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NCTM NATIONAL COUNCIL OF TEACHERS OF MATHEMATICS

The Statistics Teacher Network

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The Editor's Corner

This issue features a timely article by Lawrence Lesser, titled "Supporting Learners of Varying Levels of English Proficiency." Many students across our nation speak a language other than English as their primary language. This can pose interesting challenges in the statistics classroom.

We also have an update from the 2010 Joint Statistical Meetings in Vancouver, British Columbia, by Deborah Lurie. She reports on a panel session that focused on preparing statistics educators.

Finally, I wrote an article describing a second- and third-grade statistics project making use of time series data and incorporating statistical and other mathematical topics. This project is simple to implement and was a big hit with the students and teachers at the school that piloted it.

I encourage and welcome any articles or ideas you have to be considered for publication. Please email me directly at *dwebb@bemidjistate.edu*.

Best Regards,

Derek Webb, Editor
Bemidji State University

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Also in this issue …

Articles

Supporting Learners of Varying Levels of English Proficiency

Lawrence M. Lesser, The University of Texas at El Paso

According to Claude Goldenberg, who wrote the 2008 *American Educator* article "Teaching English Language Learners: What the Research Does—and Does Not—Say," the fraction of United States public school K–12 students who are English language learners (ELLs) has gone from 1 in 20 (in 1990) to 1 in 9 (today), and is projected to be 1 in 4 in another 20 years. This changing population poses distinctive challenges—and opportunities—for K–12 teachers of mathematics and statistics.

Lawrence Lesser and Matthew Winsor cite in their 2009 *Statistics Education Research Journal* article, "English Language Learners in Introductory Statistics: Lessons Learned from an Exploratory Case Study of Two Pre-Service Teachers," studies that show students of all levels of English proficiency (i.e., not just ELLs) struggle to navigate situations in which a term has a different use in everyday speech than it does in a specific academic field. So, teaching in a more ELL-friendly way also will be appreciated by the rest of the class. Here are 10 concrete recommendations:

#1: Identify and explicitly distinguish important words that are highly similar in sound and/or appearance.

The most blatant example is that the mode, median, and mean are typically introduced during the same day's lesson on numerical measures of location. Some students may be further confused by the similarity of other words such as medium and middle.

#2: Identify words with a (possibly different) "everyday meaning," so they can be explicitly distinguished.

Examples include random, confidence, population, bias, independent, normal, and significant. The everyday word "average" is vague—sometimes used to refer to the mean, sometimes to the median, etc. Beyond everyday language, the same word can even have different meanings in different academic contexts. For example, the "range" (of a data set) in a high-school statistics class has nothing to do with the "range" (of a function) in high-school algebra. Also, see the 2010 *Journal of Statistics Education* article by Jennifer Kaplan, Diane Fisher, and Neal Rogness, titled "Lexical Ambiguity in Statistics: How Students Use and Define the Words Association, Average, Confidence, Random, and Spread."

#3: Teaching the meaning of a phrase takes more than the meaning of each individual word.

The idiomatic phrase "in the long run" has a specific conceptual meaning that is not guaranteed by knowing the meaning of those four separate words. Even a phrase like "at least six" is not always understood by students, who sometimes only focus on the word "least" and end up interpreting the phrase as "less than six" (which gives a different answer in problems like "find the probability of at least six successes").

#4: Be explicit about when you assess recognition of multiple terminology for the same concept, or whether on exams you will be happy to provide a synonym if asked, for examples such as the following:

Statistics term	Alternate terminology
z-score	standard score, standardized score
median	second quartile, 50th percentile
line of fit	least squares line, regression line
scatterplot	scatter graph, scatter diagram, scatter chart, X-Y plot
pie chart	circle graph
boxplot	box-and-whisker plot
stemplot	stem-and-leaf plot

Also, consider if you will let students use a handbook of statistics terms that does not give definitions, but simply counterpart terms in another language (e.g., *http://isi.cbs.nl/glossary*). Excel's data analysis add-ins allow students to see statistical terms in English and their native language, and there are major collections of applets available in both English and another language (e.g., *http://nlvm.usu.edu/es/nav* and *www.eduteka.org/MI/master/interactivate*).

#5: Use streamlined language.

If something can be said without extra clauses, parenthetical asides, formal passive voice constructions, or pieces of notation, do so. Lesser and Winsor compared these two textbook descriptions for finding the first quartile:

VERSION 1: Arrange the observations in increasing order and locate the median M in the ordered list of observations. The first quartile is the median of the observations whose position in the ordered list is to the left of the location of the overall median.

VERSION 2: Use the median to split the ordered data set into two halves—an upper half and a lower half. The first quartile is the median of the lower half.

#6: Offer everyday context or analogies as a conceptual resource.

Examples the author wrote for COMAP in 2009 include "Just as a median divides a road into two halves (with opposite directions of travel), a median divides a dataset into two halves!" and "If you order a 'combination platter' at a diner, you're asking for a certain set of foods to be on your plate, but you don't care what order they're in."

Examples in Michael Martin's 2003 *Journal of Statistics Education* article, "It's Like … You Know: The Use of Analogies and Heuristics in Teaching Introductory Statistical Methods," include the archery target for estimation, the seesaw for expected value, and the leashed hungry dog for boxplot whiskers.

ANNOUNCEMENTS

ASA Booth at NCTM Annual Meeting in Indianapolis

The ASA/NCTM Joint Committee again organized the ASA booth at this year's National Council of Teachers of Mathematics annual meeting in Indianapolis on April 13–16. K-12 mathematics and statistics teachers, supervisors, faculty at higher education institutions, and other exhibitors stopped by the ASA booth in the exhibit hall for information about statistics education programs and resources. Information about these programs and resources are available under the K–12 link at *www.amstat.org/education* and at *www.amstat.org/careers* and *www.amstat.org/outreach/statsig.cfm*. We also sold Making Sense of Statistical Studies, the GAISE Pre-K-12 Report, and t-shirts available at *www.amstat.org/asastore*. We appreciate the statistics teachers and faculty who helped staff the ASA booth as volunteers during the conference.

