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Book Review

The Design and Analysis of Scientific Experiments. By K. C. Peng. Addison-Wesley Publishing Company, Reading, Mass. (1967). 252 pp. $12.50.

In his preface, the author states that the book is written primarily for statisticians, computer programmers, and persons engaged in experimental work who have some background in mathematics and statistics. This audience should find the volume a significant addition to their personal libraries—presently, as an introduction to the area of the design and analysis of experiments and, in the future, as a reference and guide to further reading and study in special areas of interest.

In initial preliminaries, the concept of the design of an experiment is explored and essential statistical background concepts are reviewed, including estimation, testing hypotheses, χ^2 and F distributions, the determination of sample size, and methods of multiple comparisons within a set of means. These preliminaries are followed by eleven chapters on selected topics, each accompanied by a set of relevant references, with a brief general bibliography and listing of statistical tables at the end of the book. The reader's attention should be called to the availability of an eighth edition of Fisher's classic work published posthumously in 1966. The seventh edition reference is given by Peng.

Three computer programs are included as appendices. These, written in FORTRAN II for the IBM-7094, are documented with an outline of the overall program organization, definitions of the functions of the component routines, descriptions of the card format of the input data and the output information provided, as well as a listing of the input deck and printed output from a sample problem. The computer programs included are for the analysis of 1) common factorial experiments, 2) Latin square and Graeco-Latin square experiments, and 3) fractional factorial experiments with factors at two levels. In addition to these appendices, there are a number of techniques presented in the body of the book that are designed expressly for computer application which should be of interest to today's experimentalist who has computing facilities routinely available.

In his first chapter, the author introduces much of the terminology of experimental design while discussing two-way arrangements, or the two-factor experiment, whereby an experimenter studies the effect of two control variables on a selected dependent variable. The treatment is expanded to three- and multi-way arrangements in Chap. 2. Here, the author describes an operator calculus and mapping scheme useful in programming multifactor analysis of variance on a digital computer.

Chapter 3 is devoted to methods of partitioning a sum of squares. Orthogonal contrasts are defined and a procedure for computing orthogonal polynomials for unequally-spaced levels is given. Crossed vs nested experiments are treated in the fourth chapter and the computation procedure for a completely nested experiment is developed.

During Chaps. 1 through 4, fixed values were assumed for the levels of the factors. In Chap. 5, the model assumptions—fixed, random, and mixed—are discussed and general procedures for obtaining expected mean squares formulas and calculating sums of squares and degrees of freedom are outlined. Models and analyses for randomized-blocks design, Latin and Graeco-Latin squares, and split-plot design are given in Chap. 6 together with the associated missing value formulas.

In Chap. 7, the author uses group theory concepts to explain the principles of fractional replication for factorial designs in covering the topic fractional factorial designs and confounding. The remaining four chapters deal briefly with response surface design; linear hypothesis, unbalanced experiments, and the assumptions underlying the analysis of variance; the analysis of covariance; and nonfactorial experiments.

In summary, the body of the book, only 217 pages in length, provides an interesting introduction to an extremely large number of topics encompassed by the title *The Design and Analysis of Scientific Experiments*. While concise, it is wisely sprinkled with numerical examples, and only in Chap. 6 are these the traditional agricultural ones.

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About the Reviewer: Margaret Butler is a member of the Applied Mathematics Division at Argonne National Laboratory. She is a past-chairman of the Mathematics and Computation Division of the American Nuclear Society and serving currently as a member of the Publications Committee. Since 1960, when the Argonne Code Center was established, she has been in charge of this activity.