THE STATISTICS TEACHER NETWORK

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Joint Committee on the Curriculum in Statistics and Probability.

WOODROW WILSON SUMMER INSTITUTES

Once again, The Woodrow Wilson National Fellowship Foundation (WWNFF) will be sending two teams of statistics teachers to various sites (see list in the February 1990 issue for dates, places, and persons to call) to conduct one-week institutes on "Data Exploration for Secondary School Teachers."

Evaluations from participants each year continue to affirm the extensive value of these institutes, each led by four teachers who have previously attended an intensive four-week institute in mathematics administered by WWNFF and held at Princeton University. The one-week institutes provide opportunities for teaching colleagues to work together and share their areas of expertise.

Topics are centered on statistics in society and include simple exploratory data analysis, simulations, probability, sampling and inference. Participants explore ways to incorporate statistical ideas into the traditional mathematics curriculum at various levels, with an emphasis on methods and materials readily available and usable in the classroom.

For further information about these statistics institutes other WWNFF institutes in science, mathematics and history, please call Wes James, Program Assistant, at (609) 924-4666.

– – Janet Gnall

QUANTITATIVE LITERACY:
The Series and the Software

Four curriculum units, written under the auspices of the ASA/NCTM Joint Committee on the Curriculum in Statistics and Probability and the Quantitative Literacy (QL) Project, are now available in both student and teacher editions through Dale Seymour Publications, P.O. Box 10888, Palo Alto, CA 94303.

If you would like more detailed information about the units, an excellent Quantitative Literacy Series Program Sampler may also be ordered at no cost from Dale Seymour at the address above.

The diskette designed to accompany the QL Series is also complete, thanks to the efforts of many people around the country. It is available in both Apple IIe series and IBM versions. The programs are partitioned into four modules with each module designed to implement one of the units in the series. The programs are menu driven, user friendly, and may be used in conjunction with the units with minimal effort or independently.

The cost of the QL Program is only $2.00 if you send a disk ($4.00 outside the USA) or $7.00 if a disk is to be sent ($10.00 outside the USA). To purchase the QL Program, write a specific order and return it with a check payable to QUANTITATIVE LITERACY, Whitnall High School, 5000 South 116 St., Greenfield, WI 53228.

– – Gail Burrill

A DATA ANALYSIS ACTIVITY

AIDS on the Increase

Year of Diagnosis	AIDS Cases
Before 1981	84
1981	290
1982	1003
1983	2925
1984	5877
1985	10862
1986	17397
1987	24678
1988	25485
Jan-Mar. 1989	2389

The above data was updated from *The HIV/AIDS Surveillance Newsletter* issued April 1989, U.S. Dept. of Health and Human Services, Centers for Disease Control, page 12.

Students were to draw a poster-size graph including a projection for the incomplete year. They were to calculate the best-fit line using the median-median method. The following questions were answered and an oral report was given to the class.

1. Is the number of cases increasing or decreasing with time? Does the projection appear to be realistic and what forces may be at work to influence it?

2. Using your equation, predict the number of cases for the years 1990, 2000, 2020.

3. Does your linear equation seem to be a "good fit"? Why?

4. The only drug known to help (not cure) AIDS patients is the Drug AZT. It costs approximately $1000 per month per person. What would it cost to pay for this drug for all new cases in 1988 for one year? Should we pay for this from taxes? Can we afford to pay for this?

I used this activity as part of group project work in the fall of 1988, when reviewing in Algebra II. Question 3 leads into a discussion of other kinds of equations and lines. This data can be referred to later in the year as other types of equations are explored.

– – Jean E. Bouts

STATISTICS: CONCEPTS AND CONTROVERSIES, Second Edition, by David S. Moore, W.H. Freeman and Company, 1986.

It is almost certainly true (at least one would hope it is true) that a very large percentage of teachers were confident students in their respective subject matters. Furthermore, taking courses in the field in which these future teachers would one day make their careers should have been an enjoyable experience. Otherwise, success at teaching almost surely would be precluded.

Teachers of statistics, however, may be notable exceptions to the above truisms. Even a cursory look at the statistics education encountered by most anyone who is old enough to teach statistics—as well as a vast number of present would-be mathematics educators—would reveal why this is so. In the latter primary grades and/or in middle school, virtually all students are taught how to calculate means, medians and modes. Graphs such as pie charts and bar graphs are also standard fare at this level. Beyond this, a student—even one who completes four or five years of high school mathematics through calculus—may encounter very little statistics or possibly no statistics whatsoever. From this most meager of foundations, the student is then thrust into a statistics course at the college level where the topics encountered may include random variables, hypothesis testing, and probability density functions. In all too rapid succession come z-tables and t-tables and F-tables and some-greek-letter-squared-tables and formulas as big as horse pills all of which came from who-knows-where and all of which are telling us who-knows-what about who-knows-what. The standard deviation may be surpassed only by the mean in number of appearances in the text. But what the standard deviation basically is—an "average" amount each data element deviates from the mean—may not be a well-made point. Integral concerns of real live statisticians such as collection of data, experimental design, and interpretation of the analysis may be given little or no priority. Even data themselves, the sine qua non of statistics, may only make cameo appearances.

