has its drawbacks since the text is designed for use in a one semester course. The exercises at the ends of the chapters are not as numerous as those found in Guilford and Tate but are quite closely related to practical psychological and educational problems. As in Garrett and Guilford, the steps involved in using new procedures are outlined in "cookbook" form. Unlike Garrett this is done in DuBois only after a good deal of theoretical development and intuitive discussion.

In DuBois the chapters on multiple and partial correlation are introduced relatively early and extensively discussed whereas in the other introductory texts these topics are relegated to the end of the book, if discussed at all. Topics such as matrices and factor analysis are discussed in DuBois and are not found in the other texts. Important as these topics are in psychology and education they should probably be presented in a second course along with the chapters on test construction (Chapter 15) and nonparametric tests (Chapter 18). The major distinction in the discussion of analysis of variance is that DuBois is less methodological than Guilford or Garrett. A minor distinction is that notation is less clear in DuBois.

For general use as a textbook in psychological and educational statistics, DuBois' book rates on a par with Guilford and considerably superior to Garrett. For use as a truly introductory text (not including analysis of variance), DuBois is inferior to Tate due to the extra topics and lengthy discussions.

Linear Programming and Its Extensions. *George B. Dantzig.* Princeton, New Jersey. Princeton University Press, 1963.

STANLEY REITER, *Purdue University*

PROFESSOR DANTZIG has written a treatise on linear programming which should stand as the main reference work in the field for some time to come. He has evidently taken pains to make the material accessible to a very wide readership, including users of linear programming as well as producers of new linear programming methods. Much of the book, especially the first few chapters dealing with the formation of linear programming problems and the simplex method of solution, presuppose almost no prior mathematics. In some later portions of the book more "maturity" is required, but the same high standard of clarity is maintained throughout. The text contains many exercises, which the reader is expected to do before venturing further. There is also a rich collection of exercises at the end of each chapter. With the aid of these problems a careful and conscientious reader can make himself master of the subject by what amounts almost to "programmed instruction".

The scope of the book is indicated by its title. However, the extensions dealt with are those that remain within the framework of finite dimensional treatment. Thus, the book does not deal with programming in infinite dimensional linear spaces, nor with methods of solution based on gradient techniques (and so involving limiting processes).

The coverage of the chosen field is remarkably thorough through 1960 and into 1961. Since then there continues to be a substantial flow of papers extending the work on integer programming, quadratic programming and so forth. Most of this work to some degree extends ideas already in this book. However, one would get no idea from this book of the connection between linear programming and discrete optimal control problems, a development taking place quite recently.

Summary of the Contents:

The first three chapters deal with the sources of linear programming and give detailed examples of applied problems which can be formulated as linear programming problems.

Chapter 4 presents the theory of linear equations and inequalities in an elementary manner. The presentation is such that, it seems to me, a reader could follow it, though with some effort, knowing very little algebra.

Chapter 5 through 11 deal with the simplex method, including the duality theorems and variants of the simplex method. Chapter 12 deals with the interpretation of dual variables as prices and with sensitivity analysis. This chapter concludes the material on basic linear programming.

The remainder of the book deals with linear programming problems exhibiting some sort of special structure and with devices for extending linear programming to deal with various non-linear problems.

Chapter 12 relates linear programming to game theory. The chapter contains a brief exposition of the matrix game model, including the concept of mixed strategy. The main material in this chapter is the demonstration of the equivalence between a matrix game and a linear program, and a proof of the minimax theorem by means of the simplex algorithm.

The next seven chapters deal with the transportation problem, the transshipment problem and the relationship between flows in networks and linear programming, including the Ford-Fulkerson theory.

In the remaining chapters there is a brief and excellent treatment of integer programming, including material that illuminates the significance of integer programming formulations as devices for bringing nonlinear problems into the class of linear integer or mixed integer problems and a presentation of Gomory's method of integer forms. There is however no appraisal of the efficiency of these methods in computation, and only a hint, easily overlooked, to warn the reader that we are still some way from having a computation code reliable and efficient enough to use on integer problems of even moderate size.

