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AMERICAN STATISTICAL ASSOCIATION

NCTM | NATIONAL COUNCIL OF TEACHERS OF MATHEMATICS

The Statistics Teacher Network

www.amstat.org/education/stn

Number 72 | The Statistics Teacher Network | ASA/NCTM Joint Committee on the Curriculum in Statistics and Probability | Spring 2008

The Editor's Corner

Welcome to the first digital issue of the *Statistics Teacher Network*! We are transitioning from paper to digital and hope you like our new format. Reasons for going to a digital format include ease of publishing more diverse materials, giving readers access to all previous editions, reaching a greater audience, and (of course) cost. Once the transition is complete, readers will also be able to search for previous articles based on author, title of article, or grade level: K-5, 6-8, 9-12.

I welcome your feedback on our new format. As always, readers are encouraged to submit articles for publication. Please email me directly at *dwebb@bemidjistate.edu*.

Best Regards,
Editor, Derek Webb, Bemidji State University

In Depth Explorations of Data and Chance: Activities for Middle School Students

Beth Lazerick, Saint Andrew's School, Boca Raton, FL

If you have ever dreamed about the perfect class in the perfect setting, then you have probably envisioned my class of 12 "talented" students at Mt. Holyoke College during the summer of 2007. I was a teacher in the Johns Hopkins University Center for Talented Youth summer program (*cty.jhu.edu*). My class was entitled "Data and Chance" which was one of the mathematically oriented classes offered in this program. Other classes offered included "Inductive and Deductive Reasoning" and "Math Sequence." Students are selected for this program on the basis of test scores, grades, and recommendations.

Also In This Issue…

Articles

Workshops

My class of eight boys and four girls, who were entering sixth or seventh grade in the fall, came from as far away as South Korea. When not in class with me and my teaching assistant, they lived in dorms and were in the care of "residential assistants." The amazing thing is that we were able to keep the students mathematically engaged for over five hours a day for three weeks!

Think about it – we spent almost 75 hours in activities that involved probability and statistics over a three-week period. You might ask yourself, what can keep kids engaged for this length of time? Let me tell you, this was not an easy task! Here is a glimpse of some of the activities that we did each day in addition to lunch and two recesses, where four-square and Frisbee were top games.

Day 1

A. Students gather data about each other. They ask questions that will later be used to create Venn Diagrams.

B. Roll dice and record outcomes for 36 rolls. Graph results and create class graph of outcomes.

C. Calculate theoretical probabilities for rolling two dice and compare theoretical and experimental results.

D. Play "Pass the Pigs" using *www.fontface.com* (We had an LCD projector and access to computers) and then using plastic pigs. Again compare results and probabilities.

E. Repeat dice rolling with 0-9 (10-sided) dice after hypothesizing outcomes.

F. Diagnostic pre-test mandated by CTY.

As you can see we did a lot that first day! We had to keep up a good pace and we really did have enough time for everything.

Day 2

A. Do Venn diagram problems using Groundworks series from Creative Publications.

B. Formulate questions to ask students from other classes. This data collection was done at the break time when 60 or so students were outside.

C. Create Venn Diagrams illustrating characteristics of the students such as "have siblings," "live in New York," and "own a pet." These were displayed around the room.

D. Collect data from class members (height, foot length, length of names). Teach mean, median, mode, quartiles and extremes. Create box-plots of the information. Create scatterplots to illustrate possible correlations.

Day 3

A. Examine "spread" of data to introduce standard deviation.

B. Use calculators to find measures of central tendency and draw various types of graphs.

C. Introduce probability with cards and teach fundamentals of Blackjack.

D. Play Blackjack.

E. Explore basic probability problems.

F. Teach and play poker. (Yes, we really did.)

G. Read from *Life: The Odds* by Gregory Baer. (This book became a favorite of the class.)

Day 4

A. Calculate probabilities for area models.

B. Explore the differences among sampling techniques using "Rolling Down the River" located at *http://courses.ncssm.edu/math/Stat_inst01/PDFS/river.pdf*.

C. Create survey questions and take surveys.

D. Create visual displays of survey information including histograms, measures of central tendency and measures of dispersion.

Day 5

A. Complete work on survey displays.

B. Take a "fake" multiple-choice test and examine data. Explore measures of central tendency and spread.

C. Discuss factorials, and introduce combinations and permutations.

D. Examine data and identify Simpson's Paradox.

E. (Sunday night) Join with Flight group to create and fly paper airplanes.

Day 6

A. Review combinations and permutations using six mismatched socks.

B. Use Skittles to predict contents of "mystery" bags of candy.

C. Construct circle graphs to illustrate combinations of colors of candy and to illustrate how CTY students spend their days.