2011 ASA 'Promoting the Practice and Profession of Statistics' Video Competition

The ASA invites the submission of original digital videos that celebrate the many and varied achievements and roles of statisticians. The competition is intended to stimulate public awareness of the many facets of statistics and life as a statistician. The submission deadline is July 15, 2011. For more information, visit *www.amstat.org/youtube*.

Judges Sought for ASA Project Competition

The ASA/NCTM Joint Committee on Curriculum in Statistics and Probability is seeking judges for the ASA Project Competition. Judging takes place via email during the summer and requires about four hours of your time. If interested, please email Jamis Perrett at *jamis@stat.tamu.edu*.

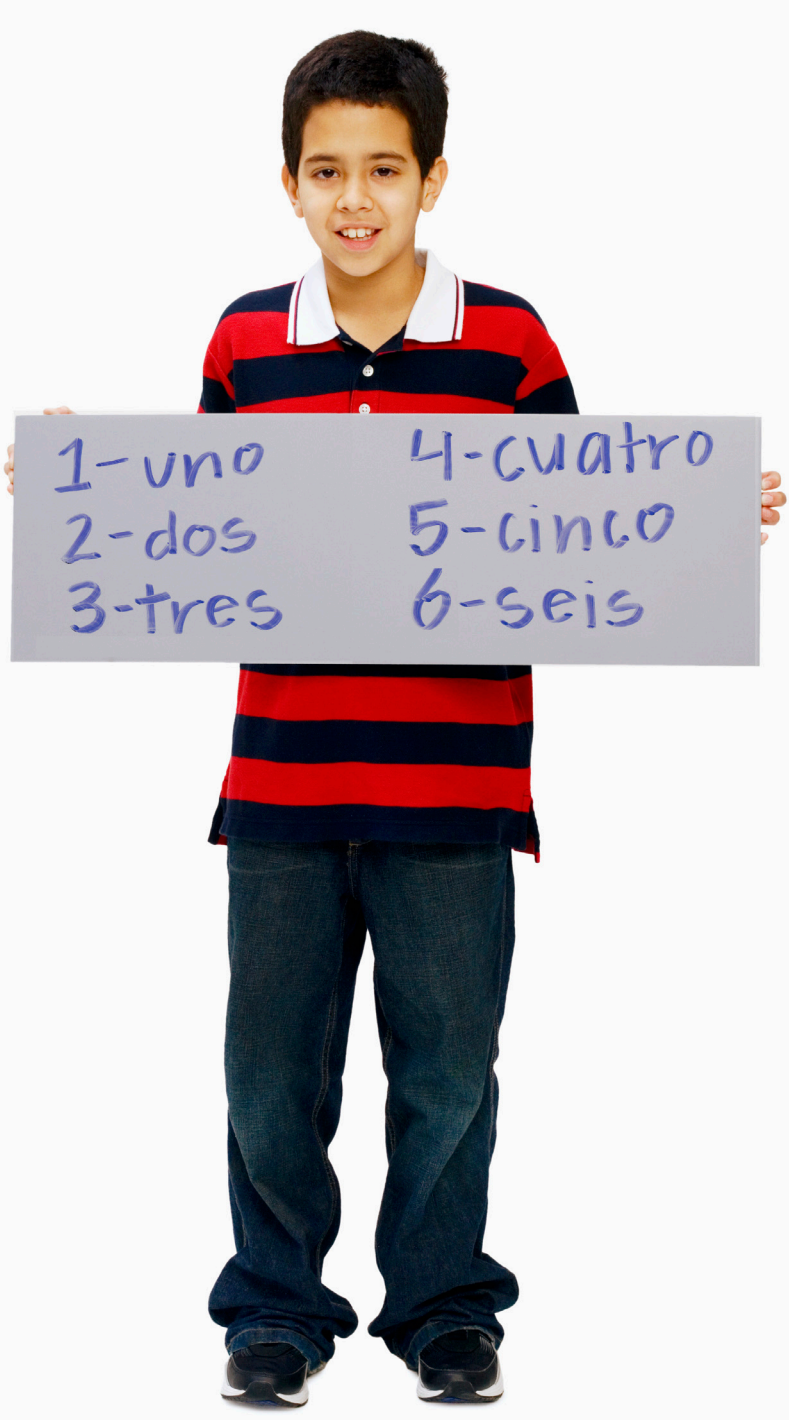
Poster and Project Competitions – Deadline Extended for Project Competition

Introduce K–12 students to statistics through the annual poster and project competitions directed by the ASA/NCTM Joint Committee on the Curriculum in Statistics and Probability. The competitions offer opportunities for students to formulate questions and collect, analyze, and draw conclusions from data. Winners will be recognized with plaques, cash prizes, certificates, and calculators and their names will be published in *Amstat News*. Posters are due every year on April 1. Projects, for all grades, are now due on June 9. For more

But, be aware of contexts or analogies that might not work as well for students of some cultures without explicit unpacking. For example, most statistics textbooks use the courtroom analogy to help readers conceptualize the framework of hypothesis testing. Following the way courtrooms work in the United States and many other countries, this analogy typically states the null hypothesis as "innocent (unless proven guilty)." This, however, is the opposite of what students are used to if they come from a country (e.g., México) with a Napoleonic Code of Law.

#7: Scaffold learning of new vocabulary.

