Biographies of speakers

Nick Watkins (British Antarctic Survey)
Nick Watkins is a complexity analyst, and is currently with the Environmental Change and Evolution Programme at NERC's British Antarctic Survey (BAS), Cambridge, UK. He is also a visitor to LSE CATS and the Centre for Fusion Space and Astrophysics at the University of Warwick. Nick currently co-supervises a doctoral student with Cambridge University's Stats Lab. Nick's career has included space plasma data analysis and instrument modelling at Sussex, for the USAF/NASA CRRES and ESA's Cluster missions; analysis of radio noise measurements from Antarctica for BAS; and most recently, the establishment of a team that both develops and applies complexity science across BAS's remit, from heavy tails in the Earth's fluctuating aurora to long range dependence in temperature, and complex networks in biology. The common threads through this diverse range of topics have been random fluctuations and time series analysis.

Jochen Bröcker (Max-Planck-Institute for the Physics of Complex System)
Dr Jochen Bröcker's research interests are on the interface of practical application, theoretical development and industrial exploitation of the analysis of dynamic systems. His current focus is on dynamical systems analysis and statistics (eg, data assimilation, parameter estimation, and nonlinear filtering) with a view on geophysical applications. Further, he works on the assessment of forecasts, in particular probabilistic weather and climate forecasts, as well as on foundational issues in the theory of predictability and the communication of uncertainty to end users. A more recent theme of his work is fluid mechanics and nonequilibrium statistical physics.

Until recently, Dr Bröcker was with the Max Planck Institute for the Physics of Complex Systems in Dresden, Germany. Prior to this appointment, he was a Research Officer in the Centre For The Analysis Of Time Series (CATS) at LSE (2003 to 2007), where his main focus was the EPSRC-DTI Smith Institute Faraday partnership project entitled "Direct and Inverse Modelling in End-to-End Environmental Prediction" (PI Leonard Smith), the central objectives of which were to determine and enhance the economic value of weather forecasts. In September 2012, Dr Bröcker will join the University of Reading as a Lecturer in Meteorology and Statistics.

Dr Bröcker obtained his PhD from University of Goettingen in April 2003, where his main research was on nonlinear filtering and noise reduction.

Dr D James Baker (The William J Clinton Foundation)
Dr James Baker is a Visiting Senior Fellow at CATS and the Director of the Global Carbon Measurement Program of the William J Clinton Foundation, working with forestry programs to reduce carbon dioxide emissions and alleviate poverty through use of remote sensing and geospatial systems in developing countries. He is also involved with developing global observing programs for forestry and climate. He is a member of the World Bank's Roster of Experts for the Forest Carbon Partnership Facility and was the lead author on the recent paper "Achieving forest carbon information with higher certainty: a five part plan," published in the journal Environmental Science and Policy. Previously, Dr Baker served as Under Secretary for Oceans and Atmosphere and Administrator of the National Oceanic and Atmospheric Administration (NOAA) at the US Department of Commerce. He was elected the twenty-seventh President and CEO of The Academy of Natural Sciences in Philadelphia, the oldest natural history institution in the western hemisphere, in April 2002. He has a PhD in Physics from Cornell University.

Henry Wynn (LSE)
Henry Wynn is Emeritus Professor of Statistics at the London School of Economics where he has been since 2003, and where he is currently Chair of the Centre for the Analysis of Time Series (CATS) . He was head of the Department of Statistics from 2003 to 2006, where he also led his own research group, the Decision Support and Risk Group (DSRG); he was also part-time Scientific co-Director of EURANDOM, the international stochastics institute attached to Eindhoven Technical University (TUE), in the Netherlands (2000 to 2005). He has a BA with honours in mathematics from the University of Oxford and a PhD in Mathematical Statistics from Imperial College London. Following a period as Lecturer and then Reader at Imperial College he became Professor of Mathematical Statistics in 1985 at City University, London, and was Dean of Mathematics there from 1987 to 1995. At City University he co-founded the Engineering Design Centre of which he was co-Director and facilitated the introduction of new degrees, notably the MSc in Quality Improvement and System Reliability and the MSc in Research Methods and Statistics. He moved, in 1995, to the University of Warwick as founding Director of the Risk Initiative and Statistical Consultancy Unit (RISCU) which he helped build to a leading centre of its kind, well supported by a range of research grants. He was a founding president of the European Network for Business and Industrial Statistics (ENBIS), which now has over a thousand members and a successful annual conference. He holds the Guy Medal in Silver from the Royal Statistical Society, the Box Medal from the European Network for Business and Industrial Statsitics (ENBIS), is an Honorary Fellow of the Institute of Actuaries, a Fellow of the Institute of Mathematical Statistics, has been awarded an Emeritus Fellowship by the Leverhulme Trust and has been awarded the Exzellenzstipendium des Landes Oberösterreich by the governor of Upper-Austria.

