THE STATISTICS TEACHER NETWORK

June 1988 Issue #18

A newsletter published three times a year by the American Statistical Association-National Council of Teachers of Mathematics Joint Committee on the Curriculum in Statistics and Probability.

THE SECOND ANNUAL AMERICAN STATISTICS PRIZE COMPETITION

Winners of the 1988 statistics contest sponsored by the Center for Statistics Education have been announced by the contest director, Mr. Dwayne Cameron. Entries were received from Vermont to Colorado and from Wisconsin to Texas with two entries being submitted from Canada. Publicity efforts on the part of the contest sponsors were rewarded with a greater number of entries than were received for the first contest held last year. However, the majority of the projects were still from the senior high division. Thus, Mr. Cameron is encouraging elementary and middle school teachers who are involved in teaching mathematics to consider submitting a project in next year's competition.

Competition results are as follows:

Grades 4-6 - $300.00 prize
Bloomfield Hills Middle School
Bloomfield, MI 48013
Advisors: Mr. Tim Loula, Mr. T. Gardella
Students: Anand Shivnani, Sridhar Kaza, Paul Fredenberg, and Ben Adida

Student Testing and Recording

In this project the students created a standardized mathematics exam and administered it to all the sixth graders in the school. After collecting the data, the students used graphing techniques such as bar charts and line graphs to analyze it.

Grades 7-9 - $300.00 prize
Public School Number Seven
Paterson, NJ 07501
Advisor: Ms. Gloria Hagopian
Students: Orlando Anaya, Pedro Semidey, and Lasko Veskov

The Role of the Sexes in TV Commercials

The students were interested in whether more men than women have leading roles in television commercials. They designed a database and spreadsheet using Appleworks to help them analyze the data.

Grades 9-12 - $300.00 prize
Willowbrook High School
Villa Park, IL 60181
Advisor: Mrs. J. Hayman
Students: Cathy and James Oczkowski

Probability of Family Groupings

The project investigated the relationship between sex and birth order. Hypothesis testing was conducted using chi-square on an Apple Computer, and the results indicated that the sex of the children is not randomly distributed as the family size increases.

Computer - $100.00 prize
Edgewood High School
Madison, WI 53711
Advisor: Mr. Peter Barbella
Students: Margaret Annen, Jennifer Fiss, Thomas Hester, and Kathleen Ley

Sex Differences in Mathematics Grades

One question raised by the students in this study was whether there were more males than females in mathematics classes. A computer was employed to establish the database, create a simulation, and check theoretical probability. EDA techniques were also applied to describe the results.

For further details concerning the winning entries of the contest or information about next year's competition, please contact:

-Dwayne Cameron
Old Rochester Regional School Dist.
135 Marion Road
Mattapoisett, MA 02739

GUIDELINES FOR TEACHING STATISTICS

The Advisory Committee for the second Quantitative Literacy Project has developed a framework for teaching statistics in the K-12 curriculum. The final version will eventually contain a set of principles which form the philosophy of quantitative literacy, a set of core curricular objectives which should be a part of the content for every student at every level, and a set of specific objectives for individual grade level clusters including examples and references to appropriate supplementary materials.

The Advisory Committee is seeking input on these objectives and would welcome comments or suggestions. Recommendations may be sent to Richard Scheaffer, Department of Statistics, University of Florida, Gainesville, Florida 32611

Draft versions of the principles and core objectives are as follows:

PRINCIPLES FOR TEACHING STATISTICS

1. Learning should be active, not passive, focused on asking questions about something in the students' environment and finding quantitative ways to answer the questions.
2. Problems should be approached in more than one way with an emphasis on discussion and evaluation of the different methods.
3. Real data should be used whenever possible in any statistics lesson.
4. Traditional topics in statistics should not be taught until students have experienced and worked with simple counting and graphing techniques and have established a foundation for those traditional ideas.
5. The emphasis in teaching statistics should be on good examples and building intuition, not on probability paradoxes or using statistics to deceive.
6. Topics should be presented in ways designed to give students hands-on experience in working with data.
7. Student projects should be an integral part of all statistics work.
8. The emphasis in all work with statistics should be on the analysis and the communication of this analysis, not on a single answer.
9. Statistics should not be taught as a separate unit. Rather, it should be introduced whenever appropriate to illustrate and expand upon standard concepts and to form interdisciplinary links for students.
10. The progression should be from the concrete to the pictorial to the abstract.

