# LGS in Mathematical Finance

MF2: Computational Finance - 2011-12 Prof William T. Shaw, University College London

### Registration

Please fill out the form using BLOCK CAPITAL LETTERS - pass it round the class please.

### **Course Dates**

Wednesdays, normally 2-4 in Oct, Nov and Dec. Rooms:

12/10 Roberts 106

19/10 Drayton B06 (see https://cmis.adcom.ucl.ac.uk:4443/roomBookings/bookableSpace/roomInfo.html?room=B06&building=107&invoker=EFD for info)

26/10 Drayton B06 02/11 Drayton B06 09/11 Drayton B06 16/11 Drayton B06 23/11 Drayton B06

30/11 Foster Court 114

7/12 Drayton B06 14/12 Drayton B06 21/12 Drayton B06 if you are here!

### WTS E-mail and contact

w.shaw@ucl.ac.uk

### **My Web Page**

www.mth.kcl.ac.uk/staff/w\_shaw.html

## **MF2 Web Page (Public)**

http://www.homepages.ucl.ac.uk/~ucahwts/lgsopen.html

### **Course Notes (Private Information)**

http://www.homepages.ucl.ac.uk/~ucahwts/lgsnotes/

There are also no public links to it. Please DO NOT publicise it.

I will secure it presently and give you password...

This will contain lots of notes, some of which are bits of drafts of chapters of the second ed. of my book. I will tell you when you need to take notes if there is something NOT on this site.

#### Topic Summary

These will be a mixture of theory and computation, and will include (this is being revised so I include more detail for the earlier topics). There will also be quick-start introductions to *Mathematica* and C++.

Quantiles: Importance to Monte Carlo simulation, non-linear differential equations and approximation methods. Gaussian vs non-Gaussian issues, Parallel and GPU optimization issues.

Copula and their simulation: 2D special cases and Laplace methods for Archimedean. Combining copulas and quantiles.

Finite Difference Methods:Summaries of truncation, stability and coding methods.

Implied Volatility problems

Fourier transforms done properly via complex analysis and the Heston model theory and computation in that setting.

Grid programming in *Mathematica* and basic CUDA work.

If time: Monte Carlo portfolio optimization and other topics.

### Journals

You might find it useful to figure out now if and how you can get access to some journals I will refer to: Journal of Computational Finance

**Applied Mathematical Finance** 

International Journal of Computer Mathematics

(check out institutional subs, db access).

Statistics

(AMF and Statistics are Taylor and Frances; JCF is Incisive (formerly RISK) and they want money if you are not a subscriber, so good idea to get this sorted through your home institution). Good catalyst for sorting out journal access anyway.

### **Mathematica**

Please check your own departmental licensing arrangements first to see if you already have access to a full working version, or a licensing deal that allows you to get a cheap personal copy. Otherwise you can get this from www.wolfram.com in two forms.

A free reader that just allows you to read my notebooks is available at http://www.wolfram.com/cdf-player/

[I am checking to see how much that new version allows computation.] Also, for student versions:

http://www.wolfram.co.uk/products/student/mathforstudents/licenses.html

### **CUDA/OpenCL**

This is an environment for programming GPUs. CUDA environment is specific to Nvidia GPUs, while OpenCL is a new open standard for programming GPUs more generally, including ATI 4000-5000 series, and also "traditional" CPUs. I will give some exposure to this. If you want to explore yourselves at http://www.nvidia.co.uk/object/cuda\_what\_is\_uk.html

and in particular you can download it at:

http://www.nvidia.co.uk/object/cuda\_get\_uk.html

I strongly advise you to get version 4 or later resources, as this has modulated into a GPU computing toolkit with BOTH CUDA and OpenCL resources. You will need to have a computer with a compatible GPU. An old 8800GT is fine for getting going and will not cost much, but is limited to single precision arithmetic. Newer 200 series do double precision well. An old GTX 260 is probably the cheapest way in to that level, though 285s with 2GB of memory are affordable with serious computation levels. If your dept or univ has Teslas or recent Quadros all the better. Newer Fermi cards, 580, C2050 etc even better - more functionality and better DP.

### University Challenge - if possible...TBD

William Shaw pretends to be Jeremy Paxman?

### Team Working

A team effort is a lot of people doing what I say, Michael Winner, Movie Producer

And a joke told to me by Lane Hughston:

Q: What is the difference between an introvert mathematician and an extrovert mathematician?

A: When he is speaking to you, an introvert mathematician will look at his feet. An extrovert looks at *your* feet.

When we talk to financial institutions they tell us that they do not need many mathematical primadonnas. One or two might be useful to lead innovation. Greatest demand is for flexible team players who will turn their hand to many things, and leave their egos at the door. So we are going to try to have some teambased projects. These will not be formally assessed, but we will have groups present to each other. Suggest grouping according to institution in first case - at least that way easier to get together. Open to ideas, else I will suggest something, for early Dec.

Note that there is no formal or informal programming prerequisite for this course. Those of you with no programming experience should team up with those who do, and perhaps do something about comparing exact solutions with numerical results, or do technology transfer - converting some maths or complicated numerical analysis into an algorithm.