Ron Bates (Rolls Royce PLC)
Ron Bates is a Robust Design Specialist in the Design Systems Engineering (DSE) division of Rolls-Royce PLC.

Since joining Rolls-Royce in 2008, Ron has developed and implemented several methods for Robust Design and is responsible for developing the strategy for Uncertainty Management within DSE. He is also co-ordinator of research for the Rolls-Royce University Technology Centre at Southampton, and is a Work Package leader on the EU-funded CRESCENDO programme, developing Robust Design methods for collaborative environments.

Ron gained his PhD (Robust Design of Complex Systems) at City University Engineering Design Centre in 1995, and then worked as a Research Assistant, Fellow, Senior Fellow and consultant in Robust Design at Warwick University and then at LSE, until his current appointment at Rolls-Royce PLC. During that time he has co-authored over 50 journal and conference papers.

Jordan Ko (DAE programme, Isaac Newton Institute)
Jordan Ko has recently joined Areva SA to develop its uncertainty quantification expertise in industrial computational fluid dynamic projects. After completing his doctoral and post-doctoral research in polynomial chaos and uncertainty quantification at the University of Paris, he was a guest researcher at the Design and Analysis of Experiments programme at the Isaac Newton Institute in Cambridge. He also holds engineering degrees from University of British Columbia and Royal Institute of Technology (KTH) Stockholm.

Bernard Sinclair-Desgagné (HEC Montréal)
Bernard Sinclair-Desgagné is the International Economics and Governance chair and Chairman of the International Business department at HEC Montréal, a Fellow of CIRANO and an Affiliate Professor at the École polytechnique of Paris. Previously, he was for several years a faculty member of INSEAD (in Fontainebleau, France) and the École polytechnique of Montreal. He holds a PhD in Management science/Operations research from Yale University. His main research areas are the economics of incentives and organization, environmental economics and policy, risk management, and environmental innovation. His publications can be found in major journals such as Econometrica, Management Science, the Journal of Environmental Economics and Management, the Journal of Regulatory Economics, and the Journal of Law, Economics and Organization. His recent work focuses on the dynamics of the eco-industry, the administrative costs of environmental regulation, and policy making under scientific uncertainty. In 2004, he was nominated a Fellow of the European Economic Association. In 2006, he won (with co-author Pauline Barrieu of the London School of Economics) the Finance and Sustainability European Research Award for the article "On Precautionary Policies" published in Management Science. He is currently an associate editor of Resource and Energy Economics and the International Review of Environmental and Resource Economics.

Massimo Marinacci (Bocconi University)
Massimo Marinacci earned his Laurea degree in Economics from Bocconi University in 1989 and his PhD in Economics from Northwestern University in 1996. He started his career in 1996 as assistant professor in the Department of Economics of the University of Toronto. In 1998 he became associate professor in the Department of Economics of the University of Bologna, and in 2000 full professor in the Department of Statistics and Applied Mathematics of the University of Torino, which he chaired from 2003 to 2009. Since 2009 he is professor in the Department of Decision Sciences of Bocconi University, where since 2011 holds the AXA-Bocconi Chair in Risk.

LSE

CATS CENTRE FOR THE ANALYSIS OF TIME SERIES

Workshop on Uncertainty Quantification, Risk and Decision-making

22 – 23 May, room CON 2.05, LSE

PROGRAMME

Tuesday 22 May	
09.30-10.00	Registration and Welcome coffee
Session 1: Characterising uncertainty (Chair Leonard Smith)	
10.00-10.45	Nick Watkins: ***"Five ways to misestimate risk"***
10.45-11.00	Discussion
11.00-11.45	Jochen Bröcker: ***"How to interpret probabilistic forecasts (in particular for weather and climate)"***
11.45-12.00	Discussion
12.00-12.45	Jim Baker: ***"Uncertainty and REDD: Characterising Forest Carbon"***
12.45-13.00	Discussion
13.00-14.30	**Lunch** (Shaw Library)
14.30-15.30	On the first topic (discussion led by Leonard Smith)
Session 2: Experimental design and robustness (Chairs: Pauline Barrieu & Henry Wynn)	
15.30-16.15	Henry Wynn: ***"Robustness and experimental design"***
16.15-16.30	Discussion
16.30-17.00	Coffee break
17.00-17.45	Ron Bates: ***"Uncertainty Management in a complex engineering environment"***
17.45-18.00	Discussion
19.00	**Workshop dinner** (LSE Senior Dining Room)
Wednesday 23 May	
Session 2 *(continued)*: Experimental design and robustness (Chair: Henry Wynn)	
10.00-10.45	Jordan Ko: ***"UQ in computer experiments with polynomial chaos"***
10.45-11.00	Discussion
11.00-12.00	On the second topic (discussion led by Henry Wynn)
12.00-13.00	**Lunch** (Shaw Library)
Session 3: Decision-Making under Uncertainty (Chair: Roman Frigg)	
13.00-13.45	Bernard Sinclair-Desgagné: ***"Economic policy when models disagree"***
13.45-14.00	Discussion
14.00-14.45	Massimo Marinacci: ***"Robust mean-variance analysis"***
14.45-15.00	Discussion
15.00-16.00	On the third topic (discussion led by Roman Frigg)
16.30-18.00	**Reception and book launch** (LSE Senior Dining Room): Arthur Petersen *"Simulating Nature: A Philosophical Study of Computer-Simulation Uncertainties and Their Role in Climate Science and Policy Advice"* (2nd edition)