Is it any wonder that many survivors of such a course still have only the most nebulous notion of what statistics does and how it goes about doing it? Is it any wonder that even among groups of mathematics teachers it is difficult to find volunteers willing to teach this subject? However, the number

of college majors which have a statistics requirement is large and growing. Statistics is playing an ever more prominent role in our daily lives and some basic knowledge of statistics has become critical to being an informed citizen and an informed consumer. Clearly, the gap between the middle-school mean-taker and the undergraduate analyzing his/her variance was unacceptably wide and in dire need of bridging.

Fortunately, over the last 15 years, this situation has been the focus of a growing number of educators and statisticians. Readers of this publication are aware the ASA and the NCTM have collaborated and made statistics education, particularly for secondary students and college underclassmen, a priority.

A most encouraging development has been the publication of materials which provide the teacher at this level with meaningful, non-trivial but understandable statistics curriculum. The *Statistics by Example* series edited by Frederick Mosteller; *Statistics: A Guide to the Unknown* edited by Judity Tanur, et al; *Using Statistics* by Kenneth Travers, et al; and the Quantitative Literacy Series are prominent examples. Earning a place alongside these materials as a work which has done a great deal to redress this critical problem in statistics education is *Statistics: Concepts and Controversies* by David S. Moore.

First published in 1979 with a second edition appearing in 1985, *Concepts and Controversies* has become a "must read" for anyone who has taken on the task of introducing statistics to high school or college students. The book is a radical departure from most other introductory statistics texts in its emphasis on concepts rather than techniques. Those wishing to look up the formula for the Mann-Whitney Test or the Standard Normal Curve will need to look elsewhere. But by de-emphasizing some techniques and bypassing others, *Concepts* gets much closer to the heart of statistics—learning something about the world around us from data—than the thickest book of algorithms ever could. Concerns of everyday statisticians are addressed at length. The entire first section is devoted to the collection of data. Entire chapters are devoted to sampling, to experimental design, including a discussion of ethical concerns, and to measurement and examining the validity of the numbers which statisticians toss about. What a luxury!

The second section deals with organizing data, but with a strong emphasis on why as well as how. Graphing techniques are used as ends in themselves and to corroborate numerical results. Moore also deals with how graphs and numbers and statistical reasoning can be used to mislead, but we never lose sight of what powerful tools for understanding we possess if statistical techniques are utilized competently and ethically. Topics such as the normal curve and correlation cover some familiar ground. But Moore's exposition, which goes to great lengths to insure the students understand the meaning of the numbers generated by the formulas, also covers much which may not be so familiar.

In the third and final section, "Drawing Conclusions From Data", Moore makes eminently clear that fairly simple probability—with which virtually all students have had some experience—is the underlying theory of confidence intervals and hypothesis testing. But rather than take us on a whirlwind tour of combinatorics, Moore utilizes simulation as the technique to foster understanding of probabilistic events. With this easy-to-grasp notion of simulation now in place, it becomes much easier for the student to grasp *intuitively* concepts such as confidence intervals, the difference between two means, and the meaning of a given correlation coefficient. The co-authors of *Using Statistics* take this notion a step further and use simulation techniques to generate values of chi-square, thus making the likelihood of any value of chi-square intuitively obvious. Think of what this means. Statistical inference, once the bane of legions of college students who heretofore had every reason to consider themselves bright and motivated, now reasonably can be understood and utilized by garden variety high school juniors and seniors. If that does not constitute a major breakthrough, I do not know what would.

The medium employed by Professor Moore for communicating these ideas is lively but businesslike prose which demands the reader's attention and reflection, but clearly is not beyond the grasp of its intended audience. The text is considerably further enlivened by the fact it is chockablock with examples, many culled from actual newspaper articles and many of which raise issues which surely will be familiar to the student. (Warning: some of the issues raised, such as the possible medicinal effects of marijuana, may prove too lively for some tastes. Teachers are advised to peruse the book carefully before passing out the texts.)

