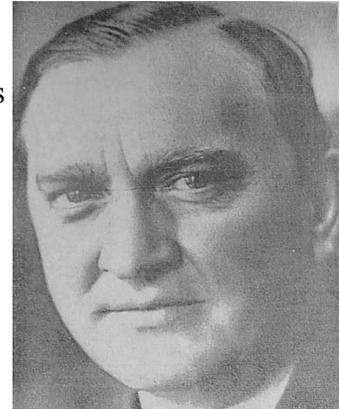


## STEFAN BANACH

Polish algebraist, analyst, and topologist **Stefan Banach** (March 30, 1892 – August 31, 1945) is regarded as one of the founders of functional analysis. The latter is the branch of mathematics concerned with the study of spaces of functions. Its historical roots are the study of transformations, and differential and integral equations. The modern view of functional analysis is the study of complete normed vector spaces over the field of real or complex numbers. Banach also made fundamental contributions to general topology, set theory, the theory of measure and integration, and the general theory of linear, or vector spaces.



Banach was born out of wedlock in Krakow to tax official Stefan Greczek and possibly Katarzyna Banach, the name given as his mother on his birth certificate. Whoever his mother was she disappeared four days after giving birth, never to be heard of again. Greczek gave his son his first name but not his surname. Later Banach attempted to discover the true identity of his mother, but his father refused to discuss the matter, saying he had been sworn to secrecy. Banach was raised in Kraków by various relatives of his father, including Franciszka Płowa. He received his early education from Juliusz Mien, the guardian of Płowa's daughter Maria. Banach was very good in mathematics and the natural sciences but cared little for anything else. After completing his studies at the Henryk Sienkiewicz Gymnasium in 1910, his father told him he was on his own.

Banach left Kraków for Lvov, where he studied engineering at the Technical University. To support himself during this period he had to work away from Lvov building roads. He graduated in 1914, just prior to the outbreak of WWI. During the war, Banach earned money by teaching in the local schools. He also attended mathematics lectures at Jagiellonian University. A chance meeting with Hugo

Steinhaus in Kraków in the spring of 1916 led to their writing a joint paper that was not published until after the war. From then on Banach published important mathematical results at a rapid rate. Through Steinhaus Banach met Lucja Braus, whom he married in 1920.

That same year Banach accepted an assistantship at Lvov Technical University. He submitted a dissertation for his doctorate, which was unusual, as he had no university mathematical training. However, because of his obvious talents, an exception was made, and he was allowed to submit *On Operations on Abstract Sets and their Application to Integral Equations*, which some people believe marks the birth of functional analysis. In his thesis, Banach axiomatically defined what is today called a Banach space. This is a vector space whose scalar multipliers are real numbers or complex numbers. Associated with each vector  $\mathbf{x}$  is a real number  $\|\mathbf{x}\|$ , called the *norm* of  $\mathbf{x}$ , which is a generalization of the length of the line segment or vector in the plane. The importance of Banach's works is that for the first time a systematic theory of functional analysis was available rather than only a set of isolated results.

Banach rose through the academic ranks at the University while continuing to produce important mathematical results. In 1928, with Steinhaus, he started a new journal *Studia Mathematica*, which became the most important journal specializing in functional analysis. In the early 1930s, Banach produced a series of Mathematical Monographs that became classics and 1932 marked the appearance of his famous book *Théorie des Opérations Linéaires* (Theory of Linear Operations), a French translation of his Polish version *Teoria operacji liniowych*, had been published the year before. The *Theory of Linear Operators* remains in print today, in part because of its historical importance but also because of Banach's modern presentation of the fundamentals of the subject. Banach was elected president of the Polish Mathematical Society in 1939. At the beginning of WWII, Lvov was occupied by Soviet troops. Banach had been on good terms with Soviet mathematicians and so was well treated

by the occupiers and became Dean of the Faculty of Science.

Things changed when the Nazis moved into Lvov in 1941. The SS units murdered forty prominent professors, scientists and writers, including Banach's doctoral advisor Antoni Lomnicki, without even the pretense of charges or trials. Banach survived by working in a German institute that was studying infectious diseases. It wasn't until the Soviets returned to Lvov that he was able to return to his mathematical investigations and resume his academic career. By this time he was seriously ill, and before he could go to Kraków to occupy the chair of mathematics at the Jagiellonian University he died of lung cancer.

**Quotation of the Day:** “Good mathematicians see analogies between theorems or theories, the very best ones see analogies between analogies.” – Stefan Banach