Introduction

Welcome to the **Statistics in a Changing Society - 175 Years of Progress**, the RSS 2009 International Conference in Edinburgh.

This book includes abstracts of over 260 presentations being made during the conference, in this order:

- Plenary speakers in order of presentation
- Invited, contributed and special sessions in the same order as they appear in the programme
- Poster presentations in alphabetical order by author surname.

All posters will be on display at the reception at The Hub on Tuesday evening and then those presented by 'career-young' statisticians will be displayed in the refreshments and exhibition areas of the conference venue for the remainder of the week.

Finally, please note that the Conference Programme Committee allocates contributed papers to topics in an effort to ensure (as far as is possible) the coherence of sessions, and this may not accord with the topic requested by the presenter.

I hope you enjoy the conference

Paul Gentry
RSS theme manager for conferences and meetings

Plenary speakers

Sir David Cox
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The Royal Statistical Society: past, present and future

A broad view will be given of some of the strands of activity of the RSS. A few possible implications for the future will be outlined.

David Cox read Mathematics at Cambridge and his first posts were in Dept of Mechanical and Structural Engineering, Royal Aircraft Establishment Farnborough and then at Wool Industries Research Association, Leeds. Subsequently he held positions at Cambridge, University of N Carolina, Birkbeck College and from 1966 to 1988 at Dept of Mathematics, Imperial College. From 1988 to 1994 he was Warden of Nuffield College, Oxford.

In retirement he has been attached to Nuffield College and Dept of Statistics, University of Oxford. His research interests are in applied and theoretical statistics.

Sir Iain Chalmers
James Lind Library

Controlled trials and the RSS at 175

My talk will present a chronological selection of RSS Fellows who, since 1834, have encouraged recognition of the needs:

- for medicine to exploit 'the numerical method'
- to address allocation bias and to study adequate numbers of events
- to increase statistical precision by synthesizing data from separate but similar studies
- to explain the fundamentals of controlled trials for non-statisticians
- to conceal allocation schedules
- to exploit record linkage to investigate possible adverse effects of drugs
- to study substantially larger numbers of events to detect plausible effects of treatments
- to improve the quality of reports of research

Most of the material on which I will draw can be found in the James Lind Library, www.jameslindlibrary.org, a website with material (in seven languages) explaining and illustrating the evolution of fair tests of medical treatments.

Reference

The James Lind Library Editorial Team: Chalmers I, Milne I, Tröhler U, Vandenbroucke J, Morabia A, Tait G, Dukan E. The James Lind Library: explaining and illustrating the evolution of fair tests of medical treatments. Journal of the Royal College of Physicians of Edinburgh 2008;38:259-64.

John Beddington
UK Government Chief Scientific Advisor

Professor John Beddington was appointed as the UK Government Chief Scientific Adviser (GCSA) on 1 January 2008. John's main research interests are the application of biological and economic analysis to problems of Natural Resource Management including inter alia: fisheries, pest control, wildlife management and the control of disease.

He started his academic career at the University of York and spent three years on secondment from York as a Senior Fellow with the International Institute of Environment and Development. He has been at Imperial College since 1984, where he headed the main departments dealing with environmental science and technology. He was Professor of Applied Population Biology at Imperial until his appointment as GCSA.

He has been adviser to a number of government departments, including the Foreign and Commonwealth Office (on Antarctic and South Atlantic matters), the Department for Environment, Food and Rural Affairs (where he chaired the Science Advisory Council), the Department for International Development, the Ministry of Defence and the Cabinet Office. He was for six years a member of the Natural Environment Research Council

He has acted as a senior adviser to several government and international bodies, including the Australian, New Zealand and US Governments, the European Commission, the United Nations Environment Programme and the Food and Agriculture Organisation. In June 1997 he was awarded the Heidelberg Award for Environmental Excellence and in 2001 he became a Fellow of the Royal Society. In 2004 he was awarded the Companion of the Order of St Michael and St George by the Queen for services to fisheries science and management.

Helen Joyce
The Economist

The use of charts, graphs and data in journalism

Helen Joyce is a correspondent for The Economist and a former editor of Significance.

She will be talking about the use of charts, graphs and data more generally in journalism, using examples from both publications. Of particular current interest to her are the new possibilities created by the web.

Dr John Haigh
University of Sussex

The Kieran Fallon trial – before and after

How a statistician became involved in this court case, the statistical issues that arose, and the aftermath.

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Darwin, Galton, and the Statistical Enlightenment

The half-century period that might justly be called the Statistical Enlightenment was inaugurated in Scotland on Thursday September 10, 1885. That event grew from a puzzle present in Darwin's 1859 Origin of Species, a puzzle that initially lay unnoticed (even by Darwin) until it was seized upon and finally solved by Darwin's equally remarkable cousin, Francis Galton.

These anniversaries will be saluted, and the circumstances will be related of how Darwin's work provided both an impetus for and a barrier to Galton's epochal advance.

Stephen M. Stigler is the Ernest DeWitt Burton Distinguished Service Professor and Chairman of the Department of Statistics at the University of Chicago, where he has taught for 30 years. He has served as Editor of JASA: Theory and Methods, and as President of the Institute of Mathematical Statistics and of the International Statistical Institute, and is the author of The History of Statistics: The Measurement of Uncertainty before 1900 (1986), and Statistics on the Table (1999), both published by Harvard University Press.

Dr David Wishart

The flavour of whisky – an illustrated talk and tutored tasting

Discover the flavours of Scotch malt whiskies at this talk and tasting by Dr. David Wishart, Fellow of Management at the University of St Andrews, and author of Whisky Classified: Choosing Single Malts by Flavour.

Dubbed the "Carl Linnæus" of whisky by whisky writer Charles MacLean, David Wishart was the first to categorise single malts by flavour. His classification of single malt whiskies by their flavour is fully endorsed by the Scotch Whisky Industry, which honoured him by designating him a "Keeper of the Quaich" in 2006.

David will guide you through the history and romance of Scotch whisky, from the aqua vitae of the early monasteries, the alchemist's art of turning barley into medicine, and the hedonistic uisge beatha of remote Scottish crofts, to the taverns of Edinburgh's Royal Mile and hot toddies in the New Town. The surgeon barbers' monopoly in licensing whisky in 16th century Edinburgh spawned illicit stills in Highland glens, battles with excisemen, and smuggling into the Royal Mile.

The Royal romance with "Scotch" started with George IV in 1822, blossomed under Queen Victoria at Balmoral, and continues with the Prince of Wales today. Whisky is evoked in the poetry of Burns, in the travelogues of Stevenson, and in the art of Landseer and Wilkie.

Sara Hughes
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The future of statistics and of the Royal Statistical Society

The pharmaceutical industry is currently facing several challenges. With the belief that many of the big 'blockbuster' medicines have been found already, with numerous companies facing patent expiry 'cliffs', all against a backdrop of increasing demands from regulatory bodies regarding the level of evidence required for approval and reimbursement of medicines, the industry is constantly striving to increase efficiency.

Statisticians are being asked to play a key role in this and will need to adapt and develop both their technical and soft skills in order to survive. I will briefly discuss these challenges and the adaptations I believe are required both by individuals and by the professional societies.

Sara Hughes is a Statistics Director sitting on the Leadership Team of the Infectious Diseases Medicines Development Centre at GlaxoSmithKline, and supporting regulatory and commercial work for existing and new HIV compounds. Sara is also the outgoing Chair of PSI (Statisticians in the Pharmaceutical Industry), and has been a member of the PSI Board of Directors since 2001, coordinating their annual conference for a number of years including the joint conference with RSS in 2005.

She is also a member of the Royal Statistical Society Council and is an industry advisor for the Statistics unit at Manchester University. Sara has a First Class Honours degree in Mathematics from the University of Manchester, an MSc in Statistics from the University of Kent, and is a Chartered Statistician with the Royal Statistical Society.

Karen Dunnell
Former National Statistician
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Perspective from Official Statistics

Challenges and opportunities in the future

- Demand and scope
- Organisational issues
- Methodology and technology
- The Statistics Act
- Government Statistical Service
- Resources

Dame Karen Dunnell is the National Statistician and the Chief Executive of the new Independent UK Statistics Authority.

Karen Dunnell started her career as a health care researcher and lecturer. She joined the civil service in 1974 to work on social surveys in OPCS – one of the departments that merged to form ONS in 1996. She carried out several bench mark surveys in the health and demography fields before promotion to manage a large portfolio of surveys. This included the GHS, the 1985 series of disability surveys and OPCS's programme for the Department of Health.

In 1990 she moved to run health statistics – which was expanded to include demography when ONS was formed. In 1999 she moved to the centre of ONS leading the Division that supported the ONS executive, prepared and launched National Statistics in 2000 and paved the way for Len Cook the first National Statistician.

In September 2005 she was appointed National Statistician and Registrar General for England and Wales to succeed Len Cook.She has recently been awarded an Honorary Fellowship of Cardiff University, elected to a visiting fellowship at Nuffield College, Oxford and awarded an Honorary Doctorate from Middlesex University. In the Queen's birthday honours 2009 received the title Dame Commander of the Order of the Bath (DCB).

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The role of the emerging generation

Statistics, as a discipline, is facing pressure from the ubiquitous computing approaches that give researchers without proper statistical awareness an ability to "solve" their own statistical problems. The discipline is in severe danger of being marginalised.

The emerging generation of statisticians, and the Society, have a key evangelising role to play to demonstrate to scientists, media, government, and the public that proper statistical approaches must be at the centre of all "evidence-based" decision-making, and without careful analyses mistakes will be made.

I contend that the best way to do this is to work together in the Society and to be inclusive of the target audiences. But above all communication is crucial – we need to get out there and proselytise!

David Leslie received his undergraduate training at Cambridge, then his PhD from the University of Bristol in 2003. He took up appointments in the Universities of Oxford and New South Wales before returning to Bristol in 2006. He is now a lecturer in statistics at the University of Bristol, a Council member of the Royal Statistical Society, and a committee member of the Statistical Computing Section. His research interests are in machine learning, online estimation, and game theory.

Professor Denise Lievesley
School of Social Science and Public Policy, King's College London

The RSS is part of a network of statistical societies, at national, regional and international levels. Denise will discuss how the RSS might act in this network to further the development of the discipline of statistics and its application, as well as education in statistics, across the world. She will focus particularly on some of the problems faced by statistical societies in poorer countries and will raise questions as to our responsibilities to help such societies get established. There is potential to build upon the key role played by the RSS in ensuring that the UK has trusted and trustworthy statistics to impact on the international statistical system.

Professor **Denise Lievesley**, a social statistician by training, is the Head of the School of Social Science and Public Policy at King's College London a position she took up in October 2008. She holds a chair in Social Statistics. Leading up to joining King's College London she was special advisor at the African Centre for Statistics of the UN based in Addis Ababa.

Denise was, until July 2007, the founding Chief Executive of the English Information Centre for Health and Social Care. Formerly she was Director of Statistics at UNESCO for seven years where she established its new Institute for Statistics.

Denise began her career as an official statistician specialising in survey sampling and subsequently conducting research on non-response and on panel surveys at SCPR (now the National Centre for Social Research). Later she was the Director of the UK Data Archive as well as Professor of Research Methods in the Mathematics Department at Essex University.

She has an honorary doctorate from City University in London and is a fellow of University College London. She has held visiting professorial positions at City University, the University of Durham and INRS in Montreal in Canada.

Denise is very active in relevant professional associations:

She was President of the Royal Statistical Society from 1999 to 2001, and has just completed a two year term as President of the International Statistical Institute, the first woman to hold this office. She has been the President of the International Association for Official Statistics, and was the international representative on the Board of the American Statistical Association for three years to the end of 2007.

Denise chairs the methodology committee of the European Social Survey and remains active in the development of social research methods and in research ethics. She is a Trustee of the National Centre for Social Research, a member of the executive board of the Institute for Fiscal Studies and is a fellow of the Academy of the Social Sciences. She has recently been appointed chair of the newly established European Statistical Advisory Committee.

Invited, contributed and special sessions

Professor Avner Bar-Hen
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Presentation of the French Statistical Society

In this talk, I will present the French Statistical Society. I will also address the future challenges facing our Society as an organisation and also the challenges facing our membership.

Professor at University Paris Descartes. President of the French Statistical Society.

Interest: Statistics for Ecology (forest dynamic, point process) and phylogenetic.

About 70 peer-reviewed papers.

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Swedish Statistical Society – the meeting place for Swedish statisticians (and friends of statistics)

The presentation will contain three parts:

1. Some facts about Sweden

2. The statistical environment in Sweden

3. The Swedish Statistical Society – its background, activities and future challenges

Bernard Huitfeldt: PhD in statistics from Uppsala university 1972, seniour lecturer at the Statistics Department of Uppsala university 1968-1973, Head of Medical Statistics at Astra Läkemedel 1974-1987, Head of Biostatistics at Pharmacia LEO Therapeutics 1988-1993, Head of Biostatistics at Astra Arcus 1994-1999, Global Director of Biostatistics at AstraZeneca 1999-2005, Private consulting 2006-, President of Swedish Statistical Society 2008 -

Professor Harvey Goldstein
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Handling attrition and non-response in longitudinal data

Procedures for handling attrition and missing data values in longitudinal studies are discussed. A multiple imputation (MI) strategy is developed that can be applied to complex multilevel data and can handle properly mixtures of normal and categorical variables where values are missing. It is both general and statistically efficient and MCMC estimation software is available.

An example of its use is given. It will be contrasted with traditional weighting procedures that, by contrast, can be unwieldy and typically are inefficient. A new 'weighted' version of multiple imputation that can incorporate sampling weights will be outlined.

Harvey Goldstein was formerly Professor of Statistical Methods at the Institute of Education from 1997-2005. He is currently Professor of Social Statistics at the University of Bristol.

He has been a member of the Council of the Royal Statistical Society, and chair of its Educational Strategy Group. He was awarded the RSS Guy medal in silver in 1998 and was elected a fellow of the British Academy in 1997. He has been the principal applicant on several major ESRC funded research projects since 1981.

He has two main research interests. The first is the use of statistical modelling techniques in the construction and analysis of educational tests with a particular interest in institutional and international comparisons. The second is in the methodology of multilevel modelling. His major recent book, Multilevel Statistical Models (Arnold, 2003, 3rd edition) is the standard reference text in this important area of statistical data analysis.

Professor John Bynner
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Longitudinal and Life Course studies – a new interdisciplinary international journal

The new peer-reviewed international journal, Longitudinal and Life Course Studies, fills a gap in the academic literature in a burgeoning area of interdisciplinary, peer-reviewed study. The journal which produced its first issue in April this year is published online, giving free access throughout the world to the papers published in it and the news items and events of interest to people engaged in, or using the results of, longitudinal and life course studies.

The presentation will state the principles guiding the selection of papers for the journal including comprehensive peer review conducted principally by the 70 strong Editorial Board coordinated by 4 section editors. It will also discuss the areas of content related to scientific disciplines in the social and health sciences and statistics that the journal covers. The publication procedures through the open journal system electronic publishing package will also be briefly described.

The talk serves as an introduction to two research papers by, respectively, Harvey Goldstein and Bianca de Stavola and colleagues, exemplifying the kind of statistical content that the journal will seek to publish.

John Bynner is currently Emeritus Professor of Social Sciences in Education at the London Institute of Education and until retirement through 2003/2004 was Director of the Bedford Group for Life course and Statistical Studies, the Centre for Longitudinal Studies, the Wider Benefits of Learning Research Centre and the Joint Centre for Longitudinal Research. He also directs Longview, a think tank promoting longitudinal research. Research interests include: basic skills, economic and political socialisation, social exclusion risks, wider benefits of learning and comparative and longitudinal research methods.

Dr BL De Stavola
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Familial and socio-economic influences on foetal growth across three generations: the Uppsala Birth Cohort Multigenerational study, Sweden, 1915-2002

Size at birth is a key indicator of the health of the newborn and a predictor of subsequent morbidity and mortality over the life course. Foetal growth is known to be influenced by familial factors, with twin and family studies having attributed 30-40% of the variance in birthweight to genes (maternal and foetal). However parental size partly reflects social disadvantage from earlier generations.

We will analyse unique data across three generations from the Uppsala Birth Cohort Multigenerational (UBCoS Multigen) Study to quantify the continuities in biological disadvantage that can be attributed to earlier social disadvantage. UBCoS Multigen includes social and demographic variables on males and females born in Uppsala during 1915-1929, and on their children and grandchildren, if born before 2003.

Path analysis will be employed to partition the size at birth associations between grandparents and their grandchildren into genetic, generation-specific and intergenerational environment contributions.

The role of missing data and the inclusion of the missing data mechanism in the model will be discussed. Comparisons with the results obtained from standard linear regression modelling will be drawn and some general conclusions suggested.

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A new method for constructing exact tests without making any assumptions

We present a new method for constructing exact tests (and confidence intervals) without making distributional assumptions. In particular it applies to nonparametric settings. The method separates the search for a powerful exact, possibly randomized test from the goal to create a nonrandomized test. The method is new to statistics and only has been previously used once in statistical decision making.

As one application we present the first exact test for testing the equality of two means based on two independent samples. Similarly we show how to construct exact tests of noninferiority. To apply our test one only has to know a bounded interval that contains all outcomes. Note that the most popular test testing equality of means, the t test, has size equal to one for any given sample size if, as we assume, no distributional assumptions are made.

With this new method, one first constructs an exact but randomized test for comparing means by reducing the environment to one with binary outcomes using a random transformation. Then one eliminates randomness by recommending a rejection when the probability of rejection under the randomized test is above a threshold, adjusting the size of the randomized test so that the nonrandomized test based on the threshold achieves the desired level. A formula that bounds type II error is provided, relative efficiency in the given finite sample can be measured. Proofs are very simple.

Tests in terms of variance and covariance are similarly constructed by reducing them to tests relating to means. The method also allows to construct tests for stochastic inequality, tests that do not require knowledge of an interval containing all outcomes.

Tests are illustrated by means of examples. The success of laser treatment is investigated, the effectiveness of common law is compared to that of civil law in 72 countries, the added value of using computers to help Indian children in school as compared to tutors is tested.

The paper containing all references can be downloaded from

http://www.econ.upf.edu/docs/papers/downloads/1109.pdf

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Nonlinear Principal Component Analysis with missing data: a forward imputation approach

Nonlinear Principal Component Analysis (NPCA) is a well-known dimensional reduction technique for categorical data, typically adopted in different fields for the setting-up of indicators. The basic form of NPCA assumes the minimization of a loss function which contemplates three objects: the scores, the category quantifications for each variable and the variable loadings (see Gifi, 1990 or Michailidis and De Leeuw, 1998 for details).

When missing data are present, the loss function includes a binary matrix M with the role of indicating missing observations. This indicator matrix assumes three different forms, leading to three standard options for missing data treatment: (i) M is left incomplete (missing data passive); (ii) M is completed by adding a single column for each variable with missing data (missing data single category); (iii) M is completed by adding multiple columns for each variable with missing data (missing data multiple categories).

We propose an alternative algorithm for missing data treatment in NPCA based upon an iterative algorithm which considers: 1) the split of the original matrix in a complete matrix not affected by missing data and in as many matrices as are the distinct numbers of missing data for each observation; 2) for each row of the missing data matrices, the nearest imputation missing data method is implemented with the use of loadings and quantifications from an NPCA performed on the complete matrix. The missing data are then updated with the values of the closest observation in the complete matrix and each new row is then appended in the complete matrix. The algorithm continues until a final NPCA is performed on a complete matrix with no missing data.

This approach is more general than standard methods and can be particularly useful when missing data are MCAR as well as when questionnaires are such that the presence of missing data is dictated by the particular questionnaire structure (presence of “go-to” questions, possibility of “not applicable” answers, etc.). Its performance is evaluated through a simulation study. An application to a customer satisfaction evaluation context is described and discussed.

References:

Gifi, A. (1990) Nonlinear Multivariate Analysis. Wiley, New York.

Michailidis, G. and de Leeuw, J. (1998) The Gifi System of Descriptive Multivariate

Analysis. Statistical Science, 13(4): 307-336.

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Bootstrap estimation in practice: correcting for sample attrition in Canada's National Longitudinal Survey of Children and Youth

Comparable in some ways to the UK's Millennium Cohort Survey, Canada's National Longitudinal Survey of Children and Youth (NLSCY/ELNEJ) is a multi-year project that collects data representing selected cross-sectional and longitudinal populations of children and youth in Canada's ten provinces. Since each of Canada's ten provinces is responsible for its own education, health and social services the NLSCY provides a useful tool for assessing the effects of policy innovations: the best-known current example being Quebec's initiative of providing state-subsidized group day-care (currently costing the parent $7 per child per day) to all residents of the province.

Several "early child development" cohorts have been followed up from ages 0-1 year old and represent longitudinal populations of children born, respectively, in 1992-93 (the "original cohort"), 1994-95, 1996-97, 1998-99 and 1999-2000. Those 0-1 year olds born in 1992-93, 1996-97 and 1998-99 have each been contacted at least four times. Supplementary samples have been selected in such a way as to represent cross-sectional national populations of children every two years from 1994-95 to 2005-06.

The data arise from multistage probability samples that are not self-weighting. Response rates have been high but, as with all surveys, there is an element of non-response and the longitudinal samples were subject to attrition. Comparisons of achieved samples with the distributions of key variables in Census data have led to the incorporation of post-stratification components into the sample weights. In addition Statistics Canada provides sets of bootstrap weights for BRR estimation.

While many analyses published to date have been cross-sectional the NLSCY provides ample scope for answering questions about longitudinal populations, using fixed effects, population averaged and survival models.

This paper reports on how household and neighbourhood factors affect child health and cognitive outcomes up to age ten. Substantive findings include that over 40% of children had changed neighbourhoods over a six to eight-year follow-up period and that both health and cognitive outcomes can be predicted from time-varying neighbourhood and household socioeconomic factors. Methodologically the paper demonstrates the importance of using bootstrap weights for the estimation of standard errors in longitudinal surveys: a technique that will be increasingly important in the future.

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Components of adjustment to regression sums of squares and their representation on a new generalisation of the Venn diagram

Where there are only two explanatory variables in a non-orthogonal linear regression, the analysis of variance is easily interpreted. Difficulties may arise, however, when there are three or more explanatory variables due to the mutual adjustment of the sums of squares. The problems are most troublesome in the case of suppression or masking.

We introduce a new approach in which the adjustment to the sum of squares of each explanatory variable is analysed into components due to the different covariates. We propose a table be drawn up for each explanatory variable showing the unadjusted and fully adjusted sums of square together with the contribution made to the adjustment by the other variables, alone and in combination. The paper demonstrates the use of this approach in deciding which variables to include in a model.

The Venn diagram is used to aid interpretation in the case of two explanatory variables but fails when suppression is present. We show a new generalisation of the Venn diagram that extends its use to the representation of non-orthogonal sums of squares for up to three explanatory variables with or without suppression. The components of adjusted sums of squares map directly onto regions of the generalised Venn diagram via a simple algebraic manipulation.

The methods are illustrated with data from the Scottish Health Survey (2003). Waist circumference is regressed on walking pace, age, occupation and family history of cardiovascular disease.

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Surviving slavery: mortality at Mesopotamia, a Jamaican sugar estate, 1762 –1832.

We use survival analysis to study the mortality of 1111 slaves living on the British West Indian sugar plantation of Mesopotamia for seven decades prior to the Emancipation Act of 1833.

Using three different concepts of analysis time and employing non-parametric and semi-parametric methods, our results suggest that female slaves first observed under the ownership of Joseph Foster Barham II (1789-1832) faced an increased hazard of death compared with those first observed during his predecessor's tenure. We find no such relationship for males.

We cite as a possible explanation a change in employment regime associated with Foster Barham II's voluntary withdrawal from the transatlantic slave trade, which resulted in increasing numbers of female workers being allocated to gang labour in the cane fields. A G-estimation model used to compensate for the `healthy worker survivor effect' estimates that continuous exposure to such work reduced survival times by between 20 and 40 per cent.

We relate our findings to the wider historical literature investigating the reproducibility problem of enslaved populations in the West Indies and the long-term demographic viability of Caribbean sugar estates.

The work illustrates the rich insights and perspectives that inferential statistics can bring to a large literature which, do date, has been dominated by qualitative and descriptive analyses.

A discussion paper which outlines our research in more detail is available from:

http://www.york.ac.uk/depts/econ/documents/dp/0903.pdf

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A newly-discovered statistical framework of 1631

The talk will describe a newly-discovered English document of 1631 which can be regarded as a basis for "political arithmetic", listing the various items which should be considered in assessing a country's strength.

Although the idea of studying a state methodically started to appear in books published on the Continent in the late 16th century, no English work on the subject seems to have been printed until Sir William Petty's books from 1662 onwards. This manuscript shows that thought was at least being given earlier than this in England to the items which should be examined by "a Statist that desires to look through a Kingdom", as the document puts it.

Although the document contains no data or analysis, it is of considerable interest as an early statistical framework for the collection of data, of both a physical and financial nature.

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Statistics in Australia – the adolescent era

Prior to the 1930s there was little to stimulate the growth of statistics as an academic or professional discipline in Australia. Statistical activity was until then largely confined to the collection and interpretation of official statistics. The "adolescent era" discussed in this paper runs from the 1930s to the early 1960s.

Before the Second World War primary industries predominated in Australia and in the 1930s agricultural advisory services began to show an interest in the statistical methods being developed by Fisher and others. Some turned for help to classics like Fisher's Statistical Methods for Research Workers or (somewhat later) to the more user-friendly Snedecor's Statistical Methods. Their only hope of obtaining local assistance was to approach some of the resident mathematicians, most of who specialized in what we now describe as classical Pure or classical Applied Mathematics.

This paper describes:

1. An early approach from an agricultural research worker to a pure mathematician that led to the recommendation of a design that was commented upon unfavourably by established statisticians overseas. Not to be put off, that mathematician later became recognised as a world authority on certain aspect of the theory of statistical inference.

2. Some pioneering work by researchers in other fields who realised the relevance of statistical methodology to their work.

3 The influence of visits to Australia by eminent statisticians from Europe and America.

3. The growing recognition of statistics as an academic discipline.

4. The role and influence of work done by statistical units in government sponsored research organisations.

5. Interaction between statistical activities in Australia and those in the rest of the world.

Brief comments will be made on developments in Australia since the 1960s.

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Learning from a random sample of the history of RSS external relations

For Founders' Day, I was asked to talk about RSS and external relations.

To recall the history of RSS external relations, I selected a 4% stratified random sample of years as follows: 1839, 1865, 1886, 1925, 1941, 1961 and 1985. I recount delightful findings from the sampled years from the Reverend John Clay, chaplain to the House of Correction in Preston, to Sir Walter Bodmer's presidential address on Public Understanding of Statistics.

I discovered that our modern-day efforts to engage with journalists and parliamentarians – as intermediaries in the public's understanding of statistics - were well-anticipated by our Founders. Much in the history of statistical science bears repeating. As statisticians, we should not only investigate but also influence effectively.

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Estimating seroprevalence: the impact of assay standardisation

The aim of the European Sero-Epidemiology Network 2 (ESEN2) project was to estimate age-specific sero-prevalence for a variety of vaccine-preventable diseases in over twenty European countries. This should provide important information for tackling infectious diseases on a European level, and enable assessment of progress towards World Health Organisation disease elimination targets.

To achieve this, serological samples were collected and tested by each country using their usual assays. To adjust for between-assay and between-laboratory variability, each country's quantitative results were transformed to a reference laboratory's units by applying standardisation equations derived through all countries testing a common panel of sera. Once all measurements were standardised, they were classified as positive or negative in accordance to the reference centre's assay cut-off.

The talk will focus on the impact the standardisation equations have on the prevalence estimates by comparing standardised against non-standardised prevalence. It will also be shown how much of these differences are due to between-assay or between-laboratory variability. Alternative techniques using mixture models for obtaining prevalence estimates directly from the non-standardised measurements will be presented and compared to the prevalence obtained by the standardisation method.

Finally, the effect of the reference assay cut-off on the standardised prevalence estimates will be discussed and a method for improving cut-off estimation using mixture models will be presented.

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An efficient sampling scheme for identifying an informative sub-cohort to measure new risk factors for a continuous outcome

Epidemiology studies often establish a parent population and measure outcomes and certain risk factors on all the subjects. New risk factors are frequently examined as the study progresses. Evaluating the new risk factors on all the subjects may not always be feasible due to cost or logistic constraints.

When such constraints arise, the new risk factors must be examined in a sub-cohort of the parent study.

This work proposes a novel study design for identifying an informative sub-cohort within the parent population to measure new risk factors for a continuous outcome. In practice, one can develop a model to predict the outcome using the initial set of risk factors measured on all the subjects. Intuitively, individuals with large residuals very likely require additional risk factors to better explain their outcome.

We demonstrate that results from the residual diagnostics literature provide fundamental insights into this intuition and provide guidance for an efficient stratified sampling scheme. Based on these insights, we propose to suitably stratify the parent population using the residuals, and sample all the individuals with large (positive and negative) residuals and ascertain some individuals having intermediate residual values.

The efficiency properties of the proposed design are demonstrated using data from the ongoing Study of Nevi in Children (SONIC). As a general guideline, evaluating new risk factors on 60% of the subjects from the parent population with half of them having large residuals and the remaining half having intermediate residual values is an efficient strategy.

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Identifiability of models for multiple diagnostic testing in the absence of a gold standard

Evaluating the performance of diagnostic tests for infection or disease is of crucial importance, both for the treatment of individuals and for the monitoring of populations. In many situations there is no "gold standard" test that can be relied upon to give 100% accuracy, and the use of a particular test will typically lead to false positives or false negative outcomes.

The performance characteristics of an imperfect test are summarized by its sensitivity, ie the probability of correct diagnosis for a diseased individual, and its specificity ie the probability of a correct diagnosis when disease-free. When these parameters are known, valid statistical inference can be made for the disease status of tested individuals and the prevalence of disease in a monitored population. In the absence of a "gold standard", true disease status is unobservable so the sensitivity and specificity cannot be reliably determined in the absence of additional information.

In some circumstances, information from a number of imperfect tests allows estimation of the prevalence, sensitivities and specificities, and this practice has become common in the epidemiology literature. It is widely assumed that if the number of degrees of freedom in the data is at least as large as the number of parameters in a model, then the model is identifiable. The contrary fact that models may still not be identifiable, even given this condition, has been known for some time.

We explore the use of a combination of geometric and algebraic arguments for establishing and illustrating local identifiability or non-identifiability of models for multiple diagnostic tests, including cases in which test results may be correlated.

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The Census in Scotland: the same but different

The 10-yearly population Census in Scotland has changed and developed over time. It is also different, in a number of ways, from the Census in the rest of the United Kingdom.

The talk will look at both of these dimensions of difference, and will conclude by looking at the plans for the 2011 Census and some of the early findings from this year's Census Rehearsal.

Peter Scrimgeour is Census Director at the General Register Office for Scotland (GROS). Previously he worked as a statistician in the Scottish Office and the Scottish Executive on a range of subjects including education, housing, industry, local government finance, crime and prisons.

In addition he spent three years in the 1990s based at the Organisation for Economic Co-operation and Development in Paris, working with the countries of the former Soviet Union on developing their price statistics for a market economy. Since 2004 he has been at GROS, planning the 2011 Census.

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Linking the Scottish Longitudinal Study back through time

This talk will introduce the Scottish Longitudinal Study which is a 5.3% sample of the Scottish population, including linked administrative data from the 1991 and 2001 Censuses, vital events registrations and hospital episodes.

The talk will describe the study, present some results of research which has used the study, and then focus particularly on some feasibility work which is being conducted to explore linking the study back through time to historical census and vital events data.

Paul Boyle is Professor of Human Geography and Head of the School of Geography and Geosciences at the University of St Andrews. He is President of the British Society for Population Studies (BSPS). He directs the Longitudinal Studies Centre - Scotland (LSCS), which has established and continues to maintain and support the Scottish Longitudinal Study (SLS), which is one of the world's largest longitudinal datasets for health and social science research.

He is co-Director of the recently funded ESRC Centre for Population Change (CPC); co-applicant on the recently funded ESRC Administrative Data Liaison Service (ADLS); and co-applicant on the Wellcome Trust Scottish Health Informatics Programme (SHIP). Paul has particular expertise in record linkage and the use of routinely collected data in health and social science research. He has published widely in demography and epidemiology.

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The Integrated Census Microdata (I-CeM) project at the University of Essex

The History Department at the University of Essex have been awarded one of the SRC's largest reactive grants to create an integrated dataset of the census returns of Great Britain for the period 1851 to 1911. This builds on existing work on census data carried out at Essex by the staff of the UK Data Archive.

The £1,000,000 plus I-CeM (Integrated Census Microdata) Project will create one of the most important comprehensive historical census data collections in the world, and provide a key resource for British and international historians. The Project team will bring together computerised versions of the censuses, and enhance these through standardisation and harmonisation. They will be working closely with commercial partners, who have created the digitised censuses for genealogical purposes, in a unique exercise in knowledge transfer.

This paper will present the background to the project and describe the problems faced and the tasks required to create the enhanced census data files. Lastly, the future possibility of linking the millions of individuals in I-CeM over time, to create a Victorian Panel Survey, will also be described.

Dr Schürer is Professor of History at the University of Essex and an Academician of the UK Academy of Social Sciences. Since 2000 he has served as Director of the UK Data Archive (UKDA). Prior to becoming Director of the UKDA, he worked for several years as a member of the internationally-renowned Cambridge Group for the History of Population and Social Structure, University of Cambridge. Following this, he moved to a teaching position at the Department of History, University of Essex, returning to the Data Archive in 2000 in the position of Director.

He is an Academician of the Academy for the Social Sciences, a Fellow of the Royal Statistical Society (RSS) and the Royal Geographical Society, and a Senior Member of Wolfson College, Cambridge. He acts as the UK representative for the European Strategy Forum for Research Infrastructure (ESFRI) working group in Social Science and Humanities and currently serves as President of the Council of European Social Science Data Archives. He is also a member of the British Library's Advisory Council, the Research Libraries Network Advisory Committee, the RSS Statistics Users Forum Executive, University of Essex Council, and several other the national and international committees.

He is currently PI on a EC-funded project seeking to create a more fully-integrated social science data infrastructure across Europe via the establishment of a new European Research Infrastructure Consortium (ERIC), and has recently received a major award from the ESRC to create a standardised and harmonized version of the censuses for Great Britain for 1851 to 1911(the I-CeM project).

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The influence of “Regression models and life-tables”

Cox’s famous paper is one of most cited statistical papers ever. Many of those citations are from the medical literature and the paper has had an enormous influence on the analysis of failure times. Thus, “the Cox model” has become the standard tool for regression analysis of such data.

But not only has the paper penetrated the medical literature, it has also had considerable influence on theoretical and applied statistics. Statistical areas strongly influenced by the paper, obviously, include event history analysis but also new areas of partial likelihood and semi-parametric inference have roots directly in Cox’s paper. This development will be reviewed in the talk.

MSc and PhD in mathematical statistics from University of Copenhagen, Denmark 1978, resp. 1982. DrMedSci in biostatistics 1997. Since 1998 professor of epidemiologically oriented biostatistics at Department of Biostatistics, University of Copenhagen. Author of more than 250 papers in the statistical or medical literature and co-author of three books, including “Statistical Models Based on Counting Processes” (with Borgan, Gill and Keiding, Springer-Verlag, 1993).

Geoff McLachlan
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The influence of the EM paper by Dempster et al

This paper considers the influence of the EM algorithm, so named by Dempster, Laird, and Rubin in a celebrated paper read before the Royal Statistical Society in 1976 and published in its journal in 1977. In this paper, a general formulation of the EM algorithm was presented, its basic properties established, and many examples and applications of it provided.

The idea behind the EM algorithm is intuitive and natural and so algorithms like it were formulated and applied in a variety of problems even before this paper. However, it was in this seminal paper that the ideas in the earlier papers were synthesized, a general formulation and a theory developed, and a host of traditional and non-traditional applications indicated. Since then, the EM algorithm has become a standard piece in the statistician's repertoire.

We focus here on the impact of the EM algorithm on statistics. The years subsequent to the introduction of EM have seen the development of modified versions of the algorithm as well as many simulation-based methods and other extensions of it.

We provide an account of some of these extensions, including those developed by Meng (a student of Rubin) and van Dyk (a “grand” student) in their paper read to the Royal Statistical Society in 1996 and published in 1997 to celebrate the 20th anniversary of the presentation of the original paper by Dempster et al. As noted then by Titterington in seconding the vote of thanks of the Meng and van Dyk paper, “the EM algorithm has had an extraordinary influence.”

Geoff McLachlan has a personal chair in statistics in the Department of Mathematics of the University of Queensland. In 2007, he was awarded an Australian Professorial Fellowship.

He is President-elect of the International Federation of Classification Societies. His research has been focussed in the field of machine learning and, more recently, bioinformatics.

In these and other fields, he has pioneered the use of finite mixture models for inference and clustering. He has written a number of monographs, the most recent being the second edition of his joint Wiley monograph on the EM algorithm.

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Teaching statistics as a university service course: an overview of past experiences, present dilemmas, and future challenges

Educational organizations should not be regarded solely as vehicles for social and structural change. They are also expected to preserve and transmit traditional values to younger members of society and thus represent an element of stability in a rapidly changing world. At the same time, they have to react to rapid changes in their environments and offer access to new knowledge to active population as well. It would thus seem that educational services nowadays must somehow succeed in integrating stability and change at the same time.

This is best reflected in curricula of the university service courses on statistics: they have been continuously adapted to the latest developments in information and telecommunication technology (ITT). On the other hand, statistical philosophy, inherent to all steps of the statistical production and dissemination process, represents one of the key elements of the curricula stability.

In other words, while ITT enables a simplified access to course materials, a steady electronic communication flow between lecturers and students, easier and less time-consuming computing, etc., the underlying logic of quantitative reasoning which should be conveyed to students in the teaching and learning process remains unchanged. Additionally (and sadly), another element of stability in university service courses on statistics can be identified: the negative attitude of students towards statistics.

In the framework of this paper we focus both on elements of change and stability while reflecting on past experiences, present dilemmas, and future challenges faced by the teachers of university service courses on statistics.

Irena Ograjenek is an Assistant Professor of Statistics at the University of Ljubljana, Faculty of Economics. At present she is a Chair of the Department of Statistics and a Member in the Department of Marketing. Her current research interests include: (1) application of statistical methods in business (with focus on marketing, especially customer data analysis in the framework of a loyalty programme, measurement of service quality, and measurement of customer satifaction); and (2) new approaches to teaching statistics to business students (with focus on ways to enhance student motivation and quantitative literacy). She is a President-Elect of the European Network for Business and Industrial Statistics (ENBIS), Managing Director of the ENBIS Academic Publications Panel and Editor of ENBIS News.

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Constructing environments for early learning of statistical thinking in higher education

Concepts of statistical citizenship, statistical literacy, statistical reasoning and statistical thinking are increasingly influencing educational developments, policy and research. Combinations of research in learning and teaching in statistics, considerations of the nature of statistical enquiry and how statisticians think, and general educational research have contributed to educational development, principles and strategies in statistics teaching in higher education.

Previous strategies that were teacher-centred, with theory followed by examples, are supplanted by student-centred, data- and context-driven, experiential learning, with emphasis on concepts and development of statistical thinking. Although opinions differ on the balance of structured and unstructured styles, the strengths of problem-solving approaches, student ownership of contexts, and carefully designed and managed constructs of learning and assessment are widely accepted by statistical educators.

Although mathematical models underpin statistical thinking in both data analysis and statistical modelling, the need for greater clarity in distinguishing statistical and mathematical thinking is recognised.

This presentation will discuss the development, implementation and evaluation of higher education learning environments that aim to develop sound foundations in statistical thinking in both data and models, with approaches that integrate experiential learning in data, contexts, problem-solving and communication, within learning constructs designed for steady development of concepts, operational knowledge and skills.

Helen Johnson is currently on secondment as a Biostatistician for the Institute of Health and Biomedical Innovation (IHBI) at Queensland University of Technology, having previously been based in the School of Mathematical Sciences as a Lecturer in Statistics. Helen completed her Honours degree in Mathematics at the University of Manchester, UK, and then moved to Australia to do a PhD in Statistics at the Australian National University.

