



**John Pullinger**

## Statistics making an impact

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**Summary.** Statistics provides a special kind of understanding that enables well-informed decisions. As citizens and consumers we are faced with an array of choices. Statistics can help us to choose well. Our statistical brains need to be nurtured: we can all learn and practise some simple rules of statistical thinking. To understand how statistics can play a bigger part in our lives today we can draw inspiration from the founders of the Royal Statistical Society. Although in today's world the information landscape is confused, there is an opportunity for statistics that is there to be seized. This calls for us to celebrate the discipline of statistics, to show confidence in our profession, to use statistics in the public interest and to champion statistical education. The Royal Statistical Society has a vital role to play.

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### 1. Introduction

Dictionaries trace the source of the word statistics from the Latin '*status*', the state, to the Italian '*statista*', one skilled in statecraft, and on to the German '*Statistik*', the science dealing with data about the condition of a state or community. The *Oxford English Dictionary* brings 'statistics' into English in 1787. Florence Nightingale held that 'the thoughts and purpose of the Deity are only to be discovered by the statistical study of natural phenomena... the application of the results of such study [is] the religious duty of man' (Pearson, 1924).

Statistics is about matters of the highest importance in human affairs. It is about our comprehension of the world around us and how that comprehension affects the lives we live: our health, wealth and wellbeing; our understanding of the state of our planet and the condition of our local communities; our choices at work and at play.

In this address I shall explore the interface between statistics and decision making. I shall identify the principles which give statistics its extraordinary ability to shape our thinking about how we view the world. I shall highlight the leading role played by the Royal Statistical Society in developing the discipline and the profession of statistics since 1834 and draw attention to why it matters so much at this time.

I shall conclude with a call to action for statistics to give people the power to make good choices. A call that chimes with the objectives of this, the International Year of Statistics (see <http://www.statistics2013.org/about-us/>), which is being promoted by the American Statistical Association, the Institute of Mathematical Statistics, the International Biometric Society and the International Statistical Institute (and the Bernoulli Society) as well as the Royal Statistical Society along with over 2000 other organizations around the world:

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- (a) to increase public awareness of the power and impact of statistics on all aspects of society,
- (b) to nurture statistics as a profession, especially among young people, and
- (c) to promote creativity and development in the sciences of probability and statistics.

## 2. Statistics and decision making

When we make decisions we draw on a variety of conscious and subconscious processes.

Politicians, advertisers and others know this. They know our biological needs and desires. They appeal to our emotions, what makes us feel good or bad about ourselves. They tap into our beliefs, the deep, spiritual, guides that tell us what is right or wrong. They present rational arguments, science or facts that back up their claims.

We also know this. In the decision-making market there are many buyers and many sellers trading emotional, spiritual and rational claims to our choices. As with any market, it is good information that makes a level playing field that is fair to all players. Statistics provides a special kind of understanding that enables well-informed decisions. It appeals to our rational side. Our heads providing a balance to our sometimes wayward hearts.

Evolution has taught us to spot patterns. Those best placed to identify the unusual have had a competitive advantage in outwitting predators. Our children see shapes in the clouds. Civilizations throughout history have celebrated order, cycles of the moon, architectural principles of length and height. Statistics can help us to interpret which patterns have meaning and which do not.

Life is a lottery. Those best placed to play the odds are more likely to come out on top. Statistics can help us to assess risk and to stay the right side of foolishness.

An easy choice is no choice at all. It is the tough ones that matter. How many birds in the bush are needed to trade my bird in the hand? What is the choice that gives the greatest benefit for the smallest cost? How much should we pay to save a life? We may find such calculation morally hard to stomach, but statistics at least gives us the tools to calculate well.

There is also something about numbers that gives them psychological power. If an argument is illustrated with a number it sounds like it is evidence based. Eight out of 10 cats prefer it. Statistics and statistical thinking help us to ask which cats, did they really prefer it and prefer it to what?

Statistical thinking also gives us the *nous* to know the limits of what can be calculated. Anyone seems to be able to come up with a number these days. What does it really mean? Does it mean anything at all? Is it just confusing us, trying to pull the wool over our eyes?

However, our use of language betrays an antipathy to statistical thinking. Something is 'just a statistic': cold; impersonal; not something that resonates with warm, human feelings. But this reaction misses something profound. Nobel Prize winning psychologist Daniel Kahneman provides many scare stories from all walks of life showing how poorly we are served if we fail to engage our statistical brain (Kahneman, 2011).

Statistics are essential to good decision making.

## 3. History of statistics and power

Power structures are different in different places and at different times: autocratic states; enlightened states; citizen states. Power can shift. The role of statistics shifts with it.

Statistics acquired its name as the science of the state because it was used by the autocrats of the day to exercise their power. How many men can we extract from this village to carry arms in our next war? How much tax can we levy to keep the coffers full?

With force, any ruler can press men and extort taxes. The smart ruler works out how many men can be pressed and how much tax can be extorted this time to leave enough for when he wants to come back again next year: and the year after; and the year after that. For that he needs facts, calculation, statistics.

The successful emperor or despot knew how to run a census. He knew how to tally. He knew how to create a *Domesday Book*. He knew how to collect records of births, marriages and deaths, of imports and exports, of money and tax and more. The statistician, in the service of the powerful, held a privileged position, as counsellor with the special ability to inform decisions of state.

It is interesting, however, that the word statistics came into common usage just as autocracy was falling out of favour in western nations. As the divine right of kings (and occasionally queens) was challenged, new forms of government were tried. The Enlightenment provided a fresh way of looking at the world. So also was this statistics, this science of the state transformed into the science of the new sources of power.

Statistics shifted in usage from being about 'ascertaining the political strength of a state' to being about

'an inquiry into the state of a country for the purposes of ascertaining the quantum of happiness enjoyed by its inhabitants and the means of its future improvement' (Sinclair, 1798).

The 19th century was the dawn of the era of evidence-based policy. The tools of statistical inquiry were turned to the service of the new enlightened, constitutional governments. How can we use statistics to gain new understanding of the quantum of happiness enjoyed by the people and how their lot might be improved?

The earlier theoretical insights of John Graunt, Thomas Bayes, Blaise Pascal, Carl Friedrich Gauss and others found ever growing practical expression through members of the Royal Statistical Society and kindred spirits throughout the Victorian era and since. Those seeking to assess the case for change and to give it voice would turn to statistics. Statistics would have a major part to play in the laws proposed by governments. As ideas of state power shifted from controlling subjects to improving the lives of people so also did the role of statistics.

But this shift was not just about new ideas of the state but more generally about a shift in power structures. Before the 19th century, power beyond the state rested with a small number of others—the church, large landowners and the early plutocrats of the industrial revolution. As the 19th century progressed the idea of the consumer gathered momentum and throughout the 20th century the power of the industrial revolution was increasingly channelled into the mass production of goods. The world of statistics had an impact here also in the service of organizations seeking to satisfy these needs. A potent expression of this is the work of W. Edwards Deming and his role in the rebuilding of the Japanese economy after 1945.

