NATIONAL COUNCIL OF TEACHERS OF MATHEMATICS

American Statistical Association

The Statistics Teacher Network

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Are you a statistic?

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If you are a middle or high school mathematics teacher, do you have enough time to thoroughly teach the curriculum you have been given? If you teach younger students, do you cover all the topics that are assigned to your grade level in all the subjects? If you do, please let me know and I would like to talk to you because you might be the only one in the country able to do so! Don't feel badly. None of us can ever do everything we want to do. The bells ring. Assemblies call. Kids are sick. What are we to do?

...Only the best we can.

The National Council of Teachers of Mathematics (NCTM) in its 2000 *Principles and Standards for School Mathematics* defined four general topics in Data Analysis and Probability for each of four grade bands. (See the next two pages for a complete overview.) The Statistics Teacher Network, a joint venture of the American Statistical Association and the NCTM created this newsletter to help teachers at all levels prepare students to become statistically literate and adept at data analysis and probability.

Also In This Issue...

Here are a few sample activities:

1. Have your Pre-K or K students take something familiar and find the attributes. If you start with something simple, say gloves vs. mittens, or tie shoes vs. buckle or velcro, you can have some good discussions using vocabulary such as “same and different.” Using the children's apparel also gives them more ownership in the activity. Sorting these items on a mat on the floor, or using circles of the “hula hoop” variety can provide the visual foundation for the Venn diagram. These items can then be replicated on paper and glued on a class chart that captures the information. (The teacher could have paper models available). By doing this, students “sort and classify objects according to their attributes and organize data about the objects.” (NCTM, 2000)

2. Have your grade 1 and 2 students collect tops from recycling materials to analyze. Plastic bottle caps from sodas, orange juice, milk and other plastic cartons, or the pop tabs from aluminum cans may be used. Ask young students to sort them and glue them on large-square graph paper in columns to create a graph. By doing this, students are also “sorting and classifying objects according to their attributes and organizing data about the objects.” (NCTM, 2000) This activity also reinforces students’ awareness of recycling!

3. Have your upper elementary students survey their classmates to determine what are the most and least favorite food items in the school cafeteria. This could be a project involving several pieces of data. How many children brought lunch from home? How many purchased the regular or alternate lunches? Data could be kept for several weeks.

Surveys could also explore children's likes and dislikes. What new foods would the children suggest for cafeteria fare? This information could then be presented to the food service manager. When they do this they are collecting “data using observations, surveys, and experiments.” Their written and oral presentations support important benchmarks in other fields, too, and give students an empowerment that upper elementary students need.

(continued on page 4)

Feature Article...

What We Need to Consider...

Data Analysis and Probability Standard for Grades Pre-K-12

NCTM, 2000

Expectations

Instructional programs from prekindergarten through grade 12 should enable all students to—

In prekindergarten through grade 2 all students should—

■ formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them

■ pose questions and gather data about themselves and their surroundings

■ sort and classify objects according to their attributes and organize data about the objects

■ represent data using concrete objects, pictures, and graphs

■ select and use appropriate statistical methods to analyze data

■ describe parts of the data and the set of data as a whole to determine what the data show

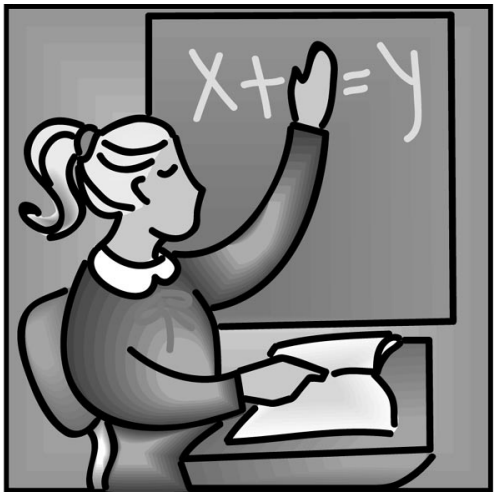
■ develop and evaluate inferences and predictions that are based on data

■ discuss events related to students' experiences as likely or unlikely .

Expectations

In grades 3-5 all students should—

■ formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them



■ design investigations to address a question and consider how data-collection methods affect the nature of the data set

■ collect data using observations, surveys, and experiments

■ represent data using tables and graphs such as line plots, bar graphs, and line graphs

■ recognize the differences in representing categorical and numerical data

■ select and use appropriate statistical methods to analyze data

■ describe the shape and important features of a set of data and compare related data sets, with an emphasis on how the data are distributed

■ use measures of center, focusing on the median, and understand what each does and does not indicate about the data set

■ compare different representations of the same data and evaluate how well each representation shows important aspects of the data

■ develop and evaluate inferences and predictions that are based on data

■ propose and justify conclusions and predictions that are based on data and design studies to further investigate the conclusions or predictions

■ understand and apply basic concepts of probability

■ describe events as likely or unlikely and discuss the degree of likelihood using such words as certain, equally likely, and impossible

■ predict the probability of outcomes of simple experiments and test the predictions

■ understand that the measure of the likelihood of an event can be represented by a number from 0 to 1.

