Memories of Chikio Hayashi and His Great Achievement

Noboru Ohsumi
The Institute of Statistical Mathematics
ohsumi@ss.iij4u.or.jp

What happened on August 6th, 2002, was the most tragic event that has torn the heart of all of us. In the early morning that day, Professor Chikio Hayashi passed away in a hospital in Tokyo. He was 84 years old.

Professor Hayashi was the pioneer and founder of data science, and for us a unique and exceptional leader and mentor in the area of statistics in Japan. He often mentioned his determination to *"die with his boots on"*, remaining active on duty throughout his lifetime. In fact, up to one month prior to his hospitalization, he had been actively engaged in various activities. Hearing the news of his passing away, therefore, I could not immediately believe it was true.

Nearly two years have passed since that day.

In Japan, a series of memorial services are customarily held for a departed soul in accordance with the tenets of Buddhism. Particularly important of these is "San-kaiki" which literally means the third mourning, and is held at the second anniversary of the deceased's death. Today, just about one month before Professor Hayashi's San-kaiki, we are having this memorial session for him at the IFCS-2004 meeting in Chicago. Professor Hayashi's wife and other members of his family requested me to convey to all of you their best regards and the feeling of high esteem. And on their behalf as well as from my sincere heart, I would like to thank the Program Committee and Dr. Banks, as well as many others, for their courtesy and support in making this memorial session possible.


His tomb in a forest

Hayashi covered a vast range of research subjects in his professional field, and was also a versatile and many-talented person with interests extending to a great many areas. Thus it is impossible to introduce all about him within a limited time allowed to me here. Needless to say, moreover, my knowledge of him must be no more than a tiny fraction of his life. Some of the things I knew about him are included in a tribute I wrote in Issue 24 of IFCS-newsletter (December, 2002) under the title of *Professor Chikio Hayashi and Multidimensional Data Analysis –"Quantification Methods and Data Analysis, from Classification to Data Science."*

"Being both a good warrior and a good scholar" is a saying often heard in Japan. Hayashi, in fact, was a scholar athlete of varied attainments. He loved skiing, climbing, "sumo" wrestling, and swimming (in old Japanese style swimming stroke). He was also a man with extensive knowledge of art. Deeply attached to music, in particular, he not only frequented concerts but also played the flute and horn himself. In his late years, he expressed dissatisfaction with his musical performance saying he could not play the horn as well as before. It unfortunately was an initial sign of his lung and heart problems that would surface later on.

His diverse interests also included calligraphy and the tea ceremony. Some of researchers who visited Japan from overseas might have been entertained by Professor Hayashi with tea. And there should be many, just like myself, who have received his calligraphic works as a gift.

As time is limited, I will touch upon Hayashi's career record only briefly here without going into details. And more thorough information will be available in the future when a collection of writings by Hayashi, that is currently under preparation, is completed and published. I will talk about this more later on.

Hayashi was born in 1918 in Tokyo. After graduated from the Imperial University of Tokyo (present the University of Tokyo), he joined the military force. Engaged in "Operations Research" as a technical officer at the air command headquarters, he devised a unique way of using a sort of "control charts" to predict air-raids on Tokyo by the US B29 bombers. This is the most famous of all episodes he left during his military service.
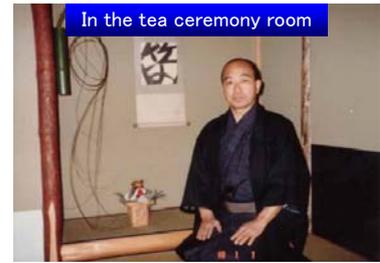
The Institute of Statistical Mathematics was established in 1944, shortly before the end of the war. Professor Hayashi joined the institute in 1946 to come into contact for the first time with *statistics*. There, under the auspices of the US GHQ, he implemented the "Survey Concerning the Japanese Literacy of Reading and Writing" and this was the first attitude survey based on statistical sampling procedure carried out in Japan. His successful achievements in this project blazed a path in statistical survey research, and became the foundation of statistical sampling procedure in social surveys we see today in Japan.