Statistics gave the new enlightened constitutional governments and consumer-orientated businesses and institutions a special kind of power.

I think that we are in the middle of a new transition. The implications for statistics will depend on what happens, but current directions call us to invest in new thinking about our idea of statistics and how it makes an impact.

#### **4. Statistics and citizenship**

The current shift in the idea of the state that is taking place in many parts of the world relates to the role of the citizen. In those countries where democracy is new, the idea of citizen power

is seen regularly on our television screens. We see it in demonstrations, in lengthy queues for polling stations and in Twitter-led uprisings.

In those countries where democracy is older, the role of the citizen is also changing. The reality is still messy and unclear but the rhetoric is creating new expectations: devolution; decentralization; localism. All claim to move power closer to the citizen. We, as citizens, are being asked to choose—which school, which hospital, which Police and Crime Commissioner?

Some see an Orwellian cloak masking a return to autocracy: a destruction of tried and tested mechanisms for democratic accountability leaving a gap to be filled by new concentrations of power; power beyond reach of carefully constructed checks and balances that respect a rich diversity of interests.

However, in no lesser way than in new democracies, a new force has been unleashed. The rhetoric has created an expectation. At the same time, the Internet, giving more ability for citizens to gather information and to transact directly and immediately with the state, is a game-changing force. Democracy is being democratized. Its power is expanding from the few elected as representatives. Democracy is now continuously engaging the many those elected seek to represent not just resting on a voice at the ballot box once every few years.

In recent years the Freedom of Information Act, the move to ‘open data’, the Statistics and Registration Service Act have all been expressed as giving power to the citizen: information available for the public good. Information is no longer viewed as the property of the ruler, used to control. Information is no longer viewed as the property of the government acting as your representative. Information is the property of the citizen.

Similarly, the rise of service industries replacing manufacturing industries as the core of economic activity is associated with a move of power from the producer of goods to the user of services. Technology is further transforming the nature of the relationship, with consumers having the ability to co-design the goods and services they receive.

Here also some see the smiling faces of Apple, Facebook, Google and Tesco as cover for a concentration of power. But as consumers we have been told that it is we who should have the power. We are becoming more vocal in demanding it.

Information is at the heart of these changes. The information now in the hands, or potentially in the hands, of the citizen and consumer is reshaping the nature of the relationship between citizen and state and consumer and business.

The information revolution can take power from the provider and give it to the user. But if, for whatever reason, that power is not exercised by citizens, the vacuum will be filled by others with a vested interest in using information to accumulate power for themselves.

In other words, in today’s world, statistics can give citizens a special kind of power. But to exercise that power we need the ability to analyse information, to be confident and competent in statistics. That requires both a personal competence and intermediaries whom we trust to do the ‘heavy lifting’ on our behalf where we do not have the time or energy to do it ourselves.

As citizens we shall be looking to institutions that protect our interests by helping us to access the information we need and helping us to judge whether a claim can be relied on or not. The Information Commissioner, *Which* magazine, the UK Statistics Authority, Full Fact, the Royal Statistical Society and many others have fundamental roles to play.

We are still at an early stage in thinking through the implications. There are plenty of horror stories, in Goldacre (2012), for example. However, as each month passes, and helped in no small measure by campaigning voices such as his, the power of statistics is becoming increasingly more available to the citizen. There is a flow that is running ever faster.

A pathway is being built to a future where as citizens we can access, either directly or through

others, the full range of data relevant to our individual situation. As Ben Goldacre himself says ‘unmediated access to niche expertise is the future’ (Goldacre, 2008).

David Hand put it this way: what statistics does is enable knowledge of the many to be focused down to improve the lot of the one (Hand, 2009).

Signs on each bus stop predict how long before my bus will arrive, giving me the chance to decide whether to wait or to start walking. There are mobile device applications which give me realtime information about when the bus is due. Dramatic improvements in weather forecasting tell me the chance of rain or shine in my locality, or anywhere I might be going. The information that is relevant to me is available to me. I can use it without difficulty.

In other areas the necessary skills may not yet be so readily to hand. I want my doctor to give a view of what is the best treatment given my particular situation but I also want to understand the balance of risks of alternative options. I want to take the decision based on the evidence. How well equipped am I to do this?

Court cases sometimes rest on the ability of a jury to comprehend the likelihood of a rare event occurring by chance. This is a scary responsibility for many. How well are jurors prepared and supported?

Power is shifting from producers of information to its users. In the case of bus trips and weather forecasts the users are receiving it in forms that they like and can use. In the case of medicine most people seem to like the opportunity but maybe do not yet have the resources or skills to make the best of it. In other cases, like the law, the jury, perhaps, is still out.

The data landscape is evolving rapidly. Our statistical brains need to be nurtured if we are to thrive in these new habitats.

## 5. Principles

The roots of the word statistics and the story of how statistics affects our lives provide pointers about how we might proceed.

We can all learn and practise some simple rules of statistical thinking.

Statistics are provisional. Findings can always be improved. We must be willing to recognize the validity of the figures that are available today but ready to applaud rather than criticize when tomorrow there is better information available through which to revise them.

Statistics are uncertain. We should be sceptical of those peddling impossible guarantees, rather than demanding them, and celebrate those who tell us about risk and imprecision.

Statistics aim for impartiality. In a world of spin, where numbers are used to substantiate assertions rather than illuminate reality, we must be doggedly determined to root out bias and to ask ourselves whether something is really what it seems.

Statistics help us to join the dots. We must be modest in jumping to conclusions about cause and effect but appreciate the real value that comes from finding patterns that help us to ask good questions.

Everyone can do this. But not everyone can be a statistician. We need also to appreciate that those who are statisticians abide by principles of professionalism that should give confidence in what they say. We should look carefully at the provenance of statistical claims to see whether they are coming from people or organizations that have signed up to the necessary standards of conduct and have the necessary technical training and degree of expertise.

The principles of statistics have been captured in a variety of ways. The late Roger Jowell, who was a great mentor to me and an inspiration to many, was the leading light in the development of the International Statistical Institute’s code of ethics (International Statistical Institute, 2010). Within this code is a set of ethical principles which set a high bar for professional conduct:

- (a) pursuing objectivity, without fear or favour and guarding against ‘predictable misinterpretation or misuse’;
- (b) clarifying obligations and roles, statisticians should take care to stay within their area of competence, and to seek advice, as appropriate, from others with the relevant expertise;
- (c) assessing alternatives impartially, assessing the respective merits and limitations of alternatives;
- (d) avoiding financial or personal conflicts of interest, exploring the likely consequences of collecting and disseminating various types of data and results;
- (e) rejecting any attempt to establish a predetermined outcome, including contractual conditions contingent on such an outcome;
- (f) guarding privileged information, although this prohibition is not to be extended to statistical methods and procedures utilized to conduct the inquiry or to produce published data;
- (g) exhibiting professional competence, upgrading professional knowledge and skills;
- (h) maintaining confidence in statistics, alerting potential users of the results to the limits of their reliability and applicability;
- (i) exposing and reviewing methods and findings through independent assessment;
- (j) communicating ethical principles;
- (k) bearing responsibility for the integrity of the discipline, not deceiving or knowingly misrepresenting or attempting to prevent reporting of misconduct or obstructing the scientific or scholarly research of others;
- (l) protecting the interests of subjects against potentially harmful effects of participation, including keeping confidential identities and records of all subjects or respondents.