Organizing Committee

Dr Pauline Barrieu
Professor Henry Wynn
Dr Roman Frigg
Professor Leonard Smith
Dr David Stainforth
Mrs Lyn Grove

ABSTRACTS

Five ways to misestimate risk

Nick Watkins (British Antarctic Survey)

In this talk I will review some of the ways in which stochastic models can misestimate risk, using examples drawn from the literature and from my own work on natural complex systems. After George W Bush, I will call the first four "misunderestimation", because they will tend to underestimate fluctuations. They are 1) using short tailed pdfs if in fact they should be long; 2) using a model with short-ranged memory if in fact a long-range dependent model applies better; 3) using uncoupled variables in a multivariate model when in fact one should have a copula or similar; and 4) using additive models when the statistics of the system are multiplicative.

For balance I will include a least one example of "misoverestimation", where heavy tails can be generated artificially from spurious measurements.

How to interpret probabilistic forecasts (in particular for weather and climate)

Jochen Bröcker (Max-Planck-Institute)

If we are forced to say whether some statement about the real world is true or false, we should give our answer in terms of probabilities, as has been argued by various authors (and for a long time, see Murphy, 1998, for an interesting historical overview). The main argument is essentially that probabilistic forecasts are "self-assessing" in that they provide information as to their own expected accuracy. This greatly enhances their potential value for decision making and risk assessment.

This talk will have two parts. In the first part, the formalism of probability forecasts will be outlined. I will show that probabilistic forecasts can be evaluated in a way that takes their probabilistic character into account. Concepts such as reliability, resolution, and scoring rules will be considered. In the second part, some limitations of this formalism in particular in weather and climate applications will be discussed. Two points seem to me most pertinent here: Firstly, due to practical reasons, operational forecasts are often generated in a way that is in fact not consistent with their interpretation as probability forecasts. Ensemble forecasts, for example, are often interpreted as independent draws from an underlying forecast distribution, but they are not generated that way. Secondly, given that operational forecasting systems issue forecasts over a long period of time, forecasters should associate uncertainties with their forecast probabilities, ie, consider some sort of second order uncertainties. Although there are attempts to do this consistently, the resulting formalism seems to be overly complicated and unsuitable for practical applications.

Murphy, A H (1998). The early history of probability forecasts: some extensions and clarifications. *Weather and Forecasting*, 13, 5-15.

Uncertainty and REDD: characterizing forest carbon

D James Baker (The William J Clinton Foundation – Clinton Climate Initiative)

Deforestation and consequent land degradation contribute approximately 15 percent of global carbon dioxide emissions. CCI's forestry program aims to develop projects that reduce deforestation and develop carbon measurement systems that enable governments and local communities to be compensated for conserving existing and regrowing new forest, both through the sale and trade of carbon credits on the international market and through international forestry finance funding (REDD).

In Guyana, CCI provided support to the Office of the President for developing and implementing the government's Low Carbon Development Strategy (LCDS) for a transition to a green economy. As part of the LCDS, CCI and its partners have worked closely with the Forestry Commission and related government agencies to assist in the planning and implementation of a world-class forest carbon Monitoring, Reporting, and Verification (MRV) system. A key element of the MRV work is the sampling scheme for ground measurements that augment and verify satellite data. The sampling scheme has to incorporate this information in such a way as to provide carbon information with sufficient precision to allow Guyana to receive payment under REDD. Traditionally the sampling method has been to place a grid of say 10 km by 10 km over the country and to make a measurement at each point. But this is impractical for remote and inaccessible areas. So a sampling scheme was developed by Winrock that is practical and cost-effective to use but still provides the required precision. The scheme chosen focuses on those areas that are most likely to experience change in the next decade. A Potential for Future Change map was created, indentifying planned agricultural development, road construction, settlement establishment, mining areas, and other changes in forestry. The first phase of the data collection focuses on those areas that have high potential for change and are more accessible (within 5 km of roads), as well as those areas that have high potential for change and are less accessible. Within these areas, clustered plots are chosen to reduce local variability. As it turns out, only about 35 such plots are required to provide carbon stocks with a standard deviation of about 6 per cent of the mean (±90% confidence intervals) instead of the several hundred plots that would be required with sampling at every grid point.

