

expected to maintain a higher level of accuracy than can be achieved by other methods. CMSR will be merged with PRISM: the combination of the two records will, first, provide

personnel managers with detailed information about senior people and, secondly, provide information for man-power planning in respect of the Civil Service as a whole.

## References

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## Book reviews

*Integer and Nonlinear Programming*, by J. Abadie (editor), 1970; 544 pages. (North Holland Publishing Co., £10.50 or \$25.20)

Most workers in the field of mathematical programming will already be familiar with the first volume 'Nonlinear Programming' edited by Abadie in 1967. Now in 1970 comes his second volume; twice the size and unfortunately at twice the price, but just as indispensable as the first. The 26 papers and three appendices cover nearly every aspect of modern mathematical programming, from the latest and most general theoretical results to the most practical methods and applications. Roughly speaking the papers fall into five groups—general nonlinear programming theory and algorithms, quadratic programming and least squares, stochastic programming, integer programming and graph-theoretic results.

The first three groups of papers reflect the considerable progress which has been made in the last few years in nonlinear optimisation, both constrained and unconstrained. There is a welcome highlighting of practical algorithms and computational results although these are still extremely thin in comparison to linear programming. It is invidious to single out individual contributions but particular attention should be paid to Wolfe's paper on 'Convergence Theory in Non-Linear Programming', an important topic which has only recently come into prominence in comparison with the long emphasis on existence and duality theorems.

Another too long neglected topic in mathematical programming has been the numerical stability of algorithms. This state of affairs is now beginning to be redressed, and Golub and Saunders's contribution to this volume analyses a number of methods for least squares and quadratic programming.

Of the eight papers on integer programming three are concerned with the recent theoretical work of Gomory on the asymptotic integer problem and the faces of integer polyhedra (including a survey by Gomory himself). Of more immediate practical importance there are three papers on the implementation of branch and bound methods in production codes with very encouraging computational results. Another welcome contribution is Balas's survey of his results on mixed integer duality theory and their practical application to mixed integer algorithms (these ideas have also been implemented commercially).

The final section is perhaps highlighted by Dantzig's diverting paper on complementary spanning trees—an interesting example of Lemke's principle. The three appendices give valuable background material for a number of the papers in this collection.

In summary this is a book with something for everyone and should be on the shelves of everybody seriously interested in mathematical programming.

J. A. TOMLIN (London)

*Algorithms and Recursive Functions*, by A. I. Mal'cev, 1970; 372 pages. (Wolters-Noordhoff Pub. \$15.50)

This is a very readable translation of a standard Russian text published in 1965. The first chapter defines some fundamental concepts such as alphabets, words, functions and the basic operations of composition, substitution, primitive recursion and minimalization. The next three chapters cover the basic ideas and theorems concerning primitive recursive functions, partial recursive

functions, recursively enumerable sets, universal functions and various enumerations of functions and sets up to the level of defining productive and creative sets. Further chapters cover Turing machines and their relation to recursive function theory and variants such as normal algorithms, operator algorithms, multitape machines and tag systems. Applications of the theory are made to the word problem for semigroups, the decision problems for first order logic and for arithmetic, the non recursive-enumerability of the theorems of second order logic and Diophantine equations. In this last application Hilbert's tenth problem—still an open question when the book was written—has now been proved to be unsolvable, the final link in the argument being provided by the Russian, J. Matijasevic.

The book therefore treats very standard material such as would be covered in a first course on the subject and could well serve as a reference book for workers in the theoretical aspects of computation or as a text book for a course. Finite state machines are not discussed, nor of course are the latest ideas in the mathematical theory of computation. This reviewer liked the style of the book, the theorems are clearly stated and the proofs rigorous without being over-mathematical. At the end of all chapters are examples and exercises which both illustrate the topics treated and also suggest recent research lines.

These complimentary remarks do not apply to the first chapters which attempts to define basic concepts such as words and functions. Several of these attempts seem rather unsatisfactory, for example the definition of a word as a sequence of cells occupied by letters, the definition of a class of algebras as an arbitrary system of algebras of the same type (what is a system?) and the difference (if any intended) between a function and an operation is unclear.

The book should not be judged by its first chapter. Scattered through the book are a few misprints which affect the sense (e.g. on pages 31, 129, 235, 288, and 305) but these should easily be discovered.

The book will be recommended reading on a course to be given by the reviewer.

D. C. COOPER (Swansea)

*Information Theory for Systems Engineers* (Econometrics and Operations Research XVII), by L. P. Hyvärinen, 1970; 197 pages. (Berlin: Springer-Verlag, \$12.10)

The first (paper back) version of this book, which is based on lectures given at the IBM European Systems Research Institute, was reviewed in the *Computer Journal* in May 1969 (vol. 12 p. 182). This new version has been improved by the addition of specific illustrative examples, e.g. of the semantic difficulties arising in the translation of natural languages. The change from 205 pages of quarto in double-spaced pica typewriting to 197 pages of 23 cm × 15 cm in letterpress allows for some increase in content, and in particular there is an additional chapter covering the applications of noiseless coding to data compression, information retrieval, taxonomy and cryptography. The section on error-correcting codes has been extended a little, but this is a large subject to try to include in a book on information theory.

The book has a list of 56 useful references and 30 problems with detailed solutions. It is a pity that it contains occasional blemishes in English spelling.

D. A. BELL (Hull)