

## Richard von Mises

Austrian-born mathematician, statistician, and aerodynamicist

**Richard Martin Elder von Mises** (April 19, 1883 – July 14, 1953)

set out a frequency theory of probability, in which he emphasized the idea of random distribution. His theory has been very influential, although it has been superseded by the growth of measure theory.

Personally aristocratic, ambitious and competitive, von Mises strove for a new synthesis of mathematics and engineering and sought the connection between scientific and artistic performances. He viewed

applied mathematics as the essential link between theory and scientific observation. An international expert on the great Austrian lyric poet Rainer Maria Rilke, at the end of his life he had the largest Rilke collection in the world.



Von Mises was born in Lemberg in Galicia, which today is Lvov in Ukraine. His father Arthur was a technical expert with the Austrian State Railways. His older brother was the famous liberal political economist Ludwig von Mises. Richard studied mathematics, physics and machine engineering at the Technical University in Vienna and after graduation, he was appointed assistant to Georg Hamel, who held the chair of mechanics at the German Technical University in Brünn (now Brno in the Czech Republic). In 1907 von Mises was awarded a doctorate from the University of Vienna for his dissertation *The Determination of Inertia Mass in Crank Mechanisms*. The next year he was awarded his habilitation at Brünn for his book *Theory of Water Wheels*. Von Mises was professor of applied mathematics at the University of Strasburg from 1909 to 1918, but during WWI he served as a pilot in the Austro-Hungarian army. Von Mises designed the first large airplane, a 600-horsepower flying machine, demonstrating that he was both a theoretician and a practical aeronautical engineer.

At the end of the war, von Mises was appointed to the new chair of hydrodynamics and aerodynamics at the Technical University in Dresden, but he stayed only briefly before moving on to the University of Berlin to become the director of the new Institute of Applied Mathematics. The Berlin years were the intellectual high point of his career and his home was a center for the scientific and literary avant-garde. He set up a new curriculum for applied mathematics, consisting of six semesters of mathematical applications to astronomy, geodesy and technology. The Institute quickly became a center for research in areas such as probability, statistics, and numerical solutions of differential equations, elasticity, and aerodynamics. In 1921, von Mises founded the journal *Zeitschrift für Angewandte Mathematik und Mechanik* and became its first editor.

Although von Mises was a Roman Catholic his ancestors were Jewish. When Nazi Germany passed the infamous Civil Service Law, having one grandparent who was Jewish was enough to mark a person a non-Aryan and force one to retire from a university post. There was an exemption for non-Aryans who had fought in WWI, but von Mises realized this loophole would soon be closed. He accepted a chair in Turkey, but before leaving Germany, he tried to ensure his pension rights. This was, however, not to be. By 1938, Turkey was no longer a safe haven for von Mises so he left for the United States. From 1940 to 1943, he lectured at the Massachusetts Institute of Technology, and, in 1944, he became Gordon-McKay Professor of Aerodynamics and Applied Mathematics at Harvard University where he remained until his death. During WWII he worked as a civilian in the U.S. army, and became an American citizen in 1946.

Von Mises worked in the areas of fluid mechanics, and aerodynamics. He introduced a stress tensor, which was used in the study of the strength of materials. His studies of wing theory for aircraft led him

to investigate turbulence. Among his 145 publications, including 14 books, were *Theory of Flight* and *Theory of Wing Sections*. These works, which stressed both theory and practice, contain one of the best introductions to the general theory of stability and his chapters on wing theory, are still valuable today for the clarity of their exposition and originality.

Von Mises' most famous and most controversial work was in probability theory. He was not satisfied with Pierre Laplace's definition of probability, believing that while it was satisfactory for games of chance, it did not work for practical applications. He introduced the concept of outcome space, the impossibility of a successful gambling system and the Poisson distribution all of current interest and use. In 1909, he attempted to build an axiomatic model for probability based on two axioms. As described by R.V. Young in *Notable Mathematicians from Ancient Times to the Present* (1998) the first was the axiom of convergence, "as a sequence of trials is extended, the proportion of favorable outcomes tends toward a definite mathematical limit." The second was the axiom of randomness, "the limiting value of the relative frequency must be the same for all possible infinite subsequences of trials solely by a rule of place selection within the sequence (that is, the outcomes must randomly distribute among the trials)." In 1939, von Mises proposed what is now known as the birthday problem. He asked, "How many people must be in a room for the probability that some share a birthday, ignoring the year and leap days, is 50 percent?" The non-intuitive answer is that if there are 23 people in the room, the probability that two of them will have the same birthday (month and day) is a bit more than 50 percent.

One shouldn't put thoughts in another's mind. Yet, it seems reasonable to assume that von Mises took counsel and comfort from the letters his favorite poet Rilke wrote to Franz Kappus, who had sought Rilke's advice. Written between 1903 and 1908, Kappus published those two years after Rilke's death, as *Letters to a Young Poet*. The following passage from Rilke's first letter to Kappus on February 17,

1903 must resonate with any scientist or mathematician, or, for that matter with any thinking and feeling person.

“You ask whether your verses are good. You ask me. You have asked others before. You send them to magazines. You compare them with other poems, and you are disturbed when certain editors reject your efforts. Now (since you have allowed me to advise you) I beg you to give up all that. You look outside, and that above all you must not do now. No one can advise or help you – no one. There is only one thing you should do. Go into yourself. Find out the reason that commands you to write; see whether it has spread its roots into the very roots of your heart; confess to yourself whether you would die if you were forbidden to write. This most of all: ask yourself in the most silent hour of your night: must I write? Dig into yourself for a deep answer. And if this answer rings out in assent, if you meet this solemn question with a strong simple ‘I must,’ then build your life in accordance with this necessity; your whole life, even into its humblest and most indifferent hour, must become a sign and witness to this impulse.”

Advising others is a tricky business. Nevertheless, I have frequently offered the following suggestion to students. Individuals should find what they are good at and happy in doing, and then, so they may earn a living, find someone willing to pay them to do the thing they are good at and happy to do.

Discovering what one is good at and happy to do is not always easy. In the marvelous ballet movie *The Red Shoes* (1948), the impresario, played, by Anton Walbrook, asks a young ballerina, played by Moira Shearer, “Why do you want to dance?” She responds, “Why do you want to live?” A bit taken back, he replies, “I don’t know exactly, but I must.” And echoing Rilke, she says, “That’s my answer too.”

**Quotation of the Day:** “The problems of statistical physics are of the greatest interest in our time,

since they lead to a revolutionary change in our whole conception of the universe.” – Richard von Mises