



EPSRC "SCALING IN SOCIAL SYSTEMS"

WORKSHOP

Thursday 1st December 2011

CABDyN Complexity Centre

Saïd Business School, University of Oxford



EPSRC "Scaling in Social Systems" Workshop

Thursday 1st December 2011

SEMINAR ROOM A

This workshop is supported by the "Scaling in Complex Systems" project, funded by the EPSRC through grant no. EP/G063753/1. The Principal Investigator for the project is Henrik Jensen of Imperial College London, and the Co-Investigator is Felix Reed-Tsochas of the University of Oxford. As part of this project a first workshop on "Scaling in Complex Systems" was held at Imperial College on 26 January 2011.

10:45 - 11:00 Dr Felix Reed-Tsochas, University of Oxford
Welcome and Introduction

11:00 - 12:00 Professor Michael Batty, University College London
"Spatial complexity and scaling laws for cities"

12:00 - 13:00 Professor Luís Bettencourt, Los Alamos National
Laboratory
"Cities as scale invariant complex systems: universal statistics of urban
scaling"

13:00 - 14:00 Lunch break - Reception Room

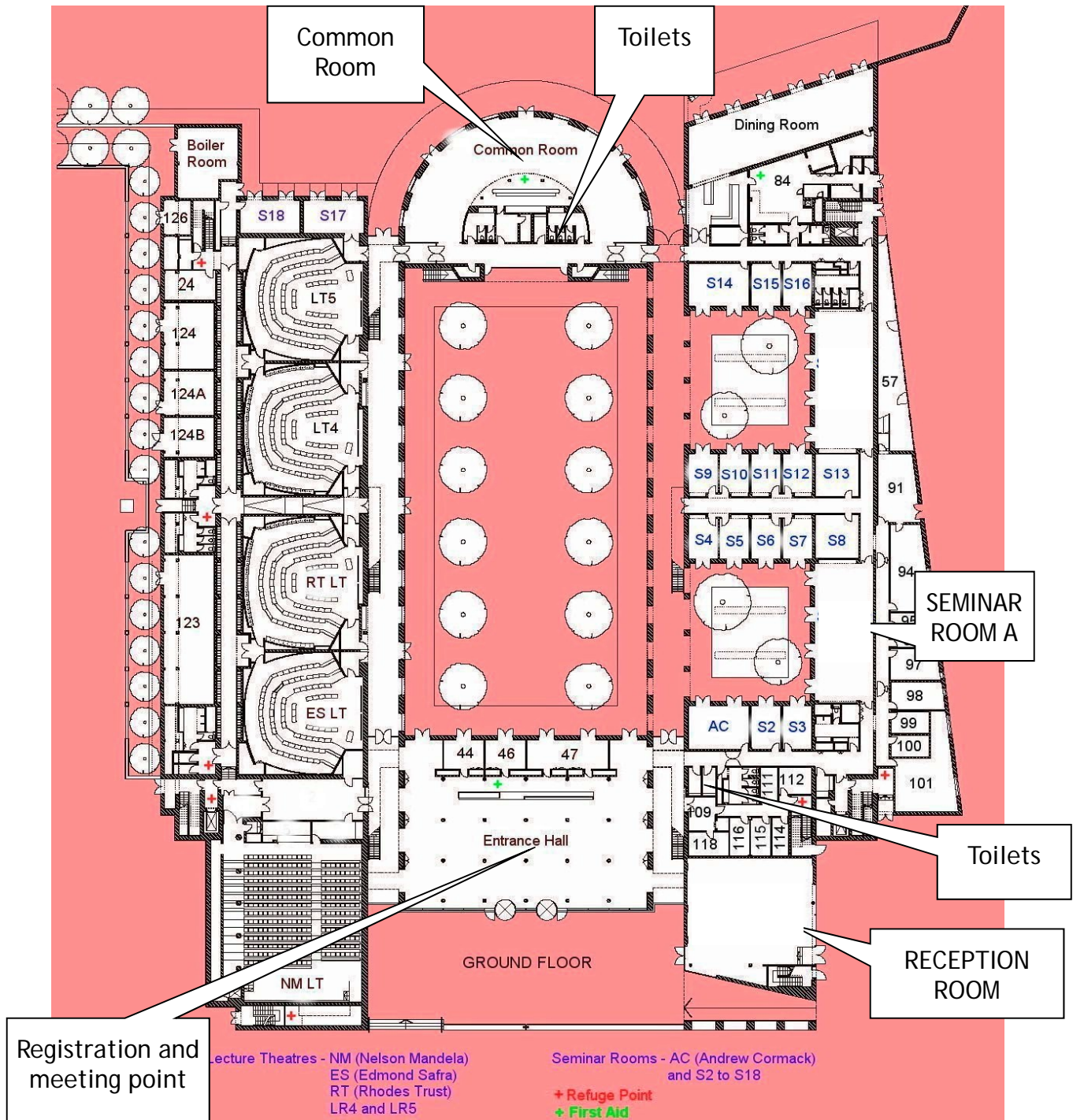
14:00 - 15:00 Professor Didier Sornette, ETH Zürich
"The dynamics of success, fame and crisis: endogenous versus
exogenous shocks in complex networks"