For the best part of the last 8 years, Helen has lectured statistics to a wide range of students including first year science students, optometry students as well as marketing research and finance students. Her current consulting role within the Research Methods Group at IHBI means that she is exposed to postgraduate students and research staff from all walks of life and ensures that most IHBI researchers' statistical methods needs are met.

Helen MacGillivray is currently a Professor in the School of Mathematical Sciences at QUT, having previously worked at the University of Queensland and the Australian National University. Helen is President of the International Association for Statistical Education, chair of Statistics Education for the 2009 Session of the International Statistical Institute, and scientific coordinator of the 8th International Conference on Teaching Statistics, 2010. Helen was the first female President, and is the

only female Honorary Life Member, of the Statistical Society of Australia. She has also been President of the Australian Mathematical Sciences Council, Board member of the Federation of Australian Scientific and Technological Sciences and a member of the Institutional Grants Committee of the Australian Research Council.

The theory, understanding and applications of the distributional properties known as skewness and kurtosis, are of importance across many areas of statistical theory and applications, with an associated range of different measures, distributional orderings, estimating procedures and interpretations. Helen's work in this area has lead to research analysing and applying distributional families used in statistical data analysis, inference and simulation studies, and to the development and application of new distributional families of interest in a variety of applications.

Helen's university teaching and curriculum design experience of more than 30 years extends across all levels and many disciplines, and in class sizes up to 500. Her work has received support through many national and university awards and grants, and she was recently awarded one of the first three Australian Senior Fellowships in University Learning and Teaching. She has reviewed university departments and centres across Australia and in the UK, and worked on secondment and as a consultant with the Royal Statistical Society Centre in Statistical Education and the UK Learning and Teaching Support Network for Mathematics, Statistics and OR.

Allan J Rossman
California Polytechnic State University

Some curriculum initiatives for undergraduate statistics in the US

I discuss some recent and current initiatives in the United States regarding the undergraduate curriculum in statistics, for students majoring in mathematical sciences as well as in other fields.

I present guidelines for introductory courses that have been endorsed by the American Statistical Association, which call for emphasizing statistical thinking, using real data, stressing conceptual understanding, fostering active learning, using technology, and designing sound assessments.

I give several examples from curricular projects for introductory statistics that implement these guidelines, focusing particularly on a project that introduces students to concepts of statistical inference through randomization-based methods. I also outline curricular efforts in developing undergraduate programs in statistics.

Allan Rossman is Professor of Statistics at Cal Poly, San Luis Obispo. His Ph.D. is in Statistics from Carnegie Mellon University, and he previously taught at Dickinson College. He is co-author of the Workshop Statistics series and also of Investigating Statistical Concepts, Applications, and Methods, both of which adopt an active learning approach to learning introductory statistics. He has received several grants from the National Science Foundation to support curriculum development, and he has given many presentations and workshops on teaching statistics at undergraduate and K-12 levels.

Dr. Rossman is a Fellow of the American Statistical Association and was Program Chair for the Joint Statistical Meetings in 2007. He is Past-President of the International Association for Statistical Education and serves as Chief Reader for the Advanced Placement program in Statistics.

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Sequential construction of choice sets for estimating the panel mixed logit model

An individually adapted sequential Bayesian design approach is presented for constructing conjoint choice experiments. It uses Bayesian updating, a Bayesian analysis and a Bayesian design criterion for generating choice sets for each individual respondent based on previous answers of that particular respondent.

The proposed design approach is compared with two non-adaptive design approaches, the aggregate-customization design and the (nearly) orthogonal design approaches, under various degrees of response accuracy and consumer heterogeneity. The simulation study reveals that the new sequential approach yields substantially better information about individual-level preferences than existing approaches.

The new method also performs well when the response accuracy is low, in contrast with the recently proposed adaptive polyhedral choice-based question design approach.

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Experimental designs for conjoint analysis studies

Conjoint analysis is a popular method for measuring consumer preferences and has been applied successfully across many industries since the 1970s. The technique produces utility scores which reflect how the different features of a product or service influence the value of goods and hence can be used to inform managerial decisions.

A crucial aspect of a conjoint study is the design of a questionnaire which asks respondents to evaluate several variants of the product or service of interest. Typically this is done by means of an experimental design which specifies the attributes of the options to be evaluated.

By carefully choosing the design the precision of the estimated utility scores can be improved. In recent years there has been a lot of interest in how efficient designs for conjoint analysis and related choice models can be generated.

In this talk I will summarize some recent results, focusing on conjoint studies which employ a paired comparison format. Topics to be covered will include efficient designs for estimating main effects and interactions in factorial experiments and designs for experiments which use only partial product descriptions.

Dr Heiko Grossmann is a Lecturer in Statistics at Queen Mary, University of London. His main area of research is optimal design of experiments. He is currently the secretary of the Business and Industrial Section (BIS) of the RSS.

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Combining market research data with behavioural data to fully understand shopper habits

Market research techniques have traditionally relied on a combination of general attitudinal data and claimed behaviours to understand the individual consumer. Using transactional data from Tesco clubcard, dunnhumby are able to combine attitudinal data with item-level purchase data of 13 million households. The ability to pull together both the "what", the "when" and the "why" allows us to generate insights into consumer behaviours and needs, for beyond simple claimed behaviours.

In the current economic environment, manufacturers are continually looking for better ways to communicate and engage with their consumers to ensure on-going support of the business and loyalty to the brand. A case study is presented that demonstrates the benefits of combining small scale research and in-depth behavioural data to develop recommendations to the client.

Dave Walter joined dunnhumby in 2005, moving from Procter & Gamble to work in the Custom Insights group where he currently leads the CPG analysis group. Working with a wide range of clients within the CPG business, Dave acts as a statistician delivering insights and recommendations to key suppliers in the retail environment.

Prior to joining dunnhumby, Dave spent over 10 years working in Procter & Gamble's R&D Statistics group, both in the UK and the US. During this time he acted as a statistical consultant to R&D centres across all business units in P&G.

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Mixed Poisson models for modelling consumer purchase behaviour

The following topics concerning the applicability of mixed Poisson Processes for modelling consumer purchase will be discussed:

- comparison of statistical procedures for model testing and parameter estimation
- handling the problem of zero-buyers
- adjusting the model for seasonal effects and other market trends
- the panel flow-through problem: detection and modification of the main model
- market research measures and variations
- testing the assumptions of the Dirichlet model for brand choice and possible modifications of it.

1981: MSc in probability theory and statistics, St. Petersburg State University, Russia
1985: PhD in probability theory and statistics, St. Petersburg State University, Russia
Since 1997: Professor at Cardiff University, UK

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How did we get here and where are we going: routine health service and public health data

The development of routine statistics about health and care reflect the policies of the eras in which they were developed. Many of the information systems used to monitor the health of the population were developed in the nineteenth century as a by product of administrative and legal processes. As publicly funded services were introduced through the twentieth century, statistical systems were introduced to monitor them and account for expenditure.

From the 1980s statistical systems reflected the development of managerialism, the internal market and moves towards privatisation. In the twenty first century, the association between the massive investment in NHS IT and the availability of reliable statistical information has been far from clear and there has been a reluctance to ensure that data collection is devised to monitor and assess new policies.

The talk will present examples of current and past data to illustrate these themes.

Alison Macfarlane worked as a statistician in agricultural research, transportation studies, the health effects of air pollution and child health until she joined the newly established National Perinatal Epidemiology Unit in 1978. She remained there until 2001 when she was appointed professor of perinatal health in City University Department of Midwifery.

She specialises in analyses and interpretation of routine data and is co-author with Miranda Mugford of 'Birth counts: statistics of pregnancy and childbirth' and with Rona Campbell of 'Where to be born: the debate and the evidence' as well as contributing to many of Radical Statistics' critiques of routine data.

Professor Allyson M Pollock
Centre for International Public Health Policy, University of Edinburgh

Joint authors: Sylvia Godden, Catherine-Rose Stocks-Rankin, Graham Kirkwood

Statistics and public accountability: monitoring and evaluating new services delivery policies in the NHS

This talk focuses on the range of policies that have introduced new patterns of service delivery in the NHS, and considers the extent to which official routine data are available to monitor and measure the impact of these new models on meeting population needs.

This topic is explored with reference to a range of case studies including:

1. Changes in the provision of secondary care: The Independent Sector Treatment Centre programme in England and Scotland

2. Changes in the provision of primary care: Polyclinics/Polysystems and Out of Hours Services

3. A feminist perspective on data to monitor long term care (being an area of healthcare utilised mostly by women)

The talk will focus on some of the key issues, including fragmentation of services and breaks in continuity and changing definitions of routine data over time. It will consider whether data sources are available and have kept up with the privatisation and outsourcing of functions in order to evaluate the impact on equity of service provision for vulnerable populations.

Professor Allyson Pollock is Head of the Centre for International Public Health Policy (CIPHP) at the University of Edinburgh.

Sylvia Godden and Graham Kirkwood are Research Fellows in NHS Information, also at the CIPHP, University of Edinburgh (though Sylvia is based in London at the Department of Epidemiology and Public Health, UCL), and Catherine-Rose Stocks-Rankin is a Research Assistant at CIPHP.

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The statistician and small clinical trials: tales from the front lines

Physicians often seek to conduct small n clinical trials. Device manufacturers seek to conduct small n equivalence testing during early product development. Cross cultural clinical trails may entail manoeuvring through political mazes. All often require adroit modifications of data collection strategies and subsequent interpretation gymnastics.

Statisticians accustomed to large, relatively stable data base manipulation who are asked to assist in small n trials will be confronted with an array of issues in which the 'old rules' may not apply. This environment is often complicated by principle investigators, other healthcare providers, manufacturing engineers and others who have had limited experience with data definition requirements, analysis specifications, and reporting standards for small clinical trials.

Project specific examples of the technical issues that arise when providing statistical consultation for these trials and possible solutions for their resolution will be presented. Also addressed will be the political pitfalls to be avoided.

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The role of the patient preference arms in the analysis of a comprehensive cohort study

The comprehensive cohort design is an extension of the standard randomised controlled trial to include additional patient preference arms that allow us to monitor response to treatment and health outcomes for subjects who decline to be randomised. These designs are adopted when recruitment rates to a standard RCT are expected to be low leading to concerns about the generalisability of results to the population of interest.

A fairly common approach to the analysis of data arising from a comprehensive cohort study is to base the estimate the difference between alternative treatments on outcomes observed in the randomised arms. Outcome for subjects in the randomised arms are then compared with outcome for subjects in the patient preference arms to enable a judgement to be made about the generalisabity of the result based on the randomised comparison. An alternative approach is to estimate treatment effects using data pooled from the randomised and patient preference arms. It is not clear whether this alternative approach can lead to results that are more generalisable to the population of interest.

These issues are discussed in the context of the north of England study of tonsillectomy and adeno-tonsillectomy in children (NESSTAC). The aim of this comprehensive cohort study was to estimate the effects of surgical management compared with medical management of children with recurrent sore throats. Patients who declined to be randomised but agreed to enter one of the patient preference arms differed significantly from those recruited to the randomised arms with respect to a number of baseline demographic and clinical characteristics. Some differences in health outcomes between patients in the randomised and corresponding preference arms were observed.

The analysis of these data suggests that, while data from the patient preference arms may be of crucial importance to our understanding of the likely effects of the medical therapies involved, there may not be a single “one fits all” approach to analysis of data arising from the comprehensive cohort design

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The design implications of care provider variation for non-pharmacological treatment trials

A recently published extension of the Consort Guidelines recommends that the reports of non-pharmacological treatment trials [1] such as physical and talking therapies report how variation due to the care provider was addressed in the design and analysis. Several papers have considered the statistical analysis implication of such variation. Nesting of patients within care provider creates clustering that has implications for precision analogous to those in group randomised trials, which can be addressed by multi-level [2,3], summary level analyses, or survey methods.

Less consideration has been given to the design implications of care provided variation. Acknowledgement of the nesting of patients within care-provider as a design factor adds complexity to trial design [4]. Trials of interventions involving the activity of a single care provider in the delivery of treatment to each patient may be nested, partially nested or crossed.

Where the trial compares professional groups or packages of care delivered by different types of care provider a nested may be used. Where the intervention is compared to pharmacological treatment a partially nested may be used. If instead the comparison is between different therapeutic techniques deliverable by the same professional group, either a nested or crossed design may be appropriate. Sample size estimation for each of these designs will be considered and compared.

Some interventions involve the activity of more than one care provider. For example in psychological treatment trials patients may receive counselling supported by medical management by another health professional. The design implications of this will also be considered.

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3. Lee KJ Thompson SG. Clustering by health professional in individually randomised trials. British Medical Journal 2005; 330(7483): 142–4.

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Mammographic breast density: why the most precise measure may not be the most clinically useful

Mammographic breast density (the area that appears white on a mammogram) is of great interest in the field of breast cancer prevention because it is an indicator of breast cancer risk (the greater the density, the higher the risk of developing breast cancer) and also a potential marker for change in breast cancer risk. This is a particularly important issue in chemoprevention, where healthy (breast cancer-free) women who have a high risk of developing the disease are offered treatment (tamoxifen, for example) to reduce their chances of ever developing the disease.

Such women are living in fear, embarking on a five year course of treatment that is not without risks or side-effects; to be able to offer reassurance that the treatment is working (if their density reduces over the first 12 months of planned treatment) and alternative interventions if it is not, would be a huge step forward.

Several methods for assessing mammographic density have been proposed. These include semi-quantitative measures based on parenchymal patterns (Wolfe, Tabar, BI-RADS) and quantitative measures assessed either by trained eye or computer software (percent dense, Boyd categories, absolute dense area), plus a number of new volumetric measures that are still in the developmental stage. A key question for researchers and clinicians is therefore, “which one should be used?”

Traditional wisdom suggests that one should pick the most precise measure. Using data from a number of published and unpublished studies, I will compare the merits of the various measures, particularly visually assessed percent density versus semi-automated assessment using specialist software, to illustrate why the most precise may not be the most clinically useful measure.

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Genomewide Multivariate Association Discovery in imaging genetics studies

Association studies in the imaging genetics framework search for statistical associations between variations in the human genome (Single Nucleotide Polymorphisms, SNPs) and variations in the corresponding imaging phenotype (intensity within Regions of Interest, ROIs) related to the disease. In such studies both the genotype and phenotype data are very high dimensional and highly correlated.

We employ a sparse Canonical Correlation Analysis to identify causative SNPs and affected ROIs simultaneously. Sparse solutions are obtained through the exploitation of penalization techniques. We present performance evaluations of this method via extensive and realistic Monte Carlo simulations and application to a real dataset.

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Statistical opportunities in brain imaging: a case study with Neuroimaging Meta Analysis

The field of brain imaging continues to provide new types of data and modelling challenges for the statistician. While many people are by now familiar with functional magnetic resonance imaging (fMRI), in just the last five years new types of structural imaging (e.g. MRI diffusion tensor imaging) and functional imaging (e.g. near infrared spectroscopy) have come into widespread use.

I will discuss what I see as three types of opportunities that exist for statisticians: First is simply bringing statistical rigor to existing techniques and revealing inherent limitations in these (often widely used) methods. Second, is to bring basic statistical technology to the problems, which usually amounts to a leap ahead of standard methods. And third is letting the neuroscientists' questions drive new statistical science, providing more relevant and interpretable models.

I will illustrate all three of these opportunities with my recent work in meta analysis for neuroimaging.

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Twice the fun-ctional: using Functional Principal Component Analysis in functional neuroimaging

A functional smoothing approach to the analysis of functional Neuroimaging data is presented. By borrowing information across space and accounting for this pooling through the use of a non-parametric covariate adjustment, it is possible to smooth the time course data thus reducing the noise.

An extension of functional principal component analysis, the Multiplicative Nonparametric Random Effects Model, is introduced to more accurately account for the variation in the data. A locally adaptive bandwidth choice helps to determine the correct amount of smoothing at each time point. This preprocessing step to smooth the data then allows subsequent analysis to be substantially improved in terms of their mean squared error.

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Discovering the false discovery rate

I shall describe the background for the paper 'Controlling the false discovery rate: a new and powerful approach to multiple testing', by Y. Benjamini and Y. Hochberg (J. R. Statist. Soc. B, 57, (1995). 289 -- 300).

I shall then describe, and explain the reason for, the slow and painful process of acceptance of the idea, that started in 1989 and ended only in 2000 when the original paper was finally published. I shall briefly review the reason for the success of the false discovery rate approach, and some of the later developments of importance in the area.

I shall point at future directions of research and development, some in progress and some in need.

Prof. Benjamini received his PhD from the Department of Statistics at Princeton University in 1981. He subsequently joined the Department of Statistics in Tel Aviv University, where he is currently professor of statistics. He has also held visiting positions at the University of Pennsylvania.

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Present and future challenges in statistics, and collaborative solutions

The American Statistical Association (ASA), closely following the lead of the Royal Statistical Society (RSS), will celebrate its 175th year in 2014. Now is an ideal time to assess the present, consider the future, and discuss possible collaboration between the RSS and the ASA.

In this talk, I will begin with a short introduction to the ASA. I will then discuss the present and future challenges in statistics from an ASA perspective, including public awareness of statistics, and recruitment and retention of statisticians in the profession, and of members in the association. Topics raised in the RSS business plan echo ASA concerns described in our strategic plan.

Similarities and dissimilarities between the RSS and ASA perspectives will be demonstrated. A dialogue between the RSS and the ASA has already begun, and collaborative activities that meet our shared statistical challenges will be presented.

Suggestions and recommendations from the audience will be welcomed.

Sally C. Morton is the 2009 President of the American Statistical Association (ASA), and Vice President for Statistics and Epidemiology at RTI International, a non-profit policy research institution based in North Carolina, USA. She is an Adjunct Professor of Biostatistics at the University of North Carolina, and is a Fellow of the ASA and of the American Association for the Advancement of Science. Her research focuses on synthesis in evidence-based medicine, and surveys of vulnerable populations. Dr. Morton received a Ph.D. in statistics from Stanford, and an M.Sc. in statistics from the London School of Economics.

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The role of the European Union in mastering the challenges for official statistics

We have to master a series of challenges: expanding statistical services, adapting the statistical programme to new developments and strengthening transparency and credibility as well as authority. At the same time we have to cut operating costs and reduce response burden. This dilemma is a certain way eternal. Our focus, however, changes over time and so do our answers. Information technology has a tremendous impact on our answers and so has statistical methodology. Our organisational structures and the qualification of our staff are equally important. Last but not least legal conditions and public attitudes towards official statistics play a significant role in our search for appropriate solutions.

It is now in this context that the European Union with its European Statistical System (ESS) comes into play, where all national statistical authorities and the European Commission with Eurostat as its Directorate General for statistics work together in close partnership. This allows not only to assure that the official statistics required for EU policy making are available, but also to give with its institutions a helping hand to meet all these challenges.

Operating costs can be cut through exploiting economies of scale. There is a huge potential to expand cross-border development work and cross-border production work has yet to be tried. The response burden can be brought down, most notably through cross border data collection and validation as well as through European sampling, wherever applicable and feasible.

For a whole range of statistics we could use much smaller samples that would be adequate for giving reliable estimates of EU totals without the need for adequate representativeness at each national level. All this is not for tomorrow, but will become feasible, if we start to build a common ICT tool box and common methodological and administrative infrastructure.

The statistical service to users can be expanded, amongst others through pooling statistical information at European level and through joint dissemination so existing statistics are used more widely. A joint statistical programme can set new accents in official statistics mainly in EU relevant domains, but the joint programming discussion makes official statisticians much more responsive to social and economic changes more broadly. And the transparency of our work as well as the credibility and authority, as proven by the recent adoption of the European Statistics Code of Practice, will certainly profit from a European umbrella. The potential positive impact of the EU on official statistics is, as sketched by these few examples, obviously considerable.

However, very little will materialise automatically. Instead it requires the active conduct of an effective statistics policy at European level. The foundations have been laid in recent years, as a new governance structure has been put in place. The European Commission is committed to conduct a statistics policy that focuses on these challenges in close co-operation with its national partners in the ESS. If successful, and we have all reasons to be optimistic, it might well be that official statisticians will develop a new more integrated and efficient business structure.

Marie Bohata studied Econometrics in Prague and got her PhD in systems theory. In her professional career she has been working mainly in applied economic research. After the political changes in her country in 1989, she has been involved in many international projects and activities and worked on boards of several professional associations, including those dealing with business and public service ethics.

In 1999 she joined the statistical community as President of the Czech Statistical Office and after the EU enlargement in 2004 she was recruited to the post of Deputy Director General of Eurostat.

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Ripeness of bananas and manure: a prediction problem using a least squares support vector machine

In agriculture and other application areas it may be of interest to predict the ripeness of fruit or the ripeness of manure (in terms of its nitrogen content). Typically, near infra red (NIR) spectroscopy is used to do this because it is a quick and cheap method. In statistical terms one wishes to predict some response variable y (such as a measure of ripeness) on the basis of a large number of highly correlated explanatory variables x from the NIR spectroscopy.

An approach that has been used increasingly in recent years is to build a regression model using a least squares support vector machine (LSSVM). In this talk the LSSVM is introduced and its properties investigated.

Difficulties with training the LSSVM are discussed; in particular tuning the hyper-parameters of the LSSVM is challenging and the choice of x-values to be used in the training process is important.

The approach is illustrated using data sets for ripeness of bananas and the nitrogen content of manure. We suggest that an approach that combines LSSVM with more traditional regression methods is a promising one.

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A multivariate cointegration approach to the influence of bioethanol and biodiesel on the price levels of certain agricultural commodities

Johansen's trace cointegration test is used to detect cointegration relationships between the prices of crude oil, bioethanol and the main commodities for bioethanol and biodiesel-production. Such relationships can arise from of the substitution of fossil fuels for biofuels in times of high oil prices like the years 2007/2008.

The topic of this poster also refers to the discussion about a food crisis caused by biofuels, but the complex structure of the agricultural markets has to be considered by careful model building. Three statistical models are generated, based on the trade volume between the most important biofuel producing countries. Monthly data are used for the period from January 2001 to October 2008.

The first model analyses the prices of (dehydrated) bioethanol and corn in the USA and the world oil price. There are no cointegration relationships found, which can be explained by the higher prices of bioethanol compared with gasoline.

The second model analyses the prices of (dehydrated) ethanol and sugar in Brazil and the world oil price, where a set of multivariate cointegration relationships is found. Because of the good integration of bioethanol in the fuel market, consumers substitute gasoline for bioethanol with increasing oil prices. Even a small influence on the world oil price can be noticed.

The third model analyses the world market prices of selected seed oils and again the world oil price. A cointegration relationship is found, but except the price of rapeseed oil all prices are weak exogenous.

This finding can be explained by the special meaning of rapeseed for the EU biodiesel industry. To fulfill certain EU biodiesel regulations, biodiesel producers import other seed oils, if they are cheaper than rapeseed oil. It's also necessary to pay attention to the food use of seed oils.

The main finding is, that cointegration relationships indicate a well working, consumer driven market for some substitutes. Such a market can't be enforced by governmental regulations, which only take effect during a limited period.

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Different approaches to model averaging in environmental risk assessment

The so-called Benchmark approach is the most popular method for calculation of safe exposure standards. An important advantage of this method is that statistical uncertainty is taken into account.

Thus, the main result, the BMDL, is a lower confidence limit of the dose which leads to a specific increase in the risk. Still, standard applications of this method ignore model uncertainty and may therefore provide results that are biased toward higher and less protective dose levels.

A wide range of model averaging techniques have been proposed to solve this problem. This paper reviews and compares these methods.

It is illustrated that the BMDL results may depend heavily on the choice of method. The main reason is that different philosophies lead to different assessments of the uncertainty in the model averaged estimates. These differences are illustrated theoretically and through analysis of an epidemiological data set collected to investigate the health effects of prenatal mercury exposure.

Keywords: benchmark dose; dose-response model; model uncertainty; Bayesian statistics

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A model-based framework for the estimation of species richness from grab samples

The talk is about a classic problem in ecological statistics “how many species are there”. The problem arises when samples of quadrats or, in the examples we use, Hamon grabs are taken from a wider spatial population. We can count the number of species in the samples, but how can we use this information to estimate the number present in the population?

This talk will briefly review the history of the problem. The mathematical roots of fitting a functional model to the observed species abundances goes back to Fisher et al (1943). They modelled the Poisson rate parameter for each species by a gamma distribution leading to a negative binomial distribution for the number of individuals per species. Craig (1953) developed a maximum likelihood estimator of the number of species for the simple situation in which all species were randomly distributed with the same intensity. Since then there have been a number of new developments.

We will then outline our new method. We use data on benthic organisms found in Hamon grabs. Our approach is based on modelling the underlying spatial process of the species. In particular we use recent work from the University of Kent to build on Barry et al (2009) - which models the spatial patterns in which species are found in the sea bed by considering them to be realisations from Matern cluster processes. We estimate the parameters of the underlying Matern processes by maximum likelihood based on simulation. We compare our results with those of other methods.

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Semiparametric plaid models with applications

The problem of two-way clustering has attracted considerable attention in diverse research areas such as functional genomics, text mining, and market research, where people want to simultaneously cluster rows and columns of a data matrix. In this paper, we propose a family of semiparametric plaid models for two-way clustering, where the layer estimation is regularised by Bayesian Information Criterion (BIC).

The new models have two ingredients: one is quasi-likelihood and the other is log-linear layer decomposition of response variables. The proposed method has some attractive features in comparison to the original plaid model. In particular, it has broadened the scope of ordinary plaid models by specifying the variance function to make the models adaptive to the entire distribution of the error term.

A formal test is provided for finding significant layers. A Metropolis algorithm is developed to calculate the maximum likelihood estimators of unknown parameters in the proposed models.

The conditional identifiability of the proposed models have been proved in terms of information divergence criterion under some conditions. The asymptotic behaviour of the proposed one-step estimators has been investigated. Two simulation studies and the applications to two real datasets are reported, which indicate our models substantially out-performs the existing models in literature.

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Detecting misspecification in the multilevel model using the forward search

This paper will consider the detection of misspecification in the multilevel model using the forward search methods of Atkinson and Riani (e.g. Atkinson & Riani, 2007).

When a multilevel model is misspecified, the residuals at the different levels of the hierarchy may not be normally distributed. Instead, the residuals may have a structure that can detected using the forward search.

The forward search is a method that is most commonly used to detect outliers in a set of data and can also be used to detect clusters. In order to examine the residuals of a multilevel model, the forward search starts with a number of cases in a set. The distance of each residual to the centre of this set is calculated. A new set is then chosen that is one element larger than the previous set and consists of those residuals closest to the centre of the previous set. Typically this new set will consist of all the elements of the original set plus one additional element.

This process of increasing the size of the set is continued until all of the residuals are in the set. While this set building has been taking place, at each step the smallest distance to the centre of the set amongst all those associated with residuals outside the set is noted. If the residuals have a normal distribution, then these smallest distances will show a steadily increasing pattern. However, if they do not follow a normal distribution, there may be abrupt changes in the smallest distances and this can be detected using plots of the smallest distances.

Although other methods also exist for trying to detect non-normality, the forward search has some advantages. It can be used for either univariate data (i.e. residuals associated with a single random effect at a particular level in a multilevel model) or multivariate data (i.e. from a multilevel model with a random effect and a random coefficient at a particular level). It can also be used to assign cases to clusters that might be detected in the forward search, raising the possibility of these cluster designations being used to try and correct for or assess the impact of the misspecification on the multilevel model.

Work to date has yielded promising results. This paper will present this work investigating the ability of the forward search to detect various forms of misspecification in the multilevel model. It will also explore the possibility of using the results of the forward search within the multilevel model it has been investigating.

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On a multivariate generalization of quantile-quantile plot

In this talk, we discuss some notions of multivariate signs and ranks. Based on these signs and ranks, we define appropriate notions of multivariate quantiles and rank functions. Based on this definition of multivariate rank we can define a notion of central rank region, CF(p), containing probability mass p. Then following the idea of Liu, Parelius and Singh (Annals of Statistics, 1999), we define a scale-curve, which plots the volume, vF(p), of these central rank regions against p for $0 < p < 1$. The volume functional, vF(p), of the central rank region provides a notion of multivariate scale and these scale curves can be used to visualise the changes in scale for a probability distribution.

For spherically symmetric distributions, these central rank regions coincide with the probability density function level sets, and we have a nice closed form formula for the scale curves. However, this definition of multivariate rank is not invariant under general affine transformations and hence the volume functional becomes incomparable in the presence of high correlations. To remedy this deficiency, we propose an affine invariant version of multivariate rank based on the transformation-retransformation approach of Chakraborty (Ann. Inst. Statist. Math., 2001). Corresponding scale curves are also affine equivariant.

Next, we propose a scale-scale curve for two competing distributions by comparing their scale curves. We show that they present a multivariate generalization of quantile-quantile plot. We discuss several issues regarding the shape of the scale-scale curves and how to detect the departures of the data from the proposed distributions, when the underlying distributions are elliptically symmetric. We illustrate our proposed methods with several real and simulated examples.

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Patient Decision Aids in primary care

When a general practitioner makes a decision about treatment for a patient, ideally s/he will involve the patient in the process, particularly when the patient has a chronic condition. Patients who feel involved about a change in therapy generally are more satisfied with the new treatment and adhere better to it, than those who do not feel consulted.

However, a doctor has to be able to communicate detailed information about the risks and benefits of new treatments to a patient. These often involve probabilities and it is a skilled task to communicate these effectively. One type of tool that has been developed to help patients and doctors is the Patient Decision Aid (PDA). There are currently over 500 PDAs on the Cochrane database but there is a paucity of proper evaluation.

Patients with Type II diabetes commonly start managing their disease by using diet and exercise, and then drugs to improve their body's sensitivity to insulin. However many have to decide eventually whether or not to have insulin injections. We will describe the development and evaluation of a patient decision aid for these patients (The Patients And Decision Aids study, PANDA). The use of a decision aid is a complex intervention and we will discuss how we used the MRC complex intervention framework1 to help in structuring of a cluster randomised trial to try and evaluate the use of this decision aid. The trial is currently ongoing but the baseline data will be presented.

1 Craig N, Dieppe P, Macintyre S, Michie S, Nazareth I, Petticrew M. Developing and evaluating complex interventions: the new Medical Research Council guidance. BMJ 2008;337:a1655

Mike Campbell is Professor of Medical Statistics, in the School of Health and Related Research, University of Sheffield, where is he Director of the Health Services Research Section. He completed his PhD at Edinburgh in Medical Statistics. He has a particular interest in Primary Care and been a member of the Royal Statistical Society Working Group on Statistics in Primary Care since its inception. He is the author of a number of books including Statistics at Square One, Statistics at Square Two and Medical Statistics: A Textbook for the Health Sciences

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Designing clinical trials of complex interventions – what can we learn from adaptive designs for drug trials?

Complex interventions are multi-factorial therapies that consist of multiple interconnecting components. Examples include group or community interventions, or interventions that are directed at modification of patients' or health professionals' behaviour.

The design, conduct and analysis of randomised controlled clinical trials (RCTs) that efficiently yield the information required to optimise and evaluate such interventions present formidable challenges, reflecting uncertainties to do with their targeting, content and implementation, and sometimes the reliability and validity of outcome measures.

In comparison with complex interventions, methodology for RCTs for the evaluation of new drugs is well-established. A recent area of much research interest is the use of adaptive designs, in which data accumulating during the course of the trial are used to modify the design.

This talk will give a brief overview of developments in adaptive designs, highlighting how they might be applied in the setting of RCTs of complex interventions. One particularly attractive approach enables combination of exploratory and confirmatory analyses as different stages in a single clinical trial. The talk will conclude with an example based on a trial to design and evaluate a web-based 'virtual clinic' for young people with diabetes.

Nigel Stallard is Professor of Medical Statistics at Warwick Medical School. After graduating in Mathematics from Cambridge University, he was a member of the Mathematical Modelling and Statistics Section at the Royal Air Force Institute of Aviation Medicine in Farnborough. He was a founding member in 1994 of the Medical and Pharmaceutical Statistics Research Unit at the University of Reading where he remained until taking up his chair at Warwick Medical School in September 2005.

His primary research interest is in the statistical design of clinical trials. In particular, he has worked on methodology for clinical trials with interim analyses and adaptations such as treatment selection.

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Meta-analysis methods for planning and evaluating behaviour-change interventions

When planning a study it is desirable to make use of summary statistics from a previous study. For the purpose of estimating sample size alone, previous studies provide estimates of quantities, such as, a prevalence, a standard deviation, an intracluster correlation coefficient, an attrition rate, or plausible effect sizes. In this talk we consider the case where several previous studies are available to provide design-stage intervention-related quantities, and where the quantities are the pairwise correlations between the primary outcome and its assumed determinants.

These correlation quantities are important when planning a behavioural intervention trial where correlations are assumed, the correlations define a causal chain between the variables, and parts of the intervention are constructed upon the assumed chain. If a chain does not apply as assumed, then the behavioural intervention may be constructed to target the wrong relationships.

A behavioural intervention trial aimed to change the physical activity of adult participants recruited through general practice registers. The several components of the intervention, were delivered by researchers during interactive sessions with a participant over six months. It was based on the causal chain specified in the "Theory of Planned Behaviour".

While the trial was proceeding we developed and compared eight meta-analysis methods to pool the fifteen pairwise correlations across eight previous studies. Methods are classified by univariate versus multivariate pooling, random versus fixed effects models, and classical versus Bayesian approaches.

In this talk we demonstrate use of these methods to answer questions of importance at the design stage of trials with an underlying causal structure of importance. We will also outline how meta-analysis methods to evaluate multiple behavioural intervention trials could be developed.

Toby Prevost is a Reader in Medical Statistics at King's College London, and a Visiting Senior Research Fellow at the University of Cambridge, where he worked previously. His methodological research interests include clustering in randomised trials, and meta-analysis for trials of complex interventions. Toby's applied inter-disciplinary research includes trials of interventions to support changes in lifestyle behaviours, and he is a member of NICE's public health interventions advisory committee.

Ivor Goddard, Stephen Penneck and Andrew Garratt

The surveillance society and the role of the statistician

Recent years have seen a growing interest in the construction and merging of large databases of personal information. Such databases are now prevalent in both the public and private sectors and they have considerable potential for public benefit. But they also pose grave risks in terms of security and individual privacy. Further, many questions of data quality have yet to be addressed, let alone resolved.

The session will illuminate both the reasons for large databases and the dangers they pose. It will also look at the role of the statistician, in terms of both ethics and data quality.

1 Accumulating personal data: the benefits to the citizen. **Stephen Penneck**, ONS Director of Methodology, setting out government ideas on data capture and sharing, and the benefits these will bring.

2 Accumulating personal data: the dangers to privacy. **Ivor Goddard**, former RSS Director General, talking about the balance between the needs of the state and the privacy rights of the citizen.

3 The database society: challenges for the statistician. **Andrew Garratt**, RSS Press and Public Affairs Officer, outlining the work of the RSS Data Capture & Society Working Party and the issues for statisticians that have been identified.

The formal inputs will be followed by a panel session and an opportunity for comments and questions from the floor.

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Have statisticians made any real impact on image analysis?

We will introduce the field of image analysis, before considering the statistical image analysis movement, which started in the UK and the USA about three decades ago.

We will highlight various historical landmarks in trying to investigate whether there has been any real impact of mainstream statisticians in image analysis. We will contrast this with the continuing contributions made by computer scientists in image analysis.

We will pinpoint the statistical topics which have had an impact, such as algorithms (MCMC, EM, CART ...), and model based techniques (shape analysis, spatial statistics, Bayesian analysis, neural nets, machine learning, directional statistics, data mining, pattern recognition ...). Differences in the emphasis of computer scientists and statisticians related to problem solving are quite evident in the developments arising from changing technology in images, machine vision, and hardware.

What is the future for statisticians in this field? Interdisciplinary research is one of the hardest of paths and does need a paradigm shift to holistic statistics. We will try to take a journey into the future role of statisticians in this context.

Kanti Mardia is Senior Research Professor at the University of Leeds. He was awarded the Silver Medal of the RSS in 2003 with the citation "The Guy Medal in Silver for 2003 is awarded to Professor Kanti Mardia for his many path breaking contributions to statistical science, including two fundamental papers read to the Society ..., his highly acclaimed monographs and his lasting leadership role in interdisciplinary research." He founded the annual LASR Workshops in 1973 at Leeds, which have grown into international conferences. His recent research covers many fields including Statistical Bioinformatics.

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Characterising HRCT lung images using integral geometry

Emphysema is a chronic condition which affects the elasticity of lung tissue and leads to a loss of respiratory capacity. High Resolution Computerised Tomography (HRCT) provides a non-invasive method to detect the structural changes in lung tissue caused by emphysema and related conditions. These structural changes present themselves as textures of distinct morphological properties.

Integral geometry provides a family of functionals that characterize the morphology and topology of random sets: Minkowski functionals or quermass integrals. In 3D there are four such functionals which are proportional to the more commonly known quantities: Euler-Poincaré characteristic, mean breadth, surface area and volume. Strictly, Minkowski functionals can only be computed for binary images, but can be extended to grey-level images via thresholding. They have desirable mathematical properties such as C-additivity which allows their efficient computation based on configuration counts. Also, Hadwiger's Theorem provides a completeness property for the functionals. On the downside there are various statistical issues related to their estimation, not least of all bias that occurs due to the inevitable discretisation in images.

In this talk I will discuss the use of Minkowski functionals to characterise diseased lung tissue in order to distinguish between regions of healthy, emphysematic or fibrotic tissue.

This is joint work with Dr Bhalerao (Computer Science), Mr Charemza (Centre for Scientific Computing) and Dr Parr (Medical School and University Hospital) at the University of Warwick.

Dr Thönnes is an Associate Professor in the Department of Statistics and the Centre for Scientific Computing at the University of Warwick. Her research interests include Markov chain Monte Carlo, stochastic geometry, spatial statistics and statistical image analysis. She has worked with images in a variety of application areas including images related to molecular synapses, medical images showing vascular structure, lung HRCT scans and forensic fingerprint images.

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Image analysis and probabilistic robotics

In image analysis, we are often dealing with a large amount of uncertainty. One way to handle uncertainty is to take care that images are recorded in a standard way with good contrast between object and background. However, in many applications we want to handle complex images with high uncertainty.

In robotics for example, decisions often have to be taken by a robot based on information extracted from complex scenes and a probabilistic framework is then needed to handle these uncertainties. This is often referred to as 'probabilistic robotics' and includes approaches like particle filters and (partially observable) Markov decision processes.

In this talk, I want to show two vision-based robot applications, one for autonomous navigation and one for weed detection. In the first application a robot has to navigate autonomously in a field of maize between rows of plants. In the second application we will try to detect weed plants in grassland, using Fourier methods in a particle filter context.

This is joint work with Frits van Evert and Santosh Hiremath (Wageningen UR) and Arjen Lamaker (MARIN)

Dr van der Heijden is a senior scientist at Biometris, the group of mathematicians and statisticians of Wageningen UR in the Netherlands. His research is focused on the application of image analysis in life sciences. He has been studying digital shape analysis and spectroscopic imaging for different applications, including plant variety testing, plant sorting and microscopy research. Current research interests include probabilistic robotics and feature extraction in complex environments for applications as large scale phenotyping of plants, virus detection in tulips and autonomous field robots.

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A mixed model Quantitative Trait Loci Analysis for multiple environment trials

In recent literature, mixed models are used for the analysis of Quantitative Trait Loci (QTLs) in multi-environment trials (METs), see e.g. Malosetti et al. 2004 and Boer et al. 2007. In this talk I will describe a general mixed model framework for the analyses of this type of data.

The statistical analyses of MET consists of several steps. First of all, we need to select an appropriate model for the genetic correlations between the environments. As I will show in this presentation, selection of an appropriate model is important for the next steps of the analyses of the MET data.

The second step consists of a genome scan for the detection of QTLs and QTL by environment interactions (QxE). In the final step, for the QTLs with significant QxE effects, the QTL responses to environmental covariables such as temperature and rainfall can be determined.

I will use both real and simulated data sets to illustrate the mixed model framework for QTL detection in METs.

