Title: The Signal and the Noise

Author: Nate Silver

Publisher: Penguin, New York, October 2012, $27.95, pp 512

Nate Silver is an intriguing man. A statistician by training, he developed a system for forecasting baseball performance that was not only bought by *Baseball Prospectus* but seems to have had real influence on how the top teams evaluate potential players. His blog, FiveThirtyEight.com, made accurate predictions, at both national and state level, of the 2008 Presidential election. Silver now has a regular slot in the *New York Times*.

This is a well written and entertaining book, with a lively style and plenty of interesting examples of forecasting. Not just baseball and elections, but poker, chess, stock markets, terrorist attacks, earthquakes, predictions by television pundits, Pearl Harbour and climate change are some of the main topics addressed. The book can be enjoyed by the intelligent layperson, who can learn, for example, about the dangers of both over-fitting and over-confidence in forecasts. Overall, this is a thoughtful and engaging book which deserves a wide readership.

But Silver also has a more serious scientific purpose, as might be guessed from the keywords of the title, 'signal' and 'noise'. Silver is a fervent advocate of Bayesian statistics. He is highly critical of the dominant frequentist approach, with its emphasis on having knowledge of the probability distribution across the entire relevant population and on its tests of statistical significance.

Most of Silver's examples are taken from the human social and economic worlds, and it is here that the really difficult problems lie. Leaving aside any epistemological fineries, in the natural sciences a theory which explains the past will also, in general, be able to make accurate predictions about the future. This is most definitely not the case in the social sciences, a point which is hard to grasp for the increasing number of natural scientists taking an interest in the social. A clear distinction needs to be made most of the time between explanation and prediction.

A key reason for this is that in the natural sciences, theories can be developed and verified, or to be more strictly accurate not falsified, by the empirical evidence obtained by replicable experiments. So, to take a very simple example, if I open the study window where I am writing this review and jump out, we can predict that I will fall to the ground and not levitate up into the sky. There is a theory, very strongly supported by empirical evidence, which explains this. In the social sciences, such strong support for a theory is rarely, if ever, possible.

The availability of Big Data raises the potential that the social sciences might begin to approach the standards of the natural sciences, by being able to observe behaviour in much more detail at a much finer level. Silver is profoundly sceptical of this, and even argues that this massive increase in data will make predictions more prone to failure, not less. Unless a Bayesian perspective is used, the number of false positives obtained in the analysis of such data will be high. As Silver puts it 'the number of meaningful relationships is [tiny]....there isn't any more truth in the world than there was before the Internet'.

The frequentist approach is valid only when it is supported by a soundly based theory. No less a social scientist than Keynes argued this in his great but now-neglected 1921 book, the *Treatise on*

Probability. Keynes was originally a mathematician, but he became diverted by the pressing practical problems of the economic world, and left the field open for the domination of statistics in the 20th century by RA Fisher, an undergraduate contemporary of his at Cambridge.

As Silver points out, the important element in Bayesian analysis of forming a prior probability of an event happening is often thought to introduce the unscientific concept of personal judgement. But in the social sciences, this is required all the time. For example, in 2007 the Bank of England produced for the first time its 'fan charts', showing the potential range of outcomes for economic growth, GDP, over the next five years. According to this, the probability of a recession in the UK 2008-12 was, to all intents and purposes, zero. Adopting a pure frequentist approach, we can take GDP growth over the years before 2007, and calibrate a probability distribution. I did this at the time, and showed that the only way the Bank could have obtained its fan chart was by throwing away all data prior to 1993. But economists had a reason for doing this, they had convinced themselves that the problems of the economy had been solved once and for all, and that we were in the era of the Great Moderation. The inclusion of data from before 1993, a matter not of objective truth but of judgement, altered dramatically the assessment of the probability of a recession in the UK, purely on the basis of the probability distribution of past growth rates.

The one major issue which Silver does not discuss, somewhat surprisingly given the title of his book, is the extent to which a given data set in the social sciences contains any signal at all, rather than being completely dominated by noise. Random matrix theory has been shown to be a useful tool in this context. It is not that human behaviour is random. Rather, there are so many factors which can influence outcomes, and behaviour is often not time-invariant, that the data produced by a system is often indistinguishable from a random series.

Paul Ormerod is an economist and complex systems theorist, and author of *Positive Linking: How Networks Can Revolutionise the World,* Faber and Faber, 2012