CORE OBJECTIVES

I. Gathering data, exploring it, and interpreting the results
   - A. Quantifying questions and understanding the problem
   - B. Gathering data
     1. Gathering data based on student interest and experience
     2. Gathering data to answer a question
     3. Selecting an appropriate method to record data
   - C. Organizing data
   - D. Describing data
     1. Analyzing the center of a set of data
     2. Analyzing variation in a set of data
     3. Comparing the variation in several sets of data
     4. Analyzing the association between two variables
     5. Transforming data and analyzing what this does to descriptive measures
   - E. Interpreting data

II. Formulating statistical inferences
   - A. Planning and conducting experiments or surveys with random numbers
   - B. Evaluating and interpreting results
   - C. Analyzing the use of statistics in society

III. Calculating the probability of simple events
   - A. Using probability as a measure of chance
   - B. Interpreting probabilities
   - C. Simulating events
   - D. Finding compound probabilities

QUANTITATIVE LITERACY UPDATE

The first Quantitative Literacy Workshop will be held June 20-24, 1988 at Lake Forest College, Lake Forest, IL. Participants representing junior and senior high schools from the Chicago area will spend the week learning techniques for teaching statistics in their classrooms using the materials developed in Quantitative Literacy I and drafts of new materials dealing with making statistical inferences through simulation and with experimental design.

The workshop leaders will be Richard Scheaffer, University of Florida; Ann Watkins, Pierce College; Kenneth Sherrick, Berlin High School; and Gretchen Davis, Santa Monica High School. Several area statisticians will also serve as consultants and advisors to the participants.

During the fall of 1988, follow-up sessions will be held to assist the participants as they begin to implement the ideas in their classrooms and to reinforce and extend the concepts they learned in the summer session.

Five workshops will be scheduled for the summer of 1989. Site selection will be made in the fall of 1988. If you have a site suggestion, contact:

-Gail Burrill
5000 South 116 Street
Greenfield, WI 53228

WOODROW WILSON MINI INSTITUTES

The Woodrow Wilson National Fellowship Foundation will again sponsor a series of mini institutes on statistics during the summer of 1988. For more details, contact Janet Gnall, WWNFF, PO Box 648, Princeton, NJ 08542. The location, dates, and contact are:

June 20-24, 1988
Dallas/Fort Worth, TX
Ms. Bonnie Dickinson
(817) 927-0609

June 27-July 1, 1988
Minneapolis, MN
Dr. Harvey Keynes
(612) 625-2861

July 11-15, 1988
St. Louis, MO
Dr. Paul Markovits
(314) 553-5650

July 18-22, 1988
Baltimore, MD
Mrs. Alice Morgan-Brown
(301) 396-8622

July 25-29, 1988
Purchase, NY
Mr. Stewart Lyons
(213) 475-3737

August 1-5, 1988
Purchase, NY
Dr. Carlo Parravano
(914) 253-5155

August 1-5, 1988
College Station, TX
Dr. James McNamara
(409) 845-7588

AMERICAN STATISTICAL ASSOCIATION NAMES EXECUTIVE DIRECTOR

Barbara Bailar has been appointed Executive Director of the American Statistical Association. Dr. Bailar comes to ASA from the Census Bureau where she served as Associate Director for Statistical Standards and Methodology from 1979 until 1988.

Dr. Bailar received a B.A. in mathematics from the State University of New York, an M.S. in statistics from VPI, and a Ph.D. in statistics from the American University in Washington, D. C. She began her career with the Census Bureau in 1958 as a statistician and progressed during her 29 years there to the highest technical level position at the Bureau. During this time she also taught statistics at the U.S. Department of Agriculture Graduate School and George Washington University.

Dr. Bailar is President-Elect of the International Association for Survey Sampling, a Fellow of ASA and AAAS and an elected member of the International Statistical Institute. She has numerous publications and has refereed for a variety of scientific journals. She resides in Washington, D.C. with her husband, John, and daughter, Melissa.

LETTERS

PLEASE WRITE TO THE EDITOR IF YOU WOULD LIKE TO SHARE ANNOUNCEMENTS, BOOKS, ARTICLES, IDEAS, OR LESSONS THAT HAVE BEEN SUCCESSFUL IN YOUR CLASSROOM.

For over 65 years, national organizations have recommended that topics in statistics should be included in the high school curriculum. Despite this, a recent survey illustrates that only a few American high schools now offer a significant amount of instruction in this area.