These requirements are echoed in other documents, e.g. the ‘Fundamental principles of official statistics’ (United Nations, 2007). It is relevant to note that the origin of these fundamental principles was to help in ‘redefining the role of official statistics’ in those countries in central and eastern Europe with new democracies. Adopted first in Europe, the principles were quickly recognized to have wider significance and in 1994 were adopted by the United Nations Statistical Commission: ‘the highest statistical authority in the world’.

And, closer to home, the Royal Statistical Society code of conduct, commended to all Fellows and mandatory on all professionally qualified Fellows, sets out principal duties in regard to

- (a) the public interest,
- (b) duty to employers and clients,
- (c) duty to the profession and
- (d) professional competence and integrity.

The professional statistician offers users of statistics confidence in the provenance of and conclusions from the data.

## **6. The place of the Royal Statistical Society**

To understand how statistics can play a bigger part in our lives today we can draw inspiration from our forebears who lived through the 19th century transition from statistics as the tool of the autocrat to statistics in the service of constitutional government, making laws to improve the lot of the people, and in the service of other organizations and institutions in science, the arts, business and elsewhere, concerned with deepening our knowledge and appreciation of life and the universe.

The founding fathers of the Royal Statistical Society took the sheaf of wheat as their symbol to show that their passion was to gather the data, so that they could be threshed to reveal the golden corn, the value hidden in the fields that lay all around them.

The Royal Statistical Society is one of the oldest statistical societies in the world. It was born following a presentation in 1833 by the Belgian statistician Adolphe Quetelet which prompted the British Association for the Advancement of Science to establish a statistical section. The following year the statistical section established a society, appointed its first officer and elected its first Council with the Marquis of Lansdowne as its first President. Prince Albert became its first Royal patron in 1840.

Among the first 313 members, at 80 years of age, John Sinclair was an elder statesman. His 21-volume *Statistical Account of Scotland* was based on detailed data collection and analysis. It was a portrait of a nation, beautifully written as well as scientifically rigorous, designed to help to assess the 'quantum of happiness' among the people and to find ways to improve their lives. He was a Member of Parliament for almost 30 years and expert in finance, agriculture and economics. His statistical thinking provided a basis for practical improvements to the law at Westminster, the economic and social wellbeing of Scotland and the agricultural practices on his own estates.

Charles Babbage is perhaps the most well-known of the founders. Lauded as the inventor of the computer he was also an astronomer, mathematician, mechanical engineer and philosopher. His insight, behind the birth of the computer, was that calculations were fraught with human error. By mechanizing calculation, error could be reduced, precision improved and conclusions reached with more confidence: statistical thinking driving world changing technological change.

Thomas Malthus is another hero among the founding group. His *Essay on the Principle of Population* has had a profound influence on policy and thinking. The eponymous Malthusian idea that population growth is exponential, but the ability of the land to grow crops to sustain the population is linear, gave impetus to the fledgling science of demography and the social improvements arising from analysis of data from censuses and from registration of births, marriages and deaths. His idea is also linked to the thinking of Charles Darwin and Alfred Russel Wallace as they grappled with the idea of natural selection.

John Elliot Drinkwater worked in Parliament as an administrator and had a strong affinity with libraries but it is his commitment to the education of girls in India that marks him out. He is better known as John Elliott Drinkwater Bethune, founder of the famous Bethune school in Calcutta. Ahead of his time, Bethune's passion for knowledge as a force for human progress is a beacon for the statistical profession today.

Richard Jones was an economist, well known for his *Essay on the Distribution of Wealth and on the Sources of Taxation*. He rejected the idea of the 'economic man' hailed in classical economic theory. His study rested instead on observation of facts and appreciation of history. His work was careful to avoid reaching stronger conclusions than the facts support. Born in Tunbridge Wells, where Thomas Bayes had lived, and like him a local clergyman, his work shows the value to statistical thinking of being grounded in the real world, the quirkiness of places and human nature, rather than the abstracted world of theory. He hosted the meeting at Cambridge where Adolphe Quetelet spoke and described statistics as dealing with 'mankind and their concerns'.

Henry Hallam was a historian and his *Constitutional History of England* became a standard text renowned for its meticulous use of source material. Although he was never a politician he was associated with important social campaigns, not the least of which was the abolition of the slave trade. Henry Hallam's presence among the founders illustrates the breadth of appeal of



the Society and of statistics. Along with Charles Babbage, John Elliot Drinkwater and Richard Jones he was a member of the original committee of four, appointed to prepare regulations for the new Society. He became its first Treasurer.

And, finally, we come to the first President of the Society, Henry, the Third Marquis of Lansdowne. Henry entered the House of Commons in 1802 and went on to have a Ministerial career spanning almost 50 years serving as Chancellor of the Exchequer, Home Secretary and (three times) as Lord President of the Council. Recognized for his wisdom and lack of political dogma he was a frequent counsellor to Queen Victoria. As the leader of the august body of founders of the Royal Statistical Society, he was an iconic symbol of the link between statistics and state and of the role of statistics at the heart of decision making.

The idea of Charles Babbage, Thomas Malthus, John Elliot Drinkwater, Richard Jones, Henry Hallam and Henry, Third Marquis of Lansdowne, sitting in a room at the first meeting of the Royal Statistical Society amply serves to illustrate the thesis that statistics has a wide appeal and matters greatly to us all.

From those first meetings of the founding fathers, the lineage of the Society stretches forwards both as a beacon and as a challenge to their successors today.

As if to make the point, Lord Lansdowne was the first person to be re-elected as President (1842–1843) and also paved the way for other leading politicians subsequently to become President, including William Ewart Gladstone (1867–1869), while he was also Prime Minister, and Harold Wilson, while Leader of the Opposition (1972–1973).

Florence Nightingale, the first female member of the Society, elected in 1858, needs no introduction. She illustrates the deep link between medicine and statistics exemplified also by William Guy (President from 1873 to 1875), whose memory lives on in medals awarded by the Society for outstanding contributions to statistics, and Austin Bradford Hill (President from 1950 to 1952), who pioneered the randomized clinical trial and, with Richard Doll, demonstrated the link between cigarette smoking and lung cancer.

For me, although not wishing to diminish the contributions of so many others, a few other Past Presidents also stand out as inspirations to guide our future ambition for statistics.

I start with Charles Booth (1892–1894) for his passion to eradicate poverty, for his role in the introduction of the old age pension (following the 1908 Old Age Pension Act) and for his wonderful statistical maps. He turned down offers to enter politics, considering that he would have more influence by educating the electorate than by being a representative in Parliament (Booth, 2013).

