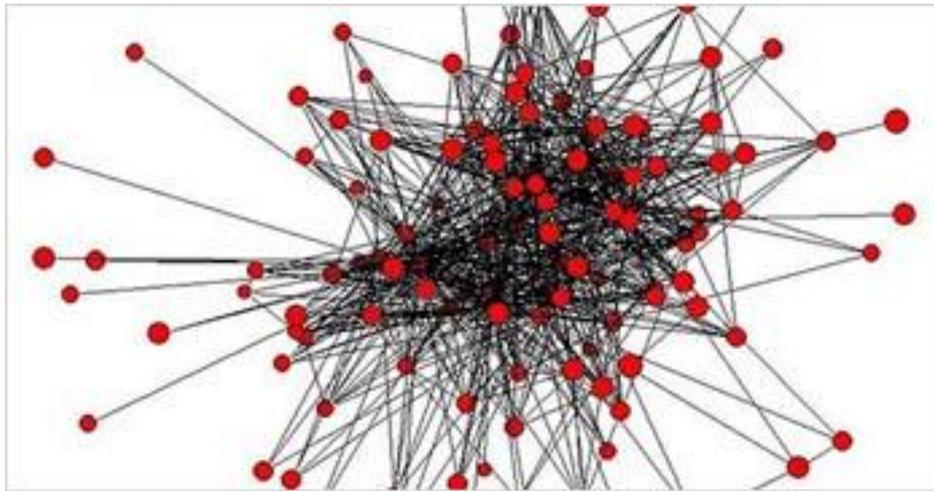


Isaac Newton Institute of Mathematical Sciences

[Systemic Risk:](#)
[Mathematical Modelling and Interdisciplinary Approaches](#)

18th August 2014 to 19th December 2014

Organisers: [Rama Cont](#) (Imperial College), [Jean-Charles Rochet](#) (Zürich), [Chris Rogers](#) (Cambridge) and [Fernando Vega-Redondo](#)(Bocconi)



The recent financial crisis, which began in 2008 in the financial markets and triggered a global recession, has demonstrated the vulnerability of the world financial system and its linkages to the real economy. Academics and regulators have since been engaged in the search for understanding of the mechanisms underlying systemic risk in the financial sector and its interaction with the real economy. This 4-month programme at the Isaac Newton Institute brought together mathematicians, economists and regulators with shared interests to advance the push for understanding.

A wide range of mathematical subject areas play a role in understanding systemic risk: stochastic optimal control, networks, game theory, risk measures, extreme value theory, statistics are perhaps the most obvious, and experts from all these areas participated. A lecture by Sir Robert May, entitled *Systemic Risk in Ecological and Financial Systems: Early Warnings?* illustrated how concepts from epidemiology and mathematical ecology provide insights into financial stability.

The discussions revealed different interpretations of what systemic risk might be and how it might be monitored and, to a certain extent, prevented: the programme confronted these views through interdisciplinary round table discussions, which were highly appreciated by the participants.

The workshop on [Systemic Risk: Models and Mechanisms](#) organized in August by Darrell Duffie, Paul Glasserman, and Fernando Vega-Redondo brought together experts in financial economics, game theory, network science and mathematical finance to discuss various mathematical techniques used to model systemic risk. One of the focuses of the workshop was the use of network models for understanding contagion of insolvency and illiquidity in banking systems.

* **Monitoring Systemic Risk: Data, Models and Markets.** Organized by Rama Cont, Michael Gordy and Christian Gourieroux, this workshop, highly attended by regulators, focused on indicators and data requirements proposed for monitoring of systemic risk by regulators. A key challenge is to incorporate contagion mechanisms in the indicators. The granularity of models turned out to be an important issue, with macro-econometric on one hand and micro-level firm-level network models on the other hand.

The final workshop, devoted to [Regulating Systemic Risk: insights from mathematical modeling](#) organized in December by Rama Cont, Martin Hellwig, and Jean-Charles Rochet, brought together macroeconomists, regulators and mathematical scientists to tackle the difficult issue of tackling systemic risk through regulation. Recurrent themes of this workshop were the interlinkage of financial intermediation, regulation and the real economy and the need for a model-based cost-benefit analysis of regulatory measures

Distributed through the programme were a number of mini-courses whose purpose was part pedagogical, part review of recent research. Among these were :

- * Over-the-counter markets (Darrell Duffie, Stanford)
- * Mean-field games (Jean-Michel Lasry, Paris Dauphine)
- * Stochastic control problems in portfolio liquidation (Ulrich Horst, Berlin)
- * Macroeconomic models with a banking sector (Jean-Charles Rochet, Zurich)
- * Mod-Phi convergence (Ashkan Nikeghbali, Zurich)
- * Bank runs, deposit insurance and liquidity (Phil Dybvig, St Louis)
- * Conflict and trading in networks (Sanjeev Goyal, Cambridge and Fernando Vega-Redondo, Bocconi)
- * Risk measures (Stefan Weber, Hannover)
- * Mathematical aspects of local vs global risk analysis (Hans Foellmer, Berlin)
- * Risk measures, scenarios and stress testing (Alex McNeil, Heriot-Watt University)

Involvement of regulators was an important element of the entire programme, and added greatly to the relevance of the discussions. At various times through the programme, we had representatives of the Federal Reserve, the Bank of England, the European Central Bank, the European Systemic Risk Board, the Bank for International Settlements (Basel), the Japanese FSA, the Deutsche Bundesbank, the Central Bank of Brasil, and the Austrian National Bank presenting their research and contributing to the discussions. A highlight of the programme was a one-day *Open for Business* event entitled 'Systemic Risk and Macroprudential Regulation: Perspectives from Network Analysis' was held in October at the Bank of England, with many participants and speakers from the Bank's Financial Stability Division.

The programme has contributed to rendering research on mathematical modeling of systemic risk visible to policy-oriented research teams in central banks, and triggered collaborations between mathematical scientists and researchers at the Bank of England, the European Central Bank, and the Deutsche Bundesbank, to mention a few. A junior mathematician participating in the programme was hired by the Bank of England's Financial Stability Division.

The journals [Operations Research](#) and [Statistics and Risk Modelling](#) have devoted special issues to the programme.

The programme has contributed to the continuing effort of regulators and academics to get to grips with the most important economic issues of a generation. Much remains to be done, and the legacy of connections among researchers and regulators generated by this programme may well prove to be an important step forward.