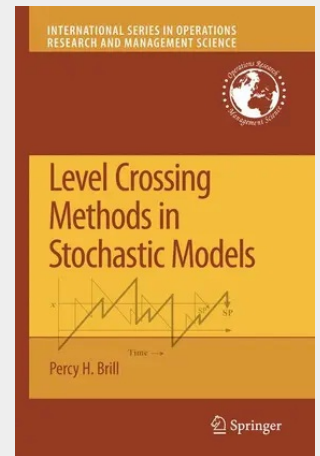


Level Crossing Methods in Stochastic Models

From 1972 to 1974, I was working on a PhD thesis entitled Multiple Server Queues with Service Time Depending on Waiting Time. The method of analysis was the embedded Markov chain technique, described in the papers [82] and [77]. My analysis involved lengthy, tedious derivations of systems of integral equations for the probability density function (pdf) of the waiting time. After pondering for many months whether there might be a faster, easier way to derive the integral equations, I finally discovered the basic theorems for such a method in August, 1974. The theorems establish a connection between sample-path level-crossing rates of the virtual wait process and the pdf of the waiting time. This connection was not found anywhere else in the literature at the time. I immediately developed a comprehensive new methodology for deriving the integral equations based on these theorems, and called it system point theory. (Subsequently it was called system point method, or system point level crossing method: SPLC or simply LC.) I rewrote the entire PhD thesis from November 1974 to March 1975, using LC to reach solutions. The new thesis was called System Point Theory in Exponential Queues. On June 12, 1975 I presented an invited talk on the new methodology at the Fifth Conference on Stochastic Processes and their Applications at the University of Maryland. Many queueing theorists were present.

Since its inception in 1974, the level crossing approach for analyzing a large class of stochastic models has become increasingly popular among researchers. This volume traces the evolution of level crossing theory for obtaining probability distributions of state variables and demonstrates solution methods in a variety of stochastic models including: queues, inventories, dams, renewal models, counter models, pharmacokinetics, and the natural sciences. Results for both steady-state and transient distributions are given, and numerous examples help the reader apply the method to solve problems faster, more easily, and more intuitively. The book includes introductory material for readers new to the area, as well as advanced material for experienced users of the method, highlighting its usefulness for analyzing a broad class of models and illustrating its flexibility and adaptivity. The concepts, techniques, examples, applications and theoretical results in this book may suggest potentially new theory and new applications. The result is an essential resource for researchers, students, and professionals in operations research, management science, engineering, applied probability, statistics, actuarial science, mathematics, and the natural sciences.



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