Next is Arthur Lyon Bowley (1938–1940) for being the first Professor of Statistics, being a pioneer in bringing sampling into social surveys and his role in the definition and measurement of national income (Allen and George, 1957).

Following we have William Beveridge (1941–1943) for his ability to appeal across the political spectrum to fight the ‘giant evils’ of want, disease, ignorance, squalor and idleness. His arguments for national insurance and the National Health Service were based on their positive effect on British competitiveness as much as on a system that would provide a minimum standard of living ‘below which no one should be allowed to fall’. His legacy to the Royal Statistical Society is recalled through the Beveridge Lectures (<http://www.rss.org.uk/site/cms/content/CategoryView.asp?category=236>).

Then comes Ronald Fisher (1952–1954) for creating the foundations of statistical method—design of experiments, maximum likelihood, analysis of variance—as well as population genetics (Yates and Mather, 1963).

Next is Stella Cunliffe (1975–1977), our first female President, who died in 2012 at 95 years of age, for her determination to bring the power of statistics to bear on the most difficult decisions

of the day, in her case advising the Home Secretary on issues of crime and punishment, including the abolition of the death penalty.

Lastly we have Claus Moser (1978–1980) for his statistical story and his creation in 1970 of the publication *Social Trends*, which was famously launched in the drawing room of No. 10 Downing Street in the presence of Ted Heath, the Prime Minister, and a string quartet. As Head of the Government Statistical Service, Claus said

‘statisticians. We are part of policy. Part of the management of the nation. What could be more important?’

(quoted in Ward and Doggett (1991a)).

More recently, in the run up to and since the merger between the Royal Statistical Society and the Institute of Statisticians in 1993, we have been well served by a sequence of Presidents who have built up the Society to the extraordinary position that it occupies today. Each of these people has inspired me during my career to date and has made a contribution not just to our Royal Statistical Society but to the wider notion of society at large. John Kingman, Peter Moore, Fred Smith, David Bartholomew, Adrian Smith, Robert Curnow, Denise Lievesley, Peter Green, Andy Grieve, Tim Holt, David Hand, Bernard Silverman and Valerie Isham I salute each of you.

## 7. Demands of now

The Royal Statistical Society is in a strong position. It needs to be. The demands on us today are great.

In deep frustration, in 1941, Winston Churchill ranted to Edward Bridges, his Cabinet Secretary, that ‘the utmost confusion is caused when people argue on different figures’ (quoted in Ward and Doggett (1991b)). He demanded the creation of a Central Statistical Office to provide ‘an agreed body of information which will be accepted and used without question’.

More than 70 years on there is still the utmost confusion out there.

The evidence put before us rarely presents a fair view of reality. It is often designed to make a point rather than to help us to understand the full picture. Those presenting it to us generally have an axe to grind. Like the apocryphal politician: they use statistics like a drunk uses a lamppost: more for support than illumination. Their use of ‘evidence’ may be partial to the point of deception.

When we put together all the incoming statistical information that we receive in a typical day we see a very strange world. Extremes are amplified. The abnormal seems normal. We are desensitized to what might be shocking. Absurd headlines like ‘people who eat meat more likely to die says expert’ are hardly unusual. Next week substitute fish or beans or pretty much anything for meat and the story starts again. We register the quirky and the surprising. We assess reality by what is close to us, not by a more disinterested standard. Put it all together and we have a systematically doctored view of the world.

We are not given the information that tells whether what we are presented with is a statistical anomaly or a real effect. Indeed we are invited to leap to false conclusions that can cause unnecessary hurt and anxiety, and drive otherwise sane statisticians to shout at the television. Stories about disease ‘clusters’ make headlines. Randomness suggests that some places across the country will exhibit clusters of cases. Yet the places that are picked out become invaded by the media intent on finding a mysterious but elusive cause.

Statistics need to be presented with more care.

The lens through which we receive evidence does not help. Our wonderful information age has

brought with it information overload. We are bombarded with words and images: e-mails, billboards, bulletins all screaming for our attention. We cannot take it all in. We filter it: sometimes rationally; often not.

The data deluge is undifferentiated. What is real evidence and what is prejudice or opinion? How do we judge statistical provenance? Where is the signal and where is the noise (Silver, 2012)?

Finding useful evidence, still less preserving it for future generations, is, for this generation, uncertain. In the predigital age, libraries and archives could keep track. Today the delete button can wreak its havoc before anyone has the chance to think of the potential value that may be lost. That library of videotaped films you carefully recorded may now be useless because the players can only be found in museums. The government's Web continuity programme and the Data Archive at Essex University are noble attempts to tackle the problem but for many items of knowledge it is already too late.

Google will find things for us but not necessarily what we need. An effective search engine for statistical information has not yet, to my knowledge, been developed anywhere.

Statistics really need to be looked after properly and put before us in ways that enable us to find what matters most to us.

Even then, with good evidence and the ability to find it, we can still founder. Those using evidence often seem to suspend common sense in their efforts to use it. Evidence only has meaning when attached to a question. It only has utility if the right questions are asked.

Statistical evidence is not a substitute for judgement. The mantra of evidence-based policy can be taken to ridiculous extremes. Evidence is always incomplete and provisional. It does not tell you what to do but used well can help you to make better judgements. When evidence is used more humbly it is more powerful.

Humility demands that we must not overclaim.

Nor must we underclaim and accept a state of affairs that is not acceptable.

It is not acceptable that the news is dominated by the latest sensation without any perspective.

It is not acceptable that debate is often settled by the one who shouts loudest in a clash of vested interests.

It is not acceptable that views so often seem to be founded on anecdote, myth, whim or prejudice with no restraint from fact.

It is not acceptable that the art of spin has been perfected to the point where there is cynicism about everything.

It is not acceptable that in the absence of any trustworthy context we assume that the only world that exists is the world we can see and verify ourselves.

It is not acceptable that received wisdom and politically correct opinions are not challenged by evidence.

It is not acceptable that the world seems so fragmented that we struggle to understand that there is a bigger picture.

Our memory of the founding fathers of the Royal Statistical Society and their successors can fortify us to rise to the challenges we face. The principles that were set down by Roger Jowell and others can give us the ethical basis to act. Let us seize the opportunity for statistics.

## **8. What we must do**

I ask you, through this address, to join me and the Royal Statistical Society community, in championing four interconnected sources of impact.

### 8.1. *The discipline of statistics*

The first is to celebrate the achievements of the discipline of statistics and to demonstrate that it is worthy of investment at this time when statistics matters so much. Too many statistics departments in universities are in trouble, underappreciated: caught in a system where others have had sharper elbows or where the jewels of success glitter more visibly in the eyes of those who hold the purse strings.

We can never know which investments in theory and method will pay dividends in future applications. We must make the case if our discipline is to thrive in the long term.

