faster than other methods available within the office. The facilities for rapidly writing or changing programs which the system affords have already proved most advantageous.

At the present time, six hours per week are allocated for testing and running mathematical programs, including Linear and Multiple-Linear Regression Analyses, Chi-squared analyses, and Linear Simultaneous Equations. Additional time is provided for urgent jobs when they arise.

Conclusion

The computer has now been in service for eleven months, its present loading being about 60% of capacity in normal working hours. Staff in the Department has been reduced by four during the current year, and worthwhile indirect savings have been made in other departments. The "break-even point" on our investment has almost been reached, and it is anticipated that within a few months real savings will begin to accrue. This position, quite apart from the improvements in efficiency and the additional information we are obtaining, leads us to believe that we made the right computer-decision for our business.

However, much remains to be done. Plans for the next stages of development are in hand, and already, ways of improving existing computer jobs are being devised.

It is intriguing to speculate as to the position six or seven years ahead. One hopes to be able to look back on a steady expansion of the mechanization of our office procedures, and perhaps the changes resulting from the introduction of decimalization of coinage; and to look forward to the next installation of equipment. What form will it take? It may well be that small-scale, but readily-expandable computer systems will be the answer for many medium-sized businesses by the late nineteen-sixties.

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Book Review

Sequential Decoding, by JOHN M. WOZENCRAFT and BARNEY REIFFEN, 1961; 74 pages. (London: *John Wiley and Sons Ltd.*, 30s.)

This book is one of a series of Research Monographs published by M.I.T. The aim of the series is the praiseworthy one of making new results rapidly available to those who are professionally interested in them. It is therefore unfair to judge this book by the criteria one would use to judge a longer and more thoughtful work, for it consists essentially of 70 pages of research notes. The reader should not therefore be deterred by having to work hard to understand it, and should feel stimulated rather than frustrated if questions present themselves to him which the text leaves unanswered.

This is certainly not a book for those who are unfamiliar with coding theory but who wish to learn something of the subject. Such a book probably remains to be written and when it is, this present volume will feature in its list of references.

The authors apply themselves to the decoding problem that arises in the following way. Suppose that when it is required for messages to be transmitted over a noisy channel such as a telephone line, they are encoded in some manner. Thus to the uncoded form of each message are added some carefully chosen redundant digits, these redundancies being such that, if a particular coded message becomes corrupted, it still resembles the original coded message more than any other. The function of the decoder is to detect this resemblance. This clearly could be done, in principle, using a stored-table procedure, where a list of all possible received messages is kept and, against each entry, a note of what actual message was sent. However, such a table would in many cases be impossibly large, so the question arises as to how else a decoder might be constructed.

The authors have realized that the decoding problem is a special case of the general statistical decision problem. The decoder has a large number of hypotheses to choose from about what message was sent, and it also has some received results. Its function is merely to determine the most likely hypothesis consistent with the results. The problem of decoding, then, is the statistical one of determining this hypothesis in an efficient manner. Hence the authors set up a statistical scheme whereby unlikely hypotheses are rejected with a small amount of computation, while the more likely ones are examined in greater detail.

To be explicit, the decoder is arranged to calculate the frequency of corruption by noise, of digits in a message, on the assumption that a particular message was sent. If this frequency is higher than would be expected, this hypothesis is rejected and a new one tried. The frequency of corruption is measured using a variable sample size, short samples being sufficient when the corruption appears to be high, and vice versa. In this way economy of computation is achieved.

This book is almost entirely devoted to an analysis of the performance of such a system when such a strategy is employed. Its achievement is the setting of bounds on the probability of an uncorrected error occurring in the presence of random noise, and of bounds on the average number of computations per digit that the decoder has to make. This latter is of crucial importance, and the valuable result derived is that this number is so low that the scheme is practicable.

This book would be improved in lucidity if some examples were given showing the decoding process in action, and if there were more examples of specific codes. It would then be easier to appreciate what problems arise. As it is, one plunges into a mass of analysis without being quite sure to what end it is being pursued. However, if one is actively engaged in the design of systems of the type suggested, this is a valuable book, because it illustrates some methods of analysis that may be usefully copied, and shows some practicable schemes.

J. E. MEGGITT.