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# Pao-Lu Hsu (1910–1970)

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Pao-lu Hsu (Baolu Xu, 許寶騷) is the founding father of probability and statistics in China. He was born on September 1, 1910 in Beijing. In his childhood he received a comprehensive training in the traditional Chinese style, complemented with some exposure to science which was just introduced to China. In 1928 he was enrolled into Yenching University (燕京大學, a Christian university in Beijing), majored in chemistry. He transferred to Tsinghua University to study mathematics in 1930 and received a bachelor degree in 1933. He spent one year for



Pao-Lu Hsu

recuperation. In 1934 he was an instructor of Peking University and an assistant to Professor W. Osgood, before he finally won a governmental fellowship in 1936 to study abroad. He studied statistics with J. Neyman at the University College London, receiving a Ph. D degree in 1938 and a D. Sc. degree in 1940, spending a substantial amount of time in Paris to work with J. S. Hadamard.

By the end of 1940 Hsu returned to China by taking a detour through the Cape of Good Hope and was appointed a professor of mathematics of Peking University, which was relocated in Kunming during the Sino-Japan War (1937–1945) and operated jointly with Tsinghua University and Nankai University as the Southwestern United University. From 1945 to 1947 Hsu visited the University of California, Berkeley, Columbia University and the University of North Carolina, Chapel Hill. In the summer of 1947 he returned to Beijing, declining several invitations to stay in the USA. In 1948 Hsu was elected as a member of the Academia Sinica, along with other four mathematicians. In 1955 he was re-elected again as a member of the newly re-established Chinese Academy of Sciences, because the academy was reorganized. He was appointed in 1964 as a member of the National Committee of the Chinese People's Political Consultative Congress. Hsu died on Dec. 18, 1970 in his apartment in the campus of Peking University.

Professor Hsu was the first Chinese to do research in probability and statistics, and had a world-wide recognition for his fundamental contributions. His research was primarily concerned with mathematical statistics, probability theory and matrix theory. He published his first paper in 1935. During the period of 1938–1947, he published 22 papers, most of them were single-authored. He continued his research after he returned to China in 1947, and published 13 papers. Three books and a few papers were published posthumously. He set a very high standard for his research. Anyone who had interacted scholarly with him was very much impressed by his rigorous scholarship. He never avoided difficult problems. He even preferred difficult problems. According to Hsu, “*the merit of a paper is not just to get published, but is realized when it is cited repeatedly by others.*” Readers are referred to the following articles for authoritative reviews.

- E. L. Lehmann, Hsu's work on inference. *Ann. Statist.*, 1979,7: 471-473.
- T. W. Anderson, Hsu's work in multivariate analysis. *Ann. Statist.*, 1979, 7:474-478.
- K. L. Chung, Hsu's work in probability. *Ann. Statist.*, 1979, 7: 479-483.

- J.D. Chen & Z.G. Zheng, Academic Achievements of Professor P. L. Hsu, *Bulletin ICSA*, 2012.

Professor Hsu was a superb teacher in the sense that many distinguished scholars identified themselves as Hsu's students. For example, Kai-lai Chung (鍾開萊) finished his undergraduate study roughly around the time when Hsu returned to Kunming from UK. Being natives of Hangzhou and colleagues of the Southwestern United University, Hsu and Chung shared many common interests. Hsu's research greatly shaped Chung's academic pursuit. In Berkeley Hsu helped Neyman to supervise Erich L. Lehmann by offering a suitable problem for investigation. After 60 years, Lehmann said that Hsu was one of three god-fathers of his Ph.D. dissertation in his memoir "Reminiscences of a Statistician: The Company I Kept." When the first department of Statistics in the U.S. was set up at the University of North Carolina, Hsu moved to Chapel Hill in 1946 as a founding member. His lecture notes were used even after his departure by the students.



Pao-Lu Hsu and his students, circa 1960

A later paper by Walter L. Deemer and Ingram Olkin was based on the 1947 lecture notes of Hsu at Chapel Hill.

Due to his poor health, Professor Hsu was unable to teach in a classroom after the fall of 1955. He continued his teaching by running seminars in the living room of his one-bedroom apartment on campus. Participants were selected students and young faculty members, given the fact that there were only a few graduate students at the time and almost all young faculty members just finished their own undergraduate studies. To bring up the capability of young colleagues and senior students to conduct research independently and to lead them to the frontier of the field, Hsu run seminars of different topics, with his wide spectrum of knowledge, deep understanding and his dedication to research and teaching. The topics of seminars include *limit theorems*, *Markov processes*, *multivariate analysis*, *experimental designs*, *order statistics*, *statistics for processes*, *combinatorial theory*, *topology*, et al. Very often his seminar turned into a small class by him. Topics and contents of his lectures were carefully se-

lected and organized, with his distinct style of conciseness and clarity. He believed that "*a good author/teacher should show the simplicity.*" He was very kind to young people, offering generously advices as well as encouragements. He was also very critical to shortcomings of young people; he did not miss even an error of using punctuations. On teaching Hsu once said: "*One may feel proud to be the advisor of a Noble laureate. On the other hand, it means nothing to be a student of a Noble laureate.*"