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Martin Boer received a Ph.D. in Mathematical Biology from the Free University in Amsterdam. Since 1998 he is working as a Statistical Geneticist at Biometris, the statistical and mathematical department of Wageningen University and Research (WUR), The Netherlands. Most of his recent research focuses on the development and application of statistical techniques for the detection of Quantitative Trait Loci in populations of plants, tested in multiple environments.

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Statistical models of veterinary diagnostic test characteristics: applying statistics for farmers and policy makers

There is nothing inherently special about the application of statistical methods to the animal sciences: the usual issues arise, such as appropriate modelling of sources of variability and of the functional structures in the data. However, some of the methodological details arising from this application area are different to those current in analogous areas such as human epidemiology and clinical research.

The Scottish Government is currently funding a Centre of Excellence to carry out explicitly quantitative research in animal epidemiology. This talk will describe some of our collaborative work within this project as we seek to meet the needs of policy makers and farmers.

Statistical methods to quantify the properties of diagnostic tests have been of interest since the seminal paper of Hui and Walter (1980). It is worthwhile to integrate latent class models for such tests into more general statistical models.

We have developed a model for seroprevalence in cattle which predicts the mean proportion of exposed animals in a herd conditional on various covariates, while avoiding any assumption of a perfect test. Using a Bayesian latent variable generalised linear mixed model, we generated estimates of the true (unobserved) level of exposure to the causal organism in each herd given a bulk-milk assay result, in addition to estimates of the accuracy of the serum assay. The use of a validated bulk milk screening test will offer significant economic benefits to the dairy industry.

We have also developed a method to analyse imperfectly observed longitudinal Susceptible-Infectious-Susceptible data, using the Chapman-Kolmogorov equations for a latent epidemic process to define a likelihood. By applying a Metropolis-Hastings algorithm we can determine the distributions of transmission and assay parameters. This extended model can provide a better framework in which to interpret patterns of positive results in repeated assays.

Dr Iain McKendrick is the Principal Consultant for Animal Health and Welfare in BioSS. He has worked in the area of statistical and mathematical methods applied to animal disease since 1987. He has overall responsibility for statistical and mathematical consultancy supplied by BioSS in the fields of epidemiology and animal science. His research interests are in mathematical modelling of epidemics, the design and analysis of epidemiological surveys, and the design and analysis of clinical trials, particularly where it is necessary to make inference about partially unobserved variates.

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90 years of research and collaboration by statisticians in agricultural research

This talk will give a Rothamsted perspective of some of the developments in applied statistics that have come about from the challenges presented to statisticians from their involvement in agricultural research.

This began when R.A. Fisher was confronted with datasets dating back to 1843 when he was appointed as the first statistician at Rothamsted in 1919. In his 16 years at Rothamsted, Fisher developed an astonishing array of techniques that include analysis of variance, design of experiments, the statistical theory for regression, permutation and exact tests, probit analysis and maximum likelihood.

Further developments at Rothamsted have included survey and sampling methods by Frank Yates, generalized linear models by John Nelder and Robert Wedderburn, quasi-likelihood by Robert Wedderburn, and canonical variates analysis and principal coordinates analysis by John Gower.

It is important also to recognise the contributions of agricultural statisticians outside Rothamsted, and especially in Edinburgh. These include design keys by Desmond Patterson and Rosemary Bailey and. most importantly, the REML algorithm developed by Desmond Patterson and Robin Thompson for analysing unbalanced linear mixed models.

The talk will review some of these techniques and show how they have been developed further by those mentioned above – and their successors.

Roger Payne spent most of his career at Rothamsted as a statistician involved in research, consulting and computing. His interests include design and analysis of experiments, generalized linear models and their extensions, statistical modelling and the study of efficient identification methods (applied in particular to yeast identification). He has also enjoyed many years of statistical collaboration with Rothamsted biologists which have helped him to retain a practical perspective.

His statistical computing has been focussed mainly on the statistical system GenStat, leading of its development since 1985. In 2002, when Rothamsted transferred GenStat and its associated statistical research to a new company VSN International, he became VSN's Chief Scientific and Technical Officer. However, he has kept an honorary position at Rothamsted, as well as his other academic links as a visiting Professor at Liverpool John Moores University and a Special Lecturer at University of Nottingham.

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Socioeconomic status and age trajectories of health among the older

The aim of this study is to examine whether socioeconomic disparities in health diverge for middle-aged adults but converge in later life.

Using three waves (2002-2006) of the English Longitudinal Study of Ageing (ELSA), a large panel study of non-institutionalised individuals aged 50 and over, this study employs a latent growth-curve modelling approach to examine socioeconomic status differences in trajectories of health over time for 1-year age groups.

The health trajectories for each age group over the follow-up period are expressed in graphical form by a series of vectors, namely ageing-vector graphs. Ageing-vector graphs reveal both the changes as people age and trends in the sum of changes up to a given age. The models included both time-variant and time-invariant covariates.

Two distinct measures of socioeconomic status are employed in this study: education and total wealth. Total wealth (excluding pension) is defined as financial, plus physical (such as business wealth, land or jewellery), plus housing wealth, minus debts. It has been suggested that wealth represents a better measure of the permanent economic status of older people than income.

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Estimating social inequalities in trajectories of health decline in studies with informative drop-out: a sensitivity analysis

A major aim of longitudinal studies in ageing research is to identify risk factors for health decline. For example, subject-specific trajectories of functional decline can be analysed using growth curve models. Such studies face problems of drop-out and missing data. The potential bias arising from selective attrition is particularly acute at older ages where attrition may be related to age-related change in health status and functioning. An additional source of health selection in longitudinal studies of ageing is mortality.

Methods for missing data are now readily available in standard software packages for situations where the missing data mechanism can be assumed to be missing at random (MAR) but methods for dealing with missing data which are not missing at random (MNAR) are less easily implemented. Many longitudinal studies are able to link in data from external sources such as mortality registers and electronic patient databases that could be used to investigate possible missing data mechanisms. Using selection models, we apply methods for dealing with informative drop-out using external data available for both respondents and non-respondents.

Using repeated measures of physical health functioning and symptoms of depression from the Whitehall II longitudinal study, we investigate social inequalities in trajectories of health. If the missing data mechanism is non-ignorable (MNAR), this may lead to underestimation of social inequalities in trajectories of health decline at older ages. We conduct sensitivity analyses to explore results under a range of different assumptions about the dependence of drop-out on current physical health functioning or symptoms of depression.

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A cross-cohort comparison to examine changing patterns in leaving the parental home in Britain across three decades (1974-2004)

This paper examines the usage of a combination of Event History Analysis and Sequence Analysis to explore methodological challenges facing researchers investigating the transition to independent housing of young people leaving the parental home.

Leaving the parental home implies two assumptions. Firstly that leaving home is associated with movement into independent housing. Secondly, that leaving the parental home is expected to connote a degree of permanency.

The paper describes how both of these assumptions can be violated in accounts of movement away from the parental home, using data from two British cohorts. Movement away from the parental home may be short in duration and may constitute a series of movements before independence is achieved. Furthermore, problems in defining and responding to questions about the 'parental home' and 'independence' may mean that conventional ways of measuring transition to independent housing may overestimate the speed of movement.

Finally, destinations away from the parental home may not in themselves be into households as an independent householder, head of household or partner of the head of household.

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A multiple process latent transition model of poverty and health

An often contested issue is whether poverty increases the risk of poor health or poor health increases the risk of poverty. In this work we test the relative strength of these relationships, using a multiple process latent transition model that estimates the cross-lagged influences on health and poverty over time.

The health and poverty dynamics are modelled as hidden two-state Markov processes. Observed health is measured by the general self-rated health question on a 5-category Likert scale. The repeated health measures are assumed to be conditionally independent given the hidden process, i.e. the underlying "true" state of good or poor health. Observed poverty is defined as below 50% of the median household income adjusted for household composition and again assumed to be conditionally independent given an underlying "true" poor or non-poor state.

Our starting point is a separate examination of health transitions and poverty transitions over time to assess whether transition probabilities are heterogeneous or homogeneous. Then a

series of nested multiple process latent transition models are used to explore the cross-sectional and bidirectional longitudinal links between health and poverty. Time-invariant and time-varying covariates are also accommodated in the framework.

We use data from the British Household Panel Survey, restricting the sample to men aged 21 to 49 years and women aged 21 to 44 years in 1991 who were still participating in the survey in 2006 (N=2344). We use data from every 3rd wave of the survey, resulting in 6 waves (1991, 1994, 1997, 2000, 2003, 2006).

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Problems and methods in deciding frequency of cancer screening

Choosing the frequency of surveillance episodes in a cancer screening programme can be complicated. The interval between screens must be sufficiently long that the prevalence of disease at repeat screens is high enough for the screening activity to be cost-effective. On the other hand, the interval has to be sufficiently short that for an individual participant, it is unlikely that a disaster in the form of an advanced cancer occurs in the interval between screens.

The estimation of the likely cancer incidence during an interscreening interval is dependent on the sensitivity of the screening tool and the rate of progression of disease from asymptomatic to symptomatic.

We show how some simple exponential models can be applied to inform the choice of regimen, and potentially assist in development of individually tailored screening programmes. These are illustrated in examples from breast cancer screening.

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Self-controlled case series analyses with event-dependent observation periods

The self-controlled case series method enables associations between exposures and outcome events to be estimated using only cases, namely individuals who have experienced the event. The method is particularly convenient for use with health databases and linkage studies, and has the big advantage of controlling for all fixed confounders.

However this comes at a price: the periods over which individual life histories are observed must be independent of event times. This is not the case for events associated with increased mortality, such as stroke and myocardial infarction.

In this talk, an extension of the case series method is described in which this requirement is lifted. The new method involves explicitly modelling the end of observation. The association parameters of primary interest may be estimated without bias, while age-related effects carry new but meaningful interpretations as population quantities.

The method will be illustrated using data on antipsychotics and stroke.

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Spatial variability in relative survival from female breast

Background: Relative survival constitutes an indicator of the quality of cancer patients' management, being useful for evaluating health care services performance. Geographical variations in cancer survival could reflect differences in the effectiveness of health care.

Objective: To assess the geographical variation in relative survival rates from female breast cancer in the Girona Health Region (GHR).

Methods: 2830 women diagnosed with invasive breast cancer were recruited in the population-based Cancer Registry of Girona, Jan-1993/Dec-2002. Patients were followed-up until Dec-2005 by means a record-linkage with the Catalan Mortality Registry and the National Death Index.

Relative survival and relative excess risk of death from breast cancer were calculated for each one of small areas (i.e. census tracts) of the GHR. The baseline model was a non-spatial Poisson formulation of a piecewise constant hazard model. With spatial data, observed counts display greater variation than expected, i.e. extra-variation: i) independently and spatially uncorrelated (heterogeneity); ii) spatial dependence, consequence of the correlation of the spatial unit with neighbouring spatial units. Three additional models were estimated, non-spatial model with heterogeneity; and spatial models without and with heterogeneity. Extra variation was captured by means of (small areas' specific) random effects, iid normally distributed for heterogeneity, and CAR for the spatial dependence. All four models (adjusted for age at diagnosis) were estimated following a full Bayesian estimation approach.

Results: Overall survival, for 1993-2005, was 66.3%. In non-spatial models (standardised) residuals were found to be heteroscedastic and (spatially) autocorrelated. The best model, in terms of goodness-of-fit, was the spatial model with heterogeneity. Five-years relative survival was estimated as 0.7935 (95% credible interval, 0.6222,0.9142). The relative hazard rate excess (rHR) estimates range was 0.122(25-35 years)-0.234(75 years or more). The representation of rHR of the census tracts in a map of the GHR showed certain geographical pattern that could correspond to a similar socioeconomic pattern.

Conclusions: The full Bayesian approach gives the best estimates of small areas' specific relative survival and risk of excess death. Therefore, it is preferable to standard methods for assisting in prioritising improvements in cancer health care.

Acknowledgments

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Using Discrete Event Simulation to assess the impact of a colorectal screening programme

Many of the challenges faced in health care delivery can be informed through building models. In particular, Discrete Event Simulation (DES) models can deal with the complexity of describing the flow of individuals through a treatment system, where the problem is stochastic in its nature; interactions between individuals are important; and where there is likely to be some constraint on resources. DES enables numerous safe and relatively inexpensive investigations to be performed into the optimal arrangements of current health care provision, and also enables assessment of the impact of possible additional health policy measures.

A colorectal screening programme is being introduced in Northern Ireland in 2009, with gastrointestinal (GI) endoscopy Day Procedure Units (DPUs) needing to provide a key resource to facilitate this programme. To assess the impact of the new screening programme, a DES model has been built to mimic the current operation of the endoscopy DPU in the Royal Victoria Hospital in Belfast, UK.

This model tracks each individual's pathway, from the time of their requesting treatment, through to the delivery of treatment. Patient characteristics considered include their in-/out-patient status, their routine/expedited status, and the type of procedure to be performed (e.g. an upper/lower GI tract endoscopy or some other type of endoscopy).

The 'creation' of patients requesting treatment (from the various groups) is a stochastic process, based on data from the Theatre Management System dataset, (detailing all scheduled entities over a nine-month period and their recorded times at various stages through the DPU). The model accounts for the block-scheduling of outpatients via the various doctors' lists (i.e. a slot-based system), which in turn influences the number of inpatient procedures that are scheduled.

The flow of patients through one of the three DPU theatres to the recovery room (on their scheduled day) is based both on patient characteristics (e.g. duration of procedure in theatre depends on procedure type) and possible resource constraints (e.g. availability of doctor, endoscopes, recovery bed etc.).

The DES model built was validated through examination of e.g. its activity levels, theatre/recovery times, waiting-list times, via comparison with the relevant data. Various scenarios were investigated to determine ways to optimise throughput, reduce queues and improve the utilisation of resources. The model suggests some resources are available for this new screening programme, particularly through targeting underutilised doctor lists.

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Balancing risk and utility – Statistical Disclosure Control for the 2011 UK Census

It is vital for legal, policy and ethical reasons that the UK Census Offices protect the confidentiality of census respondents. The aim of Statistical Disclosure Control (SDC) is to ensure that this confidentiality is maintained whilst ensuring statistical outputs provide as much value as possible to the users.

We will describe the approach that has been adopted to develop a statistical disclosure control strategy for 2011 Census tabular outputs. Focus will be given to the comparison of different disclosure control methods in terms of the protection they provide (risk) balanced against the impact that they have on the usefulness of the statistics (utility).

We will describe the range of both qualitative and quantitative measures that have been used to evaluate both risk and utility and how these have been used to test methods on 2001 Census data.

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Multi-modal sentencing – potential for reduced pressure on the prison system and an in-built randomized controlled trial to assess impact on re-incarceration rates and costs

Objective: We present three methods that redistribute custodial sentence lengths so that they are less clumped and have a lower mean; and propose a randomized evaluation of their impact on re-incarceration rates and costs.

Methods: Exploratory analysis of Home Office data on 2004-sentenced cases revealed the multi-modal nature of custodial sentence lengths for four offence types - common assault, theft from shop, driving whilst disqualified, and supply and possession with intent to supply Class A drugs. Depending on the severity of their offence, offenders tend to receive multiples of seven days; three months; or one year. To redistribute the sentences at these modes, three methods were compared –

(1) Uniform smearing – randomly select a proportion, p (say half) of the numbers sentenced at each mode and randomly allocating one fifth each to d days less, 2d days less, 3d days less, 4d days less and 5d days less.

(2) Banked smearing - taking p of the numbers at each mode and allocating n to d days less, 4n/5 to 2d days less, 3n/5 to 3d days less, 2n/5 to 4d days less, n/5 to 5d days less, where n is such that n+4n/5+3n/5+2n/5+n/5=p; and,

(3) “Extra modes”-smearing - taking p of the numbers at each mode and allocating 3p/5 to 2d days less and 2p/5 to 4d days less.

Results: All three methods achieve their objective to de-clump and reduce the mean of the distribution of custodial sentence lengths. Impacts depend on how a mode is defined, as sentence lengths accounting for either 5% or 10% of the total frequency, and on p, the proportion redistributed at each mode.

Conclusions: All three methods translate into a reduction in prison days and so have the potential to relieve pressure on the prison system – provided that there are no adverse effects on re-incarceration rates. The latter could be checked by a national suite of randomized controlled trials of post-sentence redistribution of modal lengths. The extra modes method is particularly attractive for its simplicity in translating to an in-built randomized controlled trial that can evaluate the effects of differently redistributed sentence lengths on re-incarcerations and other outcomes of interest.

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A 'Scottish Effect' for health?

Scotland has very poor health in comparison to other countries in Western Europe. For example, female and male life expectancy at birth in Scotland for 2005-07 were 79.8 and 74.9 respectively, compared to 81.7 and 77.5 in England and Wales.

Why Scotland's health lags behind that of England and Wales, in particular, is the subject of on-going research and debate. Scotland's higher level of socio-economic deprivation seems important for its poor health record. However, in recent years this appears to explain less of the difference and this suggests that there may be some additional risk factor(s) for Scotland – the 'Scottish Effect'.

In this talk I will briefly review recent evidence on the 'Scottish Effect'. Is there a 'Scottish Effect'? And if so, what is it? I will also present new analysis of mortality data from the 1950s onwards that suggests a worsening of Scotland's relative position in recent years driven, perhaps, by particular problems with premature mortality.

Frank Popham is a research fellow in the School of Geography and Geosciences at the University of St Andrews. His broad area of research interest is socio-economic inequalities in health. His research explores various aspects of this topic through secondary analysis of existing datasets. Areas of particular interest are the influence of socio-economic position measured across the life-course, socio-economic disparities in physical activity and the interrelationship between socio-economic position and employment situation.

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Scotland's multiple demographies: past and present

Compared with many countries of similar size, Scotland's demography is spatially and socially hugely diverse – and has been for more than two centuries.

This paper focuses principally on some of the key spatial dimensions of this diversity, and examines how they have changed both over recent decades and also within the context of much longer timespans. To what extent are current patterns a product of fairly recent changes, and to what extent are they an ongoing legacy of the more distant past?

Michael Anderson is Emeritus Professor of Economic History and Honorary Professorial Fellow at the University of Edinburgh, where he was employed from 1967 to 2008, including as the Senior Vice-Principal from 2000 to 2007. He has published extensively on the population history of Western Europe and of Scotland in particular, as well as on the history of the family and on how people in the very recent past have plan all aspects of their lives. He chairs the Trustees of the National Library of Scotland and has served on the councils of the ESRC, the British Academy and the Royal Society of Edinburgh and on a range of advisory boards on population, libraries and research matters.

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The establishment of civil registration in Scotland

An Act for recording births, deaths and marriages was passed for England and Wales in 1836, but Scotland did not obtain equivalent legislation until 1854. While supporting vital registration in principle, the Scottish churches and municipal authorities voiced strenuous objections to the nomination and payment of civil registrars, the imposition of fees for registration and penalties for non-registration, and the provision of new central administrative facilities.

These objections helped derail no fewer than eight attempts to push a Scottish registration bill through parliament. Four of the failed bills were also linked to proposals for reforming the Scots marriage law, which proved so unpalatable that the registration bills were damned by association. Only by placating all the key interest groups and avoiding any interference with the law of marriage did Lord Elcho's bill of 1854 succeed, establishing the compulsory registration of births, deaths and 'regular' marriages under a new General Register Office for Scotland (GROS).

Pressure from the Royal College of Physicians of Edinburgh also ensured that, like the General Register Office for England and Wales, the GROS had a medically qualified Superintendent of Statistics to tabulate the births, deaths and marriages recorded by the local registrars.

Dr Cameron received her PhD in the history of medicine from the University of Glasgow in 2004. She has since worked with Anne Crowther, Rosemary Elliot and Gayle Davis on a research project entitled 'The Scottish Way of Birth and Death: Vital Statistics, the Medical Profession and the State, 1854-1945.'

The results have been published in the Historical Journal, the Journal of the Royal College of Physicians of Edinburgh, Scottish Archives, and the project website, accessible at http://www.gla.ac.uk/departments/scottishwayofbirthand death/

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The new approach to government: challenges and opportunities for statisticians

The new Scottish Government (SG) set out their vision for Scotland in the Economic Strategy, which was published in November 2007. This introduced the National Performance Framework (NPF).

This was a change for the Scottish Government and its analysts as it represented a move to an outcomes-based approach. The NPF outlined the purpose of the SG, the five Strategic Objectives, 15 National Outcomes and 45 National Indicators and Targets.

Statisticians in the Scottish Government were involved in the creation of the National Performance Framework and advised on the selection of indicators. The Indicators are designed to be a representative set of indicators across the 15 National Outcomes, rather than key performance indicators. The new outcomes based approach has presented opportunities for analysts in the SG to bring the wide range of evidence we have available to say something about how outcomes could be delivered, and, in time, to evaluate whether they are being delivered.

This session will cover the challenges and opportunities that the new approach to Government brings to Statisticians within Government. This will include an overview of the SG's online reporting system, Scotland Performs (www.scotlandperforms.com), and how analytical rigour has been brought to this system. Also covered will be the link with local outcomes and how the SG Statistical Service has been building analytical capacity in our partner organisations.

Dette Cowden is the Senior Statistician in the Office of the Chief Statistician (OCS) in the Scottish Government. She has worked for the SG for 8 years, and before that worked in the field of biostatistics.

Mairi Spowage is a Statistician also in OCS, and has worked for the SG for 4 years. She has a background in Environmental Statistics and is the Secretary of the Edinburgh Local Group of the RSS.

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Inference from complicated to complex systems: prospects for approximate Bayesian computation

It is often relatively straightforward to simulate samples from a complicated stochastic model, yet non-trivial to write down or compute the likelihood. Increasingly, we would like to infer parameters and choose among models in such cases.

Originally motivated by modelling in population genetics, the method of approximate Bayesian computation (ABC) has become adopted in a number of different fields. ABC addresses the problem of inference in complicated models by mapping (and hence marginalising) high-dimensional data onto a lower-dimensional summary vector.

A variety of Monte Carlo techniques have then been developed to compute posterior distributions based solely on the output of simulations, without computation of the likelihood. Current methods are described and compared, and potential future directions tentatively indicated. Intrinsic to most implementations of ABC is the generation of samples from the prior and/or posterior predictive distribution, and this highlights fundamental, and intertwined, issues in the ABC approach related to the choice of distance metrics, the choice of summary statistics, and the choice of model.

Finally, it is suggested that the ABC approach is well suited to the modelling of `emergent' phenomena in agent-based models of complex systems, and the current and potential range of application is considered: in population genetics, systems biology, epidemiology, ecology, and the social sciences.

Mark Beaumont is currently a Senior Research Fellow in the School of Biological Sciences at the University of Reading. His main research interests lie in the development and application of computational statistical methods in population genetics.

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Some recent developments on auxiliary variables, perfect simulation, and importance sampling

This talk will review some recent developments in the use of auxiliary variable methods in computational statistics and simulation. Examples to be considered will include perfect simulation and particle filtering for diffusions, and pseudo-marginal MCMC.

Gareth Roberts is professor of statistics at the University of Warwick, and director of the Centre for Research in Statistical Methodology, CRiSM. His research spans statistics and probability, with a particular focus on Bayesian and computational statistics and the interface of numerical analysis and probability. His current interests lie in the theory, methodology, and application of MCMC and related methods and inference for stochastic processes.

Janet Foster
Royal Statistical Society Archivist

Out of the archives: using primary sources in the digital age

This paper will examine how increased access to and use of the archives through the internet and email works for the researcher at a distance; it will also present two brief case studies illustrating what can be found by digital means which was previously impossible without extensive research and how the "missing" Bowley papers were found.

The final section will show why there is no substitute for the "real thing" and the excitement of consulting the original archives

Janet Foster is a professionally qualified archivist with more than 30 years experience of archives and records management in a wide range of contexts. Since 1990 she has been self-employed as a freelance archives consultant working for a range of clients from learned societies to theatre companies, providing advice on recordkeeping and the care and cataloguing of their archives.

In 1991 she pioneered the Basic Archive Skills Training course concept which led to the establishment of the Archive-Skills Consultancy (TASC) partnership to provide training courses and undertake project work. Janet is also co-editor of "British Archives: a guide to archive resources in the UK", first published in 1982 and now in its 4th edition.

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'We Have What You Need!': research sources in the public records for social scientists

In 2006 the Economic and Social Research Council (ESRC) financed a scoping study to look into the extent to which social scientists did or did not use public record sources and why. This reported in 2007, and generated a year of taking forward initiatives within The National Archives, following the recommendations of that report. These were particularly within the areas of:

- working with the ESRC
- publicising research sources
- making funding bids to external sources, or partnering universities in the same
- participating in a variety of events.

At the end of the year Vanessa Carr compiled a report of achievements, and this is the basis of this talk, along with consideration of the way forward from Year One.

Vanessa Carr is the Head of Academic Liaison at The National Archives (TNA), working within the Research and Collections Strategy Department. She is a professional archivist who has worked for 36 years at the Public Record Office/National Archives, in a wide variety of roles and departments. She has been involved with the academic sector of users since 2003. Her present role, which is underpinned by TNA's academic strategy, seeks to liaise with the academic users and support their interests, and also to reach out to new users and disciplines.

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The census and the archive, 1801-1931 and beyond

This paper will argue that archival material is a vital source in providing a level of transparency to classificatory systems created in the nineteenth century censuses of England and Wales. The necessity of understanding the contexts behind the collection of data and the theoretical constructs surrounding classification is well known to contemporary statisticians.

When data created produced more than a century ago is used, understanding these contexts become more important, as they provide an additional understanding of the society in which they were created, with particular reference to the classification of occupations in the census.

Matthew Woollard is Associate Director and Head of Digital Preservation and Systems at the UK Data Archive, University of Essex. He trained as a historian and completed his PhD on occupational classification in Britain, 1660-1911 in 2005. He is also the Project Director of the Online Historical Population Reports project. The histpop website (http://www.histpop.org) contains digital copies of all pre-war British census reports as well as over 20,000 pages of archival material from The National Archives relating to the collection of population statistics.

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Using a latent class screening test model to estimate the fraction of fake art offered for sale on eBay: application to the works of Henry Moore

Under appropriate assumptions, the Hui-Walter latent class model enables one to estimate the accuracy rates of screening or diagnostic tests as well as the prevalence of a trait in the absence of a "gold standard". A major requirement is that one needs two sub-populations with different prevalence's of the trait. It has been used to estimate the prevalence of disease in herds of animals (Branscum, Gardner and Johnson, 2004) and accuracy of judge and jury decisions (Gastwirth and Sinclair, 1998).

Since artists create works in different media, e.g. sculpture, drawings and prints, it is sensible for forgers to focus on the higher valued objects. From Nov. 2005 through March 2007 all works of Henry Moore available on eBay were evaluated for authenticity by two individuals with a keen interest in and extensive libraries on his work. As some prior information had been obtained in informal conversations with art dealers and professionals involved with Moore's art, a Bayesian approach was taken.

The results indicate that one should be very sceptical about the authenticity of sculptures and drawings but that a high proportion of etchings and lithographs were genuine. Although the project was undertaken before two recent legal cases concerning the responsibility of eBay for the items offered, the approach should be useful to Consumer Protection agencies as one does not need to purchase questionable items.

It is shown that having an third independent evaluator will improve the accuracy of the estimates and that approach is recommended for future studies.

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One hundred years of goodness of fit tests: time to ask what they are for?

The 175th anniversary of the RSS is also (arguably) the centenary of a major landmark in the development of statistics, Pearson's chi-squared test of goodness of fit (gof). For the date, we have taken an average of the date of Pearson's original paper, and the date of Fisher's later RSS paper in which he corrected an error in Pearson's calculation of the degrees of freedom. Developing a myriad of other gof tests has been a preoccupation of statisticians ever since.

A gof test allows us to assess whether data x is consistent with model m. Why are we interested in m, and why are we interested in gof? Conventional answers are that model-based inferences are more accurate than model-free (non-parametric) inferences, and that passing a gof test confirms that m is a good model for such inferences. Are these answers well-founded?

The talk will look at the simplest case when x is a large random sample from some unknown distribution d, and when we are interested in estimating the value of a parameter defined as a function of d (such as the population mean). If d is assumed to belong to model m then we can calculate a confidence interval, and then see how these confidence limits depend on m through the value of a gof statistic.

This suggests that if we want to know whether m is a good model then gof is not enough: we also need some external evidence or belief that m is sensible.

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Evaluating the accuracy of diagnostic systems by means of meta-analysis

Sensitivity and specificity are well--known and well--accepted performance measures of discriminatory power for a diagnostic test. If the diagnostic test delivers a continuous or ordered categorical outcome, a cut-off value is used. In consequence, sensitivity and specificity are dependent on the choice of this threshold value - typically in a reverse order. Hence, specificities and sensitivities arising from different diagnostic studies are not comparable out-ruling a meta-analysis focusing on sensitivity and specificity.

The talk will instead re-emphasize the importance and suitability of the receiver-operating-curve (ROC) which is also called summary receiver-operating-curve (SROC) in the context of meta-analysis of diagnostic studies and will suggest to model the SROC curve using the Lehmann-family.

A further aspect is that inference concerned with the parameters involved in the Lehmann-model needs to be done appropriately and validly. The SROC-curve is conventionally set up using the sensitivity as vertical axis and 1-specificity as the horizontal axis. However, this setting is arbitrary and one could think of a SROC curve with specificity as vertical and 1-sensitivity as horizontal axis. The problem is that a conventional regression produces results which are dependent on the choice of the axis. This is similar to the known result that regressing Y on X is not the same as regressing X on Y.

We suggest a profile-likelihood approach which is invariant to the choice of the nuisance parameter (parameter estimates are identical independent of the fact if sensitivity or specificity is taken to be the nuisance parameter). Considerations are given to curvature - adjustments of the profile likelihood to achieve a valid variance estimator of the Lehmann family parameter.

The talk ends with a perspective on how to incorporate unobserved heterogeneity into the modelling.

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Do journal rankings reflect research quality?

In the UK, academic research quality in all disciplines has for many years been measured by a periodic, national "Research Assessment Exercise" (RAE). The most recent of these took place in 2008, using data from 2001-2007 (see http://www.rae.ac.uk/).

In the future, the RAE is to be replaced by a new "Research Excellence Framework", with seemingly greater emphasis on the use of "metric" data such as research-grant income and citation counts.

This talk will explore the face validity of some methods of scoring academic journals on the basis of citation counts, in particular by comparison with the results of the 2008 RAE.

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Investigating the impact of the Quality and Outcomes Framework on the quality of primary care

The new contract for GPs in the UK introduced in 2004, included the Quality and Outcomes Framework (QOF). This incentive scheme aimed to improve quality by linking a substantial proportion of practice income to achievement of a set of quality markers. Up to 30% of practice income is now linked to a complex set of quality targets around clinical care for ten chronic conditions, organisation of care, and patient surveys.

There is great interest in understanding the effects of QOF on quality and whether it represents value for money. Quality scores for all the clinical indicators in QOF have improved year on year since 2004. However, these represent only a small proportion of all clinical care, and there are concerns that quality for non-incentivised aspects of care may have suffered some neglect.

We compared clinical indicators incentivised under QOF with clinical indicators that are not. Each clinical indicator has two aspects: (i) a disease condition (eg diabetes, CHD); and (ii) a process of care (eg measurement of blood glucose; control of blood pressure). Using these we defined four types of indicator: (A) condition is in QOF and process is incentivised; (B) condition not in QOF but process is incentivised; (C) Condition in QOF but process is not incentivised; (D) Condition not in QOF and process not incentivised.

We aimed to compare the four types of indicator on changes in quality from pre-QOF to post-QOF. Our expectation was that quality for type A indicators (ie existing QOF indicators) would show most improvement; that types B and C may show some 'halo' effects since they involve either a condition or process already in QOF; but that quality for type D indicators may have declined.

We defined 57 indicators, 31 existing QOF indicators and 26 of types A, B or C. Quality trends for all 57 indicators from 1999 to 2007 were derived for a sample of 150 general practices from the General Practice Research Database (GPRD). GPRD contains electronically captured details of every patient consultation over that period, for a total sample of 600,000 patients. The richness of the resource demanded a highly complex information extraction process.

We describe the GPRD information extraction process and our analysis methodology. Our findings regarding the impact of QOF on the quality of primary care for patients with chronic conditions are presented.

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Uses and abuses of Interrupted Time Series to evaluate national programmes: an example using the Quality and Outcomes Framework in England

New programmes or initiatives in health care at the national level are typically rolled out to all providers at the same point in time. Some examples include the 2004 'new' contract for GPs in the UK, which introduced the Quality and Outcomes Framework (QOF) incentives scheme simultaneously into all primary care practices, and the regular release of NICE guidelines around medicines prescription. For those wishing to evaluate the impact of such health care initiatives, 'universal' implementations are problematic because they allow no opportunity to establish a control group for the purpose of comparing between sites that have and have not introduced the initiative.

In the absence of the ability to randomise sites into intervention and control groups, an alternative, though much weaker, research model is the 'interrupted' time series (ITS) design. Under this approach, data on the outcomes of interest is collected for a period of time prior to the introduction on the initiative, and also for a period afterwards. The complete time-series is then examined for evidence of a discontinuity in the outcome trend at the point at which the initiative was introduced.

Although arguably the strongest design available in the absence of a control or comparison group and seemingly simple in concept, ITS designs exhibit particular challenges in statistical analysis. An ITS analysis typically involves the testing of several parameters, each representing a different component of the outcome trend. This gives rise to a potential for the statistical tests of different parameters in the model to produce 'contradictory' findings, and also raises issues around adjustment for multiple hypothesis testing. The choices available here also make the method particularly open to researcher bias.

We used an interrupted time-series design to investigate the immediate and long-term impacts of the QOF scheme on the quality of clinical care provided to patients at general practices in England. We describe the research and our ITS analysis of the data, highlighting how we addressed these problematic areas of statistical testing. Recommendations are made for others interested in applying interrupted time series design and analysis.

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Statistical issues for the assessment of inequalities in cardiac care across England and Wales

Despite recent advances in treatment and lifestyle changes, coronary heart disease (CHD) continues to be the leading cause of death in the UK. Further, the UK has a high numbers of CHD deaths compared with other countries, and the most deprived patients have the worst outcomes even after considerable NHS spending.

The focus of this work is the assessment of cardiac care provided in hospitals across England and Wales. The MINAP database covers all acute hospitals in England and Wales (n=228) and collects information on the quality of care and outcome of patients admitted to acute hospitals in England and Wales with ACS. Data are collected prospectively at each hospital, encrypted and transferred on-line to a central database. By means of >100 fields, each patient entry offers details of the patient journey, including the method and timing of admission, investigations, results, treatment, and date of death (from linkage to the UK Statistics Authority). MINAP receives ~80,000 submissions per annum.

We aim to build a comprehensive risk model for patients on admission (a near point model) that will provide case mix adjustment whatever the data available. A second comprehensive risk model on discharge (a far point model) permits the assessment of hospital care. It is of interest to compare the care of older patients and identify disparities in treatments provided. Further questions include a study of the effect of deprivation on treatments offered and the appropriateness of healthcare guidelines (for example, the impact of sixty minute call-to-needle/balloon guidelines (for ST elevation myocardial infarction) on outcomes).

Generalised Linear Mixed Models (GLMMs) and their extensions are the main statistical tools used to construct both near and far point mortality risk models. A combination (or mix) of fixed and random effects allows a patient's individual characteristics to be incorporated whilst respecting the multilevel structure of the data (i.e. patients are grouped within hospital units). Initial work on the MINAP data set provides various methodological challenges to be investigated.

For example, logit and probit link functions for mortality risk are inappropriate and novel approaches such as a cauchit link may be required. Non linear relationships (e.g. between mortality risk and age) indicate that Generalised Additive Models (GAMs) form an important part of the modelling strategy. The MINAP data set contains missing values due to incomplete patient records. Hence multiple imputation methods are used to assign plausible values.

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Assessing results produced by a text mining algorithm

The National Patient Safety Agency (NPSA) has collected free text descriptions of more than three million patient safety incidents that have occurred in the NHS. We have developed a text mining algorithm that examines the data to find small groups of anomalously similar incident descriptions.

These groups of descriptions may represent types of incidents that were previously unknown to the NPSA. If so, the NPSA can send advice and instructions to NHS organisations, to try to prevent the reoccurrence of these types of incidents.

One major problem with this type of analysis is the question of how the results are to be assessed. Ultimately, the results will have to be assessed qualitatively by medical experts, who will decide whether the information produced by the algorithm is of interest. However, the experts can only spend a limited amount of time assessing the results. The algorithm has a large number of parameters whose values can be varied, and therefore produces too many results for the experts to assess manually.

In order to solve the problem, a three stage assessment process is used. Firstly, a proxy quantitative measure is used to reduce the number of results. This proxy measure is designed to reflect the quality of the models of the text. Those models that best reflect the meaning of the incident descriptions will be passed to the second stage. This involves a qualitative filtering process that can be carried out by non-medical experts. Groups of incidents that are coherent and that use varied language will be accepted. This reduces the results to a quantity that is manageable for the medical experts: their qualitative analysis is the final stage of the assessment process.

We will describe the process in detail, and compare it with the assessment processes for other data mining projects, where the value of the results must ultimately be assessed by the organisation that owns the data.

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Direct Effect Testing: a two stage procedure for effect size and importance with correlated binary predictors of a binary response

In applications such as medical statistics and genetics, we encounter situations where a large number of highly correlated predictors explain a response. For example, the response may be a disease indicator and the predictors may be treatment indicators or genetic characteristics. Constructing a good predictive model in such cases is well studied. Less well understood is how to a recover the 'true sparsity pattern', that is finding which predictors have direct effects on the response, and indicating the statistical significance of the results.

Restricting attention to binary predictors and response, we study the recovery of the true sparsity pattern using a two-stage method that separates the process of establishing the presence of direct effects from inferring their exact relationship with the predictors.

The uncertainty in the relationship between the predictors and the recovered direct effects, which is caused by multicollinearity, is represented by a discrete distribution giving the likelihood of the direct effect originating from each of a collection of predictors.

Simulations and a real data application demonstrate the method discriminates well between associations and direct effects. Comparisons with lasso based methods demonstrate favourable performance of the proposed method.

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Hierarchical Bayesian modelling of pharmacophores

One of the key ingredients in drug discovery is the derivation of conceptual templates called pharmacophores. A pharmacophore model characterises the physico-chemical properties common to all active conformations of a set of small molecules, known as ligands, which are bound to a particular protein receptor, together with their relative spatial arrangement. Mathematically, we simply represent ligands as a configuration of points. The problem then reduces to that of finding points common to all molecules.

Motivated by this important application, we develop a Bayesian hierarchical model for the multiple alignment of configurations of point sets, from which we can derive templates representing the geometry of matched points. The methodology is implemented through a multi-stage template hunting algorithm, within which it is necessary to embed a pairwise alignment method such as that proposed by Green and Mardia (Biometrika, 2006 pp. 235-254).

The algorithm identifies points matched across multiple configurations and produces a series of templates which capture their geometrical relationship. We illustrate our method by identifying geometrical templates representing matched points from sets of ligands which all bind to structurally-related protein active sites.

The resulting templates are considered to be plausible by experts. Additionally, various open problems relating to this work will be described in the talk.

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An asymptotic theory for improving inference in Hidden Markov Models

Besides their classical applications in digital communication, speech recognition, and processing of natural languages, hidden Markov models (HMM) have now been also routinely used in bioinformatics. In an HMM $(X_t, Y_t)_{t\geq 1}$, observations $X_1, X_2, \ldots,$ are assumed to be conditionally independent given an ``explanatory'' Markov process $Y_1, Y_2, \ldots,$ which itself is not observed; moreover, the conditional distribution of X_t depends solely on Y_t.

Central to the theory and applications of HMM is the Viterbi algorithm to find *a maximum a posteriori* (MAP) estimate $v(x_{1:T}) = (v_1, v_2, \ldots, v_T)$ of a hidden realisation $y_{1:T}$ given observed data $x_{1:T}$. *Maximum a posteriori paths* $v(x_{1:T})$ are also known as *Viterbi paths*, or *alignments*, and have been used in gene prediction for segmentation of coding regions from non-coding ones, and also for detection of CpG-islands.