However, do not be under the impression Moore talks about the ideas on statistics for a while and then lets us go home and forget about them. At

the end of each chapter is a veritable gold mine of interesting exercises. The exercises at the end of Chapter One alone would take a student many weeks to complete. But only a small minority of the exercises focus in on technique. The vast majority of questions are open ended. They ask students to design and/or conduct experiments, collect data, evaluate given results, reflect on articles and advertisements which utilize statistics, devise alternative methods, discuss ethical concerns. As an example, one exercise requires the students to conduct a survey among two groups. Both groups are to be asked to express if they agree or disagree with a quote which states that rebellions, now and then, are a good thing. However, to one group the quote is ascribed to Thomas Jefferson and to the other group the quote is attributed to Vladimir Lenin. Does the source of a viewpoint affect our opinion of it? Any exercise which genuinely arouses my, the teacher's, curiosity has to make my course more interesting. All good exercises should challenge students while reinforcing the ideas expressed in the course. Many of Moore's exercises fire our imaginations as well. These exercises alone would be worth the price of admission.

This example illustrates what is perhaps the most difficult-to-believe aspect of the new look statistics has taken on as result of books such as this one: the materials work well with students of extremely varying abilities. This reviewer has assigned the above problem to high school students who have completed a year of calculus as well as to students who may never master Algebra I. Both levels of students were capable of completing the problem satisfactorily; neither felt the problem trivialized their abilities; but best of all, both were highly curious to learn the outcome. Indeed, Professor Moore developed the materials for *Concepts* teaching humanities, social science, and education underclassmen, a group one might speculate to be a heterogenous mathematical lot.

In summary, *Statistics: Concepts and Controversies* is a textbook which is easy to read, covers a huge chunk of statistical ground which goes beyond the manipulation of numbers and symbols, and has a wealth of interest-piquing examples and exercises. If you are among statistics teachers who already are experiencing difficulty not with what-to-teach but with what-to-leave-out, then this book will exacerbate your problem like few other books will. However, this book comes even more highly recommended if you are among the 97% of the people in the United States who hate statistics. And if you believe that last statistic, then this book is being assigned to you as required reading.

-- Peter Barbella

STATISTICS. David Freedman, Robert Pisani, Roger Purves. W.W. Norton Company, New York, 1978. ISBN 0-393-09076-0.

This book is primarily for college level use by students with little mathematical training. It is very verbal with many charts, diagrams, graphs and very, very, few mathematical formulas or computations. The book is divided into eight major topics or parts. Each part is made up of chapters (29 in all) which are again subdivided into sections. Each section closes with a set of exercises. The exercises are well selected and usually fewer than ten in number. The answers to all of the exercise problems are in the back of the book – with adequate explanations and charts. Each chapter contains a set of "Review Exercises" without answers to be used for homework and/or tests.

One of the interesting features of the book is a section at the back entitled "NOTES". It is a listing of references and articles used in each chapter, along with comments in some cases.

There is also an accompanying supplementary workbook entitled "Mathematical Methods in Statistics". Apparently this workbook was produced to provide the algebra that was so judiciously omitted from the text. The author advises that this workbook be used with caution and has provided a diagnostic test that can be given to the class to determine if it should be used at all.

Because many of the problems, examples, charts and references deal with real data and the last copyright was 11 years ago, the real data is somewhat unreal at the present time. In addition, the newer data analysis techniques have not been included. Also the almost complete lack of computer applications is a serious drawback.

It is a well-written book, interesting to read. If it were up-dated to include the newer techniques, computer applications and more recent data, it could possibly be considered as one of the better introductory books for elementary statistics, useful at both the college and secondary levels.

-- Ethel Henderson

REVIEW of the CASIO GRAPHING CALCULATOR

The combination of affordability, portability, and computing power makes the Casio graphing calculator an effective tool for teaching and learning mathematics, probability, and statistics. It is unfortunate that these machines are called calculators; this designation is too limiting. They are actually scientific computers which fit in the palm of your hand. If they are considered to be computers, then it is easier to understand the many ways these machines can be used as teaching, learning, and problem solving tools.

General Characteristics

There are four models of the Casio graphing calculator: *fx-7000G*, *fx-8000G*, and *fx-8500G*. All four models have an 8-line by 16-character text screen used for standard calculations, entering functions to be graphed, and for writing programs. The graphics screen is 95 pixels wide by 63 pixels high. The *fx-7000G*, *fx-8000G*, and *fx-8500G* have identical keyboards with depressable keys. The *fx-7500G* is a hard-cased, folding model with touch pads instead of keys; the keyboard arrangement on this model is slightly different than the other three. All four models have a constant program memory which allows storage of 10 programs, and each will graph any user-defined function, in any viewing rectangle (portion of the plane), up to the limits of machine accuracy ($\pm 10^{-99}$ to $\pm 10^{99}$). All models have four statistical modes which perform a variety of numerical and graphical statistical procedures. Other features include a built-in pseudo-random number generator, expandable array-type memory locations, and an easily understood programming language.

