THE STATISTICS TEACHER NETWORK

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Joint Committee on the Curriculum in Statistics and Probability.

AMERICAN STATISTICAL ASSOCIATION OFFERS QUANTITATIVE LITERACY WORKSHOPS

Virtually every report on the status of mathematics education in the United States urges the inclusion of statistical and probabilistic skills and concepts for all students. In response to this need, the American Statistical Association (ASA) through its center for Statistical Education offers aid to social districts, colleges, universities, and other groups in organizing and presenting Quantitative Literacy (QL) Workshops for teachers in grades 7-12. The ASA Workshops are designed to promote professional development among secondary school teachers of mathematics and science while preparing them for the instruction of statistical and probabilistic concepts in the classroom.

No previous knowledge of statistics is required of the workshop participants. The material, used extensively by classroom teachers, is based on the publication of the NSF-funded QL Project and covers exploring data, probability, simulation, and an introduction to inference through sampling and surveys. Techniques for teaching the topics are modeled by the QL team members. Time is provided to discuss the integration of the materials into the mathematics curriculum. Participants work on projects and are given opportunities to explore computer software and the use of calculators.

The workshops are presented by teams of statisticians and classroom teachers who have worked with the QL Project. Local chapters of ASA support and provide statitisticians to participate in local workshops. Workshops are tailored to meet the special needs of different audiences in terms of both content and scheduling. A variety of schedules can be used depending upon the school district's needs and interests, including three- or five-day sessions, sessions split over two time periods, or some combination of these.

In addition to coordinating the entire instructional phase of the workshops, ASA will provide assistance with local arrangements. For more information regarding a QL workshop in your area, including specific details and costs, contact: Kathryn Rowe, Center for Statistical Education, American Statistical Association, 1429 Duke Street, Alexandria, VA 22314-3402, or call (703) 684-1221.

IT SOUNDS GOOD, BUT...

> *Our society would be unimaginably different if the average person truly understood mathematical concepts.*
>
> — Douglas Hofstadter

Do you teach probability in your mathematics classes? The NCTM STANDARDS recommend the teaching of

probability concepts at all levels. Probability is interesting, fun, and fascinating...and our everyday lives offer experiences that can be brought into the classroom.

This incident actually took place early in January, 1990. I received an unsolicited phone call from a marketing research firm and was asked to do the following: KEEP RECORDS AND RECEIPTS FOR MY PURCHASES OF CERTAIN ITEMS OVER A PERIOD OF THREE MONTHS. The research firm would send me three journal booklets in which to record my purchases. If I returned the first journal, along with receipts to verify the stated purchases, I would have one chance in ten of winning a prize worth $25.00. If I returned the second journal and receipts at the end of the second month, I would have one chance in ten of winning a second prize of like value. If I returned the third journal and receipts at the end of the third month, I would have one chance in ten of winning a third prize of similar value.

Ah, but there's more. If I returned all three journals and receipts on schedule, I would have one chance in one hundred of winning a three day trip to Las Vegas and a one chance in three hundred and fifty of winning a week's vacation for two in Hawaii. All of these odds were actually quoted to me over the telephone as the caller was describing the research project. Then I calculated:

PROBABILITY OF WINNING...

None of the minor prizes	= (.9)(.9)(.9) = 72.9%
Exactly 1 of the 3 minor prizes	= 3(.9)(.9)(.1) = 24.3%
Exactly 2 of the 3 minor prizes	= 3(.9)(.1)(.1) = 2.7%
All three minor prizes	= (.1)(.1)(.1) = 0.1%
	TOTAL..... 100.0%

Now let's consider Las Vegas and Hawaii, the "major" prizes.

PROBABILITY OF WINNING...

Neither of the major prizes	= (99/100)(349/350) = 98.72%
Las Vegas, but not Hawaii	= (1/100)(349/350) = 1.00%
Hawaii, but not Las Vegas	= (1/350)(99/100) = 0.28%
Las Vegas and Hawaii	= (1/100)(1/350) = 0.00%
	TOTAL..... 100.00%

Using the calculated probabilities, we can note the following:

PROBABILITY OF WINNING...

