THE STATISTICS TEACHER NETWORK

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Joint Committee on the Curriculum in Statistics and Probability.

STATISTICS IN UTAH

More than 30 workshops, general interest sections, short subjects, and research sections will be devoted to probability and statistics at NCTM's 68th Annual Meeting in Salt Lake City, April 18-21, 1990.

Some titles to look for in the program: Data, Graphs and Statistics: Making Sense of Messy Mathematics; Probability and Statistics-Involve Your Students In *Real* Real-World Mathematical Thinking; Casino Mathematics: A Concrete Lesson for Applied Mathematics; From Guessing Games to Probability; Probability Concepts Encountered in Algebra; Experiments in Statistics and Probability for the Middle Grades; What's the Chance?-Probability Activities for the Early Grades; Quantitative Literacy- Probability and Data Analysis Topics for Secondary Mathematics; Add Some Pizazz to Probability; Monte Carlo Methods for the Classroom and Probability and Statistics for the Elementary Grades? You Bet!

More titles and authors will appear in the final program. Stop by the ASA/NCTM Joint Committee booth at the meeting!

— — John Kinney

THIRD ANNUAL STATISTICAL PRIZE COMPETITION 1989 RESULTS

Winners of the 1989 statistics contest sponsored by the Center for Statistical Education of the American Statistical Association have been announced. Schools from seventeen states participated in this year's competition, an increase over the previous two years. The majority of the entries received continues to be from the grades 10-12 and 7-9 categories. Elementary school teachers are encouraged to submit a project in next year's competition.

Competition results are as follows:

Grades 4-6 – $300.00 prize
Sunset Elementary School
Whitehall, WI 54773
Advisor: Mr. Les Dokkestul
Students: Brent Hilgart & Zachery Sobotta
Title of Project: "POP" QUIZ

The project involved administering a "taste test" to fifth graders. The students first collected written data from their classmates regarding their favorite soda (Coke, Pepsi, or RC Cola) and then conducted a "blind" taste test comparison. The results for each were then graphed on the computer. The conclusion was that most students based their selection on the *popularity* of the soft drink rather than on the actual taste.

Grades 7-9 – $300.00 prize
Brookstone School
Columbus, GA 31995
Advisor: Ms. Helen P. Purks
Students: Bing Kao & Amy Wood
Title of Project: A Study of Silver-Jaw Minnows

The purpose of the project was to see if there were any physical differences in silver-jaw minnows due to pollution, chemical properties of water, or location of the four creeks involved. The hypothesis was that there was no significant difference between the minnows from the different creeks.

The students began by taking water samples from each of the four creeks which were tested for pH, acidity, alkalinity, hardness, conductivity, nitrates, nitrites, and phosphates. Minnows were then collected and measured (length, width, and body depth) and the number of parasites on each fish was counted. Average weights, lengths, and the number of parasites for the minnows from each creek were calculated, and the student-t test was used to compare the means.

No significant differences in the chemical features of the creek water were found. There were no significant width or body depth differences in the minnows, but the minnows from one creek were significantly longer and heavier. Also, the fish from two of the creeks had many parasites, while the specimens from the remaining creeks had none. As the creeks become more rural, the fish tended to become lighter in weight. It was also speculated that two of the creeks were more polluted due to the large number of parasites on the specimens collected and finally, the minnows in the urban creeks probably have more food than the ones from the rural creeks because of their weight-length ratio. Spreadsheets were used to analyze the data collected and bar graphs and comparative boxplots were generated.

Grades 10-12 – $300.00 prize
Glencoe High School
Hillsboro, Oregon 97124
Advisor: Mr. Michael Tinnesand &
Mr. Alan Chan
Students: Heather Lee & Marc Fox
Title of Project: Cycling Efficiency in Relation to Saddle Height

The purposes of the project were to determine whether or not small alterations of saddle height make a significant difference in a rider's heart rate, thus determining optimum riding efficiency, and to determine a percentage of the outside leg measurement (OLM) to serve in a standard equation for determining saddle position for all riders.

The experiment consisted of placing every rider on a magnetic trainer bike. Measurements were taken of the inside and outside of both legs (without shoes). The inside leg measurement consisted of a measurement from the pelvic bone to the floor. The OLM consisted of the sum of the measurements from the top of the femur to the patella, the patella to the ankle, and the ankle to the ball of the foot. The width of the shoe was taken into account and from there, measurements of experimental saddle height were calculated by dividing the ideal saddle position by the OLM. The rider then rode at a pace of 90 rpm for ten minutes while the pulse was recorded every 30 seconds for 10 minutes. The rider rode at three experimental settings with five minutes between each set. The experiment was analyzed using factorial design techniques.