The differences between the four models are the amount of programming memory (*fx-7000 - .5K; fx-8000G - 3.5K; fx-7500G - 4K; fx-8500G - 11.5K*) the printing, memory storage capability, and File Editor of the *fx-8000G* and *fx-8500G*. The *fx-8000G* and *fx-8500G* also have a command line buffer memory which will recall the last complete command line entered.

Two of the most important features of the Casio graphing calculators, from a teaching standpoint, are their price and portability. The *fx-7000G* costs about \$60; the *fx-8500G* costs about \$95. For less than the price of a good pair of tennis shoes, students and teachers can have a powerful computer for experimenting and problem solving. Students can use these computers in class, at home, in the library, or anywhere they wish. Imagine, now we can assign homework which requires use of a computer without worrying about access to an overcrowded, or nonexistent computer lab.

One of the best things about a Casio graphing calculator is what it won't do. It will not do **word processing**. This is great!!! The Casio graphing calculator is a computer dedicated to mathematical and statistical computations, not text processing. Now mathematics teachers don't have to fight with the English teachers or the office practice teachers over computer lab time. Computing power can be in the mathematics classroom for use on an as-needed basis. This flexibility is important for exploration and problem solving activities.

Statistical Functions

All four models of the Casio graphing calculator have the same built-in statistical functions. Commands and keystrokes are identical on all machines with the exception of certain graphics commands on the *fx-7500G*.

The Casio graphing calculator has four statistical modes. The two **SD** (Standard Deviation) modes operate with single variable statistical models and the **LR** (Linear Regression) modes operate with paired variable statistical models.

SD1 and LR1 Modes

Like many other scientific calculators with statistical functions, the Casio graphing calculator will do statistical computations based on single and paired variable data sets. For single variable data sets entered in the **SD1** mode, the Casio will compute the mean, population standard deviation, sample standard deviation, sum of squares, sum of the data, and the number of data values.

For paired variable data sets entered in the **LR1** mode, the Casio will compute the same descriptive statistics listed above for both the paired (x and y) data sets. In addition, the sum of the products of the paired data is computed. The calculator also computes the y-intercept and the slope of the least squares line of best fit and the correlation coefficient. Using the least squares line, the Casio will compute $\hat{y}$ based on x, or vice versa.

The Casio calculator has a constant statistical memory. Once a data set is entered it will remain in the memory of the calculator until it is cleared. This means that a data set can be entered once

and used repeatedly without reentering, even if the calculator is turned off. Data points can easily be added or removed at any time to explore extensions of a problem.

SD2 and LR2 Modes

The SD2 and LR2 modes present both numerical and graphical representations of single and paired variable data sets. The same numerical information available in the SD1 and LR1 modes is available in these modes. However, it is the Casio's ability to draw graphical representations of the data that makes it a unique tool for teaching statistics and probability. In the SD2 mode, the Casio will automatically draw a bar graph, a line graph, or a normal distribution curve of a single variable data set. Figure 1 shows the Casio's graphics screen with a line graph of a data set overlaid on the bar graph. Either type of graph can be produced separately or together in any order the user chooses. Since the Casio has a constant statistical memory, the graphics screen may be cleared and the graphs redrawn without reentering any data.

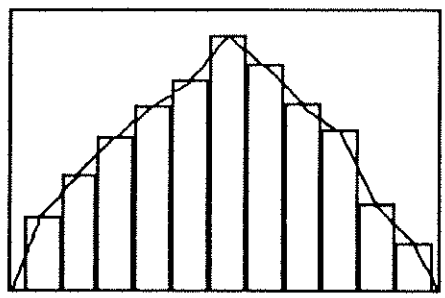

Figure 1: Bar graph and line graph of a data set.

Figure 2 shows the graph of a normal distribution curve of a single variable data set.

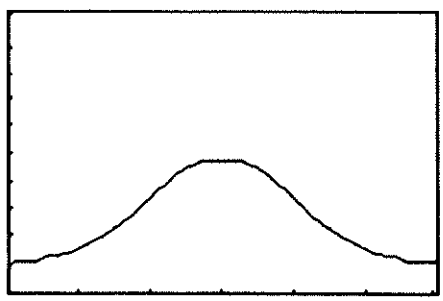

Figure 2: Normal distribution curve of a data set.

In the LR2 mode, the Casio will plot the paired variable data set in the coordinate plane, produce a scatter plot and will automatically draw the line of best fit. Figure 3 shows a scatter plot of a data set and the line of best fit drawn on the scatter plot.

