

Harald Cramér

1893–1985



Harald Cramér was born on September 25, 1893 in Stockholm, Sweden. His father was a banker. Cramér began his studies at the University of Stockholm. His initial interests were equally divided between biochemistry and mathematics. As a research assistant to H. von Euler he published papers in biochemistry. Soon he abandoned biochemistry for mathematics studying under Marcel Riesz. He received his Ph.D in 1917 for his thesis on Dirichlet series and published a series of papers in analytic number theory. In 1918 he married Marta Hanssow.

Cramér was an assistant professor of mathematics at the university of Stockholm from 1917 to 1929. In 1929, he was appointed as head of the Institute of Actuarial Mathematics and Mathematical Statistics, an institute setup by the Swedish insurance companies at Stockholm University and was offered a new chair at the institute, while continuing as Professor at the university. In 1950 he was elected President of Stockholm University and became the Chancellor of the Swedish University system during 1958-61 after which he retired but remained active. During 1920-1929 he was an actuary first for the life insurance company Svenska livförsäkringsbolaget. From 1929-48 he was an actuary for the reinsurance company, Sverigeand after which he remained as a consultant to the company till 1961. The year 46-47 he spent at Princeton, Yale and Berkeley in U.S.A. During 1961-65 he made several visits to the Research Triangle Institute in North Carolina, U.S.A. Cramér passed away on October 5, 1985 near Stockholm.

Cramér was a number theorist, probabilist and statistician. He made lasting contributions to analytic number theory. He was a mathematical master craftsman, contributed pathbreaking research in probability, statistics, insurance mathematics. He began work in probability theory in 1920 when the subject was lacking foundation and rigorous standards set by contemporary mathematics. Cramér's subsequent career spans the entire development and embodiment of probability theory into the rigorous mathematical discipline which it is today.

Cramér terms the decade of twenties as the 'decade of preparation' for the explosive development of probability theory which was to follow. His important contributions during this period include a deep study of the rate of convergence to the normal distribution in the Central Limit Theorem, considerably improving on the work of Liapunov. He gave the first rigorous treatment of the now classical characterization of Poisson Process. The thirties, which he terms as 'the heroic period', saw dramatic developments in central limit and related theory. Cramér took up systematic study of characteristic functions as an analytical tool in probability theory. His studies

resolved a conjecture that a normal distribution can have only normal components. During this phase he published an important treatise on finite dimensional distributions and their characteristic functions.

Cramér made fundamental contributions to the theory of stochastic processes. He was the first to obtain the spectral representation of stationary stochastic processes. He systematically developed, with Leadbetter the extreme value theory of stationary processes. He contributed to the multiplicity theory and innovation representations of non-stationary processes. Cramér-Rao inequality, Cramér-von Mises statistic, Cramér-Wold device, Cramér-Lévy continuity theorem, Cramér's theorem on decomposition of normal variables, Cramér-Slutsky theorem are now classical.

In his work, Cramér always had a primary concern for potential usefulness of results and was motivated by actual applications, mostly actuarial. He was the first one to model the sum of total insurances as the sum of independent random variables. He provided mathematical treatment of loadings in mortality assumptions. He provided a precise discussion of bias occurring in premium estimation and developed the zero-point method which was used for many years in setting insurance rates. His study of maxima and level crossings by normal processes was motivated by the drift of gyroscopes in spacecraft and to determine the probability that this would remain within limits needed for a successful mission.

Cramér published four books and more than 115 papers. His 1945 book *Mathematical Methods of Statistics* is a landmark in the history of mathematical statistics, influenced generations of statisticians and changed the method of teaching as well as research in statistics. This is by no means a manual on applied statistics. This book contained several important new results as well. Even in this mathematical work, he was motivated by its potential applications.

Cramér delivered the S.S.Wilks lecture at Princeton in 1970, was recipient of the Guy medal in gold in 1972. He was a member of several academies and Fellow of the Royal Statistical Society. He was President of the Swedish Actuarial Society. He received several Honorary degrees which include a D.Sc. from the Indian Statistical Institute in 1977.

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