Lines at the Airport

Applied Queueing Theory. ALEC M. LEE. Macmillan, London; St. Martin's Press, New York, 1966. 256 pp., illus. $8.50.

This book is a welcome exception in several respects. In the first place it is *not* another exposition of that pleasant mathematical game called theory of queues, in which idealized waiting lines and servers can be combined to display the nuances of stochastic theory and the intricacies of the Laplace transform. This book discusses actual queuing situations, in which actual people, with all their idiosyncrasies, wait in line to buy tickets, or in which actual buses get loaded at a busy terminal. Not that the mathematics is useless; in fact Lee gives an adequate though condensed review of its fundamentals in his first few chapters and later shows how a great deal of it was used in his case histories of applications.

For this was written by a pro in the field of operations research, by one who is keenly aware of the discrepancies between the mathematical model of an operation and the operation itself, who knows the value of the model as well as its limitations. Lee is not writing for other pros, who know these matters as well as he does. If he were he would have confined his philosophical excursions to a few semicryptic comments and concentrated on describing models and techniques he has found useful, as is the case with most books on operations research since its beginning. This book is addressed to the layman and to the beginner in the field, who is all too likely to assume that beautiful mathematics and the development of ever more complex models are the major tasks of the operations research professional worker. Lee has managed to declassify a series of case histories of actual applications of queuing theory, with enough of the realistic details retained to demonstrate the true nature of the problems faced and solved by the professional.

In the second place this is not so much a treatise on queuing theory as it is a fascinating though fragmentary description, as far as commercial security will allow, of some aspects of the operation called commercial air transport. Only occasionally are we allowed to glimpse the workings of the managerial revolution; the more successful applications of operations research are too valuable to give away to competitors, whether they be other companies or other nations. The air transport industry is not unique, but it is one of the more advanced in its use of "management science." Nearly every airline has a small operations research team, whose members may be glimpsed here and there all over the world, looking into the workings of the system. These professionals have their regular, international conferences; their discussions are not open to outsiders. Military operations research is not the only field which operates behind a security curtain.

Behind this curtain the airline pros have learned a lot about the workings of their industry. They have been at it long enough to be realistic about their model building, to have learned from their failures, and to have built on their successes. They are fortunate in that operational data are abundantly available (or at least are not jealously refused them) so they can check in detail their predictions with the actual outcome, a privilege many of their colleagues, studying other operations, wonder whether they should wish they had. In any case they have come to know a great deal, in a quantitative sense, about their operation. The communications industry and, perhaps, the petroleum industry may be the only others as well explored.

Consequently, to this reviewer, it is intriguing to have a corner of the curtain lifted and to see some fragments of the airline operation from the inside. The added insight may even be of some assistance next time he has to get across the continent and back in a hurry.

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Balancing Rigor and Practicality

Theoretical Numerical Analysis. BURTON WENDROFF. Academic Press, New York, 1966. 253 pp., $10.95.

Analysis of Numerical Methods. EUGENE ISAACSON and HERBERT BISHOP KELLER. Wiley, New York, 1966. 557 pp., illus. $11.95.

Chebyshev Methods in Numerical Approximation. MARTIN AVERY SNYDER. Prentice-Hall, Englewood Cliffs, N.J., 1966. 126 pp., illus. $7.50.

Computer science programs leading to degrees at various levels are being, and have been, established at a number of universities in this country, and some people are questioning and wondering about the existence of a body of knowledge appropriate for university teaching as against the training of technicians.

Of all the various branches of computer science, numerical analysis is undoubtedly the easiest to defend. Perhaps to gain more prestige, many people are engaged in making numerical analysis appear as a branch of mathematics. The books by Wendroff and by Isaacson and Keller are typical of what results. Both have the distinct flavor of mathematics with its characteristic rigor and elegance, while at the same time both keep some of the practical flavor of the practicing numerical analyst who wants to get answers.

After many years of experimentation the subject matter is beginning to settle down to an agreed-upon core of material which includes such topics as simultaneous equations, matrices, and eigenvalues; zeros of functions; polynomial approximation, interpolation, differentiation, and integration, with a small amount on Fourier approximation; and the numerical solution of ordinary and partial differential equations. Both books cover this material, with Isaacson and Keller's being much the more teachable.

There is a similar agreement on the ideas that need to be taught: the estimation and propagation of roundoff and truncation errors; convergence of various iterative methods; and the stability of the approximate methods for solving ordinary and partial differential equations. Although there is still a strong tendency to pick the mathematically elegant ideas over the merely useful ones, both books keep a reasonable balance in this matter.

Besides the basic texts there are in numerical analysis a growing number of monographs and books on special topics, Snyder's book on Chebyshev approximation being very typical. Such books are usually nontrivial in content and represent knowledge that is useful to the people in the field. Not only does Snyder give the relevant theorems and examples, but he also is willing to say (p. 31), "In the author's experi-