D. Use calculators to find permutations and combinations.

E. Fly paper airplanes and use calculators to test for which planes fly the farthest.

Day 7

A. Plan carnival games for the 4th of July. Games were to be of different levels of difficulty and constructed according to probabilities of success.

B. Create the carnival games using available materials.

C. Introduce major project for the end of the session. This project is a budget project in which each student envisions her or himself as a 30 year old. Then s/he uses the Internet to determine probable salary, a place to live and to rent an apartment, determine taxes, and various expenses. Students will be given an Excel template to plan their "futures." (Computer lab for most of the afternoon.)

Day 8 (Fourth of July)

A. Complete carnival games.

B. Catch and release exploration, "How do you determine how many trout are in the lake?"

C. Carnival, where small prizes were given.

D. Reading a student edition of the *Wall Street Journal* to look for statistical references.

Day 9

A. Handshake Problem, to explore triangular numbers.

B. Flip 1-5 coins and examine theoretical and experimental outcomes.

C. Explore Pascal's Triangle

D. Preparation of a skit for presentation to be given to all CTY participants.

E. Instruction on how to play Backgammon.

F. Computer work for budget project.

Day 10

A. Simulations using *Probability Simulations*.

B. Work on skit.

C. We attended a presentation by another class of CTY participants.

D. Sunday night – Backgammon tournament.

Day 11

A. Introduction and work on random walks.

B. Explore the birthday problem.

C. More probability challenges.

D. Backgammon tournament.

Day 12

A. Investigate the Monty Hall problem.

B. Trip to Mt. Holyoke Museum with our Site Director who was an Egyptologist. The museum had an exhibit on Egyptian relics.

C. Explore exponential decay using M&M's and consider exponential curves.

D. Computer work on projects

Day 13

A. Post-test mandated by CTY.

B. Work on project presentations using poster board and the information gathered.

C. Census data collection.

D. Finish projects.

E. Backgammon when finished.

Day 14

A. Develop questions and discuss experimental design.

B. Conduct and discuss experiments.

C. Present budget projects to peers.

D. Cleanup.

Day 15

A. Wrap up.

B. Probability challenge problems.

C. Ending ceremony.

Because the students were ages 11-13, spanned two grade levels, and at least one had completed algebra II (!), we always had to be prepared with additional challenges for students who finished the projects and assignments quickly. We used logic problems (Quizzles), *In the Balance* algebra puzzles, and the "Tests of Genius" from the Pizzazz series. Students also enjoyed the "24 Game" at different levels and other math puzzles.

The students were happy to see their parents at the end of the session. My assistant and I were exhausted! If you are up to the challenge, check out the CTY program at Johns Hopkins. You, too, may be able to enjoy teaching some wonderful kids during the summer.

Resources

Exponential decay using M&M's: *http://www.rcsd.ms/~mathresources/Calculus%20Flipcharts/Chapter%206%20Differential%20Equations/exponentialdecay.pdf*

Handshake Problem: *http://math.about.com/cs/weeklyproblem/a/q2.htm*

Monty Hall problem: *http://math.uscd.edu/~crypto/Monty/monty.html*

Pascal's Triangle: *http://ptri1.tripod.com/*

Rolling Down the River *http://courses.ncssm.edu/math/Stat_inst01/PDFS/river.pdf*

24 Game available from *http://www.24game.com/*

Groundworks: Reasoning with Data and Probability, Grade 6. Greenes, C. & Findell, C. (1999) Chicago: Creative Publications. ISBN: 1-4045-3202-1 (Note: Grade levels 5 and 7 would also have useful material.)

In the Balance: Algebra Logic Puzzles Grades 4-6. Kroner, Lou. (1998) Chicago: Creative Publications. ISBN: 0762205512.

In The Balance: Algebra Logic Puzzles Grades 7-9. Kroner, Lou. (1998) Chicago: Creative Publications. ISBN: 0762205520

Life: The Odds and How to Improve Them. Baer, Gregory. (2003) Gotham Books. ISBN: 1-592-40033-7

Middle School Math with Pizzazz! Grades 5–8. Chicago: Creative Publications. (Note: There are multiple binders, A-E, each with individual ISBN numbers. For example, Binder A, ISBN is 0884887383 and for the complete set, the ISBN is 156107098X.)

