tions research framework. The use of parallel and series stations leaves many problems untouched. The stochastic nature of the field does not come through satisfactorily. A chapter on mathematical programming follows, in which Arnoff and Sengupta give a superb account of progress in programming except for non-linear programming, in which there have been several recent contributions, such as that of Zoutendijk [1]. A remark at the top of page 176 regarding the unavailability of work on sensitivity is inaccurate. This reviewer has proved in the 1959 paper referred to on page 209 that at a solution vertex the objective function (in the customary notation) has the following sensitivity to a_{ij}

$$\frac{\partial V}{\partial a_{ij}} = -x_j^0 y_i^0 = \frac{\partial V}{\partial b_i}\frac{\partial V}{\partial c_j}$$

where x_j^0 and y_i^0 are the solutions to the primal and the dual, respectively. A readable and very useful account of dynamic programming, including adaptive processes, is then given by Dreyfus. Chapter 6 by Morse deals with Markov and queuing processes. Sisson studies sequencing theory in chapter 7, and a variety of very useful replacement models, developed by a number of individuals, are treated by Dean in the next chapter. In another chapter, Morgenthaler describes simulation and Monte Carlo in a manner which provides useful guide-lines for application. Thomas, well known for his contributions to game theory, treats the subject in chapter 10 in an interesting style which utilizes historical ideas on the subject. The presence of these two chapters clarifies in the mind of the reader differences between simulation and gaming. Magee and Ernst examine the future of operations research in chapter 11 and point out the need of quantitative models of human behavior, marketing, interaction of men with men and with machines, organization, and information; and they call for a better grasp of risk and competition. They point out that operations research is far from mature and has promise. This book is recommended reading.

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1. G. ZOUTENDIJK, "Maximizing a function in a convex region," *J. Roy. Statist. Soc.*, v. 21B, 1959, p. 338–355.

96[X].—THOMAS L. SAATY, *Mathematical Methods of Operations Research*, McGraw-Hill Book Co., Inc., New York, 1959, xi + 421 p., 24 cm. Price $10.00.

This book is about some selected mathematical methods of operations research, but it offers both more and less than what its title may suggest to some readers. Though full of mathematical results, this book is not a cycle of "lemma, theorem, proof, and corollary." Though it has many problems, and though Saaty is deeply concerned with principles of solution, this book is not a "problem manual." Despite the fact that there are many illustrative applications, this is far from being either a "cook book" or a collection of case studies.

For the unifying thread of the book, one must look to the exuberant creativity of Saaty himself. He sets the tone of the book in the preface with the statement

that begins, "We wish to warn the reader at the outset that even though we may attempt partly to inform him and partly to stimulate him . . ." It is the effort to stimulate the reader, to jolt him from his mental ruts, that is most striking. Saaty continually reminds the reader of the elemental role of creativity, that formal proof is not all of mathematics, nor is mathematics all of operations research. Operations research, incidentally, according to Saaty's preferred definition, "is the art of giving bad answers to problems to which otherwise worse answers are given."

The preface states nominal reader requirements of "a course in calculus, with some elements of advanced calculus and rudimentary knowledge of matrix theory," but it also admits to "compromise in the presentation" as a response to an anticipated "variety of background among the readers." As the development unfolds, it becomes clear that Saaty hesitates neither to emphasize an elementary result that he finds suggestive nor to introduce a more advanced result that he finds particularly intriguing.

The outline of the book is much what one might expect from the title. The introductory first chapter presents history and concepts of operations research. Then, Part 1 gives three chapters, also largely introductory in nature, that range rather widely over topics related to the scientific method as an approach to truth, to mathematics and logic as approaches to validity, and to some elementary classical methods useful in the formulation of mathematical models. As the first of the two major sections, Part 2 has three chapters on the subjects, respectively, of optimization, linear and quadratic programming, and the theory of games. In Part 3, the other major section, there are four chapters that dispose of basic probability, applications of probability, fundamental statistics, and queuing theory. The lone chapter of Part 4 concludes the book with an unusual essay on creativity. Each of the four parts gives a collection of interesting problems, and each chapter ends with a set of valuable references.

The logic of the outline does not always withstand successfully Saaty's attempts to stimulate the reader. Sometimes Saaty seems to give way to his own effervescence, getting ahead of his story by appealing to concepts or methods that are stated clearly only in a later chapter. The resulting unevenness of presentation would be a fault in a conventional text with more staid objectives. But conventional standards hardly apply to a book that draws upon such diverse topics as James Thurber's rooster, the trial of Madeline Smith for the murder of her lover, "The Critique of Pure Reason," "The Prince" of Machiavelli, and "The Three Princes of Serendip." Even the typographical errors, which are of at least the usual frequency, may be viewed, generously, as useful stimuli to the reader's alertness.

There is only one reference to computers ("Computers are often used in gaming methods . . . They have the advantage of speed and economy and can be controlled and relied upon."). There are several passages that touch on topics of numerical analysis. What the book conveys in fullest measure, however, is the spirit of mathematics and a passion for the creative solution of problems, wherever they may arise.

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