

<<实验设计和分析>>

图书基本信息

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前言

Our initial motivation for writing this book was the observation from various students that the subject of design and analysis of experiments can seem like "a bunch of miscellaneous topics." We believe that the identification of the objectives of the experiment and the practical considerations governing the design form the heart of the subject matter and serve as the link between the various analytical techniques. We also believe that learning about design and analysis of experiments is best achieved by the planning, running, and analyzing of a simple experiment. With these considerations in mind, we have included throughout the book the details of the planning stage of several experiments that were run in the course of teaching our classes. The experiments were run by students in statistics and the applied sciences and are sufficiently simple that it is possible to discuss the planning of the entire experiment in a few pages, and the procedures can be reproduced by readers of the book. In each of these experiments, we had access to the investigators' actual report, including the difficulties they came across and how they decided on the treatment factors, the needed number of observations, and the layout of the design. In the later chapters, we have included details of a number of published experiments. The outlines of many other student and published experiments appear as exercises at the ends of the chapters. Complementing the practical aspects of the design are the statistical aspects of the analysis. We have developed the theory of estimable functions and analysis of variance with some care, but at a low mathematical level. Formulae are provided for almost all analyses so that the statistical methods can be well understood, related design issues can be discussed, and computations can be done by hand in order to check computer output. We recommend the use of a sophisticated statistical package in conjunction with the book. Use of software helps to focus attention on the statistical issues rather than on the calculation. Our particular preference is for the SAS software, and we have included the elementary use of this package at the end of most chapters. Many of the SAS program files and data sets used in the book can be found at www.springer-ny.com. However, the book can equally well be used with any other statistical package. Availability of statistical software has also helped shape the book in that we can discuss more complicated analyses—the analysis of unbalanced designs, for example.

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内容概要

Principles and Techniques、 Design: Basic Principles and Techniques、 The Art of Experimentation
、 Replication、 Blocking、 Randomization、 Analysis: Basic Principles and Techniques、 Planning Experiments
、 A Checklist for Planning Experiments、 Real Experiment——Cotton-Spinning Experiment等等。

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插图：In the analysis of data, it is desirable to provide both graphical and statistical analyses. Plots that illustrate the relative responses of the factor settings under study allow the experimenter to gain a feel for the practical implications of the statistical results and to communicate effectively the results of the experiment to others. In addition, data plots allow the proposed model to be checked and aid in the identification of unusual observations, as discussed in Chapter 5. Statistical analysis quantifies the relative responses of the factors, thus clarifying conclusions that might be misleading or not at all apparent in plots of the data. The purpose of an experiment can range from exploratory (discovering new important sources of variability) to confirmatory (confirming that previously discovered sources of variability are sufficiently major to warrant further study) , and the philosophy of the analysis depends on the purpose of the experiment. In the early stages of experimentation the analysis may be exploratory, and one would plot and analyze the data in any way that assists in the identification of important sources of variation. In later stages of experimentation, analysis is usually confirmatory in nature. A mathematical model of the response is postulated and hypotheses are tested and confidence intervals are calculated. In this book, we use linear models to model our response and the method of least squares for obtaining estimates of the parameters in the model. These are described in Chapter 3. Our models include random "error variables" that encompass all the sources of variability not explicitly present in the model. We operate under the assumption that the error terms are normally distributed. However, most of the procedures in this book are generally fairly robust to nonnormality, provided that there are no extreme observations among the data. It is rare nowadays for experimental data to be analyzed by hand. Most experimenters and statisticians have access to a computer package that is capable of producing, at the very least, a basic analysis of data for the simplest experiments. To the extent possible, for each design discussed, we shall present useful plots and methods of analysis that can be obtained from most statistical software packages. We will also develop many of the mathematical formulas that lie behind the computer analysis. This will enable the reader more easily to appreciate and interpret statistical computer package output and the associated manuals. Computer packages vary in sophistication, flexibility, and the statistical knowledge required of the user. The SAS software is one of the better packages for analyzing experimental data. It can handle every model discussed in this book, and although it requires some knowledge of experimental design on the part of the user, it is easy to learn. We provide some basic SAS statements and output at the end of most chapters to illustrate data analysis.

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