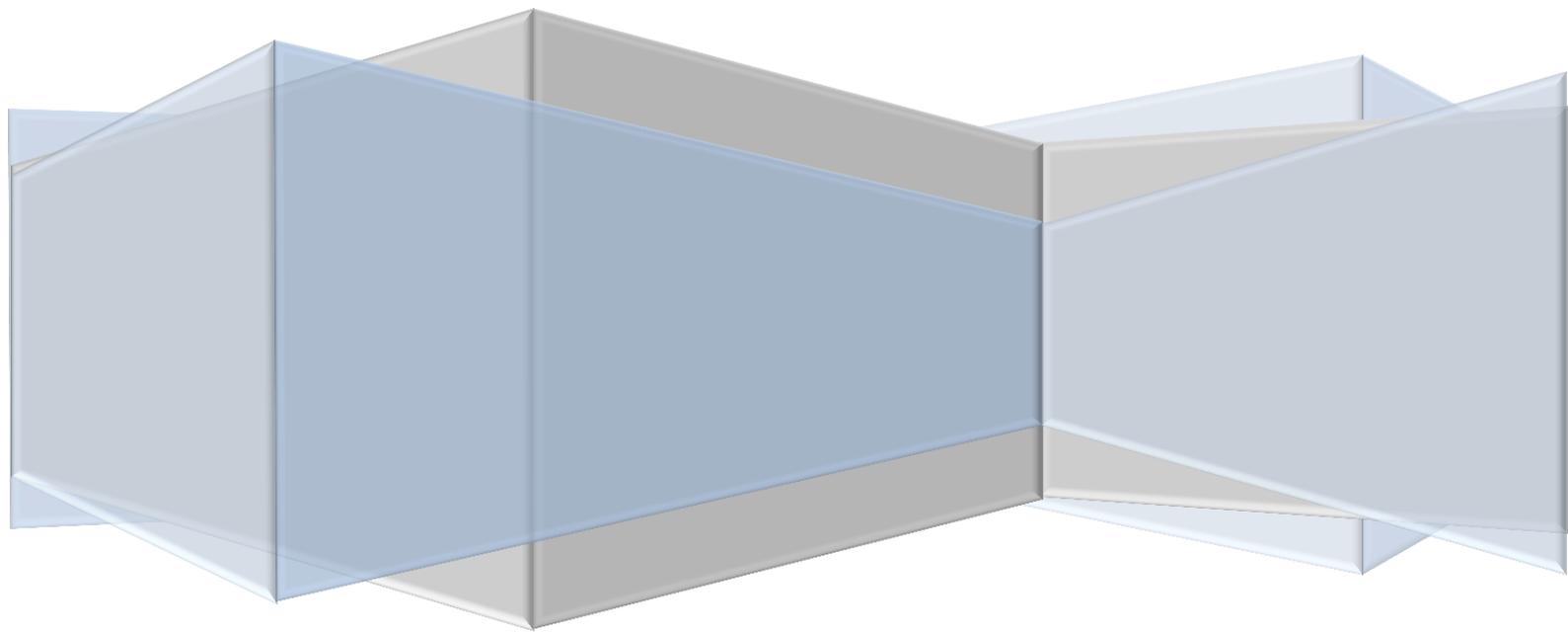


Rustat Conferences ◦ Jesus College, Cambridge

# The Use and Misuse of Statistics

*Jesus College,  
Cambridge  
Tuesday, 4 March 2014*

**Rapporteur: Nathan Brooker**



Produced under the auspices of  
Jesus College, Cambridge



# Rustat Conferences

## The Use and Misuse of Statistics

Jesus College, Cambridge

Tuesday, 4 March 2014



Jesus College  
Cambridge

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RUSTAT CONFERENCES  
JESUS COLLEGE, CAMBRIDGE  
**The Use and Misuse of Risk  
and Statistics**  
Tuesday, 4 March 2014

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- **08.30 - 09.25**  
**Registration and Refreshments - Prioress's Room, Cloister Court**  
All move to Upper Hall by 09.25 for conference start
- **09.30 - 09.35**  
**Welcome Note from Conference Chair - Upper Hall, Jesus College**
  - Professor Ian White, *Van Eck Professor of Engineering, Master of Jesus College, and Chair, Rustat Conferences*
- **09.35-09.50**  
**Keynote and Conference Overview**
  - Professor David Spiegelhalter, *Winton Professor of the Public Understanding of Risk, University of Cambridge*
  - Professor Bernard Silverman, *Chief Scientific Adviser, Home Office*
- **09.50-10.50**  
**Session One: Challenges of Understanding Statistics and Risk – Public Health**
  - Chair: Professor Bernard Silverman, *Chief Scientific Adviser, Home Office*  
*"The Limits to Individual Risk Prediction in Public Health"*
  - Professor George Davey-Smith, *Professor of Epidemiology, University of Bristol*
  - Professor Sheila Bird, *Programme Leader, MRC Biostatistics Unit, University of Cambridge*
  - Rt Hon Sir Tony Baldry MP, *Member of Parliament for Banbury and former Minister of State for Agriculture, Fisheries and Food*
- **10.50-11.15 Break - Upper Hall**
- **11.15-11.40**  
**Session Two: Data, Risk and the Global Slavery Index**
  - Chair: Chris Snowdon, *Director Lifestyle Economics, Institute of Economic Affairs*
  - Professor Kevin Bales, *Professor of Contemporary Slavery, Wilberforce Institute, University of Hull*

- **11.40-12.20**  
**Session Three: Climate Change and Data for Energy Policy Decisions**
  - Chair: Professor Robert Mair, *Sir Kirby Laing Professor of Civil Engineering and Head of Civil and Environmental Engineering, University of Cambridge*
  - Dr Emily Shuckburgh, *Head of Open Oceans Project, British Antarctic Survey*
  - Professor Daniel Ralph, *Founder and Director, Centre for Risk Studies, and Professor of Operations Research, Judge Business School, University of Cambridge*
  
- **12.20-13.20 Lunch – Master’s Lodge**
  
- **13.30-14.30**  
**Session Four: The Financial Crisis**
  - Chair: Andrew Freeman, *Director, the Finance Foundation, and Centre for Risk, Judge Business School, University of Cambridge*
  - Professor Michael Dempster, *Centre for Financial Research, and Statistical Laboratory, University of Cambridge*
  - Duncan Martin, *Partner and MD, Risk Practice, Boston Consulting Group*
  
- **14.30-15.10**  
**Session Five: The Interpretation and Presentation of Data – UK Immigration**
  - Chair: Peter Kellner, *President, YouGov*
  - David Goodhart, *Director, Demos, and author The British Dream: Successes and Failures of Post-war Immigration*
  
- **15.10-15.30 Break - Upper Hall**
  
- **15.30-16.10**  
**Session Six: Panel on Education – Improving the Understanding of Risk and the Better Use of Statistics**
  - Chair: Professor Anna Vignoles, *Professor of Education, University of Cambridge*
  - Professor David Spiegelhalter, *Winton Professor of the Public Understanding of Risk, University of Cambridge*
  - Dr Mary McAlinden, *Discipline Lead for Mathematics, Statistics and Operational Research, Higher Education Academy*
  - Professor Kevin McConway, *Vice President for Academic Affairs, Royal Statistical Society, and Professor of Applied Statistics, Department of Mathematics and Statistics, The Open University*
  
- **16.10**  
**Final Comments and Conference Close**
  - Professor Ian White, *Master, Jesus College, Chair, Rustat Conferences*

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#### Acknowledgements

We would like to thank all the speakers and chairs for their contributions, and the following for their help and advice in developing the agenda for this conference: Sir Tony Baldry, Professor Sheila Bird, Michael Blastland, Nigel Hawkes, Dr Stephen Siklos, Professor Bernard Silverman, and Professor David Spiegelhalter. In addition we thank the Development Office at Jesus College for their assistance, and Dr Laura Keynes and Nathan Brooker of the Rustat Conferences.



**RUSTAT CONFERENCES**  
**JESUS COLLEGE, CAMBRIDGE**  
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## Speaker Biographies

**The Rt. Hon Sir Tony Baldry**, *Member of Parliament for Banbury and former Minister of State for Agriculture, Fisheries and Food*

Tony Baldry has been Member of Parliament for Banbury for almost 30 years, having been elected in the 1983 General Election. He was a Minister for eight years, appointed to government by Margaret Thatcher and then served in the Conservative government throughout the whole of John Major's premiership. He has been Second Church Estates Commissioner since June 2010, a position appointed by the Queen on the advice of the Prime Minister and the approval of the Archbishop of Canterbury. It makes him the only Member of Parliament to be a member of General Synod. He is also a practising barrister, head of a commercial set of chambers in the Temple. Sir Tony was knighted for political and public services in the Queen's Birthday Honours in 2012 and became a member of Her Majesty's Privy Council in November 2013.

**Professor Kevin Bales**, *Professor of Contemporary Slavery, Wilberforce Institute, University of Hull*

Kevin Bales is professor of Contemporary Slavery at the Wilberforce Institute for the study of Slavery and Emancipation, University of Hull; and lead author of the Global Slavery Index. He was co-founder of Free the Slaves ([www.freetheslaves.net](http://www.freetheslaves.net)). His book *Disposable People: New Slavery in the Global Economy* published in ten languages, and was named one of "100 World-Changing Discoveries" by the Association of British Universities. The film version won a Peabody and two Emmys. Bales has advised the US, British, Irish, Norwegian, and Nepali governments on trafficking and slavery policy. His book *Ending Slavery: How We Free Today's Slaves*, won the Grawemeyer Prize in 2007. He also published *To Plead Our Own Cause: Personal Stories by Today's Slaves* in 2008 with Zoe Trodd; with eight Magnum photographers, *Documenting Disposable People*; and *The Slave Next Door: Modern Slavery in the United States* in 2009 with Ron Soodalter. He is currently writing a book on slavery and environmental destruction; and with Jody Sarich, a book on forced marriage.

**Professor Sheila Bird OBE FRSE FRSS**, *Programme Leader, MRC Biostatistics Unit, University of Cambridge*

Sheila Bird is visiting professor at the University of Strathclyde's Department of Mathematics and Statistics, and programme leader at the MRC Biostatistics Unit at the Institute of Public Health in Cambridge. She has been a medicines commissioner, was the first statistician on NICE's Appraisal

Committee, and has served on four Royal Statistical Society Working Parties as well as on various Medical Research Council, UK government and EU Working Parties and Groups. Bird submitted written evidence to the Home Affairs Select Committee as part of their investigation *Drugs: Breaking the Cycle*. Her research interests include UK dietary exposure to BSE, autopsy surveillance for carriage of subclinical variant CJD, quantitative understanding of injection-related Hepatitis C, drug-related deaths, and application of statistical methods in the criminal justice system's treatment of drug-dependent offenders.

**Professor George Davey-Smith FRSA**, *Professor of Epidemiology, University of Bristol*

George Davey Smith is professor of clinical epidemiology at the University of Bristol, honorary professor of public health at the University of Glasgow and visiting professor at the London School of Hygiene and Tropical Medicine. He is scientific director of the Avon Longitudinal Study of Parents and Children (ALSPAC) and director of the MRC Integrative Epidemiology Unit (IEU). His major research interest relate to the use of genetic epidemiology for informing understanding of the causal influence of environmentally modifiable risk factors and how social inequalities in health are generated by exposures acting over the entire life course. George has also worked on HIV/AIDS prevention in Nicaragua and India and on issues around the history of epidemiology, meta-analysis, lay epidemiology and epidemiological methodology. He is a foreign associate of the Institute of Medicine of the US National Academy of Sciences, and co-editor of the International Journal of Epidemiology.

**Michael A H Dempster**, *Professor Emeritus and Founder, Centre for Financial Research, Department of Pure Mathematics and Statistics, University of Cambridge*

Educated at Toronto, Carnegie Mellon and Oxford, Michael Dempster has taught and researched in leading universities on both sides of the Atlantic, including Oxford, Cambridge, Stanford, California-Berkeley, Princeton, Toronto, Melbourne and Rome. He was the first professor of finance at the Cambridge Judge Business School and is currently founding editor-in-chief of Quantitative Finance and an associate editor of Stochastics, Computational Finance and the Journal of Risk Management in Financial Institutions. Michael is founding editor-in-chief of the Oxford Handbooks in Finance, and founding co-editor of the Chapman & Hall /CRC Mathematical Finance Series. He has been consultant to a number of global financial institutions and corporations and several governments and is regularly involved in executive education in financial engineering and risk management around the world. Author of more than 110 published research articles in leading international journals, his books include *Introduction to Optimization Methods* (with P R Aday), *Stochastic Programming*, *Derivative Securities* (with S R Pliska), *Risk Management: Value at Risk and Beyond*, *Quantitative Fund Management* (with G Mitra and G Pflug), *Stochastic Optimization in Finance and Energy* (with M Bertocchi and G Consigli) and *The Euro in Danger* (with J S Chadha and D S Pickford). His work has won several awards and he is an honorary fellow of the UK Institute of Actuaries, a foreign member of the Academia Nazionale dei Lincei (Italian Academy) and managing director of Cambridge Systems Associates Limited, a financial analytics consultancy and software company.

**Andrew Freeman**, *Director, The Finance Foundation, and Risk Fellow, Centre for Risk, Judge Business School, University of Cambridge*

Andrew Freeman is the founder and managing director of Cambridge Research Associates, a research and advisory company that specialises in risk-related work for global clients. Over a 25-year career he has written numerous articles and books, first as a journalist on *The Economist* and latterly in his role as a senior knowledge expert in risk at McKinsey. Between 2009 and 2011 he was executive director of the Center for Financial Services at Deloitte LLP, overseeing its research programme on the financial services industry. In 1998 he published *Seeing tomorrow: rewriting the rules of risk*, co-authored with Ron Dembo, founder of Algorithmics. Andrew is a graduate of Balliol College, Oxford and was also elected a domus senior scholar at Merton College, Oxford.

**David Goodhart, Director, Demos**

David Goodhart founded current affairs magazine *Prospect* in 1995 and stood down as editor at the end of 2010. He remains 'editor-at-large' and is now director of social policy think tank Demos. He is the author of a book on post-war immigration and national identity, *The British Dream: Successes and Failures of Post-War Immigration* (Atlantic, 2013).

**Peter Kellner, President, YouGov**

Peter Kellner is president of YouGov. He was previously a journalist and political commentator for the *Sunday Times*, *Independent*, *New Statesman*, *Evening Standard*, *BBC Newsnight*, *BBC* election programmes and *Channel 4 News*. He wrote the 'Journalist Guide to Opinion Polls' for the European Society for Opinion and Marketing Research and is a regular speaker at industry conferences and seminars. In 2011 he was given a special recognition award by the Political Studies Association for his work over four decades on opinion polls, elections and political analysis. As well as being a member of the British Polling Council's committee on disclosure, Peter has been an adviser on polls and public opinion to the Bank of England, Foreign Office, Corporation of London, National Westminster Bank plc and Trades Union Congress. He has an MA in Economics and Statistics from the University of Cambridge.

**Terry Macalister, Energy Editor, The Guardian**

Terry Macalister is the energy editor of the *Guardian*. He is an award-winning journalist and author of *Polar Opposites: Opportunities and Threats in the Arctic*, focusing on the opportunities and threats posed by industrialisation of the Arctic. A law graduate who has specialised in business, politics and the environment, Terry has spoken at conferences in London, Stockholm and Shanghai. He has been employed at the paper and website for 14 years and previously worked at the *Independent*, *London Evening Standard* and other titles. Terry currently writes a freelance column for three specialist papers owned by NHST in Norway: *TradeWinds*, *Upstream* and *ReCharge*.

**Professor Robert Mair CBE FRS FICE FrEng, Sir Kirby Laing Professor of Civil Engineering, and Head of Civil and Environmental Engineering, University of Cambridge**

Robert Mair is the Sir Kirby Laing Professor of Civil Engineering at Cambridge University and head of civil and environmental engineering. He was master of Jesus College 2001-2011 and founding chair of the Rustat Conferences (2009-11). He is also one of the founding directors of the Geotechnical Consulting Group (GCG), an international consulting company based in London. He was appointed chief engineering adviser to the Laing O'Rourke Group in 2011. After graduating from Cambridge in 1971, he worked continuously in industry except for a three-year period when he returned to Cambridge to undertake a

PhD on tunnelling in soft ground. Throughout his career he has specialised principally in underground construction, providing advice on numerous projects worldwide involving soft ground tunnelling, retaining structures, deep excavations and foundations. He has been a member of expert review panels on major international underground construction projects, including the current Crossrail project in London. He leads a major research group at Cambridge and is principal investigator for a recently-awarded Innovation and Knowledge Centre on Smart Infrastructure and Construction funded by EPSRC, TSB and industry. He chaired the Royal Society/Royal Academy of Engineering Review of Shale Gas Extraction in the UK in 2012. He has recently been appointed chairman of the Science Advisory Council of the Department of Transport.