Lesser and Winsor discuss various strategies and tools. One tool is giving students a "sentence frame," so they have structure as they fill in the blanks. An example is "The *p*-value obtained was ____, which is [less/greater] than our preset significance level of ____, and therefore we [reject/fail to reject] the null hypothesis that _____." Another tool is having students construct (with appropriate support) their own "word square" for each new statistics word learned, using this general format:



Statistics term in English	Statistics term in student's home language
Definition in student's own words	Examples/pictures of the statistics concept

The table below is an example of a word square for "mean" constructed by a Spanish-speaking ELL.

mean	**el promedio**
la suma de los valores de los datos dividida por el número de elementos en la suma the sum of the values in the dataset divided by the number of elements in the dataset	En el conjunto {1, 2, 3, 4, 20} para encontrar el promedio suma todos los números y divide por 5 porque hay cinco elementos en el conjunto. el promedio = (1 + 2 + 3 + 4 + 20) / 5 = 6 'balance point' of the data; 'leveling value' or 'fair share value' of the data

#8: Consider how understanding also can be shown by informal language or visuals.

If a student can't readily articulate the phrase "unimodal, right-skewed distribution," could that student still demonstrate understanding by drawing a picture of such a distribution? And including more pictures (or, more generally, multiple representations of the same concept) in your teaching can help students who are less skilled with language (or who are visual learners) catch on more quickly.

#9: Use group work and active learning.

Beyond the general benefits of cooperative learning in statistics class (e.g., Joan Garfield's 1993 *Journal of Statistics Education* article, "Teaching Statistics Using Small-Group Cooperative Learning"), having students work in teams forces each of them to do more talking (and writing, when they produce a report), which offers valuable experience practicing and applying the statistical language being learned. Additionally, group members can help fill in each other's language and content gaps more efficiently than the teacher can when working with the class as one big group. Group work is more effectively used to develop conceptual understanding and connections, rather than simply practice rote skills. Lesser offers a specific example of a rich question he has had high-school and college students explore in groups in his 2010 *Mathematics Teacher* article, "Sizing Up Class Size: A Deeper Classroom Investigation of Central Tendency."

#10: Increase 'wait time.'

Teachers typically do not wait more than 3 seconds for an answer, which makes it hard for all students to think about the question and formulate an answer, especially students who first have to translate the question from English to a native tongue.

Words and data have in common that their meaning depends on context, so it is natural to expect language to play a major role in the learning of statistics. The importance of language awareness in statistics is reflected by the following goal of the *GAISE College Report*: for students to recognize "that words such as 'normal,' 'random,' and 'correlation' have specific meanings in statistics that may differ from common usage." This goal is surely at least as important in the K–12 classroom, where students are likely to have even less experience with everyday or academic English language.

Acknowledgment: This work was supported in part by Project LEAP-UP (U.S. Dept. of Education grant #T195N070132).

Further Reading

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Martin, M. A. 2003. 'It's like … you know': The use of analogies and heuristics in teaching introductory statistical methods. *Journal of Statistics Education* 11(2). *www.amstat.org/publications/jse/v11n2/martin.html*.

U.S. Census at School Program Seeking Champions

The ASA and Population Association of America (PAA) recently launched the U.S. version of Census at School (*www.amstat.org/censusatschool*), a free, international classroom project that engages students in grades 4–12 in statistical problemsolving. Students complete an online survey, analyze their class census results, and compare their class with random samples of students in the United States and other participating countries. The project began in the United Kingdom in 2000 and now includes Australia, Canada, New Zealand, South Africa, Ireland, and Japan. The ASA and PAA are seeking champions to expand the U.S. Census at School program nationally. This is a wonderful opportunity for statisticians and statistics educators to perform outreach in their communities. For more information about how you can get involved, email Martha Aliaga at *martha@amstat.org* and copy Rebecca Nichols at *rebecca@amstat.org*.

Significance Magazine Now Available in the US and Online

The American Statistical Association (ASA) and Royal Statistical Society (RSS) are collaborating on the publication of *Significance*, a quarterly magazine for anyone interested in statistics and the analysis and interpretation of data. *Significance* is now online at *www.significancemagazine.org*. The aim of *Significance* is to communicate and demonstrate in an entertaining and thought-provoking way the practical use of statistics in all walks of life and to show how statistics benefit society. As well as promoting the discipline and covering topics of professional relevance, *Significance* contains a mixture of statistics in the news, case studies, reviews of existing and newly developing areas of statistics, and practice and problemsolving techniques. A subscription to *Significance* is included as a benefit of membership in either the ASA (including the ASA K–12 teacher membership) or the RSS. It also can be ordered through Wiley-Blackwell. K–12 teachers will receive one issue of *Significance* and online access to other issues when they sign up for the free, three-month trial K–12 teacher membership (valid for new ASA members) at *www.amstat.org/membership/k12teachers* or regular K–12 teacher membership at *www.amstat.org/membership*.

Preparing Statistics Educators—Integrating Content, Standards, and Pedagogy

An Invited Panel Session at JSM 2010 in Vancouver, BC, Canada

Deborah Lurie, Session Organizer

The American Statistical Association (ASA) / National Council of Teachers of Mathematics (NCTM) Joint Committee on Curriculum in Statistics and Probability sponsored an invited panel session, "Initiatives to Create Guidelines for Statistics Education to Prepare Future Generations to Function Effectively in a Data-Centric World: A Progress Report" at the 2010 Joint Statistical Meetings in Vancouver, British Columbia, Canada. It was organized by Deborah Lurie of Saint Joseph's University, a member of the joint committee, with panelists Christine Franklin (University of Georgia), Katherine Halvorsen (Smith College), and Carolyn Cuff (Westminster College).

The objectives of the session were to update statistics educators on (1) the use of the ASA's *Guidelines for the Assessment and Instruction in Statistics Education (GAISE) Report: A Pre-K–12 Curriculum Framework* as a foundation for teacher preparation in statistics education, (2) statistics content in the new core curriculum, and (3) lessons from the mathematics community that can help address the transition from high school to college-level statistics courses. Sufficient time also was reserved for an interactive discussion with the attendees.

Use of the ASA Guidelines

Although the need for statistical literacy is well established, Franklin explained that "statistical literacy cannot be achieved with a single statistics course. Statistical reasoning skills take time. Statistical concepts should be introduced and nurtured in elementary grades and then strengthened and expanded in later grades." An ongoing, developmental model for building statistical reasoning skills can be implemented through the use of the GAISE framework.