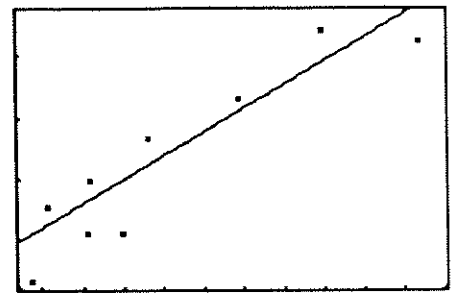

Figure 3. Scatter plot and line of best fit.

Data points can be added or removed from the data set and a new regression line can be overlaid to show the effects of a change in the data set. The graph drawing function of the Casio is active in the statistical modes. Functions of any type can be graphed on the screen with the scatter plot. Students could estimate the equation of the line of best fit and graph their guess before having the calculator graph it automatically. Comparison of the estimate to the actual line is immediate. Numerical values are also available, as in the LR1 mode, for comparison. The **Trace** function of the Casio can be used to move the cursor along the regression line giving the $\hat{x}$ and $\hat{y}$ values for each point graphed. The viewing rectangle represented in the scatter plot can be changed and a new line of best fit can be drawn so that the user may read beyond the given data. Changing the viewing rectangle, however, will erase the scatter plot.

The various ways to represent and manipulate data on the Casio graphing calculator allow students and teachers the flexibility to experiment easily with data sets in a way not usually possible with hand-held technology. Students are better able to make and test conjectures about data sets almost immediately. For example, "What would happen to the slope of the regression line if one outlying point were added to the data set, or if one value were removed?" Not only are these conjectures tested numerically, but also visually. The visual presentation of statistical data helps students build intuition about statistical processes and helps them understand statistical interpretations of data sets.

Probability Simulations

Because the Casio graphing calculator is a computer, it can be programmed to conduct monte carlo probability simulations using the built-in pseudo-random number generator. Many of the probability simulations usually done in the classroom on a microcomputer can be done on the Casio. For example, simulations of coin flipping, general binomial probability, multiple component binomial probability, dice rolling, number games like *Super Lotto*, areas of geometric shapes, and others can be done on the Casio. Graphs can be automatically drawn to display the results of an experiment. Sorting of results and setting the domain and range of the graphics screen can be done from within the simulation programs. All data, calculated values, and graphs are saved in the constant memory of the calculator, even if the machine is switched off.

Comments

Memory

The most persistent complaint about the *fx-7000G* model is its limited programming memory. The programming features of the Casio graphing calculator usually become very important to most users. The first thing that happens when using an *fx-7000G* is that memory is exhausted. Then the user must decide which program to eliminate from the memory so there is room to enter a new program.

This problem can be solved by purchasing any of the other three models (for more money). Actually, the *fx-7500G* is only a partial answer to this problem. This model has 4K of programming memory which is adequate for long programs. However, the *fx-7500G* is still limited to only 10 programs in the memory at one time. If some program locations are used for subroutines, one may have lots of free memory and no place to put a new program without erasing another existing program.

The *fx-8000G* and the *fx-8500G* are the best answers to the program memory problem. The File Editor on these two models allows storage of more than 10 programs. Utility programs can be placed in the File Editor, leaving the normal program storage area free for new or experimental programs. The contents of the normal program storage area and the File Editor can be stored on a cassette tape for later recall or loaded into other calculators. Add to this the printing capability of the *fx-8000G* and *fx-8500G*, and you have a much more versatile system. However if cost is a factor these machines may be too expensive when considering classroom sets.

Durability

The *fx-7000G* is a very durable machine. Like any other calculator, if you drop it on the floor 20 times a day, it probability will not last. But very few problems have been reported concerning the *fx-7000G*. This model has been on the market the longest (about 5 years).

The *fx-8000G* seems to be as reliable as the *fx-7000G*, except that the case is more brittle and prone to break if dropped. The interface port on the side of the *fx-8000G* is covered by a removable plastic plug which is easily lost. Like the *fx-7000G*, the *fx-8000G* comes with a very thin vinyl carrying case which offers little or no protection for the unit. A hard, plastic, slide-on cover would be a nice addition.

The *fx-8500G* is new on the market as of April, 1989. Its case and outside appearance is identical to the *fx-8000G*. Reliability of this machine should be the same as the *fx-8000G*.

The *fx-7500G* has a folding case with touch-pad keys. The screen and some of the keys are on the upper half of the case, and the remainder of keys are on the lower half of the case. The two halves are connected by a thin, plastic conductor which flexes when the case is closed. This system seems to be reliable, however the *fx-7500G* has only been on the market about two years.

The most serious complaint about the *fx-7500G* is that the wires connecting the screen to the internal circuits can easily be disconnected if the calculator falls on the floor. The usual manifestation of this problem is several blank lines at the bottom of the screen. In some cases the entire screen goes blank. One of the major causes of dropping the *fx-7500G* is the smooth finish on the outer cover. Often students have this unit on top of a sloped desk where the slightest bump can slide the unit onto the floor.