Probability Simulations. Winter, Mary Jean and Carlson, Ronald J. (2000) Emeryville, CA: Key Curriculum Press. ISBN: 1-55953-401-X

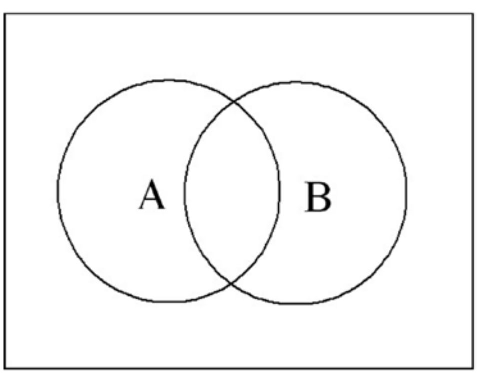
Quizzles. Williams, Wayne. (1984) Palo Alto, CA: Dale Seymour. ISBN: 0-86651-102-4 ■

The Great Event Search

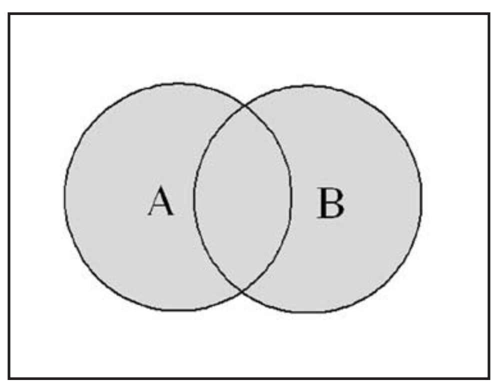
Derek Webb, Bemidji State University, Bemidji, MN

I use this activity in my statistics classes to help students learn proper set theory notation, be able to verbalize the concepts of union, intersection, and compliment, and to illustrate some rules of counting. The students enjoy this in-class activity and there is also a positive element of competition! Any basic chance experiment with two events that have an intersection could be used as the basis of this exercise. For example, consider being dealt one card from a standard 52 card shuffled deck. The two events of interest are *A* – being dealt a heart and *B* – being dealt a queen.

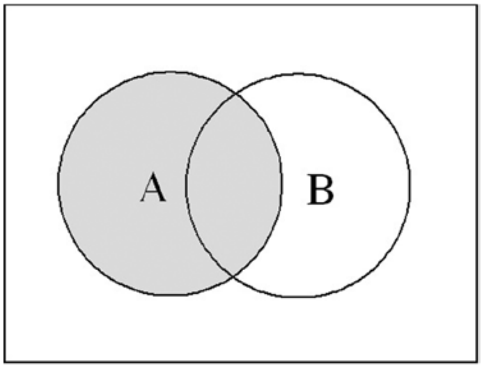
A Venn diagram that illustrates this experiment and the events A and B is as follows.



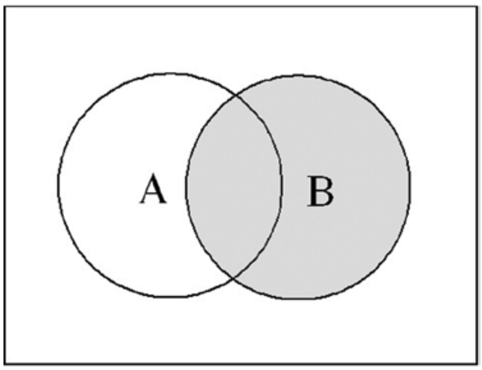
I begin the activity by having students take turns volunteering to draw one Venn diagram on the board and shading a new event that that can be created just based on the two events A and B and the set operators union, intersection, and compliment. Following is a list of all 16 events that can be created and the notation that describes each event. I also give a verbal description of the events. Depending on grade level, students may not be able to give a description of each event using mathematical notation, but they should be able to give a verbal description. Note that there are multiple ways to use notation to describe an event and multiple ways to verbally describe an event. I only give one way for each. After the list, I will discuss why there are exactly 16 events and examine some rules of counting that are important when studying experiments and probability. This activity is especially fun towards the end when students need to really think to come up with the last few events.



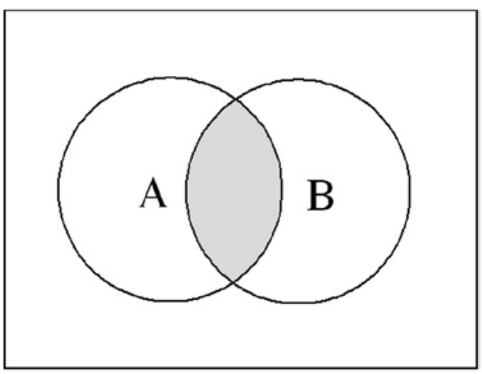
$A \cup B$ – dealt a heart or a queen or the queen of hearts.