The goals of the Pre-K–12 GAISE report are to promote and develop statistical literacy; provide links with the national curriculum guidelines; discuss differences between mathematical and statistical thinking; clarify the role of probability in statistics; illustrate concepts associated with the data analysis process; and present the statistics curriculum for grades pre-K–12 as a cohesive and coherent curriculum strand. The underlying principle throughout the curriculum is the use of the four-step statistical problemsolving process: (1) formulate a statistical question, (2) collect data, (3) analyze the data, and (4) interpret the results. The GAISE framework provides a two-dimensional model consisting of the statistical problemsolving process and the three developmental levels for evolving statistical concepts—levels A, B and C.

Franklin recommended that the best way to prepare statistics teachers is to follow the advice of Joan Ferrini-Mundi and

Bradford Findell in "The Mathematical Education of Prospective Teachers of Secondary School Mathematics: Old Assumptions, New Challenges" and promote the development of courses in which content and pedagogy are integrated. She stated, "Teachers must not only understand content appropriated at their level (A, B, or C), but must also understand the relationship between this content and the associated content of other developmental levels." This conceptual understanding can be achieved through the use of learning trajectories, according to Douglas Clements and Julie Sarama in *Engaging Young Children in Mathematics Standards for Early Childhood Mathematics Education*. A learning trajectory consists of a learning goal, a developmental progression of thinking and learning, and a sequence of instructional tasks. An example of a learning trajectory for the evolution of a statistical concept was presented that focused on the interpretation of the mean and quantifying variation in data from the mean for the different levels (A, B, and C). This example is discussed in the GAISE pre-K–12 framework. She concluded by saying, "If we expect teachers to teach with understanding, then it is important that teachers themselves have an understanding of both a horizontal alignment and a vertical alignment of statistical concepts."

Statistics Content in the Core Curriculum

Since the publication of the GAISE report in 2007, the Common Core (CC) State Standards Initiative has been undertaken. Since one of the goals of the report is to provide links with the national curriculum guidelines, Halvorsen next presented background on the development of the CC, described its major features with special emphasis on the statistics content, and addressed the ASA's response to the CC.

The Common Core State Standards Initiative is a state-led effort coordinated by the National Governor's Association Center for Best Practices (NGA Center) and the Council of Chief State School Officers (CCSSO) (*www.corestandards.org*). Their advisory board consists of representatives from Achieve, the College Board, the ACT exam, and National Association of State Boards of Education in addition to the state higher education executive officers. The major reasons for developing the common core include the plethora of standards (50 sets of state standards, NCTM standards, College Board standards, and Achieve's K–12 benchmarks); the need for consistency in curriculum across the country due to the high mobility of the U.S. population; the need for more focus in the U.S mathematics curriculum; and the need for students to master material at grade levels before moving on.

These standards are for all students. CC prepares them for college entry or the workplace. Students who plan to focus on science, technology, engineering, and mathematics will need more mathematics in high school than the CC provides. These students can complete the CC in K–10 and take more advanced courses in grades 11–12. States that adopt the CC may add additional standards as long as the CC represents at least 85% of their standards. At the time of the session, 39 states had adopted the CC standards.

Members of the ASA were asked to review the standards with special attention to the statistics content and respond to the writing committee. Halvorsen reported that the response of the ASA team focused on two main issues: "The CC ignores the idea that statistical thinking needs to be nurtured and developed in a systematic way over time in the same way that mathematical thinking is developed. The use of data in the CC's K–5 standards is there to support mathematical ideas and not to support statistical thinking."

One of the examples Halvorsen presented to illustrate these issues was from the CC's Grade 1 standards for measurement and data. The CC states, "**Represent and interpret data**: Organize, represent, and interpret data with up to three categories; ask and answer questions about the total number of data points, how many in each category, and how many more or less are in one category than in another." The ASA critique stated, "The data just appear. How or why they are obtained is not addressed in the standard. The purpose of the exercise is to count and classify and look for differences in counts. The activity supports developing 'number sense,' but not statistical thinking."

The team's suggested re-write: "Pose questions that can be answered by collecting, organizing, and interpreting categorical data. Represent the data using picture graphs with a scale of one symbol/picture representing one object. In the context of the original question, discuss the total number of data points, how

CHANCE Magazine Now Online

CHANCE magazine, jointly published by the American Statistical Association and Springer about statistics and the use of statistics in society, is now online at *http://chance.amstat.org*. It is intended for anyone who has an interest in the analysis of data. *CHANCE* features articles that showcase the use of statistical methods and ideas in the social, biological, physical, and medical sciences. It also presents material about statistical computing and graphical presentation of data. The online version of *CHANCE*, which includes previous issues, is now an ASA member benefit for K–12 and student members. K–12 teachers will receive online access to *CHANCE* when they sign up for the free three-month trial K–12 teacher membership (valid for new ASA members) at *www.amstat.org/membership/k12teachers* or regular K–12 teacher membership at *www.amstat.org/membership*.

Free Statistics Education Webinars

The American Statistical Association offers free webinars on K–12 statistics education topics at *www.amstat.org/education/webinars*. This series was developed as part of the follow-up activities for the Meeting Within a Meeting (MWM) Statistics Workshop. The Consortium for the Advancement of Undergraduate Statistics Education also offers free webinars on undergraduate statistics education topics at *www.causeweb.org*.

Statistics Education Web (STEW) in Search of Lesson Plans

The new editor of Statistics Education Web (STEW), Mary Richardson of Grand Valley State University, is accepting submissions of lesson plans for an online bank of peer-reviewed lesson plans for K–12 teachers of mathematics and science. Lesson plans will showcase the use of statistical methods and ideas in science and mathematics based on the framework and levels in the *Guidelines for Assessment and Instruction in Statistics Education (GAISE) Report: A Pre-K–12 Curriculum Framework* (*www.amstat.org/education/gaise*). Please review your "bag-of-tricks" and consider submitting several of your favorite lesson plans according to the STEW template to *steweditor@amstat.org*. For more information, visit *www.amstat.org/education/STEW*.