No prize at all	= (0.729)(0.9872) = 71.97%
One minor and no major prize	= (0.243)(0.9872) = 23.99%

It is perhaps surprising to note that after three months of journal writing and receipt-keeping, one has a 72% chance of receiving nothing at all...and a 96% chance of getting at most one of the minor prizes. The probability of winning at least one of the major prizes is 1.28%. What do you think? Are the potential awards enough to warrant the time and effort one would put into this project?

While I did not do precise calculations in my head while on the telephone, I was aware that the quoted odds were such that one would probably end up with very little, if anything, for the efforts of three months work. When asked if I would participate in this market research project, I pointed out to the caller that if one knows basic probability, one would realize that the quoted odds were highly unfavorable for the participant. The caller replied "Oh, I wouldn't know anything about that."

I declined to participate. However, I realized that I had plenty of "real life" mathematics that I could use in my Probability and Statistics class.

– – Sanderson M. Smith

A PERSONAL TOUCH

In keeping with the current trends in the area of statistics, here is a lesson plan for you to use with your class in simulation. The major part of the lesson comes from "The Art and Techniques of Simulation", Application I, from Dale Seymour Publications. I've just put a personal touch to it and this is what I'd like to share with you. Please personalize it to fit your own needs.

As a teacher, I know that time is a big factor in my daily class routine. Realizing that a particular lesson was going to be short one day, I filled the time by having each student toss a coin. They kept tallies, not knowing what the information would be used for.

The rest of the lesson would take about two class periods. Again, I used the lesson from the book and in stating the eight-step process, I changed the nouns to personal pronouns. Example: Mary has not studied for her History exam (from Application I). Change to: I have not studied for my Calculus exam.

Change four or more correct answers to five or more to find out who would pass. Oh, if my seventh grade class only knew what I had in store for them.

After stating the eight steps and relating the coin tosses we did three days ago, I continued to follow the same outline from Application I. We made Table 2 and came up with our own Estimated Probabilities.

Then came test taking time and here is where you'll have a great time with your class. I gave my seventh grade a calculus exam so all they could do was guess at the answers! I chose questions on derivatives and

integrals which might appear in any college freshman calculus course.

Lo and behold, after grading the exams, we found that two students passed just as we had estimated. One girl said she would get them all wrong, but I pointed out that using our estimated probabilities, she would get three or four right. She got three correct.

I encourage you to personalize the application that fits your needs. Good luck.

P.S. The theoretical probability for exactly 5 heads is 0.165.

-- Rodney S. Brewer

AND THE WINNERS ARE...

Are your students participating in the statistics competitions sponsored by the American Statistical Association? There are three competitions – the Poster Contest, the Quality and Productivity Scholastic Competition, and the Project Competition. Participation in one or more of these might just be the spark to ignite your students interest in statistics – and there are prizes and prestige involved! Here are the winners and their projects for the 1989-1990 school year.

The Poster Competition has winners in three categories. Our Lady of Loretto School in Novato, California won in the grades K-3 category; Ascension School in Louisville, Kentucky won the grades 4-6 category and in the grades 7-9 category, the winner was Conlara, Home-Based Education Program in Ann Arbor, Michigan.

The Poster Competition encourages students to discover the usefulness of statistics in daily life and challenges students' creative and team skills to produce a picture worth, if not a thousand words, a thousand revealing numbers!

The three winning posters, exhibited at ASA's Annual Meeting, depicted an array of statistics: the number of third-grade footprints it would take to fill one footprint of Apatosaurus, a herbivorous dinosaur that grew to 72 feet and weighed 33 tons (the answer was 29 third-grade footprints); the benefits of a "wall of water" encased in plastic and protecting tomato plants versus unprotected and less fruitful plants; and the hourly wages of a Beijing woman working in a Chinese restaurant in Ann Arbor, MI, displayed as a stem-and-leaf plot.

Each winning team won a prize of $200.

