

Working group on “Using statistics in mathematics education research”: Have statistics lost their power in public policy discussions? (The crisis of statistics – ‘Post-truth’ and Big Data)

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Statistics is one of the important branches of mathematics taught in schools, colleges and universities. It is also an important tool in public policy discussions. This session was focused on the use of statistics in society in general, rather than in mathematics education research. Participants had been encouraged to read an article by Will Davies in *The Guardian*, “Have statistics lost their power in public policy discussions?” (Davies, 2017). The article challenged the role of statistics in public discussions: “Rather than diffusing controversy and polarisation, it seems as if statistics are actually stoking them. Antipathy to statistics has become one of the hallmarks of the populist right, with statisticians and economists chief among the various ‘experts’ ostensibly rejected by voters in 2016.” The discussion went on to consider the meaning and consequences of ‘big data’, as well as the results of trends towards ‘identity politics’ and globalisation.

Keywords: ‘post-truth’; big data; identity politics; technology; globalisation

The crisis of statistics and resulting dilemmas for the citizen

We need to understand that ‘statistics’ can refer to (i) statistical data, and / or (ii) statistical techniques, and / or (iii) the discipline (which includes ‘experts’). Some dimensions of the current crisis include a lack of trust in statistical data, and a consequent decline in authority. For example, survey results in the US indicated that 68% of Trump supporters distrusted government economic statistics; and in the UK, 55% distrusted data on ‘the number of immigrants living here’. In addition, there are trends towards a lack of generally accepted baselines for discussing competing claims about society; and consequently a resort to ‘speaking one’s own truth’, drawing on ‘intuition’ and emotion as alternative bases of knowledge.

The statistical approach – some historical development

A brief overview of innovations in public policy initiatives gives some insight into the characteristics of ‘the statistical approach’. In the late 17th century, statistics were proposed to understand *an entire population* (not only potential soldiers, or tax-payers), and not necessarily by numbers, e.g. in geographical descriptions of various German states, pre-unification. In England William Petty & John Graunt introduced the estimation of population via counting of deaths, rather than via a census (costly). In France, statistics began to be produced by trained cadres in a centralised statistical office.

In 18th and 19th century Europe, the *normal distribution* was found to be surprisingly powerful for understanding several apparently unrelated phenomena: (i) errors of measurement (Gauss), (ii) approximations to probabilities of gambling outcomes (de Moivre), and (iii) the distribution of physical (and mental) characteristics (Quetelet, Galton).

In the 20th century, *specific indicators*, clearly defined and systematically produced, were constructed for simplifying description of diverse and complex populations, e.g. unemployment, GDP. Opinion polling of *representative samples* of the population, and of subgroups, using variations of simple random sampling (itself an advance on haphazard sampling) was introduced – as were experimental designs (nowadays called Randomised Controlled Trials - RCTs), and quasi-experimental designs (the latter from the 1960s). In addition, in line with a widespread general concern with comparative methods, there were attempts in statistical data production to maintain *comparability across time*, and (sometimes) *across nations* and *subgroups*.

Further aspects of the contemporary reaction to statistics, and resulting dilemmas

A key dilemma arises from the need to govern the population as a whole vs. (increasing) pressures to respond to feelings of particular citizens in a particular place and time. This can lead for example to a mismatch between *what politicians say* about the general state of the labour market, and individual / neighbourhood / local *experience* of the labour market. Recently, such problems have been aggravated by a difficulty of satisfactorily portraying the state of the nation, even with use of summary statistics (not only averages of course, but also measures of spread such as the standard deviation or the range) - because of fragmentation within society and the foregrounding of difference.

There have also been strains on existing classifications and definitions, due to changes in cultural politics – more fluid identities, attitudes and beliefs (emotions), and the reshaping of global economy and society. This has made various definitions more complex e.g. of gender, or unemployment, or GDP. There has been an evident need not only to classify, but also to measure, say *intensity* of employment, or *commitment* to actually exercising one's 'voting preference' on election day.

There have also been challenges in ensuring comparability across time, as the governance of states has changed (or fragmented), and especially comparability across nations, for example as the number and variety of countries participating in PISA has changed.

And now – here comes Big Data

What is Big Data?