Meeting Within a Meeting (MWM)

Statistics Workshop for K-12 Mathematics and Science Teachers

(*www.amstat.org/education/mwm*)

Sponsored by the American Statistical Association (ASA)
2011 Joint Statistical Meetings (JSM)*

★ ★ ★

Based on the Common Core State Standards for Mathematics (*corestandards.org*) and *Guidelines for Assessment and Instruction in Statistics Education (GAISE): A Pre-K–12 Curriculum Framework* (*www.amstat.org/education/gaise*)

Dates: Tuesday, August 2, and Wednesday, August 3, 2011, 8:00 a.m. to 3:30 p.m.

Places: Miami Beach Convention Center, 1901 Convention Center Dr., Miami Beach, FL 33139-1820., and neighboring hotels (workshop meeting room location to be announced)

Audience: K–12 mathematics and science teachers. Multiple mathematics/science teachers from the same school are especially encouraged to attend. Note: Experienced AP Statistics teachers should register for the Beyond AP Statistics (BAPS) workshop. See *www.amstat.org/education/baps* for more information.

Objectives: Enhance understanding and teaching of statistics within the mathematics/science curriculum through conceptual understanding, active learning, real-world data applications, and appropriate technology

Content: Teachers will explore problems that require them to formulate questions; collect, organize, analyze, and draw conclusions from data; and apply basic concepts of probability. The MWM program will include examining what students can be expected to do at the most basic level of understanding and what can be expected of them as their skills develop and their experience broadens. Content is consistent with Common Core standards, *GAISE* recommendations, and *NCTM Principles and Standards for School Mathematics.*

Presenters: *GAISE* report authors and prominent statistics educators

Format:
Tuesday: Grades K–4 and 9–12 sessions
Wednesday: Grades 5–8 session
One-day pass to attend activities at JSM (statistics education sessions, poster sessions, exhibit hall)
Activity-based sessions, including lesson plan development

Provided:
Refreshments
Complimentary one-day pass to attend the Joint Statistical Meetings
Lodging reimbursement (up to a specified amount) for teachers from outside the Miami area
Handouts
Certificate of participation from the ASA certifying professional development hours
Optional graduate credit

Cost: The course fee for the two days is $50. Note: Course attendees do not need to register for the Joint Statistical Meetings to participate in this workshop.

Follow up: Follow-up activities and webinars (*www.amstat.org/education/k12webinars*)
Network with statisticians and teachers to organize learning communities

Registration: Online registration available at *www.amstat.org/education/mwm*. Space is limited. If interested in attending, please register as soon as possible.

Contact: Rebecca Nichols, *rebecca@amstat.org*; (703) 684-1221, Ext. 1877

*The Joint Statistical Meetings is the largest annual gathering of statisticians, where thousands from around the world meet to share advances in statistical knowledge. The JSM activities include statistics education sessions, posters sessions, and the exhibit hall.

many in each category, and how many more or less are in one category than another."

Without the development of the GAISE Level A statistical thinking skills, students will not be prepared to successfully understand the concepts at levels B and C, which are introduced in the CC beginning in Grade 6. The statistical content in the CC for grades 6–12 was found to be adequate. However, the four-step process for statistical problemsolving is not part of the CC standards. This omission removes the consistent curriculum strand proposed in the GAISE framework.

In conclusion, Halvorsen and the ASA team applauded the CC writers for their efforts to include a large amount of statistics and probability in the middle- and high-school curriculum. Unfortunately, the lack of a statistics strand in K–5 makes the CC inconsistent with the ASA's GAISE recommendations at Level A.

Lessons from the Mathematics Community

With the inclusion of more statistics in the K–12 curriculum and the growth of enrollment in the AP Statistics course, the last panelist, Cuff, discussed the lessons we can learn from the mathematics community, which faced similar issues with AP Calculus. She also addressed the lessons we still need to provide for mathematicians teaching statistics at the college level.

Cuff reported that there are several studies funded by NSF currently under way to measure the effects of the movement of calculus into the high-school curriculum. These studies are trying to determine the factors in high-school preparation that correlate with success in Calculus I. The Mathematics Association of America (MAA) also is conducting a study of the characteristics of successful programs in college calculus.

Cuff proposed we rephrase the questions being investigated in these studies in terms of statistics. Specifically, "What is the background required for success, not just in the high-school (HS) course, but to continue to study in college? How well does the HS course prepare students for college-level work in additional statistics courses? What fraction of the students who earn a 3 or higher on an AP Statistics exam use it to exempt out of any mathematics at the college level? And finally, there is the issue of alternatives to calculus in high school. In particular, what is the effect of statistics as a senior high-school course, and does it help or hinder student preparedness for college calculus?

As many statistics courses at smaller state colleges, universities, and liberal arts colleges are still taught by mathematicians, Cuff reported on the progress to train these mathematicians to teach statistics using the GAISE framework. Substantial progress has been made in teacher training through programs sponsored by the American Mathematical Society (AMS) and Mathematical Association of America (MAA) at the annual Joint Mathematical Meetings such as Project NExT (New Experiences in Teaching), *http://archives.math.utk.edu/projnext*; the Statway project, *www.carnegiefoundation.org/statway*; and new texts for the first mathematics statistics course.

Opportunities are available for a college instructor to develop and adapt the first course to be in line with the GAISE standards. Instructors need to be encouraged and directed toward these programs and materials. Using the GAISE pre-K–12 and college reports, we now have a consistent pedagogy from pre-K–16.

After these three informative presentations, the major issues raised during the open discussion were (1) How do we disseminate this information to a wider audience, especially to K–12 teachers who are not eligible for funds to attend conferences? (2) What materials and resources are currently available for use by statistics teachers using the GAISE framework?

