

# Financial Engineering Summer School June 30<sup>th</sup>-July 3<sup>rd</sup>, Barcelona

## Schedule and Programme

### Tuesday, June 30<sup>th</sup>

10:30-11:00. *Registration.*

11:00 – 13:00. Prof. Mike Giles. (I)

15:00-17:00. Prof. Mike Giles. *Workshop on GPUs*

### Wednesday, July 1<sup>st</sup>

9:30-11:00. Prof. Mike Giles (II)

11:00-11:30- *Coffee break*

11:30-13:00. Prof. Mike Giles (III)

15:00-16:30. Prof. Mark Davis (I)

16:45-18:30. *Contributed talks*

### Thursday, July 2<sup>nd</sup>

9:30-11:00. Prof. Mark Davis (II)

11:00-11:30- *Coffee break*

11:30-13:00. Prof. Mark Davis (III)

15:00-16:30. Prof. Rüdiger Frey (I)

16:45-18:30. *Contributed talks*

### Friday, July 3<sup>rd</sup>

9:30-11:00. Prof. Rüdiger Frey (II)

11:00-11:30- *Coffee break*

11:30-13:00. Prof. Rüdiger Frey (III)

Lectures on *Tuesday* will be held at Facultat de Matemàtiques, Universitat de Barcelona, Gran Via de les Corts Catalanes, 585.

Lectures on *Wednesday, Thursday and Friday* will be held at Borsa de Barcelona, Passeig de Gràcia, 19.

# Prof. Mike Giles

## Computational finance and GPUs

### Lecture I

#### A) The "big picture" -- the rise of GPUs

- current trends in computing
- multicore CPUs and manycore GPUs
- MIMD, SIMD and vector computing
- CUDA and OpenCL

#### B) An introduction to CUDA programming

- hardware elements
- software elements
- massively multithreaded CUDA programming, graphics memory and coalesced transfers

### Lecture II: **Monte Carlo application**

- ideal "trivially parallel" application
- LIBOR example
- random number generation
- memory management

### Lecture III: **Finite difference application**

- 3D Laplace solver using Jacobi iteration  
(a non-trivial extension to 3D financial PDE applications)

## Prof. Mark Davis

### Contagion Models in Credit Risk

*Contagion in credit risk is the phenomenon whereby observed defaults either directly cause other defaults or directly affect credit spreads of other obligors. The first two lectures will review contagion and other forms of default interaction, and cover specific models and applications both in pricing and risk management applications. The final lecture will cover new results on stochastic filtering using the theory of piecewise-deterministic Markov processes and its application in contagion models.*

#### Lecture I: **Review of default interaction mechanisms and the objectives of credit risk modelling**

- Factor models
- “Frailty” (unobserved factor) models
- Contagion models
- Pricing (“Q-measure”) applications—pricing models and calibration
- Risk management (“P-measure”) applications—likelihood functions and statistical inference

#### Lecture II: **Contagion models**

- Counterparty risk: the “diamond default model” and extensions (Davis 2003, Crepey and Jeanblanc 2008)
- Portfolio models based on Markov chains (Davis & Lo 2001, Herbertsson 2008 et al.)
- Computational methods for Markov chain models.
- Other contagion models.

#### Lecture 3: **Filtering and projection in contagion models with unobserved factors**

- Use of stochastic filtering to obtain equivalent observable or ‘projected’ models.
- Piecewise-deterministic Markov processes as projected Markov chain models.
- Pricing applications—computational methods and calibration.
- Statistical inference—likelihood functions and estimation methods.

Prof. Rüdiger Frey  
Pricing and Hedging of Portfolio Credit Derivatives:  
Introduction and recent developments

Lecture I: **Introduction to portfolio credit risk**

- credit products: CDSs, CDS indices and CDOs
- basics about reduced-form credit risk modelling for a single firm
- factor copula models
- CDO pricing in copula models and correlation skews
- alternative models: overview

Lecture II: **Credit risk and incomplete information I**

- incomplete information in credit risk modelling: overview
- introduction to nonlinear filtering

Lecture III: **Pricing and hedging credit derivatives via the innovations approach to nonlinear filtering** (Frey-Schmidt-2009)

- the model
- dynamics of credit derivatives
- pricing of non-traded claims and calibration (including numerical examples)
- hedging of credit derivatives
- calibration via filtering