**Duncan Martin**, *Partner and MD, Risk Practice, Boston Consulting Group*

Duncan Martin is a partner and managing director in the financial services practice in London. He has over twenty years of experience in finance across wholesale banking, project finance and CRE, capital markets, SME and retail banking, and insurance, throughout Europe, the Americas and Asia. For the last fifteen years, he has focused on risk management. Prior to joining BCG, Duncan was head of wholesale credit risk analytics at Royal Bank of Scotland. Before RBS, Duncan was head of strategic risk management at Dresdner Kleinwort, and a senior manager in the risk practice at Oliver Wyman. In 2011, he led the BCG team that supported the Central Bank of Ireland's bank recapitalisation programme, was an advisor to the Central Bank of Portugal's banking sector restructuring programme, counselled a large Greek bank on their response to the Central Bank of Greece's loss estimation exercise, and assisted UKAR with their portfolio strategy. Duncan is the author of *Managing Risk in Extreme Environments* (Kogan Page, 2008), a review of risk management practices in environments where life and death are at stake, and the possible applications of these practices in financial institutions. Recently he has extended his expertise in this domain, working with the World Economic Forum on a post-GFC project on *Rethinking Risk Management* by adopting best practices from extreme environments.

**Dr Mary McAlinden**, *Discipline Lead for Mathematics, Statistics and Operational Research, Higher Education Academy*

Upon completion of her PhD in Applied Mathematics and Theoretical Physics, Mary McAlinden spent a year working in France before returning to the UK to take up a research fellowship at Gonville and Caius College, Cambridge. Since then she has held lecturing positions in Mathematics, currently as a principal lecturer at Oxford Brookes University, where her roles have included that of curriculum manager for mathematical sciences.

In September 2011 Mary was seconded (0.8) to the Higher Education Academy (HEA) to take up the position of Discipline Lead for Mathematics, Statistics and Operational Research. She represents the HEA on national bodies including the Committee of the Heads of Departments of Mathematical Sciences, the Higher Education Service Area of the Institute of Mathematics and its Applications and the Joint Mathematical Council. Mary is the project lead for the HEA STEM project: Skills in Mathematics and Statistics in the Disciplines and Tackling Transition. She is a principal fellow of the Higher Education Academy.

**Professor Kevin McConway**, *Vice President for Academic Affairs, Royal Statistical Society; Professor of Applied Statistics, The Open University*

Kevin McConway is professor of Applied Statistics at the Open University. He has worked as an academic there since 1980, taking part in teaching and research projects in ecology, biology, health, business, economics and music as well as directly in statistics. Professor McConway has active interests in the way statistics is represented in the media. He has been the academic adviser on the BBC Radio 4 series *More or Less* (an Open University co-production) since 1995. His publication list includes *The Big Issue* and *New Scientist* as well as more conventional academic journals, and he regularly contributes to press briefings produced by the Science Media Centre. He studied mathematics at Cambridge, statistics at UCL, and psychology and business at the Open University, and previously worked at Westfield College, London and in local government in north-east England. Professor McConway has been the Royal Statistical Society's Vice-President for Academic Affairs since 2012.

**Professor Daniel Ralph**, *Director Centre for Risk Studies, and Professor Operations Research, Judge Business School, University of Cambridge*

Professor Danny Ralph is a founder and director of the Centre for Risk Studies, professor of Operations Research at Cambridge Judge Business School, and a fellow of Churchill College. Danny received his PhD in 1990 from the University of Wisconsin Madison. He was a faculty member of the Mathematics & Statistics Department at the University of Melbourne before coming to Cambridge University for a joint appointment in the Engineering Department and Cambridge Judge Business School. Danny's research interests include optimisation methods, equilibrium models for electricity markets, and risk in business decision making. He is editor-in-chief of *Mathematical Programming (Series B)*.

**Dr Emily Shuckburgh**, *Head of Open Oceans Project, British Antarctic Survey*

Emily Shuckburgh is a climate scientist based at the British Antarctic Survey. She leads the Open Oceans research group, which is focused on understanding the role of the polar oceans in the global climate system. Her research concerns investigating the dynamics of the atmosphere, oceans and climate using theoretical approaches, observational studies and numerical modelling.

She holds a number of positions at the University of Cambridge: a fellow of Darwin College, a member of the Faculty of Mathematics and a member of the Scientific Steering Committee of the Isaac Newton Institute for Mathematical Sciences, an associate of the Cambridge Centre for Climate Change Mitigation Research and an associate fellow of the Centre for Science and Policy. She is a fellow of the Royal Meteorological Society, chair of their Climate Science Communications Group and a former chair of their Scientific Publications Committee. She is also a trustee of the Campaign for Science and Engineering. She acts as an advisor to the UK government on behalf of the Natural Environment Research Council.

**Professor Bernard Silverman FRS**, *Chief Scientific Adviser, Home Office*

Bernard Silverman is chief scientific adviser to the Home Office. His undergraduate education was in Mathematics (Cambridge BA 1973, MMath 1974) and his postgraduate education and research (Cambridge PhD 1978) in Statistics. He has held senior academic posts at Bath, Bristol and Oxford, and has spent a substantial amount of time as a visitor at Stanford and various other US and European universities. He is a highly-cited researcher whose published work is centred on computational statistics, the understanding of new statistical methods made possible and necessary by constant increases in computational power. His work has ranged widely across theoretical and practical aspects of statistics, and Silverman has collaborated with researchers in many areas of medicine, social science, and life and physical sciences. He is a fellow of the Royal Society and was recently a member of the Royal Society's Council. He is a past president of the Royal Statistical Society and of the (US-based) Institute of

Mathematical Statistics. Before taking up his current post in April 2010, Silverman's work for government included membership of the GM Science Review Panel, a non-executive directorship of the Defence Analytical Services Agency, and chairmanship of a review panel for the project for the Sustainable Development of Heathrow. He has a substantial and broad record of providing statistical consultancy advice in many areas of industry and commerce as well as in financial and legal contexts. He is currently a member of the Arts and Humanities Research Council and of the Technology Strategy Board's Emerging Technologies and Industries Strategy Group.

**Chris Snowdon**, *Director Lifestyle Economics, Institute of Economic Affairs*

Christopher Snowdon is director of Lifestyle Economics at the Institute of Economic Affairs. His research focuses on lifestyle freedoms, prohibition and policy-based evidence. He is an occasional contributor to City AM and Spiked, and regularly appears on TV and radio discussing social and economic issues. Snowdon's work encompasses a diverse range of topics including 'sin taxes', state funding of charities, happiness economics, public health regulation, gambling and the black market. Recent publications include 'The Proof of the Pudding: Denmark's Fat Tax Fiasco', 'The Crack Cocaine of Gambling?', 'The Wages of Sin Taxes', 'Drinking in the Shadow Economy', 'Sock Puppets: How the government lobbies itself and why' and 'The Minimal Evidence for Minimum Pricing' (with John C. Duffy). He is also the author of *The Art of Suppression: Pleasure, Panic and Prohibition since 1800* (2011) and *The Spirit Level Delusion* (2010)

**Professor David Spiegelhalter OBE FRS**, *Winton Professor of the Public Understanding of Risk, University of Cambridge*

David Spiegelhalter is Winton Professor for the Public Understanding of Risk, and professor of biostatistics, at the University of Cambridge. His background is in medical statistics, particularly the use of Bayesian methods in clinical trials, health technology assessment and drug safety. He leads a small team (UnderstandingUncertainty.org) that attempts to improve the way in which the quantitative aspects of risk and uncertainty are discussed in society. He works closely with the Millennium Mathematics Project in Cambridge in trying to develop an exciting treatment of probability and risk for mathematics education. He gives many presentations to schools and others, advises organisations and government agencies on risk communication, and is a regular commentator on current risk issues. He presented the BBC4 documentary *Tails you Win: the Science of Chance*. He has over 190 refereed publications and is co-author of six textbooks, as well as *The Norm Chronicles* (with Michael Blastland). He is an honorary fellow of the Institute for Risk Management, an honorary fellow of the Royal College of Physicians, was elected fellow of the Royal Society in 2005 and awarded an OBE in 2006 for services to medical statistics.

**Professor Ian White FEng**, *Van Eck Professor of Engineering, and Master, Jesus College, Cambridge*

Professor White is Van Eck Professor of Engineering, and the master of Jesus College, Cambridge. He is also head of photonics research in the Electrical Division in Engineering, and chair of the Rustat Conferences. Ian White began his time at Cambridge by being awarded the BA in 1980, and the PhD in 1984. After being appointed a research fellow and assistant lecturer at Cambridge, he moved to the University of Bath to become professor of physics in 1990. In 1996, Professor White moved to the University of Bristol, becoming head of the Department of Electrical and Electronic Engineering in 1998. He returned to Cambridge in October 2001 as Van Eck Professor of Engineering. Professor White's current

research interests are in the area of high speed communication systems, optical datacommunications, laser diodes for communications and engineering applications and RF over fibre systems.

**Professor Anna Vignoles**, *Professor of Education at the University of Cambridge.*

Anna Vignoles is professor of Education at the University of Cambridge. She has published widely on the impact of school resources on pupil achievement and on the socio-economic gap in pupil achievement. Her research interests include issues pertaining to equity in education, school choice, school efficiency and finance, and the economic value of schooling. Anna is a research fellow at the Institute for Fiscal Studies and a visiting professor at the Institute of Education. She has advised numerous government departments, including the Department for Education, the Department of Business, Innovation and Skills, and HM Treasury. She provided advice to the Browne Review of Higher Education Funding, the House of Commons Education and Skills Committee investigation of higher education funding, the House of Lords Economic Affairs Select Committee, as part of their inquiry into education and training opportunities for young people, and Lord Leitch's Review of Skills. Anna is also the economist member of the NHS Pay Review Body.

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RUSTAT CONFERENCES

JESUS COLLEGE, CAMBRIDGE

## The Use and Misuse of Risk and Statistics

### Participants List

<b>Rt Hon Sir Tony Baldry</b>	<i>Member of Parliament for Banbury</i>	<i>House of Commons</i>
<b>Professor Kevin Bales</b>	<i>Professor of Contemporary Slavery</i>	<i>Wilberforce Institute, University of Hull</i>
<b>Professor Sheila Bird OBE FRSE FRSS</b>	<i>Programme Leader, MRC Biostatistics Unit</i>	<i>University of Cambridge</i>
<b>Michael Blastland</b>	<i>Journalist; Author, “The Tiger That Isn’t” ; and “The Norm Chronicles”</i>	<i>Creator of BBC Radio 4 programme More or Less</i>
<b>Simon Briscoe</b>	<i>Author, Britain in Numbers; Adviser on statistics</i>	<i>House of Commons, Public Administration Committee</i>
<b>John Cornwell</b>	<i>Director, Science &amp; Human Dimension Programme, Jesus College, Cambridge</i>	<i>Rustat Conferences, Jesus College Cambridge</i>
<b>Dominic Cummings</b>	<i>Former Special Adviser</i>	<i>Department for Education</i>
<b>Professor George Davey- Smith FRSA</b>	<i>Professor of Clinical Epidemiology</i>	<i>University of Bristol</i>
<b>Professor Michael Dempster</b>	<i>Professor Emeritus, Centre for Financial Research, Statistical Laboratory</i>	<i>University of Cambridge</i>
<b>George de Courcy-Wheeler</b>	<i>Director</i>	<i>Lord North Street Ltd</i>
<b>Liz Dixon-Smith</b>	<i>Advisor, Financial Stability Group</i>	<i>Bank of England</i>
<b>Andrew Freeman</b>	<i>Director, The Finance Foundation; Risk Fellow, Centre for Risk Studies</i>	<i>Judge Business School, University of Cambridge</i>

<b>David Goodhart</b>	<i>Director</i>	<i>Demos</i>
<b>Professor Mark Haggard</b>	<i>Senior Visiting Researcher</i>	<i>Department of Psychology, University of Cambridge</i>
<b>Nigel Hawkes</b>	<i>former Director; former Health Editor</i>	<i>Straight Statistics; The Times</i>
<b>Dr Tudor Jenkins</b>	<i>Director</i>	<i>Wide Eyed Vision</i>
<b>Peter Kellner</b>	<i>President</i>	<i>YouGov</i>
<b>Dr James Lefanu</b>	<i>Doctor; Journalist</i>	<i>The Daily Telegraph</i>
<b>Paul Lewis</b>	<i>Editor</i>	<i>Profile Books / Economist Books</i>
<b>Terry Macalister</b>	<i>Energy Editor</i>	<i>The Guardian</i>
<b>Professor Robert Mair CBE FRS FICE FrEng</b>	<i>Sir Kirby Laing Professor of Civil Engineering, and Head of Civil and Environmental Engineering</i>	<i>University of Cambridge</i>
<b>Duncan Martin</b>	<i>Partner and MD</i>	<i>Boston Consulting Group</i>
<b>Dr Mary McAlinden</b>	<i>Discipline Lead for Mathematics, Statistics and Operational Research</i>	<i>Higher Education Academy</i>
<b>Professor Kevin McConway</b>	<i>Vice President for Academic Affairs, Royal Statistical Society, and Professor of Applied Statistics, Department of Mathematics and Statistics</i>	<i>Open University</i>
<b>Dr Elena Medova</b>	<i>Centre for Financial Research</i>	<i>University of Cambridge</i>
<b>Will Moy</b>	<i>Director</i>	<i>Full Fact</i>
<b>Dr Roger Porkess</b>	<i>CEO</i>	<i>Maths in Education and Industry (MEI)</i>
<b>Professor Daniel Ralph</b>	<i>Director, Centre for Risk Studies; Professor of Operations Research</i>	<i>Judge Business School, University of Cambridge</i>
<b>Katherine Richards</b>	<i>Senior Lecturer</i>	<i>RSS Centre for Statistical Education, Plymouth Institute of Education</i>
<b>Dr Elisabeth Schimpfoessl</b>	<i>Sociologist</i>	<i>University of Westminster</i>

<b>Dr Simone Schnall</b>	<i>Fellow; Director of Studies, Psychology</i>	<i>Jesus College Cambridge</i>
<b>Dr Emily Shuckburgh</b>	<i>Head of Open Oceans Project</i>	<i>British Antarctic Survey (BAS)</i>
<b>Dr Stephen Siklos</b>	<i>Fellow; University Lecturer, Mathematics</i>	<i>Jesus College Cambridge</i>
<b>Professor Bernard Silverman FRS</b>	<i>Chief Scientific Adviser</i>	<i>Home Office</i>
<b>Chris Smyth</b>	<i>Health Correspondent</i>	<i>The Times</i>
<b>Chris Snowdon</b>	<i>Director of Lifestyle Economics</i>	<i>Institute of Economic Affairs</i>
<b>Professor David Speigelhalter OBE FRS</b>	<i>Winton Professor of the Public Understanding of Risk; author of the Norm Chronicles</i>	<i>University of Cambridge</i>
<b>Dr Findlay Stark</b>	<i>Fellow; Director of Studies, Law</i>	<i>Jesus College Cambridge</i>
<b>Professor Mervyn Stone</b>	<i>Emeritus Professor of Statistics</i>	<i>University College London</i>
<b>Dr Mina Toksoz</b>	<i>Author, Economist Guide to Country Risk</i>	
<b>Olivia Varley-Winter</b>	<i>Policy and Research Manager</i>	<i>Royal Society of Statistics (RSS)</i>
<b>Professor Anna Vignoles</b>	<i>Professor of Education</i>	<i>University of Cambridge</i>
<b>Professor Ian White FREng</b>	<i>Master, Jesus College, Chair, Rustat Conferences; Van Eck Professor of Engineering</i>	<i>University of Cambridge</i>
<b>Professor Peter Williamson</b>	<i>Professor of International Management</i>	<i>Judge Business School, University of Cambridge</i>
<b>Dr Michael Waibel</b>	<i>Fellow; University Lecturer, Law</i>	<i>Jesus College Cambridge</i>
<b>Sharon Witherspoon MBE</b>	<i>Director</i>	<i>Nuffield Foundation</i>

***Rustat Conferences***

<b><i>Nathan Brooker</i></b>	<i>FT Journalist; Conference Rapporteur, Rustat Conferences</i>	<i>Jesus College, Cambridge</i>
<b><i>Jonathan S. Cornwell</i></b>	<i>Media Symposia ; and Rustat Conferences</i>	<i>Jesus College, Cambridge</i>
<b><i>Dr Laura Keynes</i></b>	<i>Rustat Conferences</i>	<i>Jesus College, Cambridge</i>



## Rustat Conferences Jesus College, Cambridge

The Rustat Conferences are an initiative of Jesus College, Cambridge, and chaired by Professor Ian White FEng, Master of Jesus College. The Rustat Conferences provide an opportunity for decision-makers from the frontlines of politics, the civil service, business, the professions, the media, and education to exchange views on the vital issues of the day with leading academics. Since its founding in 2009, Rustat Conferences have covered a variety of themes including: *The Economic Crisis; The Future of Democracy; Cyber Security; Manufacturing in the UK; The Future of Research-Intensive Universities; The Geopolitics of Oil and Energy; Drugs Policy; Organisational Change in the Economic Crisis.*

The format of the Rustat Conferences is a round-table discussion: expert speakers set the framework for each session by a brief exposition of points followed by a moderated discussion.