At the same time, MAP paths do not minimise the prediction error, even asymptotically, and also cause bias in model parameter (re)estimation. We will thus discuss how HMM inference based on MAP or other types of alignments such as *pointwise*, or *symbol-by-symbol* MAP (PMAP) alignments, can be improved. In particular, we will demonstrate how a newly developed asymptotic theory of alignments, including MAP and PMAP, can help in *active semisupervised* prediction of the hidden sequences.

The key results underlying this work are the existence of infinite MAP and PMAP alignments with suitable properties, and that the probability of incorrect prediction given x, can be suitably approximated.

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An inference procedure for random degeneration of paired rank lists and its application in bioinformatics

Let us assume two assessors (e.g. laboratories), at least one of which ranks N distinct objects (e.g. genes) according to the extent to which a particular attribute is present (e.g. gene expression). The ranking is from 1 to N, without ties. In particular we are interested in the following situations: (i) The second assessor assigns each object to the one or the other of two categories (0-1-decision assuming a certain proportion of ones). (ii) The second assessor also ranks the objects from 1 to N.

An indicator variable takes Ij=1 if the ranking given by the second assessor to the object ranked j by the first is not distant more than d, say, from j, and zero otherwise. For both situations our goal is to determine how far into the two rankings one can go before the differences between them degenerate into noise. This allows us to identify a sequence of objects that is characterized by a high degree of assignment conformity.

For the estimation of the point of degeneration into noise we assume independent Bernoulli random variables. Under the condition of a general decrease of pj for increasing j a formal inference model is developed based on moderate deviation arguments implicit in the work of DONOHO et al. (1995).

The decision process is based on the pairwise assessments of all objects and is designed to cope with irregular respectively incomplete rankings typically occuring in real data. Among some technical parameters a regularization parameter is introduced to account for the closeness of the assessors' rankings and the degree of randomness in the assignments.

The class of problems we try to solve has various bioinformatics applications, for instance in the analysis of gene expression measurements across platforms. We examplify the described inference procedure on both simulated and real data, also taking advantage of a new graphical tool.

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The limitations of using school league tables to inform school choice

In England, so-called 'league tables' based on examination results and test scores are published annually, ostensibly to inform parental choice of secondary schools. A crucial limitation of these tables is that the most recent published information is based on the current performance of a cohort of pupils who entered secondary schools several years earlier, whereas for choosing a school it is the future performance of the current cohort that is of interest.

We show that there is substantial uncertainty in predicting such future performance and that incorporating this uncertainty leads to a situation where only a handful of schools' future performances can be separated from both the overall mean and from one another with an acceptable degree of precision.

This suggests that school league tables, including value-added tables, have very little to offer as guides to school choice.

George Leckie is a research associate at the Centre for Multilevel Modelling, University of Bristol. His research applies multilevel modelling to social science research problems in education. He is particularly interested in, measuring school effectiveness, the limitations of school league tables and the quality of marking of educational tests.

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Sample size calculations for cross-classified models in education

In this talk we consider how one proceeds in formulating a sample size calculation when there are two non-nested clusterings of the data to be collected. We take a simulation-based approach using our newly developed MLPowSim program and the R and MLwiN software packages.

We describe an example scenario from education where our response is attainment at the end of secondary school and response is influenced by classifications representing primary school and secondary school attended by students over the course of their education. We describe how to perform sample size calculations for firstly balanced data and then several forms of unbalanced data that more closely resemble the actual data collection process. We also propose a simple design effect formula for use in the balanced case and compare it to the sample sizes obtained via simulation.

Professor William J. Browne (b. 1972, el 2000). Professor of Biostatistics, School of Clinical Veterinary Science, University of Bristol (2007-). Previously Associate Professor, School of Maths, University of Nottingham and held research posts at the Institute of Education, London. Studied for BSc, MSc and PhD in Statistics at the University of Bath in the 1990s where PhD topic was applying MCMC methods to multilevel models.

Research interests are wide including computational statistics, and statistical methodology and it's use in many application areas including education, veterinary epidemiology, ecology and public health. Particularly interested in disseminating research ideas from methodological research to a wide audience of practitioners. As a student and postdoc developed the MCMC functionality in the MLwiN software package and have since written several books on aspects of multilevel modelling, along with many journal articles and have given over many invited short courses. Current research funded by ESRC, BBSRC, DEFRA and Wellcome.

For RSS currently Associate Editor (2007-) of JRSS Series A; have served on GAS committee (2003-2006) and chaired East Midlands local group (2004-2007).

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How does children's mental health vary across schools?

As part of the evaluation of the DCSF's Targeted Mental Health in Schools Programme in England, mental health information from nearly 20,000 primary and secondary school pupils has been collected. The items in the questionnaire were designed to assess a variety of mental health problems and the analysis starts by using classical and modern test approaches to create a set of measures.

Multilevel models are constructed using a variety of explanatory variables at the pupil level and the school level to estimate the school effect. John has been working as a statistician at CEM for 2 years along side Peter Tymms. Prior to this he was involved with modelling large scale simulators and systems in the oil industry with Michael Goldstein.

John Little has been working as a statistician at CEM for 2 years along side Peter Tymms. Prior to this he was involved with modelling large scale simulators and systems in the oil industry with Michael Goldstein.

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I spy with my little eye: applications of tracking for Drosophila behavioural genetics

Genomic technologies such as microarrays and short-read sequencing have revolutionized our understanding of the structure of genetic variation in natural populations, and have led to the identification of many interesting associations between genomic regions and common human diseases.

Understanding the map from genotype to phenotype remains a difficult problem, and intermediate phenotypes such as expression, methylation, transcription factor binding site occupancy and histone marks are now routinely measured to help elucidate the map. Many interesting statistical and computational questions are raised by large-scale data such as these.

In this talk I will focus on the phenotype end of the problem, with particular reference to behavioural studies of the model organism Drosophila melanogaster. We have developed a tracking system that allows us to follow individual flies in real time over many days. We can also track multiple transgenic flies simultaneously using visible light and GFP and DsRED fluorescence. This allows tracking of multiple flies while simultaneously assaying the expression level of different genes.

I will give an overview of our approach, describe some of the statistical and bioinformatic aspects of the analysis of tracking data, and illustrate some applications, including circadian behaviour of gene expression, courtship and aging.

Simon Tavaré has been Professor of Applied Mathematics and of Oncology at the University of Cambridge since 2003, and Senior Group Leader at Cancer Research UK's Cambridge Research Institute.

Research on statistical methods in the biological and medical sciences includes cancer genomics (Illumina arrays and sequencing), population genetics (coalescent methods), palaeontology (fossil record), behavioural genetics and tumour evolution. Methodological work focuses on stochastic computation, particularly likelihood-free methods such as approximate Bayesian computation (ABC). Elected Fellow of the Academy of Medical Sciences in 2009.

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Partial exchangeable hierarchical models with an application to proteomics Quantitative Trait Loci (pQTL)

Fully integrated analysis of large genomic data sets and multiple endophenotypes is entering a period of rapid growth, and these resources are now becoming available to a wider scientific community. Recent advances in Quantitative Trait Locus (QTL) mapping focused on the identification of genetic control points that predict the variation of (intermediate) phenotypes, including, for instance, genome-wide expression, proteomics or metabolomics data.

Analysing these kinds of datasets poses significant challenges due to high dimensionality of both the quantitative phenotypes and the genomic marker data. The problem is further complicated if binary phenotypic endpoints, like for instance, disease status, need to be integrated.

In this talk we propose to analyse jointly the data thorough an extension of the Bayesian variable selection model. Genetics effects are partitioned into a variable number of groups, making the approach more flexible than existing methodologies. Moreover, we perform a dimension reduction for the QTL mapping, clustering the multivariate responses into groups.

The key feature of the proposed methodology is that these two steps are performed together using two distinct Reversible Jumps: in practice, the algorithm explores the most promising patterns of the regression coefficients obtained by two, a priori independent, partition models.

The methodology is applied to a real data set where the variation of genome-wide proteomics data in a small human population is predicted using a large number of SNPs selected from a candidate gene association study by also taking into account the disease status of the patients.

This work is a joint Collaboration with Petros Dellaportas, Athens University of Economics, Greece.

Leonardo Bottolo received his PhD in statistics from the University of Trento, Italy. He joined the Statistical Section of the University of Pavia and after he moved to Oxford, where he started working in the mathematical genetics group, Department of Statistics. He is currently based at Imperial College, London, where he is collaborating with biologists on a variety of mapping problems for huge dimensional data sets.

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Growth curves for educational attainments

Modelling repeated measures in a multilevel framework is well-established. There are, however, difficult issues especially for variables such as educational attainments that are measured in different ways over time.

This paper revisits data (Feinstein, 2003) that have had an important impact on recent discussions of UK social policy. They come from the UK's 1970 birth cohort study (BCS70) and include measures of language and mathematics on up to six occasions covering the period from early childhood to age 21. These data have some unusual features: very few cases have complete data; a bivariate growth curve approach has attractions; scaling issues that render problematic the interpretation of random effects from growth curve models.

These will be considered in the context of an underlying substantive question: the effects of social class and social mobility on the growth in cognitive and educational attainment across the first part of the life course.

The paper will address the sensitivity of the estimates of these effects to different model specifications including the form of the growth curve and a conditional model that relates the outcomes to social class as a time varying explanatory variable. The longitudinal approaches used here replicate some of Feinstein's conclusions but also extend and refine them.

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M-quantile random effects models for multilevel and repeated measures data

The idea of modelling the quantiles of the conditional distribution of an outcome variable y given a set of covariates x has a long history in statistics. The seminal paper by Koenker and Bassett (1978) is usually regarded as the first detailed development of this idea. Quantile regression can be viewed as a generalisation of median regression. In the same way, expectile regression is a 'quantile-like', generalisation of mean regression.

M-quantile regression (Breckling and Chambers, 1988) integrates these two concepts within a common framework defined by a 'quantile-like', generalisation of regression based on influence functions (M-regression). Customarily, quantile/M-quantile models are estimated without accounting for the effects of clustering when analysing multilevel or repeated measures data. In a recent paper Geraci and Bottai (2007) extend the quantile regression model into a quantile random effects model using the Asymmetric Laplace Distribution for estimating fixed effects. The distribution of the random effects, however, is assumed to be Gaussian.

In this paper we propose an alternative approach for accounting for the hierarchical structure of the data when modelling the quantiles of a conditional distribution. In particular, we extend the M-quantile model into an M-quantile random effects model.

The proposed model allows for outlier robust estimation of both fixed and random effects. In addition, by modelling M-quantiles, instead of the ordinary quantiles, we gain algorithmic stability. Robust maximum likelihood estimation of fixed and random effects is discussed in detail.

The proposed model is evaluated in a series of simulation studies and is contrasted with alternative models. Finally, we apply the proposed model to medical data consisting of repeated measures for evaluating the effectiveness of a drug used in managing labour pain.

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Networks of action and events over time: analytic designs for continuous-time longitudinal network data

Current models for the dynamics of social networks focus on repeated measurements of a network. They seek to predict or explain the appearance, maintenance, and disappearance of ties between consecutive measurements of a network both from previous network structure and properties of actors in the network. These models presuppose that (1) the measured relation is manifest and potentially enduring, and (2) any actor is able and likely to consider changing its tie to any other actor in the network. Friendship within a set of interacting people is an example of a social relation meeting these criteria.

Lots of longitudinal network data, however, do not meet these criteria, especially data on events or actions from one actor towards another. For instance, the person who is going to throw a birthday party is the only person who can invite other people. Turns in group discussions are usually short but the order of turns is likely to be driven by previous contributions to the discussion. For actions and events that are incidental rather than enduring, analytic designs developed for panel data are not appropriate.

In this paper we propose the use of multilevel discrete-time event history models to take advantage of the fact that we know who acted towards whom at what moment while correcting for different types of dependencies that exist within such data. We specify an appropriate model for these situations, and describe how substantive social network theories may be investigated in such a framework. We discuss in detail the potential and limitations of this approach.

We distinguish between exogenous and endogenous timing of action. We show that the data set constructed for the analysis of continuous-time data with exogenous timing is very similar to counting process data used for discrete-time event history models and continuous-time event history models with time-dependent covariates. Thus, exogenous and endogenous timing blend into one design for analyzing continuous-time network data. We discuss the implications of the design for our conceptualization of social ties as temporal phenomena. Some empirical results will be presented.

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The early history of the Ogive

Though Quetelet used ranks and cumulatives in 1846 to fit a binomial distribution, he did not portray them diagrammatically. Ogives were first drawn by Francis Galton in the mid-1870s. They were the visual embodiment of his own method of ranks, designed to obviate the need to take actual measurements.

Through the mediation of George Darwin, the ogive's analytical form was supplied by J W L Glaisher. Subsequently, Donald McAlister extended the curve's domain to a distribution which was not normal, relabelled it the ‘curve of distribution’ and gave its analytical form in Richard Pendlebury’s adjustment to Glaisher’s notation. This is the story of the early years of a notable statistical icon

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The early-Victorian statistical societies and the establishment of the Statistical Society of London

The emergence of the statistical societies in England in the 1830s was a larger part of a Victorian culture that was marked by an imperative to document, observe and collect facts as the basis of knowledge. For the early-Victorian statisticians, statistics was more than the mere collection of social data or a set of techniques: statistics embodied a separate academic discipline. This new field of science was to form the basis of a predictive science of society, which could explain aggregated human behaviour.

Although public health and educational interests formed the foundation of these statistical societies, it was primarily their interest in the conditions of the poor that united the members of the emerging statistical societies in London and the provinces. The ongoing statistical work that had been undertake by those statisticians trying to address the Condition of England, combined with the absence of an official requirement for registration, helped consolidate the foundation of the Statistical Society of London in 1834 when Charles Babbage, T.R. Malthus and Adolphe Quetelet joined forces to establish the Society.

Eileen Magnello received her Master's degree in statistics in 1982 and became interested in the history of statistics in the early 1980s. She eventually received her doctorate in 1993 in the history of science at St Antony's College, Oxford University, where she also worked as a statistician. Her interests deal mainly with Victorian statisticians and, in particular, the statistical work of Karl Pearson on whom she has published extensively. She is on the council of the academic group, Radical Statistics and was elected a member of ISI last year. She is a Research Associate at University College. Her book, Introducing Statistics, will be out in September.

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Effects of blinding in a randomized trial on Postmenopausal Hormone Therapy

The talk is motivated by a Hormone Replacement Therapy (HRT) trial that included two blind arms (HRT or placebo) and two non-blind arms (HRT or untreated control arm).

We will investigate the effects of blinding on the main outcomes (mortality, incidence of bone fractures, cerebrovascular and cardiovascular diseases).

Before coming to the recruitment visit the randomized women were informed on whether they were randomized to blind or non-blind arms – about 50% withdrew at this stage and the final analysis was conducted using the data of recruited women only.

The analysis showed significant outcome differences between blind and non-blind arms. In addition the data suggests that the treatment effect, where present, is possibly modified by blinding. There are two possible reasons for such differences: selective withdrawal of women after initial randomization and post-recruitment effects of blinding.

A principal stratification approach will be used to define the effects of interests. However, the effects are not estimable without additional (possibly unrealistic) assumptions. To avoid making such assumptions, a modelling approach will be proposed, where identifiability is achieved using a set of baseline covariates.

Application of these ideas on the HRT trial data demonstrates that (depending on outcome) there is some evidence that both, pre- and post-randomization effects of blinding are present. These results have important implications on generalizability of results from clinical trials, especially when conducted on healthy volunteers.

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Using a network model for prevalence estimation from Respondent-Driven Sampling in hard-to-reach populations

Respondent-Driven Sampling is a widely used variant of link-tracing sampling on a network, designed to allow for estimation in hard-to-reach populations. It is commonly used to estimate the prevalence of diseases such as HIV in high-risk populations such as injection drug users.

Beginning with a researcher-selected convenience sample, each person sampled is given a small number of uniquely identified coupons to distribute to other members of the target population, making them eligible for enrolment in the study. This strategy is highly effective at collecting large diverse samples from many hard-to-reach populations.

Current estimation relies on sampling weights estimated by treating the sampling process as a random walk on a graph, where the graph is the social network of relations among members of the target population. These estimates are based on strong assumptions allowing the sample to be treated as a probability sample.

In particular, existing estimators assume a with-replacement sample or small sample fraction, and ignore the biases introduced by the sampling procedure, including the initial convenience sample. We introduce a new estimator based on fitting a parametric social network model to the observed data, and demonstrate its ability to account for measurable biases in the sampling process.

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Effect of doctors' training in interpersonal and communication skills on women's satisfaction at labor and delivery: a stepped wedge cluster randomized trial in Damascus, Syria

In this study, we use a stepped wedge randomized design to look at the effect of training doctors, working in maternity wards in Syria, in interpersonal and communication skills. All eligible doctors in four public Syrian hospitals with maternity wards were included in this study.

The intervention included a specially designed training package in interpersonal and communication skills. The delivery of the intervention was phased over time.

We investigate whether such a training impacts on women's satisfaction with patient-doctor relationship in labor and delivery rooms. In addition, we study the impact on communicative behavior of the residents.

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Equality in safe delivery and its determinants in india

Mother's health has been emphasized in the Millennium Development Goals. Safe motherhood has begun to be identified as one of the priority for the reproductive health of Indian women. This study was performed using the data of Indian National Demographic and Health Survey-3 (NFHS-3), conducted 2005-06.

Our sample was nationally representative and included 56,438 Indian married women aged 15 – 49 years who had delivered during five years preceding the survey. The equality status was assessed by concentration index.

The relationship between different -- demographic, hygienic, medical infra structure facilities-- factors and safe delivery was investigated by two-level logistic regression. These factors included mother's age, birth order, mother's education, antenatal care visits, resident place (urban vs. rural), religion, caste/tribe, wealth index, three hygienic factors like toilet facility, cleaning facility and household structures, and states.

The covariate state is a surrogate variable for medical infrastructures. The result indicates that uneducated and poor are less likely to have safe deliveries. Antenatal care is positive and significantly associated with safe-delivery practices. Older mother has higher risk of unsafe delivery practices. Conservatism and religious taboos are likely to affect the practices; Muslim women are less likely to have safe-delivery practices compared to non-Muslims women.

Our finding exposes poor Government/ Institutional medical facilities for safe delivery in different Indian states. In spite of the improvement in delivery care in India, there are significant differences between the current situations of safe delivery in people with different socio-demographic states.

Finally, the results suggest some suggestive policy measures so that the national policy makers may take appropriate initiatives to achieve the fifth United Nations millennium development goal in reducing maternal mortality by the year 2015 by increasing accessible medical facilities for under-privileged class of women in India.

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50 years of statistical computing at Rothamsted

Statistical computing started at Rothamsted in 1954, when the Statistics Department obtained an Elliot 401 computer, which can fairly be claimed to be the first computer to be associated primarily with agricultural research and with statistics. The programming of the machine required considerable ingenuity but some complicated analyses were performed by this and its successors during the 196 0s.

The arrival of Fortran in the late 196 0s was a big step forward (or, at least, it seemed so at the time). As a result early versions of some of today's general-purpose statistical programs began to appear (e.g. GenStat at Rothamsted). Further developments in computing technology in the 197 0s led to the development of interactive statistical systems like GLIM.

The challenges were still those of inadequate computing technology, but this changed during the 198 0s and 199 0s when many statisticians became concerned that there was too much computing power but in the wrong hands! (However, the RSS would have been unable to insist that statistical analysis should only be done by CStat's even if it had wanted to do so.)

Therefore the more recent statistical computing challenges at Rothamsted involved not only the implementation of statistical research, but also the need to provide environments for statistical analysis that encourage good statistical practice.

The talk will review these changes and developments, and describe how Rothamsted's statistical computing still continues in its spin-off company VSN International.

Roger Payne spent most of his career at Rothamsted as a statistician involved in research, consulting and computing. His interests include design and analysis of experiments, generalized linear models and their extensions, statistical modelling and the study of efficient identification methods (applied in particular to yeast identification). He has also enjoyed many years of statistical collaboration with Rothamsted biologists which have helped him to retain a practical perspective.

His statistical computing has been focussed mainly on the statistical system GenStat, leading of its development since 1985. In 2002, when Rothamsted transferred GenStat and its associated statistical research to a new company VSN International, he became VSN's Chief Scientific and Technical Officer. However, he has kept an honorary position at Rothamsted, as well as his other academic links as a visiting Professor at Liverpool John Moores University and a Special Lecturer at University of Nottingham.

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Computers and statistics in business – past and future

Modern businesses cannot function without computers. They are used for stock management, external communications or running customer databases; and, of course, many other applications too. As the pace of technological progress has accelerated, one important development has been the rise in the number of personal computers (PCs). They have become so widespread that a PC sits on virtually every desk nowadays, with processing power and software capability that may outstrip many users' needs or abilities.

Most companies' PCs are networked, so that every employee can, in theory, access all of the resources and data owned by the company. For statisticians, the increase in desktop processing power and ease of data access have been a boon; PCs have allowed computationally intensive techniques to become feasible with little more than the press of a button. And the expansion of computing power has not been restricted to statisticians - it has enabled a much wider range of people to carry out their own analyses. One of the most common pieces of business software is the spreadsheet.

Spreadsheets were rst introduced in the 1970s, and, in their early days, had limited data handling capabilities. Given the ubiquity of modern desk-top computers and the powerful spreadsheet software now available, anyone who has a data set can produce their own analysis. This democratisation of analysis capability gives statisticians many opportunities, but it may also lead to problems.

This talk will describe changes, some good and some not so good, that have resulted from these developments, and will outline future challenges for statisticians in business.

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Discriminant analysis through the decades

The talk will describe the way that the topic known by statisticians as discriminant analysis has developed over the last thirty years or so.

The developments correspond to a combination of new methodology, an explosion in the sizes of datasets undergoing analysis and the arousal of interest on the part of many researchers working in machine learning.

The need for new theory will be mentioned. The presentation will be biased towards the speaker's own experience over the years!

Professor Michael Titterington has worked in Glasgow since finished his Ph.D. in Cambridge in 1972 and has been a professor there since 1982. His interests include discriminant analysis, incomplete data problems including mixture distributions, optimal design, Bayesian methods and topics at the interface with machine learning. He has been a member of the Council of the Society, he is currently a member of the Research Section Committee and he has held a number of editorial appointments including joint editorship of JRSSB and editorship of Biometrika.

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The geometry of Compressed Sensing

We will explore connections between the structure of high-dimensional convex polytopes and information acquisition for compressible signals. A classical result in the field of convex polytopes is that if N points are distributed Gaussian i.i.d. at random in dimension n<<N, then only order (log N)^n of the points are vertices of their convex hull. Recent results show that

provided n grows slowly with N, then with high probability all of the points are vertices of its convex hull. More surprisingly, a rich "neighborliness" structure emerges in the faces of the convex hull. One implication of this phenomenon is that an N-vector with k non-zeros can be recovered computationally efficiently from only n random projections with n=2e k log(N/n).

Alternatively, the best k-term approximation of a signal in any basis can be recovered from 2e k log(N/n) non-adaptive measurements, which is within a log factor of the optimal rate achievable for adaptive sampling. This is a simple example of the new theory Compressed Sensing. The results presented are joint with David L. Donoho.

Dr Tanner is a Reader in Mathematics at the University of Edinburgh. His research has focused on stochastic geometry and numerical harmonic analysis. His research contributions have been honoured with the Fox, Martin, and Leverhulme Prizes as well as a Sloan Fellowship.

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Military matters!

We describe how reactions to a Lancet article in February 2006 on UK statistical indifference to its military casualties in Iraq led to our adopting 20-week reporting periods for analyses of UK (versus other nations') military fatalities in Afghanistan and Iraq.

We took rates per 1,000 personnel-years, major causes of death, clustering, and projections as our remit. Clustered fatalities are principally due to improvised explosive devices (IED); or are air-related.

We summarise key findings from, and the media's reporting of, the first eight of our 20-week analysis reports. Period 1 was 1 May to 17 September 2006. Period 8 is 5 January to 17 May 2009.

In particular, we highlight the dramatic impact of the US military surge in Iraq; how the number of fatal IED incidents per period has increased importantly in Afghanistan; how an established weekday pattern in the occurrence of fatal IED incidents in Iraq was disrupted; and the perils, rather than pearls, of forecasting.

Three other related military matters have concerned us: friendly fire incidents during major combat (major combat is defined by us as 6+ fatalities per 1,000 personnel-years); waiting times for military inquests (much longer than for fatal accident inquiries into prisoner deaths in Scotland); and whether a major rise in the British Army's cocaine-positive rate in compulsory drugs tests in 2003-07 was a reaction to combat stress.

Parliamentarians with a military background facilitated their investigation and, as a consequence, policy changes have resulted rather quickly in response to the evidence that was marshalled.

The military motto 'serve to lead' has served us well. As has military efficiency!

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A balanced factorial experiment of clinicians' performance in treating victims of a chemical weapons attack whilst wearing level C personal protective equipment

Summary

Following the escalation in world terrorism, the United Kingdom NHS equipped all Emergency Departments and Emergency Medical Service providers with standardised level-C Chemical, Biological, Radiation and Nuclear Personal Protective Equipment (CBRN-PPE). In the event of a mass attack – such as the Sarin gas release on the Tokyo subway in 1995 – or a chemical or nuclear accident, it is proposed that emergency medical personnel don these protective suits to immediately give potentially life-saving treatment. The attire – butyl boots and gloves, chemically resistant suit and air-purifying respirator – severely limits mobility and dexterity, yet success lies in the speed at which emergency treatment can be delivered. Emergency departments are also equipped with mass casualty treatment 'pods' containing equipment to undertake essential airway control and vascular access tasks on attack victims in situ.

The objectives of this study were to estimate the times taken by clinicians to perform various airway control and vascular access tasks, both 'suited' and 'unsuited', and to determine whether the extra time taken in each case whilst suited would be clinically detrimental to a patient.

Method

Sixty-four clinicians (nurses, doctors, paramedics) performed two airway management tasks (endotracheal intubation and laryngeal mask insertion) and two vascular access tasks (intravenous drip insertion and intraosseous needle insertion) on simulator manikins. The first task in each pair has better outcomes under normal circumstances, but requires more time and dexterity to complete.

The experimental design took account of a number of key factors: medical task; previous experience; attire (suited or unsuited); and order effects (e.g. learning and fatigue). Principles of Fractional Factorial design were employed to balance the factors such that unconfounded estimates of all main effects and key interactions could be obtained. The final design required each clinician to perform each task twice while suited and once unsuited, in an order that varied by clinician. Power analysis was used to calculate the total sample needed to estimate times within a specified accuracy.

Findings

Clinicians took between two and three times as long to perform most emergency airway and vascular access procedures when wearing the protective suit, although low dexterity skills were performed much faster than high-dexterity ones. The times taken to perform high-dexterity procedures in the suit could prove fatal to many victims. Clinicians performed all skills faster on their second attempt, with the degree of improvement varying by skill. Previous experience of the suit did not improve performance.

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Mortality and cancer morbidity in a cohort of British military veterans included in chemical warfare agent experiments at Porton Down

A cohort study was recently carried out of the long-term effects on mortality and cancer morbidity of 18,276 members of the UK armed forces being included in chemical tests at the research facility at Porton Down between 1941 and 1989.

The main comparison group comprised 17,600 similar veterans who had not attended Porton Down ("non-Porton Down veterans"). Each group was followed up to 31 December, 2004 and their event rates compared using rate ratios adjusted for age group and calendar period.

While Porton Down and non-Porton Down veterans were similar in demographic and military characteristics (median year of enlistment was 1951 in both groups), Porton Down veterans had longer duration of military service (median=6.2 years versus 5.0 years).

After a median follow-up of 43 years, 7,306 Porton Down, and 6,900 non-Porton Down, veterans had died. All-cause mortality was slightly greater in Porton Down veterans (rate ratio 1.06; 95% CI 1.03-1.10, P<0.001), more so for deaths which occurred outside the UK (1.26; 1.09-1.46). Of 12 cause-specific groups examined, rate ratios were significantly (P<0.05) increased for four (infectious and parasitic, genitourinary, circulatory and external (non-medical)) and decreased for one (in situ, benign and unspecified neoplasms).

There was no clear relation between chemical exposure group and cause-specific mortality. While overall cancer morbidity was the same in both groups (1.00; 0.95-1.05), Porton Down veterans had higher rates of ill-defined malignant neoplasms, in situ neoplasms and neoplasms of uncertain or unknown behaviour.

With the lack of information on other important factors, such as smoking or service overseas, it was not possible to attribute the small excess mortality to chemical exposures at Porton Down.

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Business micro data: access and anonymisation

Scientists increasingly express the desire to use official statistics micro data for their own empirical economic and social research. In Germany, the road prescribed by the legislator is that micro data should be converted into a so called “factually” anonymised form, before they are made available to scientists. Accordingly, data items are regarded as sufficiently anonymised, if the expenditure needed for a possible reallocation is unreasonably high.

Fortunately, the work done by statistical offices in cooperation with scientists during 2002-2005, on the project “Factual Anonymisation of Business Micro Data” has shown that factual anonymisation of cross-sectional business statistics micro data can, as a rule, be achieved by using special information-reducing and data perturbing methods. Evidence of that kind has still to be provided in respect of data items that are linked longitudinally. That is why, during 2006-2008, the Research Data Centre of the Federal Statistical Office has been conducting a project “Business Statistics Panel Data and Factual Anonymisation”.

The required degree of confidentiality mainly depends on the way of data access the user decides for. The various ways of data use in general are not mutually exclusive; rather, an appropriate combination of approaches permits an adoption of anonymisation measures to the specific requirements of the data users. For instance, a scientist may in a first stage adapt his program codes to so called Structure-Files (data for teaching purposes, which have previously been absolutely anonymised and possess the same structure as the original data) and in a second stage he may apply his adapted programs to the original data via remote execution.

In our presentation we give an overview on various surveys of German business micro data and discuss the ways of their access; namely “on-site” the statistical office, different variants of “off-site” like Scientific-Use-File or the previously mentioned Structure-Files and “remote data execution”.

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Circular (Angular) data

Fernández-Durán (2004) developed a family of univariate circular distributions based on nonnegative trigonometric (Fourier) sums (series). This family is suitable to model populations that present skewness and/or multimodality.

In this talk, I present the extension to the multivariate case by using multiple nonnegative trigonometric sums to model the joint distribution of a vector of angular (circular) random variables. Practical examples of vectors of angular random variables include the wind directions on different monitoring stations, the directions taken by an animal on different occasions, the times at which a person makes different daily activities, the dihedral angles of a protein, among many others.

Applications of the univariate and multivariate cases are presented including:

1. Marketing Research: The modelling of seasonal effects in the Bass Forecasting Diffusion Model

2. Actuarial Science: The use of a seasonal mortality assumption for the distribution of future lifetime between integers which takes into account the relationship between number of deaths and month of the year, especially the winter excess mortality effect

3. Protein Modelling: Estimation of the joint distribution of dihedral angles in proteins.

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Information flow, volatility measurement and jump prediction

This paper empirically tests whether volatility contains information in predicting jump intensity of S&P 500 futures prices.

By extending GARCH jump model of Maheu and McCurdy (2004), we find evidences that one day lagged volatility measurements can predict next day's jump intensity with model free implied volatility contains incremental information compared to realized volatility to predict jumps and realized volatility contains incremental information compared to model free implied volatility to predict volatility in the GARCH component.

In addition, we develop a new approach to compare parametric jump prediction with nonparametric jump identification using Poisson regression and find jump intensity rate which is a function of one day lagged implied volatility, model free implied volatility or realized volatility respectively match well with nonparametric jump identification of Andersen, Bollerslev and Dobrev (2007) from 1990 to 1997 when market is less volatile.

We then compute the jump components based upon quadratic power and bipower variation using intraday 5 minute returns, we find volatility Granger (Geweke-Meese-Dent) cause jumps, but the evidences for jumps Granger (Geweke-Meese-Dent) cause volatility are weaker.

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Assessing the risk of infertility in women following chlamydial infection using Bayesian synthesis

Introduction: Chlamydia trachomatis is the most commonly diagnosed sexually transmitted infection in Scotland amongst women. Little information is available on the attributable risk of tubal factor infertility (TFI) in women with a current or previous diagnosis of Chlamydia trachomatis infection. Recently published results indicate that the risk is lower than originally reported in the 1980s/1990s. Using a Bayesian synthesis approach, the probability of TFI following past or current chlamydial infection in women in Scotland is determined.

Methods: By employing a Bayesian model to synthesize data, various data sources are combined. Routinely collected Scottish Chlamydia lab test data is combined with UK data from the National Survey of Sexual Attitudes and Lifestyles II (NATSAL II) to produce a more reliable estimate, stratified by age group, of the population prevalence of chlamydial infection in females aged 16-44 in Scotland. The probability of chlamydia in those with TFI is assessed by conducting a meta-analysis of case-control studies. Other parameters investigated for the model are the prevalence of TFI amongst those seeking treatment for infertility and reinfection rates. By then combining each of these components together in a Bayesian framework the overall risk of tubal factor infertility following chalmydial infection can be assessed.

Preliminary results: Of the probability in those aged 16-44 of ever having chlamydial infection; this is estimated at 4%, 3%, and <1% in those aged 16-19, 20-24, and 40-44, respectively. Modelled re-infection rate estimates that 30 individuals per 100 will become reinfected within a year at age 20 reducing to eight per 100 person year at age 40. Meta analysis indicates that the prevalence of TFI in individuals seeking infertility treatment is higher than those with evidence of past or current chlamydial infection than in those without. Combining these results together results in a Scottish estimate of risk which, whilst still suggestive of a link between chlamydial infection and tubal factor infertility, is lower than hypothesised previously.

Conclusion: While questions remain about how infertility occurs following chlamydial infection, the availability of a reliable age-related probability estimate of the risk of TFI for women undergoing chlamydia testing is a useful public health educational tool.

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A semiparametric test for independence in competing risk models

Competing risks models, which describe models for multiple durations of a given subject and where only the minimum duration is observed, are widely used in applied quantitative sciences. Central question in these models is whether or not the latent durations are conditionally (on observable characteristics) dependent. Conditional dependence between the latent failure times is caused by the presence of dependent unobserved factors across the risk-specific hazard rates.

We construct a semiparametric test-statistic for detecting this type of dependence by deriving asymptotic results and a Monte Carlo study is carried out to assess the behavior of the test-statistic in finite samples.

For the hazard rate of each failure time we assume proportionality in the unobservables and we also impose the weak restriction that observed factors enter the hazard rate through a linear index. The test statistic is applied after the estimation of the covariate effects under the null hypothesis of independence between the failure times and then we check whether or not the null hypothesis is correct.

The fact that we first estimate the covariate effects and then test for conditional independence is not a surprising result. In particular, Heckman and Honore (1989, Biometrika 76, 325-330) and Abbring and Van den Berg (2003, Journal of the Royal Statistical Society Series B 65, 701-710) show that identification of the multivariate distribution of the unobserved factors is achieved by varying the values of the covariates given that the covariate effects have been already identified.

The application of the test-statistic has practical implications. Verification of existence of conditional independence between the failure times has as consequence the use of more efficient semiparametric estimators of the covariate effects.

Additionally, conditional positive (negative) dependence between the failure times implies that elimination of a particular type of failure will result in lower (higher) failure rates attributed to the rest failure types.

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Teaching medical statistics in an integrated curriculum

Medical statistics has long been a core component of the undergraduate curriculum in UK medical schools. However, traditionally there have been problems in teaching statistics to medical students. Despite the best efforts of teachers, however, medical statistics is seen by students as inherently mathematical and irrelevant.

In 1993 the General Medical Council (GMC) published Tomorrow's Doctors with recommendations for change to MBBS undergraduate curriculum in the UK. Whilst the GMC set out the knowledge, skills, attitudes and behaviour expected of students across the key curricular themes, they did not make specific suggestions for the teaching of medical statistics. Nonetheless, it was stressed that over and above all, the clinical and basic sciences should be taught in an integrated way so that students can appreciate the application of their teaching.

Teachers of medical statistics have embraced a need for change. Over the last twenty years there have been moves away from more theoretical based courses to ones that practice research and critical appraisal skills. However, it is not obvious if these encompass the GMC recommendations or meet the needs of future doctors.

This presentation will describe the authors' approaches to, and experiences of, teaching medical statistics in an integrated curriculum. Students are exposed to a variety of teaching styles incorporating small and large groups, practical classes, project-based work, plus self-directed learning and problem-based learning. Teaching is supported by methodological notes, self-assessment exercises, video trigger tapes plus whole and small group exercises. The implications for resources, curriculum content plus assessment will be discussed.

The authors are currently performing a national questionnaire survey as to how medical statistics is currently taught and delivered in the undergraduate medical curriculum. It is hoped to present the initial findings of this research.

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Quantifying and interpreting assessment reliability

Assessment in education, as in all the behavioural sciences, is a challenging exercise, in which "reliability" is a key concept. The challenge arises from the fact that we are frequently trying to measure something that is not directly measurable, because it is not directly observable. The best we can do is require students to attempt test items and tasks that are designed to elicit application of the abilities and skills of interest, and to use the surrogate measure of the performance results as evidence.

The test items used in most assessment applications in education should properly be considered as samples from some more or less well-defined "domain", and as such they contribute to measurement error. Other potential contributions to error include student-item interaction, curriculum influences, gender-item interaction and so on.

The essential reliability question is the extent to which the same assessment result would have emerged had one or more of the conditions of assessment been different: would a student have been classified in the same way had a different set of test items been used, and/or a different mark scheme applied, and/or had testing been undertaken on a different day?

In practice we can never know the answer to this question for any particular individual. But various ways have been proposed to address the general issue, leading to quantifications of reliability in the form of indices of various kinds (as in generalizability theory), information curves (as in item response theory), and other measures.

The paper focuses on this general issue of conceptualising, quantifying and interpreting measures of reliability in educational assessment.

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Statistics on young people not in education, employment or training (NEET)

The United Kingdom has one of the highest proportions of young people not in education, employment and training (NEET) in Europe. Despite the employment boom over the last 10 years, the proportion of young people NEET has remained fairly constant. This varies greatly between local authorities, 5 per cent in the South East to 10 per cent in the North East.

There is a public service agreement (PSA) target to reduce the number of 16 to 18 olds NEET by 2010. Young people NEET is an important issue to local authorities and is the most commonly selected indicator in their local area agreements: 115 out of 150 local authorities adopted this indicator.

Parliament's Children, Schools and Families Select Committee requested that the National Audit Office look at the profile of young people NEET. We used data from a range of administrative systems to examine the personal and family characteristics of NEETs, factors associated with being NEET, the length of spells and the number of 'persistent' NEETs.

We analysed data from three main sources: the Labour Force Survey, data collected by Connexions service about its clients, and a combined data set built from Youth Cohort Study and Longitudinal Study of Young People in England. With the longitudinal study data, we were able to follow the young people at age 13/14 to age 16/17 and whether they became NEET at 16/17. To examine the length of spells and factors associated with NEET, we used various innovative statistical analyses to make best use of the datasets.

Our key findings show that the first spell NEET averaged 32 weeks during 2007-08, but a number of young people spent much longer out of education, employment and training. Our statistical model shows that young people who went on to be NEET at 16/17 appear to have different characteristics, attitudes and behaviours at age 13/14 than those in education, employment or training. Other contributing factors are poor key stage 3 attainment results and living in disadvantaged family.

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How consistent are we at assessing bruises? An investigative study

Bruising is the commonest injury seen in physically abused children, requiring accurate recording for clinical and legal purposes. Bruise margins are difficult to define and bruises may contain many colours that change over time. Currently, there are no standardised procedures for assessing and recording bruises. The aim of this pilot study is to investigate variation in the assessment of the size and colour of bruises, within and between observers, using both printed (hard-copy) and electronic (computer screen) images.

On two occasions 45 volunteers assessed six bruises, four common to both sessions to assess reproducibility. They recorded the greatest length and greatest perpendicular width, using a tape-measure on printed images; (up to) 3 predominant colours, using a 216-block colour palette with 6-digit RGB codes; and various other measurements, including Feret's diameter (the greatest distance between two points), using electronic images to define the boundary of the bruise.