The results showed that the only significant source of variation was due to the rider. All other sources, including that due to the saddle position, were negligible. Therefore, there was insufficient evidence to show that the tested variation of saddle position had any direct effect on the energy expended by the rider, as measured by the heart rate. Several possible sources for error in the experiment were discussed and analyzed as well.

The study did not verify the results of an earlier study but that could be due to the differences in sample size, test duration, and work load on the rider. Also the relationship between outer leg length based on bone measurements to inner leg length remained an open question.

Computer Category – $100.00 prize
Booker T. Washington High School
Tulsa, Oklahoma 74120
Advisor: Ms. Wanda Kertzman
Students: Mark Long, Lewis Remington, and Alex Novovich
Title of Project: Nuclear Facilities and State Demographics

This project was selected due to curiosity about nuclear installations and the availability of information regarding them. Locations of all the nuclear power plants, waste disposal sites, and fuel manufacturing plants were obtained from the Department of Energy, while other data was obtained from the 1989 World Almanac. The students concentrated the investigation on population density, state income, and land forestation.

Harvard Graphics and Paint Show on a Hewlett-Packard Vectra RS/20 were used to produce the graphs and map. A computer program in Pascal was written to calculate the correlation coefficient of the three types of data related to the number of nuclear installations by state. The results were interesting, but not conclusive. However, the utilization of the calculator and computer in analyzing the data for this project was first rate.

For further information on these projects, please contact the advisors or students listed earlier. For additional details about next year's competition, request an informational brochure and entry form by sending a stamped, self-addressed envelope to:

Dwayne Cameron
National Contest Director
Old Rochester Regional School District
135 Marion Road
Mattapoisett, MA 02739

Deadline for entries: May 15, 1990.

AMERICAN STATISTICS POSTER COMPETITION

The Poster Competition for 1990 has been announced by the Section on Statistical Graphics and the Center for Statistical Education of the American Statistical Association. This competition offers an opportunity for students to discover the usefulness of displaying data from their everyday lives, an opportunity to discover new graphical techniques, and a challenge to use their creative skills to manifest the maxim that "a picture is worth a thousand words." In today's information society, appreciation of graphical displays of data is a critical skill that should become part of every students' education. The Poster Competition is a rewarding and fun way to emphasize graphing skills.

Prizes of $200 will be given to the winning student or team in each of the following categories: Grades K-3,4-6,7-9, and 10-12. A plaque will be given to the school of each winning team.

For additional information and an entry form, contact the Center for Statistical Education, American Statistical Association, 1429 Duke Street, Alexandria, VA 22314-3402 or call 703-684-1221, ex.48.

BOOK REVIEW

Statistical Abstract of the United States, 1988

Editor's Note: Robert J. Samuelson is a columnist who writes regularly for the *Washington Post* and *Newsweek*. For each of the past several years, he has shared with readers his delight with the U.S. Census Bureau's annual publication of the *Statistical Abstract*. The following review appeared in the April 6, 1988, *Washington Post*, and it is reprinted here with the author's permission.

Every year, the government publishes its version of the Great American Novel. The date roughly coincides with the start of the baseball season, which is fitting. Like baseball, this book bursts with the triumphs, the tragedies, and the general wierdness of our national life. It's full of fun, surprises, and sadness. But it's not fiction. It's the *Statistical Abstract of the United States*.

As a great fan of "the Abstract," I annually cheer its arrival. Celebrating a book so unusual may be a character flaw. No matter. Like all great books, the Abstract can be read and reread for new insights.

No one has ever claimed that it offers much in the way of style. But its number-filled pages constantly contradict conventional wisdom and spotlight new trends. It provides a portrait of daily life beyond the headlines. Could you ask for more?

Glancing through the latest edition (the 108th), you stumble upon some unhappy news. The crime rate, which had been declining in the early 1980s, is rising again. Between 1980 and 1984, it had dropped about 15%. During the next two years, about half that decrease was reversed. There have been big jumps in the rates for car thefts (up 16% since 1984), street robberies (up 10%), and murder (up 9%).

Here's another depressing note: In 1985, the United States had more lawyers (655,000) than doctors (577,000). Somehow our society keeps becoming more lawyer-intensive. Since the mid-1950s, the number of lawyers has been growing more than twice as fast as the total work force. In the 1980s, that trend has accelerated. The 1980-1985 increase in lawyers (21%) was almost triple overall job growth. In Washington–where regulatory agencies and lobbying require absurd numbers of attorneys–there's 1 lawyer for every 22 people. The national average is 1 for every 360 Americans.