Previous participants include: Lord Rees, *Astronomer Royal, former Master of Trinity College, Cambridge, and former president of the Royal Society*; Sir Terry Leahy, *CEO, Tesco*; Baroness Pauline Neville Jones, *UK Government Special Representative to Industry on Cyber Security*; Adam Wethered, *Director, Lord North Street Ltd*; Sir Kevin Tebbit, *Chairman, Finmeccanica UK*; Paul Skinner, *Chairman, Infrastructure UK, and former Chair, Rio Tinto*; Professor Bernard Silverman, *Chief Scientific Adviser, Home Office*; Jon Moynihan, *Executive Chairman, PA Consulting Group*; Lord Turnbull, *former Cabinet Secretary and Head of UK Civil Service*; Dr John Jenkins, *HM Ambassador to Iraq*; Sir Samuel Brittan, *Financial Times*; Sir Richard Dearlove, *former Chief, Secret Intelligence Service MI6*; Sally Keeble MP, *Treasury Select Committee*; Baroness Onora O'Neill, *former President, British Academy*; Jonathan Neale, *Managing Director, McLaren Racing*; Dominic Casserley, *Managing Partner, McKinsey & Co. UK & EMEA*; Simon Hayes, *Chief Economist, Barclays Capital*; Chris Saul, *Senior Partner, Slaughter and May*; David Strachan, *Director, Financial Stability, FSA*; Lord Eatwell, *Professor of Financial Policy, University of Cambridge*; Lord Wilson, *former Cabinet Secretary and Master, Emmanuel College, Cambridge*; John Harley, *Head of Private Equity, Ernst & Young*; Will Hutton, *The Work Foundation*; Tony Wright MP; Peter Kellner, *President, YouGov*; Matthew Taylor, *CEO, RSA, former Chief Adviser on Strategy to the Prime Minister*; Robert Chote, *Director of Institute for Fiscal Studies*; Lord Gus Macdonald, *Senior Adviser Macquarie Infrastructure and former Minister Cabinet Office*; Professor Sir David Omand, *former Director GCHQ*; Dr Richard Bridge, *Head of Government Political Affairs, BP.*

In addition to acting as a forum for the exchange of views on a range of major and global concerns, the Rustat Conferences provide outreach to a wider professional, academic, student and alumni audience through the publication of reports. The conferences are held at Jesus College, Cambridge and are named after Tobias Rustat (d.1694), an important benefactor of Jesus College and the University. Tobias Rustat is best remembered for creating the first fund for the purchase of books for the Cambridge University Library. The Rustat Conferences are supported through sponsorship and the Rustat Conferences Membership scheme - we are grateful to members Lord North Street Ltd and David and Maria Willetts for their support.





## The Use and Misuse of Statistics – 4 March 2014 - Jesus College, Cambridge

### Executive Summary

Risk and statistics have been greatly misunderstood in the past. Once side-lined by schools and universities and considered 'softer' alternatives to pure mathematics, risk, statistics, and the interpretation of data have, in recent years, become respected fields of study in their own right. But more needs to be done. Whether that involves tailoring classes, study courses or MOOCs in critical thinking or generally improving the numeracy of the public, greater emphasis needs to be placed on equipping people with the tools to better utilise statistics and assess risk in their day-to-day lives.

The Rustat Conference on the Use and Misuse of Statistics, by bringing together leaders who would not usually meet from the worlds of business, academia, government and the media, attempted to determine how risk and statistics could be used to benefit the economy, protect public health and wellbeing, appraise and communicate climate change and be marshalled fairly in the press.

The following summarises the main outcomes of the meeting set out in response to key questions raised during the day:

1. **What fields are affected by risk?** A major problem with boosting the public understanding of risk is getting to grips with what it is and how and where it can be applied. The problem is further aggravated by the fact that some sectors – finance, public health and climate change included, though there are many more – often appropriate the study for themselves. Put simply, there is a sense that what representatives from those fields do *is* risk, rather than simply being an application of it. A consensus was reached that the transferrable nature of statistical understanding meant that new light could be shed on one application of risk, from the study of it elsewhere. That, for example, results taken from risk-based experiments in the social sciences, could impact on the understanding of climate change and the ability of climate change scientists to better communicate their message.
2. **How do we evaluate risk?** Risk is non-intuitional, and as a result is constantly under- and overestimated by the public at large. Tools for evaluating risk are tailored to their respective fields, falling in and out of favour over time. In the financial sector, for example, before the crash, the VaR tool for evaluating risk was common, after the crash, the stress test has become more popular. Though this shift was welcomed by the plenary, there was a consensus on the fact that no model for calculating risk is without its drawbacks. Though models can and should be refined constantly, the perfect model is unattainable. Many in the meeting echoed the maxim: All models are wrong, but some are useful.
3. **How do we communicate risk?** A series of challenges were cited as pertinent to the discussion:

a. The language used: Once risk has been evaluated, the language used in the communication of the subsequent advice is crucial, yet difficult to determine. Because all risk modes inherently factor in uncertainties, too conclusive a report can be disingenuous. The last government had a poster campaign on climate change recalled by the Advertising Standards Agency because the language described catastrophic effects of climate change as certainties. The posters said certain deleterious outcomes 'would' happen, rather than 'could' happen. There was little consensus among the delegates as to whether such causes required language designed to convince, or language designed to be neutral.

b. Negotiating bias: this discussion was structured as follows –

(i) **Political bias** – Statistics are often used for political gain. When this happens, the integrity of the data and the message needs to be pulled into question. The plenary reached the consensus that statistics should not be used as weapons, as this can negatively affect the perception of the field in general. Nevertheless, they frequently are. Some speakers discussed the impossibility of a neutral approach to statistics where political bias is concerned. Studies show people are more likely to question the validity of, and ultimately disregard, statistics not in accordance with their views. With that in mind, some delegates asked if it was even worth putting out 'better' data on some given subjects, as they scarcely inform the argument. The majority of the plenary thought that, despite the probability of failure, it was always worth the effort to publish improved data.

(ii) **The 'narrativisation' of statistics** – Newspapers want to publish stories, so how a statistic can inform a story is crucial to the likelihood of that research being picked up and reaching a wider audience. Because journalists are under more strain than ever before – being understaffed and under-resourced – a full and detailed critical analysis of some data is often impossible. Instead journalists rely on claims made in a report's abstract or, more likely, in the press release that they are sent accompanying the research. No firm consensus was reached over who was to blame, the journalists or the people sending the research. Some argued that charities were the worst offenders for disseminating misleading statistics.

(iii) **Inculcating critical appraisal** – Others questioned the level of critical appraisal that journalists conduct when researching a story. Though certain agencies have been set up by media providers and other interested third parties to better police the use of statistics, incorrect or misleading data still frequently reach the public, informing (or misinforming) key debates.

4. **How do we deal with an uneven level of understanding?** The financial sector has long had a tradition of selling products like derivatives to companies based on a fundamental mismatch in their understanding of risk. A board member might invest some of his or her company's assets into OTC derivatives that, though they may provide short-term gains (or sweeteners), in the long term will always lose money. The plenary was divided on whether this came about through a poor understanding of risk on the part of the company executive or, conversely, a good understanding

on the realities of the situation – that when the long swap starts losing money years down the line, they will already have retired or moved on to another company. The plenary agreed that the practice was unethical. Some mentioned that, since the crash, rules as to who can buy certain financial products are changing. Regulation currently being brought in states that who constitutes ‘a responsible adult’ in these situations (i.e. a person capable of making the trade) will change, helping to alleviate the disparity in understanding between the two parties. The plenary all agreed that the practice of selling sweeteners should be outlawed.

5. **How do we better teach risk and statistics?** A series of challenges were cited as pertinent to the discussion:

a. The classification of statistics

For too long statistics has been seen as a branch of mathematics. Though the interpretation of data requires a high level of numeracy, the interpretive element distances the study from pure mathematics. The plenary were almost in consensus when it was suggested that science is the true root of statistics.

b. Dealing with the gap between schools and universities

Many students encounter statistics as an elemental part of their higher education course. They have not chosen to study statistics, but are required to do so as part of a degree in the social or physical sciences. As a result, many students – who may have neglected to study maths at further education – feel anxious about their level of numeracy. The plenary agreed that more should be done to bridge the gap between schools and universities in this regard, and that the onus sits largely with universities, who could do more to enter into dialogue with schools and better explain what their course requirements were.

c. The inclusion at A level of ‘Core Maths’

No consensus was reached as to whether the introduction of a ‘core maths’ A level for students with an A-C grade at maths GCSE but who were not taking further mathematics was a benefit to the study of risk and statistics. Though many applauded the more applied aspects of the course – there is an emphasis on critically appraising statistics in the media, for example – some thought it unwise to bring in an A level that could be seen as a soft option. How university admissions tutors would respond to the new course is yet to be seen.

d. Teaching risk to ‘outsiders’

No consensus was reached as to the best way to engage members of the wider public with risk and statistics. Some suggested the development of MOOCs (Massive Open Online Courses) would be effective, though these would need to be pitched at the right level. Others disagreed, saying that the real challenge was to engage people outside of academia and business. This could best be done by not framing statistics as a numerical exercise at all, but as an aspect of critical thinking.

## The Understanding and Misunderstanding of Risk and Statistics

### Keynote and Conference Overview

Introduction and Chair: Professor Bernard Silverman, *Chief Scientific Adviser, Home Office*

Speaker: Professor David Spiegelhalter, *Winton Professor of the Public Understanding of Risk, University of Cambridge*

In his introduction, **Professor Bernard Silverman** spoke about the changing reputation of statistics. When he was a student it had been thought of as something someone took if he or she were not good enough at pure maths. There was a joke, he remembered, that has since been rendered obsolete by the change in its reputation:

“If you need statistics to understand your data, you should collect more data.”

As for risk, Professor Silverman said he was relieved we are now approaching an understanding of what it is and how it is useful. He then invited Professor Spiegelhalter to deliver the keynote address, and highlight the different facets of risk and who or what they affect, helping in essence, to set some of the agenda for the day’s proceedings.

**Professor David Spiegelhalter** said that people often appropriate the understanding of risk to their own fields. “Different people,” he said, “have different ideas of what risk is.” Representatives from the worlds of finance, government, natural disasters and climate change have, on occasions, told him: “Well, you must know about [my] subject because this *is* risk.”

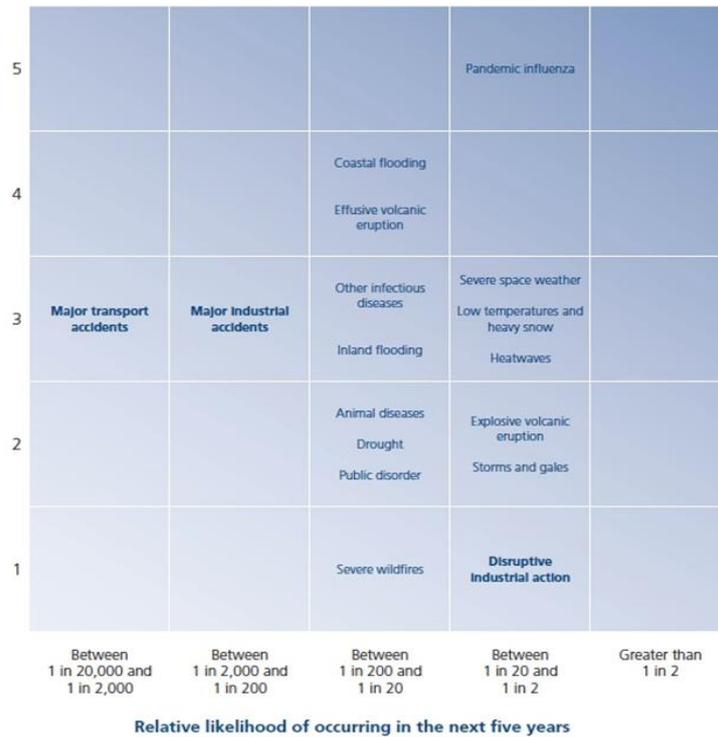
Risk is a huge range of different things, he said. The only definition he was prepared to offer was the following:

“Risk is anything to do with a situation in which you don’t know what is going to happen and it may turn out badly or it may turn out well – which of course covers absolutely everything in the whole of life. So, in that respect, risk is everything.”

Professor Spiegelhalter then showed his first slide on risk assessment, displaying the ‘Risk Matrix’ from the UK National Risk Register

# Risk Assessment

Figure 2: Other risks



This is “the scientific end” of risk, he said. It is an approach which looks for evidence of events that might occur and for the probability of those events occurring. However, referencing the financial crash as just one example, Professor Spiegelhalter said: “We have to be very cautious and humble with our use of risk models.” He then quoted the late statistician George EP Box:

“All models are wrong, but some are useful.”

Professor Spiegelhalter said he admired agencies like the IPCC who are attempting to produce a scale of confidence in their scientific findings. So, sometimes they might publish probability data and sometimes, when they do not feel confident in their evidence, they might not publish probabilities.

The professor then spoke about risk perception and the difficulties in communicating risk. Because humans are not ‘rational’ weighers of evidence, how they might feel about a certain outcome happening, and whether they trust the bodies involved, is a major part of risk communication. “It is about more than telling,” he said, “it is about listening, engaging and creating a two-way dialogue.” A failure to understand this is evident in the style of some government communications, he added, which despite much best-practice advice to the contrary, still appear to be based on a “decide, announce, defend” policy, rather than having a more nuanced approach

Professor Spiegelhalter then showed the following slide to illustrate the relationship between risk and the media:

## Risk and the media



It is easy to see the dilemma journalists are faced with: “Newspapers need to present narratives,” he said, so it is understandable that sometimes the complexity of a piece of risk analysis research can get lost in the published article. “If you think of the probability of a thing happening as a fraction, a numerator and denominator,” he said, “then the media only care about the numerator. They don’t care about how many it times it didn’t happen. And that’s their job; they’re there to sell stories.”

Since taking on his professorship, Spiegelhalter said his respect for journalists has increased. “The people I have less respect for are the people who send press releases to [journalists], particularly charities, who are often the worse culprits when it comes to the misuse of statistics, with scientific journals not far behind them.”

Professor Spiegelhalter said he hoped the conference would be the correct forum to discuss how risk and statistics are taught in schools and at university. He predicted the formulation of Core Maths, a new subject available at sixth-form that will feature statistics and be for students with a GCSE grade C or above who are not taking Maths A Level, will play a large part in such discussions.

## Challenges of Understanding Statistics and Risk – Public Health Session One

Chair: Professor Bernard Silverman, *Chief Scientific Adviser, Home Office*

Speaker: Professor George Davey-Smith, *Professor of Epidemiology, University of Bristol*

Speaker: Professor Sheila Bird, *Programme Leader, MRC Biostatistics Unit, University of Cambridge*

Speaker: Rt Hon Sir Tony Baldry MP, *Member of Parliament for Banbury, former Minister of State in the Ministry of Agriculture, Fisheries and Food*

With regards to the connection between statistics and public health, **Professor Bernard Silverman** said that it was his view that “In the 19<sup>th</sup> century more lives were saved by statistics than by medicine.”

**Professor George Davey-Smith** said his presentation would deal, essentially, with the limitations of individual risk prediction with regard to epidemiological data. “The idea that we can personalise to the individual therapeutic interventions [to disease] is very much the order of the day.”