This talk describes how to utilise Euclidean distance using RGB (a system of quantifying colour based on red, green and blue components) to assess both inter-observer and intra-observer variation. Similarly, we compare variability in the measurements recorded by the observers, for both printed and electronic images. 2-way ANOVA demonstrates that differences in measurement stem more from inter-observer variability ($p<0.001$) rather than intra-observer variability ($p=0.689$ printed, $p=0.913$ electronic).

Comparing printed vs. electronic images shows that in almost all cases the mean size from printed images is significantly smaller than from electronic ones. Additionally, the distributions of measurements recorded by observers for printed images have smaller standard deviations than for electronic measurements. The question of accuracy is raised; currently no 'right answer' exists for comparison of error rates so the analysis here focuses on variability and consistency, as well as comparing relative magnitudes between methods.

After completing my BSc in Mathematics, Operational Research and Statistics in 2002, I was given the opportunity to stay on at the School of Mathematics, Cardiff University, to study for a doctorate. My PhD, entitled 'Modelling the progression of treatment scenarios in the HIV/AIDS epidemic', was awarded in 2005 with thanks to Prof Jeff Griffiths and Dr Janet Williams, my two internal supervisors. We also published a paper in JORS at this time (Griffiths J D, Lawson Z and Williams J E, Modelling treatment effects in the HIV/AIDS epidemic, J. of the Operational Research Society, 2006, 1413-1424, 57 (12)).

Zoë Lawson: upon conclusion of I post-graduate studies I chose to move into business where I stayed for 3 years working as a Decision Science Analyst for HBOS Card Services, before my return to academia just last year. I now work as a Medical Statistician/Research Associate for the School of Medicine, Cardiff University, specifically as part of the PROTECT project team in Child Health.

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The application of statistical methods to collision risk modelling in aviation

Safety is a priority for the design and control of airspace. In particular, flights operate at or above safe separations standards to mitigate collision risk. The design of the North Atlantic airspace presents a collision risk problem that is tractable to mathematical and statistical modelling. Here, aircraft are separated in three dimensions – lateral, vertical and longitudinal.

Focussing on the longitudinal dimension, we seek to determine how often aircraft are required to send positional reports to a controller in order for a given separation standard to remain safe. Statistical distributions combine to give a probability-based model of collision risk.

Gail Hutton has worked as a statistician in the Operational Analysis department of NATS since 2007. NATS is responsible for the provision of air traffic control services within UK airspace and over part of the North Atlantic; Gail is involved in the analysis of the safety of these operations. She has a PhD in the development of statistical theory and its application to share trading.

Mark Kelly

The impact of life course events on mental health: a longitudinal analysis of the British Household Panel Survey

Mental health has been identified as a growing public health issue by the World Health Organisation. Despite the burden of poor mental health, there is little longitudinal research on the factors which affect the stability of mental health.

Most mental health measures only provide a snap shot of an individual's health and there is a need for a mental health scale which can measure a person's mental health over a longer time period.

A necessary precursor for such a scale is the identification of which factors affect mental health and the quantification of the size of those effects. Moreover, with such a lack of longitudinal research there is the real possibility of reverse causality (e.g. poor mental health resulting in an individual losing their job). Disentangling the impact of life-course events from such health selection effects is therefore a crucial step in order to avoid this potential pitfall.

The British Household Panel Survey (BHPS) is an annual survey of each adult (aged 16 years or older) member of a nationally representative sample of over 5,000 households, making a total of approximately 10,000 individual interviews. All individuals in each household are interviewed every year.

This presentation will summarise the results of a longitudinal analysis of 15 waves of the BHPS investigating the impact of various life-course events (e.g. changes to marital status, income, employment status, physical health) on mental health and discuss the methodological issues that were encountered.

Mark Kelly graduated with a BSc in Maths and Statistics from University College Cork in 2002, before going on to do an MSc in Statistics. During this time he worked as the data manager for the National Suicide Research Foundation. In 2003 he went to Cardiff University to do a PhD in Medical Epidemiology. He has been working as a statistician in the Department of Primary Care and Public Health for the past two years.

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Asset allocation to optimise life insurance annuity firm economic capital and risk adjusted performance

With the advent of new risk-based regulations for financial services firms, specifically Basel 2 for banks and Solvency 2 for insurers, there is now a heightened focus on the practical implementation of quantitative risk management techniques for firms operating within the financial services industry.

In particular, financial services firms are now expected to self assess and quantify the amount of capital that they need, to cover the risks they are running. This self assessed quantum of capital is commonly termed risk, or economic, capital.

This talk is concerned with two important questions:

Question 1: How should a capital constrained firm allocate its assets to minimise its economic capital requirement?

Question 2: How should a firm allocate its assets to optimise its risk adjusted performance?

The talk will focus on the impact that asset allocation has on the economic capital and the risk adjusted performance of financial services firms. A stochastic approach, using graphical models, is used in conjunction with a life insurance annuity firm as an illustrative example. It is shown that traditional solvency-driven deterministic approaches to financial services firm asset allocation can yield sub-optimal results in terms of minimising economic capital or maximising risk adjusted performance.

Our results challenge the conventional wisdom that the assets backing life insurance annuities and financial services firm capital should be invested in low risk, bond type, assets. Implications for firms, customers, capital providers and regulators are also considered.

Reference: Asset Allocation to Optimise Life Insurance Annuity Firm Economic Capital and Risk Adjusted Performance, Porteous, B.T. and Tapadar, P. To appear in Annals of Actuarial Science.

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The case for fully integrated models of economic capital

In the wake of recent events, banks' capital adequacy models and Basel II have come in for widespread criticism. A general deficiency of current practice is the tendency to measure risk for disaggregated parts of an enterprise (business units, asset classes, banking versus trading book) and then to aggregate using crude assumptions about correlations between the performances of different assets. There is concern that this may lead to an underestimation of true dependencies, particularly in periods of financial stress.

An interesting and challenging alternative is to build truly integrated stochastic models of enterprise-wide risk that explain the origins of dependence in terms of driving risk factors related to the financial markets and the macroeconomy. We discuss the advantages of this approach and the stochastic modelling and statistical calibration problems involved.

Alexander McNeil is Maxwell Professor of Mathematics in the Department of Actuarial Mathematics and Statistics at Heriot-Watt University, taking up his position there in 2006. He was formerly Assistant Professor in the Department of Mathematics at ETH Zurich. He has a BSc in mathematics from Imperial College, London and a PhD in mathematical statistics from Cambridge University.

He is joint author, together with Rüdiger Frey and Paul Embrechts, of the book "Quantitative Risk Management: Concepts, Techniques and Tools", published by Princeton University Press in 2005.

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Recessions, credit risk and capital

The Basel II Accord was designed to improve banks capital calculations, letting them better understand how much money they need to set aside to cover losses in a downturn.

As we pass through the first major recession in two decades and the banks losses mount, we ask the question – how good were their calculations? Other questions we will look to explore are:

- How different is the 2009 to 1991?
- Have consumers performed as we would have expected?
- With the benefit of hindsight, have we learned anything for the future?
- Has Basel II worked?

Will Cook is a Director at Volterra Consulting, having joined the company in 2000. He also holds the position of Head of Credit Risk Solutions and acts as the project director for many of Volterra's Financial Services assignments. Will holds a degree in mathematics from Durham University and an MSc in applied statistics from Oxford University.

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Application of joint modelling to longitudinal data with high rate withdrawal in eye research

In some longitudinal clinical studies it is common practice to assume that when subjects withdraw from the study, this is due to reasons that are unrelated to what is being measured. Clinical findings may be misleading when such assumption is violated, especially in studies with a relatively high rate withdrawal.

Several approaches have recently been proposed to jointly model the longitudinal and timeto-dropout data, allowing for a more flexible model that takes into account the possible association between the longitudinal and survival information.

In this talk, we analyse several parametric and non-parametric approaches to joint modelling and their role to investigate changes in visual acuity over time in patients with neovascular age-related macular degeneration.

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A method for exploratory repeated-measures analysis applied to a breast-cancer screening study

In some applications, repeated-measures data permit a statistical model to be fitted separately to each individual unit. An initial modelling aim is to explore behaviour across the group of units, in order to develop a suitable model for the complete data. For such data sets, plots of individual point estimates may help the statistician to better understand between-individual variability, and to identify possible relationships in the parameters (when there is more than one parameter in the individual model). However, some information will be lost in the charts because estimation uncertainty is disregarded.

We present a simple method for exploratory analysis to complement the point-estimate plots. The idea is to use a likelihood-based measure of a "similarity" between individuals, in order to usefully show some information on uncertainty. The measure follows from approximating the random-effects distribution by an empirical representation of the parameter fits, and then applying Bayes' rule. The approach can aid exploratory analysis by drawing attention to groups of similar individuals and to possible outliers. It applies quite generally, to any likelihood model for the individual's data.

The method is demonstrated using data from the CADET II clinical trial. In this study over 28,000 mammograms were screened in a paired comparison of double reading by two radiologists, and single reading by a radiologist using a computer-aided detection tool. The approach helped to flag up some unusual reader behaviour, to assess differences in performance, and to identify potential random-effects models for further analysis.

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The cost of pooling: bias-modelling of individual patient longitudinal data pooled across a small number of studies in cardiac surgery

Models based on random effects analysis of individual patient data pooled across different suitably selected studies are considered the gold standard and superior to meta-analyses based on published data.

The reason for this is that they allow for examination of both intra-study and between-study heterogeneity in treatment effect as well as multilevel modelling of treatment effect. They also present particular challenges.

We are concerned with the challenges posed when the number of studies is small, and treatment allocation is not controlled. Bayesian approaches provide a natural framework for pooling data across studies and their use in medical research has grown. However, "vague" prior specifications on critical parameters, such as between-study variance, have dominated the literature. Recent studies have shown that such specifications can lead to marked variations in results, especially with small amounts of data.

On the other hand, sensitivity analysis scenarios are generally limited and unrealistic. In the present study in cardiac surgery, the existence of genuine prior information allowed us to model these critical parameters explicitly.

We present a model for jointly estimating the treatment effect and the precision profile of the outcome that is responsible for the between study variation. The model is fitted in a Bayesian setting using Markov chain Monte Carlo methods.

We illustrate the model using data from four randomised clinical trials examining the effect of different cardiac surgery interventions on the same outcome i.e. inflammatory response and organ injury. The aim of pooling the studies was not to examine the effect of the trial interventions, which differed across the four trials, but to quantify the effect of leucodepleted red cell transfusion on the inflammatory response.

Inflammatory response and organ injury is measured by soluble cytokines in serum. Cytokines have very low concentrations under normal physiological conditions. Their quantification is done by immuno-absorbent assays which are often subject to left censoring with higher censoring rates in the untreated group.

We compare effect estimates resulting from standard-pooling with vague priors, a naïve model for censored measurements and explicit modelling of the outcome's precision profile based on external calibration data. We discuss the inferential and predictive consequences of quantitative treatment of hypotheses about bias.

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A spatio-directional model for extreme waves in the Gulf of Mexico

The characteristics of extreme waves in hurricane dominated regions vary systematically with a number of covariates, including location and storm direction. Reliable estimation of design criteria requires incorporation of covariate effects within extreme value models.

We present a spatio-directional model for extreme waves in the Gulf of Mexico, motivated by the non-homogeneous Poisson model for peaks over threshold. The model is applied to storm peak significant wave height H_S for arbitrary geographic areas from the proprietary GOMOS hindcast for the US region of the Gulf of Mexico for the period 1900-2005.

At each location, directional variability is modelled using a non-parametric directional location and scale; data are standardised (or "whitened") with respect to local directional location and scale to remove directional effects.

For a suitable choice of threshold, the rate of occurrence of threshold exceedences of whitened storm peak H_S with direction per location is modelled as a Poisson process. The size of threshold exceedences is modelled using a generalised Pareto form, the parameters of which vary smoothly in space, and are estimated within a roughness penalised likelihood framework using natural thin plate spline forms in two spatial dimensions.

By re-parameterising the generalised Pareto model in terms of asymptotically independent parameters, an efficient back-fitting algorithm to estimate the natural thin plate spline model is achieved. The algorithm is motivated in an appendix.

Design criteria, estimated by simulation, are illustrated for a typical neighbourhood of 17 x 17 grid locations. Applications to large areas consisting of more than 2500 grid locations are outlined.

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Spectral analysis of Burgundy Pinot Noir grape harvest dates

The discovery that the period of the seasonal cycle as measured in temperature is not the tropical year was announced in DJT, Science 268, pp 59–68 (1995)). The topic was recently revived, (see DJT News & Views pp 391–392 of the January 22, 2009 issue of Nature). None of the climate models used by IPCC predict this effect.

As part of the study for the News & Views I reviewed newer data and, having spent much of the intervening time working on solar problems (see Proc. IEEE 95 pp 1085–1132 (2007)) noticed features of the climate data that had previously been missed. Since then, my student, Karim Rahim, and I have been working on this. We have found century–scale systematic nonstationary features in this data that are similar to those found in solar data. In particular, the publication of the dates of the Pinot Noir harvest in Burgundy (see Chuine et al. Nature 432 (2004)) and a similar series from Switzerland (see Meier et al. GRL 34 (2007)) allow new investigations into pre–industrial climate fluctuations.

These series are highly coherent. The coherence between the Burgundy and the Kyoto cherry blossom bloom series is lower, possibly because of geographic factors. Our demonstration that the series is nonstationary implies that extreme caution must be exercised in drawing inferences about climate from these series when the calibration region is in a different mode. They may, however, shed some light on the general problem of Holocene climate fluctuations.

We have also developed some new quadratic–inverse based tools for the study of such nonstationarity. These, however, are reasonably complicated (see DJT, Phil. Trans. R. Soc. Lond., A 332 539–597 (1990) for background) and will be mentioned, but are better suited for a paper than a talk or poster.

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Quantifying the uncertainties of climate change: from global temperatures to local impacts

Until recently, the focus of climate research has been investigating whether climate change is happening, and if it is caused by humans. Since the IPCC statement of the Intergovernmental Panel on Climate Change in 2007 that climate change is "very likely" caused by humans, the focus has shifted towards predicting the impacts of climate change, and what we can do to avoid the worst of those impacts. Whereas the possible range of future global average temperatures is relatively well known, the local impacts of climate change on human and Earth systems are much more uncertain.

If we are to make rational decisions about how to best adapt to, or mitigate against climate change, we need a clear understanding of the uncertainty of its impact on a huge range of human and Earth systems. These cover all scales, from the risk of the loss of the Amazon rainforest, to the risk of a heatwave on an elderly person.

Projections of the future climate are crucial to investigating the impacts of climate change. The projections are made using Global Circulation Models (GCMs) that describe the physics of the climate system mathematically and are run on supercomputers to simulate climate over the next century. The projections can then be fed into impacts models to investigate the impacts of climate change on individual systems.

There are three main sources of uncertainty associated with GCMs: future greenhouse gas emissions, natural variability, and modelling uncertainty. Whilst the first two have been considered in detail, recent advances have allowed the latter to be quantified more rigorously then ever before using "ensembles" of models. The ensembles are made up of different model versions, or even groups of models developed in different research centres. GCM projections of temperature and other climatological parameters provide a global picture of the future climate, but with a resolution typically in the order of 300km, they do not provide a local picture.

Alternative techniques to provide more local climate change projections include i) using regional, higher resolution climate models, ii) statistically downscaling results from global to local scales. With each technique, different sources of uncertainties must be taken into consideration. Here we discuss the techniques used to examine future climate impacts and their uncertainties.

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Computers at work: blessing or curse?

In the latest i2010 report, Britain scores well in all indicators of diffusion of e-services and e-technologies across the population. The i2010 initiative builds on the belief that a wider use of new technologies will enhance growth through employment. However, a higher percentage of calculators per person is hardly evidence of improved numeracy skills: could a similar argument be made for the relationship between broadband diffusion and computing skills? This paper considers the need and complexity of computer use at work to gauge the importance of new technologies in society. Notwithstanding the importance of ICTs in all facets of life, much of the current public expense in this area is justified using employment arguments.

Computer use is unevenly distributed across jobs, from the cashier in the supermarket to the programmer of new code in the aeronautic industry. This imbalance makes analyses of the rewards to these technologies based on averages misleading, as they conceal great differences between workers who use ICT and those who do not. Quantile regressions evaluated at various points of the earnings distribution, conditional on personal characteristics, give a more accurate picture of the importance and rewards to computer use and the complexity of this use. This paper compares results across 3 representative cross-sections of the British workforce spanning nearly 10 years, the Skills Surveys carried out in 1997, 2001 and 2006, providing enough time elapsed to observe changes in the use of these technologies. Computer use can be defined broadly as using any automated equipment or narrowly as using a PC. Complexity spans 4 levels from basic (cashier) to advanced (programming) for the narrow definition.

As with other working conditions (Fernandez & Nordman, 2009) the rewards to these skills differ along the earnings distribution, reflecting a divide between workers who use ICT and those who do not. The nature of a digital divide at work matters for policy because whether the divide is caused by the supply of jobs with an ICT component or by the supply of ICT skills entails different public action. Some jobs are simply not susceptible of being computerised (e.g. bed-making) so they should not carry a penalty for the absence of technologies. Are technophobes more likely to end up in these jobs? A counterfactual decomposition of the contribution of the personal characteristics and the labour market rewards to those characteristics in the spirit of Machado and Mata (2005) will ascertain the degree to which it is the technology and not the person that drives the ICT penalties and premiums along the earnings distribution.

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The evaluation of an area-level crime reduction intervention

Interventions to reduce crime may, of necessity, be applied to areas. This poses special problems for their evaluation coupled with the fact that RCTs of effectiveness may not be implemented.

Some of the problems are: crime events cannot be assumed to be independent, any areas used for comparison may have different levels of crime and also the relationship between variability and average-level may be unclear. Crime data may have a multivariate, multilevel structure.

The presentation builds on earlier work which identified some problems in a meta-analysis of research on the effectiveness of crime reduction. The talk will give preliminary results from and evaluation of a country-wide ‘stepped wedge’ implementation of a crime reduction intervention.

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Who creates the jobs? Survival and growth of the quarter of the million British firms born in 1998

In 1979 David Birch argued, contrary to the prevailing wisdom, that smaller, newer, firms contributed more to job creation in the United States than did larger, older, firms. Thirty years later, despite studies covering of a number of countries and over various time periods, there is still no consensus on the answer to the question: "who creates the jobs?"

Progress in resolving the issue has been slow in part because that the data needed to address it properly - firm-level employment histories covering a population of firms - have been relatively rare. The increasing availability of more, better, data has revived scientific interest in the question and there is renewed and increasing pressure for answers that can be fed into the policy-making process from agencies responsible for encouraging entrepreneurship and for business support.

We use a new ONS dataset (the Business Structure Database), which provides firm-level employment data for all British businesses from 1997 onwards, to un-pack the jobs growth story by focusing on a single cohort – the quarter of a million businesses 'born' in 1998.

At birth these firms had 1.1 million employees, a decade later 60% of them were 'dead' and the 'surviving' cohort members employed around 640 thousand. We identify two distinct strands connecting birth to 2008, survival (or not) and the growth of survivors.

By tracking survival and growth by size over the decade we shed new light on the job creation question and provide a more nuanced conclusion: large firms contribute the bulk of jobs at birth and a decade later; but most of the growth in jobs comes from survivors who were born relatively small, but by age 10 had become relatively large.

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Saddlepoint approximations for transition densities in stochastic differential equations

Various methods are available for making parametric inference about discretely-observed continuous-time stochastic processes modelled by stochastic differential equations (SDEs). The Markov property makes likelihood approaches simple in principle, but a complication is that the transition density is known only for a few SDEs, and in most cases must be approximated.

Previously used methods for approximating the transition density include: (i) numerical solution of the corresponding Kolmogorov partial differential equation; (ii) simulation, such as by Markov chain Monte Carlo or exact simulation methods; and (iii) analytic approximations, for example using Hermite polynomial expansions; see references below.

We consider saddlepoint approximations to the transition density which, so far as we are aware, have not been used before. We will present numerical results and discuss potential advantages of our approach over (i)-(iii).

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Multiscale imputation of irregular spatial data

In a spatio-temporal example from agriculture concerning crop monitoring and pest control, it is desirable to fit surfaces describing covariates in a geographical region. We describe a method for imputing – or interpolating – values observed from functions on an irregularly spaced data grid using a Voronoi-based lifting scheme.

The lifting scheme is a generalisation of wavelet decompositions used to obtain multiresolution analyses on irregular grids without restrictions on the number of data points. This allows us to identify activity with localisation in scale and location and also, under certain assumptions, gives us a method of minimising distortion due to noise.

Suppose we have some data, XF, collected on an irregular two-dimensional grid, and for each data point, xi, a corresponding function value, fi, is observed. The observed values are the sum of a true function value, gi, and some normal noise, ?i. We wish to make estimates of the function value at points where we have no observations, which we call XM.

To make these estimates, we first perform a lifting transformation on the combined grid, X = (XF, XM). We then estimate the lifting coefficients corresponding to grid points XM utilising the sparsity property of the lifting transformation. The missing function values are then obtained by inverting the lifting transformation.

We also obtain estimated posterior distributions for the missing function values, which are mixtures of the posterior coefficient distributions. It is possible to simulate directly from these mixture distributions; confidence intervals and other summaries can be derived from such samples. An advantage of this method is that it does not require MCMC, providing good computational efficiency.

We show an example of this method on a UK farm-based pest count data set which contains both densely and sparsely observed regions, ideal for the use of such multiscale methods. We build a two-dimensional surface of pest infestation levels by imputing on to a regular grid. Simulations will also be shown comparing our method to similar methods – Kriging and Heaton and Silverman's lifting-based imputation method which requires MCMC simulation

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Curve extraction and the analysis of facial shape

A study was recently conducted to characterise residual deformities of ten-year-old patients following surgical repair of cleft lip and/or palate. Together with 68 control children, images were captured of 44 unilateral cleft patients and 51 unilateral cleft lip and palate patients. From each of these images, 36 anatomical landmarks were identified.

Landmarks, although a natural starting point for facial shape analysis, contain a very small proportion of the data available from a captured image. Curves, with anatomical landmarks at the endpoints, have the advantage of providing additional information about the shape of a face while retaining relatively low dimensionality.

We use a plane cutting method to represent a total of 5 facial curves as a dense set of discrete points. Some of these points are anatomical landmarks and are held fixed; most are intervening 'pseudo-landmarks'. With the plane cutting method as a starting point, we improve the estimation of the upper lip through the colour change at the vermillion border and the estimation of the midline profile through surface curvature.

The effectiveness of this approach is investigated and the use of these curves in characterising shape is also illustrated.

Sir Michael Scholar

UK Statistics Authority: priorities, progress and change

Sir Michael Scholar was appointed Chair-designate of the UK Statistics Authority in August 2007 and took up his post in a shadow capacity on 3 September. His appointment (and that of the rest of the Board) became formal on 1 April 2008. As Chair his appointment is a Crown appointment, made after the new procedure for the most senior appointments, with the approval of Parliament.

With strong links to south Wales, his place of birth, Sir Michael holds an Honorary Fellowship at Cardiff University, and at the University of Wales (Aberystwyth), and an Honorary Doctorate at Glamorgan University. He was Permanent Secretary to the Welsh Office between 1993 and 1996. He was also Permanent Secretary to the Department of Trade and Industry (1996-2001), and Private Secretary in the early 1980s to the then Prime Minister, Margaret Thatcher. He was awarded a CB in 1991 and a KCB in 1999.

Sir Michael is President of St John's College, Oxford. His personal interests include music, literature and the arts. He plays the organ and piano and holds an Associateship of the Royal College of Organists. He also enjoys long distance walking and gardening. Sir Michael is a Fellow of the Royal Statistical Society.

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Nonparametric regression on a graph

There are a number of statistical models that contain some sort of graphical structure. For example: scatterplot smoothing, image analysis, disease risk mapping, and spatial and longitudinal models.

We will discuss penalised regression in the context of removing noise from observations made on a graph. Regression on a graph requires the fitting of a function that somehow explains the observations made at the vertices. The fitted function, and shape of the graph, may be completely arbitrary. Therefore it is appropriate to use nonparametric regression, which makes less restrictive assumptions about the function.

Our approach may be seen as a generalisation of total variation denoising, in which the smoothness or simplicity of the function is controlled. The generalised method penalises departures from the data on the vertices, and roughness on the edges of the graph. There are computational challenges in implementing this penalised regression. We will see the results of a new active set algorithm for denoising on a graph, and discuss some applications including image analysis and mapping UK house prices.

Andrew Smith is a graduate student at the University of Bristol, under the supervision of Dr. Arne Kovac. Previously he completed undergraduate and postgraduate studies at Bristol and The University of New South Wales, Sydney.

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An additive approach to derivative estimation

It is often the case that when analysing data the derivative, or rate of change, of the underlying function describing the observed data of primary interest. A popular tool for derivative estimation is spline smoothing, with a large number of variants being available.

We present a method for derivative estimation which extends the P-spline fitting procedure to include an extra additive penalty term for increased robustness in smoothing. The method is applied to biometrical data and compared with several alternative techniques. Simulations are used to gain further insight about the relative perfomrance of the approaches.

Andrew Simpkin received a BA in Mathematics from Trinity College Dublin in 2007 and began studying for a PhD at the National University of Ireland, Galway in September of that year.

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Joint modelling of event counts and survival times

In studies of recurrent events, like epileptic seizures, there is typically lots of information about an individual's seizure patterns over a period of time, which is often not fully utilized in analysis. Most standard survival analysis may treat pre-randomisation event count information as a covariate, possibly as a covariate measured with error.

We develop methodology that allows pre-randomisation seizure counts and multiple post-randomisation survival times to be jointly modelled. This method assumes that both these outcomes are predicted by (unobserved) seizure rates.

We consider the analysis of data from the MRC Multicentre Trial for Early Epilepsy and Single Seizures (MESS), which was undertaken to assess the differences between two policies: immediate, or deferred treatment in patients with single seizures or early epilepsy.

Jennifer Rogers grew up in Wakefield, West Yorkshire. She obtained a first class BSc (Hons) Mathematics with Statistics from Lancaster University in 2006. She subsequently obtained GradStat status from the RSS and remained at Lancaster to undertake an MSc Statistics, which she passed with distinction. Whilst completing my MSc Jennifer was appointed Assistant Dean of Furness College, which had been her undergraduate college. She joined the University of Warwick in 2007, where she had been working on her PhD, under the supervision of Prof. Jane Hutton.

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Eigen Techniques as tools to study the decadal variability and predictability of Scottish temperature

Eigen-based linear techniques are powerful tools that are extensively used in climatology to extract information from spatial-temporal datasets. They are designed to keep as much information as possible of complex climate systems in only a few degrees of freedom or modes.

In this study, a number of Eigen techniques were used to investigate: 1) the decadal variability of temperature in Scotland and 2) the predictability of temperature at the decadal time-scale using North Atlantic Sea Surface Temperature (SST) as a predictor.

An overview of the analytical methods is provided and a comparison is made based on the application to real data and the testing of hypotheses. Empirical Orthogonal Function (EOF) analysis was used on monthly mean air temperature (MAT) anomalies to identify the main independent modes and associated principal component time-series of decadal variability in Scotland for the period 1960-2001.

Canonical Correlation Analysis (CCA) was performed on MAT and North Atlantic SST to establish if there is a strong relationship between these two variables and to identify which North Atlantic region plays the most important role in regulating Scottish MAT. CCA revealed that European shelf seas SSTs (45°N-65°N, 20W-20E), particularly, the North Sea, have a strong influence on Scottish MAT.

Finally, Redundancy Analysis (RA) technique was used to develop a statistical model for possible predictions of Scottish MAT based on shelf seas SST.

The RA results indicate a good potential to forecast decadal trends in spring, autumn and particularly summer Scottish temperatures.

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Forest inventories – past and present

The Forestry Commission has been carrying out national woodland surveys since 1924, to provide information on the area, distribution, composition and condition of woodlands. The talk will present information from these surveys, describing the trends over the past century as woodland cover has increased from historic lows, and outlining the methodologies used.

A new National Forest Inventory is now underway. In addition to the requirements addressed by previous surveys, the new inventory will be required to provide a better statistical basis for timber production forecasts and for forestry's role in mitigating climate change through carbon stored in growing trees.

Underpinned by a new digital map of woodland down to 0.5 hectares to be published in autumn 2009, field survey work started in summer 2009. The talk will describe the design of the new survey, including the statistical methods used to improve the efficiency of sampling and to assess the impact of the multiple sources of uncertainty.

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Comparison of statistical methods for phenology

Climate change is likely to affect the timing of natural events and this in turn may upset ecosystems. As a result, there is renewed interest in phenology.

Phenological records can be related to weather data using association-based models or mechanistic models. Examples of the latter include thermal time models. In these the event is expected to occur once sufficient temperature-time units have been accumulated. There may also be a chilling requirement. Although in principle mechanistic models seem to provide the better approach because of their biological basis, they can be difficult to fit and are less flexible. Also such models are not available for all types of natural event.

In the case of association-based methods, linear regression is commonly used, particularly stepwise regression. However such methods generally do not perform well with many highly correlated regressors, so weather data is typically aggregated to monthly means.

Penalised regression has been proposed as a way to analyse daily measurements, giving more interpretable results than other methods for high dimensional data such as partial least squares or ridge regression. Differences between consecutive regression coefficients are penalised, resulting in a smooth profile of coefficients. Extensions of this methodology allow the exploration of the effects of covariates, generating multidimensional surfaces of coefficients.

Here we compare stepwise and penalised regression with some examples of mechanistic models. We investigate to what degree results from a regression can be interpreted in terms of an underlying biological model and how the number of observations affects the quality of results.

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Approximate Bayesian Computation under model uncertainty

In many areas of computational biology, the likelihood of a scientific model is intractable, typically because interesting models are highly complex. This hampers scientific progress in terms of iterative data acquisition, parameter inference, model checking and model refinement within a Bayesian framework.

We provide a statistical interpretation to current developments in likelihood-free Bayesian inference that explicitly accounts for discrepancies between the model and the data, termed Approximate Bayesian Computation under model uncertainty (ABC?) [1].

We augment the likelihood of the data with unknown error terms that correspond to freely chosen checking functions, and describe possible Monte Carlo strategies for sampling from the associated joint posterior distribution without the need of evaluating the likelihood.

We discuss the benefit of incorporating model diagnostics within an ABC framework, and demonstrate how this method diagnoses model mismatch and guides model refinement by contrasting three qualitative models of protein network evolution to the protein interaction datasets of Helicobacter pylori and Treponema pallidum.

The presented methods will be useful in the initial stages of model and data exploration, and in particular to scrutinize several models for which the likelihood is intractable by direct inspection of their summary errors, prior to more formal analyses.

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Partially Collapsed Gibbs sampler for Bayesian quantile regression

Quantile regression has become a widely used technique to describe the distribution of a response variable given a set of explanatory variables. In the last few years, Bayesian inference for quantile regression has attracted much attention in literature.

Although the Metropolis-Hastings algorithm has been employed in Bayesian quantile regression, including median regression, this paper explores a Partially Collapsed Gibbs (PCG) sampler to perform Bayesian inference on quantile regression models. Partially collapsing an ordinary Gibbs sampler is a generalisation of 'blocking' and therefore has superior convergence properties to an ordinary Gibbs sampler.

Moreover, using the PCG sampler described here requires less computation than the ordinary Gibbs sampler and can significantly reduce the computation involved in approximating the Bayes Factor.

Like the ordinary Gibbs sampler, the PCG sample can also be used to calculate marginal and predictive distributions. The quantile regression PCG sampler is illustrated by analysing simulated data and the data of length of stay in hospital. The latter provides new insight into hospital performance

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Methods for assessing consistency in Mixed Treatment Comparisons meta-analysis

Decision makers, whether working at the bedside or at a policy level, are often confronted with several alternative treatments or therapies for a single medical condition, but must rely on a series of pair-wise randomised comparisons, A vs B, A vs C etc to make decisions. Often, treatment A is a Placebo and interest is on the relative efficacy of B vs C (the active treatments) for which no evidence is available.

Indirect Comparisons have been proposed to extract information on the B vs C effect from the separate pairwise comparisons of A vs B and A vs C. However, if data from randomised controlled trials (RCTs) comparing treatments B and C was available, we might wish to combine this "direct" evidence with the indirect evidence provided by the A vs B and A vs C trials to yield a single estimator of treatment efficacy.

This pooling of direct and indirect evidence from randomised trials, known as mixed treatment comparisons (MTC) or network meta-analysis, is becoming increasingly common in the clinical literature. MTC allows coherent judgements on which of several treatments is the most effective and produces estimates of the relative effects of each treatment compared to every other treatment in a network – even though some pairs of treatments may not have been directly compared. However, doubts have been expressed about the validity of MTC, particularly the assumption of consistency between "direct" and "indirect" evidence.

Several methods have been put forward in the literature – inconsistency models, or calculating the difference between 'direct' and 'indirect' evidence – to attempt to formally or informally assess, test for and investigate the consistency assumption in different ways.

We will explain the consistency assumptions in MTC and propose new methods for checking consistency of evidence in arbitrarily complex treatment networks, based on the ideas of node-splitting and shared variance models. The merits and drawbacks of these approaches compared to the existing ones will be discussed with the help of some examples.

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Accounting for a non-ignorable tracing mechanism in a retrospective breast cancer cohort study

Around 15000 healthy women answered a questionnaire and undertook a mammogram between 1979 and 1987. Tracing of these women in 2007 was carried out using the CHRIS health registry. Tracing was incomplete and the tracing method was non-ignorable as only women alive in 1991 are on the registry, but records of cancer before 1991 are available for those women. The aim of the study was to identify possible risks factors for the onset of breast cancer from covariates available in the questionnaire and mammography, ensuring that the tracing mechanism is accounted for.

A standard competing risks model using only traced women who were healthy in 1991 was performed. Two additional methods based on explicit modelling of post-cancer survival within a multi-state model framework, enabling all the data to be used, were also considered. Firstly by pseudo-likelihood, adapting methods developed for augmented prevalent-cohort data. Secondly by considering the data before 1991 as a purged process and correcting the hazards for the resulting distortion factors.

All three methods gave similar results, identifying parenchymal patterns and past-family history as possible risk factors for breast cancer. Greater precision of the regression parameter estimates were obtained through the methods based on additional modelling of post-cancer survival.

Adopting a multi-state modelling framework allows non-ignorable tracing in a competing risks model to be accounted for without information loss. Use of pseudo-likelihood is more straightforward to implement than approximate partial-likelihood methods based on distortion factors. However, the distortion factor approach does not require additional knowledge of dates of entry into the study.

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Estimating treatment effect from clinical studies with missing data at baseline: relative efficiency of adjusted and unadjusted analyses

In clinical studies, one typically uses post-treatment measurements of an outcome variable to estimate a treatment effect. One may also wish to take account of potential pre-treatment differences between the treatment groups, by adjusting for a baseline covariate (or covariates).

However, the baseline data are sometimes missing or unavailable, because of administrative or resource reasons. For instance, researchers in surgery often wish to take account of pre-surgical quality of life, but identifying and accessing patients some time before surgery may be difficult and costly. If a traditional complete case analysis is used, patients with missing baseline data are excluded, resulting in a loss of power.

We have studied the trade-offs in efficiency and cost-efficiency that exist between using an unadjusted analysis including all patients, or an adjusted analysis limited to patients where baseline observations are available. The preferred choice between these alternative analyses is a function of the study sample size, the proportion of patients with missing baseline data, the extent of the baseline difference between treatment groups, the correlation between pre- and post-treatment measurements, and the cost of making observations.

We have derived expressions for the relative efficiency and cost-efficiency of adjusted and unadjusted estimates of treatment effects. We also derived values of the minimum required correlation between the baseline variable and the study outcome, and the maximum required proportion of missing data, such that the adjusted analysis would yield the more precise estimate of treatment benefit. These ideas are illustrated using data from a randomised trial comparing two surgical treatments for torn meniscus.

The findings can help researchers to choose between an analysis adjusted for a baseline variable with potentially missing data, and an unadjusted analysis based only on post-intervention observations. In situations where the unadjusted analysis is thought to be more efficient, researchers may then forgo the need to gather the pre-treatment observations

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A decision-theoretic framework for the application of cost-effectiveness analysis in regulatory processes

Cost-effectiveness analysis (CEA) represents the most important tool in the health economics literature to quantify and qualify the reasoning behind the optimal decision process in terms of the allocation of resources to a given health intervention.

However, the practical application of CEA to regulatory processes is often limited by some critical barriers, and decisions in clinical practice are frequently influenced by factors that do not contribute to an efficient resources allocation, leading to inappropriate drug prescription and utilisation.

Moreover, most of the times there is uncertainty about the real cost-effectiveness profile of an innovative intervention, with the consequence that it is usually impossible to obtain an immediate and perfect substitution of a product with another having a better cost-effectiveness ratio.

The objective of this paper is to propose a rational approach to CEA within regulatory processes basing our analysis in a Bayesian decision-theoretic framework and proposing an extension of the application of well known tools (such as the expected value of information) to such cases. The regulator can use these tools to identify the economic value of reducing the uncertainty surrounding the cost-effectiveness profile of the several alternatives.

This value can be compared to the one that is generated by the actual combination (in terms of market shares) of different options: one that is the most cost-effective and others in the same therapeutic category that, despite producing clinical benefits, are less cost-effective.

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The use of hot decking and propensity score matching in comparing student outcomes

The performance of institutions such as colleges and schools are of increasing interest to funders and stakeholders because they require accurate estimates of success rates and retention rates. However it is important that the information these estimates are based upon is consistently applied on a like-with-like basis1. Students who attend different institutions do not have the same background characteristics and if this isn't taken into account certain institutions may be misplaced in terms of performance.

This study uses the technique of causal inference and employs the methods of hot-decking2 and propensity score matching3 since these methods can provide a true like-with-like comparison. The study compares the retention rates of Scottish entrants who studied at non-Scottish higher education institutions (HEI's) against the retention rates of Scottish entrants who studied at Scottish HEI's.

A basic method, which didn't take account of background characteristics, came to the following conclusion: if those entrants who studied outside Scotland had studied in Scotland they would have been 5% more likely to drop out of their studies. However, the methods of hot-decking and propensity score matching, which perform a true like-with-like comparison, came to the conclusion that the difference in drop-out was less than the 5% quoted by the basic method. Hot-decking provided an estimate of 2% and propensity score matching provided an estimate of 4%.

Further work is required to assess the sensitivity of the results to the assumptions employed in the models. However, the estimates from this causal inference study help to provide an understanding of the impact of different background characteristics upon the performance of institutions.

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What are you inferring?

Pension funds are in crisis mode – trustees are facing crucial, even existential questions: Stop using hedge funds? Search over more managers to find the best? Pay active management fees or stay passive? etc.

As a consulting statistician in finance I find that trustees presume statisticians can produce definitive inferences which will serve as neat answers to their questions. This is a gross misrepresentation, not to mention an underestimation, of what a statistician does. Statisticians contribute to clients' inference procedures by marshalling theory, laying out logic and crunching numbers.

Statisticians do not in fact produce inferences, at least not definitive ones. Isolated statistical outputs can be dressed up to resemble inferences – the usual suspects are things like hypothesis test results, posterior distributions, statistical significance assignments, likelihood ratios and so on . But when such outputs are fetishised by clients and served up by statisticians as ready made answers (often spewing automatically from machines), they only contribute to the noxious fumes that Leamer refers to in the quote above.

Operationally, inference proceeds something like a syllogism: "premise1 + premise2 + ... ==> conclusion". In this context statisticians contribute things like: appropriate logical machinery to get to coherent conclusions (e.g. Bayes theorem); premisses themselves; and reasons for and against believing in premisses. With large data sets and rich theories to work with, as is the case in finance, a statistician's contribution to inference is broad and in parts deep.

I have attached 3 case studies – the common thread between them consists of financial questions that render a statistician to be a contributor to, rather than producer of, inferences. The meat of the case studies is a pluralistic (in terms of Bayesian, Frequentist et al) discussion of the philosophical underpinnings and practical demands of a statistician's role in inference. With respect to the current pension crisis, it is up to the trustees to do the inferring, but statisticians will have an important and positive role to play . As a more general summary of what I am talking about, the following quote says it better than I can (replace "scientific" with "financial"):

"Three forces influence the state of statistical science at any one time: mathematics, computation, and applications, by which I mean the type of problems subject-area scientists bring to us for solution. The Fisher-Neyman-Pearson theory of hypothesis testing was fashioned for a scientific world where experimentation was slow and difficult, producing small data sets focussed on answering single questions. It was wonderfully successful within this milieu, combining elegant mathematics and limited computational equipment to produce dependable answers in a wide variety of application areas.