Expectations

In grades 6-8 all students should—

■ formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them

■ formulate questions, design studies, and collect data about a characteristic shared by two populations or different characteristics within one population

■ select, create, and use appropriate graphical representations of data, including histograms, box plots, and scatterplots

■ select and use appropriate statistical methods to analyze data

■ find, use, and interpret measures of center and spread, including mean and interquartile range

■ discuss and understand the correspondence between data sets and their graphical representa-

tions, especially histograms, stem-and-leaf plots, box plots, and scatterplots

■ develop and evaluate inferences and predictions that are based on data

■ use observations about differences between two or more samples to make conjectures about the populations from which the samples were taken

■ make conjectures about possible relationships between two characteristics of a sample on the basis of scatterplots of the data and approximate lines of fit

■ use conjectures to formulate new questions and plan new studies to answer them

■ understand and apply basic concepts of probability

■ understand and use appropriate terminology to describe complementary and mutually exclusive events

■ use proportionality and a basic understanding of probability to make and test conjectures about the results of experiments and simulations

■ compute probabilities for simple compound events, using such methods as organized lists, tree diagrams, and area models

In grades 9-12 all students should—

■ formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them

■ understand the differences among various kinds of studies and which types of inferences can legitimately be drawn from each

■ know the characteristics of well-designed studies, including the role of randomization in surveys and experiments

■ understand the meaning of measurement data and categorical data, of univariate and bivariate data, and of the term variable

■ understand histograms, parallel box plots, and scatterplots and use them to display data

■ compute basic statistics and understand the distinction between a statistic and a parameter

■ select and use appropriate statistical methods to analyze data

■ for univariate measurement data, be able to display the distribution, describe its shape, and select and calculate summary statistics

■ for bivariate measurement data, be able to display a scatterplot, describe its shape, and determine regression coefficients, regression equations, and correlation coefficients using technological tools

■ display and discuss bivariate data where at least one variable is categorical

■ recognize how linear transformations of univariate data affect shape, center, and spread

■ identify trends in bivariate data and find functions that model the data or transform the data so that they can be modeled

■ develop and evaluate inferences and predictions that are based on data

■ use simulations to explore the variability of sample statistics from a known population and to construct sampling distributions

■ understand how sample statistics reflect the values of population parameters and use sampling distributions as the basis for informal inference

■ evaluate published reports that are based on data by examining the design of the study, the appropriateness of the data analysis, and the validity of conclusions

■ understand how basic statistical techniques are used to monitor process characteristics in the workplace

■ understand and apply basic concepts of probability

■ understand the concepts of sample space and probability distribution and construct sample spaces and distributions in simple cases

■ use simulations to construct empirical probability distributions

■ compute and interpret the expected value of random variables in simple cases

■ understand the concepts of conditional probability and independent events

■ understand how to compute the probability of a compound event.

From the editor:

A bit of introduction—The American Statistical Association—National Council of Teachers of Mathematics Joint Committee on Curriculum in Statistics and Probability for Grades K-12 (whew, quite a title) have honored me by giving me an opportunity to edit the Statistics Teacher Network. I wish to thank them for their trust and Jerry Moreno for doing this task for many years. I am so pleased that Murray Siegel is continuing as the associate editor and hope that he will keep STN and me on the right path.

Who am I? I am in my 31st year of teaching. This year I enjoy the company of high school students during the day, and university students at night. Before this I spent 27 years in public and private schools, urban and suburban, teaching primarily grades 3-8. I LOVE data analysis (statistics) and probability. Oh, maybe not so much when I was trying to pass doctoral level courses in probability! I went to University of Pittsburgh and studied elementary education and mathematics. Then I earned an MA at Columbia Teachers College in math education, and finished with a PhD in curriculum and instruction at Kent State University. At a later time I will tell you about some wonderful mentors at these institutions. So you see, I am a practicing teacher (I still don't always get it right), just like the audience of this publication.

What I envision for this newsletter is a way to get interesting, practical, and successful activities for teaching data analysis and probability into teachers' hands. Along with this, I hope that organizations will tell us about upcoming events, publishers will let us review their books, and other companies will give us an opportunity to preview their materials that support the NCTM *Standards*. Occasionally, research done in these areas may have implications for the classroom teacher and I hope that university-type people will send along abstracts and summaries for our dissemination.

What can you do? If you have any great ideas, projects, or worksheets that relate to one of the NCTM Standards at any grade level and can be shared with your colleagues, choose a level and a Standard (see inside pages.) Send an abstract or summary of what you propose to write to me at *STNeditor@aol.com* I will get back to you about possible publication. You don't need to be a "writer," as someone can help you refine an idea or put one into better shape. Anyone willing to help edit? Those of you who teach Advanced Placement Statistics are urged to submit ideas that relate what you are doing to what high school teachers in "regular" math and other subjects can do to support statistical literacy.

Thanks in advance for your efforts. I hope you like what you see. If not, help me make this newsletter into something interesting and useful for you.

Beth Lazerick

Are You a Statistic? *(continued from page 1)*

4. What about having middle school students compare temperature variation in various towns? Recording the high and low temperatures from the previous day, and perhaps graphing the room temperature, can be an interesting 3-part line graph. (Red line for connecting the highs, blue for the lows, and green for the room temperature.) It makes for a practical exercise in graph reading. "On what day did the outside temperature first match or surpass the room temperature?" "What was the lowest temperature during October?" This could be expanded to include temperatures in various cities. What if tables or teams of students each picked a city to graph for several weeks? It would be interesting to compare Anchorage, Alaska; Honolulu, Hawaii; Washington, DC; etc. This can be part of science or geography class, using map skills and climatic zones.

Needless to say, it would involve using the newspaper or television to find the temperature information.

5. High school students can certainly follow the upcoming elections and discuss polling and random samples. U.S. history as well as math classes can "explore the variability of sample statistics from a known population and construct sampling distributions."

As a former classroom teacher, administrator in a central office mathematics department, and currently a school principal, this writer will certainly attest to the many occasions that data analysis and probability enter the curriculums at all levels and in all subjects. The chances that you will encounter some statistical idea in your teaching during the next week or month are high. You can bet on it!!!

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