The Quality and Productivity Scholastic Competition was won by the seventh grade mathematics classes of Ms. Kathy Enders at Dundalk Middle School in Dundalk, Maryland. The classes won by compiling points in a variety of activity categories using statistical concepts and tools. The contest encourages teamwork and scientific problem solving as skills that will be advantageous in the work world.

The Dundalk classes chose activities which focused on student use of tools (cause and effect diagrams, flowcharts, and scatterpoints); on business involvement in their project; and on activities outside the classroom using bulletin boards and other communication tools. The prize was a complete edition of MINITAB, statistical software, along with an awards certificate.

The Statistics Project Competition has grade categories 4-6, 7-9, and 10-12 with a winner in each category. A prize of $300 is awarded to each winning team. There is also a fourth prize given for the entry demonstrating the best use of a computer.

The second period math class of the University School of Milwaukee, taught by Greg Bach, won the prize in the 4-6 grade category for a project entitled "The Second Period TV/Video Game Survey." Mr. Bach's first, fifth, and seventh period math classes also won three of the four honorable mentions in the grades 4-6 category.

The second period students' survey -- written, distributed, analyzed, and put in graph form -- asked a random sample of 182 fellow students (selected by drawing classes from a hat) about their TV viewing habits and preferences and about the video games they own and use.

A few of their results: 63% said they have four or more TV's at home; 34% reported that they watch from 5 to 10 hours of TV a week with another 23% watching less than 5 hours. Asked what bothered them most about TV, "commercials" was the top answer, with no worry at all about violence, to the student surveyor's surprise.

To the question, "How long could you go without watching TV?" over half responded 1 to 7 days (22% said one day; 39% one week; 23% a month; 8% a year and 8% a decade.) Asked which TV family they would like to live with, 43% selected the Simpsons (over Cosby, Family Ties, Married With Children, Growing Pains, and Doogie Howser). The student surveyors speculated that this was because "The show is a cartoon and they are not a perfect family."

In the grades 7-9 category, Steven and Michael

Kushner, students at Goerge Washington High School, Philadelphia, PA were selected as winners.

Advised by James P. Smith, the Kushners submitted a project entitled "Computer Simulation of the Random Allocation Problem," using data on muscle fibers of five cats and finding "a strong indication that reinnervated muscles fibers have a distribution of three cell types that more often seem nonrandomly distributed than normal control fibers."

A team of six students at Shoreham Wading River High School, Shoreham, NY, – – Anne Marie Gatz, Mary Elizabeth Luckas, Chris Broussard, Bill Anckner, Gerrick Johnson, and Chris Agharabi – has been selected as winner of two prizes. Advised by social studies teacher Herb Meserve, the group won both the prize in the 10-12 grade category and the computer prize for their project, "A Comparison of American Attitudes on Civil Liberties."

The students surveyed grades eight and eleven to see if differences in age and education influence opinions about civil liberties, asking questions related to people's rights, cruel and unusual punishment, freedom of speech and of assembly, and freedom of the press.

After examining these five aspects of civil liberty, the students concluded that the respondents believed in the theory of civil liberties, but when faced with an actual situation often changed their opinion (such as agreeing with the general right of citizens to hold an orderly public meeting but not always agreeing that the American Nazi part also has this right). In each of the five civil liberties, the sex of the student influence his or her response to some extent (for example, females seemed to have a strong belief in freedom of the press than males). Education played a role in the decision making process for three of the civil liberties: cruel and unusual punishment, freedom of speech, and freedom of assembly.

The Honorable Mention list includes Sunset Elementary School, Whitehall, WI in the grades 4-6 category; in grades 7-9, Alamo Heights Junior School in San Antonio and Roncalli High School of Indianapolis; Clarke Central High School in Athens, GA, North Providence High School of North Providence, RI, and Thomas Jefferson High School for Science and Technology of Alexandria, VA in the grades 10-12 category.

For information on these competitions, contact Kathryn Rowe, American Statistical Association, 1429 Duke Street, Alexandria, VA 22314-3402, phone: 703-684-1221.