Pseudo-random Number Generator

The pseudo-random number generator built into the Casio calculators exhibits some unusual behavior when repeatedly executed within a program. This random generator produces values in the range $0.000 \leq R \leq 0.999$, so there are only

1000 distinct 3-digit values available. When this function is called repeatedly within a program, it tends to produce a skewed distribution.

One solution to this problem is to place the random number generator in another program location to be called as a subroutine. However, this procedure is not entirely successful.

Another solution to this problem was to use an independent pseudo-random number algorithm to replace, or supplement, the one built into the calculator.

Owner's Manual

The *Owner's Manual* supplied with each calculator is not a good reference source for the operation of the Casio graphing calculator. This manual has a general table of contents, but no detailed index to help the user find various functions and topics. Many commands and explanations of function keys are buried in examples and not easily found. Some functions are only used in examples and never explained in any detail. The programs listed in the manual are very difficult to read because all commands are concatenated with colons. The manual seems to be written for much more sophisticated users like engineers and scientists, and not for students, teachers, or other novice users.

Conclusion

Even though the Casio graphing calculators have some minor problems, there is no doubt that these machines will revolutionize the way we teach mathematics and other related topics. These machines are personal computers for exploring mathematical topics and solving problems. Computing power, affordability and portability have finally come together in one easy to use package which challenges students to ask the question "What if..."

-- Chuck Vonder Embse

INTRODUCTION TO THE PRACTICE OF STATISTICS

by David S. Moore and George P. McCabe, W.H. Freeman and Company, NY, 1989.

This textbook presents an elementary and up-to-date introduction to statistics that is intended for a general (non-calculus) college audience. It is also the textbook accompanying *Against All Odds: Inside Statistics*, the 26-program telecourse on statistics and its applications that is being shown on public television stations around the country. Several of the television programs have been given excellent reviews in previous issues of this newsletter, opinions in which I concur. The book can stand alone as a text apart from the telecourse, and this review discusses only the book.

Introduction to the Practice of Statistics contains nearly 800 pages of text and exercises and, I believe, covers all the standard topics in the general purpose, introductory college course. The following important features distinguish this book from most others written for this course. It includes a serious, modern approach to data analysis as a key component in the *practice* of statistics; this topic is the subject of the first third of the book. A chapter on collecting and producing data, including fundamental ideas of experimental design, is included before the chapters on statistical inference. The text includes discussion and recommendations of statistical strategy for analyzing data; many practical issues of doing statistics are emphasized, rather than simply choosing the right formula or doing the calculations correctly. The explanations are clear, although at times a bit wordy. Finally, there is a large number of exercises, many with real or realistic data; specifically, the median number of exercises per chapter is 71 with a range from 56 to 109.

The authors state that they intend to introduce statistics as it is used to practice. As one who does use statistical methods for a variety of problems, I feel that they have done a good job of achieving this goal, especially in the first half of the book. In order to give a flavor of their approach, I will summarize a bit of the content and give a few quotations that I found noteworthy.

The first chapter covers the basic topics in analyzing data from a single variable and emphasizes graphical displays. "1) To interpret data, you must first learn something of their context: What exactly was measured? How was the measurement carried out? Are the data intended to answer specific questions? Are they appropriate for that purpose? 2) Always examine your data. An informative picture comes first and is usually supplemented by some numerical calculations. 3) Look first for an overall pattern, then for deviations from that pattern, such as outliers." These ideas represent a style that most statisticians would agree with, but it is easier said than done. One of the nice features of this book is that the treatment of many of the examples actually follows this pattern. "Quickly resorting to

fancy calculations is the mark of a statistical amateur. The trained practitioner looks, thinks, and chooses calculations selectively." Normal distributions are introduced as a model for some data, and this is followed immediately by the normal quantile plot as the recommended tool for assessing normality. Normal quantile plots are used often throughout the remainder of the book in examples, so the authors practice what they preach.

The second and third chapters also discuss data analysis topics. Changes in a variable over time are considered, including control charts; an optional section treats exponential growth and the use of logarithms for data transformations. Relationships between two variables are introduced through scatterplots, and these plots are augmented in several different ways. The median trace can display a smooth relationship between two variables; adjacent box plots are valuable especially when one variable is categorical; and the least squares line is introduced as a purely descriptive summary of linear relationship. The authors note, however, that "least squares regression is not resistant. The position of the least squares regression line is heavily influence by observations that are extreme in x. The influence of these points often guarantees that they are not outliers, however, because they draw the regression line toward themselves. Influential observations are easy to detect (as long as there is only a single explanatory variable), but merely looking for large residuals doesn't do the job." Displays of two categorical variables and Simpson's paradox are also treated in Chapter 3.