In the talk I will briefly describe the application of the sampling scheme that has been developed for Guyana and how it is being implemented with new high resolution measurements of forest degradation, concluding with comments about the broader implications for preservation of tropical forests as a way to generate income for forest-dependent and other rural communities. The program has been successful so far – in recognition of Guyana's progress, Norway has already agreed to provide $70 million in payments for climate services through the world's second largest REDD+ deal. A total of $250 million over 5 years has been committed.

Robustness and experimental design

Henry Wynn (LSE)

For many years uncertainty quantification has been studied on the interface between statistics and design under a heading of robust engineering design (RED). This rediscovered some principles of which the leading one is the importance of bringing the wider environments, into which a manufactured product would pass or be used, into the experimental setting. The separation into control and noise variables is critical. The principle is old and and goes back to the ideas of "artificial" and "spontaneous" experiments of John Stuart Mill and into the conundrum of controlled experiment versus observational studies in medicine and social science. The modern theory of Bayesian learning or Bayesian experimental design is a framework, or at least a starting point, for bringing the ideas together. This theory is sketched with the aim of establishing a meta result, namely that a mixture of passive observation and controlled experiment is often best.

Uncertainty Management in a complex engineering environment

Ron Bates (Rolls Royce PLC)

This talk concerns the implementation of Robust Design methods in engineering.

This presentation will begin with a brief overview of some aspects of the design and development of a civil turbofan engine.

This will be followed by a description of a typical multi-disciplinary analysis environment.

We will then go on to explore how one might go about developing a framework for managing uncertainty in this environment, including discussion of the development and implementation of methods to translate uncertainty on inputs and models to variation in output performance.

UQ in computer experiments with polynomial chaos

Jordan Ko (DAE programme, Isaac Newton Institute)

I will present a framework in which the uncertainty and sensitivity of complex numerical models are quantitatively analyzed. Engineering models often employ deterministic model parameters or simplified boundary conditions estimated from experimental or idealized numerical studies. These model inputs can be affected by uncertainties arising from the inherent system randomness or the lack of knowledge of the phenomena studied. Examples abound of sensitive systems in which the aggregate effects of the stochastic inputs can lead to the occurrence of bifurcation or extreme events in the solutions. Thus, there has been an increased interest in uncertainty quantification (UQ) whereby the numerical solutions are examined in the context of stochastic inputs.

The Polynomial Chaos (PC) expansion is a spectral representation of the stochastic solutions on an optimal basis in the random input space and has recently been applied to many UQ studies in solid and fluid mechanics. It is essentially a solution metamodel as a polynomial function of the random inputs. When constructed with sufficient fidelity, the PC metamodel can be used in place of the original complex numerical solver in UQ, sensitivity analysis, model calibration, parameter optimization and reliability analysis.

Selected studies in computational fluid dynamics, global circulation models and extreme-quantile estimation will be shown to demonstrate the applicability, adaptivity and flexibility of PC in different fields.

Economic policy when models disagree

Bernard Sinclair-Desgagné (HEC Montréal)

This paper proposes a new way to conceive public policy when there is no consensual account of the situation of interest. The approach, which builds on a general version of Farkas's lemma, requires that the value of a remedy's projected outcomes agrees with the willingness-to-pay to escape the current situation. Unlike the methods currently put forward in the literature, it does not need (but is compatible with) a representative policymaker's objective function (as in the ambiguity aversion literature), a reference model (as in robust control theory) or some prior probability distribution over the set of supplied scenarios (as in Bayesian model-averaging). Policies constructed in this manner are shown to be effective, robust, simple, and precautionary in a precise and intuitive sense.

Robust mean-variance analysis

Massimo Marinacci (Bocconi University)

The talk is based on the paper "Alpha as Ambiguity: Robust Mean-Variance Portfolio Analysis". We derive the analogue of the classic Arrow-Pratt approximation of the certainty equivalent under model uncertainty as described by the smooth model of decision making under ambiguity of Klibanoff, Marinacci and Mukerji (2005). We study its scope by deriving a tractable mean-variance model adjusted for ambiguity and solving the corresponding portfolio allocation problem. In the problem with a risk-free asset, a risky asset, and an ambiguous asset, we find that portfolio rebalancing in response to higher ambiguity aversion only depends on the ambiguous asset's alpha, setting the performance of the risky asset as benchmark. In particular, a positive alpha corresponds to a long position in the ambiguous asset, a negative alpha corresponds to a short position in the ambiguous asset, and greater ambiguity aversion reduces optimal exposure to ambiguity. The analytical tractability of the enhanced Arrow-Pratt approximation renders our model especially well suited for calibration exercises aimed at exploring the consequences of model uncertainty on asset prices.