STAT 598W
Financial Computing and Algorithm Design

SPRING 2014. Classroom and time: TR 4:30 pm - 5:45 pm in REC 121.

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Course Webpage:
`http://www.stat.purdue.edu/~wang913/teaching/stat598w2014/index.html`

Course Description

It is expected in the financial industry today that the quantitative analysts are proficient in coding and implementing financial algorithms. This course aims to teach the students coding in different programming environments, especially C and C++ (possibly Excel VBA if we have enough time), in general terms, and in the specific context of financial algorithms.
Another purpose is to review and implement all kinds of advanced computational statistics skills and numeric methods which are very useful in quantitative finance, such as Monte Carlo, EM, MCMC, importance sampling, finite difference method, etc. by case study and projects. And the focus will be how those methods can be applied to solve pricing/estimation/simulation problems in quantitative finance.

Grading

Final grade percentages are at the discretion of the instructor, but the following are highly likely:

Homework Assignments (60%)

There will be homework problems assigned and due, typically on a weekly basis. Solutions will be discussed in class during the week to follow. Collaboration on homework assignments is permitted, even encouraged, but each student should write up his/her own solution. Note that identical solutions among two or more students are not acceptable, and constitute plagiarism. The homework will be graded for completion and it is mandatory to show in the HW write-up all the coding (with verbal explanations of the results) and the corresponding numerical summaries, and when applicable, the analyses.

You need to send the electronic version of solutions to **wang913@purdue.edu** before the HW due time. And you are required to submit the **print-out** of your solutions (including all the code, analysis, explanations) in class on the due date.

Quizzes (10%)

In this class the participation is extremely important and, therefore, to encourage students study more actively in class, a 10-minute quiz might be given during several selected classes. The contents of the quiz will be closely related to what we cover in the previous classes. There will be NO made-up chance for quizzes no matter whatever the reason is.

Project (30%)

The students are required to define a project topic from a refereed research paper that includes financial algorithms or the description of a numerical scheme in quantitative finance. The students have to present a project proposal during the last week of March. Once they have selected a specific paper, they have to do a complete computational implementation using C++. The students are required to give an oral presentation

during the last week of classes. The final report has to be turned in by the Friday of Finals Week. More details will be given during the course. The project should be done preferably in individual, but pairs or groups of no more than three students would also be allowed by the instructor; larger groups are not acceptable. Because C++ is the language of choice in many sectors of the quantitative finance industry, students are required to use C++ as their main implementation languages.
Possible topics of the projects can be:

- Develop a powerful C++ library for derivative pricing. You need to follow important principles of implementation of financial models and master algorithms of evaluation of different types of derivative securities: **European, American, standard, barrier and path dependent options on stocks and interest rates**. You also need to follow the Object-Oriented programming (OOP) styles, and show that you have good interpretation on **pattern designs, classes, namespace, inheritance, templates**, and so on.

- You may also work on a specific topic in quantitative finance (however this is not recommended unless it covers comprehensive computing and programming work with C++). Here I use "statistical arbitrage" as an illustration to show the requirements for a project like this:
  You need to first introduce the basic concepts and techniques for statistical-based trading, and then develop a C++ library to implement some of standard approaches to statistical arbitrage including market neutral strategies such as pairs trading, value-based or constrain methods, momentum based strategies, cointegration based trading, algorithmic and high-frequency trading. Again, you need to follow the principles of OOP in developing the library.

Outline

The outline of the course will look like the one below, but note that based on the students' feedback and time limitations, possible changes can be made:

- Basics of C (1-2 weeks). Main reference: Chapter 1,3-5,6,9,11 in book [7].

- Basics of C++ (2-4 week) Main reference: Section 1.1-1.4, Section 2,4,5,6,7 in [8]. Secondary reference: Chapter 6,7 in book [1].

- Deeper introduction on C++ libraries, the query language SQL, the idea of design patterns as object-oriented "building blocks", memory management, and some other Object-Oriented programming topics.
  Main reference: Chapter 3, 8 - 16 in book [8]. Secondary reference: Chapter 2 - 13 in book [6]; Chapter 11,13,14,16 in book [5]; Chapter 2-5 in book [1]. (4-6 weeks)

- Implementations of all kinds of quantitative finance algorithms such as pricing of derivatives of stocks or interest rates, hedging, numeric methods on PDE, and simulation methods for stochastic calculus with C++. Some statistical computing algorithms useful in quantitative finance might also be reviewed and illustrated, such as EM, MCMC, Importance sampling, kernel methods and so on.
  Main reference: Chapter 15 - 20 in book [2]. Secondary reference: Chapter 1-9 in book [5]; Chapter 8 - 20 in book [1]; Chapter 1-7, 10-19, 24,25,26 in book [3]. (4-6 weeks)

- If there is still time left: Excel VBA and the interface between Excel and C++. Main reference: Chapter 2,3,4,10,11,16 in book [4]; Secondary reference: Chapter 15 in book [5]; Chapter 28,29,30 in book [1].(1 week)

Structure

Every week homework solutions will be discussed, and basic syntax introductions will be given. In any remaining class time, the TA and the students will work together on additional financial implementations.

References

[1] Daniel J. Duffy, *Financial Instrument Pricing Using C++ (The Wiley Finance Series)*, Wiley, August 2004.

[2] ———, *Introduction to C++ for Financial Engineers: An Object-Oriented Approach (The Wiley Finance Series)*, Wiley, December 2006.

[3] Gianluca Fusai and Andrea Roncoroni, *Implementing Models in Quantitative Finance: Methods and Cases (Springer Finance)*, 1 ed., Springer, March 2008.

[4] Mary Jackson and Mike Staunton, *Advanced modelling in finance using Excel and VBA*, Wiley, May 2001.

[5] Mark Suresh Joshi, *C++ design patterns and derivatives pricing*, vol. 2, Cambridge University Press, 2008.

[6] Nicolai Josuttis, *The c++ standard library: a tutorial and reference*, Addison-Wesley Professional, 1999.

[7] Al Kelley and Ira Pohl, *A book on c: Programming in c*, 1998.

[8] Stanley B Lippman, Josée Lajoie, and Barbara E Moo, *C++ primer, 4th edition*.

[9] Scott Meyers, *Effective c++: 55 specific ways to improve your programs and designs*, Pearson Education, 2005.

[10] T.J. Teorey, S.S. Lightstone, T. Nadeau, and H.V. Jagadish, *Database modeling and design: Logical design, fifth edition*, The Morgan Kaufmann Series in Data Management Systems, Elsevier Science, 2011.

[11] John Vlissides, R Helm, R Johnson, and E Gamma, *Design patterns: Elements of reusable object-oriented software*, Reading: Addison-Wesley **49** (1995), 120.

Hypixel Player Stats. Player Information. [MVP+] 598 [PURPLED]. Name History. froffymilkshake 92L 593 Sandparty. Rank History. VIP - 2018-08-20 23:24 MVP+ - 2019-04-23 21:18. Multiplier: Level 267 (x8) Level: 267.89 Karma: 16,204,475 Achievement Points: 5,455 Quests Completed: 2,698. Firstlogin: 2014-07-04 02:51 EDT Lastlogin: 2020-06-09 18:05 EDT. Friends: 1594. SkyBlock Stats.