David Cox has described the years 1925–1960 as a golden era of statistical thought (Cox, 1997). He notes that there is no shortage of interesting new ideas and challenging problems, many stemming from the relatively large sets of data that are now so common. His inspirational call is for statisticians to be ‘involved in important issues in science, technology and public affairs’ and thereby to herald ‘a major new period of innovation’. The potential exists in each of his three ‘interlinked pillars’ of statistics: the mathematics of probability, the general principles for the design of investigations and the general principles for the analysis and interpretation of investigations.

The role of academic affairs within the Society has been upgraded in recent years through the leadership of Valerie Isham. We can build on this and find an ever clearer voice in our own right, through the Committee of Professors of Statistics, with our friends on the Council for the Mathematical Sciences and more widely.

The Royal Statistical Society has world leading journals. We have an outstanding tradition of Ordinary Meetings. We have an appeal that encompasses all substantive subject disciplines. We work actively with all of the UK’s research councils, many other professional and Learned Societies and a plethora of bodies in the UK and across the world. As Valerie Isham observed in her Presidential address, we should ‘celebrate the diversity that statistics encompasses’ (Isham, 2012) and make it our strength.

Open access publishing (Finch, 2012; Department for Business, Innovation and Skills, 2012) is a major threat to the Society’s income in the medium term and we must manage the transition well, but, as scientists, we must embrace it. Open access publishing also opens up the data sets on which research in so many disciplines is based. And those data sets which are becoming open are growing bigger. Open big data provide a unique opportunity for the discipline of statistics to add value. We can form new partnerships in multidisciplinary teams, we can cross-fertilize ideas for analysis across disciplines, we can develop new applications and methods and use these amazing new data sets as the basis for new theoretical insights into the discipline of statistics itself.

To give us strength at this moment of opportunity, we should celebrate the role models of our discipline. We are not short of examples. Simply looking at the achievements of the last four Guy Medallists in Gold should get others to sit up and appreciate the range and depth of what statistics can offer.

John Kingman’s work on stochastic processes has fundamentally changed the way that we understand issues as wide ranging as population genetics, the way that queues work and the management of power stations.

C. R. Rao’s work on estimators has enabled us to understand the validity of claims made using data of all kinds. How confident can we be that this is right? Is the result biased? How much data do we need to obtain a more precise result?

Jim Durbin, who died in 2012 at 88 years of age, developed statistical tests which form the basis for analysis of data across all the sciences and other disciplines as well as techniques for making sense of time series that are so essential to economics.

John Nelder developed the generalized linear model and made ground breaking contributions to experimental design and statistical computing among others. Without his work we would be unable to interpret patterns in large and complex data sets in the manner that is now commonplace.

The contribution of these four people to our understanding of the world is immense. We take their work for granted. It enables us to make better decisions. These people are recognized and appreciated with our profession. They should be household names.

## *8.2. The statistics profession and statistical qualifications*

The second area of impact is to show confidence in our own professional qualifications. They are world class and should have a special value for those who hold them. This is especially true for Chartered Statisticians but our other qualifications also could be taken up by more people.

Our Professional Affairs Committee, with able guidance and stewardship from Trevor Lewis and now also Steve Pyke, has given us a position, recognized across the world, which is a great platform from which to build. It should be as unthinkable for a major piece of statistical work to be overseen by someone who is not a Chartered Statistician as it would be for a complex medical procedure to be carried out by someone who is not a qualified doctor, responsibility for a bridge to be given to someone who is not a Chartered Engineer or annual accounts to be signed off by someone who is not a Chartered Accountant.

The value of chartered status for statisticians is becoming increasingly recognized. It is a prestigious award that attests to professionalism and quality of work. It is an award that is valued by employers, clients, colleagues and funders. It is an award that is of personal value to the holder.

The Graduate Statistician scheme as a stepping-stone to chartered status is now well established.

The process for revalidation is embedded and is built on good practice from other professions where chartered status is widespread.

The Society has been developing courses through its Professional Development Centre and its on-line continuous professional development offer. It has built links with counterpart professional bodies in the USA, Canada and Australia reflecting the internationalization of professional awards. The Society's Examinations Board has partnerships across the world delivering respected qualifications at a variety of levels that are valued by candidates and employers alike.

The work of several Sections of the Society reflects the professional work done by statisticians. The Quality Improvement Section with its links to the Chartered Quality Institute and the British Standards Institution is a good example. The Business and Industrial Section is another, exploring themes like innovation in the workplace, or the Environmental Statistics Section, looking at the effect of environmental extremes on the insurance industry. Statisticians play prominent roles in medicine, pharmaceuticals, finance, retail, technology and many more sectors.

Every organization can benefit from professional statistical help in understanding risk, assuring quality, obtaining customer insight, measuring performance, assessing staff attitudes and much more.

We need to cherish the professional statisticians operating in universities, businesses, government and other institutions. They need to be supported in taking their place as thought leaders in academia and counsellors to leaders in industry and public life.

Let us promote the value of the Chartered Statistician award to employers, government, other professions and the public. Let us promote the award internationally, obtaining mutual recognition with other statistical awards. Let us promote the award to statisticians.

As Hal Varian, Chief Economist of Google, has said, ‘statistics is the new sexy profession’: the profession where you are making a real difference to the success of your company, your institution, your country; the profession with the special ability to make sense out of data to improve quality of service, to drive efficiency and to deliver growth.

### 8.3. *Statistics for the public interest*

The third source of impact is statistics for the public interest. Three examples of the work of the Society illustrate the kind of work that is to be done:

- (a) the guide by the Statistics and the Law Working Group on the probative value of DNA evidence;
- (b) the work of the Panel on Statistics of Ecosystem Change on the scale and uncertainty challenges of ecosystem services and natural capital valuation;
- (c) the policy statement, issued with the supportive endorsement of Statisticians in the Pharmaceutical Industry, on best practice for statisticians in the reporting and publication of pharmaceutical-industry-sponsored clinical trials.

These are all areas of deep public interest affecting decisions that affect us all.

Statistics for the public interest also encompasses those official statistics that provide the management information system for ‘UK PLC’. The first wave of development of official statistics was closely associated with the beginnings of the Society. The creation of the Office of the Registrar General in 1836 provided both a catalyst and a central resource to ‘comment on current economic and social problems and to provoke action from government’ (Nissel, 1987).

Over more recent generations the development of official statistics has mirrored the challenges that are faced by the state. The political imperative to build new economies after the Second World War was a period where symbiosis between state and statistics was especially strong as witnessed by the investment in the systems of statistics supporting the national accounts.

The UK Government Statistical Service saw a blossoming during the 1970s followed by a decade where its role was questioned and sharply focused by government. It is from 1992 that the current link between UK official statistics and citizenship can be traced. Norman Lamont, then Chancellor of the Exchequer, announced

‘it is vital that the government should have the information it needs. But official statistics are produced not just for the government but for the benefit of business and for the public at large’ (Lamont, 1992).