When the federal government conducted its first census in 1790, no one imagined the huge variety of statistics that would be available two centuries later. There are times when it seems that someone is trying to put a number on every itch or twitch that Americans experience. *American Demographics*–a magazine devoted to statistics and their meaning–reported recently that 65% of adult Americans say they "are making a real effort" to eat more brussels sprouts and cauliflower.

But the explosion of statistics since World War II is more than a source of cheap comedy. The numbers by which we take our pulse–including the inflation and unemployment rates and hundreds of others–have created their own cultural upheaval. They help define our mood. They punctuate our political debates. They help determine how the government spends its money. After the 1980 census, 52 lawsuits were filed against the Census Bureau. Many came from disgruntled states and cities that felt population undercounts would shortchange them of federal aid.

In a sense, the Statistical Abstract is the bible of this revolution. It is the essential primer on almost any social or economic condition. What's the state of religion in America today? Check the Abstract, and here's what you find: In 1985, about 143 million Americans–roughly 60% of the population–belonged to a church or religious organization. Of these 79.1 million were Protestant, 52.7 million Catholic, and 5.8 million Jewish. The rest were scattered among many denominations. There are 346,000 churches and places of worship. The Abstract lists 87 religious denominations with more than 50,000 members. The United Methodist Church has the most churches (37,990), followed by the Southern Baptist Convention (36,898). Total Sunday school enrollment is nearly 30 million. About half of Americans say they watch religious television programs. But only a quarter of the population are regular weekly viewers. Audiences are largest in the South, where nearly two-thirds of the population sometimes watch. By contrast, only a third of Easterners ever watch.

Political scientist Steven Kelman of Harvard University has noted that the early American enthusiasm for statistics stemmed partly from a desire for recognition. In a country so large and diverse, different social and business groups wanted to stand out. The census was one small pathway to status. Groups could demonstrate their importance by having the government count who they were or what they did. In 1888, the National Electric Light Association requested that the government conduct a special census of the electric industry to show how vital its activities were.

There are lighter uses for the Abstract. With it, you can play an endless game of Trivial Pursuit. What share of pretax profits do corporations give to charity? (About 1%.) How many sick days does the average American student have annually? (About five.) Which state is the largest producer of asparagus, carrots, celery and tomatoes? (California.) What proportion of households own a VCR? (About half, up from only 10% in 1984.) What percentage of the popular vote did Ronald Reagan win in 1984? (58.8%.) What share of households have vegetable gardens? (38%.) And flower gardens? (44%.)

Of course, statistics can be misused. Our political and economic debates are full of numbers that have been twisted out of context to make some dubious point. But there are ways to combat this abuse. Statistics can sometimes be used to check other statistics. Consider a frivolous example: Americans say they're trying harder to eat cauliflower. Are we really? There's an easy way to find out. Consult recent editions of the Abstract to find out whether cauliflower production is rising.

Lo, it is. Between 1976 and 1986, it doubled. Maybe we are trying harder. Who would have thought it?

– Robert Samuelson
Newsweek

Reviewers Wanted!

If you would like to become a book reviewer, please contact the editor indicating your teaching experience with probability and statistics.

Statistics and Probability in K-12 School Mathematics Receives a Big Push from the NCTM *Standards for Curriculum and Evaluation in School Mathematics*

Part 2 - The High School Expectations

Henry S. Kepner, Jr.
University of Wisconsin-Milwaukee

This is the second in a two-part series on the statistics and probability components of the NCTM *Standards*. Part 1 appeared in the previous issue, Number 22, October, 1989. This segment will focus on the probability curriculum for grades 5-12 and the statistics for the high school, grades 9-12. While the high school expectations are valuable to read and consider, remember that they are built on the assumption that "...students entering the ninth grade will have experienced mathematics in the context of a broad, rich curriculum in the K-8 standards." (p. 124) This will not be the case for most students entering high school in the near future. Thus, some of the foundation experiences stated in Part 1 must be included for high school students. This should not deter the teaching of such topics, but it raises a caution about continuing to provide foundation work that eventually might be part of children's background.

