conference Room LB - 921.04. In order to follow it, you must bring to class a laptop running *Mathematica* and make sure that its battery is fully charged. If you do not have your own laptop, you can borrow one from the Webster Library.

Software: The course requires *Mathematica* 10. Earlier versions of Mathematica will not have some of the features used. Concordia University now has a site license for *Mathematica* and all registered students are entitled to install *Mathematica* on their personal computers free of charge. The process of installing *Mathematica* is described on your MyConcordia web portal. Internet access during lectures will be required. **Please note that you must have a Concordia e-mail address to activate *Mathematica*.**

Mathematica and Wolfarm/Alpha: *Mathematica* and *Wolfram|Alpha* are part of a teaching, learning, and research environment developed and supported by Wolfram Research. They have become dominant mathematical research tools around the globe. In addition, thousands of users have written so-called "demonstrations" that solve problems and provide illustrations of topics ranging mathematics to science, the arts, and entertainment. You will be able to use these demonstrations and the following list of *Mathematica*-based questions as sources of inspiration for choosing relevant project themes. Please click on the hyperlink in each question to access the course material. **Don't get scared, I will post all of the executable *Mathematica* scripts embedded in the listed questions as**

downloadable notebooks and will explain and simplify the code, if necessary.

Question 1
Just how big were the dinosaurs?
Modeling the size of dinosaurs using Monte Carlo simulations
Question 2
Flight Operational Safety Analysis
Modeling aircraft safety using *Mathematica* manipulations
Question 3
Imaging Mars with Mathematica
Modeling the geography of Mars using *Mathematica* image processing
Question 4
An eye on cancer prevention
Modeling medical diagnosis with dynamic step distance transforms
Question 5
Constructing magic squares
Modeling moments of inertia in engineering using magic squares
Question 6
Computing knowledge
Modeling computable objects using Wolfram Alpha
Question 7
What can you do in a tweet?
Modeling mathematical communication using Tweet-a-Program
Question 8
Learning mathematics
Modeling learning using the Wolfram Problem Generator
Question 9
Simulating an Ebola outbreak
Modeling the outbreak of a disease using *Mathematica*
Question 10
The future of pure mathematics
Modeling aspects of mathematics with the Wolfram language

Due dates: The due dates for the submission of the written assessment items will be discussed and agreed upon in the first week of the course.

Attendance: You are expected to attend and participate in the lectures. If you cannot attend a lecture for any justifiable reason, you must inform me of your potential absence ahead of time.

Moodle: MATH 618 is managed on a Moodle website. The site will contain the course outline, lecture notes, research material, announcements, sample slide shows and sample projects, feedback material and other items. Since only registered students have access to the website, all material on the site is confidential to you, your classmates, and me. No material posted on our website will be used elsewhere without your explicit written permission.

Communication: E-mail exchanges in this course are managed through the Moodle forum and use the Moodle e-mail system.