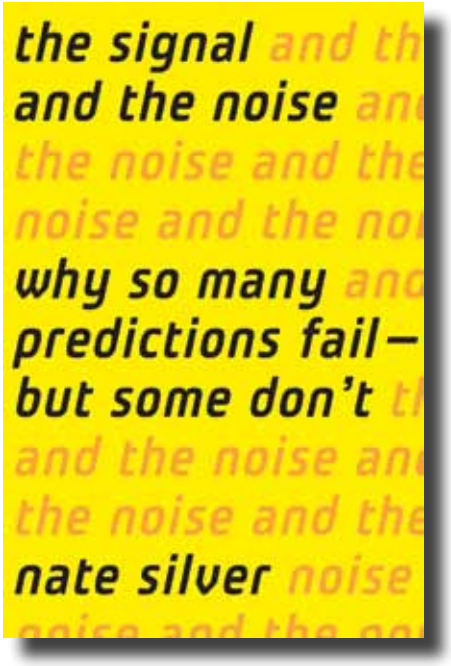


## Nate Silver's *The Signal and the Noise: Why So Many Predictions Fail – But Some Don't*

Reviewed by David Orrell

During the 2012 presidential election, the forecaster Nate Silver did something that I imagine happens rarely in the world of political bloggers – he became part of the story that he was trying to predict.

Prior to the election, Silver had built up a reputation as one of the most reliable forecasters in the business, correctly predicting all but one state of the 2008 election. His *New York Times* fivethirtyeight blog became a primary source of information for readers of political tea leaves. In October, just as Romney seemed to be gaining momentum, Silver announced that "Romney's momentum seems to have stopped." Immediately newspaper headlines followed his lead ("Mitt-mentum? Not so fast," wrote one). Others accused Silver of being motivated by ideology and called his predictions a joke.

In the end, Silver surpassed his 2008 score and got every state correct. As he wrote on his blog, at the end of a long election night: "This is probably a good time to link to my book."

Which brings us to *The Signal and the Noise: Why So Many Predictions Fail – But Some Don't* – an entertaining, thought-provoking, wide-ranging, but still somewhat incomplete introduction to the art and science of forecasting.

Silver's book covers a wide variety of forecasting areas, including sports betting; scientific forecasting of weather, earthquakes, and the economy; and games such as chess and poker, which require the ability to predict the behaviour of opponents. To borrow a poker analogy, the hand he deals us here is generally excellent, with just a couple of blanks.

The book's best parts are its sections based on Silver's direct experience. He first got into forecasting by developing a program called PECOTA, using methods such as nearest neighbour analysis to predict the future performance of baseball players. He also supported himself for a time by playing Internet poker. Part of the appeal of the book is the interesting parallel it draws between

forecasting and gambling. Both activities require similar attitudes to succeed: poker, for example, "is an incredibly mathematical game that depends on making probabilistic judgments amid uncertainty, the same skills that are important in any type of prediction."

Throughout the book, Silver highlights the importance of Bayesian statistics, which can be viewed as a tool for weighting and updating information to make forecasts. Forecasters are often faced with a variety of noisy and sometimes conflicting data: to make sense of it we have to take into account not just the quantitative data, but also a (largely subjective) set of prior beliefs, which we then update in the face of new information. To do this successfully requires a realistic assessment not just of the data, but of the predictability of the system, and the robustness of our models. "The key to making a good forecast ... is not in limiting yourself to quantitative information. Rather, it's having a good process for weighing the information appropriately."

The chapter on economics deals mostly with the Efficient Market Hypothesis, which Silver describes as "more robust than you might think" because he conflates it with unpredictability. However the EMH refers to a specific type of unpredictability, caused by random perturbations to an assumed stable equilibrium (snowstorms, earthquakes, and terrorist attacks are also unpredictable, but no one calls them efficient). While a plot of a stockmarket index may superficially resemble a random walk (page 341), real markets have far more extreme events, a fact which is highly relevant to forecasters. The difference became apparent during the 2007/8 crash, when risk models were expecting a random walk rather than a jump off a cliff. As Silver himself points out, the prior belief in the accuracy of models can be dangerous, and not just in poker.

In many areas, Silver notes that forecasters tend to be both biased and overly confident. For example, GDP forecasts have consistently been too optimistic, and their margin of error too small. As remedies, he suggests "supply-side" methods such as prediction markets that will create economic incentives for better forecasts, and "demand-side" methods such as educating consumers.

Forecasting techniques can be divided roughly into two types: statistical and mechanistic. Silver's approach is rooted in statistical forecasting. This seems to work especially well in data-rich games or sports like poker or baseball, where the rules are stable and known. U.S. politics has also increasingly resembled a sport, with two well-defined teams facing off against each other in a political equivalent of the Super Bowl. Silver's program, which works by aggregating different polls using a proprietary weighting formula, and using this to generate a probabilistic forecast, has done extremely well on an admittedly small sample (it understandably performed much less well in the 2010 UK election, in which there were three parties and more complex dynamics).

The less convincing sections are those dealing with mechanistic models, where Silver occasionally seems to entirely relax his

Bayesian analysis of prior beliefs, particularly our belief in the accuracy of scientific models. For example, in the chapter on weather forecasting he writes that "the weather system ... is governed by relatively simple and easily observable laws." Forecast error is blamed on the butterfly effect (the charming idea that a butterfly flapping its wings can cause a storm on the other side of the world a couple of weeks later). However processes such as turbulent flow, or the formation and dissipation of clouds, which make up most of what we call the weather, can only be approximated using empirical parameterisation schemes. There is no equation for a cloud, which is better described as an emergent property of the system.

Rather than the flapping of butterfly wings, a far more plausible explanation for forecast error is the presence of model error, which is inevitable when dealing with a complex system like the atmosphere, with its emergent features and highly nonlinear feedback loops (subjects touched on only lightly in the book). The chapter on climate change is realistic about model accuracy and does a better job of getting the balance right, although even here the only concrete example of model error discussed in any detail is coding error.

I would recommend *The Signal and the Noise* to anyone who wants an engaging and informative account of the art and science of forecasting; the book is also packed with interesting facts and statistics. Silver is very good at describing the various biases which affect our judgement when making forecasts and showing how we can compensate for them – and distinguish the signal from the noise – by taking a probabilistic Bayesian approach. "Most of the time," he warns, "we do not appreciate how noisy the data is, and so our bias is to place too much weight on the newest data point." But without a serious analysis or even much mention of the nature and causes of model error, which are so important in many of the areas discussed, the book's answer to the question posed in the subtitle – why so many predictions fail – is incomplete.

**David Orrell** is a mathematician and author. His latest book is *Truth or Beauty: Science and the Quest for Order* (Yale University Press).***www.davidorrell.com***

**dorrell@systemsforecasting.com**