One such concept is variability in a probability setting. I am continually overwhelmed by the difficulty students have in accepting a range of answers from a standard probability experiment. In dealing with a "fair" coin or die situation, they have accepted the theoretical probability conclusions: half heads - half tails; or one-sixth. "Surely," they comment, "if we do it long enough it will work!" When the experimental results for individuals or pairs are listed for an entire class, students are quick to point out the extreme results and often claim they were done incorrectly. They are always surprised to observe that none of the experimental trials yield the theoretical result! E.g., on 60 rolls of a die, no pair got 10 rolls of each number - at least not in my many years of doing such experiments! Such activities require extensive class discussion where students can make an estimate of reasonable variation in experimental settings. The distinction between experimental and theoretical probability is at issue here. The traditional belief that school mathematics always produces a single right answer places children in conflict here. They honestly believe there must be a way for everyone to get the same result - that's what mathematics has always been! They look for a formula to give such a result - who cares about the concept - *or will test for it on the exam.* The NCTM Communication standards are critical components of teaching such concepts. It is interesting and challenging to ask students to present an argument for their parents on why such results are "correct." Students should face the issue of variability in numerous settings over the K-12 mathematics curriculum. Current high school students may have missed the challenge and will need frequent exposure.

Probability in Grades 5-8

The K-4 standard on probability, "students can explore concepts of chance" suggests games with "...an exploration of probability from data analysis." and "Discussions following the game can include the concepts of events that are likely, events that are certain, and common perceptions of 'luck." (p. 56) From that, the document continues,

In grades 5-8, the mathematics curriculum should include explorations of probability in real-world situations so that students can -

- **model situations by devising and carrying out experiments or simulations to determine probabilities;**
- **model situations by constructing a sample space to determine probabilities;**
- **appreciate the power of using a probability model by comparing experimental results with mathematical expectations;**
- **make predictions that are based on experimental or theoretical probabilities;**
- **develop an appreciation for the pervasive use of probability in the real world.** (p. 109)

In reading these standards, please note that the emphasis is on the appreciation the power and use of probability in describing the world around us - in varied contexts. The curriculum should not be centered on a collection of formulae - permutations, combinations, multiplication principle for independent events, etc. The challenge should emanate from experimental settings which the students can model. Through attempts at modeling, student analysis of the setting and examination of the model are powerful experiences for the total mathematical growth of the student - not just for the statistics/probability objectives. Following initial experimental work and discussions on building a model, the opportunity for constructing the theoretical probability is sometimes possible. Often, however, an interesting experimental setting cannot be turned into a simple theoretical formula at the students' level of mathematical sophistication. Not making this last step must not be viewed as a failure or a lack of rigor in statistics instruction. It is developmentally appropriate for students in their learning of mathematics. Regardless of the depth of study, the expectation that students should interpret and discuss their results in natural, as well as mathematical, language is critical to mathematical instruction in the spirit of the *Standards*.

Probability in Grades 9-12

"In grades 9-12, students should extend their K-8 experiences with simulations and experimental probability to continue to improve their intuition. These experiments provide students with a basis of understanding from which to make informed observations about the likelihood of events, to interpret and judge the validity of statistical claims...." (p. 171) Remember, we are talking about **ALL** high school students - not just the select few who remain in mathematics to get an abstract, rule-based chapter in precalculus mathematics. The complete standards are:

In grades 9-12, the mathematics curriculum should include the continued study of probability so that all students can -

- **use experimental or theoretical probability, as appropriate, to represent and solve problems involving uncertainty;**
- **use simulations to estimate probability;**
- **understand the concept of a random variable;**
- **create and interpret discrete probability distributions;**
- **describe, in general terms, the normal curve and use its properties to answer questions about sets of data that are assumed to be normally distributed;**

and so that, in addition, college-intending students can -

- **apply the concept of a random variable to generate and interpret probability distributions including binomial, uniform, normal, and chi square.** (p. 171)

With adequate prior experiences, students in grades 9-12 should be comfortable considering problems involving uncertainty in probabilistic representations, using basic probability language. Students should have experience with both experimental and theoretical probability representations, and they should value both. In facing an uncertainty problem for the first time, it may not be obvious which approach could be most useful. The more general technique is to attempt building an experimental model, that is a simulation. Powerful, creative mathematical thinking is expected here - as opposed to an expected to recall a previously memorized formula!

The challenge to investigate uncertainty settings is a major opening for the connections of probability to other disciplines. I strongly believe that all probability instruction should start with an uncertainty challenge from an application - often from outside of mathematics. Through discussion and interpretation of each setting, students can practice trying to model the setting. From such experiences, students can refine their modeling skills and be motivated to investigate new techniques or relationships that should improve their ability to estimate probabilities. Such an experimental introduction to independent and dependent events and their relationship to compound and conditional probability will force the students and the teacher to focus on conceptual issues. "Formal definitions and properties should be developed only after a firm conceptual base is established so that students do not apply formulas indiscriminately when solving probability problems." (p. 171)

The vision of probability instruction proposed in the *Standards* clearly requires a serious consideration of many probability experiences over the full extent of a student's tenure in school. The probability exposure cannot be relegated to one chapter in the middle school and another for the elite in precalculus mathematics. Every year, there must be one or more challenges related to uncertainty contexts so that students may build and refine their intuition and formal conceptual background to handle varied situations. This may be the single most important statement to us in the development of children's probabilistic knowledge.