As we know very well, Hayashi is also widely known as the person who proposed and diffused the *quantification methods*. The speakers of today's session will mention this fact in their respective topics. Acclaimed as a particularly notable achievement of Hayashi is the fact that he had established *quantification method Type III* before *correspondence analysis* was conceived by Benzécri of France, and bore remarkable fruits by applying it to practical problems.

Academic contributions:

Hayashi's research activities were not limited to the areas of quantification methods and sampling surveys. At present, his successors including Murakami and Sugiyama are engaged in a project to compile and publish a collection of his writings. When completed, this collection would likely be comprised of over 10 volumes when completed.

Separately from this project, I am organizing a plan to make a database of all available information regarding Hayashi, including his treatises, causeries, critical essays, comments, newspaper articles, and interviews. While it depends on how you count, we now have more than 1,800 entries including co-authored documents.

This database is planned to cover Hayashi's all achievements throughout his life as a researcher in the field of statistics, which we may be allowed to say started when he joined the Institute of Statistical Mathematics in 1946 and continued on for nearly 55 years. Upon completion, the database will be distributed on CD-ROM as an archive to libraries and other appropriate facilities throughout Japan.

Some of the major keywords in his research achievements are as follows:
1) Conception of *the principles of quantification theory and the methods*
   Research and development of *the quantification methods: Types I through VI*, and activities for their diffusion
2) Establishment of practical methodologies for *the sampling survey method in survey researches* including social survey and opinion survey.
3) Study of the *Japanese National Character*
4) *Cultural Link Analysis (CLA)* for International Comparative Survey Research, in extended application of the above study.
5) Studies of *statistical research methods for investigating wildlife*, which include:
   ・ Originally devising statistical estimation method for animal population
   ・ Attitude surveys on symbiosis of humans, nature and wildlife

Hayashi integrated these studies into a concept that extends *Behaviormetrics* and *EDA* (Exploratory Data Analysis in his own way), and deployed it as *Data Science (Deta no Kagaku* in Japanese). In

Hayashi's idea, Data Science is not merely claiming some theories but is *a science* that:

- Enables us to understand or clarify phenomena through data that are gathered *by careful design of experiments*,
- *Classification* is just the fundamental operation that should precede in all sorts of thinking, and
- Executing and conducting carefully *data analysis, classification, statistics*, and other relevant methods.

As described here, the basis of data science is an extremely straightforward concept. I am certain that Hayashi had intended to lead the way in achieving a breakthrough on many problems. He was actually trying to give us many well-designed examples by himself. However, this idea, unfortunately, was still incomplete, and much to our sorrow Hayashi had to depart on the course of integrating it. For your reference, I would like to introduce some documents that were written in English on the idea:

1) Hayashi C. (2002), Questionnaire Construction, Data Collection and Data Analysis: An Approach by the Idea of Data Science. in *Measurement and Multivariate Analysis*, Nishisato, S. and others (eds.), Springer-Verlag Tokyo, 13-24.
2) Hayashi C. (1997), Chikio Hayashi and Data Science -What is data science? -, *Student*, Vol.2, No.1, 44-51.
3) Hayashi, C., Suzuki, T. and Sasaki, M. (1992), *Data Analysis for Comparative Social Research: International Perspectives*, North-Holland Tokyo.

International contribution:
In the area of international conferences, Hayashi made substantial contribution in implementing a variety of international conferences. For example, he assumed the role of the President or an Organizing and Program Committee member in the following meetings:

- *International Statistical Institute, the 46th ISI Session, Tokyo (1987)*
- *The XIIth International Biometric Conference, Tokyo (1984)*

Japanese-French Scientific Seminar

There are many others in which he played an indispensable role such as *Japanese-French Scientific Seminar* (held in 1987 and 1992, for which Baba and myself were involved), The *World Association for Public Opinion Research (WAPOR)*, and *International Conference on Social Science Methodology*.