But how well we can predict personal risk is up for debate. Professor Davey-Smith displayed the following slide and said that, despite the quotation being made 40 years ago, it might have been made today for all the advancements made in the field since:

### Mis-specifying individual risk of ischaemic heart disease: what to do?

“.. within any risk group, prediction is poor; it is not at present possible to express individual risk more precisely than as about a 1 in 6 chance of a hitherto healthy man developing clinical IHD in the next 5 years if he is at high risk” .... “There is a pressing need for prospective observational studies in which new risk factors are identified”

Meade TW, Chakrabarti R. Arterial disease research: observation or intervention? *Lancet* 1972;ii:913-6



The observation was met by a feeling of ‘must-do-better’, he said, so a great escalation in the study of risk factors followed. This has led to the phenomenon that we have today where many factors are cited as causal in the media:



Another problem with predicting individual risk is the so-called 'black swan' story:



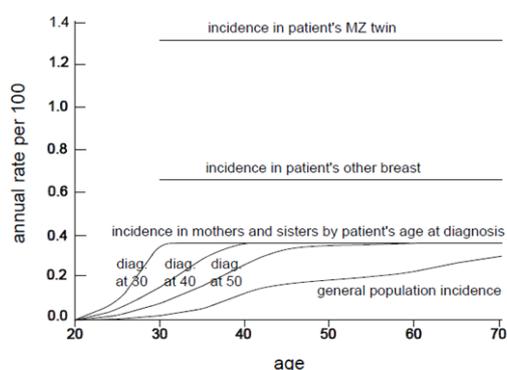
From: Davey Smith G, "Epidemiology, epigenetics and the gloomy prospect", Int J Epidemiol 2011

Professor Davey-Smith then listed four reasons for the limited ability to predict phenotypic variation (e.g. in the risk of disease):

- Quantitative genetic analyses: the predominance of the “non-shared environment”<sup>1</sup>
- Increasing evidence that much of the “non-shared environment” component is stochastic
- Substantial evidence that a major component of phenotypic variance is stochastic in clonal organisms
- Including in human clones (i.e. identical twins)<sup>2</sup>

With regard to the fourth reason, Professor Davey-Smith showed the following graph:

### The suggested pattern of breast cancer incidence in patients' relatives and the general population



Peto J, Mack TM. High constant incidence in twins and other relatives of women with breast cancer. *Nature* 2000; 26: 411-414.



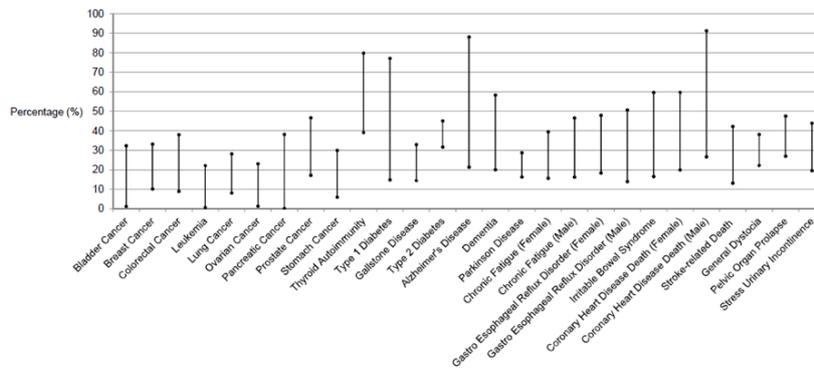
The above data show families with a high-risk of breast cancer (i.e. where families have one person who develops the disease under 30). If you look at the other females in that family, risk is higher than the population at large. But the really dramatic thing is, if one of those females happens to be a monozygotic twin their risk is about twice the risk of the original female developing a second primary cancer in the other breast. It is rather difficult to think of any risk factor that affects one breast over another – both of which have the same experience of environmental and genetic risk factors – then the ability to predict risk becomes hard to quantify.

“These data have been known for years,” he said, “but they have been forgotten because they are inconvenient.”

<sup>1</sup> Rather than shared genetics or the shared environment. Typically, it breaks down to about 40 per cent due to genetics, the shared environment is a small contributor and the non-shared accounts for the rest

So, though it is difficult to predict risk in the individual – even MZ twins – predicting risk in the wider population is much easier.

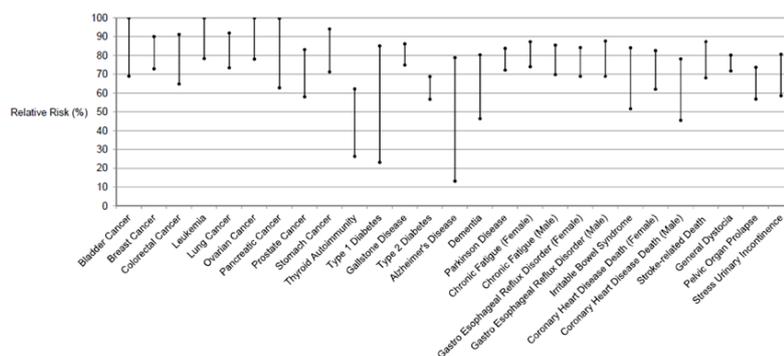
## The fraction of cases (patients with disease) who would test positive by whole genome sequencing



Roberts NJ. The predictive capacity of personal genome sequencing. Science Translational Medicine 2012; doi: 10.1126/scitranslmed.3003380



## Relative risk of disease in individuals testing negative by whole-genome sequencing.



Roberts NJ et al. The predictive capacity of personal genome sequencing. Science Translational Medicine 2012; doi: 10.1126/scitranslmed.3003380



In lung cancer studies for example, in cohort studies of individuals the pseudo-variance (i.e. the estimate of variance for a dichotomous outcome) explained by predictors is 5-10 per cent at best. But at population level the risk is much better understood. Studies show that in the US, 93 per cent of variance

in disease risk over time is explained by smoking, and that smoking accounts for nearly all the difference in lung cancer rates between US states, as it does across countries.

By way of analogy, Professor Davey-Smith suggested the incidence of earthquakes. “We know where earthquakes are likely to happen, and have a strong idea of where earthquake bands are across the globe. However, within those bands, predicting the occurrence of any one earthquake is very difficult indeed.”

**Professor Sheila Bird** spoke about risk and statistics associated with variant CJD. “We have fewer than 200 cases of variant CJD in the UK,” she said, “but what I want to talk about today is that though assumptions can be wrong, the models based on those assumptions may nevertheless be useful.”

BSE was first announced in 1986, with slaughter compensation and a feed ban being introduced two years later. In 1989, the Specified Bovine Offals Legislation was introduced because brain, spinal cord and dorsal root ganglion were the tissues with the highest rate of infectivity. But what did not happen was any serious inspection at abattoirs, and so not until December 1995 was a full-scale ban on mechanically recovered meat introduced. The next year came the announcement in parliament of 10 cases of variant CJD, a new strain of the disease which seemed to affect people at a much younger age than classical CJD (around 26-27 as opposed to over 60).

Perhaps the most drastic measure taken, however, was made in April 1996, the decision was taken that any cattle over the age of 30 months would be admitted neither to the food chain nor the feed chain, and instead be slaughtered and destroyed .

The first major paper on the subject was published in Nature in August 1996 by Roy Anderson, Christian Donnelly and colleagues and was entitled: Transmission dynamics & epidemiology of BSE in British Cattle. “They made a whole range of assumptions – one of which, that mean BSE incubation period was 5 years was correct – most of the others (such as dam to calf being the only residual route of BSE transmission; or BSE-infected [not affected] cattle having the same survival characteristics as uninfected cattle) were wrong. However, the model was very important.”

Professor Bird then showed the following slide, breaking down vCJD cases into birth cohorts:

### SEAC vs UK dietary exposure to BSE: infectivity from beef MRM & head meat

(Cooper & Bird, 1999-2003; gender & **birth-cohort** ⇔  
age-susceptibility to clinical progression of dietary BSE)

Birth-cohort	vCJD cases to . . .	Median infectivity: Bo ID50s (5 <sup>th</sup> , 95 <sup>th</sup> percentile)	
		1980-1989	1990-1996
Post-1969	64	83,150 (80K-87K)	188,200 (183K-193K)
1940-1969	47	161,900 (156K-168K)	190,600 (187K-194K)
Pre-1940	1	39,300 (37K-44K)	47,200 (45K-50K)

“The data show that there has to be an age-dependent susceptibility to the progression from dietary BSE exposure through to clinical disease. And so if you’re exposed young, it is much more likely for that exposure to lead to clinical disease, rather than if you’re exposed later in life.”

Professor Bird then showed the following slide, detailing two cases of blood-borne vCJD transmission, one subclinical:

## Blood-borne vCJD transmission

**Dec 03: vCJD-blood-recipient, MM, male, born pre-1940**  
 Donation = March 96, donor’s vCJD onset = 1999  
 Recipient’s vCJD onset = autumn 2002 [6.5 yrs]  
 Recipient’s death (undiagnosed, but **PM**) = autumn 2003.

**July 04: sub-clinical vCJD-blood-recipient, MV, female, born pre-1940, spleen +ve**  
 Donation = ? mid 99, donor’s vCJD onset = late 2000  
 Recipient’s vCJD onset = **not applicable**  
 Recipient’s **PM**-detected sub-clinical vCJD = July 2004.

From the above, scientists knew that vCJD is indeed blood-borne, (as had been anticipated from animal experiments). Genotype matters but, as yet, no blood test was available for detection of the abnormal prion protein. Research ethics permission was then sought and granted to carry out widespread no-names post-mortem testing – an approach latterly scaled back to consist of testing for the abnormal prion in human appendices. From that testing, the following data were produced.

## Human surveillance in appendices for abnormal prion: UK studies

Birth Cohort	Hilton Study 1995-99	National Appendix Survey 2009-12	Sum of UK appendix studies	Abnormal prion positive rate per million [95% CI]
Pre-1940	nil	nil	***	***
<b>1941-60</b>	0/ 573	6/ 8181 <b>3MM+1MV+2VV</b>	<b>6/ 8754</b>	<b>685</b> [250-1490]
<b>1961-85</b>	3/10278 <b>Two VV One untested</b>	10/24260 <b>5MM+3MV+2VV</b>	<b>13/34538</b>	<b>380</b> [200- 640]
1986+	0/ 396	nil	***	<b>RATE ratio = 1.8</b> [0.5 to 4.5]

Despite wide confidence intervals, the central subclinical carriage rates – higher for the older birth-cohort - were consistent with Bird's prior expectation based on UK's dietary BSE exposures. Importantly, positive cases were found for all genotypes – VV; MM and heterozygote – but disproportionately among homozygotes. The way forward was debatable. Bird's clear preference was for iii) & iv):

## Human surveillance in appendices for abnormal prion: UK studies

### What next?

#### Health Protection England plans to test

- i) 20,000 appendices removed prior to 1980
- ii) 20,000 appendices from those born after 1996.

#### Science & Technology Inquiry recommends

- iii) Research funding for **"surveillance" blood-test** ?
- iv) Extra 40,000 (at least) appendices to be tested in older birth-cohort; and 30,000 in the younger?

*However, we need 100,000 tested per birth-cohort for 50% power to discern prevalence ratio of 1.5 for older: younger birth-cohort . . .*

Professor Bird closed by saying that, for there to be any reliable data on the subject – or indeed for any incredibly rare disease – enormous samples need to be taken.

**Sir Tony Baldry MP** said there were two main concerns for politicians with regards to risk: firstly, how they evaluate it; and secondly, how they communicate it.

"The machinery of government has been quite clever over the years in developing ways to share risk," he said. So during the privatisation of Royal Mail, for example, a range of different consultants were brought in to advise on the best price to sell the shares at. "That way when a minister is challenged at the dispatch box, he can say that he has taken advice from various experts."

Where this system falters is when those consultants are unsure of the situation themselves and so find it difficult to advise confidently.

Where risk sharing becomes even more difficult is during acute public health crises, such as with CJD. "In those situations," Sir Tony said, "you can do little more than accept the best advice given to you by the chief medical officer and the chief veterinary officer [...] in those situations the minister is effectively put in the position of explaining the scientific evidence provided by those advisers to the House of Commons."

Real problems arise when a minister deviates from official advice - such as in the cases of John Gummer and Edwina Currie.

With regards to communicating risk, Sir Tony said: “Imagine you’re on the Today Programme with John Humphrys interviewing you. You probably have just three soundbites [to get your message across]”

Further to the point, he said, you are not given the time freely to communicate the science “because that doesn’t make for interesting television and radio.” Instead, culpability, mechanics and costs are three aspects that dominate the conversation.

With regards to certain public health scares such as CJD and HIV/AIDS, Sir Tony said that because 1000s of people did not die – as was feared – then ministers in the future will have a harder time proving the severity of crises.

## **Discussion**

The first participants to speak asked about the public money spent on protecting people from a flu pandemic that has never happened. Professor Davey-Smith said that certain health scares have heightened the suspicion of the public because it has transpired later that the public servants issuing the warnings had financial ties to the drugs companies who stood to gain.

One participant said that epidemiological and medical journals have to shoulder some of the blame for the sensationalist ‘scare’ stories that are published in the mainstream press. He said that ‘a common sense approach’ should be taken to new studies that seem to implicate one or other foodstuff/lifestyle choice with serious disease.<sup>3</sup>

He also blamed the popularity of the cardio-vascular risk algorithm to the over-medication of over-75s in this country. “The average amount of medications any member of my surgery is on who is over 75 is seven, which is around 20 pills a day.”

Another participant questioned whether the government should try to distinguish between the risk of a disaster that is genuinely random or unpredictable, and the risk of a disaster that has occurred through some sort of human error.

Sir Tony Baldry said that he thought the electorate expect politicians to be “omniscient and omnipotent”. “The truth of the matter is,” he said, “when you’re on Newsnight, if I started to plead that this was the sort of risk that was random and non-predictable rather than predicted risk, then I wouldn’t last very long.”

Other participants rose questions about the quality of journalism, questioning Professor Spiegelhalter’s remark that his respect for journalists since taking on his professorship has increased. “Surely it’s not that hard,” said a delegate, “even if you’re [working] on the Today Programme to shape the message or to dissect the information you’re being presented with in a clinical, sceptical manner? Journalists are far too credulous.”

Professor Spiegelhalter said that journalists could scrutinise more, but stood by his remark by saying that they are bombarded with “second rate epidemiology and it is incredibly hard for them to wade through this nonsense.”

He also added that the critical portion of some media outlets is getting stronger. Organisations like Full Fact, The Statistics Authority or Fact check on Channel Four are improving the levels of scrutiny in the British media.

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<sup>3</sup> The example the participant gave was to the supposed increase risk of cancer from eating bacon. “Processed meat to blame for 1-in-30 deaths” was a headline for a recent edition of the Daily Mail

## Data, Risk and the Global Slavery Index

### Session Two

Chair: Chris Snowdon, *Director Lifestyle Economics, Institute of Economic Affairs*

Speaker: Professor Kevin Bales, *Professor of Contemporary Slavery, Wilberforce Institute, University of Hull*

**Chris Snowdon** quoted film director Steve McQueen who said, when he collected the Best Picture Academy Award for *12 Years a Slave* some 24 hours before the conference: “There are 21 million slaves still in the world.” Mr Snowdon added that, during a conversation with Professor Bales earlier, the professor had told him this figure was a considerable underestimate.

“That figure of 21 million was issued by the ILO<sup>4</sup>,” said **Professor Bales**, “but that figure is subject to interference from one or two governments who would not allow the full extent of the slavery problem in their country to be published in the report [...] It is a suppressed figure.”<sup>5</sup>

For most people, the idea of contemporary slavery and the risk of being enslaved is a new idea, and in many respects it is a new science. “Work in this zone – particularly statistical work – is just beginning.”

Compared to a global population of 7bn, the amount slaves is an incredibly small fraction, likewise of the trillions and trillions of USD in the global economy, the \$40-50bn represented by slavery is vanishingly small. While many campaigners and charities say things like “Slavery is very important to us because it affects everything we buy”, to Professor Bales and his team, that simply does not ring true. “If we were to eradicate slavery instantaneously over-night,” he said, “you wouldn’t see the price of anything increase by a penny. You would see no increase whatsoever.”

Slavery, therefore, is fundamentally just a human rights abuse. And, considering its small scale, Professor Bales said that he thought the investment of \$12bn over a 20-year period would be sufficient to drastically reduce instances of slavery. “The goal is not to eradicate [slavery] completely, because this is unrealistic, but to take it down to the level of cannibalism, which is incredibly rare today.”

Professor Bales then outlined two key questions:

- How do we calculate the risk of someone becoming enslaved?
- How do we react to that risk?

Until recently, data on the subject had been incredibly sparse and overly reliant on anecdotal evidence. The Global Slavery Index, published in November 2013, is the first attempt to estimate prevalence in most countries.<sup>6</sup>

Professor Bales then spoke about defining what is meant by slavery:

“We define slavery in terms that would be recognisable across all human history. If you look at slavery in ancient Rome, ancient Greece, the American South, and you strip away all the wrapping of those cultural bounds, the religious justifications and the economic rationalisations as to why people were enslaving others you get to the key attributes between slave and slave owner. [The definition] is fundamentally: the complete control of

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<sup>4</sup> International Labor Organization

<sup>5</sup> The best estimate, according to professor Bales, is that there are currently just under 30 million enslaved people in the world today.

<sup>6</sup> 162 countries are counted in the first edition, 168 countries will feature in the next edition

one person by another person. Violence is used to uphold that control – or the threat of violence – and the point of it all is primarily economic exploitation.”