15:00 - 16:00 Dr Tim Evans, Imperial College London
"Scaling and citations"

16:00 - 16:30 Coffee break - Reception Room

16:30 - 17:00 Professor Geoffrey West, Santa Fe Institute
"Workshop summary and concluding comments"

EPSRC "Scaling in Social Systems" Workshop
 Thursday 1st December, Saïd Business School, Oxford
 Ground Floor



WELCOME TO THE SAÏD BUSINESS SCHOOL

If you hear a continuous alarm at any time other than 10.30am on a Monday when the fire alarms are tested, you **MUST** evacuate the building via the nearest fire exit and wait at the assembly point, which is on the pavement at the front of the building. Do not re-enter the building until you are instructed to do so.

Smoking is not permitted anywhere within the School building, in common with the regulations in force throughout the University. Smoking is permitted in the central courtyard and in the garden; please use the ashtrays provided there.

Talks:

Speaker: Professor Michael Batty, CASA, University College London

Title: "Spatial complexity and scaling laws for cities"

Abstract: In this talk, we define several laws of scaling that pertain to cities: first relating to city size distributions, next relating to how cities scale with respect to their size or laws of positive allometry and then relating to how interactions in cities between populations scale with distance or deterrence between them. We complement these laws with more speculative ideas about scaling which have not yet been validated and pertain to their sustainability, density and related issues. We then introduce the concept of spatial complexity that relates the detail at which cities are defined to their distributions in terms of size, and this serves to show how cities can increase in complexity as they grow in size. All these ideas are speculative but plausible and we will assess their relevance with respect to empirical evidence and what they imply about future urban growth and distribution.

Speaker: Luís Bettencourt, Los Alamos National Laboratory & Santa Fe Institute

Title: "Cities as scale invariant complex systems: universal statistics of urban scaling"

Abstract: Cities are among the most complex systems in human societies. Their understanding is critical for economic growth, security and sustainable energy and resource management both at the national and international levels. Cities are characterized by a myriad of quantities all co-varying in non-trivial ways, such as their demographic characteristics, economic productivity, public health and material infrastructure. Despite this complexity I will show that on the average urban indicators are surprisingly predictable in terms of a small number of quantities. Their expected values show non-trivial scaling with population size, manifesting either increasing per capita economic productivity or savings in material infrastructure. These scaling relations hold across quantities, time and for distinct urban systems. I illustrate these findings in light of scaling in physical and biological systems and show how social systems can achieve new forms of organization and dynamics that enable open-ended innovation and increases in economic productivity.

