James Franklin’s *The Science of Conjecture: Evidence and Probability before Pascal*

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Decision under conditions of uncertainty is an unavoidable fact of life. The available evidence rarely suffices to establish a claim with complete confidence, and as a result a good deal of our reasoning about the world must employ criteria of probable judgment. Such criteria specify the conditions under which rational agents are justified in accepting or acting upon propositions whose truth cannot be ascertained with certainty. Since the seventeenth century philosophers and mathematicians have been accustomed to consider belief under uncertainty from the standpoint of the mathematical theory of probability. In 1654, Blaise Pascal entered into correspondence with Pierre de Fermat on two problems in the theory of probability that had been posed by the Chevalier De Méré – the first involved the just division of the stakes in a game of chance that has been interrupted, the second is the likelihood of throwing a given number in a fixed number of throws using fair dice. This correspondence resulted in fundamental results that are now regarded as the foundation of the mathematical approach to probability, and historical studies of probabilistic reasoning almost invariably begin with the Pascal-Fermat correspondence. Franklin has no interest in denying the significance of the mathematical treatment of probability – he is, after all, a professional mathematician – but the principal theme in his book is the gradual “coming to consciousness” of canons of inference governing uncertain cases.

One striking fact about the development of the mathematical theory of probability is just how late it comes on the scene. Long before Pascal there was a rich and varied tradition of probabilistic reasoning, although the canons of probabilistic judgment were not expressed in explicitly mathematical terms. Many authors writing in law, religion, rhetoric, philosophy, and the sciences addressed the question of how to evaluate claims in the light of less than certain evidence. Such discussions of probabilistic judgment trace back to ancient sources, and Franklin’s account offers a quite comprehensive survey of ancient, medieval, and early modern doctrines drawn from a wide variety of authors. The story Franklin tells is that of a gradually emerging science of probable knowledge, whether in witch trials, medical diagnoses, or maritime insurance. He interprets the history of probabilistic reasoning on analogy with that of visual perspective: people have always seen things in perspective, but awareness of the
mathematical principles underlying perspective came about only gradually. Likewise, everyone makes judgments on the basis of uncertain evidence, but the development of a proper theory of risk and likelihood is a long and complex process.

Franklin’s first three chapters detail the development of canons of evidence in legal proceedings. Beginning with the ancient “two-witness rule” in criminal cases, he discusses the evolution of the law of evidence through the mid-seventeenth century, offering a thorough treatment of the opinions and doctrines that progressed from trial by ordeal, through the medieval notion of a “half proof” and have ultimately led to the English “beyond reasonable doubt” standard. As Franklin notes, the law of evidence offers “the most consistent tradition of dealing explicitly with evidence that falls short of certainty.” Lawyers’ penchant for writing everything down also makes legal history is the richest source of information about the evolution of criteria for weighing conflicting evidence and drawing conclusions under conditions of uncertainty. Franklin’s account of the development of probabilistic legal concepts will likely be of greatest interest to readers, but there is a wealth of other material that handsomely repays close attention.

Chapter four explores theological and ethical issues from the standpoint of probabilistic judgment. Here, the focus is on “cases of conscience” in which individuals seek to resolve doubts about the permissibility of actions, and the accompanying development of the notion of “moral certainty.” If the learned doctors of the church disagree on a moral question, how can one determine which course of action is correct? Answers to this question led to sophisticated (and occasionally sophistical) discussions of casuistry[2] and the relative weight of authorities. The fifth chapter examines the relationship between probability and rhetoric. Contemporary readers might find it odd that rhetoric should have much to do with probability, since we are accustomed to thinking of probability as a branch of mathematics. But the very etymology of the term ‘probable’ goes back to the Latin probabilis, namely that which is capable of proof or worthy of belief. This highlights the connection between rhetoric (whose job it is to persuade by proof and argument) and probability (which is concerned with cases where proof falls short of complete certainty). As Franklin shows, rhetoricians’ concerned with probability led in the course of time to issues in logic, and specifically to the question of whether there could be a logic of non-demonstrable inference, or a canon of probabilistic inference rules modeled on the traditional logic of Aristotle.

Chapters five and six consider probability and the sciences, both the “hard sciences” such as astronomy and the “soft sciences” like medicine and history. As elsewhere, Franklin’s treatment is quite thorough, beginning with ancient sources and working up to the seventeenth century. The history of astronomy provides a rich ground for investigation into probability, since the choice between heliocentric and geocentric models of the cosmos explicitly involves questions of probability. Copernican arguments for the geocentric model, for instance, claim that the simplicity of the model is evidence for its truth, notwithstanding the fact that the Earth does not appear to be in motion. In the case of medicine and other “soft” sciences, Franklin shows how discussions of medical diagnosis or historical evidence were treated probabilistically, with authors
developing a variety of ingenious arguments to settle questions that by their nature cannot be answered with complete certainty.