The panelists had the following suggestions:

- Review the materials available through the ASA website, *www.amstat.org/education*
- Encourage presenters to summarize their talks in the *Statistics Teacher Newsletter* (*STN*).
- K–12 mathematics and science teachers can participate in the Meeting Within a Meeting (see *STN* Vol. 76). The registration process began in March, and further information about the workshops will be available at *www.amstat.org/education/mwm*. Questions about the MWM workshop should be directed to Rebecca Nichols, ASA K–16 education manager, at *rebecca@amstat.org* or (703) 684-1221, Ext. 1877.
- The ASA/NCTM Joint Committee has published *Making Sense of Statistical Studies* for use at GAISE Level C. Activities for levels A and B are under development and should be available in early 2012.
- Additional peer-reviewed lessons are under development for STEW, the Statistics Education Web, at *www.amstat.org/education/stew*.

Additional information about the mission of the ASA/NCTM joint committee can be found at *www.amstat.org/committees*.

Further Reading

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Clements, D., and J. Sarama. 2004. *Engaging young children in mathematics standards for early childhood mathematics education*. Wahwah, New Jersey: Lawrence Erlbaum Associates, Inc.

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BAPS - Beyond AP Statistics

A WORKSHOP FOR EXPERIENCED TEACHERS

Sponsor: ASA-NCTM Joint Committee on Curriculum in Statistics and Probability

Miami Beach, Florida • Wednesday, August 3, 2011 • 8:30 a.m. – 4:30 p.m.

The ASA/NCTM Joint Committee is pleased to sponsor a **Beyond AP Statistics (BAPS)** workshop at the annual **Joint Statistical Meetings in Miami Beach, Florida**, this August. Organized by Roxy Peck, the BAPS workshop is offered for AP Statistics teachers and consists of enrichment material just beyond the basic AP syllabus. The course is divided into four sessions led by noted statisticians.

Presenters

Linda Young, University of Florida - **Experimental Design**

Robin Lock, St. Lawrence University - **What Do We Do When Assumptions Are Not Met?**

Allan Rossman & Beth Chance, Cal Poly - **Randomization Tests for Paired and Categorical Data**

Tom Short, John Carroll University - **Logistic Regression**

Cost

The course fee for the full day is $50. Workshop attendees do not have to register for the Joint Statistical Meetings to participate in this workshop.

Location

Miami Beach Convention Center, 1901 Convention Center Dr., Miami Beach, FL 33139-1820, and neighboring hotels (workshop meeting room location to be announced)

Provided

Refreshments (lunch on your own)

Handouts

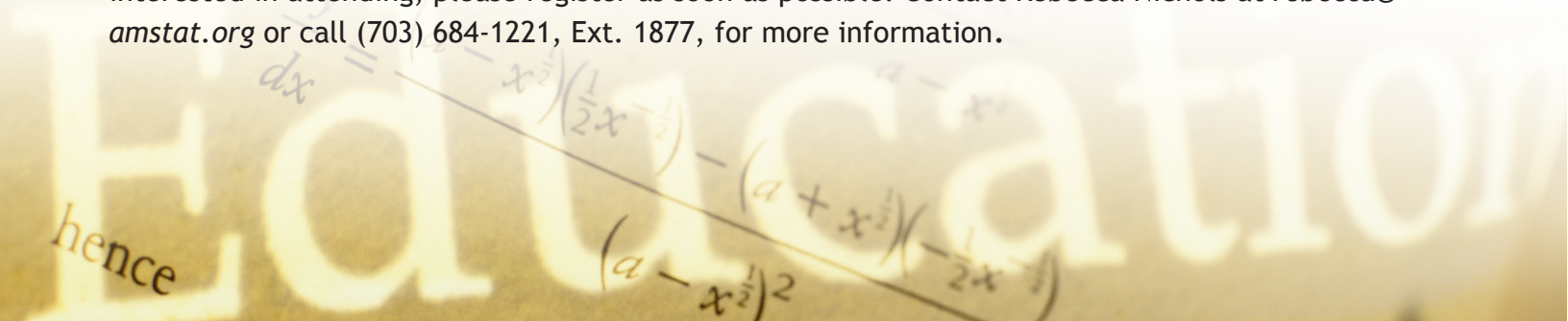
Pass to attend the exhibit hall at the Joint Statistical Meetings

Certificate of participation from the ASA certifying professional development hours