In a 1987 survey of all Ohio high schools, 289 schools responded to a questionnaire that collected information on the role of probability and statistics in the schools' curriculum. Only about 20% of these schools reported that they currently offer a course in probability and statistics. In the schools which do offer such courses, the typical topics included are descriptive statistics, elementary probability, and the binomial and normal distributions. In about 75% of these courses, some topics on elementary inference are discussed. More importantly, in 25% of these courses, no time is spent discussing statistical inference. Approximately 50% of these courses cover correlation and chi-square tests, while regression is covered in less than one third of the courses. Surprisingly, only 40% of these courses use the computer. Approximately 15% of those surveyed reported a plan to introduce a separate course in probability and statistics in the near future.

On the other hand, 75% of the schools reported teaching some probability or statistics in other math courses. Typically, this means that descriptive statistics is included in a General Math course, and some elementary probability is taught in Algebra II or Precalculus. Less than 20% of the schools reported teaching any statistical inference topics, such as confidence intervals or hypothesis testing, outside of a separate probability and statistics course.

Judging from the results of this survey, it appears that we are a long way from meeting the goals that have been set by the various curriculum reform groups. Programs designed to narrow this gap must include broad based teacher re-training, as well materials development. For further information, please contact:

-David Kullman or John Skillings
Dept. of Mathematics & Statistics
Miami University
Oxford, Ohio 45056

I enjoy receiving the Network and fully support the movement toward increased attention to probability and statistics in the schools. Something in the March 88 issue troubles me, though. In the description of Kim Meyer's prize-winning work. you relate, "...students spending at least 3 hours a week using the computer did significantly better in school than those who did not."

There are two aspects of my concern. First, "significant" in statistics does not mean "important". With a large sample size, a null hypothesis of $\text{mean}_x < \text{mean}_y$ may be rejected at the 5% level of significance with, say $x = 2.68$ and $y = 2.62$, if the sample variances are small enough. However, such a difference in GPA's would hardly be considered important. Secondly, interpretation of the results is not mentioned, so this may not be a criticism at all. I would be very troubled, though, if it were concluded, on the basis of Kim's study, that students can improve their GPA's by starting to use a computer at least 3 hours a week. Do the students who already routinely use computers come from more favorable socioeconomic backgrounds? If so, that (with all of its other ramifications) is likely to be a stronger influence than computer use.

I am certain that Ms. Resnick is doing an admirable job, and these comments are not intended to detract from that. Incidentally, I think that all students would be encouraged to use calculators and computers routinely.

-Barry W. Brunson
Department of Mathematics
Western Kentucky University
Bowling Green, Kentucky 42101

SUGGESTIONS FOR DESIGNING A HIGH SCHOOL STATISTICS COURSE

As a result of the work of the Joint Committee and the NCTM Commission on Standards for School Mathematics, many mathematics teachers and supervisors across the nation are now actively engaged in developing a single semester course in probability and statistics which highlights not only traditional statistics, but also the newest techniques featured in the QL Series. The response to this challenge at Texas A&M University led to the development of a single course that integrates these two domains.

Our strategy allocates each of 30 one hour classes to a single topic. Sequencing requires teachers to use two specific design rules. Rule one requires that the exploratory data techniques be introduced first. Once these median-based methods are adequately covered using the QL materials, teachers may introduce traditional topics emphasizing mean-based procedures. Rule two requires teachers to use both the EDA and the traditional techniques on each problem studied. Solutions should be compared and contrasted to illustrate three points. First, both strategies almost always yield similar solutions. Second, students quickly learn that many EDA methods are often simpler and quicker to use and that the plots are easier to interpret. Third, using both strategies gets students beyond the notion of seeking the "one true answer" and toward exploring properties of data, asking questions, and justifying how they reach conclusions.

The 30 topics are distributed over six units. Unit one consists of 7 classes using the QL module Exploring Data. Topics include line plots, stem-and-leaf plots, comparative stem-and-leaf plots, medians and quartiles, interquartile range, box plots, and comparative box plots. Unit two consists of 4 classes taught from a traditional statistics text which introduces measures of central tendency, measures of variability, traditional graphic techniques, and the normal distribution. Adherence to rule two allows students to compare the relative merits of histograms and stem-and-leaf plots to reveal the central tendency, variability, and shape of a distribution.