One topic of import is that of randomness. Students in middle school are fascinated by the idea of random selection and "random numbers." What it means, our ability to simulate it, and how to interpret some of its "unexpected" results are fascinating ways to initiate discussion. The recent introduction of lotteries, in their own or a neighboring state, has made the idea visible to all students. To model situations where randomness is an underlying assumption, students must face the issue of picking items randomly from a set: face of a die, student from school roster, phone number from community directory, etc. This requires a basic intuition of equally likely from prior settings. It is a surprise to students that we have no mathematical technique for generating truly random numbers. We can only approximate such a set with various tools: e.g., roll of a polyhedral die, use of a printed random number table, use of a random number generator in a calculator or computer.

Statistics in the High School

The statistics expectations in the NCTM *Standards* clearly build on statistical and probabilistic concepts delineated in the K-4 and 5-8 sections as reported earlier. Most students currently in, or entering, high school do not have those experiences. Thus, it is important for high school mathematics teachers to thoroughly examine the prerequisite experiences as opportunities for introduction. In particular, baseline concepts gained through experiments and extended discussions are needed. Building a way of describing and thinking about the world of data is a more fundamental prerequisite than a memorized collection of formulae and computation techniques. "It is essential that students come to understand the difference between the right-or-wrong quality characteristic of most mathematical thinking and the qualified nature of outcomes in statistical analysis." (*Standards*, p.167)

For students without statistical background, the Quantitative Literacy series has many components of an appropriate introduction. This set of materials was developed prior to the recent mathematical reform. The author teams developed materials which do not require a statistical background. Numerous Wisconsin high schools are using part of the series, in particular, the *Exploring Data,* text as an excellent introduction at the ninth grade level - for **all** students.

The standards for high school students are:

In grades 9-12, the mathematics curriculum should include the continued study of data analysis and statistics so that all students can -

- **construct and draw inferences from charts, tables, and graphs that summarize data from real-world situations;**
- **use curve fitting to predict from data;**
- **understand and apply measures of central tendency, variability, and correlation;**
- **understand sampling and recognize its role in statistical claims;**
- **design a statistical experiment to study a problem, conduct the experiment, and interpret and communicate the outcomes;**
- **analyze the effects of data transformations on measures of central tendency and variability;**

and so that, in addition, college-intending students can -

- **transform data to aid in data interpretation and prediction;**
- **test hypotheses using appropriate statistics.** (p. 167)

In considering the above statements, one striking observation is that the student outcomes focus on large scale student activities - not merely reproducing a set of memorized rules or formulae. Computational deficiencies of a high school student *must not* be a screen to stop that person from exploring statistical concepts and uses! Currently, only a few states mandate in any significant way that all high school students should experience statistics as part of their mathematical program (I.e., Wisconsin, California). The ever-expanding use of statistics as a means of communication in our society drives the societal need for exploring statistics with all students.

In several public schools where I visit frequently, the staff start all the ninth grade courses with several weeks of the *Exploring Data* materials. To the surprise of many teachers, the students attack these activities enthusiastically and bring excellent, varied insights to the tasks. Students enjoy taking on tasks where obvious gaps in their mathematical backgrounds are not highlighted constantly. Starting a mathematics course by attacking new problems requiring new mathematics can bring a strong wave of student enthusiasm and self-confidence to the year. Student comments like, "I can do this!' and "I see where we can use this!" are powerful personal realizations for students who have a history of being defeated by the traditional mathematics curriculum. The building of statistical concepts and intuition clearly challenges our traditional linear sequencing of math topics. Teachers I work with continually admit that some of the students they have labeled as poor in mathematics have good, often creative, mathematical capabilities that are overlooked with our obsession to evaluate students on computational efficiency in arithmetic, algebra, and calculus.

The advances in computing technology and the development of exploratory data techniques which are heavily graphical, such as the box plot, present the opportunity for all students to construct data representations and interpret them even though computational limitations are present. As easy to use statistical calculation and graphics tools and programs are becoming available for secondary students, the size and reality of the data set students can handle increases. Students should not be limited to experiments with only a handful of data points because the calculations required would overwhelm any of us!