Hsu's role as a great teacher was enlarged in 1956 when *probability and statistics*, along with *numerical analysis and differential equations*, was identified as a key subject in mathematics to be developed with a priority in the National Research Project for Science Development. Only a few Chinese knew probability and statistics by that time. To produce qualified teachers at an accelerated pace, a specialized program was set up at Peking University and Professor Hsu acted as the head coach of the program. There were 54 junior students, selected from Peking University, Nankai University and Sun Yat-sen University, together with some auditors, to study probability and statistics at Peking University. In addition to some faculty members of Peking University, several instructors were summoned from the Chinese Academy of Science and Sun Yat-sen University. Many courses specialized in probability and statistics were offered, such as *measure theory*, *probability limit theorems*, *mathematical statistics*, *Markov processes*, etc. The students trained in this specialized program were then dispatched to universities all over China. Many of them had a life-long career in conducting research and teaching, served as the corner stone of the field of probability and statistics. The specialized program continued until 1964. Among eight graduating classes, Professor Hsu directed five classes to write theses. The teaching plan and course outlines of the specialized program, formulated under the supervision of Professor Hsu, emphasized the basic knowledge, basic skills and basic capabilities. The principle still shed light on today's practices. Several texts for courses of the program were based on his lecture notes. Lecture notes on sampling theory were later compiled by Professor Shanze Sun as a textbook, published by Peking University Press.

Following the Soviet pattern, the division of probability and statistics was set up within the Department of Mathematics and Mechanics at Peking University in 1956. Professor Hsu served as the founding director. Under his leadership, actions were taken to promote further the field of probability and statistics. Dynkin, Fisz and Urbanik from the USSR and East Europe were invited to give lectures or to teach at Peking University, and several young men were sent to Moscow to study probability and statistics. As the leader of probabilists and statisticians in China, Hsu had a broad view and his seminar was not limited to members of Peking University. He once suggested to set up a statistical laboratory in order to promote applications of statistics. This must be inspired by

the fact that Jazy Neyman single-handed ran a statistical lab at Berkeley in 1940s which later evolved into a department. Hsu would like to found a journal of probability and statistics as a launch pad for young researchers. It was not merely a suggestion. He was willing to subsidize the journal by his own money. His desire to boost Chinese journals was so strong that he submitted 11 papers to Chinese journals after 1949. He once said that *"I do not want to get famous because my paper appears in a well-established journal. I wish a journal is well established because my paper appears in that journal."* Unfortunately, his many efforts were discounted and his envisagement was not realized in his life time, although he was immune from politics.

A dedicated scientist and a modest gentleman, Professor Hsu led a simple and isolated life. According to a colleague of Peking University, *"Mr. Hsu was essentially a legendary hero, somewhat mysterious to us."* Nonetheless he inherited a rich Chinese tradition from his well-educated family. He was able to perform quite professionally the traditional opera of Kunqu (崑曲).

He had a strong sense of responsibility. For example, he learned Russian by himself in order to proofread the translation of Russian textbooks in 1950s. Both in 1940 and in 1947 he returned to China during the Sino-Japan war and the civil war. In 1947 *he was looking forward to being part of the emerging new society in his homeland.*

He was never married, though at some point he was close to get engaged. His singlehood and his poor health were reciprocally causations. He was 5 feet 6 inches tall but only weighed 88 pounds. For his light weight he was disqualified in his bidding for a fellowship to study abroad in 1933. He was hospitalized in 1948. In a letter to Herbert Robbins, Hsu wrote: *"It appears that my system has gone wrong, a stomach ulcer and a lung TB are just serious enough to force upon me a complete rest for one year at least."* In his last ten years or so, he was almost confined to bed, reading and writing in bed. When the Cultural Revolution broke out in 1966, teaching and research were stopped and he was left alone. We now know little about his life in the last 4 years or so. What we did know is that his last assignment was to proofread a translated book in a month. He looked at it and said he could do it in 10 days. Indeed, so he did. He spared no efforts in dying days. He died lonely in his apartment, leaving some unfinished draft and a Parker pen (with the brand removed) near his bed.

Professor Hsu was remembered by his colleagues and students. In 1979, T.W. Anderson, E. L. Lehmann and K. L. Chung published articles in the *Annals of Statistics* to review Hsu's achievements and impacts. "Selected Works of Pao-Lu Hsu" was compiled by his colleagues at Peking University, and was published by Science Press of China in 1981. "Pao-Lu Hsu Collected Papers," edited by K. L. Chung, was published by Springer-Verlag in 1983. Memorial meetings were held at Peking University in 1980, 1990 and 2000. In 2010, a memorial collection was pub-

lished, a bronze statue was made, an international conference on probability and statistics was held, and an official commemoration was held on his centennial birthday. The Pao-Lu Hsu Lecture Series was launched at Peking University in 2009 with a roster of distinguished speakers: Shige Peng (2009), Tzu-Leung Lai (2010), Howell Tong (2011), Jeff Wu (2012), Wing H. Wong (2013). Tsinghua University also inaugurated the Pao-Lu Hsu Distinguished Lecture in Statistics and Probability, with Brad Efron as the first speaker. The International Chinese Statistical Society (ICSA) set up the P.L. Hsu award in 2012.

For more information, please visit the memorial webpage at <http://www.math.pku.edu.cn/teachers/Hsu/>.