Speaker: Professor Didier Sornette, ETH Zürich

Title: "The dynamics of success, fame and crisis: endogenous versus exogenous shocks in complex networks"

Abstract: We discuss the evidence for and theory of a generic dynamical law characterizing the activity of systems going to and following a peak, a crisis or a climax. A deep relationship is uncovered between the response to exogenous shocks and the endogenous fluctuations of the activity of systems driven by the epidemic-like interactions, such as word-of-mouth contacts in social networks and triggering processes in natural systems. This constitutes a generalized fluctuation-susceptibility theorem of such out-of-equilibrium systems with punctuated dynamics. Applications include the dynamics of commercial sales,

YouTube video success, financial volatility shocks, market crashes, bursts of cyber-risks, social conflicts and crises, epileptic seizures, earthquakes, landslides, climate dynamics and so on.

Speaker: Dr Tim Evans, Imperial College London

Title: "Scaling and citations"

Abstract: The pattern of innovation seen through citations of academic papers has long fascinated academics. It has been known for at least fifty years that the data shows various long tailed distributions suggesting interesting scaling phenomena may be at work. In this talk I will look at some of the features of the data and show how to extract some simple universal patterns. I will discuss some of the implications of the results and the questions it raises.

Speaker: Professor Geoffrey West, Santa Fe Institute

Title: "Workshop summary and concluding comments"

Abstract: Geoffrey West will provide his perspective on how and to what extent scaling laws can be applied to social systems, and what they may be able to tell us about underlying mechanisms. He will do so both by responding to the preceding four talks, and by identifying how he thinks the field can move forward.

Speaker Bios:

Michael Batty



Bio: Michael Batty is Bartlett Professor of Planning at University College London where he is Chair of the Centre for Advanced Spatial Analysis (CASA). Previously (1990-1995) he was Director of the NSF National Center for Geographic Information and Analysis (NCGIA) in the State University of New York at Buffalo and from 1979 until 1990, he was Professor of City and Regional Planning in the University of Cardiff. His most recent books are *Cities and Complexity* (MIT Press, 2005) *Virtual Geographic Environments* (edited with Hui Lin, ESRI Press, 2011), and *Agent-Based Models of Geographical Systems* (edited with A. J. Heppenstall, A. T. Crooks and L. M. See, Springer, 2011). He is editor of the journal *Environment and Planning B: Planning and Design*. He was elected as a Fellow of the British Academy in 2001, awarded a CBE in the Queen's Birthday Honours in June 2004 for 'services to geography', and made a Fellow of the Royal Society in 2009.

Luís Bettencourt



Bio: Luís M. A. Bettencourt is a Professor at the Santa Fe Institute and a Senior Research Scientist at Los Alamos National Laboratory. He obtained his PhD from Imperial College, University of London, in 1996 for work on critical phenomena in the early Universe, and associated mathematical techniques of Statistical Physics, Field Theory and Non-linear Dynamics. He held postdoctoral positions at the University of Heidelberg, Germany, as a Director's Fellow in the Theoretical Division at LANL, and at the Center for Theoretical Physics at MIT. In 2000 he was awarded the distinguished Slansky Fellowship at Los Alamos National Laboratory for excellence in interdisciplinary research. Luís carries research in the structure and dynamics of complex systems, with an emphasis on dynamical problems in biology and society. Currently he works on real time epidemiological estimation, information processing in complex systems, innovation in science and technology and urban organization and dynamics. He is a member of advisory committees for international conferences and referees for journals in physics, mathematics, computer science, computational biology, urban studies and for international fellowship programs. He is the Principal Investigator of the Synthetic Cognition team at Los Alamos National Laboratory, which is pursuing new science and technology for image and video processing inspired by biological insights. He is also a consultant for the Office Science and Technology Information of the US Department of Energy on the subject of Scientific and Technological Innovation and Discovery