The strength of this definition, he said, is that it is clear cut. It focuses solely on slavery, rather than encompassing incidents of what might simply be termed severe economic exploitation.

“The key area of risk that we are concerned about is the context of risk in which a person who is vulnerable to enslavement might end up in slavery.”

To demonstrate how this is done, Professor Bales described the five dimensions of risk, including the 33 variables that are connected to them:

- 1) Slavery policy**
- 2) Human rights**
- 3) Development**
- 4) State stability**
- 5) Women’s rights and discrimination<sup>7</sup>**

To assess the prevalence of slavery two independent surveys are carried out. The resulting data produce the following table:

Country Name	Ranking	Weighted Measure
Mauritania	1	97.90
Haiti	2	52.26
Pakistan	3	32.11
India	4	30.84
Nepal	5	26.56
Moldova	6	25.68
Benin	7	23.57
Côte d’Ivoire	8	23.35
Gambia	9	23.20
Gabon	10	23.03
Senegal	11	22.31
Ethiopia	12	22.06
Sierra Leone	13	21.82
Togo	14	21.53
Cape Verde	15	21.31

“These are not raw numbers of slaves,” said the professor, “but the proportion of the population in slavery”. India has a high proportion of its population enslaved; it also happens to have the highest raw number of slaves. Mauritania, on the north-west coast of Africa has a very low population, but a high proportion of its population are involved in (mostly hereditary) forms of slavery.

“Corruption in particular is the strongest predictor of slavery in any country. This is fundamental in the sense that if the rule of law is not there to protect you from slavery, then you are in trouble.”

Professor Bales then spoke about the difficulty of conceptualising or theorising their findings. “We want to create a science around the risk of enslavement.”

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<sup>7</sup> The 33 variables pertinent to these dimensions are reproduced in appendix I.

What sets enslavement aside from the other risk-probability studies is that they typically operate with very low probabilities – like tsunamis or other natural disasters – whereas instances of slavery are very probable. “The question then becomes: how do we adequately measure and compute the probability of slavery in these different contexts? [...] Ultimately with the view to reduce the pool of vulnerable people [estimated at between 500 million and 1 billion] from which those 30 million modern day slaves are drawn.”

## **Discussion**

The first section of the discussion focussed on the turnover for the slave trade relative to turnover for the drugs and guns trades.

Professor Bales said that he was unsure of the estimated turnover figure for drugs, but that it was much greater - perhaps three times more – than the \$40bn attributed to slavery.

The next participant asked about possible unforeseen consequences of new anti-slavery legislation. The participant cited a study that appeared in the 1990s that focussed on human trafficking in Dubai. After the city was placed under increased scrutiny and immigration laws were tightened, one unseen consequence was that women who were trafficked into the sex industry were criminalised, a development that increased reluctance for these women to complain to the authorities when they suffered cases of abuse.

Professor Bales said that such concerns are at the front of everyone involved in his research’s minds. “It is important to say that this is a scientific exercise, not [like the report that the participant mentioned] a political one.”

Returning to the statistic that Chris Snowdon mentioned at the beginning of the session, one participant asked how flow would affect the number. “So if [you could find out whether] a person typically spends a year in slavery or they spend a lifetime, you can fundamentally alter the likelihood of anyone experiencing slavery.” Furthermore, he added, if it were possible to identify a year of someone’s life when they are at most risk from becoming enslaved – for example 16 – one could drastically reduce their probability of enslavement.

Professor Bales agreed that if his research group could measure flow better, then that would be a much more useful figure than stock. He added that during a study of slavery in the US, useful data were recovered. “We found that the average time a person spent in slavery was between 5-7 years [...] but, unfortunately, we do not get that quality of data elsewhere.”

## Climate Change and Data Policy Decisions

### Session Three

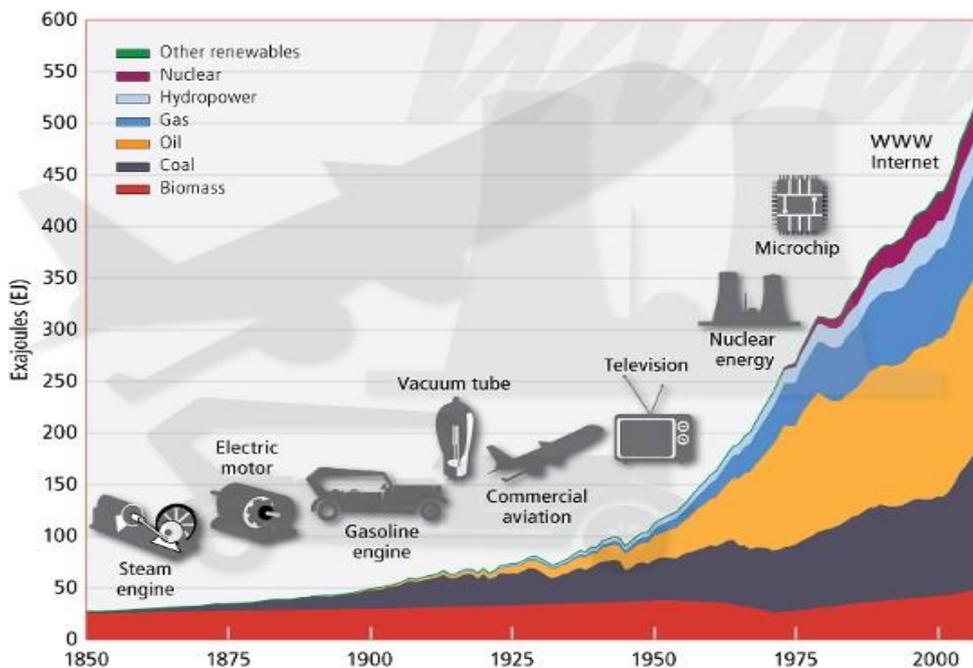
Chair: Professor Robert Mair, *Head of Civil and Environmental Engineering, University of Cambridge*

Dr Emily Shuckburgh, *Head of Open Oceans Project, British Antarctic Survey*

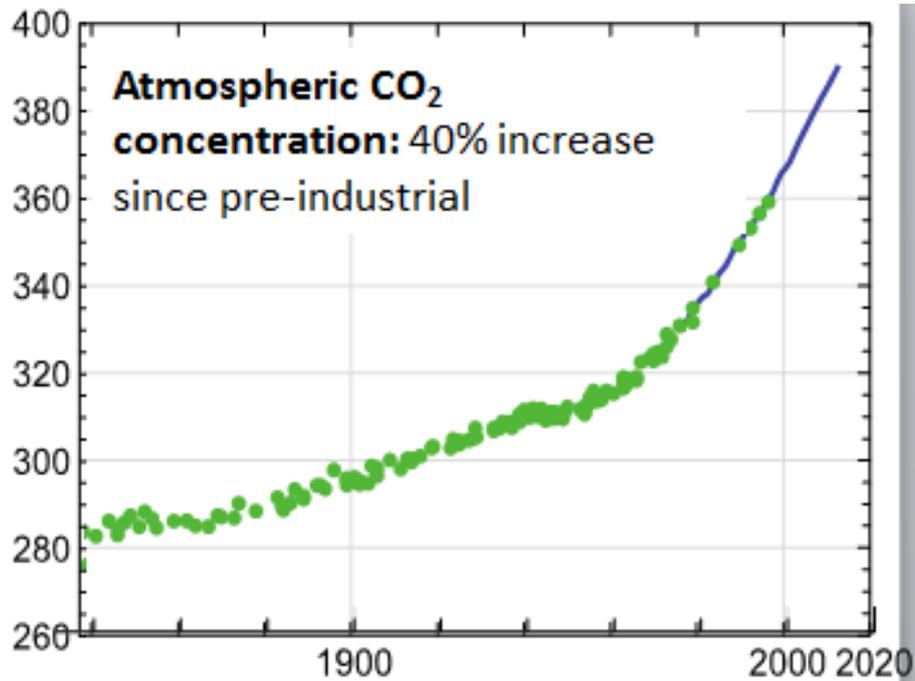
Professor Daniel Ralph, *Founder and Director, Centre for Risk Studies, and Professor of Operations Research, Judge Business School, University of Cambridge*

**Professor Robert Mair** said the understanding and misunderstanding of statistics was a topic close to his heart because he recently chaired a report for government on fracking, which he described as a highly emotive and important issue and one with a conspicuous lack of data.

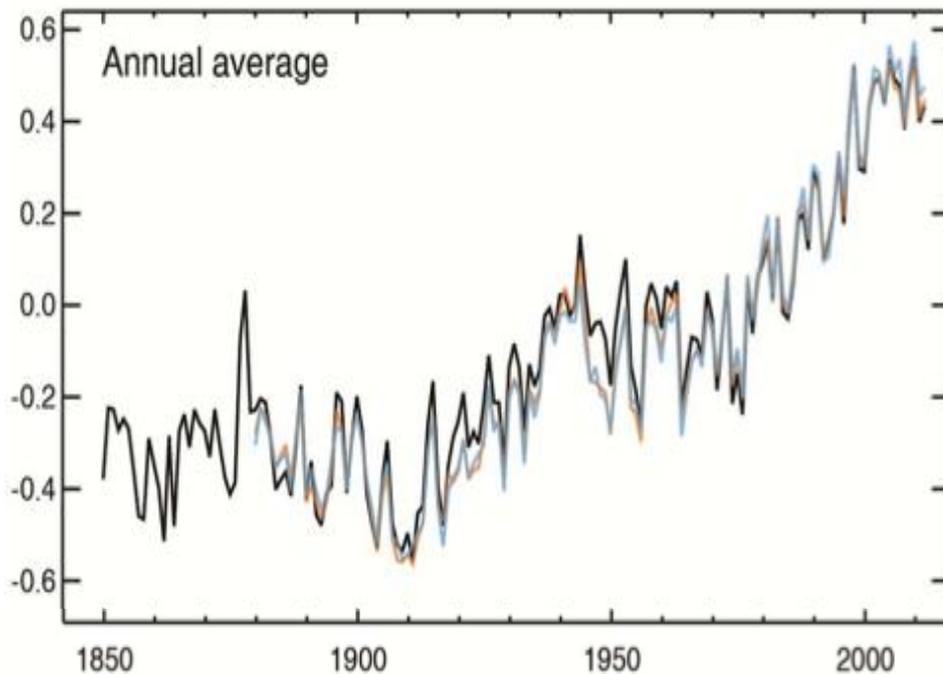
**Dr Emily Shuckburgh** showed a series of slides showing the increase in carbon dioxide in the atmosphere, its causes and its implications.



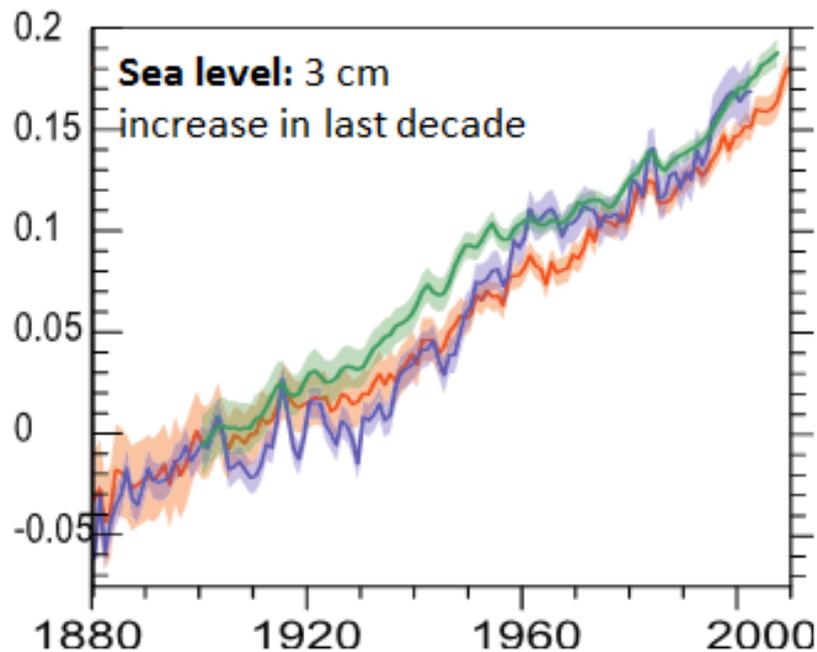
Global energy use has increased five-fold in the last 50 years, and is largely attributable to the burning of coal, oil and gas.



Since pre-industrial times there has been in the region of a 40 per cent increase in CO<sub>2</sub> in the atmosphere.



The rise in atmospheric CO<sub>2</sub> has resulted in a global surface temperature increase of around 1°C over the last 100 years. However, Dr Shuckburgh added, it was important to note that whereas the rise in atmospheric CO<sub>2</sub> is a steady increase, apart from an annual cycle, the rise in temperature is far more erratic owing to the influence of the weather and other natural modes of variability.



Due to the rising temperature, there has been an increase in sea levels, caused because water expands as it heats, and also because of the added volume provided by sources such as the melting ice caps.

In light of these findings, Dr Shuckburgh asked: “How should this affect policy?”

“There has been a lot of work on how to communicate the statistics associated with the above data,” she said. The most recent IPCC<sup>8</sup> report contained a series of statements of varying complexity. “The simplest message to get across,” she said, “is that warming in the climate system is unequivocal.” However, some other statements are more difficult to communicate to the wider audience because the data contain uncertainties – some absolute uncertainties and some due to our limited understanding.

Therefore a very precise framework has been devised to aid communication, whereby calibrated probability terms like ‘likely’, ‘very likely’ and ‘unlikely’ are given numerical values associated with probability ranges, e.g. ‘likely’=.66-100%. Furthermore, confidence can be similarly ranked on the amount of consensus it achieves among the scientific community. As a result, the IPCC can issue statements such as “it is extremely likely human influence has been the dominant cause of the observed warming since the mid-20<sup>th</sup> century.” And: “Warming is about as likely as not to exceed 4C at the end of this century under a business-as-usual emissions scenario.”

Dr Shuckburgh noted that the IPCC qualified the last statement as having “medium confidence”.

At which point Bernard Silverman interjected, clarifying that it was a “two-sided medium confidence”, as some forecasters predicted a rise of more than 4C, and some predicted less or no rise.

Dr Shuckburgh noted that this is one method of communicating the data and, though it is not perfect, it has been designed primarily because the IPCC’s purpose is to inform the UN framework convention on climate change. “Its primary audience is policy makers,” she said, “and these statements [the calibrated probability terminology] can cause a huge amount of confusion when they are used more generally.”

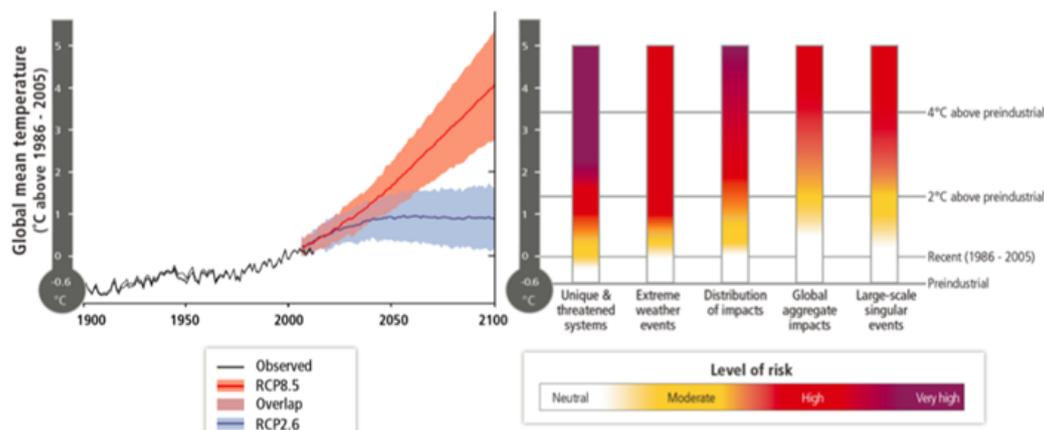
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<sup>8</sup> Intergovernmental Panel on Climate Change

It is thought 'likely' that to prevent a 2C temperature increase, the human race can burn no more than 1 trillion tons of carbon throughout history. We have already used 70 per cent of the carbon dioxide allowance in this budget. At current, the rate with which we burn through fossil fuels is 10 billion tons per year, meaning we have 30 years (at the current rate) before we reach the 1tn maximum.

Article 2 of UN Convention on Climate Change requires ...

**"... stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system."**



UK Climate Change Committee: "We therefore believe that global policy should seek to limit the central expectation of global temperature rise to, or close to, 2°C and that it should ensure that the probability of crossing the extreme danger threshold of 4°C is reduced to an extremely low level (e.g. less than 1%)."

