REVIEWS

The Theory of Games and Linear Programming. By S. VAJDA.

[Pp. 66. London: Methuen and Co., 1956. 8*s.* 6*d.*]

THE subjects of linear programming and the theory of games have had a great deal of attention during the past fifteen years. A brief explanation of these two terms might run somewhat as follows. A game is a collection of rules that determine what moves a number of players may make and the value to the players of each of the possible outcomes of the game. The outcome of the play is dependent on some probability model combined with the strategies that the players adopt during the progress of the game. The problem is to find the best strategy for a player to use. Linear programming is essentially an algebraic process. For example, x_1 and x_2 are two non-negative variables and the constraint that $6x_1+4x_2=8$ is given. It is then required to find the non-negative values of x_1 and x_2 that make the linear function $2x_1+x_2$ a minimum. The answer can be obtained in this case by inspection, but in the more general problem there will be n variables and m constraints where m is less than n and the solution will not be obvious. The solution of problems in the theory of games requires the solution of other problems in linear programming and hence the marriage of the two subjects in one book.

Dr Vajda's monograph is concise and endeavours to cover much ground. No previous knowledge of the subject is assumed, and an attempt is made to bring the theory of games and linear programming from an elementary level up to the standards demanded by present-day developments. Concentrated study is required in order to extract the greatest benefits from the work, although it is best studied as a whole rather than piecemeal. The first chapter gives a general discussion of what is meant by a game using as illustrations 2 by 2 games, 2 by 3 games and 3 by 3 games, where the number refers to the possible strategies that are open to each of the two players in a game. It is amusing to note that in the example on p. 2 concerning warfare the General commands fewer troops than the Colonel. It rather suggests that we are not in at the start of the battle! The next chapter deals with the graphical representation of the simpler games, whilst the third chapter develops the algebraic expressions necessary to find the optimum solution of a game and demonstrates how the solution leads to a problem in linear programming. The remainder of the book, except for one short chapter of five pages, is concerned with linear programming. This part of the work seems very good. Simple examples are given and solutions are obtained from first principles and later by means of the simplex method. The link with graphical solutions when there are just two more variables than constraints is clearly explained and drives home the underlying principles. Perhaps one feels at times that the examples are over-simplified, but it is clear that to have introduced greater complexity consistently throughout the book would have increased its length enormously. The practical applications of the methods discussed in the book have been made possible by the advances in electronic computers over recent years. The methods described in the book are very nearly in the form where they are ready to be given to a computer for solution.

At a first glance the mode of writing used in the book appears very tiring to the reader. Abbreviations are used in great profusion, and although a glossary

is given it takes a little time to get accustomed to them. The notation, too, seems rather awkward and clumsy, especially as regards the use of subscripts. For example, expressions such as $z_{u_s u_{m+k}}$, used throughout the algebraic portion of the book, are rather frightening, especially since the three levels of type required are not always very well separated. Actuaries have a habit of festooning the four corners of a symbol with affixes and perhaps some such system could be adopted in this connexion. There are occasions where a little more practical guidance would be useful. For example, the discussion on repeated loops and degeneracy on p. 65 seems to imply that the examples of loops that have been quoted are likely occurrences, but this is not so, and for practical purposes such loops may be virtually ignored.

The book as a whole devotes rather more attention to linear programming than to the theory of games, the latter being represented by about a third of the book, and only the simpler forms of games are discussed. From the title of the book this is disappointing, and the reviewer feels that given the subject-matter included in the book the theory of games should have been put after linear programming both in the title and in the order of contents. This is, however, only a minor criticism of a very useful work which provides in a compact form some idea of the problems that can be tackled with the aid of the theory of linear programming.

P. G. M.

Statistical Method and Scientific Inference. By Sir RONALD A. FISHER, Sc.D., F.R.S.

[Pp. 175. London and Edinburgh: Oliver and Boyd, 1956. 16*s*.]

IN this book Sir Ronald Fisher sets out the basis of the reasoning underlying his two previous works—*Statistical Methods for Research Workers* and *Design of Experiments*. Many of the ideas contained in these books have been the subject of controversy, and a substantial portion of the present work is devoted to a refutation of criticisms. For a full appreciation of the book some acquaintance with past criticisms is desirable. Students beginning the study of statistics will, therefore, find the book unrewarding. On the other hand, it should prove of interest to a much wider circle of readers than professional statisticians. Indeed, any scientist who considers, at all seriously, the basic logical procedures involved in research work is likely to find it profitable to read this book.

The author starts with a description of the historical development of the study of scientific inference, with particular reference to the work of Bayes, Boole and Venn. Although the name of Laplace occurs fairly frequently in this discussion, the general impression is that the systematic study of the logic of scientific inference has been, for the most part, a British undertaking. Considerations of space may have contributed to this limitation of the historical treatment of the subject, but it is unfortunate, in view of the universal nature of the title, that the rather parochial tone thus set persists to some extent throughout the book. Within these limits, however, the book contains a most valuable discussion of statistical methods in relation to experimental work. This is, indeed, to be expected, since a considerable part of the present-day repertoire of statistical techniques derives from the author's work.

Coming to the discussion of modern ideas on scientific inference, the author soon introduces his concept of 'the fiducial argument'. This has been the subject