A more general political focus on the citizen provided an opportunity to extend this message. Indeed reliable social and economic statistics were recognized as fundamental to the Prime Minister’s ‘Citizens Charter’ (Her Majesty’s Government, 1992). The Open Government white paper of 1993 noted that

‘official statistics... are collected by government to inform debate, decision making and research both within government and by the wider community... Vital as this is, open access to official statistics provides the citizen with more than a picture of society. It offers a window on the work and performance of government itself... allowing the impact of government policies and actions to be assessed’ (Her Majesty’s Government, 1993).

A new Office for National Statistics was established in 1996 by merging former statistical bodies. The real benefit of the new organization was seen to be to go

‘beyond the mandate of... the old organisations... to give a comprehensive statistical picture of the United Kingdom, its economy and society’

(Office of Population Censuses and Surveys–Central Statistical Office, 1995). David Bartholomew as President of the Society ‘wholeheartedly approve[d] of the proposal’ saying ‘it is entirely consistent with the views that the Society has expressed over many years’ (Pullinger, 1997).

These themes for official statistics found even clearer voice in 1997 in the incoming Labour Government’s programme for constitutional reform. Greater independence for statistics from government was positioned in a package of measures designed to give citizens a stronger voice and to move government closer to the people. This package also included devolution for Scotland and Wales, creating a Mayor for London and freedom-of-information legislation (Her Majesty’s Government, 1998).

Engagement of statisticians in new policy developments connected with citizens and communities rose sharply: at the level of cities and regions (Holt and Pullinger, 1998) and then at progressively more local levels down to individual neighbourhoods (Social Exclusion Unit, 2000).

A new Statistics Commission to give independent oversight of official statistics separate from government was established in 2000 (National Statistics, 2000) but many felt that an even more radical approach was needed. The Society developed a ‘Vision for National Statistics’ in which Tim Holt, as President, wrote that

‘the use of statistics pervades our society... [statistics] must meet levels of quality and integrity that will command public confidence... a fundamental part of this is the enactment of comprehensive statistical legislation that guarantees statistical quality, integrity and productivity’ (Royal Statistical Society National Statistics Working Party, 2006).

The enactment of the Statistics and Registration Service Act 2007 was therefore a significant milestone, enshrining in law the public good mission for statistics at the service of citizens. Notably the board of the new UK Statistics Authority was

‘to have the objective of promoting and safeguarding the production and publication of official statistics that serve the public good... in particular (a) informing the public about social and economic matters, and (b) assisting in the development and evaluation of public policy’.

The new Board had a successful first few years under the chairmanship of Michael Scholar, establishing its new position. There is now a chance for the community of official statistics to reach out and embrace other communities involved in statistics that shape public affairs, including the world of market research and statistics emanating from private, voluntary and a plethora of public bodies. This wide community for public statistics is now poised, with Andrew Dilnot as its leader, to deliver for the ‘citizen user’ a new kind of power: the power of statistical information, readily available and in easy-to-access forms, that gives citizens a voice in shaping the world around them and in making decisions about themselves, their families and their communities.

#### 8.4. *Statistical education and literacy*

The fourth source of impact for statistics is statistical education and literacy.

The Royal Statistical Society launched the ‘getstats’ campaign on World Statistics Day in 2010. The 10-year getstats campaign has struck a chord. With financial support from the Nuffield Foundation as well as funding and encouragement from a variety of other partners for specific projects—including the Institute of Actuaries for research work, the Department for

Business, Innovation and Skills for work with the media and SAS for statistical literacy work in Parliament—the first years of the campaign have met their goal of mobilizing partners and setting the direction for the future.

The 2010 position, revealed through polling by Ipsos-Mori and vox pops on the streets, would be amusing if it was not so terrifying. Limited awareness or attention is given to statistics. Statistics is seen as boring: lies, damned lies; difficult; irrelevant. The campaign seeks to turn this around so that by 2020 there will be widespread statistical awareness. Statistics will be valued as useful to people. Greater understanding will improve trust. Lack of statistical skills will be perceived as a disadvantage.

The top priority is to improve statistical education at all levels. Statistics has a value not just in its own right but also as an essential skill in so many other subjects. Biology, economics, engineering, geography, medicine, pharmacy, politics, psychology, sociology are just a few examples where statistical methods play a major role in the advancement of the substantive discipline. Others include astrostatistics, where physics and statistics come together in a union designed to help to unlock the secrets hidden in the incredible data sets being yielded by the Large Hadron Collider and other projects examining the fundamental nature of the universe; or chemometrics, which creates new knowledge from the combination of chemistry and statistics by analysing thousands of variables to uncover answers to questions ranging from composition of foods or doping in sport to forensic examinations.

In so many sectors statistics is essential to success yet the ‘quantitative skills deficit’ has been well documented. This is increasingly recognized as a national problem that requires a ‘people pipeline’ with a much greater capacity than we have had in recent times.

The ‘Society counts’ position statement on the quantitative skills deficit as it relates to humanities and social sciences, co-ordinated by the British Academy, calls for a national strategy and a joint approach to meet the challenge (British Academy, 2012). The high level Strategy Group for Quantitative Skills is setting to work to tackle this question with representatives from the British Academy, Department for Business, Innovation and Skills, Economic and Social Research Council, Office for National Statistics, UK Statistics Authority, Nuffield Foundation, Advisory Committee on Mathematics Education, Universities UK and Russell Group members as well as the Royal Statistical Society.

The Nuffield Foundation, Economic and Social Research Council and Higher Education Funding Council programme for up to 15 centres of excellence in undergraduate (with links to postgraduate) social science training in quantitative skills is getting under way. This is a major initiative with 50 prominent lectureships aimed at providing more quantitative degree pathways for social scientists, faster streaming and higher standards (see <http://www.nuffieldfoundation.org/QM>).

Other initiatives include plans being progressed between the Royal Statistical Society and the Royal Academy of Engineering. There are many opportunities to develop similar connections in other disciplines.

The Nuffield Foundation report ‘Is the UK an outlier?’ (Nuffield Foundation, 2010) presents a shocking picture of just how far behind international comparators we are in terms of upper secondary mathematics education. For statistics, the position is even more perilous with relatively few A-level students taking up optional statistical elements within the curriculum.

The Advisory Committee on Mathematics Education’s report, ‘Mathematical needs’, has recommended a new post-16-years qualification with an emphasis on problem solving which will support students on academic, mixed and vocational programmes and drive up participation (Advisory Committee on Mathematics Education, 2012).

The Royal Statistical Society Centre for Statistical Education at Plymouth University has



played a special role in statistical education at all ages with globally recognized initiatives such as CensusAtSchool. Their work shows what can be done.

All these efforts point the way towards a serious strategic approach to statistical education at all levels in our schools and universities.

In addition to active engagement with the world of education, the first 2 years of the getstats campaign focused on three other groups, seen as the most important intermediaries, who could help to reach or shape public perceptions and attitudes: politicians, the media and employers.