QUANTITATIVE LITERACY SERIES

Exploring Data
James M. Landwehr and Ann E. Watkins

Exploring Probability
Claire M. Newman, Thomas E. Obremski, and Richard L. Scheaffer

The Art and Techniques of Simulation
Mrudulla Gnanadeskian, Richard L. Scheaffer, and Jim Swift

Exploring Surveys and Information From Samples
James M. Landwehr, Jim Swift, and Ann E. Watkins
Dale Seymour Publications, Palo Alto, CA, 1987.

In most math classes in public schools, the content of instruction is all too familiar. Basic math operations and number facts seem to be the constant focus of elementary math, while the traditional algebra, geometry, trigonometry, and calculus sequence of courses has been enshrined in the secondary programs as if it were ordered by natural law. In the movie *Peggy Sue Got Married*, Peggy Sue returned, in time, to her high school of the 1950s. There she refused to take an algebra test, saying, "I happen to know that I will never use this math again in my lifetime." Many students, like Peggy Sue, wonder about the purpose and usefulness of the math they are taught.

It should not be too hard to figure out that all of us are regularly bombarded with statistics – Dow-Jones averages, consumer price index, unemployment rates, federal budgets, deficits and trade balances, presidential polls, election-night projections. Nielsen television reports, birth rates and life expectancies. We all figure the odds of all sorts of events from Super Bowl results or horse racing to airline crashes or succumbing to the dread disease AIDS. We need to know a good deal about statistics to be intelligent decision makers. Yet that is one area in which the typical school curriculum and math textbooks have not kept up with the times. In fact, many teachers are uncomfortable in the subject area and worry that it is not real mathematics as they know it.

An excellent new series of instructional materials has now been prepared as an outgrowth of the Quantitative Literacy Project of the American Statistical Association. With this four-part series, schools now have available a variety of interesting and engaging instructional materials that bring many topics of useful statistics to life. These books reflect the interest level of secondary

students. For example, they present stem-and-leaf problems in comparative terms by using the numbers of calories, fats, carbohydrates, and salt in Big Macs versus Whoppers. Automobile safety is the theme of an activity to learn box plots by comparing sports and specialty models of domestic and import cars. The data from the National Basketball Association teams, the Celtics and the Lakers, are studied in scatterplots. The topics of chance and probability are taught with dice and spinner simulations or through coin and thumbtack tosses. Such concrete examples make the abstract statistical ideas understandable to average students.

Students working on these problems with these materials have real experiences in problem solving. The projects have a "hands-on" feel to them. Students have fun thinking through alternative ways to state, test, and solve statistical problems. Classes using the material seem to burst with student enthusiasm and discussion.

One of the goals of a curriculum specialist is to find opportunities for transfer of learning between discrete subjects. Through these interdisciplinary math lessons, students are introduced to statistical applications easily connected to their social studies or science classes, to career and health education, or to outside hobbies and interests. To teach statistics, it is essential to have a preconceived or artificial set of data for this introductory study. We also need to teach students to connect these analytic strategies to real data of real problems that arise in most areas of contemporary life. Teacher initiative and creativity will be needed to extend the material of the textbooks to such applications. Extensive staff development will be necessary to realize the full potential for this transfer.

These books are manageable for instruction in most secondary classes. In my school district, we are using the first two books in the series in the middle grades (7th and 8th). Both of the later two works are more appropriate for older students in high school. The books are modest in cost and are presented in "consumable" paperback format. They can, therefore, easily be updated with new data sets.

Teachers tend to shy away from new approaches and wonder how they can ever "cover" the existing curriculum. Therefore, they will need to be encouraged to try these books, and they will have to be willing to learn along with their students imaginative ways to work with statistics. They also need to be reassured that this is "real" mathematics, as important as the more traditional topics. I introduced these materials to teachers through a short summer training workshop to increase teacher comfort and confidence.