Units three (4 classes) and four (3 classes) shift the emphasis from univariate to bivariate distributions. From QL module 1, students learn how to design and interpret scatter plots, time series plots, median-lines on scatter plots, and smoothing plots over time. Topics covered in the fourth unit include the traditional topics of correlation coefficients, simple linear regression, and multiple linear regression using two predictor variables. Following rule two allows the opportunity to compare the slope estimate generated by a median-fit line with the one obtained from a simple linear regression.

Unit five consists of 6 classes and uses the simulation and sampling books from the QL Series to explore the eight-step simulation model, probability and guessing strategies, sampling distributions, 90% box plots, confidence intervals, and an overview of sampling and estimation methods used in national polls. Unit six returns teachers to the traditional topics of sampling distributions and standard error, confidence intervals, hypothesis testing, t tests, chi-square tests, and one-way analysis of variance models. Applying rule two again, one comparison procedure we have employed uses box plots to analyze the data sets used in t test and analysis of variance models.

A 1988 NCTM paper detailing this and other experimental strategies for teaching statistics is available from:

-James F. McNamara
Texas A&M University
College Station, TX 77843

WHERE TO WRITE

Address all letters, announcements, questions, articles being submitted for publication, and requests to get on or off of the mailing list to the editor:

-Beth Bryan
Department of Math & CSC
Augusta College
Augusta, GA 30910

DON'T LET THIS PASS YOU BY...

...The October 30, 1987 issue of the journal Science. The article, "Teaching Reasoning", by Nisbett, Fong, Lehman, and Cheng focuses on whether people carry over the methods of reasoning they have learned from courses to everyday life events. Happily, they report a qualified "yes" for certain types of statistical reasoning. For example, they refer to a study that examined the effects of statistical education "on answers to a problem asking subjects to explain why a traveling saleswoman is typically disappointed on repeat visits to a restaurant where she experienced a truly outstanding meal on her first visit. Subjects who had no background in statistics almost always answered this question with exclusively nonstatistical, causal answers such as 'maybe the chefs change a lot' or 'her expectations were so high that the food couldn't live up to them.' About 20% of the time, subjects who had taken one statistics course gave answers that included statistical considerations, such as 'very few restaurants have only excellent meals, odds are she was just lucky the first time.' Beginning graduate students in psychology, who had taken one to three courses in statistics, gave statistical answers about 40% of the time. Doctoral level scientists at a research institution gave statistical answers about 80% of the time. (Though we do not wish to create the impression that these scientists would necessarily think in statistical terms so often in real life contexts! In this case, performance in the laboratory undoubtedly outstrips competence in the world.)"

Another study reported in this article concerned opinions about sports. "The subjects were males who were enrolled in an introductory statistics course at the University of Michigan. Some subjects were randomly selected and 'surveyed' during the first two weeks of the term, the others at or near the end of the term. In addition to filler questions on NCAA rules and NBA salaries, subjects were asked questions for which a statistical approach was relevant. For example, they were asked to explain why the rookie of the year in baseball usually does not perform as well in his second year. Most subjects answered this question in a purely nonstatistical way, invoking causal notions such as 'too much press attention' and 'slacking off.' Some subjects answered the question in a partly or completely statistical way. For example, 'there are bound to be some rookies who have an exceptional season; it may not be due to any great talent advantage that one guy has over some of the others - he just got a particularly good year.' The statistics course markedly increased the frequency and quality of statistical answers to this question and to two of four other questions that were asked."

-Jim Landwehr
Summit, NJ

FROM THE PRESIDENT'S DESK

In the April, 1988 issue of AMSTAT NEWS, Dr. Bob Hogg in his column, "President's Remarks", commented favorably on the work of the Joint Committee and, in particular, the QL Forum held in Minneapolis last January with support from the Minnesota Mathematics Mobilization. To quote Dr. Hogg, "It was a super program, and we should be very proud of Dick Scheaffer, Jim Landwehr, and Ann Watkins for their presentations. Gail Burrill, Tom Meskel, and Martha Wallace had organized the program and made super arrangements. My thanks to all of them."

Dr. Hogg discussed the talks by Brian Joiner and John Dossey, the President of NCTM. Brian's topic, "Who should teach statistics in the schools?", included his version of the Deming and Joiner triangle: Quality, Scientific Approach, and All One Team. His conclusion - "the math teachers" included another intriguing question, "Who should teach the teachers?" Dr. Dossey compared our mathematics program to those of other countries. The latter appear to cover more mathematical material in their high schools while our stress on repetition and review results in bored students and poor retention in advanced math courses. One of Dr. Dossey's suggestions for remedying the situation is to introduce more of the QL topics into the mathematics curriculum.