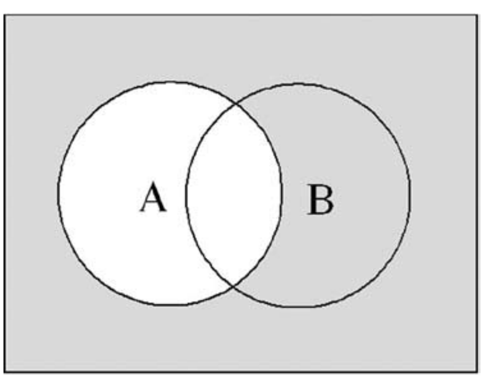
A – dealt a heart.



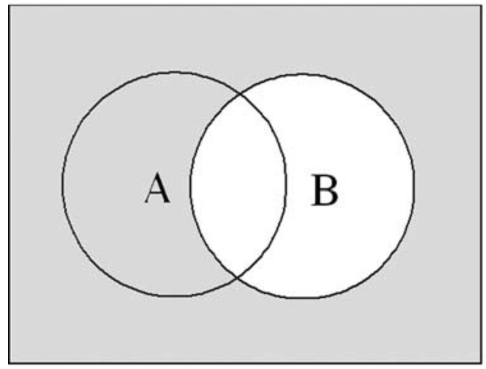
B – dealt a queen.



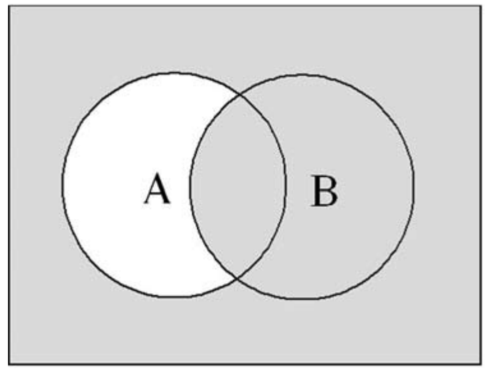
$A \cap B$ – dealt the queen of hearts.



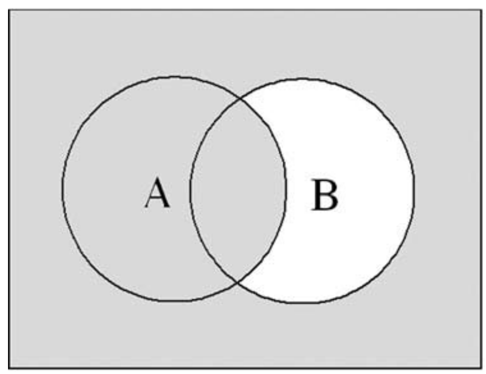
A^C – dealt any card that is not a heart.



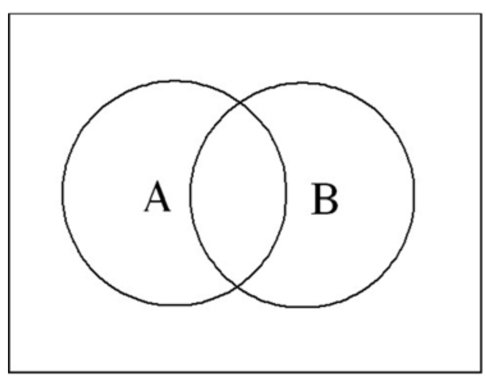
B^C – dealt any card that is not a queen.



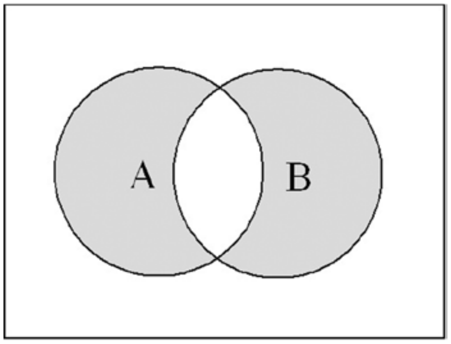
$A^C \cup B$ – dealt any card that is not a heart except if it is the queen of hearts.