Optional graduate credit available

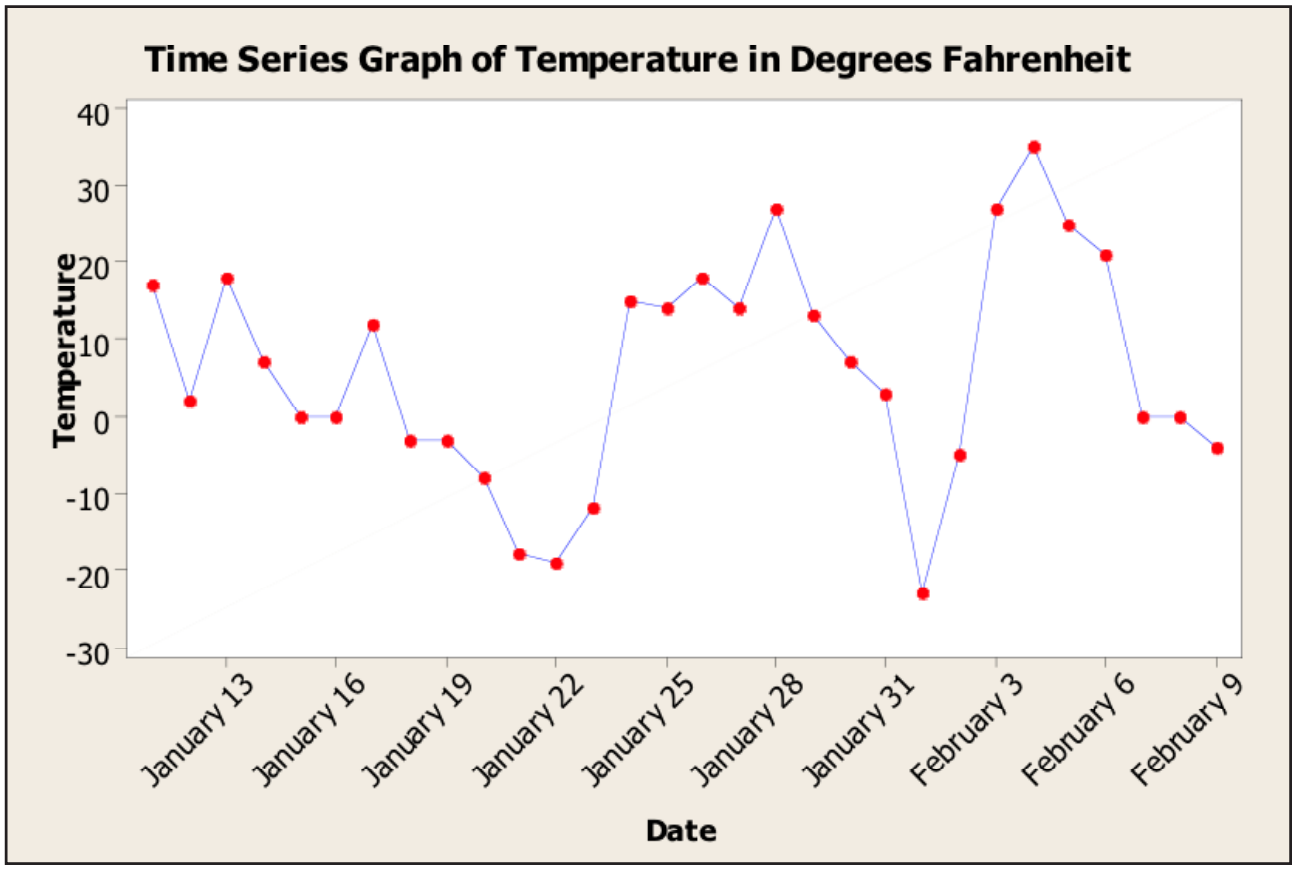
Registration

Register online or print out a registration form at *www.amstat.org/education/baps*. Registrations will be accepted until the course fills, but should arrive no later than **July 15.** Space is limited. If interested in attending, please register as soon as possible. Contact Rebecca Nichols at *rebecca@amstat.org* or call (703) 684-1221, Ext. 1877, for more information.



Statistics and Mathematics Through Data Collection and Graphical Display for the 2nd and 3rd Grades

Derek Webb, Bemidji State University



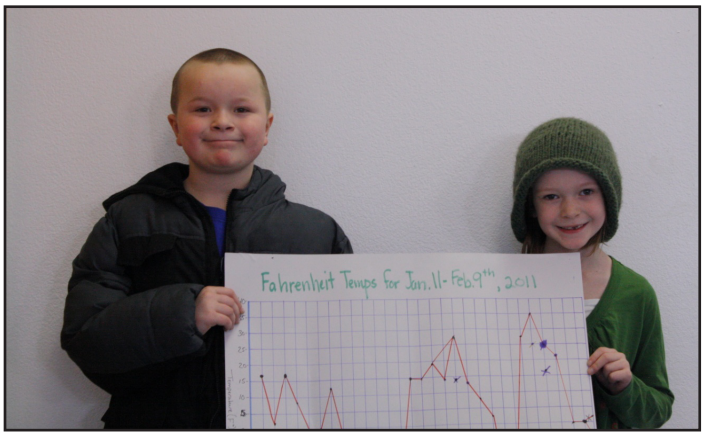
Nothing is talked about more in northern Minnesota in January than statistics and the temperature outside! OK, maybe just the temperature outside. But, for two classes of second-graders and one class of third-graders at Schoolcraft Learning Community in Bemidji, statistics and temperature were on their minds daily from January 11 through February 9. Students recorded the outside temperature each day between 9 a.m. and 10 a.m., thereby learning basic scientific data-collection practice. They plotted the temperature on a time series graph similar to the one created on computer software above. (The graph above contains the actual data recorded by the third-grade class.)

In each classroom, the students' teachers created a graph on poster board about 24 inches wide by 12 inches tall. The axes were drawn out and grid lines were lightly drawn to assist the students with placement of each data point. The second-grade students had grid lines for each degree, but the third-grade students had grid lines at 5-degree intervals. This required third-grade students to estimate the placement of points down to the nearest degree, which compliments other math skills appropriate for this grade level.

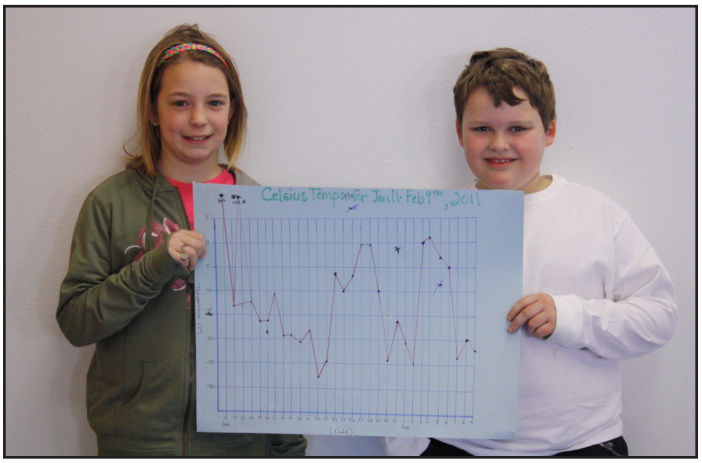
Students in third grade actually created two graphs—one in degrees Fahrenheit and one in degrees Celsius. The National Council of Teachers of Mathematics (NCTM) recommends students in all grades learn about the English (United States Customary System) and metric systems of measurement, because the English system in the United States is not going away and the metric system is used by almost all of the rest of the world. Having two graphs in different units side-by-side was useful in showing students that the general temperature trends and information conveyed in the graphs was the same, regardless of the measurement system. This is a powerful property of graphs.

