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Comment: The 2005 Neyman Lecture: Dynamic Indeterminism in Science

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Professor Brillinger wrote a very stimulating paper on Neyman's life history and some of his contributions to applied statistics. The paper's central theme is to review how Neyman used stochastic processes in data analysis. The paper contains a number of illuminating examples of Neyman and of Brillinger with other collaborators. I am honored to have been invited to be a discussant.

Professor Brillinger quoted Neyman (1960), "The time has arrived for the theory of stochastic processes to become an item of usual equipment of every applied statistician." In the post-Neyman era, data come in our way fast and in all forms, such as streams, functions, manifolds, random shapes, trees and images. The importance of the theory of stochastic processes in applied statistics cannot be overemphasized.

Brillinger's observation of Neyman's thought processes in conducting applied research resonates with me. My discussion will be primarily to amplify it from a somewhat different perspective, namely from Neyman's teaching and his research projects on sampling and cancer. Included in the discussion will be recalls of some of my personal experience having Neyman as a teacher. Neyman's sampling and cancer projects are selected in this discussion in part because of their broad impact which appears to be not a focus of Brillinger's paper. Although Neyman's sampling work does not involve stochastic processes, it fits the title of Brillinger's paper "Dynamic Indeterminism in Science." Neyman had engaged in cancer research for many years until his death in 1981. His cancer research (including survival analysis) used Markov processes extensively. Neyman's contribution to survival analysis links nicely to Brillinger's view on the importance of point processes. Special attention will be paid to Neyman's *Lecture Notes and Conferences on Mathematical Statistics* (1938, 1952) in which Neyman introduced many fundamental statistical concepts and statistical theory, and discussed his views on statistical research which I believe are still very current.

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1. NEYMAN AS A TEACHER AND HIS PROBLEM-DRIVEN APPROACH

I was a student in several of Neyman's classes and a regular in his weekly seminar. My thesis advisor, Lucien Le Cam, sent me to Neyman's classes. Actually, Neyman and Le Cam were like co-advisors to many Ph.D. students of theirs. Neyman would say, "Go ask Mr. Le Cam" or the other way around.

Neyman did not use notes and the lectures were based mostly on his research work. A typical lecture started with a description of a physical problem which was then followed by a discussion of the chance mechanisms operating in the physical phenomenon, and the construction of a model for the data. Next he would pose a statistical hypothesis for testing or developing some estimation procedures. We learned firsthand why he introduced such statistical concepts and methods. Neyman's way of first studying a physical problem and leading to the eventual development of a statistical procedure is quite opposite to the practice of starting with some available statistical methods and applying them to a physical problem. The order of attacking a scientific problem seems reversed.

In these classes, we went through stochastic processes and solved differential equations for probability generating functions with a wide range of applications. For a while we had seminar every Wednesday evening, discussing models of carcinogens and passing around photos of tumors of all shapes (not pretty). Students were called to the blackboard for questions and discussions. Sometimes, the seminars could last until 11 PM and Neyman would take us to Shattuck Avenue for