

Statistics for Experimenters: Design, Innovation, and Discovery, Second Edition by George E. P. Box, J. Stuart Hunter, and William G. Hunter. John Wiley & Sons, Inc., Hoboken, New Jersey, 2005, xvii + 633 pp. \$99.95.

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THE FIRST edition was published in 1978, entitled *Statistics for Experimenters: An Introduction to Design, Data Analysis and Model Building*, and the order of the authorship was George E. P. Box, William G. Hunter and J. Stuart Hunter, with a nickname "BH²". Lloyd S. Nelson (1979) reviewed this book for *Journal of Quality Technology* (1978, p. 50). His comments were very positive, he wrote

"The authors are to be congratulated for having written an excellent book. Students fortunate enough to have this as a text will have the opportunity to learn much, and not the least from the review questions and numerous well constructed problems (answers are not given). Engineers wishing to advance their elementary understanding of statistical design and analysis will be delighted with this work. The writing is literate, and the technical aspects impeccable."

Well, Lloyd is always right. The first edition is known to be the best-selling book, not only in the design area, but across all statistical disciplines, exclusive of general introductory statistics books. It is widely used in many design courses, both academic institutions and six sigma trainings. It is also the most cited book in all statistical research papers.

After 27 years, the second edition is now available. The new title is *Statistics for Experimenters: Design, Innovation, and Discovery*, and the order of the authorship is now George E. P. Box, J. Stuart Hunter, and William G. Hunter. It is much more transparent now than in 1978, these authors are the leading researchers, skillful educators, and excellent writers in the field—with the understanding that Bill Hunter unfortunately passed away in 1986. It is so tempting to have a (non-technical) comparison at the first glance (see Table 1).

In the three decades since the first edition of BH² was published, the subject of quality assurance has been extremely active. The impact of Dr. Genichi Taguchi, notably from the 1980's, has received much attention regarding robust parameter design. This

TABLE 1

	BH ² —Edition 1	BH ² —Edition 2
Years of Publication	1978	2005
Total Pages	653	633
Price	\$23.95	\$99.95
Inside the Front/Back Covers	Advertisement of Wiley books	Intelligent quotations*

*These quotes are so good and so familiar, some examples are

- *The best time to plan an experiment is after you've done it.* (R. A. Fisher)
- *It is the data that are real.*
- *Experiment and you'll see.* (Cole Porter)
- *Anyone who has never made a mistake has never tried anything new.* (Albert Einstein)
- *There's never been a signal without noise.*
- *Few things are less common than common sense.*
- *It's better to solve the right problem approximately than the wrong problem exactly.* (J. W. Tukey)

soon evolved to a series of important quality control studies, from total quality management (TQM), to variation reduction, to quality and productivity improvement, to Six Sigma (Green Lean Six Sigma), for example. A systematic way of thinking about quality assurance is also popular. This eventually results in some advanced work in areas such as Knowledge Discovery and Statistical Learning, etc. On the other hand, research in the area of design of experiments is also active—a significant number of new results have been obtained. Advanced studies on orthogonal arrays (especially in Plackett and Burman type designs), compound design, projection properties, small response surface design, split-plot design, etc. are becoming more important. These phenomena are more or less reflected in the second edition and are discussed with updating from recent research results.

Wiley's blurb page indicates that the second edition now includes

- A greater emphasis on the value of sequential experimentation and the sequential assembly of experimental designs for economical problem solving;
- A demonstration of how multi-response problems can be solved using the concepts of active and inert factor spaces and canonical spaces;
- A further development of robust product and process design using split plot arrangements and minimization of error transmission;
- A simplification of transformation using lambda plots;

- Bayesian approach to model selection and sequential experimentation;
- Discussion of graphical analysis of variance, computer analysis of complex designs, and hands-on experimentation using response surface methods;
- A new approach and introduction to process control, forecasting, and time series analysis;
- Complex experimental arrangement, including Plackett and Burman designs;
- Expanded coverage of Evolutionary Operation (EVOP);
- An explanation of how to make the best choice of follow-up runs.

These are in addition to all the goodies of their first edition. A brief comparison is displayed in Table 2.

Compared with the first edition, new developments in quality assurance and knowledge discovery have been incorporated, and new results in robust parameter design and split-plot design etc. have been added. In spite of the much more expanded coverage, the total number of pages is slightly smaller. Some topics in the first edition have been significantly shortened or even deleted. This new edition will certainly be another new collection for all people in the areas of Statistics, Engineering, Quality, and Learning, just to name a few.

One minor concern about its use as a text for a design of experiments course is that some classical topics such as higher level (fractional) factorial design, nested design, design for random effects, and recently popularized computer experiment are not

TABLE 2

Chapter in BH ² -2e	Content	Chapter in BH ² -1e	Remark
1	Catalyzing the Generating of Knowledge	1	
2	Basic (Probability, Parameter, and Statistics)	2, 3 & 5	
3	Comparing Two Entities: Reference Distributions, Tests, and Confidence Intervals	2 & 4	Tomato example is now replaced by an industrial example, the boy shoes example is kept
4	Comparing a Number of Entities: Randomized Blocks, and Latin Squares	Part II (6, 7 & 8)	
5	Factorial Design at Two Levels	Part III (10 & 11)	
6	Fractional Factorial Designs	12 & 13	
7	Additional Fractionals and Analysis		New Research Results from 1978
8	Factorial Design and Data Transformation	Sect 7.9	Mostly new materials
9	Multiple Source of Variation	17	
10	Least Squares and Why We Need Designed Experiments	14	
11	Modeling, Geometry and Experimental Design		Second-order Response Surface
12	Some Applications of Response Surface Methods	15	Chemical Example is now replaced by the popular paper helicopter example
13	Designing Robust Products and Processes: An Introduction		New Research Results
14	Process Control, Forecasting, and Time Series: An Introduction	18	
15	Evolutionary Process Operation (EVOP)	Sect 11.4 & 11.5	Also in Box and Draper (1969)

discussed. Of course, these topics are probably important more so for agricultural experiments than for industrial experiments, and of course, this is a book beyond design of experiment.

The references, questions and problems at the end of each chapter are rather special. The references are given with "guidance," helping the reader "to read, or not to read"; the questions are designated to refresh some important concept/ideas, while the problems provide real applications, most with real data.

This is an excellent book indeed. Like the first edition, this book will soon become a must for all experimenters and educators/trainers. I would strongly recommend this book to everyone. Although, as if not to insult the gods with the weaving of a perfect rug—a term stolen from Lloyd Nelson (1978)—with so many new competitors and software available, it

will be very challenging to beat the sales record of the first edition. I hope this is only needless concern from a person who has long known and respected these authors.

References

- BOX, G. E. P. and DRAPER, N. R. (1969). *Evolutionary Operation*. Wiley, New York, NY.
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- NELSON, L. S. (1978). "Book Review on *Statistics for Experimenters* by Box, Hunter and Hunter". *Journal of Quality Technology*, 11, p. 50.