The three forces have changed relative intensities recently. Computation has become literally millions of times faster and more powerful, while scientific applications now spout data [and questions] in fire-hose quantities. (Mathematics, of course, is still mathematics.) Statistics is changing in response... I believe, or maybe just hope, that our new scientific environment will also inspire a new look at old philosophical questions. Neither Bayesians nor Frequentists are immune to the pressures of scientific necessity."

I hope that you think one of my case studies would make a worthwhile contribution to the RSS Edinburgh conference. I would welcome any feedback.

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Counterbalance – weighing up the need for professional statisticians in a global environment

Many industries are now global and UK statisticians working in industry increasing collaborate with work colleagues in other countries. Some industries are also highly regulated and require qualified staff to perform tasks.

With the exponential increase in data generated, the increase in computing power and the availability of sophisticated statistical software the potential for data analysis is enormous. Standards need to be maintained such that the resulting information is reliable, increases knowledge and is an enabler for robust decision making.

This talk with focus on how the profession of statistics should evolve to meet these challenges. In particular the need to create an International professional identity for statisticians that accommodates both the theoretical and the applied - but is independent of mathematics. This will require greater international collaboration, a greater focus on continuing professional development and a more determined effort to sell the benefits to employers.

Dr Andrew Garrett has a BSc in Economics, an MSc in Medical Statistics and is Chartered Statistician and Chartered Scientist. During his time at Quintiles, he completed a PhD part-time.

Andy has worked in the pharmaceutical industry for 25 years – over half of which has been spent working for CROs. He joined Quintiles in 1995 and his current position is VP, Global Biostatistics. Andy has responsibility for over 300 staff in Biostatistics Operations in Europe, North America, Africa, Australia, India and China. He has previously worked for Warner Lambert, Parexel and Cyanamid.

Currently Andy is a VP of the Royal Statistical Society Council and is Honorary Secretary in his role of Chairperson of the Professional Affairs Committee. For many years he has been actively involved with PSI, and until recently was a member of the Regulatory Sub-committee.

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Continuing Professional Development (CPD) for statisticians in government

Greater emphasis on the evidence base for policy making changes the context for statistical professionals across government. We now need to work much more collaboratively with other professional groupings such as economists, social researchers and scientists and the 'Integrating Analysis' initiatives of the last few years have sought to facilitate this.

Statistical drivers in this process include greater usage of administrative data, data matching, complex modelling and analytical techniques and statistical disclosure control. Innovation, like all other aspects of our work, is guided by professional standards enshrined in the UK Statistics Authority's 'Code of Practice for Official Statistics' and at the forefront of the National Statistician's role.

The Government Statistical Service, the biggest employer of statisticians in this country, therefore has a strong need for a well trained large cadre of professional staff (the Statisticians Group) with up-to-date skills. With a shortage of appropriately qualified new graduates and other pressures such as the relocation of the ONS's headquarters from London to Newport, there is an increased focus on Continuing Professional Development for a broadly based Statisticians Group.

To this end, a recently developed GSS Framework for Statistical Training has been developed to complement competence frameworks already in place and marries well with RSS led initiatives for the statistical profession more widely.

Stephen Penneck joined the Office for National Statistics (ONS) in 1997 and became Director of Methodology in 2008. He has wide experience as a government statistician, initially in economic statistics, and more lately heading the Surveys and Administrative Sources Directorate.
Stephen currently has responsibility for methodological advice to the ONS and the Government Statistical Service (GSS), including advice to the National Statistician on quality, standards and best practice; and advice on surveys, administrative sources, analysis and the census.

As Director of Surveys and Administrative Sources, he had responsibility for all ONS surveys and for their outputs, including the Consumer Price Index, the Labour Force Survey, and business surveys feeding the National Accounts. Previously Stephen provided policy advice to the former National Statistician, Len Cook, and in 2002, he completed a five month secondment to the Australian Bureau of Statistics. Earlier jobs include heading the National Accounts division in ONS, and Chief Adviser on Statistics at the Department of Trade and Industry. Stephen has also worked on statistical research and at the Office of Fair Trading.

Stephen studied for his BSc in Economics and Statistics at Southampton University and has an MSocSc in Econometrics from Birmingham University. He is a Fellow of the Royal Statistical Society and a Chartered Statistician. Stephen is currently Vice President of the International Association of Official Statistics, and has published articles in *Economic Trends* and *Statistical News*.

Ron Wasserstein
American Statistical Association

Professional development and the American Statistical Association

The professional development needs of members may be as diverse as the membership itself, which is about 42% from academe, 31% from business and industry, 11% from government, and the remaining 16% from other areas, including private consulting practice. In addition, we are diverse in age and education (though more than half of ASA's membership holds the PhD).

While always important, professional development will take on additional significance as the ASA begins to accredit members. We will discuss our current activities and discuss future plans.

Ron Wasserstein is the Executive Director, American Statistical Association. Previously, he was Vice President for Academic Affairs, Washburn University, 2000-2007; Associate Vice President for Academic Affairs, Washburn University, 1992-2000; Assistant Dean, College of Arts and Sciences, 1988-1992; Professor of Statistics, 1996-2007; Associate Professor of Statistics, 1991-1996; Assistant Professor of Statistics, 1987-1991 and Instructor of Statistics, 1984-1987.

Wasserstein received his PhD, Statistics, Kansas State Universityin 1987 and his MS, Statistics, Kansas State University, 1984. He earned his BA in Mathematics from Washburn University in 1978.

His field of Major Statistical Activity is statistical education and statistical consulting.

Wasserstein is President-elect, Kappa Mu Epsilon National Mathematics Honor Society, 2005-2009 (President, 2009-2013) and serves on the Board of Directors, MATHCOUNTS, 2007-Present.

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Measuring ethnic segregation in schools: a model-based approach

Segregation is the unevenness of sorting of people with different characteristics into different groups, for example of pupils of varying economic status into schools or of people of varying ethnicities into neighbourhoods.

It is important to measure segregation in schools because it may affect pupils' outcomes, for example if ethnic segregation is present and if non-White students tend to go to less effective schools this would put such students at a disadvantage in terms of exam grades. In itself, the lack of opportunity to mix with students from other backgrounds implied by the presence of segregation may also have an important negative impact.

Previous work has calculated indexes to measure the degree of segregation. We point out some problems of this approach, including that it does not assume each group has an underlying proportion around which the observed proportion varies.

We also point out some limitations, including the difficulty of adding explanatory variables, measuring segregation at more than one level simultaneously (e.g. at the school and LEA level), or measuring segregation when people fall into more than 2 categories (e.g. ethnic segregation).

We demonstrate an alternative approach, modelling segregation (via a multilevel model), which has been applied by Goldstein and Noden (2003) to segregation according to a 2 category variable, and explain how this overcomes many of the problems of the index-only approach. We also show how extending this model can overcome the limitations of the index-only approach that we mention.

We apply the extended model to PLASC data, looking at ethnic segregation in schools over time.

(This is a presentation of work done with Harvey Goldstein, George Leckie and Kelvyn Jones.)

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Rebecca Pillinger is a Research Assistant at the Centre for Multilevel Modelling at the University of Bristol. As well as segregation, she has worked on a project decomposing pupil progress into school, neighbourhood, family and individual effects. She is hoping to start a PhD in October, remaining at CMM, looking at decomposing the relationship between intelligence tests and achievement into genetic, shared environmental and non-shared environmental components and allowing these to vary across background characteristics.

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Reflections on the measurement of ability

Human ability, whatever we mean by that term, is a latent variable. Attempts to measure it have a long history and any roll-call of the great names in that field would include Binet, Spearman, Thomson, and Jensen among many others.

However, none of them were statisticians although the problem they faced was essentially statistical. The talk will aim to delineate the problem in statistical terms and to identify some of the key contributions.

David Bartholomew is Emeritus Professor of Statistics at the London School of Economics. He joined the School in 1973 after 6 years as Professor of Statistics at the University of Kent.

He was Pro-Director of the School from 1988 to 1991. He was President of the RSS from 1993 to 1995 and served on Council for over 20 years, including terms as Treasurer and Honorary Secretary. He has been a Fellow of the British Academy since 1987. Since 2006 he has been involved in an ESRC-supported project on mental testing in the Psychology department of the University of Edinburgh.

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Governing by numbers – performance management in school education

In education, as in other public services in Britain, there is increasing emphasis on performance management, quality assurance and accountability – with a major focus on quantitative measurement of performance. This is linked to a massive increase in the amount of data required by government from and about schools.

Policy makers say that performance data provide evidence that can help improve the quality of education – but their focus on data leads to narrow definitions of "quality", and places considerable pressures on schools, teachers and pupils. Similar trends are found throughout Europe. Performance is compared internationally using indicators such as those developed by the Programme for International Student assessment (PISA).

This talk presents findings of current research at the Centre for Educational Sociology (CES), on the implications of governing by numbers. It is based on research funded by the Economic and Social Research Council (ESRC) and European Science Foundation (ESF) running from 2007-2009. There are two linked projects: a European comparative project called "Fabricating Quality in European Education Systems" (FABQ); and the UK project "Governing by Numbers" that is nested within it. FABQ involves teams of researchers in Sweden, Finland, Denmark and the UK (England and Scotland).

See http://www.ces.ed.ac.uk/research/FabQ/index.htm for papers.

Dr Linda Croxford is a senior research fellow at the Centre for Educational Sociology, University of Edinburgh

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Making probabilistic climate projections for the UK

UKCP09, the latest set of climate projections for the UK were released on June 18th 2009. For the first time the climate projections for the UK are probabilistic, so that it is an appropriate tool for people who are taking a risk-based approach to policy and decision making.

This talk will dovetail with Roger Street's talk. I will give a brief overview of how the probabilities were estimated using a) a combination of a number of climate model ensembles which explore parameter uncertainty in different components of the Earth System and b) a Bayesian framework which combines this climate model output with observations to provide probabilities that are relevant to the real world and therefore relevant to risk-based decision making.

I will also outline the main areas of the production system that could benefit from further research into statistical methods and better experimental design.

David Sexton: I have worked at Met Office since 1993. Originally I worked on detection and attribution of climate change to anthropogenic effects culminating in a PhD done jointly at Met Office and University of Reading Meteorology and Applied Statistics departments.

Since 2001 I have worked in the area of Ensemble Climate Prediction using ensembles that explore different choices of climate model input parameters to understand the uncertainty in climate change projections. Since 2006 I headed the team that produced the data underpinning the latest set of climate change projections for the UK published by DEFRA in June this year. For the first time these projections were probabilistic in nature so that a risk-based approach can be used in deciding how to adapt to climate change.

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The role of low-order stochastic climate models

A careful treatment of uncertainty in future climate prediction requires us to take account of our climate models' limitations, typically classified as 'parametric' and 'structural' uncertainty.

Low-order stochastic climate models allow us to have rich specifications of parametric and structural uncertainty, to condition on large amounts of observational data, and provide plentiful opportunities for model criticism. But they require progress on one of the major methodological challenges in dynamical systems: data assimilation with uncertain static parameters.

Recent advances, such as hybrid particle / MCMC methods may provide the answer, especially when implemented in parallel on computer clusters.

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Users' perspectives on UKCP09, the latest set of climate projections for the UK

UKCP09's probabilistic information offers opportunities and challenges towards including uncertainty in developing our understanding of vulnerabilities, impacts and adaptation options in the context of projected climate change.

This presentation will be presented in two parts, dovetailed along with the related presentation by David Sexton and will focus on our current understanding of these opportunities and challenges from the perspective of using the probabilistic and supportive information that UKCP09 offers.

It begins by presenting the rationale behind the decision to take this major step forward of offering users probabilistic projections of climate change and what, from a use perspective has been produced. Following the presentation by David Sexton, this presentation will then provide further details, once again from the perspective of using UKCP09, of the identified opportunities and challenges and of the efforts underway to address these through an evolving set of user directed guidance and support, and by further engagement of the user community.

This tack for the presentation has been taken as it has been recognised that using UKCP09, or any climate information offered to support decision and policy making, to be successful must be part of a continually evolving effort that engages the ever-changing climate and adaptation science communities and the user community.

Roger Strret came to UKCIP in January 2006 after working over 32 years with the Canadian federal government. Much of his work focused on climate, climate impacts and adaptation and involved working with the climate and impacts and adaptation science communities nationally and internationally. As UKCIP Technical Director, Roger leads the Programme's technical and scientific work aimed at guiding impacts and adaptation studies, and at developing and delivering new supportive resources and tools, including UKCP09.

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Rubber statistics – their history and value

The earliest references to (natural) rubber (NR) occur in the accounts of the second voyage of discovery by Christopher Columbus to the New World in 1495-96. However, it was not until the late 18th and early 19th centuries that rubber became used in some applications. The plantation industry for natural rubber started in Malaysia, Indonesia and Thailand, following successful planting by Henry Wickham of seeds from Brazil in the late 19th century. The early development of synthetic rubber (SR) was first seen during World War I, but it was not until the cessation of natural rubber supplies from South East Asia in 1940-41, during World War II, that its production began in earnest.

Due to the long gestation period of a rubber tree (6-7 years and a life of 25-30 years) and to maintain production and to meet future increased demand, a programme of new planting and replanting of rubber trees must be undertaken that allows for the inherent time lag. To plan this, a time series of various historic NR statistics needs to be collected. There is also a similar situation for SR, as a new SR production complex of 50,000 tonnes capacity takes about 4-5 years to plan and build. It should also be noted that, as about 55% of all rubber (natural plus synthetic) is consumed by the tyre industry, it is crucial that demand for both NR and SR is met to satisfactorily maintain the world's road transport system.

The earliest recorded data for natural rubber is to be found in a publication entitled 'India Rubber Journal' (London, UK) in 1823. The beginning of the newly developed plantation industry for rubber in South East Asia in 1880-1900, meant that the recording of data began in earnest. The stabalization schemes in the inter-war years required extensive collection of monthly data records. Thus the major data series for natural rubber can be traced back to 1900 providing an annual time series of over 100 years.

In the case of synthetic rubber, its history with regard to statistics is well-documented, as its production was controlled by governments during World War II and detailed records exist. Since 1944, the International Rubber Study Group, an inter-governmental organization located in Singapore, has been charged with collecting, collating and publishing extensive monthly statistics through its Rubber Statistical Bulletin.

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Post war development of detailed business statistics – the decline and fall of detailed production statistics

Churchill was not the only interested party in good statistics they were an essential part of the overall war effort, especially for regulating the output of the whole of manufacturing industry, not just armament production. The immediate post war period was also one of shortages, rationing and controls. The output of industry was allocated rather than sold and the extensive collection of collection of production statistics including the highly detailed 'k' series survived until the mid 195 0s 'bonfire of controls' under the Macmillan government.

As usual with major changes it went too far and by 1958 Harold was ruefully commenting that planning the economy was rather like planning a railway journey with last years Bradshaw [the timetable bible of the time]. This insight coincided with the rise of marketing planning not only by business, but also by government including in the early 196 0s the setting up of the National Economic Development Office [NEDO] and the formation of the Industrial Marketing Research Association leading to a strong demand for better business statistics.

The election of a Labour Government with a statistician as Prime Minister more than answered the call and the 1966 House if Commons Select Committee report provided a comprehensive review of official statistics. This, under the newly appointed director of the CSO Claus Moser, was followed by a complete re-assessment of business statistics and the setting up of the Business Statistics Office, resulting in a series of statistics that actually met the needs of manufacturing industry. A position that survived until 1979 and the introduction of the Rayner doctrine in 1981 which began the systematic dismantling of the detailed business statistics series.

The final acts were the 1988 Armstrong Rees and the 1989 Pickford reports. There was a 'dead cat' bounce in 1992 following the EU directive on PRODCOM, but effectively the UK remains alone among large western without a short term detailed production series.

This paper will enlarge on the way the business statistics developed from 1939 to 2009 and catalogue the factors preventing their re-emergence as an effective planning aid for British business, in spite of the recommendations of the Treasury Select Committee.

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State figures – review of the 1984 reflections of Claus Moser and John Boreham

In 1984 the RSS organised the recording of a discussion between Claus Moser and John Boreham entitled State Figures. Moser was a Royal Statistical Society Past President, while he and Boreham were the second and third heads of the Central Statistical Office (following Harry Campion) covering the period from 1967 to 1985. The discussion ranges over many topics, from the establishment of the CSO, through to the philosophy of official statistics and the threats that they perceived to statistical system. It also highlights what they saw as their achievements as the CSO head.

This paper looks at this discussion in the light of the present setting for official statistics. I will review how the history of official statistics has now moved on, how the fundamental principles underlying official statistics have remained important, and the boundaries of the statistical system.

Some elements of the original discussion have been encapsulated in the 2007 Statistics and Registration Service Act and its Code of Practice. The conclusion is that many of the fundamentals of 25 years ago are still critical for public trust and confidence in today's official statistics.

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How statistical literacy and official statistics shaped social enquiry in the 19th century

Statistical literacy is important for understanding the world around us and is the cornerstone of evidence-based research. Statistical thinking and statistical reasoning are motivated by real-world problems, which in turn promote the development of new methods of enquiry.

In this talk we see how social enquiry and the collection of official statistics led to the development of statistical methods for social data in the nineteenth century and ultimately contributed to the newly emerging science of statistics of the early twentieth century.

In particular the innovations of social researchers in assessing poverty, deprivation and ill-health are highlighted.

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The Scottish Health Informatics Programme (SHIP): how can electronic patient records support clinical trials?

The Wellcome Trust funded Scottish Health Informatics Programme (SHIP) is an ambitious and innovative multi-disciplinary project, part of which aims to conduct health research using routinely collected electronic patient records (EPRs) and to investigate the extent to which EPRs could support clinical trials.

A key research question is whether the validation of routinely collected data could be extended for more general use as endpoints in clinical trials. EPRs for mortality and hospital admissions in Scotland have already been used to study long-term follow-up in a large clinical trial (Ford et. al, 2007). Historical EPRs have been linked across databases and to clinical trial data by Information Services Division (ISD) of NHS National Services Scotland using probability matching, since a unique identifying number (CHI) has only recently been brought into routine use across databases.

There are, inevitably, errors in historical record linkage using probability matching, due to ascertainment and reporting error, as well as errors in the linkage itself. We have analysed data from two large, long-term clinical trials (WOSCOPS and PROSPER) linked to EPRs in order to compare the rates of matching of important clinical events and endpoints, such as deaths, fatal and non-fatal myocardial infarction, cancers and cancer subtypes.

We have found that the levels of matching are very high, and are likely to improve further with the use of the unique CHI number across databases. This work raises ethical questions about the use of routinely collected data in research, particularly in terms of informed consent and the accuracy of recording of major endpoints and safety data, and these will be discussed.

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The prediction of liver disease diagnosis and all-cause mortality following liver function testing in primary care patients using accelerated failure time models

When a patient presents with raised liver function tests (LFTs) and no clinically obvious liver disease in primary care this can lead to variation in clinical practice. Some patients may have serious liver or non-liver related disease and be under-investigated whilst others with no underlying illness may be over-investigated. This population-based retrospective cohort study followed-up patients from Tayside, Scotland with LFTs initially performed in primary care, with no clinically obvious liver disease, to subsequent diagnosed liver disease or mortality. The aim was to derive and assess models to predict liver disease diagnosis and all-cause mortality that could be used by GPs to aid their decision making.

Record-linkage of databases (regional biochemistry, death registry, SMR01 hospital admissions and the epidemiology of liver disease in Tayside (ELDIT) database), using the Community Health Index number, ascertained risk factors and outcomes. Risk factors included gender, age, deprivation, baseline co-morbidity, hospital diagnosed alcohol and drug dependency, LFTs (Albumin, alkaline phosphatase, bilirubin, GGT and transaminase), and use of statins, NSAIDs and antibiotics. Missing liver function test results were imputed using Markov Chain Monte Carlo (MCMC) multiple imputation. Accelerated failure time (AFT) models were fitted to investigate the effect of the baseline characteristics on time to liver disease diagnosis and all-cause mortality within one year. The best fitting model was chosen using the Akaike's Information Criterion (AIC). Final models were assessed for predictive ability using the C-statistic to test discriminatory ability and the Grønnesby-Borgan method to measure calibration of predicted versus observed events.

An AFT model using the Weibull distribution was derived for liver disease diagnosis prediction. Risk factors for liver disease diagnosis included being female, alcohol dependency, deprivation, methadone, transaminase, alkaline phosphatase, GGT and albumin. All-cause mortality was predicted using a log-logistic AFT model and had many significant risk factors including male gender, age, deprivation, history of cancer, renal disease, stroke, IHD and respiratory disease, use of antibiotics, and all LFTs. Both models had very good discriminatory ability (liver disease model C-statistic=0.77 (95% CI 0.70, 0.83); all-cause mortality C-statistic=0.82 (95% CI 0.80, 0.84)) and calibrated well internally.

This study has successfully developed, internally validated and assessed models that predict the risk of liver disease diagnosis and mortality in primary care patients. Further work involving external validation on other populations within the UK, and transformation into a computer decision support system could result in fewer unnecessary referrals and faster appropriate referrals.

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Informing staffing levels in Scottish care homes using DEA, Linear Regression, CHAID

Critical to the provision of a good quality service to older people in care homes is having the 'right' level of care staff to meet the needs of all the residents. Currently however there is no standard method for determining staffing levels in Scotland, though agreement on staffing is a part of the Registration process.

In this context, the Care Home Staffing Project was instigated. The aim of the project was to investigate if, and how, the dependency characteristics of older people resident in care homes can be used, alongside other information, to better inform consideration of staffing levels of care homes across Scotland.

Using data collected on residents in the participating homes and CHAID (Chi Squared Automatic Interaction Detector) ISD (Information Services Division) has developed a modified version of the IoRN (Indicator of Relative Need), a dependency tool used by Social Work/NHS on older people in the community. The modified IoRN questionnaire uses information about the characteristics of individual residents that should normally be known to care home staff.

Using the staffing information collected from participating homes a model was created by combining the care hours of the homes with the dependency tool data. The model was developed using primarily DEA (Data Envelopment Analysis) and Linear Regression to create a baseline by which all subsequent homes can be compared.

From this an Excel spreadsheet was designed so that each care home could collect the data themselves and then see immediately how the model informs their staffing levels.

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Modelling the impact of a general practice based screening intervention on the economic burden of chronic hepatitis C in Scotland

Background: The Hepatitis C Virus (HCV) is a significant public health risk. In Scotland it is estimated that 50,000 people have been infected with HCV, of which 38,000 are thought to be chronically infected. Approximately 90% of Scotland's HCV infected population contracted their infection via injecting drug use behaviour and a large proportion of this high risk group, the majority having ceased injecting, remains undiagnosed.

In 2006 the Hepatitis C Action Plan for Scotland was launched with one aim being to reduce the proportion of HCV infected individuals who are undiagnosed. The general practice (GP) setting is an ideal location to target former IDUs as they can be identified easily as having a medical history indicative of past injecting drug use.

Aim: To investigate the effectiveness of an opportunistic screening intervention to detect, refer and manage former IDUs chronically infected with HCV in a GP setting.

Methods: An individual-based Markov model was developed which followed a hypothetical cohort of 10,000 former IDUs. The model structure incorporates HCV testing and diagnosis, treatment and disease progression. The model follows a lifelong time horizon where costs and quality of life scores are generated on an annual basis. The impact of two screening approaches is compared to the current approach where no systematic case-finding is implemented. The cost-effectiveness of each screening approach is measured using the Incremental Cost-effectiveness Ratio (ICER).

Results: The model is used to predict the burden of HCV disease, the number of HCV cases diagnosed and the number of individuals who commence HCV antiviral therapy. The results are used to generate direct costs and quality of life scores so that the cost-effectiveness of each screening approach can be assessed. The utility scores and discount rates applied appear to be significant parameters responsible for a lot of the uncertainty in the model.

Conclusions: Screening for HCV in the general practice setting results in a large proportion of the undiagnosed population becoming diagnosed and increases the number of people commencing antiviral therapy each year. The findings from this work will impact current practice in Scotland and will inform the Hepatitis C Action Plan for Scotland.

Keywords: Hepatitis C, Markov Model, cost-effectiveness.

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An introduction to GLAM

This talk is the first of four talks on generalized linear array models or GLAMs and as such it will be introductory.

I will start with smoothing 2-dimensional tables using a Kronecker product basis of B-splines. This leads to a discussion of the scoring algorithm for the generalized linear model (GLM) with such regression matrices. The alternative GLAM algorithms are described and their advantages in terms of computational speed and storage requirements are emphasized.

The rest of the talk consists of a number of examples which show the breadth of possible applications. I will provide no technical detail here and simply describe the data, the GLM and its GLAM equivalent, and the resulting graphical output. Some of the technical detail will be provided in the following talks. Here are some of the examples I will describe.

1. Smoothing mortality tables is the basic example of a GLAM, data from the Human Mortality Database.

2. Additive models for spatially varying microarray background data. Patterns show three components: smooth spatial trend in two dimensions, sudden changes at the boundary of subgrids, and noise. We model these features with an additive GLAM.

3. Density estimation in more than one dimension in many cases fits naturally into the GLAM framework. The Old Faithful data is one example.

4. Joint models of mortality tables. Mortality data from insurance companies can come in two forms: (a) deaths are claims and lives are number of policies, or (b) deaths are amounts of claim and lives are policy amount. A joint model of these two mortality tables can expressed as an additive GLAM.

5. Mortality tables can be subject to external shocks (the Spanish flu epidemic of 1918 is an extreme example). We describe an additive model for a mortality surface: one component is a smooth surface, the other component consists of smooth age dependent shocks for each year. This is a large GLM but it can be expressed as an additive GLAM. The model enables automatic detection of shocks in historical data.

6. Spatio-temporal smoothing: Maria Durban and Dae-Jin Lee.

7. Seasonal models for life table: Paul Eilers

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Seasonal models for life tables

The 'Mortality Detail Files' for the United States are a rich source of data, cross-classified after type of cause of death, gender, age, and time (year and month). Here we study seasonal patterns in deaths caused by respiratory and cerebro-vascular diseases.

Seasonal patterns are evident in these data and it of interest to model the shape of the repeating pattern and how its strength changes over time and age. We assume a modulation model in which a fixed waveform is modulated by a surface that changes smoothly with time and age. The surface is modelled by tensor-product P-splines.

The seasonal pattern can be described by a combination of sine and cosine curves, by an arbitrary series of monthly values (to be estimated from the data), or by a combination of both. The model describes the logarithm of the expected value of over-dispersed (wrt the Poisson distribution) counts. In the spirit of generalized linear models we use penalized quasi-likelihood to estimate the components of our model.

We are dealing with large data tables and the use of array algorithms (GLAM) speeds up the computation by an order of magnitude.

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Space-time modelling of air pollution with array methods

In recent years spatio-temporal modelling has become a challenging area of research in many fields (epidemiology, environmental studies, disease mapping). However, most of the models developed are constrained by the large amount of data available. Smoothing methods present very attractive and flexible modelling tools for this type of data set.

In the context of environmental studies, where data often present a strong seasonal trend, the size of the regression basis needed to capture the temporal trend is large and, as a consequence, the estimation of the spatio-temporal interaction is computationally intensive.

We propose the use of Penalized Splines as mixed models for smoothing spatio-temporal data. The array properties of the regression bases allow us to fit Smooth-ANOVA-type models, imposing identifiability constraints over the coefficients. These models are fitted taking advantage of the array structure of the space-time interaction and the use of the GLAM algorithms. In addition, we propose the use of smaller B-spline bases for the interaction terms.

These basis functions are easily calculated by using an appropriate number of knots, and have two main advantages: (i) they preserve the hierarchical nature of the models and (ii) reduce the total number of parameters fitted. We illustrate the methodology with the analysis of real environmental problems.

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Mixed models are very popular and widely available in standard software, this is one of the reasons why penalized splines as mixed models have become a common approach in the smoothing context. They provide a unified approach for fitting a large class of complex models (random effects, correlated data, longitudinal analysis, etc.), and standard techniques may be used for estimation and inference.

The extension to two or more dimensions has been a subject of study in recent years, however, the development of this methodology has encounter two main drawbacks: 1) the size of the matrices used in the regression basis leads to heavy computation, and 2) the identifiability constrains needed in a multidimensional additive setting are not easy to implement.

We present a re-parametrization of multidimensional p-splines as mixed models based on the singular value decomposition of the penalty matrix. This representation allows the fit of main smooth terms and interactions avoiding identifiability problems. Array algorithms are adapted to speed up the estimation of fixed and random effects, and the smoothing parameters used in the model.

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Costationarity and stationarity tests for locally stationary time series with application to stock index returns

In this presentation we introduce the novel concept of costationarity. Given two (or more) locally stationary time series we introduce a method to discover, possibly time-varying, linear combinations that are stationary (costationary series). The existence of costationarity between time series implies an interesting and interpretable relationship between the series.

We exhibit and interpret this relation for the FTSE and SP500 series. Initially we present a new analysis of the FTSE and SP500 stock index log return series and provide evidence that they are not stationary. We then discover two time-varying linear combinations of the FTSE and SP500 series that are stationary and hence declare the two series to be costationary. The stationary combinations are themselves worthy of study using classical time series methods.

To determine costationarity we develop a new bootstrap stationarity test and demonstrate uniform consistency for the power function and good empirical performances. Our method searches for the simplest time-varying linear combination of two (or more) series that results in a stationary series. Additionally, we introduce direct methods for estimating the evolutionary cross-spectrum and cross-covariance of locally stationary wavelet processes.

For costationary series a formula exists that permits the time-varying cross-covariance to be estimated indirectly in terms of the induced stationary series variance and each series' time-varying variance. For the FTSE and SP500 series we show that our indirect estimate(s) compare favorably to the direct estimate and that this provides a partial validation of our costationary determination.

Costationary series possess a `variance-correction' interpretation where series `self-correct' if their current linear combination is to maintain stationarity. This is akin to the `error-correction' model in cointegration theory. We show that this implies bounds on the time-varying cross-covariance of our series and we show that these are obeyed by the FTSE and SP500 series.

Overall, our methodology enables the discovery of new potential, interpretable, relationships between locally stationary series. We provide a practical example where our methodology is applied to a portfolio selection problem. In addition, our approach provides tools to study important quantities such as localized cross-spectra and cross-covariances. Our methodology is applicable to both locally stationary Fourier and wavelet processes.

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Joint estimation of common and specific factors in Nonstationary Dynamic Factor Analysis

In this work the Nonstationary Dynamic Factor Analysis (Peña and Poncela (2004, 2006)) and Alonso et al. (2008)) is extended to the case in which the specific factors present a dynamic structure. In practice, once the common factors that follow a VARIMA model have been extracted, the specific factors are not white noise, they present a dependence structure and an autoregressive model must be fitted (Ortega and Poncela (2005)).

They provide a two-step procedure: the first one in which all the parameters of the model are estimated as well as the common factors are extracted and the second in which the AR models for the specific components estimated using estimated common factors and loads.

In this work we provide the joint estimation of common and specific components as well as the improvements obtained in terms of estimation and point forecasts and forecasting intervals, in comparison to the two-step estimation (). The joint estimation procedure developed is applied to compute forecasts of electricity prices in deregulated power markets.

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Experimenting with modelling default of small and medium sized enterprises (SMEs)

In many western economies Small and Medium Sized Enterprises account for up to 50% of GDP. They can therefore be critical to a nation's success. Given their importance it is surprising that until recently there has been limited research into SMEs credit risk assessment.

In this paper the authors will explore default for a dataset of listed SMEs. For companies generally there are two approaches to modelling default, one based on market data using a Merton-type model and the other regression models based on accounting information.

This paper examines the performance of both these approaches for modelling default in SMEs. Rather than using the traditional binary definition of survival and default the paper considers four categories: default, financial distress type I, financial distress type II and healthy of SMEs. It develops the accounting based models by using standard credit scoring approaches to move away from solely linear modelling.

The regression models considered are logistic, survival and ordinal regression. The performance of the models is measured and implications for good prediction are investigated.

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Bayesian inference for stochastic epidemic models with non-exponential tolerance to infection

The transmission dynamics of an infectious disease during the outbreak of an epidemic have been traditionally described through a time-inhomogeneous Poisson process, thus assuming exponentially distributed levels of disease tolerance following the so-called Sellke (1983) construction. This has been mathematically convenient, but recent advances in statistical methodology allow generalisations of the Sellke structure.

In this talk I will present such generalisations under the susceptible-exposed-infectious-removed (SEIR) class of epidemic models, and focus on a model with Weibull individual tolerance thresholds. Examples of simulated and real epidemic data are discussed, where inference is carried out using MCMC methods following a Bayesian approach to tackle the issue of the partial observation of the temporal course of the epidemic.

The adequacy of the models is assessed using methodology based on the properties of Bayesian latent residuals, demonstrating the limitations of more commonly used model checking techniques.

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Prior influence plots

The Bayesian paradigm offers the opportunity to integrate prior knowledge with the information content of new data. However, with the more widespread usage of Bayesian methods since the advent of MCMC, many users of Bayesian inference do not wish to impute subjective information into an analysis. Whilst avoiding an element of subjectivity can not be achieved globally, it should be possible at least approximately for univariate unknowns (model parameters, expected values of predictions).

In this paper / poster, we discuss some diagnostic plots that can be used to assess the influence of prior specifications on univariate unknowns. These are based around the simple ideas of plotting unknowns against each other and against corresponding values of prior pdfs.

Such plots allow informal assessment of the degree of influence of prior specifications on unknowns of interest, both those for which they are designed to be uninformative and those for which they may turn out to be informative by accident rather than by design.

An important feature of our approach is that it can be used after a single MCMC run and so is relatively computationally inexpensive. We shall illustrate the method through application to some simple examples.

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Bayesian estimation with optimal quantising of data

Quantisation, as method of approximating a continuous range of values by a discrete set, arises in many practical situations which include modern methods of digital information processing, data compression, and some procedures of collecting data.

In particular, quantising is a fundamental element of signal processing, which necessarily involves roundoff of input data, and plays an important role in image processing as a lossy compression technique. On the other hand, quantising replaces the original sample by multidimensional discrete vector and can be viewed as a problem of high-dimensional data analysis.

In this work the effect of quantized data upon Bayesian parameter estimation is investigated. It is well known that quantising of observations reduces value of information contained in data. This information loss can be diminished by selecting the optimal partition.

I consider two criteria of optimal quantisation in Bayesian estimation: the criterion of Bayes risk minimum and the criterion of minimum of information loss measured using Shannon information. As alternative to optimal partitioning, which realisation is often computationally demanding, an asymptotically optimal quantisation is also considered

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You can run but you cannot hide: data analysis and decision-making in a resource limited healthcare system.

The desire to obtain the maximum benefit from available health budgets has led to the advent of bodies such as Pharmaceutical Benefits Advisory Committee (PBAC) in Australia, (Canadian Agency for Drugs and Technologies in Health (CADTH) in Canada, the National Institute for Health and Clinical Excellence (NICE) in the United Kingdom and the Scottish Medicines Consortium (SMC) in Scotland. These make recommendations regarding the re-imbursement of healthcare technologies based on an assessment of their clinical and cost-effectiveness.

These assessments require comparable estimates of the cost and effects associated with relevant treatment options over a sufficient time horizon. These assessments are based on data from clinical trials designed primarily to fulfil regulatory requirements. A variety of extrapolations are often required to inform re-imbursement decision-making. For example, it may be necessary to extrapolate beyond the trial lifetime, from surrogate endpoints to final decision endpoints, and beyond the trial comparisons.

We will discuss the various statistical techniques used in these extrapolations, the focus on estimation rather than inference, and how the uncertainty is considered in decision-making. In particular we will discuss the implications for clinical trial design, the choice of endpoints and inclusion and exclusion criteria. It is important that statisticians working in clinical development have an appreciation of the requirements of health technology assessment to ensure patients are not denied access to cost-effective treatments due to a lack of appropriate evidence.

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Classification and phase-type modelling of patient emergency admissions in hospital

Previous research has modelled patient waiting times in hospital using a Conditional phase-type distribution (C-Ph). The C-Ph model incorporates the methods of survival analysis with Bayesian networks where the skewed survival time is conditioned on a network of patient characteristics known on admission to hospital.

This paper expands upon this technique to form a family of Discrete Conditional Phase-type (DC-Ph) models of which the C-Ph is a member. The first component of the model is a classification method used to predict the likely outcome of the patient whose waiting time is then modeled according to their outcome using a Coxian phase-type distribution.

The flow of patients through a hospital system is prone to long delays possible at any stage from the start of the process when patients await assessment from a medical consultant right through to the discharge mechanism when patients may experience delays in leaving hospital. Delayed discharges prevent patients leaving the hospital when they are fit to do, but instead leads to bed blocking making the current beds unavailable for newly arriving patients.

The UK National Health Service (NHS) focused a major drive on the delayed discharges followed more recently, by a focus on the delays in the admission process. In particular, the long waiting times in Northern Ireland’s Accident & Emergency (A&E) departments are being addressed by new targets introduced by the NHS with the focus on reducing the total time spent waiting from arrival until departure.

This paper applies the DC-Ph models to waiting times in the Accident and Emergency Department of a local Northern Ireland hospital.

Jim Cuthbert , and Margaret Cuthbert
Public Information Research Network at Strathclyde University

Do official statistics provide an adequate basis for the debate about the UK economy?

How adequately was Britain served by its official statistics in the run up to the current economic crisis? Should it have been clearer that the economy was running into danger, and that the public finances were not as soundly based as might have appeared?

This talk does not attempt an overview of the whole of official statistics. What it does is to use three examples, (the Private Finance Initiative, utility pricing, and the funding of the UK current account deficit), to illustrate how official statistics provide a quite inadequate, and in some respects, highly misleading, picture of important aspects of the UK economy.

But there are general lessons to be learned from these examples. The key underlying problem has been a failure of official statistics to adapt fast enough to a rapidly changing world – and, in particular, to adapt adequately to the blurring of the distinction between the public and private sectors.

A fuller version of this presentation will be available on the website www.cuthbert1.pwp.blueyonder.co.uk.

Jim Cuthbert is an independent statistician, and a member of the Public Information Research Network at Strathclyde University: he has been formerly an academic, Chief Statistician at the Scottish Office, and a business consultant.

Do official statistics provide an adequate basis for debate about Scottish independence

It is ten years on from Scottish devolution, and an appropriate time to consider the question of whether official statistics provide an adequate basis either for the debate on changes to the devolution settlement or for the debate about Scottish independence. We argue that there are important deficiencies in official statistics, which seriously hinder, and indeed, distort, the debate about further changes to devolution in the UK, and about Scottish independence.

(Note that this is not a talk about Scottish independence: that is a political issue, which official statistics can inform, but not settle.)

The subjects covered in the talk include:-

- -The requirement to expand Government Expenditure and Revenue on Scotland (GERS) towards a full system of national accounts
- The interface between devolved and reserved expenditure and how adequate the Treasury's Public Expenditure Statistical Analysis is in allocating expenditures.

A fuller version of this presentation will be available on our website: www.cuthbert1.pwp.blueyonder.co.uk

Margaret Cuthbert is an independent economist, a member of the Public Information Research Network at Strathclyde University, a former lecturer, and a business consultant.

Jill Leyland
RSS Vice-President and Chair of the National Statistics Working Group

Improving Official Statistics – what the RSS is doing

Fellows of the Royal Statistical Society have one hundred and seventy five years experience of highlighting issues with statistical outputs from governments. Over recent years the society has concentrated its efforts on getting the legislative framework for National Statistics in place, and encouraging greater user engagement by official statisticians so that their outputs can meet the needs of the public as well as government.

We will discuss the current work of the RSS through the National Statistics Working Party and the Statistics User Forum and the concerns they have in common with the GSS and the UK Statistics Authority to improve public trust in official statistics.

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How useful is a reminder system in collection of follow-up quality of life data in clinical trials?