If the global carbon budget were to be divided per capita between the countries, the UK would already be considerably over budget.

In light of this, the Committee for Climate Change has called for an 80 per cent reduction in all UK greenhouse gases by 2050, based on figures from 1990. They estimated cost of this reduction to be between 1 and 2 per cent of GDP.

The cited 80 per cent reduction would require enormous changes on both the supply and demand sides and include energy-efficiency improvements right across the board, as well as a radical decarbonisation of the power, industry and transport sectors.

Communicating that target is very difficult. It is tempting to simplify the complexity, and in particular the scientific uncertainty, for a lay audience. But about five years ago the then government conducted a campaign to get the message across where this approach failed. The campaign used posters based on nursery rhymes that were attempting to show the risks of climate change.

"These posters made statements such as: 'Extreme weather events such as storms and floods and heatwaves *will* become more frequent and intense if we carry on like this.'"

The posters were pulled up by the Advertising Standards Agency who rightly said they should have phrased matters more tentatively.

In closing, Dr Shuckburgh said that meeting the CCC targets and their equivalent at a global scale will be challenging and will likely require carbon capture and storage techniques to be adopted and perhaps geo-engineering technologies to be implemented.

As a result, many R&D providers, including universities like Cambridge, are investing a lot of time and money in investigating geo-engineering options. “However,” she said, “that itself comes with its own communications challenges.”

**Professor Daniel Ralph** said that, though he did not feel qualified to discuss aspects of climate change, the work carried out under his auspices at the Judge Business School might impact on the topic, as it has done for topics like cyber security, pandemics and civil disorder.

“At the risk centre we try – often by network analysis – to map out a system, which might be as simple as a supply chain for a business, and then to try and built scenarios to say what would be the impact on the system [of any given factor].”

“Though we haven’t focused on climate change yet,” he added, “it is an obvious topic to focus on.”

Professor Ralph then presented two pieces of literature that he thought pertinent to a discussion on risk and climate change: the first called “On Modelling and Interpreting the Economics of Catastrophic Climate Change” by Michael Weitzman (2009); and the second being *The Stern Review* by Nicholas Stern (2006).

Professor Ralph précised the thesis of the first paper as follows: if you are trying to do estimates – and Weitzman’s are about the rate of temperature change and the resulting cost on human society – and then you extrapolate from those estimations, you need to consider to what extent the data quads will describe statistical variation. “Going from interpolation to extrapolation,” he said, “is always going to be a problem.”

Weitzman thought that, with regards to climate change, the usual method extrapolation might not work because often physical scientists are dealing with distributions that have thin tails.

Essentially, Weitzman called into question the ability to put confidence intervals upon the estimates going forward. “Weitzman was not a naysayer,” said Professor Ralph, “far from it. He is saying that the cost estimates might be much, much bigger than we’re willing to contemplate.”

Another of Weitzman’s studies asked “How we should we set the discount rate?” A question touched upon in the second text Professor Ralph intended to focus on, *The Stern Report*. In that study, Nicholas Stern argued that depending on where you set the discount rate you will get very different effects and, therefore, you can come to very different policy conclusions.

Bearing those texts in mind, Professor Ralph asked the plenary: “statistically speaking then, are we even equipped to talk about the ceiling on the damage? And with regards to the discount rate, are we at all equipped to say what that should be, if we want to carry out a simple cost-benefit analysis that looks to the future?”

To close, Professor Ralph spoke about the difficulty in communicating climate change advice and quoted from Dan Kahan’s study “Why are we Poles Apart on Climate Change?”

“Social science research indicates that people with different cultural values [...] disagree sharply about how serious a threat climate change is. People with different values draw different inferences from the same evidence.”

Kohan’s study goes on to say “Present them with a PhD scientist who is a member of the US National Academy of Sciences, for example, and they will disagree on whether he really is an ‘expert’, depending on whether his view matches the dominant view of their cultural group.”

Furthermore, when that view contradicts that of our cultural group then we sack the evidence and we sac the speaker who presented it to us.

Therefore, Professor Ralph said, when apportioning blame for the climate change crisis, we must look at the science communication environment. “It is not stupid people,” he said, “You have clever people who are in different cultural camps. It’s not about cleverness. It’s not about scientific literacy. It’s about being able to disentangle our identification from the issues.”

## Discussion

The first participant asked about the wording Dr Shuckburgh highlighted in her speech (“likely, very likely, almost certain”). She asked why the words had not been tested on a cohort of volunteers (numbering 100 people, say), and have the results dictate the phrasing of the message. “These are highly testable questions,” she said. It would also offer protection from the Advertising Standards Agency because, were they to protest to the wording, it would be possible to respond by saying that testing had proven that a particular term carries the certain connotations.

Dr Shuckburgh said she thought the issue even more complex. “Ideally, what we want to be doing is displaying the science as dispassionately as possible, without trying to encourage any particular behaviour.”

The next participant commented on what he felt was the reality of communicating statistics through the media. “The fact is, over the past 5-10 years with the internet there has been an enormous transformation and a hollowing out of traditional news media, leaving [newspapers] chronically understaffed. The demands on journalists are greater than ever [and because] Newspapers are typically owned by proprietors who have a particular political view, that comes into play in the way that stories are presented.” He added that he sympathised with scientists who were trying to get their research out to the public, but that there was little anyone could do.

“My feeling is though,” he added, “the public is able to make its own mind up [...] after all 40 per cent of Daily Mail readers are thought to vote Labour or Liberal Democrats. You certainly wouldn’t believe that by reading the paper.”

Professor Bales asked if Dr Shuckburgh thought a reduction in carbon emissions of 2.5bn tons would help reduce global warming. “I only ask,” he added, “because we are coming to the end of a five-year study of the amount of slave labour that is actually being used in environmentally destructive ways.”<sup>9</sup>

He added that stopping this might also represent an uncontroversial way of lowering emissions. “If people were not willing to reduce their carbon use due to ideological reasons, well, this is simply the combatting of a crime, they couldn’t oppose that and yet the result will be the same.”

Dr Shuckburgh agreed and responded by saying that climate change is highly inter-connected with other issues like illegal industrial practices. “That connectivity works both ways,” she said, “in the respect that there is sometimes an increased risk, but sometimes it allows for co-benefits to be taken advantage of, like those mentioned by [Professor Bales].”

The final participant questioned some of the reasoning behind the climate change message. Firstly, he queried the idea that to say 95 per cent of scientists were in agreement over the man-made aspect of

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<sup>9</sup> Professor Bales noted that this was not from fossil fuel abuse, but from illegal deforestation and by process like illegal; brick-making, which uses old tyres and motor oil as the primary fuel sources.

climate change is a convincing statistic. “Throughout history often new science is saying that 100 per cent of previous scientists are wrong.”

The second point he made was to offer a thought experiment. If we were to toss a true coin 100 times, he said, we know that it will come down nearly 50-50 heads and tails, and we can work out the distribution around it. However, if we have a coin and we do not know if it is true or not, we would still predict that, from the information we have, it would come down 50-50 heads and tails, though we would be unsure of the distribution. If we knew more about that coin, we might be able to say that it would fall 70-30 heads and tails. “Now,” he asked, “when you say here are the central predictions for climate change, are we dealing with a true coin or a bent coin? And, if we had much more complete information, would we come up with the same figure? If, on the other hand, there are quite a lot of uncertainties in the climate change debate, I wonder if these probabilities are really the right way to present the data.”

Dr Shuckburgh responded by saying, on the consensus question, that some people are convinced by consensus and others aren't. “It comes back to the Kahan article,” she added, “in that on some audiences it works and on others it doesn't.”

On the question about whether climate change a bent coin, she said: “Yes it is a bent coin.” There are ‘known unknowns’: the model projections that show future climate change are only as good as those models allow them to be – they are therefore not currently able to predict variables such as ice sheet collapse. But to create any sort of decision-making framework, risk needs to be built into the projections.

The participant interjected saying that, to then put a figure on this is “providing hostages to fortune to the climate change deniers [...] If you were clearer about what you know and what they don't know, then there would be a smaller target for people to aim at.”

Dr Shuckburgh disagreed. She said the IPCC “bends over backwards” in trying to be clear about what it knows and does not know. “In fact, I think [the message] sometimes lacks clarity because they are trying to be too precise about these things.”

## The Financial Crisis – Attitudes to Risk and the Misuse of Statistics

### Session Four

Chair: Andrew Freeman, *Director, The Finance Foundation, and Centre for Risk, Judge Business School, University of Cambridge*

Professor Michael Dempster, *Centre for Financial Research, Statistical Laboratory, University of Cambridge & MD, Cambridge Systems Associates Limited*

Duncan Martin, *Partner and MD, Risk Practice, Boston Consulting Group*

**Andrew Freeman** began the session by asking if anyone present knew the chances for winning the National Lottery on any given Saturday. The odds, established by the plenary, are approximately 1 in 14,000,000. Mr Freeman then said that in 2007, the Chief Financial Officer of Goldman Sachs (David Viniar) was quoted on the front page of the Financial Times saying: “We are seeing 25 sigma events several times a day every day.”<sup>10</sup> Mr Freeman said it was amazing that such a statement was quoted without incredulity in the FT, considering that, in UK Lottery terms, a 25 sigma event is the same as winning the lottery 23 times in a row. “So,” he said, “here you have the CFO of Goldman Sachs talking utter nonsense and being quoted on the front page of the Financial Times.” Mr Freeman then said that he gave this example to show how the misunderstanding and misrepresentation of statistics in the media is “pretty egregious”

**Professor Michael Dempster** spoke about the realities of buying “over-the-counter” or OTC derivatives, which he described as pertaining to both risk and the misuse of statistics. He said this is because the way OTC derivatives are valued when they have complex structuring is to construct a model-based distribution of the time discounted present value of all the cash flows of the deal and draw an expectation from it. “This is the simplest of statistics,” he said, “it is a mean of possible time discounted cash flows .”

To get a so-called “mark-to-market” price, the possible cash flows must actually also be risk discounted, which though more complex, is essentially similar. However, the actual market price at any point in time may be any one of the possibilities and the risks can only be evaluated by considering the *actual* underlying distribution and its extremes. Interestingly, the documents describing such deals for clients often state that “the risks are unlimited”, but that is hardly a useful evaluation of their likelihood or severity.

He went on to describe what his team has learned from nearly seven years of experience in evaluating these OTC derivatives as expert witnesses for disadvantaged clients, commercial, governmental and individual, in European jurisdictions.

“What I want to convince you of,” said Professor Dempster, “is that the statements made on the following slide [in red] are false.”

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<sup>10</sup> The actual wording of David Viniar’s quote in the FT on 13/08/2007 was “We were seeing things that were 25-standard deviation moves, several days in a row”

Commenting in 1998 on the proposed repeal of the 1933 Glass-Steagall Act *separating commercial and investment banking* “ **an archaic set of restrictions**”

**Lawrence Summers**

US Secretary of the Treasury & Future President, Harvard University & Advisor, Citigroup

*Bloomberg Business Week*, 12<sup>th</sup> August 2013

“Commentators speak loosely about going back to Glass-Steagall. But the Glass-Steagall Act was **introduced to deal with a problem that no longer exists: the distribution of fraudulent securities to unformed customers**”

**Martin Jacomb**

Chairman, Share PLC & Former Chancellor, Buckingham University

*Financial Times*, 14<sup>th</sup> September 2011



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The risks involved in valuing financial products have been problematic for a long time, said Professor Dempster, who showed the following slide, a cartoon from the New Yorker from 1937:



The financial markets have developed since the breakdown of the post war Bretton Woods fixed exchange rate agreement in the early 1970s. Chiefly, these developments may be split into three areas:

- Technical changes (including market data, pricing calculations, spreadsheets, global communications and state-of-the-art computing hardware)
- Regulatory changes (chiefly Basel I and II)<sup>11</sup>
- Changing product paradigms (including risk transfer, transferring property and exchanging contractual obligations)

Professor Dempster gave some background on changes made to financial services trading from the 1980s to the crash. Essentially, these were characterised by a shift from customer benefit to shareholder benefit. Further changes include the increasingly complex and structured nature of financial products, the introduction of risk management and hedge portfolios, and ever-increasing financial institution leverage due to globally lax regulation.

Professor Dempster then showed the following slide detailing the crises which have resulted from these developments:

- 5
- **Caused by** **Financial Crises 1980-2013**
    - **Inflation**
      - Russian default August 1998
    - **Currency crashes**
      - Mexican peso crisis 1995. After NAFTA (Canada, Mexico, US)
    - **Currency debasement**
      - Argentine default 2001. Failed US\$ peg with horrifying domestic consequences
    - **Asset price bubbles**
      - South American debt crisis in the 1980s. Recycling 'petrodollars' in the 1970s
      - Black Monday October 1987. US credit expansion by Savings & Loans sector
      - Japanese crisis 1990. Property bubble fuelled by export led growth
      - Asian crisis 1997. Corporate debt burden financed by property bubbles & "hot" money
      - Internet bubble 2000. Irrational exuberance ?
      - US subprime crisis 2008. (Self) deception
      - Euro crisis 2010. Reality avoidance
      - China crisis 201?. Credit expansion to fuel export led growth



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"I want to draw special attention to the China crisis, which hasn't quite come yet, but it *is* coming," he said.

Financial crises have marked the development of capitalism since the renaissance. And yet, "Every time we are told: it's different [this time]," he added.

One thing that has changed is presidential rhetoric. The professor contrasted Franklin D Roosevelt's famous saying: "We have nothing to fear but fear itself," with a quotation made by George W Bush in 2008: "This sucker could go down." And it did!

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<sup>11</sup> Work is currently underway on Basel III



Professor Dempster turned next to the following views of the role derivatives have played in the crisis.

13

## Views on the Rôle of Derivatives

- **Guns don't kill people. People kill people!** **US National Rifle Association**
- **Derivatives are weapons of mass destruction** **Warren Buffet**
- **There are two types of derivatives – “bought” and “sold”**  
– in proportion 30% to **70%** **City MD**
- **Banking is the last industry to go “high tech” after aerospace, oil, manufacturing, airlines, logistics, film making, etc.**

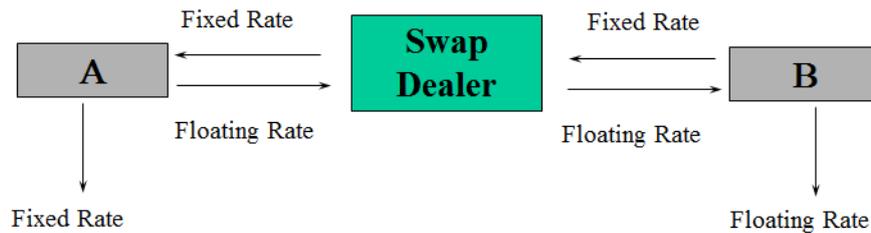


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His next slide highlighted a particular type of derivative called a swap:

## Generic Rate Swap Structure



- Counterparty **A** converts from **fixed** to **floating**
- Counterparty **B** converts from **floating** to **fixed**
- Through an **over the counter** (OTC) product of a **swap dealer** who charges both parties a **spread**



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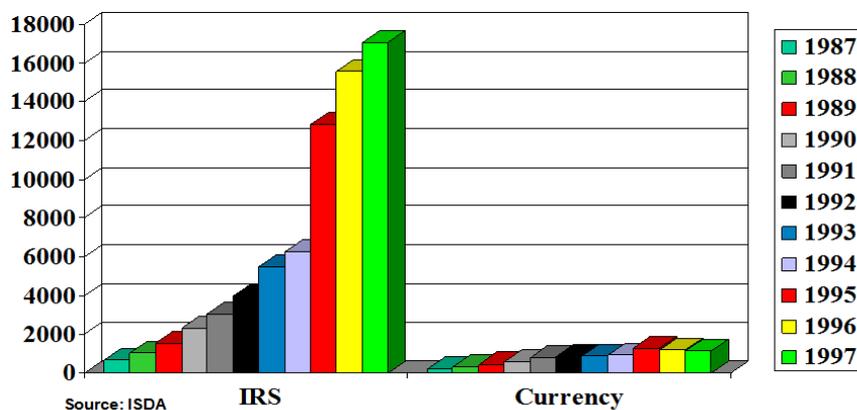


“Essentially a swap is two counterparties exchanging cash flows. Usually one is based on a fixed rate applied to a notional principal and one on a floating rate.” It is equivalent to exchanging two bonds with the same face value (the notional principal). Though it can be demonstrated that these arrangements can be beneficial, they have changed considerably from what they initially were. “They got started by being parallel, back-to-back loans, [as with the] IBM-World Bank cross-currency swap of 1981.” When the International Swap Dealers Association (ISDA) formed a standard contract in 1985, then the market for these swaps really took off.