In Parliament, getstats has run seminars on, for example, the role of data and statistics in evidence-based health policy, the way that statistics are used to assess the performance of schools, the need for data and statistical know-how by the new police and crime commissioners and the numbers behind the budget. A training programme in Parliament, 'making the most of data', has begun. The Society now provides the secretariat for the All Party Parliamentary Group on statistics and is working to support that group in extending its reach and influence.

In the media, in 2012 alone, 31 workshops were held with 25 different clients. This involved 356 journalism students, 70 working journalists and 105 press officers. At the same time, the RSS Awards for Statistical Excellence in Journalism received a record number of nominations in 2012, their seventh year.

With employers, getstats is seeking to raise awareness, to support continuing professional development activities in various workplaces and more generally to draw attention to the role of statistics in improving competitiveness.

The next phases of the campaign, to be chaired by Robert Chote, will progressively extend its reach to change perceptions of statistics, attitudes towards it, behaviours and levels of skill and confidence across the population.

## 9. Call to action

Power is shifting. The world of statistics is shifting also. If we are indeed living at a time when citizens have more power to influence the decisions that affect their lives, then the power of statistics must be put in their hands so that the influence they exert can be based on sound evidence.

I argued in 1997 that given the growing role of the citizen, at that time expressed through the Citizens' Charter and Open Government policies of John Major's government,

'working in partnership together, the community of statisticians must ready itself to provide a vital medium of understanding to fit the needs of the new millennium' (Pullinger, 1997).

In 2013, the International Year of Statistics, statistics and statisticians are now ready.

The Royal Statistical Society is ready: with its international membership and dedicated staff; with its communities of interest at local levels and across all disciplines; with its infrastructure of well-established Sections and new Sections in areas as varied as applied probability and statistics in sport; with its growing and vibrant Young Statisticians Section; with its high energy international conferences; with its well-respected journals; with its tradition of sharing information across the Society, fostered over so many years by Frank Duckworth, whose wonderful contribution to statistics I would like to acknowledge today as he steps down from his role as Editor of *RSS News*, with its partnership with the American Statistical Association to deliver the runaway success that is *Significance* magazine; with its rich history for inspiration.

The Royal Statistical Society is ready to play its special role.

Through support for statistical education and the getstats campaign, we are ready to help to give people the competence and confidence to use statistics and to think statistically: making

the data deluge a force that helps citizens to make better choices in their lives rather than letting it wash over them or, worse still, sweep them aside.

Through supporting statistics for the public interest, we are ready to help to make knowledge about the work and performance of government and the state of the world around us relevant and available to everyone.

Through promoting the role of the professional statistician, we are ready to inspire the next generation to make statistics their career of choice.

Through celebrating the discipline of statistics, we are ready to help it to thrive in our universities, to attract the best and brightest minds and to provide the insights and innovations that will support us in addressing the problems of the future.

The ideas of statistics and the state go hand in hand. If this century is to be the citizen's century, statistics is ready to give the people the power to choose. Our choices will continue to be governed by our biological needs, our emotional desires and our spiritual beliefs. That is the joy of the human condition. But through statistics we can have a special kind of understanding that enables us to make well-informed decisions:

- (a) informing the state in making just laws that we as citizens respect and informing the delivery of the justice that those laws demand;
- (b) informing businesses in giving citizens the goods and services that we want at prices we can afford and building a strong economy;
- (c) informing individuals and communities in making wise choices for today and for a sustainable future for our children.

Statistics appeals to our rational side, our heads providing a balance to our sometimes wayward hearts. In the data rich world that is emerging as our future, those nations, governments, businesses and individuals who use the power of numbers will prosper. Those who 'get stats' will get on. Those who do not will get left behind.

Let us use statistics to make an impact.

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## Vote of thanks

V. Isham (University College London)

I want to congratulate John, and to thank him on behalf of the Society, for his Presidential address on the impact of statistics; it is a real *tour de force*. He gives a very interesting and thought-provoking account of the development of statistics and of political power structures, whereby statistics evolved from being data collected by rulers concerned with their political strength, through a way of assessing and improving the lives of the people, to become a means of enabling citizens to take control of their own lives and decision making. Thus, the role of statistics has moved from control through public benefit to empowering citizens, with power passing from the few to the many.

Hand in hand with this perspective, John has described how the Royal Statistical Society (RSS) has evolved, keeping pace with changing societal needs and aspirations. Its founding fathers brought a range of interests and expertise (in economics, history, politics, engineering and physical sciences): a breadth that is not only maintained by today's RSS members but also is ever expanding. During its first century or so, the leaders of the RSS were often also highly influential politicians. Although subsequent Presidents have seldom held political office, many have been involved in advising government, and the Society has been active in ensuring that evidence on economic and social wellbeing has been at the forefront of political decision making.

There is a clear path from the start of the Society in 1834 to the 'getstats' campaign, launched in 2010 with the intention of improving statistical literacy, and the public understanding of data without which informed decision making is impossible. It is in large measure thanks to John's energy and commitment as the first Chair of the Getstats Board that the campaign has been able to achieve a high profile and impact in its first 2 years. But it has a huge task ahead. As John points out, within society we need both personal

competence and trusted intermediaries who can do the ‘heavy lifting’. The RSS has, and is already playing, a fundamental role as a Learned Society, as well as through the individual efforts of its members—we can all help to debunk the horror stories and to educate our fellow citizens. If, collectively and individually, we cannot act as trusted intermediaries then who can?

In his address, John argues powerfully of the need for us to do much more, making a clarion call for statisticians to be involved in all aspects of current affairs. In the 2012 membership survey, only about 11% of 1240 respondents said that they were already actively involved as a volunteer for the RSS (through organizing activities, attending governance meetings or producing materials), and yet around 65% mentioned supporting the discipline or profession as a reason for belonging to the RSS, and almost 1000 respondents indicated that they would be interested in actively contributing to the work of the Society. Even if these respondents are atypical of our membership as a whole, there is clearly plenty of untapped willingness to become involved that we should be activating.

In recent weeks, through its membership of the Council for the Mathematical Sciences, the RSS has taken part in two important meetings publicizing the vital contribution that the mathematical sciences make to the UK economy. A Parliamentary reception in the Palace of Westminster marked the publication of the ‘Deloitte report’ (Deloitte, 2012), sponsored by the Engineering and Physical Sciences Research Council and the Council for the Mathematical Sciences, which gives a quantitative picture of the breadth of impact of the mathematical sciences. A week later, the Minister for Universities and Science, David Willetts, held a mathematical sciences research roundtable discussion to explore what can be done to

‘nurture excellent research and innovations in the mathematical sciences and foster wider recognition of the importance of mathematics to the economy and society’.

Probability and statistics are playing a huge part in this impact—from the retail sector, through banking and finance, pharmaceuticals, genomics and epidemiology, environmental risk and so many more, the list is endless—and with ‘big data’ the demand for statistics and for statisticians can only increase.