I have visited high school classes working with these materials and found the students enthusiastic about the problems and the solutions they were finding. When I asked them what use they could expect to make of these strategies, they had no difficulty answering my question. They know that these skills will be helpful to them in many ways. Some of the more enterprising students were confident that they could use the skills to enhance the profit potential of their future business endeavors. Others saw themselves as better informed citizens with this knowledge. If they appeared in the year 2010 in the movie sequel to *Peggy Sue Got Married*, they would not be inclined to ask why they needed to know this material. I am confident that they would pass that remembered test from their high school days too, thanks to this curriculum project. It belongs in every secondary school in America.

– Valdimar C. Sandberg
Wallingford-Swarthmore
School District, PA

SOFTWARE REVIEW

The *Student Version of Data Desk* software was written to accompany the text *Learning Data Analysis With Data Desk* (289 pages plus exercises) by Paul F. Velleman (W.H. Freeman and Co., 1989).

Student Version of Data Desk provides a laboratory that gives students practical, hands-on experience with randomness. It covers the statistics and graphics methods needed in typical high school and undergraduate statistics courses. Topics covered include summary statistics, displaying data and working with displays (almost 40 pages), derived variables, frequency and contingency tables, random numbers and simulation, simple inferences (confidence intervals including Bonferroni adjustment, hypothesis testing), one-way and multi-way ANOVA, simple and multiple regression, and correlation.

The Student Version of Data Desk (459K) is a special version of the Data Desk Professional 2.0 program produced by Odesta Corporation. It works with any Macintosh computer with at least one megabyte of memory, an 800k disk drive, and another disk drive (hard disk or floppy). The owner of a Macintosh with only a single 800k drive may be able to squeeze Data Desk, a small System file, and Finder on a single 800k disk, but it is not advisable to do this.

The program is menu driven and user friendly. Any person who knows some statistics and is familiar with the use of a Macintosh can boot the program and start to explore without reading the accompanying text. One feature that I particularly like about the program is the ready availability of a Help File (123K). It comes with a Help index that is cross-referenced with sections of the text. The program is capable, fast, and well documented.

The disk contains sample data sets that are used in the examples and exercises in the book. (The first exercise on Simple Summaries directs the student to the Summary Reports in the **Compute** menu. There is no Compute menu; actually Simple Summaries is found under the **Calc** menu.) No answers are provided. It is easy to create and edit your own datafiles with Data Desk. Files created in any other format cannot be used with Data Desk. Teachers who want to import data from other sources (ASCII files, Double Helix databases) to create new exercises for their students would need a copy of the full Data Desk Professional 2.0 program. A new Data Desk Student Version datafile is limited to 15 variables if you want to save the file. However, during a session, you may generate and use any number of variables containing up to 1,000 cases, depending on the amount of memory available.

Each variable is displayed on the Data Desk desktop in icon form which can be opened to show the cases. An icon Info gives the date and time *each* icon was created and modified, its size, and how many cases it has. There is a comments box for additional information. Dependent variables highlight differently from independent variables. Any variable may be made dependent or independent by an appropriate combination of Shift/Option keys.

The most appealing feature of the software is its versatility and interactive nature, especially with regard to the graphics. For example, we know that histograms of the same data drawn on different scales or with different group boundaries can look quite differently. Without an appropriate statistics package, a teacher must spend much time and effort to demonstrate the importance of scale. With Data Desk, a simple resizing of the display window gives immediate feedback on the importance of finding the right scale for a display.

Data Desk is an open environment. Having asked for, say, a scatterplot of two variables, you might then want their correlation. A HyperView menu in the output window actually *suggests* this next step. Or press the mouse button over an axis label of the scatterplot and the HyperView menu allows you to locate the icon, make a histogram, or make a normal probability plot of the variable on that axis.

The Data Desk Student Version is intended for individual student use and **is not** licensed for multiple use in a laboratory. It is possible to equip a laboratory facility or software lending library with Data Desk by obtaining the appropriate licenses from Odesta Corporation.

– – Bishnu Naraine

ELEMENTARY STATISTICS

Fifth edition by Robert Johnson, 1988. PWS-Kent Publishing Company.

This newly revised book is intended for college level use by students who need a knowledge of statistics but are not mathematically oriented. It is stated in the Preface that "those students who have not had Intermediate Algebra should complete at least one semester of college mathematics before beginning this course".

