Modern Experimental Design

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Modern Experimental Design

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Preface

Although there is a moderate amount of data analysis, especially in certain chapters, the emphasis in this book is on the statistical design of experiments. Such emphasis is justified by the widely held view that data from a well-designed experiment are easy to analyze. Certain types of designs are not simple, however, such as those covered in Chapters 7, 8, and 11, and the problem is compounded by the fact that some popular statistical software packages have quite limited capability for those designs.

The book would be suitable for an undergraduate one-semester course in design of experiments. For a course taught to nonstatistics majors, an instructor may wish to cover Chapters 1–4, part of Chapter 5, and then pick and choose from the other chapters in accordance with the needs of the students. The selection might include either or both of Chapters 10 and 12 and then cover sections of interest in Chapter 13.

For statistics majors, the book would be suitable for use in an advanced undergraduate course, perhaps covering Chapters 1–5, 7, 8, and much of Chapter 13. There is also enough advanced material for the book to be useful as a reference book in a graduate course taught to statistics majors, and might also be used in a graduate course for nonstatistics majors, depending on the needs and backgrounds of the students.

There is also enough material for a two-semester course, with the first course perhaps covering Chapters 1–6 and the second course covering Chapters 7–12 and 14, and parts of Chapter 13.

There is a considerable amount of material that is not covered to any extent, if at all, in other books on the subject, and some or all of this material might be used in special topics courses. These topics include conditional effects, uniform designs, and designs for restricted operating regions. (I have covered this material in an Internet course.)

A two-semester course in statistical methods should provide more than enough background for the book since the emphasis is on designs rather than statistical concepts. Matrix algebra is used in various places in the book, although it is not used extensively. Nevertheless, proficiency in the basics of matrix algebra is necessary for following some of the material.

One of the special features of the book is the emphasis on conditional effects in Chapters 4, 5, 6, and 10. This is an important topic that is not covered to any extent in most books and is addressed in very few journal articles. Another somewhat unique feature is moderate use of URLs, especially links to published articles that are available to the general public as well as article preprints and technical reports. There are other links for articles that are available to certain groups, such as members of the American Society for Quality. Some of those URLs might of course become outdated but I decided to list them since many of them, such as links to journal articles, will probably not become outdated in the near future. They make available to the reader a considerate amount of important resource material.

It is worth noting that this book does not contain catalogs of designs, as are given in some other books on the subject. Rather, the emphasis is on understanding design concepts and properties, the software that is available for generating specific designs and when to use those designs, and as stated, a moderate amount of analysis of data from experiments in which the designs are used, with extensive analysis provided in some case studies. Although there is some hand computation, the emphasis is on using appropriate software to generate output and interpret the output.

It is also worth noting that whereas there are case studies and a moderate amount of data analyses, there is not a "full" analysis of any dataset as that would include checking for outliers and influential observations, testing assumptions, and so on, which are covered in books on statistical methods. This is important but comes under the heading of data analysis rather than design and analysis of experiments. Although this book has more analysis than most books on design of experiments, it is not intended to be a handbook on data analysis.

I wish to gratefully acknowledge my editor, Steve Quigley, who motivated me to write this book, in addition to the contributions of associate editor Susanne Steitz, production editor Rosalyn Farkas, and colleagues who have made helpful comments, including Dennis Lin and Ivelisse Aviles, plus the helpful comments of three anonymous reviewers.

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