There is a chapter devoted to convex programming problems. Here the object is to dispense with the condition imposed by Kuhn and Tucker that the functions involved be differentiable, and to give a constructive solution procedure using the generalized programming approach, (A generalized linear program is a linear program involving variable co-efficients). This chapter also contains a variant of Wolfe's procedure for convex quadratic programming. The following chapter applies this material to problems involving uncertainty.

There is a chapter dealing with the so-called Decomposition Principle for linear programs (Ch. 43). This procedure involves breaking a large problem with block diagonal structure into several smaller subproblems and a master problem which relates them. The solution procedure involves solving the master and subproblems several times and using intermediate solutions in an iterative procedure which alters the problems. This principle offers a device for coping more effectively with very large scale linear programming problems, but also has interesting interpretations in terms of the organization of economic units corresponding to parts of the linear programming problem.

The decomposition principle is interpreted as offering a "decentralized" way of solving the problem. However, much ambiguity clouds this interpretation. Dantzig recognizes the existence of differing views and he is therefore careful to say that the principle involves "central planning with incomplete information at the center." However, in spite of this the term "decentralized" appears very frequently in this chapter.

The book concludes with formulations of two illustrative "real" problems; Stigler's diet problem, and a problem of assigning aircraft to airline routes in the face of uncertain demand for seats. Both problems are solved numerically in detail.

There is a very complete bibliography, a satisfactory subject index and an index of authors.

We are indebted to Professor Dantzig for what is surely to be the standard work on linear programming for years to come. It is good that he has done the job so carefully and with such concern for the reader.

Models, Measurement and Marketing. *Peter Langhoff (ed.).* Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1965. 216 pages.

RONALD FRANK, *University of Pennsylvania*

THIS volume consists of a collection of nine papers each of which deals with some aspect of the problem of modeling markets. The papers were originally present at the monthly luncheon meetings of the Advertising Research Council during 1960–61, and are published under its auspices.

The following papers are included:

1. Peter Langhoff, The Setting: Some Non-metric Observations.
2. C. West Churchman, Reliability of Models in the Social Sciences
3. Harold W. Kuhn, Mathematics and Marketing
4. Martin Starr, Computers: The Marketing Laboratory
5. Sebastian B. Littauer, Fundamental Scientific Aspects of Marketing and the Development of Marketing Models
6. Alfred A. Kuehn, Models for the Budgeting of Advertising
7. William J. Baumol, Models of Economic Competition
8. Paul E. Green Decision Theory in Market Planning and Research
9. Guy-Robert Detlefsen, Theory Into Practice

According to the editor the objective of the book is to contribute to the exploration and evaluation of management science as a source for improving decision making in the field of marketing as well as to expose the reader to the basic concepts of this new science and to sketch the opportunities it may have to offer.

The content of the volume is not quite what one might expect given this statement of objectives and its title. First, the problems of measurement are barely touched upon. While a number of the papers talk about different models none of them presents a specific model let alone a discussion of its impact on managerial decision making. In other words, the book does little to permit one to either evaluate the contributions of management science nor does it provide a vehicle for sketching the opportunities it may have to offer, primarily because it lacks the type of detailed reporting necessary for assessment.

The one extremely important goal that it does achieve is to expose the reader to the basic philosophy of the scientific method as it is reflected by the approach and the techniques utilized by the field of management science. If marketing management is to make increasingly effective use of this field it needs this exposure. *It needs to understand and accept the goals of science.* This volume, which contains nine papers of consistently high quality, is a step toward that end.

Quantitative Analysis for Business Decisions. *Bierman, Fouraker and Jaedicke.* Richard D. Irwin, Inc., 1961. Pp. 358+xi, $7.95.

M. J. MORONEY, *Unilever Limited, London*

IS IT a good thing for students of business or industrial administration to get a reasonable grasp of linear programming, decision-making under uncertainty, utility theory, game theory, simulation, waiting line theory and computers? Are these relevant in practice to problems of inventory, capital budgeting, pricing policy and so