About the speaker

Professor Kai Wang Ng is Head of Department of Statistics and Actuarial Science, The University of Hong Kong. This is his fourth headship in the same Department. He received his B.Sc. degree from the Chinese University of Hong Kong in 1967, M.Sc. degree from the University of Alberta in 1969 and Ph.D. degree from the University of Toronto in 1975. Upon graduation, he joined the faculty at Toronto and was appointed Associate Professor with tenure in 1981, before his long affiliation with The University of Hong Kong till now. He has published five books and eighty articles in statistics. His first book in 1990, co-authored with K.T. Fang and S. Kotz, *Symmetric Multivariate and Related Distributions*, was published in Chapman & Hall Monographs on Statistics and Applied Probability. The Google Scholar Search has found more than one thousand citations of the book, while more than 500 citations in articles from 140 listed international journals are found on the ISI Science Web, 40% of which appear since 2006. His fifth co-authored book, *Bayesian Missing Data Problems: EM, Data Augmentation and Noniterative Computation*, was published in the Chapman & Hall/CRC Biostatistics Series in 2009. The methods in the book are based on particular forms of the Converse of Bayes' Theorem — the subject of this seminar.

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An Unexpected Journey to the Converse of Bayes' Theorem

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The University of Hong Kong

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Synopsis of Seminar

Bayesian inference has become more and more popular in all areas of research in the last 30 years or so. The related paradigm of inference is based on what is now called Bayes' Theorem, or Bayes' Formula, and was presented in a self-contained paper, "*An Essay towards Solving a Problem in the Doctrine of Chances*." The author Rev. Thomas Bayes did not see it published in his lifetime and died on 17 April 1761. The manuscript was found among inherited papers by his friend, Richard Price, who communicated it to the Royal Society. The paper was read on 23 December 1763 and published by the Royal Society. It is still a mystery as why Bayes, himself a Fellow of the Royal Society since 1742, did not communicate the paper to the Royal Society in his lifetime. There have been interesting conjectures, including those offered by Sir R.A. Fisher in his writings and by S. M. Stigler in his 1983 article in *American Statistician*. This seminar's speaker adds one more to the collection: Bayes withheld his *Essay* because he obtained the converse of his theorem, or he recognized the implications of such a possible converse, and wanted more time to re-write it in those days of feather-and-ink.

The supporting argument is four-fold. (a) The process of inference being proposed in the *Essay* inputs an unconditional probability distribution for the parameter in question, called the "prior distribution," and outputs the conditional probability distribution of parameter given data, called the "posterior distribution." If the converse of Bayes' Theorem holds, one can always find an input for any prescribed output. In that case, Bayes had to argue very carefully for his proposal in order to avoid the impression of inviting the misuses of choosing a prior distribution by reverse engineering, and to defend criticisms on this issue. (b) As a tradition, able mathematicians would normally ponder and explore all possible converses and corollaries of important theorems, especially if the theorem is one's own invention. (c) Bayes being an F.R.S. was not an ordinary mathematician, as records and comments have shown; e.g., William Whiston (Isaac Newton's successor in the Lucasian Chair at Cambridge) wrote about him, having had a breakfast with him one day: "a dissenting Minister at Tunbridge Wells…and like him a very good mathematician also." (d) The converse of Bayes Theorem is true, after all, and its derivation does not need any new mathematics invented after Bayes' time. So obtaining the converse was well within Bayes' capability, given his familiarity with the subject and his standing in mathematics.

In this seminar the speaker will share with the audience a totally unexpected journey that led him to the converse of Bayes' Theorem, based on very simple mathematics. Even more surprisingly, it all started with a problem of solving the key integral equation in an invited paper in the *Journal of American Statistical Association* in 1987 that was discussed by five prominent experts in the field, including two from Harvard University.