Professor Dempster then showed two slides detailing the growth of the swap market.

## First Decade Market Growth

Market volume by end 1997 about **\$17 trillion** in notional principal  
and about **\$560 trillion** now



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## Global OTC Derivatives Markets

(In trillions of U.S. dollars; notional amounts of contracts outstanding)



Source: Bank for International Settlements.

Note: Over-the-counter data through June 2009; exchange-traded data through December 2009.

<sup>1</sup>Includes foreign exchange, interest rate, equity, commodity, and credit derivatives of nonreporting institutions.



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The result was that by the time of the crisis derivative notional principals swamped the value of all other financial assets to represent about 10 times global GDP:

## Asset Value Proportions of 2009 Global GDP

▪ Derivatives (notional)	1012%	\$ 600 T	80%
▪ Debt & ABS	129%	\$ 77 T	10%
▪ Broad Money	115%	\$ 69 T	9%
▪ Money	9%	\$ 5 T	1%



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Professor Dempster next discussed the cost of derivatives to mostly non bank clients by referring to a statistic previously mentioned in his presentation, namely "that 30 per cent of derivatives are bought and 70 per cent are sold".<sup>12</sup>

This means he said that only 30 per cent of deals are between counterparties who are professionally able to assess the risks involved, while 70 per cent involve counterparties who have no idea of what they are buying.

"A rule of thumb," said Professor Dempster, "is that such a counterparty should never accept a restructuring of an existing losing deal by the issuer but rather cut their losses then and there."

Professor Dempster said his team began researching "toxic" derivatives which were sold in 2004 around 2007, and are currently seeing examples sold only last year, demonstrating that this questionable practice has not been stopped by the financial crisis.

"The really obvious bad features have to do with common sense," he said. "If you [have an arrangement] where the bank can cancel the deal and not pay you anything, but if you cancel it you have to pay the bank market value, that doesn't sound right. But that is the nature of many of the contracts."

Professor Dempster then listed some stylised features of OTC derivatives which represent the general asymmetry of information between dealer and client:

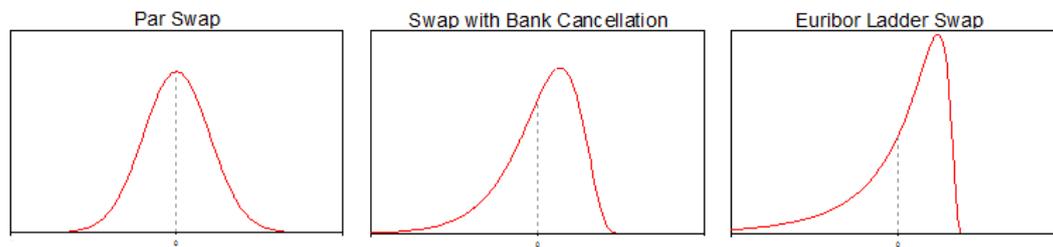
- Each deal represents a play by the issuing bank that exploits their superior knowledge of possible future market evolution relative to the client's
- Issuers are usually the client's commercial bank and the term sheets/contracts usually bear a feminine bank signature
- Often the bank **requires** the deal as a condition of a loan, a refinancing or a bond flotation
- Most recently loan rollovers contain "embedded" derivatives which charge the borrower the high break costs of the bank's possibly non-existent interbank market risk hedge
- Each deal is structured to have the enticement of some kind of short term client "sweetener" which can sometimes be very subtle
- Often enticement can be buried in a programme of successive similarly structured deals which only in the latter stages become egregious – playing the "fish"
- Due to severe asymmetry of information the client is in no position to understand the relative risks to client and bank which are often extreme for the client
- When a deal begins to go wrong for the client the bank offers to postpone the agony by restructuring the deal(s) to one(s) even worse!

With reference to one-sided bank cancellation options and the effects of structuring to clients, the professor showed the following slide to demonstrate the differences in the present value distributions of various swaps:

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<sup>12</sup> A figure recently revised to 20 per cent to 80 per cent.

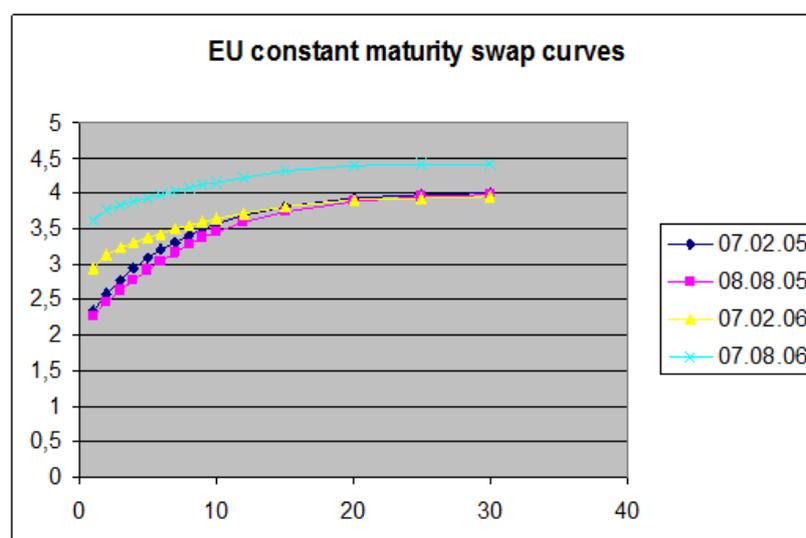
## Swap NPV Distributions



The Par Swap on the left shows how most inter-bank deals are carried out - though there is a fee involved on the part of the issuing bank, this type of deal could ostensibly work out favourably for either party. If a bank gets a one-sided cancellation option, then that skews the present value distribution favourably towards the bank, and if the deal is further structured the skew gets even more pronounced.

Professor Dempster showed the following graph, detailing a play involved in structuring :

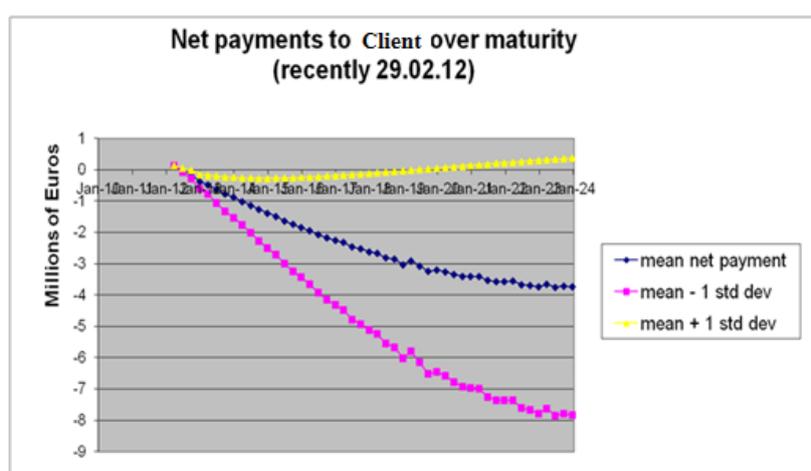
## Play on the Flattening Yield Curve



He then showed a graph detailing a specific, second restructured swap in which expected projected quarterly client payments to the bank reach nearly 40% of current notional principal to result in a model based mark-to-market value in 2012 over 72.3 million euros in favour of the bank on a notional principal nearly 7 times smaller :

## 2<sup>nd</sup> Restructured CMS10 Memory Swap Amortised NP €10.5M

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“So why do people sign these deals?” he asked. “If you use the proper theory, in which everyone is rational, then there is no reason why you should invest in these things at all.”

“However, you will invest – if you overestimate the likelihood of positive results to you, which lots of corporate treasurers and local authority people have done – when in fact such bad deals then look as if they’re okay.”

Professor Dempster listed other reasons people enter into these contracts with some examples:

- Desperation
  - City of Detroit
- Coercion
  - Bank loan or loan rollover *requires* accompanying “hedge” derivatives (UK & US SMEs)
- Trust
  - IllePapier v DB German Supreme Court case (2011)

- Gullibility
  - German Landesbanken (unknown 100s of B € of notional value)
  - Austrian National Railways (€ 90 M)
  - Milan, Pisa, Sicily, Monte Casino, ... (600 municipalities, over 1000 global deals, c. € 2.5 B lost)
  
- Complicity
  - Italian (1999) (c. € 31 B lost to 2012) and Greek (2001) (€ 5.1 B lost to 2005) concealment of government debt for Eurozone entry
  - Monte dei Paschi di Siena (c. € 8.4 B)
  - StichtingVestia Group (€ 700 M)

To show the overall benefit to banks, Professor Dempster presented his final slide:

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## Current Derivative Valuations

Risk Category / Instrument	Notional amounts outstanding					Gross market values				
	Dec 2010	Jun 2011	Dec 2011	Jun 2012	Dec 2012	Dec 2010	Jun 2011	Dec 2011	Jun 2012	Dec 2012
<b>Total contracts</b>	<b>601,046</b>	<b>706,884</b>	<b>647,777</b>	<b>639,366</b>	<b>632,579</b>	<b>21,296</b>	<b>19,518</b>	<b>27,278</b>	<b>25,392</b>	<b>24,740</b>
<b>Foreign exchange contracts</b>	<b>57,796</b>	<b>64,698</b>	<b>63,349</b>	<b>66,645</b>	<b>67,358</b>	<b>2,482</b>	<b>2,336</b>	<b>2,555</b>	<b>2,217</b>	<b>2,304</b>
Forwards and forex swaps	28,433	31,113	30,526	31,395	31,718	886	777	919	771	803
Currency swaps	19,271	22,228	22,791	24,156	25,420	1,235	1,227	1,318	1,184	1,247
Options	10,092	11,358	10,032	11,094	10,220	362	332	318	262	254
<b>Interest rate contracts</b>	<b>465,260</b>	<b>553,240</b>	<b>504,117</b>	<b>494,427</b>	<b>489,703</b>	<b>14,746</b>	<b>13,244</b>	<b>20,001</b>	<b>19,113</b>	<b>18,833</b>
Forward rate agreements	51,587	55,747	50,596	64,711	71,353	206	59	67	51	47
Interest rate swaps	364,377	441,201	402,611	379,401	369,999	13,139	11,861	18,046	17,214	17,080
Options	49,295	56,291	50,911	50,314	48,351	1,401	1,324	1,888	1,848	1,706
<b>Equity-linked contracts</b>	<b>5,635</b>	<b>6,841</b>	<b>5,982</b>	<b>6,313</b>	<b>6,251</b>	<b>648</b>	<b>708</b>	<b>679</b>	<b>645</b>	<b>605</b>
Forwards and swaps	1,828	2,029	1,738	1,880	2,045	167	176	156	147	157
Options	3,807	4,813	4,244	4,434	4,207	480	532	523	497	448
<b>Commodity contracts</b>	<b>2,922</b>	<b>3,197</b>	<b>3,091</b>	<b>2,994</b>	<b>2,587</b>	<b>526</b>	<b>471</b>	<b>481</b>	<b>390</b>	<b>358</b>
Gold	397	468	521	523	486	47	50	75	62	53
Other commodities	2,525	2,729	2,570	2,471	2,101	479	421	405	328	306
Forwards and swaps	1,781	1,846	1,745	1,659	1,363					
Options	744	883	824	812	739					
<b>Credit default swaps</b>	<b>29,898</b>	<b>32,409</b>	<b>28,626</b>	<b>26,931</b>	<b>25,069</b>	<b>1,351</b>	<b>1,345</b>	<b>1,586</b>	<b>1,187</b>	<b>848</b>
Single-name instruments	18,145	18,105	16,865	15,566	14,309	884	854	958	715	527
Multi-name instruments	11,753	14,305	11,761	11,364	10,760	466	490	628	472	321
of which index products	7,476	12,473	10,514	9,731	9,663					
<b>Unallocated</b>	<b>39,536</b>	<b>46,498</b>	<b>42,610</b>	<b>42,057</b>	<b>41,611</b>	<b>1,543</b>	<b>1,414</b>	<b>1,976</b>	<b>1,840</b>	<b>1,792</b>
<b>Memorandum Item:</b>										
Gross Credit Exposure						3,480	2,971	3,912	3,668	3,626



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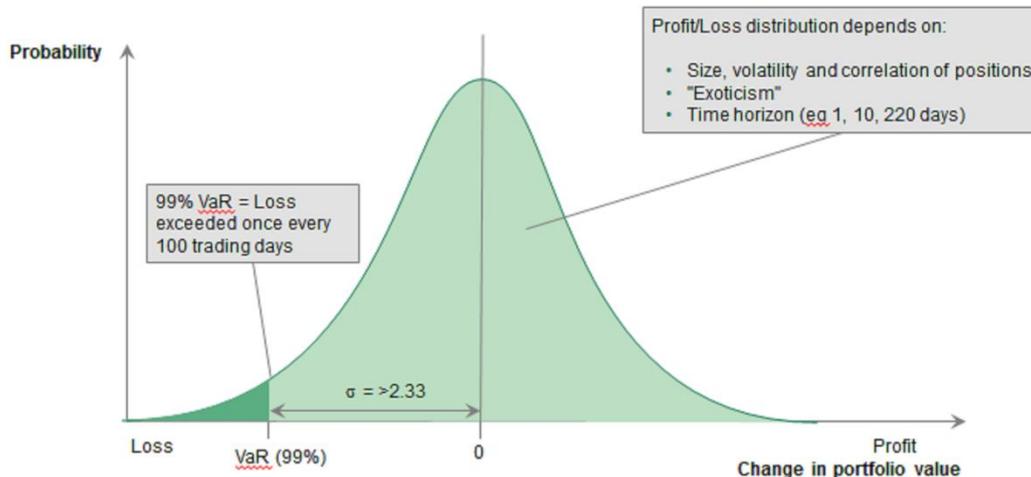


According to these Bank of International Settlements calculations, derivatives sold to clients who are not sufficiently sophisticated counterparties -- the 70% of deals "sold" and not fully hedged -- currently account for something like 6 per cent of global GDP, the present value of *pure rent* to global derivatives dealers extracted from the "real economy".

**Duncan Martin** began his presentation on Value against Risk (VaR), by saying that he could not believe that David Vinar was talking about anything other than VaR when he made his statement about the 25-Sigma events.

To explain what VaR is, Mr Martin showed the following slide:

## Value at risk (VaR) describes potential losses from a portfolio of financial assets



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“The hump-shaped thing is the change in value of a given portfolio,” he said. “You might have bonds in there, you might have equities, you might have commodities – you might have all of the above.”

“Simply put”, Mr Martin said, “the right-hand side [of the graph] is good, that’s where there is a positive change in value and there is a profit; the left-hand side is bad, that’s where it loses value and you lose money.”

VaR is a number on the left-hand side of the graph. If one were to pick an arbitrary or semi-arbitrary quantile – 90 per cent, 95 percent, 99 per cent – then there is a 10, 5 or 1 per cent chance of losing more than that amount.

Mr Martin then gave an analogy. “So, if I have a \$1bn in exposure and my 95 per cent VaR is at \$50m, then that sounds pretty reasonable. But actually that means I have a 5 per cent chance of losing more than \$50m on a given day; VaR doesn't tell me how much more.”

So why do people use VaR? Mr Duncan returned to the slide: “VaR has some useful characteristics. If you look at the box on the right-hand side – with all other things being equal – the value of risk increases with the size of the portfolio. Similarly, VaR increases with the volatility of positions and the correlation between them. So the dodgier the position, and the more that positions move in the same direction at the same time, the higher the VaR.”

In addition to these useful properties, VaR leveraged biases in our perceptions of risk.

## Perceptions of risk differ from risks incurred

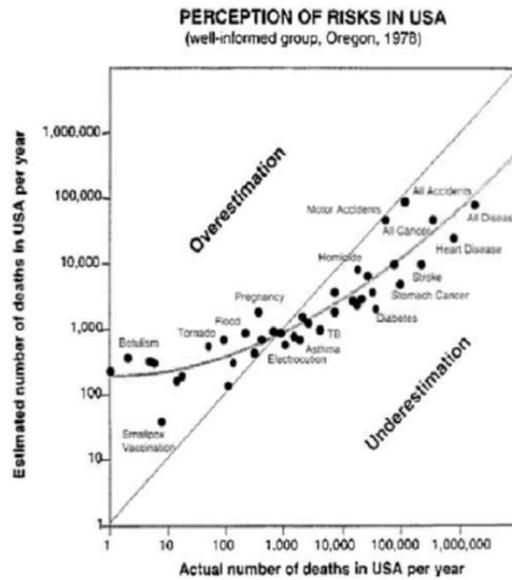


Figure 2. Relationship between judged frequency and the actual number of deaths per year for 41 causes of death (adapted from Slovic, 2000)

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Risk Perception Slides Mar14 v2.pptx

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“There are systematic biases in people’s perceptions of risk,” he said. “The horizontal axis here, for want of a better term, is actual risk, measured as the number of deaths per year in the USA from various causes; and the vertical axis is people’s perceptions of that risk, meaning their estimate of the number of deaths per year.”

