since all these commands are disc limited; e.g. to open at a file of 500 cards takes about 2 sec at the average disc transfer rate of 5000 words/sec. No response is obtained from the RUN command until about 10 sec have elapsed. There is a similar delay at the end of the foreground run when return to the background system occurs.

When the first COSEC commands were written, it was felt that users would require as much output information as possible—e.g. for OPEN, the name of the file, the reserved and occupied sizes, the format of the contents, and the time and date when the file was last updated. However, a little experience showed that such verbosity was extremely irritating particularly to the more experienced users. In COTAN, output of such information has been greatly reduced and may be suppressed entirely if specifically requested by the user. On the other hand, during the input phase the user does feel the need for more frequent prompting than just the **'name'** and **'data'** queries of COSEC, and this feature has been considerably enhanced in COTAN.

It is of interest to compare the use of the two editors available in COSEC. The line number editor was available first, but as soon as the context editor was written, users quickly showed their preference for this mode of operation. This command has proved very attractive and convenient to use, and was well worth the labour involved in writing it. The line number editor still finds some use for large scale modification of files, e.g. merging of two files.

It should be noted that COSEC does not embody a full implementation of the philosophy 'interaction only when absolutely necessary'. It is a step in this direction, since a user may type in a large amount of data before actually calling on the system to obey the command. However, if the data is incorrect, the only interaction currently provided is to ask the user for another command. Any data following the offending section is lost. Thus, users tend to break up lengthy input sequences into a number of short sections to avoid the possibility of having to retype. However, this situation has been corrected in COTAN, and the facilities available in this system which allow a user to input a large amount of data with confidence will be described in a later paper.

COSEC does not attempt to handle the problem of interaction between a user and his own program. Clearly this is possible, since there is only one console, but it is obviously a very inefficient use of the machine. The problem is still with us in COTAN, but interaction is allowed if the program is small (<8K).

Conclusion

In a computer with a comparatively slow backing store, the cost of allowing complete user interaction in all phases of on-line operation is probably prohibitive. However, if such interaction is restricted mainly to file manipulation and then provided only when absolutely necessary, the resulting system can be attractive and convenient to use while still being reasonably efficient. COSEC has illustrated the feasibility of such an approach to on-line access within a batch processing system, in addition to providing a very powerful tool for future development.

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Reference

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Book Review

The Design and Analysis of Scientific Experiments, by K. C. PENG, May 1967; 217 pp. of text, 29 pp. of appendices. (New York: *Addison-Wesley Publishing Co.*, 72s.)

This is a theoretician's book, being mainly concerned with the analysis of variance in factorial experiments. Described by the author as 'designed for statisticians, computer programmers and persons engaged in experimental work who have some background in mathematics and statistics', this book does not seriously compete with the well-known texts with similar titles.

Statisticians will find little in this book which is not discussed more thoroughly elsewhere, nor will they find references to recent work in this field. Students of statistics may, however, obtain profit from studying the middle chapters on factorial design where the author is at his best.

For computer programmers the main interest will be in the use of the operator calculus for partitioning sums of squares in balanced factorial schemes. Three FORTRAN programs are supplied in the appendices (i) for complete factorial designs (ii) for Latin squares and (iii) for 2^n fractional replicates. By modern standards these programs are very limited in their conception of the users' needs (see e.g. Yates, F. and Anderson, A. J. B. (1966) *Biometrics* Vol. 22, pp. 503–24), and would require considerable extension to be of much practical use. Real users want to present data in a way that suits themselves and not the programmer, and want a readable output over which they have some control, ideally an output which could be published without further explanation. A general program should be able to derive combinations of variates, to estimate missing data automatically, to compute nominated orthogonal effects etc.

Experimentalists will not be greatly helped by this book as there is little discussion of the reasons for choice of design or of the meaning of the analysis. The numerical examples are all fictitious, and the multiple summation formulae are not well suited for instructing laymen in the computation of analyses.

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