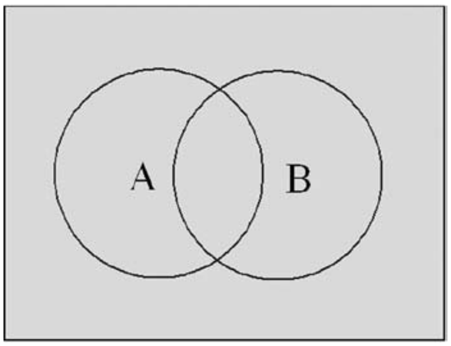
$A \cup B^C$ – dealt any card that is not a queen except if it is the queen of hearts.



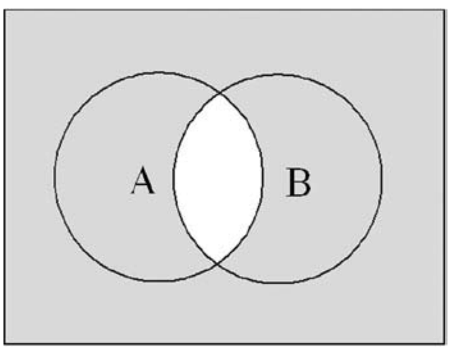
$A \cap A^C = \varnothing$ – empty set or an event that contains no outcomes such as being dealt the joker (impossible) or being dealt the Queen of England (impossible).



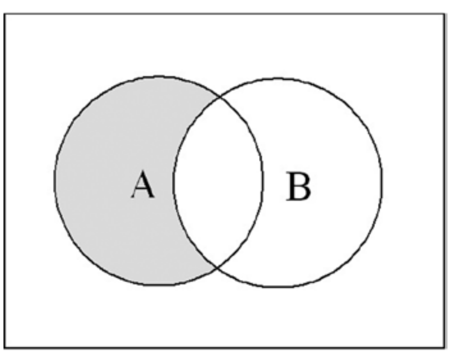
$(A \cap B^c) \cup (A^c \cap B)$ – dealt a heart or a queen but not the queen of hearts.



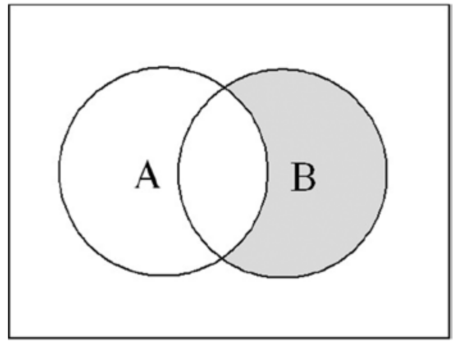
$A \cup A^c$ – dealt any card.from the 52 card deck.



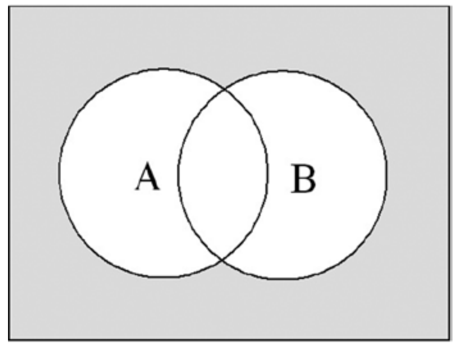
$B^c \cup A^c$ – dealt any card except the queen of hearts.



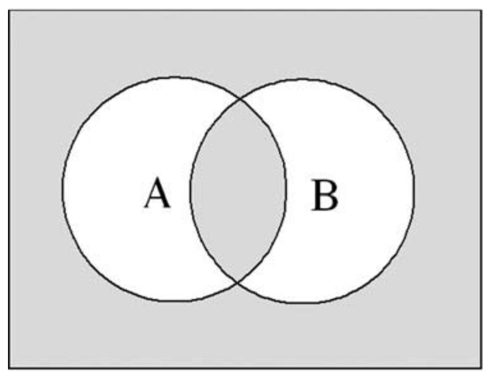
$A \cap B^c$ – dealt any heart except the queen of hearts.



$A^C \cap B$ – dealt any queen except the queen of hearts.

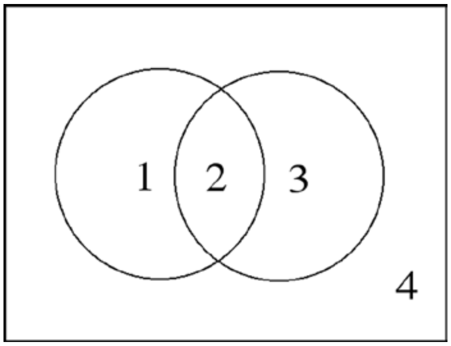


$(A \cap B^c)$ – dealt any card except a heart or a queen.