Elementary statistics books have always had a chapter or two on descriptive statistics at the beginning, and the current trend in such books seems to involve including more graphics and using phrases such as "exploratory data analysis." In some texts these changes are just window dressing. Moore and McCabe's book, however, treats these topics as the important yet often subtle issues that they truly are in actual statistical problems.

Chapter 4. "Producing Data," discusses statistical techniques and practical issues for designing reliable experiments and sample surveys. This material also represents an innovative and attractive feature of the text. The topics are introduced through interesting examples, such as estimating the number of homeless in Chicago. General principles are emphasized, including controlling the effects of outside variables, the importance of randomization, the need for adequate replication, and the value of blocking. These important ideas are inherently statistical and they cannot be "mathematized" into simple calculation formulas. As a consequence, I believe, these topics tend to get less emphasis in elementary texts than they deserve. Concerning sample surveys, the authors state that, "The wording of questions is the most important influence on the answers given to a sample survey.... Never trust the results of a sample survey until you have read the exact questions posed. The sampling design, the amount of nonresponse, and the date of the survey are also important. Good statistical design is a part, but only a part, of a trustworthy survey."

The next three chapters introduce probability and the basic ideas of statistical inference. The treatment is not as innovative as in the first four chapters, but the topics are explained clearly and with many examples. The probability topics are kept to the minimum needed for later statistical work, as is appropriate in a beginning course concentrating on statistics, and extra probability topics of interest in their own right are not developed. Independence is defined using an informal discussion of conditional probability ideas, and the formal definition of conditional probability is given in an option section. Bayes' Theorem is not treated, although some of the examples work towards this idea through the use of tree diagrams. The basic rationale of statistical inference procedures are extensively discussed and then followed by cautions about their use in practice. "There is no correct method for inference from data haphazardly collected with bias of unknown size. Fancy formulas cannot rescue badly produced data... Deciding when a statistical procedure should be used in practice often requires judgment assisted by exploratory analysis of the data. Mathematical facts are therefore only a part of statistics. The difference between statistics and mathematics can be stated thus: mathematical theorems are true; statistical methods are often effective when used with skill." Statistical tests of significance are explained, but the formalism of Type I and Type II errors is in an optional section. The authors state that, "The remedy for attaching too much importance to statistical significance is to pay attention to the actual experimental results as well as to the P-value.... Confidence intervals are not used as often as they should be, while tests of significance are perhaps overused."

Chapter 8 through 11, approximately the last third of the book, apply the principles and ideas

that have been developed to the standard statistical problems typically covered in elementary texts. These include inference for the means of one and two populations, contingency tables, linear regression, and analysis of variance. The ideas and formulas are explained clearly, but again the presentation is more standard than is the first third of the book. Practical aspects of the statistical topics are emphasized, however, and I especially like the following. The main treatment of the two-sample t procedure assumes unequal population variances., Normal quantile plots are used in examples to evaluate the normality assumption. In examples analyzing sample survey data, the sample demographics are compared to the population demographics. For two-way analysis of variance, there is a brief discussion of the advantage of two-way (crossed) experiments compared to doing two one-way experiments (changing one variable at a time). The authors suggest using side-by-side boxplots to display both the within-group and between-group variation for one-way analysis of variance, and this is an excellent statistical technique to use in practice, but unfortunately none of the examples shown in the book actually does this.

This last point illustrates a general difficulty I find with these chapters. Although the authors give fine advice on statistical practice, the examples do not illustrate the full use of this advice to the extent that I would like to see. Some exercises ask students to perform a full analysis, but I would also prefer to have some examples worked through completely including all the stages of a statistical analysis, from questions of interest and data collection, through the appropriate use of graphical displays, and leading to statistical inference and conclusions.

Many readers of this newsletter teach at the precollege level, so here are a few thoughts on the possible use of this book outside the elementary college course. I have spoken with a teacher using this book (along with some of the videotapes) for advanced students in a small, private high school, and he was happy with it. This book is certainly among those that should be considered as a text for a statistics course for 11- and 12-grade students. Some concerns, however, include the reading level and the long length in which many of the topics are covered. I also believe that the approach advocated by the text would be learned the best when students have statistical software available and use it for plots and calculations. Another possible use of the book, however, is as background reading and as a source of extra examples for the teacher to bring into the classroom. For the mathematics teacher who will be teaching a course in statistics and who feels the need for further preparation, I have absolutely no hesitation in recommending the first four chapters (approximately 175 pages plus exercises) as an excellent source and guide to important, current ideas in statistics.