Education is vital, and the ‘people pipeline’ is a particular concern. School pupils need a stimulating foundation in mathematics and statistics that gives understanding, enjoyment and motivation to study further. We need to ensure that statistics flourishes at all universities, not just a select few. Those of us who are academics can surely help to rectify the ‘underappreciation’ to which John refers, by educating our Pro-Vice-Chancellors and Deans to be aware of the major advances to which probability and statistics can contribute through research collaboration with interdisciplinary colleagues, as well as to understand the increasing need for statistical literacy among our undergraduates, not only in the natural and life sciences but also in social sciences and the humanities.

In the past, it was traditional for the President to give his (or, on just two occasions, her) Presidential address right at the end of his (or her) term of office, identifying issues and challenges for the RSS and the wider society, based on knowledge and experience acquired, but at a time when action would largely be the responsibility of successors. David Hand broke this tradition and both he and I gave our addresses half-way through our 2-year terms. Now, with the change in timing of the address from December to June, John has chosen to deliver this insightful address only a few months into his own presidency, giving us a vision of what he would like to achieve. We shall not only watch with great interest, but also (I hope) join with him in helping the RSS to broaden its influence and to raise the standards of statistical literacy and competence throughout society. I wish John every success in his presidency.

It gives me great pleasure to propose the vote of thanks for this Presidential address.

#### **David J. Hand** (*Imperial College London*)

Like Valerie, I am delighted to congratulate John on his *tour de force*. He covered just about every aspect of statistics, statisticians and indeed our own statistical Society. It would have been nice to have been able to identify some point on which I disagreed, or some critical omission he had made, just so that I could point out where he had gone wrong, secure in the knowledge that, by tradition, there is no rejoinder to the two discussants of a Presidential address. But, unfortunately—or perhaps I should say fortunately—I agree with everything he says, although I did think I detected one slight oversimplification: I am not sure that all modern statisticians would agree with his characterization of ‘the bread and butter of students of statistics today—design of experiments; maximum likelihood; analysis of variance’.

I particularly liked John’s *call to action*. Certainly, throughout most of my lifetime, statistics has suffered from a poor press. Remarks such as ‘lies, damned lies, and statistics’ are often what pass for wit among the seminumerate when trying to convey their perception of the discipline. In part, I think that this must be because we statisticians have not been sufficiently forceful in making our case, in demonstrating that

statistics are vital for steering the ship of state, crucial to scientific and medical understanding, and central to economic advance.

Of course, it is clear that considerable progress in improving lay understanding has been made in recent years, and the Royal Statistical Society has played its part. But it is also clear that the ground that we have gained could be very easily lost, and that we still have many miles to travel. I also think that much of the gains that we have made are not in fact attributable to actions of statisticians at all.

The Internet and Web, automatic data capture, massive data stores, all advances in data management and manipulation have led to radical changes in perceptions of the importance of data. Books such as *Freakonomics*, films such as *Moneyball*, and predictions such as Nate Silver getting right 49 of the 50 US Presidential state election outcomes in 2008 are what have really altered perceptions. And therein lies a real danger: because the examples that I listed tend not to put the word statistics in pole position. Rather data, data scientist, 'big data', are what the media jump on. Indeed, at present we see the phrase 'big data' everywhere. We see politicians demonstrating almost Olympian skills in leaping aboard a bandwagon. But they do not see it as statistics.

The danger is that people have become carried away with discussions on data management and manipulation, forgetting that without being able to extract information and knowledge from those data nothing useful can be achieved. The forgotten fact is that people do not actually want data. What they want are answers. Iron ore is just rock until the iron has been extracted and data are just numbers until the statistical blast furnaces have been applied.

So that is something I would like to add to John's call to action. We should convince people that the first port of call for any newspaper or television channel when preparing a story about big data should be a statistician.

And it goes deeper. The government's current big data initiative, 'Open data', is all very well, but it is not enough. Although it has the potential to make a huge beneficial impact, enabling accountability, empowering communities, driving economic growth, that will not happen merely by virtue of the data being put out there. The data need to be understood and analysed effectively. *Skill* is vital to extract information meaningfully and validly from data. I imagine that everyone in this room understands the dangers of ill-informed analysis. Such things as selection bias, regression to the mean, the prosecutor's fallacy and Simpson's paradox are just the tip of the iceberg, but I know that not everyone outside this room understands them. As John puts it we need to get people to say 'I want to take the decision based on the evidence: how well equipped am I to do this?', and then to do something to become equipped. Indeed, I think that we need to go even further than this. In the spirit of the Society's strengthening of professional qualifications, I think that we need to get people to say 'I want to take the decision based on the evidence: who is properly qualified to guide me in this?'. After all, when I go to the doctor or consult a lawyer, I like to know that they are properly qualified and have not, for example, just hoped to pick it up by trial and error on the job.

I said that I thought that the widespread misperception of statistics was partly our own fault for failing to be sufficiently forceful in communicating the fundamental importance of the subject, as the key discipline for making that transformation from data into understanding. But I also think that there is a rather more subtle issue, and one which will be difficult to tackle by a mere call to action.

The context is that I agree with John that statistics are provisional and uncertain. And I also agree that it follows that statisticians have a duty to be sceptical—about the source of data and the inferences drawn from them. As John put it 'In a world of spin, where numbers are used to substantiate assertions rather than to illuminate reality, we must be doggedly determined to root out bias and to ask ourselves whether something is really what it seems'. We should ask where and how.

Now, to the considerable benefit of society as a whole, there are currently several bodies which serve as such sceptical monitors. We have the UK Statistics Authority, with independence enshrined in an Act of Parliament, and other organizations, such as the Radical Statistics Group and Full Fact.

But I think that there is a danger here. The danger is that every time we stand up and say 'you got it wrong: your data, your statistics, your conclusions cannot be trusted' we reinforce a general belief that statistics as a whole cannot be trusted. The danger is that our professional scepticism about particular data sets and analyses could be transformed in the eyes of an observer to a general suspicion about all data sets and all analyses: 'lies, damned lies, and statistics', as one might say.

So how do we get round this problem? What should we say to a lay person, who can understand the numbers but not the data collection strategies or inferential tools lying beneath them? 'Take my word for it' is hardly an answer, but nor is 'take nobody's word for it'.

We are in danger of a 'Catch-22': we must caution the public to be sceptical, to question, to doubt.

When presented with numerical conclusions we must encourage them to ask ‘but are you sure?; should I believe it?’. But then we expect them also to respect numerical data, quantitative conclusions and, indeed, statisticians.

So, although I fully endorse John’s call to action, I think that our actions must be carefully nuanced. The law of unintended consequences is always poised to strike.

It gives me great pleasure to second the vote of thanks.

The vote of thanks was passed by acclamation.

## Reference

Deloitte (2012) Measuring the economic benefits of mathematical science research in the UK. *Final Report*. Engineering and Physical Sciences Research Council, Swindon. (Available from <http://www.epsrc.ac.uk/SiteCollectionDocuments/Publications/reports/DeloitteMeasuringTheEconomicsBenefitsOfMathematicalScienceResearchUKNov2012.pdf>.)