Public policy issues as a route to statistical awareness

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Statisticians regularly bemoan what they perceive to be the lack of impact and appreciation of their discipline on the part of others. And it does seem to be true, as we approach the magic 2000 number, that we are faced with the paradox of more and more information being available, more and more complex problems to be solved – but, apparently, less and less direct appreciation of the role and power of statistical thinking. The purpose of the conference talk will be to explore one possible pedagogic route to raising awareness of the central importance of statistical thinking to good citizenship – namely, a focus on public policy issues as a means of creating an awareness and appreciation of the need for and power of statistical thinking.

We all know that our discipline is both intellectually exciting and stimulating in itself – and that it provides the crucial underpinning of any would-be coherent, quantitative approach to the world around us. Indeed, one might even go so far as to say that our subject is ‘the science of doing science’, providing theory and protocols to guide and discipline all forms of quantitative investigatory procedure. We have certainly expanded our horizons way beyond the rather modest ambitions of the founding fathers of the Royal Statistical Society, who set out to

‘collect, arrange, digest and publish facts, illustrating the condition and prospects of society in its material, social and moral relations’.

Today’s statistician would now describe the discipline’s tool-kit under the following kinds of heading: the framing of questions; design of experiments or surveys; drawing up protocols for data collection and recording; collection of data by sampling or observing; monitoring compliance with protocols; monitoring data quality; data storage, summarisation and presentation; stochastic modelling; statistical analysis; model criticism and the assessment of assumptions; inference reporting and the use of results for prediction, decision-making or hypothesis generation.

This expanded spectrum of activities can be conveniently summarised under four broad headings: data collection and presentation; inference from relatively small sample surveys or experiments; modelling and analysis of complex stochastic systems; and, crucially, involvement with the ‘larger stage . . . the territory of politics, management, the law, philosophy and the sciences . . .’

The central theme of the conference talk will be that we should more systematically invoke this larger stage as the key to generating and forming greater cultural awareness and acceptance of disciplined quantification as the central tool of mature social discourse in all contexts where the ultimate problems are those of taking decisions in the face of uncertainty. The various subheadings above then emerge naturally as responses to a public need for understanding, rather than as an arid catalogue of procedures.
When individual members of the public are confronted by arguments about health or environmental issues, the question most likely to be asked is ‘how does this affect me or my immediate family?’ In so far as the statistician’s answer is couched in terms of ‘averages’, or frequencies of occurrence calculated by reference to membership of a ‘population’ with which the individual does not readily identify, there will be a lack of perception of relevance on the part of the individual and a failure of communication on the part of the statistician. There are no doubt contexts in which the unavailability of disaggregated data makes this inevitable, but even when – let us say – careful studies have made it possible to identify a risk factory taxonomy of a population are we really able to communicate this in a meaningful way?

In part, of course, communication is bedevilled by problems of the basic lack of the requisite mathematical education. But it is not just a matter of mathematics. I think that there is much more that we could do to have an effect – both in terms of formal education and in the realm of communication to the general public.

First, there is specific concern with relevance to the individual; secondly, there is an explicit reference to decision-making; thirdly, there is an implicit commitment to taking into account individual utilities. If we aspire to more effective outreach to the general public, we need to pay more attention to individual psychology, and individual perceptions of chances and choices.

People are fascinated with people, particularly with themselves. But, as statistical educators and communicators, we do not acknowledge or exploit this sufficiently. For example, people are fascinated to learn how population responses to questions can be affected by the order in which alternatives are presented and many authors, mainly psychologists have surveyed the role of this and other psychological factors in activities such a perceiving randomness, interpreting evidence and making decisions.

Greater concern with these issues on the part of statisticians would, I believe, have two benefits. First, it would make us more aware of how people actually think and behave – and this is surely a necessary prerequisite for learning how to communicate more effectively. Secondly, the introduction of more of the psychological dimension into our teaching and general public outreach would both humanise the project and emphasise the relevance of statistical thinking to the individual.

Psychological and technical elements combine particularly effectively in the context of individual decision-making in situations of uncertainty. However, despite the clear pedagogical opportunities which this offers, decision-making and utility are topics which play little role in the dominant statistical paradigms as they are taught to most students and in the public perception of what constitutes the discipline of statistics. Instead, they are topics that are more likely to be found in psychology or operational research courses.

Perhaps the main way in which members of the general public engage with public quantification is in seeking guidance on ‘risks’, typically from an individual perspective against the background of public policy debates and decisions. There is certainly a growing public concern about the ways by which risks are identified, quantified and managed. Statistics is by no means the only discipline involved here, but it certainly plays a key role.
We most of us operate with the underlying premise that being ‘scientific’ is good and being ‘unscientific’ is bad. However, it is important for us to be aware that, in one manifestation of ‘post-modernism’ – an increasing number of people are coming to see science more as part of the problem than as the pre-eminent way of finding solutions. For example, risks from the use of nuclear power and chemical manipulation in the production of food-stuffs loom large in many people’s thoughts. Typically, the scientific and technical response is to claim that all would be well but for ‘human error’ (reactor operators’ faults at Chernobyl; farmers’ faults in using herbicides under in appropriate conditions, thus causing the production of dioxins). This kind of response is ultimately alienating.

Where do we fit into all this as statisticians? I think that we have positive things to contribute that distinguish us from mainstream science and technology, and provide us with opportunities to offer the public a different perspective.

From a technical point of view, the kind of thinking that comes naturally to us in the context of the Taguchi approach to experimental design is highly relevant to the robust design of complex technological systems and to considerations of robustness in the conditions of use of herbicides. In this latter context, for example, scientific studies of the toxicology of the relevant chemicals, conducted under carefully controlled conditions in the laboratory, established beyond any doubt that a certain class of herbicides, used under the correct specified conditions, posed no danger of producing dioxins. But this is of monumental irrelevance to actual usage in the field, where instructions for use are mislaid, or become illegible after rain or are ignored because of time or economic pressures. An aware, statistical design perspective, with an eye to robustness in use, would have suggested building these externally varying factors into the laboratory studies.

So far as the dangers of close relationships between scientists and government and industry are concerned, there may be valuable lessons to be learned from the conduct of clinical trials. Here, there are often close associations between the pharmaceutical industry and individual scientists and statisticians working in the areas. But the existence of a regulatory framework, and the statutory need for monitoring and ethical committees in the conduct of trials, seems to provide sufficient checks and balances to maintain public confidence in the process. This latter provides an excellent vehicle for raising both awareness of statistical ideas and procedures and underlining the role of statisticians as the "good guys" - we can use the perspective of statistics as the science of doing science to distance ourselves somewhat from the insensitive excesses of single-minded science and technology, and to assert rather more strongly our potential role as a resource for disinterested comment and advice.

The conference talk will flesh out these general ideas with a number of concrete illustrations.