Big Data can be characterised as the availability of large amounts of data, accumulated by default, as a by-product of other processes, usually without attention to research design (e.g. sampling), and requiring the extensive use of electronic technology for production, analysis, and/or publishing. Examples include: the use of speed cameras or other video cameras, for behaviour monitoring, and storage of alleged proof of mis-behaviour (allowing efficient legal prosecution). The use of loyalty cards allows monitoring of purchasing behaviour, plus correlation of such data with a number of demographic variables ('freely' produced by the card applicant), for

the targeting of marketing communications - with an option of experimenting with differential offers ('treatments'). A further example is the harvesting of electronic texts from individual acts of communication, which in an earlier form might have been assumed to be private, e.g. web searches, Facebook posts (and possibly emails and VOIP phonecalls?). These texts can now be subjected to "data mining" (using AI), data linkage, and 'sentiment analysis' (used to striking effect by certain companies in the US election and the UK referendum; see Cadwalladr, 2017).

Other examples are perhaps more positive: 'Citizen science' (e.g. astronomical observation by many citizens) and 'Citizen maths' (performing calculations / simulations by many citizens). In contrast, Mass Observation (1937, continuing in various forms to the present) was not electronically supported, and relied on named volunteers.

Issues with Big Data

The data involved is 'big' indeed, i.e. not limited in the ways relevant to the pre-electronic period, but there are several serious limitations. First, the approach involves 'haphazard' harvesting of large amounts of data – indeed impressive amounts. However, a huge sample can still be biased and, if there is no known sampling design, generalisation to any recognisable population will be difficult in principle. (Nevertheless, the problem lessens if you are able to gain access on data on 'almost everyone').

In many cases, the data comes without settled categories, since people can take on self-selected identities, so data from one source may be hard to 'link' with data from another. And data linkage raises issues of *privacy*.

Other issues arise for the responsible citizen. The 'freely chosen' declarations of 'informed consent' (EULAs) that individuals are asked to sign in order to use all manner of applications – and that many sign in an inappropriately off-hand way – are not necessarily proximate to the moment of appropriation of data, and are "forever". Finally, the data are often appropriated to private companies, which have no obligations towards openness, so you never know what the data says about you – much less how it might be interpreted by a suspicious user.

Finally, even using a huge data set, correlation is – still – not causation!

Conclusion: Some social and political consequences of the changes underway

At one level, we might call this a shift from a 'logic of statistics' to a 'logic of data analytics'. On the one side, we have the 'experts' of the Office of National Statistics (bound by research ethics, monitored by UK Statistics Authority), and on the other, the experts of Google, Facebook, and other less known policy actors, such as Cambridge Analytica (Cadwalladr, 2017). These latter *appropriate* data from (unsuspecting?) individuals, analyse it and sell it on to a range of "customers", to be used for a range of purposes, such as 'tailored messaging' – by people like marketers, politicians, 'opinion formers', as was done by Vote Leave, and the Trump campaign.

However, without statistics, and social research more generally, *made available publicly* and *discussed freely* (without interference or manipulation from entities, including some "bots" which are not even human), we cannot construct unambiguous, objective, potentially consensus-forming claims about society – nor can we provide a corrective to faulty claims. In such a situation, there will be few mechanisms to prevent people from instinctive reactions and emotional prejudices.

And certain Open Data initiatives offered by state statistics and certain agencies, will not likely be mirrored in the sharing of ‘the benefits’ of data analytics.

(For data analytics is “suited to detecting trends, sensing the mood, spotting things bubbling up” – but the numbers are “generated behind our backs and beyond our knowledge” (Davies), and appropriated and owned by private concerns – secretly!)

Thus, in Davies’s summing up, the battle is not between “an elite-led politics of facts versus a populist politics of feeling”. Rather, it is between those committed to public knowledge and argument versus those who profit from an appropriation and privatisation of information and “the ongoing disintegration of (public knowledge and argument)”.

Epilogue: Which feelings are most prominent in the new politics of feeling?

Future discussion and analysis would be needed on these issues. Most important would seem to be:

- Anxiety / Fear vs. Love
- Trust vs. Distrust
- Anger (often against Others - Mishra, 2017) vs. Solidarity

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