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Fall 1995 Graduate Education Issue of *Chemical Engineering Education*

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provided at the end of the chapter is 1979. Finally, the chapter on the effects of tobacco smoke on the occupational environment seemed out of place with the following chapters that analyzed specific chemical families for their toxic effect. The location of the chapter might have been more appropriate if it had been grouped with other overall classes of materials (e.g., radioactive materials, municipal wastes, etc.). Apparently the location of chapters, as pointed out by the editors, was directly influenced by the availability of the manuscripts prepared by the authors.

Despite these objections, the text provides an intensive evaluation of the toxicity effects of a number of widely used chemicals. Fortunately, the extensive subject index and chemical index of fifty-four pages simplifies the task of obtaining toxicity information on a specific chemical even in those chapters where the information is provided in a different format. In most chapters except the one noted above, the information provided contains data obtained through 1991. □

ChE book review

STATISTICS FOR ENGINEERING PROBLEM SOLVING

by Stephen B. Vardeman

PWS Publishing Company, Boston, MA 02116-4324; 712 pages plus appendices (1994)

Reviewed by

Charles H. Barron

Clemson University

Most academic curriculum builders have, in recent years, confronted the question of how to incorporate statistics into their efforts. This has been called for by our industrial feedback systems, both from industrial advisory boards and from alumni in industry; in addition, there is a mandate in the current ABET criteria that stipulates the need for evidence of proper statistical incorporation within our engineering laboratory and design courses. This book is an excellent choice as a textbook for a statistics course designed to help meet these needs.

There have been several problems with traditional statistics course offerings in the past. Frequently, the courses have been populated by students who do not have the mathematics background of the typical engineering student, and for this reason, many faculty advisors have been reluctant to recommend statistics as an elective course. The approach taken in this book by Professor Vardeman is one oriented toward solving problems by using statistical methods

and thought patterns. This is exactly the approach needed in order for the course to appeal to most engineering students. No formal background in statistics is expected, but the material presented advances rapidly through the necessary techniques and methodologies.

After a brief review of variability and random error as they arise in data-collection processes, the author introduces simple descriptive statistics and some common experimental plans are described without belaboring the theoretical basis for their design. Standard numerical summary measures are discussed by using extensive graphical presentations of distribution functions and their moments, especially means and variances.

With this background the students moves on to introductory concepts of regression and computing and using residuals. This section of the presentation benefits from an extensive use of graphs. After introducing the fitting of curves and surfaces, a full discussion of the fitted effects of factorial data structures is presented. By this time, about a third of the way into the book, the student is becoming quite accustomed to the author's strategy of introducing statistical tools as they are needed in the context of the problems.

It is only at this point that the background notions of probability and the mathematics of randomness are raised. Chapter Five deals with discrete and continuous random variables and goes much further than previous coverage in the development of a number of distribution functions. Several of these functions will be new to the student, such as geometric, Poisson, exponential, Weibull, and the beta distribution. Each of these distributions arises in the context of an application, and the motivation to understand the distribution arises naturally. Joint probability distributions are discussed after this background work is completed. Chapter Six introduces the concepts of statistical inference, confidence intervals, and significance testing.

The next few chapters continue to expand the student's toolkit by describing multisample studies, simultaneous confidence intervals, analysis of variance, and variance decomposition. Control charts arise in this section of the discussion. Inference for multisample studies provides a platform for introducing the full factorial data structure of such systems. With this basis, the full inference methodology for general least squares curve- and surface-fitting is developed, and response surfaces are introduced. Finally, the book concludes with the elaboration of some of the more advanced concepts of experimental design.

The author has provided numerous examples and problems for the student at every step along the way. This textbook is highly recommended both to teachers of statistics courses for engineering students and to engineering faculty who would like to sharpen their own statistics skills in order to do a better job of using these tools in their engineering laboratory courses. □