Student outcomes go beyond calculation techniques. In understanding and applying measures of central tendency and variability, students should be able to obtain such values - often using technology to do the number crunching. After the mastery of such calculation or graphical techniques, students must practice communicating interpretations using the various measures. At this point, our challenge is to help students learn that one measure may be better, or more appropriate, than another to communicate about data in the context of a real problem. E.g., I don't know how to choose an "appropriate" measure of central tendency for a set of meaningless numbers If the numbers have meaning, such as the selling price of new homes, I can consider contextual questions where the median might be better, as well as other questions where the mean would be more appropriate, and also the mode! Students need this contextual experience in order to learn to comprehend the information that society is providing for their personal decision making.

Until the advent of graphics tools, the standard calling for the "use curve fitting to predict from data" was difficult to introduce and have students actively explore. Now students can enter data to have a graphics tool generate a scatter plot. Then, students may "play" with hand sketches of good fit lines, or even curves, to be used in prediction. This "play" encourages consideration of multiple curves and the need to discussion their value in context - including the domain and range, reasonableness of prediction, etc. The purpose and construction of initial curve fittings can be quickly grasped by students in well-constructed meaningful contexts. With appropriate data, a non-linear curve of fit is as natural as a linear one! Only algebraic techniques limit our choices in the traditional expectations. All students can compare their curves of best fit with one generated by a standard computational technique and represented through computer graphics. Examination of the similarities and differences - geometrically - can be discussed by all. For students with adequate algebraic background, the accepted techniques can be analyzed. All students can predict what outlying or extreme data might do to a curve generated under such a rule - some reasoning from the graph, some from numerical data, and others from algebraic representations.

The *Standards*: A Challenge All Students

A closing caution on what the *Standards* are saying, and possible interpretations by those who do not read thoroughly or carefully. Many college faculty members, on hearing about some highlights from the Standards, complain that this calls for a weakening of school expectations. On the contrary, it calls for more mathematics - quantitatively and qualitatively - for all students. Most of the outcomes discussed here are intended for all students - a tremendous increase in the statistics seen by over three-fourths of the current school population! In addition, the college intending students, the only ones ever seen by most college faculty, are challenged to do more in each of the areas addressed. In statistics, college-intending students are expected to test hypotheses with consideration of an appropriate test from the Student's t, Poisson, and chi square. The document anticipates that other nonparametric distributions will become popular and included soon. That's much more than the background students bring to college today. Keep that distinction in mind as you reflect on student expectations generated from the vision presented in the *Standards*.

Resources for your deliberation:

deLange, Jan and Verhage, Heleen. *Data Visualization.* Researchgroup on Mathematics Education OW & OC, University of Utrecht, the Netherlands, 1989 experimental version.

Middle Grades Mathematics Project. *Probability.* Menlo Park, CA: Addison-Wesley, 1986.

NCTM. *Standards for Curriculum and Evaluation in School Mathematics.* NCTM, 1906 Association Drive, Reston, VA 22091. $25.

NCTM. *Teaching Statistics and Probability.* 1981 Yearbook of the Council. (Ed. Albert Shulte). NCTM, 1981.

Quantitative Literacy Series. *Exploring Data, Exploring Probability, The Art and Techniques of Simulation, Exploring Surveys and Information from Samples.* Palo Alto, CA: Dale Seymour Publications, Box 94303.

Stats. The Magazine for Students of Statistics. ASA, 1429 Duke Street, Alexandria, VA 22314.

Teaching Statistics. Longman Group UK Limited, Subscriptions Dept., Fourth Ave., Harlow, Essex, CM19 5AA, ENGLAND.

U.K. Annual Applied Statistics Prize 1988-89

Once again, there were signs of improvement in the standard of entries. In particular, the oldest group (16+ to 19 years) produced more entries of better quality than it had done in previous years. Much then is going well in the realms of statistical education. However, inevitably the Statistics Prize serves to highlight some of the problem areas.

A slightly disappointing trend was observed in that almost all of the entries were in the form of questionnaire-based surveys, to the exclusion of experimental and simulation studies. This may in part be the result of the "suggestions for projects" which is implied in current examination syllabuses. It is however, a sad restriction on the students' understanding of the role and scope of applied statistics.

It is hoped that the Statistics Prize will go some way towards dispelling *four commonly held misconceptions*. The first is that *"Stats. is data collection (full-stop)"*, in other words that it is an amassing of data about anything or everything, with little sense of purpose in its collection. The second misconception is that *"Stats. is art"*. Projects reveal this misconception when they comprise little more than collections of data presentations in varying degrees of technicolour with little attempt to define what is shown by the charts and diagrams. The third problem area is based on the notion that *"Stats. is sums"*. This is manifest in those projects which comprise pages of, often repetitive, computations merely demonstrating the students' abilities to perform like electronic calculators. A further misconception is that *"Stats. is a questionnaire survey."* It may be, but it does not have to be!