Background: Quality of life (QoL) measures are increasingly being used as an important outcome when comparing treatment alternatives in randomised controlled trials. Missing data can be a problem for any outcome but are particularly prominent for QoL, as the reason why the data are missing is likely to be related to the QoL itself. Ignoring this could lead to biased results and ultimately impact on clinical practice. Postal questionnaires are often used to collect this data and a reminder system is implemented to improve the response rate.

Objective: To determine whether the reminder system is helpful in obtaining the least biased estimate of treatment difference.

Methods: Several trial datasets were obtained where QoL (generic and disease-specific) was collected through postal questionnaires. Using the reminder responses the missing data mechanism, suitable imputation methods and alternative model-based strategies were explored. Reminder responses were excluded and the accuracy of different strategies determined.

Results: In one trial the initial response rate was 38% increasing to 89% when the reminder-responses were included. A second study had initial response rate of 51% increasing to 64% with reminders. Using the example trials different strategies to deal with the missing data were found to affect the trial conclusions as the result of the significance test changed. For example in the second trial (N=5292) a complete-case analysis of all observed responses (N=2879) produced p= 0.05 while using only immediate responses (N=1919) gave p=0.16 and repeated measures (N=3906) was p=0.02.

Conclusion: Without the reminder system a poor response rate would have occurred potentially leading to a biased result. Using reminders minimizes the amount of missing data and reduces the threat of bias. Data collected by reminders enables a more informed selection of imputation methods which reduces the risk of bias. There is no single way of dealing with missing QoL data that is applicable in all situations, but the approaches developed in this study inform a strategy to deal with the problem of missing QoL outcomes.

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Analysing the rate of change in a longitudinal study with missing data, taking into account the number of contact attempts

In longitudinal and multivariate settings incomplete data, due to missed visits, dropouts or not-return of questionnaires are quite common. The impact of missingness on the analysis and different models for the missingness process must be carefully discussed.

A longitudinal trial in which (informative) missingness occurs is the Collaborative Ankle Support Trial (CAST). The aim of this study is to estimate the clinical effectiveness of four different methods of mechanical support after severe ankle sprain. The clinical status of multiple subjects was measured at four points in time via a questionnaire and, based on this, a normalised and bounded outcome score was calculated.

Commonly used models for the analysis of longitudinal data, such as marginal models and random effect models, would lead to a generalization of a linear model and concentrate on the modelling of the overall mean. However, our score is bounded and we are particularly interested in the rate of improvement. Therefore, we will present non-linear mixed models which enable us to analyze the rate of improvement including the dependence on explanatory variables.

This non-linear mixed model is derived under the assumption that the rate of improvement in a given time interval is proportional to the current score and the still achievable score. Based on this assumption a differential equation is solved in order to obtain the model of interest.

Using this model the impact of missingness on the rate of improvement is evaluated, taking into account different missingness processes and the number of reminders needed to retrieve a questionnaire. The performance of several analysis methods is assessed for the CAST data set.

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Modelling health scores with the multivariate skew normal

Health care interventions which use quality of life or health scores often provide data which are skewed and bounded. The scores are typically formed by adding up responses to a number of questions. Different questions might have different weights, but the score will be bounded, and might be scaled to the range 0 to 100.

If improvement in health over time is measured, scores will tend to cluster near the 'healthy' or 'good' boundary as time progresses, leading to a skew distribution. Further, some patients will drop out as time progresses, so the scores reflect a selected population.

We fit multivariate skew normal distributions to data from a randomised controlled trial of four treatments for sprained ankles, in which scores were recorded at baseline and 1, 3 and 9 months. In these data, the scores at 3 and 9 months have skew marginal distributions, but the variance is similar across the four times points.

We consider the extent to which variance and skewness can be explained by covariates including treatment and age. In order to address the effect of clustering at the boundary, we consider censored multivariate normal and skew model. The extended skew normal is used to model the selection due to drop-out.

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Sensitivity of inferences in forensic genetics to assumptions about founding genes

Many forensic genetics problems can be handled using structured systems of discrete variables, for which Bayesian networks offer an appealing practical modelling framework, and allow inferences to be computed by probability propagation methods.

However, when standard assumptions are violated – for example when allele frequencies are unknown, there is identity by descent or the population is heterogeneous – dependence is generated among founding genes, that makes exact calculation of conditional probabilities by propagation methods less straightforward.

Here we illustrate different methodologies for assessing sensitivity to assumptions about founders in forensic genetics problems. These include constrained steepest descent, linear fractional programming and representing dependence by structure. We illustrate these methods on several forensic genetics examples involving criminal identification, simple and complex disputed paternity and DNA mixtures.

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Simultaneously testing means and variances from paired-samples

This talk considers the problem of testing $\mu I = \mu 2$ and σ^2_1 using a random sample from a bivariate normal distribution with p.1.rameters (11[,112,17i,17~,p). The new contribution is a decomposition of the Bradley-Blackwood test statistic for the simultaneous test of {Ill = *Il2,17i* = 17n as a sum of two statistics.

One is equivalent to the Pitman-I\Iorgan test statistic for 17i = 17~ and the other one is a new altefllative to the standard paired-t test of *Ilv* = *Ilt* - *Il2* = O. Surprisingly, the classic Student paired-t test makes no assumptions about the equality (or otherwise) of the variance parameters.

The power functions for these tests are quite easy to derive, and show that when17i =17~, the

p.1.ired t-test has a slight advantage over the new alternative in terms of power, but when di t=~, the new test has substantially higher power than the paired-t test.

While Bradley and Blackwood provide a test on the joint hypothesis of equal means and equal variances their regression based approach does not sep.1.rate these two issues.

The rejection of the joint hypothesis may be due to two groups with unequal means and unequal variances; unequal means and equal variances, or equal means and unequal variances. We propose an approach for resolving this (model selection) problem in a manner controlling the magnitudes of the relevant type I error probabilities.

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Rumours and epidemics on random networks

The Susceptible-Infected-Removed (SIR) epidemic model is a fundamental model for the spread of infection in a homogeneously-mixing population. It is a special case of a more general rumour model in which there is an extra interaction.

Thus, not only does an ignorant (susceptible) contacted by a spreader (infective) become a spreader, and spreaders may "forget" the rumour and become stiflers (removals), but also spreaders may become stiflers if they attempt to spread the rumour to a spreader or stifler (who will have already heard it).

For both epidemics and rumours, there is particular interest in using a random network to represent population structure, with applications to the spread of infection or information on social networks. The talk will discuss a) the effect of the population size on thresholds for epidemic/rumour spread, and b) the effect of different network structures.

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Estimating the force of infection of chickenpox in young children in the UK

The introduction of varicella mass vaccination in 1996 in the USA has generated an intense debate in various countries, including the UK, regarding its cost effectiveness and impact on infection control.

Past work has been focused on a range of vaccination scenarios that could be used to model the effects that boosting specific immunity to varicella zoster virus (VZV) in young children may have on later development of shingles. A crucial aspect of VZV epidemiology concerns the changes in the force of infection across age and social groups; analyses of these variations may inform public health policies designed to target susceptible groups.

In the UK there have been very few epidemiological studies looking at the force of infection of VZV in young children adjusting by population structure. We analyse data from the Millennium Cohort Study concerning maternal report of varicella experienced by children up to the age of five and discuss models for age-specific force of infection based on disease prevalence adjusted for heterogeneities in the population structure.

A Bayesian framework for statistical inference is adopted; this coherently embeds the missing information resulting from incomplete maternal declarations regarding their child's chickenpox acquisition.

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Small worlds and giant epidemics

Key problems for models of disease spread relate to threshold, velocity of spread, final size and control. All of these depend crucially on the network structure of individual interactions.

Networks of interest range from the extreme spatial case, where typically the population is evenly distributed on a lattice with interactions only between nearest neighbours, to the homogeneously mixing (or `mean-field') extreme, where all interact equally with all. Intermediate cases of practical interest include `small-world' and metapopulation models.

I shall discuss the various structures of such models, their similarities and differences, and some approximations to them. The main aim is to identify what features of contact structure need to be captured when formulating a model for any specific problem of disease spread.

Draft of talk: http://www.ma.hw.ac.uk/~denis/talk.pdf

References: http://www.ma.hw.ac.uk/~denis/epi.html

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Measuring health inequalities by an approach unaffected by the overall prevalence of the outcomes at issue

Over the last three decades considerable resources have been devoted to the study of demographic inequalities in health and healthcare in the United Kingdom and elsewhere. The principal conclusion of such research, as most recently expressed in a report of the Health Committee of the House of Commons, is that while health has improved for all socioeconomic groups, health inequalities have been increasing.

All health inequalities research, however, has been crucially flawed by the failure to recognize the ways measures of differences between rates of experiencing favourable or unfavourable outcomes are affected by the overall prevalence of an outcome. The most notable of these tendencies is that, the rarer the outcome, the greater tends to be the relative differences between rates of experiencing the outcome and smaller tends to the relative difference in avoiding it.

Absolute differences and odds ratios also tend to be systematically affected by the overall prevalence of an outcome, though in a more complicated way. Viewed in terms of favourable outcomes, like receipt appropriate healthcare or favourable health out comes, as uncommon outcomes become more common, absolute between rates will tend to increase until a point beyond which 50 percent of the advantaged group experiences the outcome. Thereafter, further increases in the outcome will tend to decrease absolute differences between rates.

Differences measured by odds ratios tend to change in the opposite direction of absolute differences. Differences between life expectancies, whether measured in relative or absolute terms, also tend to change solely as a result of overall changes in life expectancy rates, though in less systematic ways than the other measures.

This presentation would illustrate these tendencies with actual and hypothetical data and explain the problems such patterns create for the interpretation of the size of health inequalities in different settings, including at different points in time. The presentation would then explain a method for measuring differences between rates of experiencing health and healthcare outcomes, as well as outcome in other settings, and apply that method to recently cited data on health inequalities in the United Kingdom

Poster presentations

POSTER

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On some variation of goodness of fit test

Many works have been carried out to compare the efficiency of several goodness of fit procedures for identifying whether or not a particular distribution could adequately explain a data set.

In this paper a study is conducted to investigate the power of several goodness of fit tests such as Kolmogorov Smirnov (KS), Anderson-Darling(AD), Cramer- von- Mises (CV) and a proposed modification of Kolmogorov-Smirnov goodness of fit test which incorporates a variance stabilizing transformation (FKS).

The performance of these selected tests are studied under simple random sampling (SRS) and Ranked Set Sampling (RSS).

Keywords—empirical distribution function, goodness-of-fit test, order statistics, ranked set sampling

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Statistics in Islamic Scriptures

Statistics has been used in modern religious studies for fairly long time. Among the areas where statistics has been applied are: authorship studies (determining authorship of some ancient books); studying various religious movements from sociological and historical perspectives; and presence of statistical and probabilistic notions in religious writings and how such notions have been used in theological inquiries.

There are a good number of such studies applied to Torah and Talmudic writing of Judaism and Biblical writings, especially New Testament, of Christianity. However, there does not seem to be any such studies focused on Islamic scriptures, viz. the Qur'an and Hadith (the narration of the Prophet of Islam). Such a study is relevant not just as a matter of historical curiosity, but also because there are modern attempts by Muslims to bring their Islamic perspective to social and behavioral sciences.

Based on the Arabic lexicons and scriptural hermeneutics from the Qur'an and Hadith, this paper explores the Islamic perspective on statistics and how it may have evolved within the Islamic discourses. The authors find that the Islamic understanding of statistics may be even closer to the contemporary definition of statistics.

POSTER

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Accounting for better survival of screen-detected cancers, taking into account lead time bias

It has been well documented that screen-detected breast cancers have better survival compared to symptomatic tumours. However, there are a number of well-know biases associated with this. One of these is lead time bias.

Lead time is the time by which the diagnosis of a malignancy is advanced due to being diagnosed early by screening. This confers an artificial survival advantage to screen-detected cases. We have developed a method of adjusting estimated survival for lead time.

This study aims to find the combination of relevant variables and lead time that will account for the better survival of screen-detected breast cancers. Using information collected in the West Midlands Screening Histories project, we first estimate the effect of screen detection as compared to symptomatic diagnosis on survival unadjusted, thereafter corrected for lead time, and finally for the prognostic variables such as tumour size via which the screening effect on mortality is already known to be partially mediated.

The aim is to quantify any remaining survival advantage of screen detected tumours which may indicate the existence and size of any screening effect confined to tumours of specific biological types.

POSTER

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"You mean your statistics are facts, but my facts are just statistics"(1)

As statisticians we work with numbers, but we have to communicate in words. This poster takes a series of statistically related quotes, and using these alone, broadly summarises the case for and against statistics.

These quotes blend the profound with the popular, and the modern with the historical. This includes politicians and prime ministers such as Churchill, Asquith and Kissinger, philosophers like Nietzsche, and writers such as HG Wells, Lewis Carol, T.S Elliot. Added to the mix are some interesting others like Charles Babbage, Stalin, Florence Nightingale, Henry Ford, Galileo, Einstein, St Thomas Aquinas and even Sherlock Holmes.

We are so often using words to describe our statistics, whether analytically or methodologically, but can these series of quoted words capture the real essence of our world of statistics?

For extra interest, there will be 5 quotes for readers to match the quote with it's owner. Answers provided but with a statistical twist.

(1) Yes Prime Minister, BBC. Paul Eddington to Nigel Hawthorn.

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Towards the improvement of 2D coordinates transformation techniques between UTM and ETM

Most of the engineering projects in Egypt are required to be tied with the Egyptian Transverse Mercator (ETM) coordinate system, whose geodetic datum is Helmert 1906. So, the control points of such projects should be established in the ETM coordinate system, in order to position all features of the considered project in the same coordinate system too.

On the other hand, if the involved control points of such projects are positioned using GPS, their coordinates will be resulted according to the international coordinate system called Universal Transverse Mercator (UTM). So, a transformation for these coordinates should be done in order to get the corresponding ETM coordinates.

The transformation between UTM and ETM can be performed in two approaches called 3D and 2D approaches. The 3D approach is based on the estimation of the transformation parameters between the WGS-84 and Helmert 1906 datums.

This approach is faced with the problem of finding out reliable values of the transformation parameters due to the existing distortions in the national Egyptian geodetic network. On the other hand, the 2D approach is based on the direct transformation between UTM and ETM coordinates. This approach is mathematically simpler, especially for non-specialist GPS users. So, it is of great importance to evaluate its accuracy to be compared with the most used 3D approach.

In this research, the most five famous 2D transformation models were applied on a network covering Great Cairo city and its vicinity. The results are compared with the 3D transformed coordinates, which are the base for assessment. Results proved that the surface polynomial technique is the closest one to the 3D approach.

However, the obtained discrepancies are found relatively large. Consequently, another technique was introduced that is dependent on line-based algorithm instead of point-based algorithm. This technique was applied three times for the similarity, affine and projective transformation models. Results showed that an increase of about twice the accuracy can be obtained when applying such technique.

At this stage, a new approach was thought to improve the obtained accuracy of the line-based transformation. This approach is based on the formulation of a mathematical expression for the relative scale factor between the UTM and ETM. Then, this scale equation is merged with the line-based transformation equation to get the 2D coordinates of check points, using least squares principles.

This technique increases the accuracy of the line based transformation with about 85% in the computed lengths of some check lines.

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One-stage parametric meta-analysis of time-to-event outcomes

We consider individual patient data meta-analysis of survival data. With this type of data, the most common approach is to make a proportional hazards (PH) assumption, and to use the hazard ratio as a measure of treatment effect.

We propose an alternative, non-PH approach, where the measure of treatment effect is taken to be a ratio of percentiles, typically of the treatment group to the control group, which we call the percentile ratio. The percentile ratio is well-defined, regardless of any distributional assumptions we may make about the data. In general the percentile ratio may vary across percentiles. It is therefore most naturally adopted in conjunction with accelerated failure time (AFT) models, for which it is constant across percentiles.

In particular we propose using the extended log-gamma model, which is a three-parameter AFT model incorporating several of the most-commonly used AFT models. We illustrate our methods using a data-set taken from a meta-analysis investigating the use of chemotherapy in patients with high-grade glioma.

POSTER

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An empirical Bayes approach for estimating the size of an elusive population

In this note we suggest a smoothed generalization of Zelterman's estimator of the size of an elusive population. This estimator is often used to adjust for undercount in registration lists. The latter is defined as the Horvitz-Thompson estimator

$$\hat{N} = \sum_{i=1}^{N} \delta_i / p_i$$

where $\hat{N}$ is the population size estimator of *N*, and δ_i is the indicator for the i-th unit being identified, p_i is the probability for the i-th unit being sampled. The Zelterman estimator $\hat{N} = n/(1-\exp(-\lambda))$ is achieved using a constant Poisson probability $p_i = 1-\exp(-\lambda)$ and it is suggested to estimate the Poisson parameter λ using $2f_2 / f_1$, where f_i is the frequency of units identified exactly *i* times. The estimator suffers under the fact that all units have the same identification probability attached and it seems desirable to allow an estimator

$$\hat{N} = \sum_{i=1}^{m} f_i /[1-\exp(-\lambda_i)]$$

which allows for different probabilities of inclusion $p_i = 1-\exp(-\lambda_i)$ conditional upon the number *i* of repeated identifications. The crucial question is how λ_i can be estimated. We suggest using an empirical Bayes estimator on the basis of the equation

$$E(\lambda \mid i) = (i+1)m(i+1)/m(i)$$

where $m(i) = \int_0^\infty \exp(-\lambda)\lambda^i / i!\, p(\lambda) d\lambda$ is the marginal distribution w.r.t. prior $p(\lambda)$. Using the idea of Robins (1955) one can achieve an estimator of *m(i)* without any knowledge of the pior *p(.)* by replacing *m(i)* by their empirical relative frequency $\hat{m}(i) = f_i / N$. Note that the unknown size *N* cancels out when taking ratios so that the suggested estimator is

$$\hat{N} = f_m + \sum_{i=1}^{m-1} f_i /[1-\exp(-\frac{(i+1) f_{i+1}}{f_i})].$$

Various choices for estimating the prior distribution including a parametric choice of the Gamma distribution as well as various non-parametric choices are possible. A simulation study compares these and provides some recommendations.

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Effect of changes in the distribution of maternal age and parity on the rate of preterm birth

The increased risk of adverse reproductive outcomes with increasing maternal age is of particular interest as the age at which women are having children continues to increase. An analysis of routinely collected data on Scottish births between 1980 and 2003 shows a steady three-fold rise in the percentage of women aged 35 or over having children from 5.9% in 1980-84 to 16.7% in 2000-03.

The proportion of live singleton preterm births in the same period has risen from 5.2% to 6.2%. In order to determine how much of this increase in preterm birth can be attributed to changes in the maternal age and parity distributions over the years, the change in the preterm birth rate was split into two parts using a method described in a paper by Yang et al1. This determined the change in rate which can be attributed to the changes in the maternal age-parity distribution and that associated with changes in the preterm rates within specific maternal-age and parity groups. The latter is therefore measuring how much of the change is explained by factors other than the increase in the age of mothers, for example changes in obstetric practice.

The results indicated that the increase in preterm births is largely due to differences in rates within the maternal age-parity groupings and is not explained by the increase in maternal age. The same method was also applied within each of the five deprivation categories. This suggested a greater percentage of the change in the preterm rate could be attributed to changes in maternal age-parity distribution as the level of deprivation increased.

Identifying the source of the change has important implications for policy and this method of decomposition gives an insight into these changes in rates. The preterm rate was also modeled using logistic regression which indicated a trend towards a reduction in risk for both younger and older mothers. This risk reduction was particularly marked in the older mothers whose risk seems to have been reduced to a similar level to mothers in the middle of the age range.

1. Association of maternal-age and parity-related factors with trends in low-birthweight rates: United States, 1980 through 2000. Yang, Greenland and Flanders. American Journal of Public Health, 2006, 96,5 pg 856-861

POSTER

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Modulation models for digit preference

A two-dimensional generalization of a penalized composite link model is presented to model latent distributions with digit preference, where the strength of the misreporting pattern can vary over time, and among groups.

A general preference pattern is superimposed on a series of smooth latent densities, and this pattern is modulated for each measurement occasion. Smoothness of the latent distributions is enforced by a difference penalty on neighbouring coefficients.

An L1-ridge regression is used for the common misreporting pattern, and an additional weighted least-squares regression extracts the modulating vector. The BIC was used to optimize the smoothing parameters.

We present a simulation study and several applications for demonstrating the performance of our model and its practical characteristics.

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MortalitySmooth: An R package to smooth Poisson counts with P-splines.

Mortality developments over years or over ages normally show regular patterns and, therefore, smoothing approaches are a natural choice to analyze mortality changes.

The package MortalitySmooth provides a framework for smoothing mortality data in both one- and two-dimensional settings. The total number of deaths over a specified age- and year-interval is assumed to be Poisson-distributed and P-splines are employed as a suitable regression methodology. The one-dimensional smoothing follows the approach outlined by Eilers and Marx (1996), whereas the two-dimensional smoothing is viewed as a Generalized Linear Array Model (Currie et al., 2006).

Though general in its purposes, the package is specifically tailored to demographers and actuaries who intend to use a practical, albeit appropriate tool for smoothing mortality data over ages and/or years. To employ the tools, users just need to supply the series of ages and/or years, deaths and exposures. The package offers various criteria for an optimal selection of the required smoothing parameter(s) and model specifications can be controlled by specific arguments.

Structured in an S3-OOP system, MortalitySmooth has two main functions which fit the data and define two classes of objects: Mort1Dsmooth and Mort2Dsmooth. Methods for such classes (print, summary, plot, predict and residuals) are also included. This helps the users to easily extract and manipulate the outcomes. Furthermore, a collection of mortality data and a specific function for selecting those data by country, sex, age and years is provided.

The poster gives an overview of the main design aims and principles as well as strategies for applications and further extensions.

POSTER

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Prevalence, social determinants and mortality of dementia cases and subcases in people with high levels of absolute poverty but low levels of cardiovascular risk and depression

Background The effects of social determinants of health on dementia remain controversial. Little is known about the risk and outcome of dementia cases and subcases in people with high levels of absolute poverty but low levels of cardiovascular risk and depression.

Aims: To determine prevalence, socio-economic factors and mortality of dementia cases and subcases in such a population.

Methods: 1567 participants aged ≥ 65 years in urban and rural China were examined using the Geriatric Mental State interview and recorded risk factors. 5-years all-cause mortality was analysed.

Results: Age-standardised prevalence for dementia was 3.05% (95%CI 2.08%-4.02%) and for its subcases was 10.0% (8.38%-11.6%). Dementia cases and subcases were significantly related to older age, shorter height, larger waist circumference at Action Level 2, and lower socio-economic status (SES).

Compared with those having middle income and high educational level, elderly having high income but lower education or high occupational class had the highest risk of dementia; multiple adjusted odds ratio were 6.70 (95%CI 3.56-12.6) and 6.94 (4.19-11.5) respectively. Mortality increased in dementia cases (multiple adjusted hazards ratio 1.98, 1.14-3.44), but not in subcases. There were no significant differences in increased dementia mortality between low and high SES groups, while mortality in subcases seems to be higher in low SES group.

Conclusions: The prevalence of dementia in China may be lower than that in the West, which requires further investigation. But increased risk of dementia subcases in relation to SES suggested a potential epidemic and burden of dementia in transitional countries. More care is needed for dementia subcases in low socio-economic groups to reduce mortality.

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Assessment of fit for item response theory models to ordinal data

Ordinal data arising from responses to questionnaires can be modeled using item response theory (IRT) models such as Ordinal Regression and/or Rasch analysis with a set of predictor variables. The ordinal regression model is based on McCullagh's Proportional Odd's model and there have been several link functions developed relating to the distributions of the response variable.1-2

There are several Rasch models for different response scales and the most appropriate is selected for analysis.3 This research proposes to determine the model goodness-of-fit by measuring the association between the predicted categories generated from ordinal regression and Rasch analysis and actual categories chosen using a weighted Kappa statistic.

Statistical software packages in which the analyses can be performed, standard outputs include parameter estimates and goodness-of-fit measures. For ordinal regression other selected outputs such as estimated category probabilities (ECP's) for each of the response categories for every person-item encounter can also be generated and from these values the predicted category for each person-item encounter is also found.2

While ECP's are not a normal standard output for Rasch analysis, they too can be calculated. Pseudo R-squares statistics are often used as an indication of whether the model is a good fit for the particular link function used, however it does not suggest which link function is the most appropriate for the data.

An example is given where both analyses are applied to data generated from patient responses to a visual functioning questionnaire. ECP values from both analyses were plotted to examine if a known distribution could be fitted and used to generate values from which a predicted category could be chosen as alternative to using either ordinal regression or Rasch analysis. The new set of predicted categories was tested for goodness-of-fit by measuring their association with the actual categories chosen by patients using a quadratic weighted Kappa.

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POSTER

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Number insight and narrative image: developing statistical analysis strategies utilizing graphical displays of quantitative information

Pictorial representation of data embodies the best of visual display and information transmission. Pictorial representation organizes and summarizes research data in a visual format. Within this visual format, number patterns are more readily discerned and themes magnified through visual data exploration and discovery.

Creating a visual rendition of research data provides a powerful channel for information exchange: with increased communication of findings, magnification of ideas, and enhanced pattern recognition. Providing students with "real-world" opportunities for data analysis and reflection helps to both introduce and reinforce statistical concepts and strategies.

Thus, students in my Visual Mathematics course (statistics and graphical display) are asked to examine various graphical displays of data in order to investigate and analyze the underlying quantitative information, and develop critical thinking skills with regard to both the relationships between variables, and the phenomena of interest.

One famous example of graphical display presented to the students is Dr. John Snow's Broad Street Pump graph. The students examine the graph, and then respond, in writing, to the following items (prompts adapted from Tufte's Beautiful Evidence, 2006):

1. Place the data in an appropriate context for assessing cause and effect;

2. Make quantitative comparisons;

3. Consider alternative explanations and contrary cases;

4. And assess possible errors in the reported numbers.

Students are then asked to describe the narrative story told by the underlying data – to describe the connections between the location of water pumps, and the frequency and location of reported cholera deaths.

This presentation will share examples of student writing and thinking regarding visual data displays, and present original graphical displays constructed by my students. By sharing these instructional strategies, and receiving comments and suggestions from my peers, I hope to improve student instruction, and aid their learning of important statistical concepts and ideas.

POSTER

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An investigation of outlier treatment methods in the AWE

There are two main measures of short term earnings, the Average Earnings Index (AEI), and the Average Weekly Earnings (AWE). Although both measures use the same data source, the Monthly Wages and Salaries Survey (MWSS), they sometimes show a different pattern of year on year growth. The AEI is the current National Statistic, and the AWE is an experimental series.

There are conceptual and methodological differences between the AEI and AWE, including their outlier procedures. In AWE a simple outlier detection and treatment is currently utilised for point in time data, on the full sample. The method is automated and contrasts with the method employed within the AEI, which has a manual element, and is based on the impact on growth calculated from a "matched" sample from successive months.

Additional development work is needed on the outlier methodology in order to move the AWE to National Statistic status. There are two main variables in the AWE, regular pay (pay excluding bonuses), and bonuses, and both variables undergo separate outlier treatment.

This paper will investigate the possibility of detecting outliers in regular pay in the AWE using a method based on growth, such as in the AEI. We propose a suitable extension to the AEI methodology to include the non-matched sample such that it could be applied within the AWE estimation framework.

We also investigate ways of improving the outlier detection in bonuses based on the level of average bonus paid. For both regular pay and bonuses we investigate an alternative outlier treatment to post-stratification, which is currently used in the AWE: this is achieved through reducing the weight of outliers using a heuristic method. It uses the principle of Winsorisation, but without the sophistication of optimising the outlier weights to minimise the mean squared error (MSE), which would be a difficult theoretical problem to solve in this context.

We will compare the methods developed against the existing AWE methodology using real MWSS sample data, and further test the performance of the proposed and current methods via a simulation study on a pseudo population of MWSS data.

POSTER

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Non-response weighting in ONS social surveys

In the last two decades response rates for social surveys run by the Office for National Statistics (and other UK survey takers) have fallen steadily. Non-response is a particularly serious issue for surveys with larger respondent burden, such as the Expenditure and Food Survey where a diary is kept.

Differential non-response among subgroups in the population is a key challenge for any survey because it can result in biased estimates being produced. In order to reduce non-response bias, weights can be applied to the respondent data with a view to making the dataset representative of the whole population.

Sample-based weighting schemes are generally hard to implement since there is not much information known about non-respondents. In most social surveys there are only two things known with certainty about non-respondents: their address and their means of non-response. However, it is possible to link their post code to a geodemographic classification, in order to provide general characteristics about the area in which they live. In longitudinal surveys information gathered from households who responded at the previous wave can be used to construct a model for attrition weighting.

A population-based weighting scheme entails the creation of weighting classes based on variables known for both the respondents and for the entire population. This is more readily implemented and can be employed either by itself or in conjunction with a sample-based weighting scheme.

This poster will examine some of the non-response weighting strategies applied by the Office for National Statistics and will discuss issues surrounding them.

POSTER

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Store refurbishment and patronage intention: an empirical analysis

Store refurbishment is a popular decision option for companies wishing to upgrade their image and improve business performance. The paper concerns the impact of store refurbishment on customer attitudes in the electrical retail sector.

As a real application demonstrates, structural equation modelling provides a powerful methodology for analysing and representing the relationships between store attributes, shopper characteristics, store image and patronage intention.

POSTER

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Design issues and solutions in a surveillance study for stage I seminoma (TRISST/MRC TE24, ISRCTN65987321)

Survival for testis cancer patients diagnosed with stage I seminoma is excellent. For those who choose to be managed by surgery alone, 80% will be cured with no further treatment. For the 20% who relapse, treatment is also highly successful leading to overall 5-year survival in all stage I patients of approximately 98%.

In order to detect relapse early when treatment is more likely to succeed, patients undergo a surveillance program which includes regular clinical examination, tumour marker assessment, chest x-rays and CT scanning. However, there is concern over repeated radiation exposure associated with such surveillance, particularly in younger patients, and efforts to reduce this are encouraged. Currently, the surveillance schedule after treatment varies across the UK.

Possibilities for reducing radiation exposure include giving fewer CT scans or replacing CT with MRI scanning which does not use ionising radiation and has no known associated risk of cancer induction. However, it is not known how this will affect detection rates for relapse at sufficiently early stages. We have designed a study to compare different scanning technologies (CT versus MRI) and surveillance schedules (frequency of scans).

We discuss some of the issues that arose when planning the design of this study, and our proposed solutions. In particular, we focus on (i) choice of study design, (ii) multiple study questions, (iii) number and timing of scans, (iv) timing of analysis and (v) choice of outcome measures and the approach to sample size calculation. We hope this will be useful for other researchers faced with similar problems, especially in the fields of surveillance, prevention of disease and evaluation of different technologies.

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Joint estimation of common and specific factors in Nonstationary Dynamic Factor Analysis

In this work the Nonstationary Dynamic Factor Analysis (Peña and Poncela (2004, 2006)) and Alonso et al. (2008)) is extended to the case in which the specific factors present a dynamic structure. In practice, once the common factors that follow a VARIMA model have been extracted, the specific factors are not white noise, they present a dependence structure and an autoregressive model must be fitted (Ortega and Poncela (2005)).

They provide a two-step procedure: the first one in which all the parameters of the model are estimated as well as the common factors are extracted and the second in which the AR models for the specific components estimated using estimated common factors and loads.

In this work we provide the joint estimation of common and specific components as well as the improvements obtained in terms of estimation and point forecasts and forecasting intervals, in comparison to the two-step estimation (). The joint estimation procedure developed is applied to compute forecasts of electricity prices in deregulated power markets.

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Sustainable tourism in rural areas; cooperative tourism

During the last years the Tourism of Interior has taken a sublime importance bearing in mind that Spain is a country eminently of the Sun and beach as tourist destination(destiny), it(he,she) has been modifying his(her,your) behaviors diversifying the offer and adapting to the needs that the demand(lawsuit) had.

This tourism of Interior has tended to be based strongly on all those tourist resources that have survived the step of the years and the action(share) of the human being: nature reserves, landscape sets, historical patrimony - artistic, etc.

The patrimony of the rural world cannot have the same baremación that the cultural patrimony of the cities or of the big rural cores(nucleuses) that could have had an advance so much social, since(as,like) culturally after the years so from this article one has wanted to show a new trend in the tourist sector, very in vogue in Europe, which is the Industrial Tourism, and adapted to the rural world, the Cooperative Tourism, as principal representatives of the industrial patrimony of the Social Economy.

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What's statistics got to do with my degree: is relevant context useful in the enhancement of students' understanding of statistical concepts?

Many university courses, for example Sports Science, expect students to understand and conduct statistical analyses. Statistics is not the main focus, but a means to an end. A key question is whether students find statistics difficult and unconnected to their other learning. Past research suggests perceived lack of relevance as a barrier to statistical literacy.

This study explored whether the use of data from sports contexts enabled students to understand more effectively those concepts presented in 'standalone' statistics modules. Students' achievements and experiences were investigated through both quantitative and qualitative methods.

The student sample (n= 196) was drawn from a Sports Science degree where entry requirements were 220-280 UCAS points. Statistics tutors used workshops to present sports science problems, and introduce relevant statistical techniques to address them. During the course of a semester, tutor guidance was gradually reduced to give students the opportunity to take charge of their own statistical decision making.

Results showed that statistics marks were significantly lower than marks from other core sports science modules. Qualitative interviews with 12 level two students found little evidence of appreciation of the contextual settings used in statistics modules. They saw tasks as essentially mathematical.

The results indicate that the introduction of relevant context to standalone statistics modules is insufficient to establish connections between statistics and Sports Science.

POSTER

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Parametric survival models with time-dependent covariates for right censored data

Joint poster: Hisham Abdel Hamid and Alan Kimber

One standard approach in survival analysis is to use the Cox proportional hazards regression model. This is easily extended to incorporate one or more covariates whose values are subject to change over time.

An alternative and potentially more efficient approach is to use simple parametric accelerated failure time models with standard survival distributions such as the Weibull, log-logistic and log-normal. Again these models may be extended to incorporate time-dependent covariates. However, in some areas of medical statistics simple parametric models often fit poorly.

In this paper the standard Weibull regression model is extended to incorporate time-dependent covariates and made more flexible by using splines. The competing methods are implemented and compared using two large data sets (supplied by NHS Blood and Transplant) of survival times of corneal grafts and heart transplant patients.

Keywords: parametric models, right censoring, splines, time-dependent covariates

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After a brief introduction to astronomy and, in particular, the UKIRT Infrared Deep Sky Survey (UKIDSS) data, a novel, probabilistic approach to classifying multi-band astronomical data into star and galaxy classes will be presented.

Indeed, digital sky surveys collect vast amounts of data, typically terabytes of raw data per night. Star-galaxy classification is one of the most fundamental data-processing tasks in survey astronomy, and a critical starting point for data exploitation.

Even though an almost bewildering number of methods have been used to perform star-galaxy separation, many of these are ad-hoc in nature and fail to satisfactorily address several problems inherent to astronomical survey data: there are many missing detections, the data sets can be very large, there is a lack of labelled training data and it is not clear how best to incorporate prior knowledge about star and galaxy distributions.

Our classifier, based on a parametric mixture model, addresses these challenges. In order to harvest domain knowledge, a statistic constructed by domain experts is used. Whenever possible and sensible, common astrophysical models have been incorporated into the classifier.

Initial results will be given and comparisons with other methods will be discussed.

POSTER

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Change points in linear mixed models

Detection and estimation of change points is a problem that has been developed in many statistical areas.

This work summarizes some methods for detection and estimation of change point in the context of Linear Regression Analysis: Recursive residuals, cumulative sums of residuals (CUSUMs), moving sums of residuals (MOSUMs), moving regression, log-likelihood ratio technique, F-tests and Schwarz information criteria (SIC).

An extension of some of these methods to Linear mixed models is presented and assessment of their performance is shown by applying them to a simulated data set.

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Improving 2011 census coverage adjustment

Introduction

Important resource allocation and planning decisions are based on the Census. However, no Census is perfect and so people and households will be missed. This undercount is not evenly spread, being highest amongst young men. To estimate and reduce the effect of undercount ONS uses a Census Coverage Assessment and Adjustment methodology to adjust Census data for this undercount.

Coverage Adjustment methodology

To achieve this adjustment ONS carries out a Census Coverage Survey (CCS) which re-enumerates approximately 1% of the population. Dual System Estimation and Ratio Estimation methodologies are then used to estimate Census undercount from the discrepancy between Census and CCS enumeration. The Census database is then adjusted by imputing missed households and missed people in captured households so that all tabulations from the census are fully adjusted for the measured undercount. This procedure is based on a donor imputation algorithm which is driven by a set of weights that are obtained from modelling census non-response. The imputation process is constrained so that population totals, by age and sex, match the estimated population totals. This constraint is implemented by iteratively adding and removing people until the required distributions are obtained.

Methodological improvements

Based on the performance of this adjustment process in the 2001 Census innovations have been suggested for the 2011 Census. These include the use of larger areas to provide better stabilised models for rare groups, and the use of more fine grained categorisations in the predictor variables, such as household structure, for the imputation model. To measure how these changes to the imputation system will improve the adjustment process, simulation methods have been used. This allows for the comparison of the results of the imputation process to known population distributions. Comparison of the new system to the performance of the system used in the 2001 Census is also provided.

This poster will present the results of the evaluation of these changes to the imputation system in terms of imputation accuracy and system efficiency.

POSTER

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Estimation of a population total from stratified survey data

Building on a Napier University study estimating commercial and industrial waste in Scotland based on survey data, this study explores the problems of estimating confidence intervals for a total from stratified data.

The problem of skewed data in biasing estimates is discussed as is the principal behind stratification i.e. minimisation of strata variance. The assumptions of the central limit theorem in producing estimates from small strata are tested.

Linearization of variance to deal with the design effect is discussed.

Approaches to dealing with skewed data are investigated, using data transformation and bootstrapping.

Finally, the performance of confidence intervals produced by different methods (bootstrap percentile or normal assumption) are tested using a simulation approach. The findings are that bootstrap confidence intervals for a total have equivalent coverage to those based on the normal assumption so long as the sample size is large enough for the central limit to hold.

With small strata, data transformation followed by producing confidence intervals based on the normal assumption give better coverage properties than for confidence intervals based on untransformed data or bootstrap percentile intervals.

The conclusion is that minimizing bias in estimates comes at a price of reducing the precision. This can only be addressed at the design stage with adequate sample sizes and appropriate stratification criteria.

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Multilevel modelling of progression among undergraduate social work students in England using longitudinal routinely collected data

Reducing the numbers of students who leave university before achieving their intended qualification is an important policy priority. However, there is growing evidence of differential progression rates among higher education students in the UK.

In the subject of social work, we have previously shown that the probability of delayed progression for a variety of reasons, including failure, withdrawal, the need to repeat assessed work or periods spent on placement, or temporarily suspending studies for personal reasons, was significantly associated with students' ethnicity, as well as other personal characteristics, among those enrolling between 1995-1998.

In this study, using longitudinal routinely collected national data on undergraduate full time students who were enrolled for social work courses during 2003-2005 in 62 English universities, we examine whether personal as well as higher education institutional (HEI) factors are significantly associated with various outcomes of study.

Using multilevel binomial models we examine both individual and HEI effects on each of the possible outcomes for students namely: pass, fail, withdraw, applied for an extension for personal reasons or required to repeat part of their studies. The results identify a significant HIE effect for all possible outcomes except for failure, while different individual students' characteristics remain significantly associated with all possible outcomes.

Both the methodology adopted in this research and the results have wider implications for UK higher education as a whole.

POSTER

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Pandemic influenza preparedness: estimating influenza vaccine effectiveness from routinely collected consultation data

Introduction: A key element of preparedness for potential pandemic influenza is the ability to monitor levels of influenza in the community and assess the effectiveness of the influenza vaccination. Currently in Scotland anyone who suffers from heart or lung problems, or is 65 or over, is targeted for flu vaccination. By using routinely collected consultation data from the Pandemic Influenza Primary care Reporting (PIPeR) system, between 2006 and 2009, real time estimates of the effectiveness of the influenza vaccination in the community can be calculated.