I kicked off the project by visiting each classroom and giving an overview of statistics, describing statistics as *the science of data*. Of course, many students naturally asked "What is data?" I then gave examples of data such as counting the number of legs of different types of animals, observing the

Group photo of all second- and third-grade students.



Two third-grade students displaying time series graph in Celsius.



Two second-grade students displaying time series graph in Fahrenheit.

eye color of students, observing whether students had gloves or mittens that particular day, and recording the grade for each student. I revisited the school 30 days later to find out how the project turned out. I interviewed each class telling the students I was a reporter for the Statistics Teacher Network publication and I needed information for my story! It was a big hit.

One outcome of this project revealed that time series data is easy to collect and graphically analyze, so it can be incorporated into the curriculum early on. It is also commonly encountered data, but does not usually show up in most curricula. This is unfortunate because not only is time series data a good statistical topic, there are many mathematical topics that can be studied at the same time. Here is a list of some of the mathematical and statistical topics the teachers at Schoolcraft Learning Community covered with their second- and third-grade students through the course of this project:

> Students were exposed to "slope of a line" using correct terminology to describe trends through time. For example, the time series graph has a nearly constant trend from January 24 through January 27, a decreasing trend from January 28 through February 1, and an increasing trend from February 1 through February 4.
>
> Students learned about the scientific activity of taking data readings regularly through time. This is called longitudinal data and helps scientists learn about how a process changes through time and allows them to go back and study historical data.
>
> Students compared the data they collect at Schoolcraft to data from different geographic locations such as Miami,

Florida; Minneapolis, Minnesota; Chicago, Illinois; or Coos Bay, Oregon. Students also talked about how temperature is different at different geographical locations at any given time.

Students learned about the range of a data set, which is the maximum value minus the minimum value. For the data illustrated above, the range is 35 - (-23) = 35 + 23 = 58 degrees. Students can find the range from counting degrees on the graph. They don't have to do subtraction with negative numbers if they are not ready to.

Students are exposed to the Cartesian, or x, y coordinate system. They don't have to use the very abstract x, y axis labels. They can talk about the axes in terms of date and temperature. This is useful for building up to mathematical concepts encountered later. Students also got to plot points on the graph, testing their understanding of the coordinate system.

Students got to visualize data through time. In other words, they tracked the value of a variable (temperature) through time. This illustrates a way to keep track of information so students can "go back" and talk about what the temperature was yesterday, a week ago, or a month ago. Most people don't have good recall of historical data, so this project illustrates a simple way to keep track of historical data. It also allows students to talk about how temperature changed through time—a calculus concept.

Depending on the grade level, students were exposed to both the Fahrenheit and Celsius temperature measurement scales.

After students collected 30 days of data, they created a tally table of the number of days at or below zero vs. the number of days above zero. Other tally tables can be created, and this gives students exposure to frequency tables.

An extension is that students could also collect qualitative data (non-numerical data) every day such as cloudy, sunny, partly cloudy, and snowy. Students could then examine the qualitative data for relationships with the quantitative temperature data. The beginnings of scientific inquiry into associations!

Here's a list of statistical and mathematical vocabulary terms used throughout the project:

1. Graph
2. Grid lines (those faint lines on the graph that allow students to easily graph data)
3. Axis labels
   a) Date-axis (x-axis)
   b) Temperature-axis (y-axis)
4. Trend and slope of a line
   a) Increasing trend or positive slope
   b) Decreasing trend or negative slope
   c) Constant trend or constant slope
5. Maximum value of all the data
6. Minimum value of all the data
7. Range: maximum – minimum
8. Median
9. Data point – particular points on the graph

One more detail that needs mentioning is that students had "homework" to do each weekend: They had to record the temperature on Saturday and Sunday between 9 a.m. and 10 a.m. and bring the data back to school on Monday. The problem the students then encountered was that many students had recorded different temperatures due to where they live and the measurement process they used. So, for each weekend day, the median was calculated and plotted on the graph.

The second-grade students found the median by lining up in order from smallest recorded temperature to largest. Then, they sat down in pairs starting at the ends and worked their way to the middle. Students noticed that if there was an odd number of observations, there was a middle student or median. If there was an even number of students, then they had to find the middle value or median based on the values of the two middle students. Pretty good for second grade!

The students in third grade wrote all their values down on the board, ordered them, and then found the median. Many students were surprised by the different temperatures brought in by their classmates. This helped illustrate an important statistical topic: variability.

MAKING SENSE OF STATISTICAL STUDIES

Making Sense of Statistical Studies consists of student and teacher modules containing 15 hands-on investigations that provide students with valuable experience in designing and analyzing statistical studies. It is written for an upper middle-school or high-school audience having some background in exploratory data analysis and basic probability.

www.amstat.org/education/msss

CENSUS at SCHOOL

FREE international classroom project to engage students in statistical problemsolving

Teach statistical concepts, statistical problemsolving, measurement, graphing, and data analysis using your students' own data and data from their peers in the United States and other countries.

Complete a brief online survey (classroom census)

13 questions common to international students, plus additional U.S. questions

15–20-minute computer session

Analyze your class results

Use teacher password to gain immediate access to class data.

Formulate questions of interest that can be answered with Census at School data, collect/select appropriate data, analyze the data—including appropriate graphs and numerical summaries for the corresponding variables of interest—interpret the results, and make appropriate conclusions in context relating to the original questions.

Compare your class census with samples from the United States and other countries

Download a random sample of Census at School data from United States students.

Download a random sample of Census at School data from international students (Australia, Canada, New Zealand, South Africa, and the United Kingdom).

International lesson plans are available, along with instructional webinars and other free resources.

www.amstat.org/censusatschool

For more information about how you can get involved, email Martha Aliaga at *martha@amstat.org* and copy *rebecca@amstat.org*.