Didier Sornette



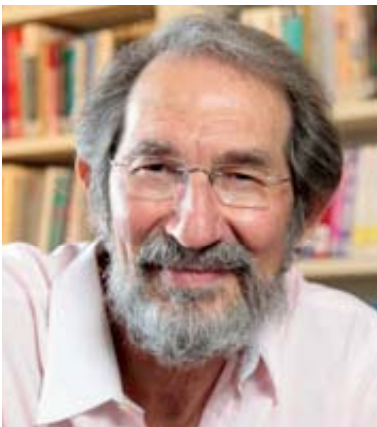
Bio: Didier Sornette is professor of Entrepreneurial Risks in the department of Management, Technology and Economics at the Swiss Federal Institute of Technology (ETH Zurich), a professor of finance at the Swiss Finance Institute, a Professor of Physics and a professor of Geophysics also at ETH Zurich. He is the author 450+ research papers and 5 books. His research focuses on the prediction of crises and extreme events in complex systems and in particular of financial bubbles and crashes, and the diagnostic of systemic instabilities. Other applications include earthquake physics and geophysics, financial economics and the theory of complex systems, the dynamics of success on social networks and the complex system approach to medicine (immune system, epilepsy...). In 2008, he launched the Financial Crisis Observatory to test the hypothesis that financial bubbles can be diagnosed in real-time and their termination can be predicted probabilistically.

Tim Evans



Bio: Tim Evans studied the mixture of quantum field theory and statistical physics in his PhD at Imperial College London. He was supervised by Prof. Ray Rivers who also supervised another speaker, Prof. Luis Bettencourt. Tim then spent time as a researcher at the University of Alberta in Edmonton, Canada, before returning as a researcher at Imperial, latterly as a Royal Society University Research Fellow. He was appointed to a lectureship at Imperial in 1997. Around 2003 he expanded his work on statistical physics to cover problems in complexity, with a particular interest in network methods. This has included participation in an EU collaboration with social scientists on innovation, "ISCOM", run in part by Prof. Geoff West (another speaker today). This fuelled his interest in social science applications including an ongoing collaboration with an archaeologist.

Geoffrey West



Bio: Distinguished Professor and former President, Santa Fe Institute. Senior Fellow and former leader of high energy physics, Los Alamos National Laboratory. Visiting Professor of mathematics, Imperial College and Associate Fellow at the Said Business School, Oxford University. BA, Cambridge (1961); PhD, Stanford (physics, 1966). Post-doctoral fellow, Cornell and Harvard Universities, before joining the Stanford faculty. Theoretical physicist with primary interests in fundamental problems: elementary particles, cosmological implications, origins of universal scaling laws, unifying quantitative framework of biology, including metabolic rate, growth, aging, mortality, sleep, cancer, and ecosystem structure and dynamics. Recent focus on developing underlying theory of cities, companies and sustainability, including rates of growth and innovation, and the accelerating pace of life. Awards include the Mercer Prize from the Ecological Society of America; the Weldon Memorial Prize for Mathematical Biology; the Glenn Award for Aging research; Harvard Business Review breakthrough idea (2007) and *Time* magazine's list of "100 Most Influential People in the World" (2006).

Workshop organiser:

Felix Reed-Tsochas



Felix Reed-Tsochas is James Martin Lecturer in Complex Systems and Deputy Director at the Institute for Science, Innovation and Society (Saïd Business School). He is also a founding Co-Director of the CABDyN Complexity Centre, where CABDyN stands for Complex Agent-Based Dynamic Networks. CABDyN was launched in 2003 to coordinate complex systems research activities across Oxford and to build bridges between different disciplines using tools such as agent-based modelling and complex network analysis. Felix's academic background is in theoretical condensed matter physics, and his research focuses on developing an interdisciplinary approach to understanding the dynamical and functional properties of complex networks in different contexts, as well as the emergence of collective behaviour in complex systems.