The physics of society

Statistics

By seeking to uncover the rules of collective human activities, today's statistical physicists are cautiously aiming to return to their roots.

Philip Ball

The introduction of probability into the fundamental nature of the quantum world by Bohr, Born and Schrödinger in the 1920s famously perplexed some scholars of science's philosophical foundations. But arguments about chance, probability and determinism were no less heated in the mid-nineteenth century, when statistical ideas entered classical physics.

James Clerk Maxwell allowed probabilistic physics to bring him to the verge of mysticism: "It is the peculiar function of physical science to lead us to the confines of the incomprehensible, and to bid us behold and receive it in faith, till such time as the mystery shall open." The use of statistics as a mathematical tool of all the sciences provoked passionate responses from philosophers, novelists and social commentators. Few scientific issues besides darwinism (itself given a statistical treatment by Darwin's cousin Francis Galton) attracted such debate in parlours and periodicals.

It was not physicists who started this fuss but sociologists, who found that chance and randomness in the world of people and politics, far from banishing predictability and making social science oxymoronic, seemed to have laws of their own. This, to widespread dismay, seemed to challenge the idea of free will.

In the seventeenth century, Sir William Petty recognized that the study of society could only hope to emulate the precision of science if it became quantitative. Petty's call for a 'political arithmetic' induced his friend John Graunt in the 1660s to advocate 'social numbers' as a way to guide political policy. Graunt compiled mortality tables, reasoning that good legislation and government are impossible without such demographic data.

Births and deaths were a major preoccupation of early social statisticians, including the astronomer Edmund Halley. In 1781, Laplace tallied male and female births in Paris, explaining their near-equality as merely the result of a random process, rather than, as was previously thought, a sign of divine wisdom.

Laplace showed that variations in such social statistics could be described by a universal 'error curve', which was introduced in 1733 by the mathematician Abraham de Moivre to describe the results of coin tossing. The ubiquity of this curve, now familiar as the gaussian, was then seen as miraculous: a natural law that applies as much to human affairs as to errors in measuring planetary motion.

The idea that society is governed by laws as precise as those of physics was a product of the Enlightenment, and was espoused by Immanuel Kant and the political philosopher Auguste Comte. When the Belgian astronomer Adolphe Quetelet came to the French Royal Observatory in 1823, he was captivated by Laplace's statistical regularities and began to argue in favour of what Comte later called "social physics". Quetelet's popularization of Laplace's data impressed the likes of John Herschel and John Stuart Mill.

But the most visible exposition of these laws was given in the epic (and misnamed) *History of Civilization in England* (1857–61) by Henry Thomas Buckle, who believed that historical events occurred with a law-like inevitability. "The great truth," he said, "is that the actions of men ... are in reality never inconsistent, but however capricious they may appear only form part of one vast system of universal order." One of the book's earliest readers was Maxwell, who found it "bumptious" but remarked that it contains "a great deal of actually original matter, the result of fertile study, and not mere brainspinning".

Others dismissed the idea that people's actions are governed by laws. At times, Buckle seemed to imply a compulsion whereby individuals would find themselves acting in a certain way to fulfil 'quotas'. Ralph Waldo Emerson mocked what he saw as the absurd rigidity of the idea: "Punch makes exactly one capital joke per week; and the journals contrive to furnish one good piece of news every day." In *Notes From the Underground*, Dostoevsky had Buckle in mind when his narrator raves that man would rather make himself mad than be constrained by law-like reason.

Maxwell concluded that the error curve is the signature of all random processes, and of processes that, although deterministic, are too complex to be reduced to newtonian terms. So the gaussian curve was the natural choice for the velocity distribution in his kinetic theory, and the statistics of social physics thus helped to launch statistical mechanics. Ludwig Boltzmann also drew on the analogy with the statistical regularities of Quetelet and Buckle when he extended Maxwell's work on molecular probability distributions in 1872.

There is a pleasing symmetry to the way in which today's statistical physicists cautiously seek to extend their models and concepts into social science, such as pedestrian and traffic movement and descriptions of the economy. Statistical methods are hereby returning, much refined, from whence they came.

The statistical nature of quantum mechanics is different from that of classical physics, as it invokes variables with values that are not merely unknown but unknowable. Nonetheless, quantum probability would have had a rockier path if physicists had not been prepared by the knowledge that a statistical approach does not preclude the existence of precise laws. As early as 1918, the physicist Marian Smoluchowski considered probability to be central to modern physics: "Only Lorentz's equations, electron theory, the energy law, and the principle of relativity have remained unaffected, but it is quite possible that in the course of time exact laws may even here be replaced by statistical regularities." ■

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FURTHER READING

Porter, T. M. *The Rise of Statistical Thinking 1820–1900* (Princeton Univ. Press, Princeton, 1986).

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