and goes on to deal with the problem of translating ordinary sentences into a formal logical language. The difficulties inherent in this process are not minimised and the author makes clear some of the pitfalls involved. A natural deduction system for the predicate calculus is then set up followed by a section dealing with a number of metatheorems. An axiomatic treatment of logic is also given followed by a number of examples of formal theories. A final chapter is included on the history of logic.

The section on sets would have benefited from the inclusion of a brief description of Venn diagrams and how they can be used to illustrate the properties of sets. Another point where greater clarity could have been achieved is in the section on truth tables. Examples of truth tables are given for fairly complex sentences, but the truth tables for the basic sentential connectives are not explicitly given. One place where the author takes up a contentious position is in describing criticisms of the " tertium-non-datur " as foolish.

However, the overall impression the book makes is favourable. It is well supplied with illustrative examples and should make a useful introduction for newcomers to the subject.

M. PARTIS

SHCHIGOLEV, B. M., *Mathematical Analysis of Observations* (Iliffe, London, 1965), xvi+350 pp., 63s.

In many branches of science it is becoming necessary to find mathematical laws which govern physical phenomena. These laws may be suggested by direct experimental measurements or may be based on theoretical considerations and later tested experimentally. It is therefore essential that scientists should have a clear understanding of all aspects of correct evaluation of experimental data. This book, written by a leading Russian mathematician and physicist and well translated, usefully collects together several relevant topics in numerical analysis and statistics which are often found scattered in different books.

The first part deals with errors due to limited sensitivity of measuring instruments and rounding-off. The ideas of exact error, limiting absolute error, limiting relative error and the estimation of error are developed. The compounding of errors in the fundamental arithmetic operations of addition, subtraction, multiplication and division of components subject to independent errors is examined. This section is completed by a discussion of the errors in functions of one or more variables subject to error; illustrative examples of the simpler elementary functions of one variable are included.

There follows a comprehensive treatment of interpolation which covers the general ideas of polynomial interpolation with reference to tables with constant and with varying intervals. Most of the standard formulae are developed and their accuracy and relative merits are examined.

The interpretation of most experimental results depends on mathematical statistics. The third section of the book discusses probability and its axioms and the properties of discrete and continuous random variables. Properties and applications of the binomial, the Poisson and the normal distributions are described. Various limit theorems and inequalities, which among other things emphasise the extent of agreement between theoretical probability and relative frequency in repeated trials and the fundamental role of the normal distribution are introduced. A final chapter is devoted to theoretical joint distributions of two random variables including the concepts of correlation and regression, and the general ideas are illustrated by detailed treatment of the bivariate normal distribution.

The fourth part of the book deals with the best estimation of an unknown parameter or parameters from observational data subject to experimental error by the method of least squares. Both the single parameter problem and the problem of simultaneous estimation of several parameters are discussed for equally weighted and unequally

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weighted data, and the precision of the estimate or estimates is examined. The modifications introduced into the several parameter problem by the existence of exact conditions between the parameters are described.

A final section deals with the calculation of the properties of univariate and bivariate frequency distributions and the inferences which can legitimately be made from the values obtained.

The whole book is presented in a lucid manner and the approach is at times quite stimulating. Although only a relatively elementary treatment of each topic is given, the appearance of all the material in a single, readable, volume makes this a useful book for workers in all branches of experimental science, provided they have a basic understanding of calculus and algebra including the binomial theorem.

J. R. GRAY

WARNER, SETH, *Modern Algebra* (Prentice-Hall, Inc., 1965), two volumes, 806 pp.

These books are designed for students who are inexperienced in modern algebra. Undoubtedly the reader who studies the volumes properly will gain valuable mathematical experience and an extensive knowledge of algebra. But if his task is not to be too protracted, there will be little time for anything else!

Many of the important notions of modern algebra are developed in the exercises at the end of each section. These are carefully arranged so that the reader's thoughts are guided along the right lines, but some of the problems are quite difficult. Thus a good supervisor seems to be essential for anyone inexperienced in the subject.

The overall plan of the two volumes is commendable. After the now standard introduction to set theory, the work is properly launched through the concept of a general binary operation. From there the reader is led to the specialised structures of semi-groups, groups, rings, fields, vector spaces and polynomial rings. Natural numbers are discussed in Volume I; the real and complex number fields are postponed until the first chapter of Volume II. Algebraic extensions, linear operators and inner product spaces are also discussed in Volume II and there is a final chapter on the axiom of choice; the latter might well have come earlier in the work.

In every case the topic under consideration is given a very full treatment. Thus Chapter V on vector spaces occupies 105 pages; Chapter IX on linear operators is nearly as long. The scope of many of the chapters is much wider than the titles suggest. That on vector spaces, for instance, introduces the reader to divisible groups and modules, structure theorems such as the Wedderburn-Artin theorem, and affine geometry. However, many such notions are met in the exercises and not in the text! Some parts of this chapter are fairly elementary. Thus matrices make their first appearance and a method for solving linear equations is explained. But other sections are much more sophisticated. Indeed the last section of the chapter seems a very difficult one for an inexperienced reader, who should be well pleased with his progress if he can do the exercises at the end.

Most of the chapters are developed on similar lines. Whilst the impressive amount of material has been carefully compiled, it is open to argument whether it is necessary to introduce so many details and so many terms. There seems to be a genuine danger that the reader will find these overwhelming. Moreover the notation is often too fussy, which helps to make the going difficult. Some of the definitions are not standard; for instance simple rings are assumed always to be artinian.

The printing and general production are extremely good and I found the detailed index very helpful. With reservations about the excessive amount of material, I would recommend these books as being worthy of a position in any mathematical library.

E. M. PATTERSON

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