Methods: In a subset of the General Practitioner (GP) practices in Scotland, the PIPeR system generates individual level data on the number of acute respiratory illness (ARI) consultations. By matching this data to the individual patient records, influenza vaccine effectiveness (VE) estimates can be calculated on a weekly or monthly basis. VE=1-RR where RR is the relative risk of influenza infection in vaccinated individuals compared to the unvaccinated population.

Logistic regression is used to estimate VE and its corresponding confidence interval taking into account possible confounding effects such as differences between GP practices (indicating possible socio-economic factors or recording differences between practices), sex, risk group status and previous/other vaccinations. Daily data on 300,000 patients in 30 practices is available together with historical data over the previous 5 years. We compare the results of using individual data through a logistic regression and grouped data using poisson regression with time varying covariates.

Results: Real time estimates of vaccine effects are possible with routinely collected data. Vaccination of individuals falling into the asthma and diabetes risk groups was found to significantly reduce the odds of an ARI consultation, 63% less likely with 95% CI (14%, 84%) and 83% less likely with 95% CI (53%, 94%) respectively. The major statistical problem is bias associated with the propensity for some individuals to consult more readily and the same individuals being those who are likely go for vaccination.

Conclusion: This poster demonstrates that real time calculation of vaccine effectiveness from consultation data is possible. However careful adjustment for bias associated the propensity of individuals to visit their GP is required. A number of bias adjustment methods are compared and the effects of these on the estimate of vaccine effect are presented. It is important to have individualised data for proper bias adjustment and the use of grouped data which does not take into account practice effects produces biased results.

POSTER

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Testing for seasonal unit roots in monthly panels of time series

We consider the problem of testing for unit roots at cyclical frequencies in the autoregressive lag polynomials for monthly panel data. To this aim, we generalize the quarterly cross-sectionally augmented test for seasonal unit roots in autoregressive processes proposed by Otero, Smith, Giulietti (2005) to the monthly case.

This parametric test is contrasted with a new nonparametric test, which is the panel counterpart to the univariate record unit-root seasonal (RURS) test by Kunst (2008) that relies on counting extrema in time series.

All methods are applied to an empirical data set on overnight stays in the nine Austrian provinces. The power properties of the tests around the unit-root null are evaluated in simulation experiments that are tuned to the tourism data. We also study the behaviour of the null distributions of both classes of statistics for increasing cross-section dimension.

POSTER

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Evaluating the technical quality of the Scottish Survey of Achievement (SSA)

The Scottish Survey of Achievement is a sample-based survey programme with multiple aims. A primary aim is to provide periodic and quality estimates of the attainment of pupils in Scotland in key curriculum subjects at particular stages in schooling: currently P3, P5, P7 and S2.

Among the technical challenges associated with programmes such as this one is choice of an appropriate measurement model. The SSA is unique in its model choice. Unlike the well-known international programmes (PISA, PIRLS, TIMSS), which have adopted item response theory (IRT), the SSA is based on domain sampling, with attainment estimation following conventional sampling theory methods.

Generalizability theory is applied in secondary data analysis to evaluate the effectiveness of survey design, by exploring contributions to measurement error. The presentation will focus on this aspect.

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Estimation of autoregressive models – a comparison of methods

The paper is largely simulation based, although by the time of the RSS Conference I aim to add more theoretical results. The paper compares estimators of autoregressive coefficients and introduces some new methods.

We simulate the bias and mean square error (MSE) of several estimation techniques for stationary ARX models. It is found in particular that higher-order analytical approximation of bias can be used for improved practical bias correction.

Also, a particular type of Jackknife procedure is found to be very good at removing bias in dynamic models, but is relatively inefficient. The residual bootstrap generally does well, particularly in bias-correction, although it is not often the least biased. The first-order analytically corrected ordinary least squares (COLS-1) estimator tends to do well, particularly in terms of efficiency

The simulation results for the AR(1) agree with a theoretical result comparing the approximate MSE of the OLS and COLS-1 procedures. A new higher-order Jackknife estimator is presented, derived using a moment approximation and the Quenouille half-sample jackknife, and simulation results are given for this too.

Results are given for normal, gamma and Pareto disturbances, and it can be seen that bias in ordinary least squares estimation of autoregressive models increases as the model errors depart from normality. The different estimation methods vary in their ability to cope with substantial deviations from normality.

Some interesting observations can be made near the nonstationary regions. The specific models considered are AR(1), ARX(1) and AR(2) so far, and in the AR(2) case the paper looks at the bias in estimation of the sum of the autoregressive coefficients, the sum of the coefficients being a measure of shock persistence. Results are for sample sizes of 20 and 50.

Poster: the poster is made up of graphs of relative bias or relative absolute bias figures. I also show the intuition behind the bootstrap, jackknife and COLS estimators.

POSTER

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Employment in the economy from the emergent renewables energies

We are in a moment in which finally we have realized the unsustainability of our energetic system and the caducity and depletion of the fossil energies. Finally we have assumed that we need new energies that avoid the deterioration accelerated towards our planet and especially they allow to support the level of development of our society.

To the time we have a sector since(as,like) it(he) is that of the Social Economy that has been kept nearby and still(yet) it(he,she) is kept to the agricultural way, and here we can find the solution to the energetic needs of the markets. The potential that the biocombustibles and the biomass can contribute to the Social Economy is revealed in this article. Our study across the knowledge and the contact with the nature has allowed us to calculate the potential ranges of employment that it(he,she) would bring I obtain the exploitation(development) to major scale of the renewable energies, centring on the use of the biomass for stays and public institutions.

Therefore there are opened for the agrarian new cooperatives routes of diversification of business and it(he,she) extends the possibilities of employment in the environment in the one that is going to develop the activity of the cooperative, in turn, since(as) the same genesis of this type of companies they go implicit the environment is improved in the one that they are located. These are the different lines that this article has checked to present in the present publication as route of diffusion of the emprendimiento that can be carried out in the sector of the Social Economy.

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The phenomenon of active citizenship in Europe: a cross-national perspective

The current European climate and the revitalized Lisbon strategy have put social cohesion at the heart of the European policy agenda. An important dimension of social cohesion is the active citizenship with its determinant of values, representative democracy and civil society.

Focusing on 19 European Countries, Mascherini and Hoskins, (2009), measured Active Citizenship thought a composite indicator based on a list of 61 basic indicators for which the data has been drawn from the European Social Survey of 2002.

Following this framework, in order to characterize the profile of the active citizen, in this paper we deepen the analysis by exploring the active citizenship concept respect to a set of socio demographic variables, (as age, gender, education, etc.), and behavioral variables, (as the media impact, the politics interest, etc.) in one single model for the entire Europe, by using a random effect multi-level regression model.

The goal of this paper is to draw the identikit of the active citizen in Europe taking into account some significant country differences by studying the relation between individual behavior and country effect. Countries are described by the economic, social, political and cultural dimension, while the individual behavior is cached by objective and subjective variables.

POSTER

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Surnames in the UK are mostly patrilinearly inherited, so they correlated well with Y-chromosomes and can be used as genetic indicators. One application of surnames in the field of child health is as indicators of ethnicity in probabilistic record linkage.

A potential application of surnames frequencies is their use in childhood disease epidemiology as an indicator of genetic association. The 'enhanced electoral register' contains the names and addresses of all adults entitled to vote in the UK, with additional non-registered voters sourced from commercial surveys and credit scoring databases.

The 2001 register contains surname frequencies from 45.6 million individuals across 434 districts of the UK, which can be grouped into 12 regions. Measures of vocabulary diversity developed in linguistics, such as Yule's K, can be applied to surname frequencies to explore the diversity of surnames in a population.

Surnames can also be categorized by their geographical origin using the National Trust profiler (http://www.nationaltrustnames.org.uk/).

Our study1 shows that the 12 geographical regions of the UK are well differentiated in terms of their surname structures, with districts in London and the South East of England having the highest surname diversity whilst Scotland, Northern Ireland and particularly Wales have the lowest.

Reference:

[1] McElduff, F., Mateos, P., Wade, A. and Cortina-Borja, M. (2008) What's in a name? The frequency and geographic distributions of UK surnames. Significance. 5(4): 189-192

POSTER

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Investigating the determinants of sentencing decisions

Background: Exploratory analysis of Home Office data on 2004-sentenced cases for common assault suggested an interaction between the proportions of male, adult offenders receiving a custodial sentence and the relative frequency of the respective offence type in larger police force areas.

Methods: To investigate the above data-inspired hypothesis, three statistical methods were compared -

1) multi-level modelling using the available data plus additional terms at the police force area level (available data);

2) sampling from the court case files to ascertain the influence of offence and offender characteristics (sampling plan); and,

3) an experimental approach that entails sentencers deciding on the sentences for a randomly assigned set of hypothetical court cases (factorial experimental design).

Results: Each of the methods has their strengths and weaknesses ranging from convenience (multilevel modeling); resource and missingness implications for acquisition from court files (sampling); and, limitations in the range of characteristics represented in the hypothetical court cases (experimental design).

Conclusions: While our multilevel analysis was quick, cheap and simple to implement, both the sampling and experimental approaches are specifically designed, can be tailored to research interests and have the potential to be more fruitful.

POSTER

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Using life tables to predict mortality risks in health impact assessment.

Increasingly, policy makers are required to complete quantitative Health Impact Assessments for proposed policy changes, often feeding into Cost-Benefit Analyses. Where, as for air pollution reductions, these are expected to impact on mortality rates, consistent predictions require the use of life-table methods. This is because changes in mortality in one year affect the size and age distribution of the population in following years.

We have developed IOMLIFET, a system of spreadsheets to facilitate mortality impact predictions and economic valuations for these.

Results are best expressed in units of (life-)years, but these are often poorly understood by non-specialists and journalists, who prefer statements of numbers of deaths caused or avoided. It may help to place results against impacts of better-known hazards. We show an example where air pollution impacts were compared with mortality impacts for second-hand smoke and for motor vehicle traffic accident fatalities.

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Environmental strategy in agricultural cooperatives

The environmental strategy of the organization materializes in the selection of a series of environmental practices to putting in march in the cooperative society and, in the degree in which the same ones develop and are coherent between(among) yes, we prune to classify the environmental strategies of the cooperative societies according to three bosses:

- the stocks in the legal fulfillment
- practices punctual that simultaneous and immediately they allow environmental and competitive improvements
- the most proactive practices.

The offers are in the habit of turning concerning(around) that the existence of certain specific capacities of the organization, understood as skills to manage resources, they are those who make possible that an organization develops with major(bigger) facility his(its,her) more proactive environmental expositions(approaches).

Before the doubts on the effect of the environmental management on the competitiveness of the cooperative societies, it will be tried to verify if his(its) environmental proactive management can have a few positive effects similar to which it(he,she) has in big companies

POSTER

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Estimating disease outbreaks based on self-reporting

A growing public awareness of the possible devastating consequences associated with epidemics of contagious diseases, has driven a great deal of attention to the problem of timely detection of disease outbreak and has triggered an intensive brainstorming on the subject among the public health agents and the researcher community in general. In particular, there has been a considerable investment in systems for performing outbreak detection based on symptoms rather than confirmed diagnosis – syndromic surveillance.

Gripenet is a particular type of scheme within this class of syndromic surveillance methods, tracking information on Portuguese population about their influenza-like (ILI) symptoms over the influenza epidemic season and also on gastrointestinal disorders symptoms, based on self-reporting of voluntary participants whom, on a weekly basis, answer to an online symptoms questionnaire. Demographic characteristics of the participants as well as their residence location are also available.

Of course that not only the nature of the data in Gripenet, but also the way they are collected, very much condition the inferences that we will be able to do from them. We borrow a state space formulation from animal population dynamics modelling, to address this difficulty.

We aim at estimating the (non-observable) state of the ILI symptomatic and un-symptomatic Portuguese population at each week, linking that to the symptoms delivered by the Gripenet respondents every week (observational process), through the referred space state model. Estimation is carried out under a Bayesian framework, more precisely making use of sequential importance sampling techniques with resampling. We illustrate our work with data relative to the past four influenza seasons.

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Obesity in Scotland – a quantile regression approach for studying the BMI distribution

Obesity is an increasingly widespread concern, with serious public health and economic consequences worldwide. Its prevalence varies with socioeconomic status with potential implications on policy.

We study the prevalence of obesity in Scotland by analysing data from the Scottish Health Surveys of 1995, 1998 and 2003. We model obesity rates and more generally the conditional distribution of the body mass index (BMI) as a function of age and socioeconomic status using various statistical methods including quantile regression.

In addition we briefly discuss time trends in the distribution of BMI and in obesity prevalence, and compare the analysis of the Scottish data to recent published results obtained from data from England (e.g. Mills (2008) and Zaninotto et al. (2009)). Quantile regression enables us to investigate not only whether there is an increasing trend in the percentage obese in the Scottish population, but also the possibility of a shift in the overall BMI distribution.

POSTER

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A multidimensional approach to income response errors in surveys

The objective of the paper is to study survey respondents' propensity to misreport their sources of income. We use the 2004 wave of the Survey of Household Income and Wealth (SHIW, thereafter).

Income reporting in surveys is generally a two-stage process involving first the reporting of income sources and then the reporting of amounts received from those sources. Errors can occur at either stage. In the literature (see Moore et al., 2000 for a review), response error is tackled by two major approaches according to whether or not identification is achieved with external information.

Response error can be easily dealt with when administrative data are available and an exact linkage with survey data can be done. In absence of external information, identification can be achieved in particular cases. For instance, see Schennach, Hu and Lewbel, 2007 for the non parametric regression model with response error under the classical assumption. Another solution by Bollinger 1996, Pudney 2002, Manski 2003 is the identification of bounds or of intervals in which the parameter lies.

Our method is based both on the use of external information (although we are not able to make an exact linkage with survey data) and on parametric assumptions. Our identification strategy is as follows. First, we assume a simple economic model for response error based on the cognitive factors suggested by Tourangeau et al. (1984).

Respondents are assumed to belong to latent classes with different propensity to misreport. Conditional on their latent class, their probabilities to misreport on specific income items are independent (Goodman, 1974). Second, we construct a set of 11 dummies variables indicating whether a respondent has misreported a specific income item. This is achieved developing an ad hoc adjustment procedure for each item. Namely, for the problem of underreporting of secondary incomes we do a statistical matching with the Eu-silc survey in which income for work percipients are adjusted using tax registers. Adjusted incomes from financial assets are estimating through an external validation sample a survey run by an Italian leading commercial bank in which both survey and administrative data are available. For income from secondary dwellings we replicate an experiment run by Brandolini et. al (2004) using SHIW data.

Finally, we deal with the entrepreneurs' underreporting following the approach approach proposed by Pissarides and Weber (1989) and Cannari and Violi (1995). At the end of the adjustment procedures we have for every SHIW respondent who has not reported a given income item during the survey, his or hers fitted probability to truly have it.

We then impute an ownership through a random experiment. Third, we use the set of 11 proxies of response error to fit our latent class model (conditional on a set of demographics) using the EM algorithm (Dempster 1977). The initial values for the latent class membership are estimated using Item response theory framework. Fourth, we replicate steps 2 and 3 in order to take in to account the variance due to the imputation process.

We finally present some remarks on the bias due to income response error and its distribution across respondents.

POSTER

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Studying behaviour of response data sets and effectively modelling them can involve finding the distribution that best fits the observations. More than that, modelling can aim at finding curves that represent data at every percentile. After all, not all data sets behave the same everywhere.

Consequently, questions such as what curve represents the 25th or the 67th etc. quantile arise. From here comes the idea of quantile regression aimed at completing the regression picture comprehensively. When dealing with observations from the medical and health fields, the search is for distributions applicable to response data that take positive values only.

The 3-parameter continuous univariate generalized gamma life distribution is our proposed model. In its different pdf formulations it can take as special cases more than 7 of the known life distributions, such as the exponential, gamma and Weibull distributions. Being a 3-parameter distribution, it can deal well with skewness of given data sets. From here comes it importance and richness.

An iterative method for maximum likelihood estimation of the parameters of a generalized gamma distribution is presented; all parameters are unknown and none of them fixed. Comparison with other optimization methods offered by software such as R is done. The work is extended to quantile regression which is the aim and motivation of our study. Likelihood ratio tests are conducted to choose the best models.

Inspired by the generalized gamma distribution, a new 3-parameter (2 of them being shape parameters) distribution is proposed; one of the shape parameters controls the part of the distribution close to zero and the other controls the tail of the model.

POSTER

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Anchoring vignettes with sample selection

Anchoring vignettes are a powerful tool for enhancing self-report data comparability across countries or socio-economic groups. They take into account individual differences in the interpretation of the survey questions in order to correct for differential item functioning (DIF).

SHARE (Survey of Health, Ageing and Retirement in Europe) is a new, multidisciplinary and cross-national survey that collects data on the life circumstances of individuals aged 50 and over in several European countries, by means of a CAPI interview and a self-completion paper and pencil questionnaire drop-off. In some countries, a sample of individuals was randomly selected to receive vignettes as the drop-off questionnaire.

Unlike other surveys working with vignettes, in SHARE sample selection problems may arise also when respondent completes the CAPI questionnaire, but does not fill in the vignette drop-off. Fitting models to the observed sample ignoring potential selection bias may lead to inconsistent estimates. This paper aims at extending the standard (hopit) model for estimating vignettes in order to allow the specification of some selection variables.

The model is then applied to investigate and compare across countries the effects of DIF and the sample selection on the response scale differences in the self-reported work disability SHARE vignettes. Our findings support the ability of the vignette approach to correct for DIF. Thus, there is evidence of sample selection effects even in the case of high rates of collected vignettes, but in such case the bias induced by the selection mechanism is negligible. On the other hand, when the collected vignette response rate is low, sample selection affects the hopit estimates, leading to reverse the directions of some DIF corrections.

POSTER

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GTSS: rationale, implementation, and challenges in monitoring adult tobacco surveys

Tobacco control requires an efficient and systematic surveillance mechanism to monitor trends in consumption and other key tobacco control indicators. The Global Tobacco Surveillance System (GTSS) addresses this need through school-based surveys, such as the Global Youth Tobacco Survey (GYTS), the Global School Personnel Survey (GSPS), and the Global Health Professions Students Survey (GHPSS), and through a household-based survey, the Global Adult Tobacco Survey (GATS).

GATS, a national household survey of adults aged 15 years and older, aims to collect data on adult tobacco use and key tobacco control measures by using a standard global protocol. Results from the GATS will enable countries to develop, track, and implement effective tobacco control interventions. GATS were initiated in 14 countries: Bangladesh, Brazil, China, Egypt, India, Mexico, Philippines, Poland, Russian Federation, Thailand, Turkey, Ukraine, Uruguay and Vietnam. The partners in this initiative include Centers for Disease Control and Prevention (CDC), CDC Foundation, Johns Hopkins Bloomberg School of Public Health (JHSPH), RTI International, World Health organization (WHO), and the participating national governments.

The paper provides a comprehensive review of critical areas in comparative surveillance research. Focusing on major challenges, the paper discusses coverage, comparability and equivalence, quality and study design specifications, standardization and field implementation, and questionnaire design, adaptations and translations.

Besides the common challenges for household surveys, the paper also tries to explore particular challenges posed by the international nature of the GATS. The unique nature of GATS: collecting data using handheld technology (iPAQs), particularly in developing countries, warrants the need to demonstrate the difficulties in questionnaire programming, data collection, aggregation and transfer, preparation of standard analyzable statistical data sets and reporting mechanism for health policy impact.

POSTER

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Bayesian profile regression with an application to the study of lung cancer in a large cohort study

Standard regression analyses are often plagued with problems encountered when one tries to make meaningful inference going beyond main effects, using datasets that contain dozens of variables that are potentially correlated.

We propose a method that addresses these problems by using, as its basic unit of inference, a profile, formed from a sequence of covariate values. These covariate profiles are clustered into groups using the Dirichlet process, and are associated via a regression model to a relevant outcome. The Bayesian clustering aspect of the proposed modeling framework has a number of advantages over traditional clustering approaches in that it allows the number of groups to vary, allows comparison of arbitrary subgroups of the data, can incorporate a priori known structures as well as covariate domains, uncovers subgroups based on their association with an outcome of interest and fits the model as a unit, allowing an individual's outcome to influence cluster membership.

Different variable selection approaches have been implemented and compared. Profile regression has been applied to a large cohort study in order to examine the effect of environmental carcinogens and explore possible gene-environment interactions.

POSTER

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Proposal construction for reversible jump MCMC

We propose a general methodology to construct proposals densities in reversible jump Metropolis algorithms such that consistent mappings across competing models are achieved. We focus on linear regression models and produce concrete guidelines on proposal choices for moves between any models.

These guidelines can be immediately applied to regression models in which the posterior density is close to normality. We illustrate our methodology by providing implementation details for log-linear and graphical model problems. Analysis of a 2^6 contingency table shows that the consistency of the proposed moves together with the freedom to propose any model improves the mixing of the reversible jump Metropolis algorithm.

POSTER

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Data-driven bandwidth selection for backfitting estimation of partially linear models

We propose a data-driven bandwidth selection method for estimation of partially linear models when the nonparametric term is treated as a nuisance parameter. A partially linear model is a combination of parametric terms and a nonparametric term, where a special case of interest is when a parameter represents the average treatment effect in the Rubin potential outcomes framework in causal inference.

In our work the estimation is done by backfitting and the smoothing method employed is local polynomial regression. For the latter a smoothing parameter (bandwidth) must be chosen. Using leave-one-out crossvalidation (LOOCV) in order to choose the bandwidth is not optimal if the main interest is to estimate the parametric part of the model. In particular, the resulting estimator is not root-n consistent.

We propose the use of a two-step estimator of the mean-squared error of the backfitting estimator of the parametric terms, where LOOCV is employed in the first step for choosing the bandwidth. We show with a simulation study the properties of the proposed method.

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TEST of CAPM (capital asset pricing model)

The capital asset pricing model has been essentially developed by William F.sharpe at 1964 (economics Nobel Price at 1990), but also Lintner and Mossin. This model explains the asset rate of return, in function of their risk. More precisely, it establishes the relation between the incurred risk (the proportion of risky assets in the portfolio) and the profitability of the portfolio). It is use to evaluate the investment strategy on the financial market, in relation to a "passive" strategy to define the rate of discount to apply in the investment choice.

This model assumes that:

• All individual have the same anticipation on the risks and the returns of the financials stocks are rationales, this mean that it building optimal risky asset portfolio;

• All individual have the same risky assets portfolio, which are equivalent to the portfolio market;

• All the individual combine this optimal portfolio with the asset without risk in the proportion which vary according to the person.

In consideration of the important place CAPM in the investment choice, its validity is capital. Thus, the purpose of this study is to review the different CAPM tests and to make an application on the real data.

The results on the data use in this study are mitigated. On individual data on each firm, the beta of CAPM is significant on 82% of case. Nevertheless, the CAPM test inspires to the FAMA and Macbeth (1993) techniques have showed an absence of allowance for risk.

Though some large studies often contradictory about the CAPM, this method always bring up certain problems:

• The Hypothesis are very simple (possibility to invest and to loan at rate without risk; existence of financials assets only; homogenous taxation between assets; not cost of transaction);

• It is very difficult or even impossible, to determine the "truth" portfolio of the market: the one which contain all the risky assets (action, obligation, raw material, property, human capital, etc.);

• It exist many betas for the same value, each one give the sensibility at a macroeconomic factor (pricing theory).

However, the fundamental reasoning is always good: the allowance for risk on the stock depend of the systematic risks support by all.

POSTER

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Using the Stochastic EM algorithm to validate mixture analyses

Estimating the number of components in a mixture model is a difficult and not fully solved problem, since regularity conditions concerning the likelihood ratio test statistic ? are not valid any more, for 2log(?) to have its usual asymptotic null chi-square distribution.

The approach on which we will concentrate is based on a stochastic version of the well-known EM algorithm, called Stochastic EM (SEM), which was built specifically in order to deal with the mixture problem. The SEM algorithm inserts a stochastic step between the E-step and M-step of EM, thus making the method less sensitive than EM to saddle points and local maxima.

This algorithm and its theoretical properties have been fully described in the literature, but we will state here the main results and also present a few simple simulations we performed, in order to show the method's good ability to estimate parameters in the mixture context, especially for large sample sizes.

Furthermore, a procedure that appeared in the literature, uses SEM in order to investigate the adequacy of the estimates for the number of components provided by some other method, in the case of large sample sizes.

In order to implement the method, the estimated parameters-which are to be tested- are taken as starting values for SEM, and successive SEM iterates are recorded, in order to be used in the procedure. Then it has been stated that the theoretical properties which are derived for this procedure are based on the approximate asymptotic independence of the aforementioned SEM iterates.

We argue about that, and we present a few simple simulation results which are in favour of our approach. Finally, we also present a result which is only valid as the number of SEM iterations increases to infinity.

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Statistical analysis of child labour and schooling in Ghana

Child labour is a widespread and growing phenomenon in the developing world. International Labour Organization, ILO (1996a) estimates put the prevalence of child labour as 250 million in the World, out of which 61 per cent is in Asia, 32 per cent in Africa and 7 per cent in Latin America.

The same source also indicates that 120 million children are full time workers and 80 per cent of them are between 10-14 years of age. In terms of child labour force participation rates Africa ranks highest with 33 per cent in East Africa, 24 per cent in West Africa and 22 per cent in middle Africa, followed by East Asia and South Asia with 20 and 14 per cent respectively.

The above information indicates the intensity of child labour and the necessity to address it, in order to eliminate its adverse effects on human capital development and the future growth potential of developing countries.

POSTER

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Conditionally Heteroskedastic Seasonal Dynamic Factor Analysis for forecasting electricity prices and their volatilities

Nowadays, in competitive markets, there are two ways to trade with electricity: bilateral contracts and the pool. As far as bilateral contracts are concerned, what is interesting is to reduce the risk that they imply.

This can be done by forecasting electricity prices with a horizon that covers, at least, the length of the contract, usually one year, which means long-term forecasting. The other scenario to trade with electricity is the pool, in which both the generating companies and the consumers submit to the market operator their respective generation and consumption bids for each hour of the forthcoming day.

Having short-term accurate forecasts helps the producers schedule the production of their units for profit maximization. Besides, lectricity prices present the special feature of having structure both in mean and variance.

In this work the Seasonal Dynamic Factor Analysis proposed by Alonso et al. (2008) is applied and extended. We allow unobserved common factors to have ARCH disturbances, considering that ARCH effects can be handled in state-space formulation, where the conditional teroscedasticity may be present in either the measurement or transition equation errors, as proposed in Harvey, Ruiz and Sentana (1992).

The new model developed is applied to forecasting electricity prices and their volatilities.

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Comparison of two extended activities of daily living scales with the Barthel Index – cohort study within the South London Stroke Register (SLSR)

Objectives

To compare the Frenchay Activities Index (FAI) and Nottingham Extended Activities of Daily Living (NEADL) scale with the Barthel Index (BI) and to find out whether the same predictors explain the variation of the three scales.

Methods

Survivors from a population-based first-ever stroke cohort (n=238), within the South London Stroke Register (SLSR), were assessed with BI, FAI and NEADL 3-months post-stroke. The scores from each scale were transformed to a 0-100 range. The relationship and agreement between each pair of scales were studied using scatter plots, fractional polynomials and Bland and Altman plot. Effects of some baseline variables were investigated using negative binomial regression.

Results

The median total score for BI, FAI and NEADL were respectively 90, 24 and 49. BI was most affected by a ceiling effect (33% had the highest possible score) and FAI was most affected by floor effect (19%) but NEADL was least affected by both floor (4%) and ceiling effect (4%). The FAI and NEADL agreed partially with BI for the highest and lowest level of activities while there was substantial disagreement for average/medium active patients. The agreement of NEADL with BI was higher than that of FAI with BI. The National Institute of Health Stroke Scale (NIHSS) was the only universal predictor for all 3 scales suggesting a good predictor for future functional status.

Conclusions

NEADL scale had the lowest floor and ceiling effects in a general stroke population. The agreement and correlation between NEADL and BI were higher than those between FAI and BI. Given these advantages, NEADL might be advantageous compared with a combined score based on BI and FAI as suggested in the literature. NIHSS can be used to predict 3-months post-stroke functional status.

POSTER

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Modelling volatility of stock prices on the Nigerian stock exchange

This paper examine and obtain estimates of volatility of stocks prices in the banking sector of the Nigerian stock market with a view to building models that provides the optimum forecast for future stocks using the ARCH and GARCH models.

It seeks to measure volatility in equity prices of some commercial banks in the Banking Sector of the Nigerian stock exchange using the BIC and AIC criteria to check model adequacy. The data on stock of five major banks in Nigeria show varying degree of volatility, the share prices for Access Bank Plc does not indicate strong evidence of volatility which implies that the stock of Access bank is relatively stable among the banks considered.

The First bank share prices appears to be non-stationary and it unconditional variance is not finite suggesting that Fist bank shares may belong to the Integrated Generalized Autoregressive IGARCH (1,1) model.

This study show a general persistence in the volatility of the stock prices in the banking sector with some few exceptions that exhibit relative tranquility in their stock prices which could be attractive to investors

Keywords: stock prices; ARCH; GARCH; volatility; banking sector

POSTER

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We consider the problem of using routinely collected primary care data to monitor the progression of undiagnosed incipient renal failure in a large sample of people in primary care. Progression is characterised by a sustained rise in serum creatinine, as determined from blood samples. A typical level in an adult with two healthy kidneys would be around 50 units, whereas a subject in acute renal failure could expect to return values in excess of 1000 units.

Many specialist renal treatment centres are now using estimated glomerular filtration rate (eGFR) as an alternative to serum creatinine. The eGFR tends to decrease naturally with increasing age, and to vary unpredictably for other reasons, for example in response to changes in a person's general level of fitness. Nevertheless, an unusually sharp decrease is considered to be a useful predictor of kidney failure; current guidelines suggest that a rate of change of 5\% per year or more is indicative of a need for specialist treatment.

Our data are obtained from one UK treatment centre. They consist of an irregularly spaced time series of eGFR measurements on each person together with a number of explanatory variables including each person's age, any relevant co-morbidity and medication. We shall formulate and fit a dynamic regression model for the data, in which the rate of change of eGFR over time is modelled as a continuous-time stochastic process $C(t)$, an integrated Random Walk.

Conditional on a subject-specific i and a time-specific rate of change $C_i(t_{ij})$, the model for the time-sequence $Y_{ij}:$ $j=1,...,n_i$ is that $$Y_{ij}=\alpha_0+\alpha_1\times x_i+\alpha_2\times \mbox{min}(0,x_i-65) +U_i+C_i(t_{ij}) +Z_{ij} \quad : \quad j=1,...,n_i ; i=1,...,m$$ where, $C_i(t_{ij}) = \int_0^{t_{ij}}B_i(u)du$, with $B_i(u)$ a Brownian motion. The Z_{ij} are mutually independent, $Z_{ij} \sim N(0,\tau^2)$, the subject specific random effects U_i are mutually independent realisations of the distribution $U_i \sim N(0,\nu^2)$. Finally, the starting value for $B_i(0)\sim N(\beta,\omega^2)$ and the process $B_i(t)$ evolves over time as Brownian motion, hence for any $t\geq u$, $$B_i(t)|B_i(s)\sim N(B_i(s),(t-s)\sigma^2).$$

The parameter α_2 reflects the apparent change in the rate of pregression above age 65, as seen in preliminary analysis. Two different time metameters are also used, age and time since first measurement, to admit the possibility that the cross-sectional and longitudinal effects of age may be different, i.e. $\beta \not= \alpha_1$.

We then use the model to make predictive inferences for the current rate of change in eGFR. Considering a subject i with initial age x_i, who provides measurements of eGFR at time $t_{ij}:j=1,...,n_i$. For any $k\leq n_i$, let $Y_i^k=(Y_{i1},...,Y_{ik})$. The main goal is to evaluate the conditional distribution of $C_i(t_{ik})$ given Y_i^k.

POSTER

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Multi Sensor Image Fusion with Singular Value Decomposition

Design of spacecraft systems within the frame work of data transmission constraints is a challenging activity for acquiring very high resolution satellite data; an increase in spatial resolution leads to an exponential increase in data volumes. Digital image analysis including statistical pattern recognition is being increasing used on fused imagery from multiple sensors.

Recent advances in image processing facilitate fusion of hyper spectral remote sensed imagery with a synoptic coverage of large areas with panchromatic or multi-spectral data that is of much higher spatial, spectral and temporal resolutions. Deployment of very high resolution satellites with along track stereo imaging capabilities (IRS Cartosat, Spot etc) has facilitated geo-scientists to map and visualize spatial details of large areas in 3D in almost real time (with a latency associated with time difference between imaging sensors).

Image analysis with transformations like singular value decomposition is extremely useful in areas of object recognition and facilitates monitoring of structural changes over space and time. In the present study, singular value decomposition is applied on raw images of pan and mss sensors of Quickbird data to generate fused images at 0.6 meters resolution using inverse mapping photogrammetric equations as a single stage process unlike other multi-stage processes generated with “system corrected” products. Since, fused images from raw data are resampled only once, the geometric and radiometric fidelity of the fused images is very sharp.

The applicable image fusion processes are detailed with an example of how canopy cover may be estimated from “trees –off –the forests” in urban areas. It is observed that principal component substitution performs remarkably well and does not admit of “spectral distortion” problems as noted by many other authors.

Visual analysis indicates that this methodology does not introduce artifacts while domain experts indicate that digital classification accuracies on selected themes are far superior to polynomial methods. In addition, multi sensor fusion adopting photogrammetric techniques permits rectification of terrain relief (ortho rectification) that are easily interfaced to Virtual reality systems for creating 3D colour composites from multi-spectral and hyper spectral imagery in geographic space.

Thus, a user can choose that particular representation that is most appealing to him/her and can travel through space and time to understand the influences of structural changes, navigate inside data, interact with the objects in the world, change scales, perspectives, as a part of living experience.

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Modelling prepayment risk

The talk will review approaches for modelling prepayment risk in a bank's mortgage book from a statistical perspective.

We look at data from the mortgage book of a large bank, and identify the key factors that determine the likelihood that borrowers prepay their mortgage early, taking into account issues such as penalty for prepayment, the economic incentive to refinance the mortgage (e.g. higher prevailing interest rates in the market) and seasonality among others.

The prepayment behaviour of borrowers will be modelled through a proportional hazards model using a nonparametric baseline hazard. The talk will discuss the statistical challenges of doing this for a short data history. It will also provide the main statistical findings such as the impact of a prepayment penalty or the refinancing incentive.

POSTER

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Comparing different methods of smoothing parameter selection in hazard rate estimation

Kernel type estimators can be used to estimate the hazard rate nonparametrically. This class of kernel estimators can be divided into the so-called internal and external estimators. However implementation of this estimators depends on the choice of a smoothing parameter.

Tanner and Wong (1984) proposed a maximum likelihood cross-validation method for uncensored hazard estimation. Least squares cross-validation was adapted to censored hazard estimation by Patil (1993). A bootstrap method based on an asymptotic representation of the mean weighted integrated squared error was proposed by Cao, Conzales-Manteiga and Marron (1996).

The purpose of this presentation is to discuss and compare the different methods by means of an empirical study.

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POSTER

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Hierarchical modeling of adult age-at-death in paleodemography

The inquiry of an adequate method for the estimation of age-at-death from human skeleton samples is a topic of considerable interest in paleodemography ("Paleodemography", edited by Hoppa & Vaupel, 2002).

In the past 20 years, many different approaches have been developed which exploit the information from reference samples constituted by known-age skeletal material to obtain age-at-death estimates from human skeleton remains. See Samworth and Gowland (2007) for an examination of the statistical assumptions underlying the estimation methods.

We propose a novel hierarchical model for estimation of age-at-death in paleodemography. The model incorporates the possibility of misclassification of anthropologists when scoring the senescence of bone ages in ordinal classes.

For the purpose of illustration, we analyse data of auricular surface and pubic symphysis of known-age skeleton remains in Spitalfields, London and from the Coimbra Identified Skeletal Collection, Portugal.

POSTER

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Joint modelling and forecasting of mortality tables

We are concerned with the joint modelling of a number of mortality tables. We propose an additive model in the generalized linear array model or GLAM framework: the first component is a smooth 2-dimensional surface and the remaining components are smooth age dependent curves which are constant in time. The poster will describe four applications of the method.

1) We compare male and female mortality over time. It is well known that female mortality is lighter than male mortality and the method gives an economical summary of the difference between the two mortality surfaces.

2) We compare the mortality (male) of a number of European countries. Again the method gives an economical summary of the differences between countries.

3) Mortality data from insurance companies can come in two forms: (a) deaths are claims and lives are number of policies, or (b) deaths are amounts of claim and lives are policy amount. It is well known that mortality by amounts is lighter than mortality by lives. We use mortality data provided by the UK insurance industry to illustrate our models.

4) The model has a particular advantage when we consider forecasting since built in to the model structure is the property that forecasts of mortality for different mortality tables will be consistent. We illustrate forecasting with the model for both national mortality data and for insurance data by lives and amounts.

Our work is based on smoothing with P-splines. Our models, when expressed as additive generalized linear models (GLMs are computationally heavy; the GLAM structure allows compact model formulation and the GLAM algorithms enable the computations to be performed efficiently.

POSTER

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Using the Latent Risk Time series approach for modelling road casualties in Great Britain

In 1987, the Government set its first ever numerical target and this related to road safety. The target was to reduce the number of road accident casualties in Great Britain by one third by 2000. As the target year of 2000 approached, TRL research played a central role in planning for post-2000 targets. Standard statistical techniques such as regression and General Linear Modelling were used to generate these forecasts, concentrating on one series and treating other factors as independent variables.

There are some fairly basic assumptions that are violated in using these techniques to analyse time series data, such as the assumption the errors in the observations are independent. Researchers at the Institute for Road Safety Research in The Netherlands have developed a multivariate time series model, called the latent risk model.

This state space technique simultaneously models exposure to an event and risk of the event occurring, by splitting the time series into several components and allowing those components to vary with time, making this technique far more suitable for modelling road casualty data. Explanatory and intervention variables, such as the introduction of the British seat belt law in 1983, can also be included as components.

This model has been applied to 27 years of road casualty data from Great Britain to assess the benefits and practicality of applying these advanced statistical techniques to this complex dataset.

POSTER

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Frequency matching and balance as design strategies in case control studies

Frequency matching and using two-stages of sampling are both well-established strategies aimed at improving the efficiency of case-control studies. For design, generally robust approaches are typically used and little is known about the optimal design of these studies.

We systematically examine the efficiency loss when using robust traditional frequency matched and balanced two-stage designs. By adapting a semi-parametric maximum likelihood method developed for the analysis of two-stage case-control studies (Scott & Wild, Biometrika, 1997), an expression for the asymptotic variance of both designs has been derived and used to find optimal designs for studies with arbitrary number of strata.

For frequency matching, the asymptotic efficiency of optimal and traditional matched designs are compared. For two-stage designs equivalent comparisons are made between optimal and balanced second stage designs.

POSTER

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Computational and statistical aspects of pricing models

Based on the analysis of the real market data, a simple and realistic model for share price is suggested. Monte Carlo simulations show that our model gives higher share option's payoff then the corresponding Black-Scholes model.

Other properties such as the homogeneity and the embedding problem (a la Elfving, Kingman, Rosenthal and which seems to be an NP-hard problem) are considered for our data as well.

This is joint work with Sergey Utev (University of Nottingham).

POSTER

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New directional statistics for patterns in protein and RNA structure

There are many statistical challenging problems in protein and RNA Bioinformatics. We can regard the backbone of a typical protein as an articulated object in three dimensions with fixed bond lengths between successive amino acids. Hence it can be viewed as a long time series (with hundreds or thousands of amino acids), where all the information lies in the angles between successive bonds.

There are two types of angles: bond or planar angles, analogous to colatitude, which are nearly constant here; and dihedral angles, analogous to longitude, which contain all the information. Thus the basic protein description is reduced to a circular time series. There is also further angular information coming from side chains.

The aim is to find patterns in such data (see for example, Boomsma, Mardia, Taylor, Ferkinghoof-Borg, Krogh and Hamelryck, Proceedings of the National Academy of Sciences, 2008). This poster will give new methods and visualisation tools, including circular principal component analysis and clustering, together with examples. A similar analysis can also be carried for the structure of RNA molecules.