Contribution to classification studies:
Particularly, in the services for *International Federation of Classification Societies* (IFCS), Hayashi's contribution to IFCS is a common knowledge for us all. He had acted President of IFCS-96 held in Kobe. He was also the IFCS President between 1998 and 2000, and helped establish the *Travel Awards Program* (TAP), a travel expense support program for young researchers. It will be a very pleasant news for us if that IFCS will be able to decide at this meeting to name this program as the "Hayashi Award."

In Japan, he was involved in the foundation of *Japanese Classification Society* (JCS), and several times served as President. For more information regarding this, please refer to the aforementioned tribute text in IFCS-newsletter (issue 24).

Hayashi's acquaintances and session speakers:
Hayashi had many friends and acquaintances. He maintained flourishing interchange with eminent researchers from around the world, including L. Guttman, D.J. Finney, J.B. Kruskal, and so on. Moreover, he had acquainted with many European researchers after his first lecture in France in 1979. Lebart and Bock, who are today's speakers, are among them. There are many others including Diday,

Escoufier, Fichet, Jambu, Lauro, Nakache, Rizzi, Roux,…. and the list goes on almost endlessly. Details of these can be found in my papers listed below:

1) Ohsumi, N. (2000), From Data Analysis to Data Science, in *Data Analysis, Classification, and Related Methods*, H.A.L. Kiers, J.-P., Rasson, P.J.F. Groenen and M. Schader (eds.), 329-334, Springer-Verlag Heidelberg.
2) Ohsumi, N. (1997), From Data Analysis to Data Science - An Overview and Future Prospects: the Research Interchange in Data Analysis between Japan and France -, SFC-97: The Meeting of the 20th Anniversary of Societé Francophone de Classification, September 17 - 19, 1997, Université Lumière Lyon 2, Lyon, France.

As an example, Maurice Roux was the first researcher invited to Japan through research exchange program supported by JSPS (Japan Society for the Promotion of Science) and CNRS (Centre National de la Recherche Scientifique). It was a very important event that set the course in succeeding years of research exchange activities between France and Japan (attached a paper written by M. Roux and sent me from him).

Thus, there are many people whose lecture would move impressively us at this memorial session. However, as the period for adjusting the speakers is limited, we can only have a handful of speakers.

Thus, I have met with a most difficult question of whom I should ask to speak. Fortunately, however, many of Hayashi's friends mentioned earlier were also my friends, and I could hear their candid opinion from several researchers of them. Helped by their support, as well as valuable insights provided by Dr. Banks, who is one of IFCS Executive Committee and the IFCS secretary, I managed to draw up a policy for choosing the speakers as follows:

1) Select from close friends of Hayashi, or people of his school,
2) Particularly preferable are people who were engaged in a collaborative research with him, those who worked jointly for foundation and organization of IFCS,
3) If possible, select one person each from countries in which he had interchange in his research activities, and so on.

The special session speakers who have been finally selected through such a process are as follows:

Speakers and titles:
Ludovic Lebart (Centre National de la Recherche Scientifique, ENST, France)
Validation Technique in Correspondence Analysis

Hans-Hermann Bock (Technical University of Aachen, Germany)
Classification in the Life Span of Chikio Hayashi

Baba Yasumasa and Noboru Ohsumi (The Institute of Statistical Mathematics, Japan)
Chikio Hayashi and Data Science in Japan

About his awards:
Professor Hayashi's great achievements over a period of many years were recognized when he was awarded the *Purple Ribbon Medal in 1981*, followed by the Order of the Sacred Treasure, *Gold and Silver Star in 1989*. In particular, the Purple Ribbon Medal is conferred to a handful of persons that have highly contributed in the fields of academic researches, cultural activities, sports, and entertainments.

Following his death, he was posthumously conferred with *"Shou-shi-i" in Japan's official court rank*. The professor was 84 years old when he passed away. It was too soon and we still need his wisdom. I pray for the professor's happiness in the next world.

May his soul rest in peace.