– – James M. Landwehr
AT&T Bell Laboratories

TEACHING QUANTITATIVE LITERACY A MANUAL for WORKSHOP LEADERS

The materials in this handbook and the set of masters which accompany it were assembled and developed at a Leadership Conference in Madison, Wisconsin. The purpose of this book is to provide workshop leaders with materials and suggestions for carrying out professional development and awareness activities with teachers, administrators, and parents. The overall intent is to allow as much flexibility and latitude as possible.

The major portion of the materials are oriented towards and derived from the Quantitative Literacy materials developed by the Joint Committee. However, a number of the ideas are drawn from other sources or are creations of the talented teachers who helped to develop this handbook. It is strongly recommended that any workshop which is conducted using this book as a guide should make the Quantitative Literacy materials available for the workshop participants.

The book is divided into six sections. The first section is devoted to materials and suggestions for a general workshop which is intended to be of a motivational nature and is not designed to impart specific skills or knowledge. The next four sections are devoted to the four books which make up the Quantitative Literacy Series. The final section presents graphical display of data and is designed to contain material that can either stand alone or be used in conjunction with the other sections.

The handbook is accompanied by a set of blackline masters that can be used to produce overhead transparencies and/or handouts for participants. All masters except those taken from copyrighted materials can be used to produce student worksheets. Almost all of the masters have been reduced

and copied in the handbook so that the reader may refer to the master while reading the suggestions for its use.

Checks and money orders, for $15.00 per copy, should be made payable to QUANTITATIVE LITERACY and orders sent to: QUANTITATIVE LITERACY, Whitnall High School, 5000 South 116 St., Greenfield, WI 53228.

-- Gail Burrill

QUANTITATIVE LITERACY IN PRINCE GEORGE'S COUNTY PUBLIC SCHOOLS, MARYLAND

Last summer four teachers from Prince George's County Public Schools, Connie Davis, Carol Hodges, Alice Petillo, and Ken Schwartz participated in the course in Quantitative Literacy offered at Towson State University. All four are using the QL materials in various ways this year. This summer two of our math specialists, Pam Quidley and Sylvia Reeder are planning to attend. Our county school system is already committed to major curricular reform which includes Quantitative Literacy as a key component at all levels.

Our county has also just recently purchased the telecourse series *Against all Odds: Inside Statistics*. The Office of Television resources plans to air this program over cable channel 12 beginning in the fall. Virtually all of the schools and sixty-five percent of county residents have cable television. We have included offering the telecourse to county teachers for credit as part of various grant proposals for next year. The series is already enjoying use as a resource for staff and teacher inservices by Dr. Gene Adcock in our Office of Research and Evaluation.

During the 1989-90 academic year the Office of Television Resources has made a concerted effort to produce and acquire instructional and staff development mathematics programs. A major emphasis has been placed on producing staff development programs for our pre-algebra teachers in the middle schools. Two series have been developed and produced: *Pre-Algebra: The Teaching Variable* and *Math Matters*. Various programs have dealt with the topics of statistics and probability. Demonstrations of computer software from the QL Project and other resources were utilized. One of the *Math Matters* programs included excerpts from the *Against All Odds* series that was made available by the ASA. Another *Math Matters* program featured Dr. Richard Scheaffer, one of the authors of the QL series, as a guest speaker.

As part of our plans for next year we have submitted various grant proposals with QL as a key component. Letters of support were received from the American Statistical Association and the National Council of Teachers of Mathematics along with other agencies. We look forward to continuing to work with the Quantitative Literacy Project.

QL is here to stay!

-- Alice E. Petillo

STATISTICS: A Guide to the Unknown, 3rd edition, Judith Tanur et al, Wadsworth and Brooks/Cole, Pacific Grove, California, 1989.

This third edition is an update and upgrade of the previous book. The twenty-nine essays describe applications of statistics and probability in four areas: biological, political, social, and physical. The original book was prepared by the ASA-NCTM Joint Committee of the Curriculum of Statistics and Probability to help explain the contributions that statisticians make to society. This new edition continues in that manner with twelve new essays and updates on several from the previous edition.

This book is intended for an audience that has no special background in statistics or probability. Two tables classify the subjects of the essays by statistical tools employed and another by data sources employed. This collection of essays has more graphs and data tables — a definite plus. The inclusion of new examples on uses of statistics is crucial because examples from the 1980's maintain a certain advantage over examples from the 1960's with a young audience. I believe this to be a very important point as I would recommend this text as a supplement to a high school mathematics or statistics course. Each essay has a series of questions that could be used as an assignment if desired. There are certain other uses for the book such as a supplement to a college course or as informative but light reading in mathematics.

I particularly enjoyed two essays, "Children's Recall of Pictorial Information" and "Making Essay Test Scores Fairer with Statistics" due to my background and interest in education. I also enjoyed current topics "How to Count Better: Using Statistics to Improve the Census" and "The Consumer Price Index".

-- Ken Sherrick