The topic of probable judgment has long been prominent in philosophical discussions of knowledge and action, and a good deal of its history appears in Franklin’s eighth chapter. The inductive problem of how to draw inferences from past cases to future cases (and the related problem of how to conclude anything about past events from present evidence) are discussed in some detail, and Franklin is a reliable guide through a thicket of philosophical argument. The same may be said of his ninth chapter, where non-deductive arguments for belief in the existence of God are taken up. The venerable “design argument” (which concludes that the order and structure of the natural world are best explained as the result of a divine design) is considered from the standpoint of the development of probabilistic inference, and Franklin shows that medieval discussions of such non-deductive inferences are a key part in the development of the concept of probability. The chapter concludes with a discussion of Pascal’s famous “wager argument,” which makes a prudential (as opposed to evidential) argument for belief in God: the cost of belief is small, the potential benefit of everlasting life is incalculably great, while the potential loss involved in disbelief is also incalculably great; thus, regardless of the likelihood of God’s existence, it makes sense to believe.

The history of aleatory contracts (i.e., contracts in which one party assumes a risk in exchange for a monetary payment) in chapter ten stands out as particularly informative. Ancient maritime contracts show that lenders would adjust their interest charges depending upon time of year, port of origin, and destination in order to reflect their judgments about the relative peril of shipwreck. The medieval practice of buying and selling life annuities offers a somewhat more detailed example of the attempt to quantify risk. As Franklin explains, the thirteenth and fourteenth centuries saw the development of “a trade in perpetual and life annuities, in which one pays a sum of money and receives a stated annual income.”[3] The pricing of the annuity reflects the seller’s bet on the buyer’s likely date of death, and Franklin rightly analyzes these contracts as based on an implicit quantification of survival probabilities, even though they were not expressed in the explicit form of mathematical probability now familiar to actuaries and insurance underwriters. Perhaps the most surprising aspect of the medieval annuity business is the fact that “[m]onasteries were among the principal sellers of annuities, and churchmen common among the buyers,” notwithstanding the Church’s prohibition against usury. [4] Church doctrine was reconciled with the practice of selling annuities by Alexander Lombard, whose 1307 Treatise on Usury reasoned that “when the price [of an annuity] is of such quantity that, after weighing with care and consideration the age of the buyer and his health, and the risks concerning the profits from the possessions, it does not appear that either the buyer or the seller has notably the better side.”[5] Thus, an annuity is a fair bargain for both buyer and seller, provided that the relevant adjustments for risk have been taken into account.

The examples of maritime insurance and annuities illustrate the crucial role of money in the development of a quantified approach to probability. The quantitative assessment of risk is greatly facilitated when a price can be assigned to loss or gain, and Franklin
shows how the mathematical theory of probability ultimately depends for its development on institutions of money and pricing. If money is one great source of the mathematical theory of probability, gambling is another. In his final chapter (entitled “Dice”) Franklin traces the history of games of chance, showing that such gambling devices as dice offer the most salient model of stochastic processes. By the time of the Pascal-Fermat correspondence, all the elements of a mathematized treatment of probability were in place: a long history of legal, philosophical, and scientific discussion of rational belief under conditions of uncertainty, a wealth of accumulated experience in estimating and underwriting risk, and extensive study of games of chance as models of uncertain payoff. In the end, Franklin sees this tale as “an example of the gradual explication of concepts that were already implicitly present” in even the earliest thinking about uncertainty.[6]

On matters of historiography, Franklin cheerfully admits that his is a “Whig history of mentalities, a story of the Advance of Knowledge as the forces of Reason rolls back the frontiers of ignorance.”[7] He has little patience for postmodernist theorizing or for currently-fashionable intellectual histories that depict the development of doctrines and concepts as a random walk, unconstrained by any external realities and driven exclusively by social or political interests in the accumulation and exercise of power. Franklin seeks to show that humans really do understand probability much better now than they did several centuries ago, contrary to the views of postmodernists who (in his words) hold that “the deployment of evidence in support of conclusions is just a rhetorical cover for ‘power relations’.”[8] On the other hand, he is at pains to show that this understanding of probability did not appear suddenly and out of nowhere in the Pascal-Fermat correspondence. Although the mathematical theory of probability can rightly be said to have been founded by Pascal and Fermat, probabilistic inference was discussed and developed in both quantitative and non-quantitative terms for many centuries before their contributions. All in all, this is a fine book that should be read by anyone interested in the history of judgment under conditions of uncertainty, whether in law, theology, philosophy, science, or commerce.


[2] Casuistry is the determination of moral or religious obligation by the examination of specific cases that are taken to illustrate general rules.


