# Ronald A. Fisher

British statistician and geneticist **Sir Ronald Aylmer Fisher** (February 17, 1890 – July 29, 1962) was a pioneer in modern statistical methods. He developed techniques for the design and analysis of experiments where it is not possible to control every element that might affect the outcome. His classic book *Statistical Methods for Research Workers* (1925) was extremely influential in biological research. It was followed by the seminal *The General Theory of Natural Selection* (1930), which contained his views on eugenics and greatly contributed to the study of population genetics. Fisher was involved in numerous long public disputes with others, including eugenicist Karl Pearson and his son Egon, American geneticist Sewall Wright, geophysicist and mathematician Sir Harold Jeffreys, and statistician Jerzy Neyman.

Fisher was born in London, one of eight children of a successful auctioneer. With his wife Ruth Eileen Gratton Guinness, whom he married in 1917, Fisher also had eight children. As a child, Fisher had very poor eyesight, making reading difficult. At 14, the year his mother died, he won a scholarship to Harrow. Because of his eyesight Fisher received private mathematical tutoring. He won a scholarship to Cambridge University and earned a B.A. in astronomy in 1912. Fisher stayed an additional year to study the theory of errors under F.J.M. Stratton as well as astronomy and quantum physics with Sir James Jeans. Fisher's interest in eugenics began at Cambridge where he was a member of the Council of the University Eugenics Society.

At the time, when there was still much controversy about Charles Darwin's theories and Gregor Mendel's recently rediscovered work on genes, Fisher gave talks on the theories of evolution and

natural selection at the Society's meetings. Eugenics sparked his interest in the practical applications of statistics and after graduating he took a statistical job with the Mercantile and General Investment Company in London. In 1914, he began teaching high school mathematics and physics as his service for the war effort, as his eyesight prevented him from enlisting. Working on the statistics of human inheritance, Fisher showed that Mendel's laws must lead to the correlations observed. He also showed that Mendel's work on genetics and Darwin's on natural selection were in accord, rather than in conflict, as some had believed.

Fisher's article on general sampling distributions appeared in Pearson's journal *Biometrika* in 1915. Two years later the Pearson published a study that included a criticism of Fisher's paper. This led to a violent confrontation between the two men and a dispute that lasted for years. Fisher, who hated to admit a mistake, never forgave Pearson. He took great pleasure pointing out errors in his enemy's works. Even in his last book, *Statistical Methods and Statistical Inference* (1956), Fisher's attacks on Pearson were more violent and personal than ever before. This shows something about Fisher's personality, as Pearson had been dead for 20 years, and by that time it was universally recognized that in all their disputes Fisher had been in the right.

Because of their dispute, Fisher turned down Pearson's offer of a position in his department at University College, London. Instead in 1919, Fisher was appointed as the only statistician with the Rothamsted Experimental Station where he was given 66 years of data on agricultural field trials to examine and analyze. He investigated the linkage of genes for different traits and was the first statistician to consider the methodology for the design of experiments. To avoid unintentional bias in selection of materials used in investigations, Fisher studied the design of experiments and introduced the principle of randomization and the analysis of variance, techniques now universally used. Before an experimental effect can be attributed, the experiment must be repeated on control units of the material

and all material used in experiments must be randomly selected from the entire population it is intended to represent. Analysis of variance is a statistical procedure used to design experiments that answer several questions at the same time.

Fisher illustrated the most important ideas of experimental design in a very readable article "Mathematics of a Lady Tasting Tea." He remained at Rothamsted for 14 years before becoming professor of eugenics at University College, London in 1933, followed by occupying the genetics chair at Cambridge from 1943 until his retirement in 1957. He then moved to Australia to join the Commonwealth Scientific and Industrial Research Organization (CSIRO).

In the 1920s, Fisher investigated the problem of natural selection and population genetics. He believed that natural selection should be studied by itself and not in correlation with the theory of evolution. The next year, Fisher published a paper in which he introduced what later would be known as the method of maximum likelihood for estimation of parameters of probability distributions. The likelihood of a parameter is proportional to the probability of the data and it produces a function that has a single maximum value, called the maximum likelihood.

In 1922, Fisher gave a new definition of statistics asserting that its purpose was the reduction of data. He identified three fundamental problems of statistics: specification of the kind of population from which the data derives, estimation, and distribution. Fisher revolutionized inferential statistics, developed the concepts of analysis of variance and factorial design of experiments. His analysis of variance has become standard practice in medical, biological, and agricultural work. Many in the field regard him as the father of modern statistics.

Fisher was small, forceful, eloquent, eccentric, flamboyant and by today's standards a politically

incorrect man. He possessed a colossal, overbearing ego, attacking the work of everyone with equal ferocity. He lacked a sense of humor and his colleagues reported that in meetings he would become enraged by some harmless remark that others would merely smile at. Even his disciple Maurice G. Kendall recalled that the character defects Fisher attributed to others were easily discernable in himself. One unnamed colleague stated, “Whenever he paints a portrait, he paints a self portrait.”

Although he was correct in most of his disputes, he was stubbornly wrong in at least two. The first was with W.S. Gossett over randomization and the second with Jeffreys on the meaning and philosophy of inference. A smoker himself, Fisher argued to the end of his life that smoking should not be causally related to disease. In most other matters his views and methods have been extended and adapted for use in the many areas where statistical analysis is possible. Among the honors bestowed on him were three medals of the Royal Statistical Society, the Darwin Medal (1948) and the Copley Medal (1956) both awarded by the Royal Society. He received honorary degrees from numerous universities and was knighted by in 1952.

**Quotation of the Day:** “The statistician cannot evade the responsibility for understanding the process he applies or recommends.” – Sir Ronald A. Fisher