When undertaking a research project, it is unwise for students to assume that they are the first to research that area. More attention to existing research studies would be beneficial. For example, some familiarity, gleaned from other related studies, with the range of behavioural indicators of left- and right-handedness, such as arm-folding, using a broom, etc., would preclude a project based on the rather simplistic notion that it is sufficient merely to use a questionnaire item of the kind "Are you left- or right-handed?"

Students are often taught about the relative merits of samples over censuses. For example, they are taught about the possibilities for gains in the reliability and in the amount of information gathered, which consequently increase the efficiency of research. If they are asked to "write short notes on..." different types of sampling methods, or even to state what sampling method they would apply in particular research studies, many of them could give good answers. However, when students actually tackle their own research studies, such knowledge is apparently forgotten. It is rare to see considerations of the research efficiency feature, or evidence of measures to enhance it.

Results, 1988-1989

Winning the 9 to 13 years age group was Broadclyst's entry, "Safety in a child's environment". This was a lively, wide-ranging project incorporating secondary hospital and accident data, together with primary data based on the pupils' investigation of hazards in their homes, their school and the environment. The experiments and equipment which they used to test various aspects of slipping and skid-resistance in shoes and floor surfaces were impressive.

Commended entries in the same age group with the Ryhope School Census and Moore CP School seeking evidence in support of reopening a local railway line. Also deserving a mention was Cooper Perry's Parish Review which was a reasonably comprehensive survey of parish involvement and demographic characteristics, taking advantage of a local survey which was already being conducted.

In the 13 to 16 years age group, Braunton School won with a nice set of experiments on illusions, some of which are described in the school's Council booklet "Seeing is Believing". It would have been nice if they had given more attention to a further experiment on reading instructions. Hewett School were commended for their attempt to link the percentages of drivers disobeying certain motoring rules with the responses to a questionnaire about traffic congestion.

Winners in the 16 to 19 years age group were Saffron Walden. They carried out an empirical comparison of various voting systems. More consideration of particular voting strategies adopted when voters have knowledge about the nature of the voting system would have been interesting.

In the same age group, Bexhill College's evaluation of recorded crime was used to draw comparisons between the data for Bexhill itself and those for the rest of Sussex. The study was commended but adjudicators would have liked the team to say more about the definitions of the offences which they included in their study. Crompton House was commended for their trade analysis for 1985 to 1988 which led to a useful collaboration with a local manufacturing firm and won them the prize for the best use of a computer in an applied statistics project.

– – Anne Hawkins

BOOK REVIEW

ELEMENTARY STATISTICS (4th Edition) by Mario F. Triola, Benjamin/Cummings Pub. Co., 1989.

This text is an excellent version of the classic textbook for the standard high school or elementary college (non-calculus based) course. It is well written and is stocked with brief readings on the uses and abuses of statistical thinking. Definitions, formulas and examples are highlighted throughout the book. There is a wide variety and a more than sufficient number of problems for every topic. The audience for the book is identified by the author as "non-mathematics students" and I would have rated this as a superior book for that audience five years ago – before being introduced to Quantitative Literacy.

Stem-and-leaf plots and box plots were added in the Third Edition. No effort was made in this newest edition to expand the use of these valuable EDA techniques. Triola's description of stem-and-leaf plots is brief but thorough. Unfortunately the stem-and-leaf technique is not used throughout the book to examine distributions, this despite the fact that the stem-and-leaf is an excellent tool for displaying characteristics of distributions, especially for "non-mathematics students".

Box plots are discussed briefly and only after variation has been discussed at length. The box plot and interquartile range are excellent introductions to the concept of variation. Thus, it would make sense for the author to introduce box plots before examining the computational measures of variation such as variance and standard deviation. Also, the author uses "hinges" rather than quartiles for the ends of the box. He notes this difference but does not explain the reason for the change.

The median fit line is not mentioned in the text and simulations are used only once, and that in a Case Studies Activity. The use of simulations to develop the concepts of probability and hypothesis testing should be well known to the author. Given the audience for whom Triola is writing it is unfortunate that he has chosen to avoid the use of simulations.

The best example of what is wrong with the book is found in Chapter 2. Much time is spent discussing the rules for constructing frequency distributions by class. Experience has shown that this is a turn-off to the "non-mathematics student". In the hands of a teacher familiar with Quantitative Literacy and able to supplement this book with the use of median-based statistics and simulations, Triola's text would be a stimulating resource. Otherwise it is simply a well-written example of a less than adequate approach to teaching a vital subject.

