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This Week's Citation Classic

Papoulis A. *Probability, random variables, and stochastic processes.* New York: McGraw Hill, 1965. 583 p.
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Axiomatic development of the theory of probability and stochastic processes with emphasis on conceptual clarity is presented. It includes: repeated trials and asymptotic theorems, ergodicity, spectral analysis, linear systems, estimation and filtering, normal and Markoff processes, Shot noise. [The *SCI*® indicates that this book has been cited over 995 times since 1965.]

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"Probability is not a typical scientific discipline. Students of the subject find the definitions often ambiguous and they interpret the results not as manifestations of physical laws but rather as measures of our ignorance. I wrote this book mainly because I wanted to overcome the resulting skepticism.

"In my view, the book has been highly cited for two reasons: (1) It presents the theory of probability as a deductive structure free from conceptual ambiguities. (2) It treats a variety of seemingly difficult concepts and applications with clarity, simplicity, and perspective.

"To achieve the above objectives, I stressed early in the book that probability, like any other science, is a mental structure whose conclusions are based not on experience but on logic. Departing from the tradition of technical books, I devoted the first chapter on the philosophical meaning of probability to explaining the necessity for a clear distinction between assumptions and deductions. The starting sentence of this chapter is an indication of my approach: 'Scientific theories deal with concepts, never with reality. All theoretical results are derived from certain axioms by deductive logic. The theories are so formulated as to correspond in some useful sense to the real world whatever that may mean. However, this correspondence is approximate, and the physical justification of all theoretical conclusions is based on some form of inductive reasoning.'

"My second task was to simplify and unify the treatment of applied topics: Poisson processes, Brownian motion, thermal noise, harmonic analysis. Such topics are developed in specialized books where the primary emphasis is on applications. I chose a different approach: I tried to develop them as illustrations of the general theory concentrating always on probabilistic content and minimizing peripheral, descriptive material.

"A typical illustration is the Wiener theory of estimation. This topic, first published as a classified report during the war, appeared in the open literature in a yellow monograph[1] known as the *yellow peril* because it was written in a language that was foreign to most engineers. The importance of the theory was soon recognized and new applications were discussed in engineering texts. However, most treatments were based essentially on the original derivations that involved advanced theory of functions, integral equations, and the calculus of variations. Perhaps the main reason for my involvement with this book was my conviction that a simpler approach was possible. Starting from the estimation of one random variable in terms of another, I formulated the 'orthogonality principle' and used it to solve a variety of estimation problems. The development is often heuristic but it leads to simple results. It is in this sense characteristic of the entire book: occasional sacrifice of mathematical rigor for the sake of clarity, perspective, and economy. The results were unexpected; they are gratifying."

1. **Wiener N.** *Extrapolation, interpolation, and smoothing of stationary time series.* New York: MIT Press and John Wiley, 1949. 163 p.