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Rejoinder: The 2005 Neyman Lecture: Dynamic Indeterminism in Science

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I was so fortunate as to spend formative periods of my statistical career watching and working near two of the powerhouses of twentieth-century statistics—Jerzy Neyman (JN) and John Tukey. The first championed the responsibility the statistician has to set down a clear pertinent set of assumptions guiding her/his data analyses. The second emphasized the importance of looking for discoveries and surprises in data sets.

The Neyman Lecture gave me an opportunity to show my admiration for Professor Neyman and his applied work. The examples from my own work are meant to parallel analyses from his work. In some cases the analyses were done some years ago. The paper may be considered a substantial update of Brillinger (1983). Both Grace Yang and Hans Künsch add meat to the paper and thereby increase our understanding of Jerzy Neyman and his contributions.

I begin with Grace's Discussion. Her comments "resonate" with me, to use her word. Indeed her Discussion, with its emphasis on Neyman's teaching and research projects on sampling and cancer, creates here a collaborative paper concerning Neyman's applied statistics career.

As well as lively anecdotes, Grace presents some Neyman quotes. One that she found that I like particularly is,

> I deeply regret the not infrequent emphatic declarations for or against pure theory and for or against work in applications. It is my strong belief that both are important and, certainly, both are interesting.

The various quotes plus Grace's own words bring out Neyman's approach to science in general and statistics in particular. I refer you to the second paragraph in her section "Neyman as a teacher and his problem-driven approach." Grace further emphasizes today's appearance of massive data sets and the steady appearance of data of novel types that may be perceived as realizations of stochastic processes. She focuses on the Neyman–Fix competing risks model and on a Markov-branching model for the effect of radiation. There are figures displaying yeast cell survival data and the results of fitting a science-based model.

Grace refers to the importance of point processes. I mention in admiration that I regard Yang (1968) as one of the earliest statistics papers bringing a nontrivial point process analysis into a statistical analysis. Her expression (2.1) in the 1968 paper in a sense introduces the conditional intensity function, a concept that has proved an incredibly powerful tool in both theory and applications.

Hans Künsch's Comments are of a different character, and give me an opportunity to elaborate on some of the material in the paper and to mention my future directions. Also let me say that, like Grace's Discussion, I do not find anything in Hans's that I disagree with. Hans chides my analyses some, and then leads the reader into the modern world of simulation, and stochastic difference equation (SDE) methods. (Let me remark somewhat defensively that every scientific paper is a progress report and apologize for not having provided enough detail in some cases.)

Concerning SDEs, Hans mentions the lack of bounded variation of their paths and the natural unreasonableness of this. (This provides an explanation of why one can estimate the parameter σ with probability 1, by the way.) I saw Brownian-based SDEs as a convenient motivator for stochastic models of trajectories and consequent data analyses. Their uses include provision of convenient approximations to Markov processes in discrete time. As generally formulated, however, they lead to Markov processes, which animal tracks are not, for animals eat and then there is a period when they do not eat, for example. To handle this I am now including time lags in the Brownian SDE model, leading to non-Markov processes. I am also working with noise processes other than the Brownian, and consequently the Stratonovich form of SDEs. This allows inclusion of general lagged time effects.

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