The diagonal line represents a perfectly calibrated response to risk. The curved line shows people’s estimation, revealing a systematic overestimation of risk in some cases and a systematic underestimation in others.

The difference, Mr Martin said, is down to the interaction between ‘dread’ and ‘uncertainty’.

## This difference boils down to "dread" and "uncertainty"



Fig. 3. Public perception of risks in terms of risk space quadrants (Morgan, 1993)

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Placing the results on a chart, the north-south axis displays a mixture of uncertainty and immediacy; and the east-west axis dread and control. Events which are therefore uncertain and dreadful are placed in the north-east quadrant; these are most feared and tend to have the greatest overestimation of risk. Events in the south-west quadrant are certain and controllable and are most underestimated.

The hypothesis that Mr Martin wanted to share with the plenary then, is as follows:

“The reason why VaR became so popular – in addition to the fact that it is relatively easy to explain to a board member that knows nothing about banking – is that it positions banking in the bottom left quadrant. So it makes it seem as though it is certain and immediate, ordinary and controllable.”

Over in the past five years, in response to the dreadful, uncertain economic crisis, VaR has migrated northeastwards and in parallel banks have moved away from VaR and towards Stress Testing.

In closing Mr Martin said: “The hypothesis today is that biases in [the banking community’s] risk perception predisposed us to want a single catch-all risk measure that would appeal to our intuition. Events have corrected some of these perceptions and some of this complacency.”

## **Discussion**

Andrew Freeman kick-started the debate by linking the two presentations. He asked the panel why, if banking is no longer seen as occupying the bottom-left quadrant, why the derivatives that we have been warned against are still being traded?

“Though there is less derivative activity than there was, there is not a lot less,” said Professor Dempster.

“It has been put up into the top-right quadrant because politicians and the media are keeping it there,” said Mr Duncan. “The rules around derivatives have changed. And there will be more rules coming into play that will ask: ‘who is a consenting adult to these kinds of transactions?’ The bar for who qualifies has been raised dramatically.”

Mr Freeman said that he thought ‘the sweetener’ element to the sale of derivatives should be outlawed because the short term gains that are negotiated are often done so by a man or woman who will leave the company or other institution and be working somewhere else before the negative effects present in the tail of the deal come to the fore.

The first participant spoke about a recent meeting with people from the Bank of England. “We were discussing the motivation people have for choosing their mortgage. And apparently most people choose a mortgage on the basis of the first two years’ repayment. So the ‘sweetener’ issue applies to the general public too.”

The second delegate asked the panel whether, with regard to public companies, they had any idea what losses were attributable to gullibility, and what were due to short-term incentives and timescales that meant decision-makers would have moved on before they were likely to face any repercussion.

Professor Dempster said the best answer to the question was an anecdote. He said around 2000 he had given a technical talk to some investment bankers and, at the dinner that followed, he had asked them how they priced their derivatives, since, when they started some 10 years previously a long swap was around 3-5 years, and now they were selling 50-60 year swaps to the insurance industry?

“The guy looked me straight in the eye and said: ‘I’ll be honest with you, we move every parameter as far in our favour as we can and if a client buys it we’ll be in another bank, we’ll be retired or we’ll be dead by the time it will come back to us.’”

## The Interpretation and Presentation of Data – UK Immigration

### Session Five

Chair: Peter Kellner, *President, YouGov*

David Goodhart, *Director, Demos, and author: The British Dream: Successes and Failures of Post-war Immigration*

**Peter Kellner** described a New Year poll that YouGov published in the Sunday Times that took the form of a knock-out policy competition. Sixteen policies were arranged in eight pairs and the reader was asked to choose the policy from each pair they preferred, with the winners moving on to the next round and so on. The winner of the 16 was easily determined; it was to stop all immigrants receiving welfare benefits for their first two years in Britain.

Subsequently, the perception of the prevalence of so called 'welfare tourism' benefits was tested. Of the 2.3m EU immigrants in the UK, participants were asked how many they thought were claiming jobseekers' allowance. "The median figure the poll received was 400,000," said Mr Kellner, "The actual figure is 60,000."

Aspects of welfare tourism are commonly overestimated by the public. A phenomenon he said was not helped by the fact that speeches made by the Secretary of State for Work and Pensions Iain Duncan Smith have contained inflammatory language. He referred recently to "a growing groundswell of concern about benefit tourism," but Mr Kellner questioned why the minister did not say that the growing concern was largely unfounded?

In response **David Goodhart** said that many commentators are quick to point out how dim and reactionary the public are about matters to do with immigration welfare and crime, but that their criticism might not be wholly reasonable. "I want to, within reason, stick up for the public," he said.

"Often their irrational beliefs can be shown to be not as wrong as people assume they are, or they are expressions of intuition and, as such, are neither right nor wrong."

Mr Goodhart said that he wrote the book, *The British Dream*, for people who consider themselves left wing. "I was trying to persuade them that they should be more sceptical than they are [...] about large scale immigration and the more separatist aspects of multiculturalism; and that they should be rather less sceptical about how open British society is for its minorities."

People select evidence that fits their prior values and assumptions, a phenomenon that is as true for the pro mass-immigration lobby, as for those opposed to immigration.

"Immigration is an emblematic issue," he said, "and disaffection with large-scale immigration is [interpreted as] disaffection with rapid social change."

Discussing the fiscal benefit or otherwise of immigration, Mr Goodhart gave the example of a recent report made by Christian Dustmann and Tommaso Frattini at UCL. According to the press release, immigrants who had arrived in Britain since 2000 had generated a modest net profit for Britain.

"It is now an established fact that immigration is fiscally beneficial to Britain," he said, "and the truth is: it is not."

The report itself is far more nuanced. It says that, when taking a wider view, immigration between 1995 and 2011 produced a deficit close to £100bn. “That’s not a particularly startling figure,” he added, “the established citizens in the country [produce] a hugely negative figure; that’s why we have a deficit.”

“It is true of only one significant immigrant group [...] that pay in more than they pay out,” he said, “and that is the better off Europeans, people from the EU 15.”

From immigrants from outside the EU, from poorer parts of the world, who tend to have larger families, their fiscal contributions are likely considerably negative – “probably more negative than the average established citizen.”

It is estimated that 40 per cent of minority Britons – not just immigrants – are classified as ‘poor’, compared to 20 per cent of white Britons. “If you’re poor,” said Mr Goodhart, “almost by definition you take out of the system more than you put in.”

Returning to Mr Kellner’s assertion that the public over-estimates the prevalence of immigration, Mr Goodhart said that it is often quoted that the public think 30 per cent of the British population are immigrants, a figure that is, in fact, more like 13 per cent. “But most people don’t distinguish between immigrants and settled minorities,” he said. Taking that into account, the public’s estimation is not that far from the actual figure, which he stated at 25 per cent.<sup>13</sup> “They are not making a huge miscalculation,” he said, “they are making a category error – and an understandable one.”

Similarly, the size of the Muslim population is often cited as an area where the public over-estimate. Polls have indicated people think Muslims make up 15 per cent of the country, when in fact they make up only 5 per cent. “I think in that case it’s down to the focus on Muslims every now and then in the media when there are Muslim-related troubles of one kind and another.”

Mr Goodhart said that he thinks the British public are far less reactionary than many liberals give them credit. “Look at the changing attitudes to gender and race over the last 40 years [...] Compare the Falkland’s War to Danny Boyle, and I think that sums up how – though people still feel a strong attachment to nation – it’s a much less chauvinistic one.”

He added that there are some areas where the perception of the public is completely in line with what is actually occurring. “So, in the 1990s, when net immigration was close to zero, anxiety about immigration was close to zero too.”

In closing, Mr Goodhart said: “Welfare tourism is not very prevalent [...] but what it seems to be symptomatic of is a great, baggy concept of ‘non-discrimination’ [...] Essentially, this means anyone from the European Union can come to Britain and be treated exactly like a British citizen more or less from the start [...] People think this is wrong.”

## **Discussion**

The first participant said the plenary ought to be rather grateful to Mr Goodhart for giving a level-headed view on what is a major problem.

The second participant asked for a point of order, “This is a statistics conference,” he said, “we should get the statistics right: the white population of Britain is 86.1 per cent, so 13.9 per cent is the figure for non-whites.”

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<sup>13</sup> This figure was hotly disputed in the discussion section of the session

Mr Goodhart responded by saying that he was speaking only about England and Wales, and that he believed his figure of 25 per cent was accurate.

Another participant said that the population of Scotland is only 6 per cent of Britain, so that would not account for the significant difference in the statistics. He added that he didn't think this was even relevant because it is clear that the public over-estimate certain things, like the median income. "People think the median income is double what it actually is."

The next participant said that, though she agreed with Mr Goodhart's point that the British public at large were not an uneducated or reactionary set of people, she thought the debate had little to do with statistics. "This is a debate about culture."

Mr Kellner said that he agreed. "[In this debate] people employ statistics as weapons," he said, "but do we think that if there were better statistics out there that this would improve the debate or not?"

Most participants said that they thought it would.

The next delegate to speak questioned the argument over the fiscal benefits or otherwise of immigration. "What we're often guilty of doing with statistics is taking a very narrow view of a very complicated system," he said, "without applying a reasonableness test."

"We should stop telling people that we are going to put 'the truth' out there, which is a statistical number, because in reality it is not the truth. [...] So, in the immigration debate we can ask ourselves: 'do we think that large countries are richer than small countries?' the answer is no, there's no evidence for that. So why do we think that if we invited more people over to Britain in the long term we would end up richer? The only reason you come up with these statistics is because you're taking a point in time before the whole system has worked through to a new equilibrium."

The last participant to speak maintained that to get the right figures out is always useful to a debate. With reference to Mr Goodhart's assertion that such debates were 'emblematic', the participant said: "A lot of these debates are about the emblematicity, rather than just the facts [...]. If people project their own prejudices onto the statistics, then you get nowhere."

## Panel on Education - Improving the understanding of risk and the better use of statistics

### Session Six

Chair: Professor Anna Vignoles, *Professor of Education, University of Cambridge*

Professor David Spiegelhalter, *Winton Professor of the Public Understanding of Risk, University of Cambridge*

Dr Mary McAlinden, *Discipline Lead for Mathematics, Statistics and Operational Research, Higher Education Academy*

Professor Kevin McConway, *Vice President for Academic Affairs, Royal Statistical Society, Professor of Applied Statistics, Department of Mathematics and Statistics, The Open University*

**Professor Anna Vignoles** said that in many ways this session constituted the heart of the conference on statistics because it deals with the methods used to improve people's understanding of statistics. The two strands of the debate, as she saw it, were as follows:

- Statistical knowledge. i.e. knowledge of method
- Perceptions and biases and whether education can redress them

**Professor David Spiegelhalter** said that statistics in the media suffered from two problems. Firstly, there was the way statistics are used in stories as weapons to fulfil an ideological standpoint; and secondly by an unnuanced understanding of number. "Statistics are useful but they are not the end of the story," he said.

"The BBC has just appointed a head of Statistics, Anthony Reuben," he added, "So there is some hope in the way things are going."

The introduction of Core Maths to the post GCSE syllabus will mean that good students can no longer stop maths at 16 and continue through education. Revisions within the maths GCSE syllabus also mean that there will be more probability and more statistics-linked work in there too.

"There is, however, a more general problem about where statistics lies in the education system," he said. "Should it be part of maths? Or part of another subject?"

With regards to policy, Professor Spiegelhalter said that statistics is in a period of change. "Personally, I think [government] can do much more transparent communication but, as we have heard today, communication is not just telling someone something and expecting them to be grateful. You have got to engage with people."

Professor Spiegelhalter said that ministers need to acknowledge scientific uncertainty more, "and trust the public not to be silly about things and that they can handle more nuanced messages"

**Professor Kevin McConway** said: "Most people in higher education that are studying statistics are not doing so because they chose to – it's part of their studies in Social Sciences, Economics, Business. It is therefore a pretty difficult role to fulfil from the teacher's point of view – you have to persuade people it's relevant."

Similarly, he said, there are students of mathematics who do not like to study statistics because – when faced with a model that is wrong but useful - they do not like the subjective nature of their findings.

“The Smith Report on post-14 mathematics in schools came out 10 years ago almost to the month,” he said, “and one of the very interesting things that was in there was a proposal that statistics should be taught, not as part of maths, but as part of those subjects that use it.”

In closing, Professor McConway offered his own thoughts on where Statistics should fall within the curriculum. “Statistics should be taught as part of a discussion on rational argument,” he said, “and form part of the understanding of the scientific method.”

He added that teaching people about rational argument was deeply unfashionable at the moment in this country. “We are much more concerned with teaching people which came first, the battle of Trafalgar or the battle of Waterloo.”

**Dr Mary McAlinden** said that she would draw attention to a project being carried out by the Higher Education Academy which has been looking at mathematical skills across a range of disciplines. The work has ranged from disciplines in the sciences, e.g. chemistry to those in the social sciences e.g. geography.

With a particular focus on the transition into higher education study in the disciplines, this project work has brought together teachers, policy makers and those working within higher education to discuss the issues.

Mathematics anxiety and numeracy skills are areas which are issues for some students who struggle with mathematical/statistical work in higher education.

For the students that do come into higher education, it is important to make sure that the support that is available is such that students will be able to progress with their courses.

Higher education has an important role to play in terms of the messages it sends out to the pre-university sector about the need for mathematical and statistical skills.

## **Discussion**

Professor Vignoles asked the panel if they thought the new investment in teaching statistics to social sciences undergraduates was too little too late.

Professor McConway said that he thought it was. “You have to lay the ground work. Once students are at university, you have to go through the whole process of convincing them they should be doing [statistics] while you’re teaching them.”

The first participant to speak commented that while the school curriculum is far more enlightened than it used to be, there has been a decline in teaching numeracy.

The second delegate to speak said that, to his mind, the only problem that needed fixing was the specialisation after GCSE. “In North America you cannot get rid of mathematics unless you leave school, essentially. If you are going to university you had to, and you still have to, do math no matter what you’re going to do.”

“The problems with education in this country are deep,” he said, “and you are not going to solve them with one alteration.”

Other participants talked about the classification of statistics. One delegate remarked: “I do think that a statistics department ought not to be contained within a faculty of mathematics. Science is the root of it.” While he taught at UCL, the delegate added, he was pleased to see the name changed from the department of statistics, to the department of statistical science.

The participant that followed suggested that universities in the UK get rid of the single-subject honours courses. “The insulting language that is used against people who prefer a broader-based degree system proves that they are right.”

“I’ve also been looking at MOOCs,”<sup>14</sup> he added. “Stanford have a good one but is at an advanced Master’s level. There should be more courses that are accessible for the general public.”

The next speaker spoke about a report produced by the Royal Statistical Society called “A World full of Data.” He said that where statistics has infiltrated many subjects at degree level, the same cannot be said of GCSE courses. The report concluded that there is a huge need for engagement with data for school-age pupils.

Professor Spiegelhalter said that he agreed. He added that there seems to be a prevalence of opinion in the data science world that says: “If you have enough data, it will speak for itself.” This is an attitude that frustrates statisticians, because it ignores the interpretive power of their field. He added that he thought there were five great insights that the study of statistics provides:

- Sampling variability
- Selection bias
- The problems with multiple testing
- Correlation is not causation
- Regression to the mean

“If you have an enormous amount of data,” he concluded, “the only one of those insights that could disappear a little bit is the first one; the others would all get worse.”

Another participant criticised the fact that, so often, discussions of educational reform are carried out among experts (or interested parties) within the field. He said that to get people interested “we need to understand the cognitive approach [to life] people have as a default. We will never do this talking to other statisticians.”

He added that, to see a positive example of engagement, the plenary should look up Dragon Box, a new app designed for children that teaches them algebra – not through number, but through symbols that behave like numbers and mathematical processes.

“It has been developed by people who have said to themselves: ‘You do not learn through arithmetic’ [...] you learn from the idea that these are conceptual processes – things eliminating each other and balancing. It is that kind of cognitive understanding that lies at the heart of people [engaging outsiders] well.”

The next participants spoke about the debate between Daniel Kahneman and Gerd Gigerenzer over rationality. Kahneman says that because humans have cognitive biases they need to unlearn ways of thinking and study incredibly advanced intellectual process to get around them; Gigerenzer says that no one does any overly analytical thinking intuitively, so the necessity is to teach people from the foundations they already possess.

The final participant to speak criticised the terminology that accompanies the study of statistics. “Terms like ‘standard deviation’, and ‘standard error’ are immediately confusing to anyone who hears them.”

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<sup>14</sup> Massive Open Online Courses