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Reviews

J. W. COHEN, *The Single Server Queue*, Wiley-Interscience, New York, N. Y., 1969, 671 pages, $35.00.

FEW NEW fields of applied mathematics have a literature that is simultaneously as large, and as widely distributed, as the theory of queues: it can be said that much of the research in queuing is bibliographic. The reasons for this situation are that the same problems arise in many practical fields, and that very slight variation of such factors as order of service, setup time, batch size, and buffer organization gives rise to a new queuing problem about which someone will write a paper. The situation is ironic because there are only a few analytical devices that are used or useful in queuing theory, and these are used over and over: Markov processes, Rouché's theorem, Lagrange's expansion, Wiener's and Hopf's factorization, renewal theory.

Thus it is a help when a part of this body of knowledge is gathered, systematized according to the latest techniques, and published under one cover. This is what PROFESSOR COHEN has done for the set of problems that can loosely be termed 'the queue with one server.' He has divided his task into three parts.

In Part I, he reviews that part of the analytical theory of stochastic processes most relevant to queuing: Markov chains, birth-death processes, and regenerative processes; the treatment is for the reader who has read FELLER if not DOOB, and the emphasis is on analysis rather than technical niceties.

In Part II the author introduces his subject matter and the mathematical model for it and gives detailed and up-to-date accounts of the systems that in KENDALL's notation are referred to as M/M/1, G/M/1, M/G/1, and G/G/1. Because of his admitted affinity for Pollaczek's method he ends this part with a catalogue of other special methods: Markovization by supplementary variables, collective marks, phases, ballot theorems.

Part III is devoted to variants of the basic single server queue considered in Part II: First group arrivals and batch service, then some half-dozen priority disciplines, systems with bounded waiting or storage room, and finally some limit theorems.

The book ends with an Appendix on results from real and complex analysis that have turned out to be particularly useful in queuing theory, and with some Notes on Literature, being an account of who first worked on what problem. There is of course an extensive bibliography.

In summation, Cohen has written a substantial addition to the systematized theory of queues, one that reviews some necessary elementary parts of the theory of random processes for the reader's benefit, that has a clear predilection for the complex variable approach of FELIX POLLACZEK, and that concentrates on the analytical problems of calculating the distributions useful in applications.

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JOSEPH A. PANICO, *Queuing Theory: A Study of Waiting Lines for Business, Economics and Science*. Prentice-Hall, 1969, 214 pages, $7.95.

THIS BOOK is addressed to students of business, economics, engineering, and other disciplines of the physical and social sciences. It is written as a supplementary textbook, providing real-life examples of queues taken primarily from business and manufacturing, and based on the author's own experience while consulting with forty-eight companies. The discussion of these examples is carried out satisfactorily, and to this extent the book achieves its objective. However, the sections dealing with mathematical derivations contain errors, of which the following two are the most serious: On page 52 it is stated that the exponential distribution "yields values for the probability that x assumes values of zero." The derivation of the equations of the queue-length process on page 77 creates confusion between behavior during an infinitesimal time-interval ($dt \to 0$) and steady-steady behaviour ($t \to \infty$). It is unfortunate that such errors should occur in a book that is presumably meant for those who in their eighth grade studied "permutations, combinations, probabilities, stocastic (sic) processes, measure theory, and other exotic subjects" (page vi).

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Books Received

JULIUS S. ARONOFSKY, *Progress in Operations Research, Volume III: Relationship between Operations Research and the Computer*, John Wiley & Sons, New York, N.Y., 1969, 571 pages, $18.75. Number 16 in ORSA's Publications-in-Operations-Research series.

KENNETH J. ARROW AND MORDECAI KURZ, *Public Investment, the Rate of Return, and Optimal Fiscal Policy*, Johns Hopkins Press, Baltimore, Maryland, 1970, 218 pages, $9.00.

RICHARD F. BARTON, *A Primer on Simulation and Gaming*, Prentice-Hall, Englewood Cliffs, N.J., 1970, 239 pages, $8.95 ($4.95 in paper).

JOHN W. BISHIR AND DONALD W. DREWES, *Mathematics in the Behavioral and Social Sciences*, Harcourt, Brace & World, New York, N.Y., 1970, 714 pages, $10.95.

JOSEPH L. BOWER, *Managing the Resource Allocation Process*, Graduate School of Business Administration, Harvard University, Boston, Mass., 1970, 363 pages, $8.00.

JAMES M. BUCHANAN AND NICOS E. DEVLETOGLOU, *Academia in Anarchy—An Economic Diagnosis*, Basic Books, New York, N.Y., 1970, 187 pages, $5.95.

ELWOOD S. BUFFA, *Modern Production Management*, Third Edition, John Wiley & Sons, New York, N.Y., 1969, 809 pages, $10.95.

CHARLES CARTER, *Wealth*, Basic Books, New York, N.Y., 1969, 176 pages, $5.95.

KONG CHU, *Quantitative Methods for Business and Economic Analysis*, International Textbook Co., Scranton, Pa., 1969, 391 pages, $8.95.

D. B. COX, *Analysis of Binary Data*, Methuen & Co., London, England, distributed by Barnes & Noble, New York, N.Y., 1970, 142 pages, $6.50.