– – Murray H. Siegel

A THREE DICE CASINO GAME

As part of a team project, two students in my Probability and Statistics class devised this interesting (and perhaps deceptive) casino game:

> A player pays $3 for the privilege of playing the game. Player rolls three dice. If the number of 3's showing is one the player wins $5; if there are two 3's the player wins $10; if there are three 3's the player wins $100.

The game is interesting because

(a) it can be played by students in an attempt to determine who (player or casino house) it favors;

(b) one can determine the theoretical expectation for a player (or the casino house);

(c) it can be simulated with a simple computer program. (My students were fascinated by "how close" the computer results came to the theoretical expectation when the computer simulated thousands of games.)

I leave it to the reader to explore the game and come to his or her own conclusions. If the reader would like a computer (Apple) simulation of this game and thirty Quantitative Literacy simulations, these can be obtained by sending me a blank diskette and a self-addressed, stamped envelope. I will copy the programs on the blank diskette and return it to you.

– – Sanderson M. Smith
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QUALITY AND PRODUCTIVITY PRIZE

High school students believe many myths about the subjects they study in school. One of these is that statistics, mathematics, and science will not be relevant to the "real world" after graduation. Such beliefs are intellectual time bombs that will substantially hamper economic success, both on a national and individual level. today American industry spends millions annually training employees from the shop floor to the boardroom in statistical thinking and scientific problem solving. Unfortunately much of this training is remedial in nature because few people are exposed to these "intellectual technologies" during their formal education. Thus corporate executives are emphasizing the need for a statistically knowledgeable and scientifically literate workforce. Nobel Laureate and AT&T Vice President Arno Penzias, for example, called for the statistical education of engineers in the June 2, 1989 issue of the prestigious journal *Science.* Alcoa CEO Paul H. O'Neill puts the issue into a broader perspective:

> As world competition intensifies, understanding and applying statistical concepts and tools is becoming a requirement for *all* employees. Those individuals who get these skills in school will have a real advantage when they apply for their first job.

To provide students with an appreciation of the usefulness of statistical tools in the workplace, the Section on Quality and Productivity and the Center for Statistical Education of the American Statistical Association (ASA) has established a Scholastic Prize. This program is for grades 7 through 12. A copy of MINITAB Statistical Software, donated by MINITAB, Inc., will be awarded to five schools given based on random drawings.

A school's chances to win are based on points earned for a wide variety of activities including: in-class presentations; science fair projects; business involvement including plant tours; cooperation with other schools; and linking the use of statistical tools in industry with the process of scientific problem solving. **Entries are due by May 1, 1990.** A detailed brochure is available from The Center for Statistical Education, American Statistical Association, 1429 Duke Street, Alexandria, VA 22314.

– – David Fluharty

ILLINOIS INSTITUTE FOR STATISTICS EDUCATION

The Illinois Institute for Statistics Education (IISE) will hold a three-week summer workshop on the teaching of statistics for middle school and high school teachers, July 2-20, 1990, at the University of Illinois, Urbana-Champaign.

The IISE summer program, funded by the National Science Foundation, is open to school district teams of 3-5 teachers. The workshop staff is made up of UIUC faculty in statistics and mathematics education, classroom teachers and computer specialists. Team members may teach mathematics or another field that uses statistics.

Graduate credit, housing, meals, transportation, and stipends are provided for summer participants. For details, contact: Dr. Janny Q. Travers, IISE Program Coordinator, UIUC Department of Statistics, 725 S. Wright Street, Champaign, IL 61820. 217/244-7284. **DEADLINE FOR APPLICATIONS – March 1, 1990.**

WOODROW WILSON SUMMER INSTITUTES

The Woodrow Wilson National Fellowship Foundation has announced nine summer institutes in statistics for secondary teachers. The institutes, dates, and person to contact about that institute are:

Los Angeles, CA: July 30-August 3, Ms. Toby Bornstein, 213-622-5237

Louisville,KY: August 6-10, Dr. Wiley Williams, 502-588-6826

Baltimore, MD: June 18-22, Tony Barnes, 301-396-9361

Marquette, MI: June 25-29, Dr. Phillip Larsen, 906-227-2002

Kearney, NE: July 9-13, Dr. Charles Pickens, 308-234-8531

Purchase, NY: June 25-29, Dr. Carlo Parravano, 914-251-6691

Murfreesboro, TN: July 16-20, Dr. George Beers, 615-898-2669

Kingsville,TX: July 23-27, Dr. Dwight Goode, 512-595-3189

Arlington, TX: July 30-August 3, Dr. Eddie Warren, 817-273-3261

Information about institutes in other areas can be obtained from Dr. Janet Gnall, Woodrow Wilson National Fellowship Foundation, 330 Alexander St., Box 642, Princeton, NJ 08542.