The book is very readable with current and timely data and examples applicable to everyday life. Many statistical examples reprinted from USA TODAY add interest and humor.

The main areas covered are Descriptive Statistics (three chapters), Probability (four chapters), and Inferential Statistics (seven chapters) – in that order. Each chapter is subdivided into three to seven sections. There are many, many exercises – at the end of each section and, then again, at the end of each chapter.

There are fourteen Chapters, with a recommendation that Chapters 1 thru 9 be considered basic. I felt that even nine chapters would be difficult to cover in one semester – the usual time limit for a college level course.

Two of the newer methods of displaying data – the stem-and-leaf and the box-and-whisker displays have been included. The use of the computer is limited and not necessarily an integral part of each chapter. Where it is included, students are requested to use Minitab or referred to "your local computer center" for assistance.

Supplementary materials were listed as:

- a study guide with self-correcting exercises for students
- a solutions manual for the teachers
- a partial solutions manual for students

- test items and transparency masters
- a Minitab student supplement

I requested the first three materials above from the publisher but only received the student solutions manual, therefore I cannot comment on their usefulness.

– – Ethel C. Henderson

STATISTICS AND DATA ANALYSIS: AN INTRODUCTION

If anyone is looking for an alternative to the traditional introductory statistics textbook, *Statistics and Data Analysis: An Introduction* by Andrew F. Siegel (John Wiley & Sons, 1988) should be considered. This book is designed to provide an introduction to basic ideas of statistics, probability, and inference for the "nontechnical" student. Several features of this book are quite unique and appealing.

One distinguishing feature is that methods of exploratory data analysis provide a central focus for the book. I have noticed that in other texts few of these methods may appear at the end of a chapter as an alternative to traditional methods, or as an additional method of interest. However, these methods are typically not well integrated into texts unless the book is explicitly a text on exploratory data analysis, as opposed to an introductory statistics text.

Another feature is that the calculation of statistical measures such as variance, interquartile range, and correlation coefficients are explained in words, using a sequence of steps rather than using formulas with complicated symbols. Formulas are offered later, after the procedures are presumably understood.

A third feature is the emphasis on conceptual understanding, which is apparent in how the text is written, how concepts are explained, and how questions are posed at the end of each chapter. These questions are designed to help students better think about and understand the reading, before applying statistical methods in solving series of problems following these questions.

Statistics and Data Analysis also differs from traditional texts in the actual content of the book: in terms of what topics are included and how they are emphasized. The first eight (of nineteen) chapters focus on methods of describing and exploring data, introducing methods of making and modifying plots: stem and leaf, histograms, box plots, grouped and cumulative distributions. Instead of specifying the intricate details on finding percentile ranks, an easier, visual method is offered. There is a brief chapter on probability which tries to stay more conceptual and less mathematical.

A chapter on probability distributions and the normal distribution combines too much information together which would be better treated in separate chapters. The chapters on estimation and hypothesis testing rely mainly on the idea of one and two-sided confidence intervals in order to test hypotheses (which are allowed to be accepted in this book).

One criticism of this text for use in an introductory course is that the treatment of bivariate data is almost at the end of the book and leads directly into data transformations and tests of significance. Although the presentation of the basic material is excellent, it would be nice to have the information included in the earlier sections on methods of exploring and describing data.

I have used this book in an introductory statistics course for underprepared college students with little background in mathematics and find it is well-liked by students. It also provides a nice complement to activities from the Quantitative Literacy Project materials by providing a text to read as background before applying statistical methods to analyze data sets.

– – Joan Garfield

LETTER

Dear Editor,

I am a student at the Institute of Education, in London.

I am planning some research in the use of STELLA as a modelling tool to help students of probability and statistics to apply theory to real world problems. I hope also to explore the possibility that STELLA might enable students to identify their own misconceptions about probability, and help them to correct them.

I would like, through your newsletter, to make contact with anyone who has done related work using STELLA, or similar dynamic modelling software, in the area of probability or statistics education.

I can be contacted here at the Institute of Education.

– – Peter Wilder

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