sequences has been to assume that a direct program is too difficult to write. This has usually led to study of a cognate problem—generation of all states of a function whose states can be placed in one to one correspondence with permutations. The function is chosen so that its states are simply generated and the correspondences are amenable to mathematical study.

The present paper shows that the problem can be solved by direct programming.

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Book reviews

Modelling and Performance Evaluation of Computer Systems, edited by H. Beilner and E. Gelenbe, 1977; 515 pages. (*North-Holland*, Dfl. 95.00)

This book consists of 31 papers presented at the 1976 International Workshop of Modelling and Performance Evaluation of Computer Systems. Two thirds of the contributions are from West European research laboratories and universities, and the remainder from Eastern Europe and USA.

The largest group of papers aims at an understanding of the processes within a computer, hence mathematical models of virtual storage systems, multiprogramming facilities, file assignment and other characteristics associated with large computers are presented. Some of the authors provide solutions to classes of queueing networks which have made advances to probability theory, whereas others use existing modelling techniques such as queueing theory, simulation, Markov processes, or dynamic programming. The other major group of papers is concerned with scheduling of externally given tasks through the computer. Simple statistical models are described as well as more complicated heuristic models. In addition, two papers concentrate on measurement aspects of information inside a computer, and there is a textbook type contribution on 'Statistics and simulation'.

The papers vary in length from two to 32 pages and differ considerably in quality. Some authors present no more than a theorem or mathematical formula with sparse explanation, whereas others describe their models in some detail together with experimental evidence. The editors give no guidance to the reader who wishes to select certain topics, nor are the papers arranged in any coherent sequence.

This is not a book for the commercial computer installation, but could be of benefit to the mathematically orientated researcher in computer science or probability theory.

R. HOLSTEIN (London)

Interactive Data Analysis, by R. R. McNeil, 1977; 186 pages. (*John Wiley*, £7·00, paper only)

The title of this book requires interpretation. 'Data analysis' is a branch of statistics pioneered by J. W. Tukey of Princeton University, whose influence is pervasive throughout the book—it may indeed be regarded as an introduction to Tukey's *Exploratory Data Analysis*, recently published by Addison-Wesley after some years of informal circulation. 'Interactive' is taken to imply that the results of one piece of data analysis can be used immediately as input to the next piece, without a computer necessarily being involved.

On the statistical side, the original flavour of the book may be illustrated by the fact that it contains no mention of significance tests of any kind, and that the mean as a measure of location is only introduced (in a rather complex form) in the final chapter. The methods illustrated are essentially descriptive. They are based on medians and inter-quartile distances as measures of location and spread and their output is usually a simple plot shown on a typewriter. The problems tackled are mostly concerned with expressing the data in a simple way, such as with equal spreads in different groups or straight line relationships between variables, and with spotting outlying values which require special attention. The approach is a refreshing change from that of the standard statistical texts, though (as with the parent book) it is not always clear just what the proposed analysis is *for*; the recommended approach seems to be 'Here's some nice data—let's analyse them' rather than one which starts with the purposes for which the data were gathered in the first place. Symptomatically, the brief section on experimental design is almost worthless.

The book contains algorithms both in APL and FORTRAN for doing the various analyses. These are potentially quite useful but could have been far more so had a little more care been taken. I cannot speak for the APL, but the FORTRAN contains many non-standard features and the algorithms are imagined as embedded in an operating system which is fairly sophisticated in its handling of temporary files, default parameter values and so on. I hope to try them out in practice, but I do not anticipate that this will be a particularly easy task.

M. J. R. HEALY (Harrow)

Systems: Analysis, Administration and Architecture, by J. W. Sutherland, 1975; 339 pages. (*van Nostrand Reinhold*, £6·95)

Computer scientists and computer practitioners make frequent use of the word 'systems' but rarely so in the sense in which it has become used in system science circles. Indeed system science has, so far, not had much practical impact on the computer field except perhaps tangentially in the field of 'systems analysis'. However, even there very few systems analysts are in fact aware of the thinking that has gone into the system science area these past 20 years.

It is of course not only in the analysis of a potential computer application, and the design of the hardware and software to implement it, that system science can make a contribution. Examination of the complex problems facing the software industry, the design of the software process, the implementation and maintenance of large programs, all constitute problems that are typical of those for whose solution system science offers an approach. Similarly, as computer system design moves further and further into the distributed computer area, the system approach becomes increasingly important.

Systems thinking is thus a must for the serious computer scientist or practitioner, the system architect, the software designer and the executive with computing responsibilities.

Sutherland's book, *Systems: Analysis, Administration and Architecture*, gives a first class introduction to the subject area. It is relatively simple reading yet comprehensive. Once picked up it is difficult to put down and this reviewer can only recommend it in the strongest terms.

M. M. LEHMAN (London)