A key feature of twentieth-century science is the clear understanding of the role played by mathematical models of real phenomena. One of the first to fully articulate this was the applied mathematician Richard von Mises, who constructed such models for a number of disciplines. One of these was his 1919 model for frequentist probability. An alternative subjective concept of probability was axiomatized slightly later by Bruno de Finetti and Frank Ramsey. An axiomatization of probability in purely mathematical terms without regard to its interpretation was provided by Kolmogorov in 1933. It has the advantage of being applicable to both the frequentist and the subjective concepts of probability and, unlike those interpretations, is accepted fairly generally and is noncontroversial.

The frequentist concept of probability that von Mises axiomatized interprets probability as a model of the empirical phenomenon of stable frequency in a long series of repeated independent random events. This interpretation goes back to, among others, Bernoulli, Ellis, Cournot, and Venn. After von Mises, it was championed by Neyman as a foundation for statistical inference. However, Neyman noted that the long-run stability of a frequency held even for a series of quite different random events as long as they were independent. This greatly increased the usefulness of the frequentist approach for statistics.

A second basic issue for Neyman was how to interpret the result of a statistical investigation. Fisher thought he had solved the century-old problem of induction with his concepts of likelihood and fiducial probability. Neyman protested that Fisher’s idea of inductive inference was meaningless and instead advocated a behavioral philosophy: that the aim of statistics was to provide a guide to the best action, and to accomplish this by minimizing the probability of errors.

Adopting Neyman’s approach and utilizing concepts of the theory of games developed by von Neumann and Morgenstern, Wald established a new framework for statistics in his 1950 book, *Statistical Decision Functions*. Wald’s book provided the basic concepts and results for his decision theory but was very abstract and contained only a few examples of its application. The implementation of the theory in many areas of statistics was carried out
by the next generations of statisticians, particularly by Jack Kiefer, in whose work the minimax principle played a central role, and by Larry Brown, much of whose work was concerned with admissibility problems.

45. Richard von Mises (1883–1953)

Richard von Mises was an outstanding applied mathematician and probabilist. In addition, he made contributions to philosophy and to the literature on the poet Rainer Maria Rilke.

Von Mises grew up in Vienna and, after graduating from high school with high distinction in mathematics and Latin, from 1901 to 1906 he studied mathematics, physics, and mechanical engineering at the Vienna Technical University. In 1908, he wrote a dissertation on the theory of water wheels, and the following year was appointed associate professor of applied mathematics at the University of Strassburg, where he remained until the outbreak of the First World War.

At the beginning of the war, von Mises joined the Flying Corps of the Austro-Hungarian army (he already had a pilot’s license) but was soon transferred to act as technical advisor, organizer, and instructor. His lectures on the theory of flight became the basis for his book, *Fluglehre*, first published in 1918 and subsequently going through many editions.