SYLLABUS MATH 6635 SPRING SEMESTER 2013

MATH 6635 Spring, 2013 meets 12:05-1:25 on Tuesday and Thursday in Room 202 of the Engineering Science and Mechanics building.

Instructor Information: Stephen Demko has office in Room 265 Skiles; office phone 404-894-2713

e-mail demko@math.gatech.edu **Web Site:** http://www.math.gatech.edu/~demko
As a rule, I send all notes and other communications to you via e-mail rather than posting them.

Office Hours: Tuesday and Thursday 10:00-11:30 and at other times by appointment.

Computer Accounts and e-mail: Every student has access to a GT-Account from the Office of Information Technology http://www.oit.gatech.edu/
I will make mass e-mailings at various times to your GT Accounts, so be sure to activate your account and check it regularly. You may send me individual mails from your personal accounts and I will respond to them, but ***my mass mailings will always go to your GT Account***.

Course Materials

(1)Lectures—it is your responsibility to take notes and to ask questions. I encourage questions at the beginning of class and during class. If you raise a question of general interest after class that could have been asked during class, I will answer it during the **next** class if you bring it up again.

(2) Notes and links that I send you.

(3) Notes written for the course by Professor Gunter Meyer. They can be found on his web site www.math.gatech.edu/~meyer. Download all of them today.

(4) If you have a book on Numerical Analysis, you might find it useful at times. Some of what we do you will not find in any of the standard books.

Computer Programming

Students will implement various financial models, perform experiments, and report on the experiments. I am a language agnostic. For some problems Excel is quite appropriate. Other assignments are better completed in a language like C, C++, Java, Matlab, or Python. If you are not yet comfortable in one of these, I suggest you use this course as an opportunity to pick up some Python. I will give you sample code segments in a number of languages. Those who have completed Math 6767 might want to practice C++.

Policy and Course Overview

Please read and abide by the Institute's **Honor Code found at** http://www.honor.gatech.edu/plugins/content/index.php?id=9 and the Graduate Addendum. I encourage you to learn from each other. Some group work *may* be assigned. For individual homework assignments and quizzes what you hand in must be your own. If you use code from other sources, you must give complete, proper acknowledgment. Failure to do so can result in reduction of letter grade. Any assignment can be followed by an "audit quiz" based on the assignment. This quiz might be written, in class or oral, in the instructor's office. Poor performance on the audit quiz can result in reduction of letter grade.

Grading

There will be 4 or 5 homework assignments of a computational type. Some can be done in a spreadsheet, but not all. You will be graded on your understanding of (1) the underlying financial concepts and models; (2) the mathematical underpinnings and properties of numerical algorithms used to implement the models; (3) the implementation of the algorithms; (4) the expression of your understanding. (If you cut and paste from web sites, you get an A in cutting and pasting and maybe in Googling; but a D in written expression of your understanding.)

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It is likely that there will be a mid-term exam and perhaps one interview-style-exam based on a homework. These will be announced in advance, but not today. Similarly, the "audit quizzes" mentioned above will be announced in advance and, if given, will be part of the grade for the homework. There will likely be a final exam as well. All homework assignments are exams are equally weighted.

Topics discussed: There will be some overlap with some topics discussed in Math 6767 during Fall, 2013. This is unavoidable. Hopefully, the treatment this semester will add to the material that you might have learned in Math 6767. The topics listed here are basic; but, I may modify this list as I see fit.

Computer Arithmetic and Errors

This is an introduction to some of the issues one has to deal with when one trusts machines to perform arithmetic. I will give you notes and some programs. This is boring, but important: the first disaster reported on in the link http://www.ima.umn.edu/~arnold/disasters/disasters.html was the result of the accumulation of errors arising because the number 0.1 cannot be represented exactly on computers.

Background on Financial Derivatives and Their Pricing

Meyer Chapter 6 and class notes. Most applications will be to options of some sort.

Approximation of solutions of Stochastic Differential Equations and Monte Carlo Simulations.

Meyer Chapter 3 and Class Notes. Application to pricing options with an assumption of stochastic volatility.

Pricing with Tree Methods Meyer Chapter 6 and Class Notes

Solution of non-linear equations.

This has application to calculation of implied volatilities of options and yields of fixed-income investments. See Meyer Chapter 1, plus my lectures and notes.

Approximation and Interpolation and applications.

Applications to construction of yield curves, volatility surfaces, solution of option pricing problems, and general approximations. I will give you notes.

Numerical Solution of Ordinary Differential Equation, Numerical Integration, Richardson Extrapolation Meyer Chapter 3 and class notes.

The Black-Scholes PDE and its numerical solution. This also includes a treatment of some aspects of Numerical Linear Algebra and the Heat Equation. Main application is pricing of an American Put with a discrete dividend and the determination of the early exercise boundary. Meyer Chapters 4 and 5, class notes, maybe some papers.