$(A \cup B)^c \cup (A \cap B)$ – dealt any card except a heart or queen, not excluding the queen of hearts.

Why are there exactly 16 possible events? The following Venn diagram illustrates two events that have an intersection. There are four different regions that are created and they are numbered one through four. One way to generate all 16 events given above is to consider shading in zero, one, two, three, or four of the regions. Counting using combinations is useful to determine all the ways to shade the regions.



The concept of combinations is important for the study of probability and the definition is as follows: there are

$$\binom{n}{r} = \frac{n!}{(n-r)!r!}$$

ways to choose r objects from n distinct objects when the order of the r chosen objects does not matter. For our example, $n = 4$ and $r = 0,1,2,3$, or 4. There is

$$\binom{4}{0} = \frac{4!}{(4-0)!0!} = 1$$

way to choose zero regions from the four to shade,

$$\binom{4}{1} = \frac{4!}{(4-1)!1!} = 4$$

ways to choose one region from the four to shade,

$$\binom{4}{2} = \frac{4!}{(4-2)!2!} = 6$$

ways to choose two regions from the four to shade,

$$\binom{4}{3} = \frac{4!}{(4-3)!3!} = 4$$

ways to choose three regions from the four to shade, and

$$\binom{4}{4} = \frac{4!}{(4-4)!4!} = 1$$

way to choose four regions from the four to shade. Therefore, there are

$$\sum_{i=0}^{4}\binom{4}{i} = 1+4+6+4+1 = 16$$

possible events that can be created from two events that intersect.

There is another important counting idea that can be used to arrive at the total of 16. Consider the four regions in the Venn diagram above as a set of regions $S = \{1, 2, 3, 4\}$. This set, S, could be thought of as a sample space containing four outcomes. The total number of events that can be created from S is $2^4=16$. The general counting rule is that if a sample space contains n outcomes then there are 2^n possible distinct subsets or events. This is due to the fact that

$$\sum_{i=0}^{n}\binom{n}{i} = 2^n .$$

Variations of this exercise can be used for a variety of grade levels. The following table illustrates these variations. The variations are listed in ascending order based on difficulty. A variation includes all variations that came before it.

Variation	**Concept**
Create 16 Venn diagrams and shade each of the 16 possible events. Verbally describe what each event stands for.	Using Venn diagrams to represent events, using verbal skills to describe events, and using logical thought processes to come up with all 16 events.
Verbally describe what each events stands for using the terms *and*, *or*, and *not*.	Verbalization of the concepts of intersection, union, and complement.
Use mathematical notation to represent each of the 16 possible events.	Properly using mathematical notation for intersection, union, and complement.
Give a mathematical argument for why there are exactly 16 possible events.	Counting ideas including combinations.

Is it Possible to Teach Statistics to Six Year Olds?

Missy Courtney, Mason Ridge Elementary School, St. Louis, MO

Would you rather be invisible or have the power to fly? First grade students would be able to tell you what the majority of their classmates decided based upon data that they collected and then analyzed. Many wonder if teaching statistics in first grade is even possible. Yes, even at the ages of six and seven students are learning about and applying statistics!

In my classroom I teach a series of lessons in which the students are becoming statisticians. The lesson begins with me posing a question to the students: Would you rather have ice cream in a cup or in a cone? Hands raise with excitement and students are eager to share their responses. After a few students have shared their answers I stop and ask the students if they have an idea how I can keep track of the number of students who like ice cream in a cone and the number who like ice cream in a cup. Silence momentarily takes hold of the room while the students are thinking; however, a few seconds later someone suggests that I make tally marks on the board. I continue recording student responses on the board until all of the students have shared. Next, I model counting the tally marks and making a bar graph of the data. At the conclusion of the lesson, I introduce the term data to the students and ask them what the ice cream data tells me. Several students raise their hand and say that more students in our class like ice cream cones.

The next day I revisit our ice cream survey and tell the students that today they are going to get to ask a question to their classmates, but that they need to have a plan in place before they start. With a partner, the students generate a survey question. Next, they brainstorm how they are going to record their data and make sure that every student in the class is polled once. I give the students a class list to help them with this step in the process. After the students have a plan they begin methodically collecting data. This is a "busy" time in the classroom. The students cannot wait to ask their questions to one another!

Once all the data are collected the students immediately begin tallying the results and analyzing the data. The partners work together to make a bar graph representation of the data. The students realize that the bar graph is a "picture" of the data and people can quickly look at it to see the answer to the survey question.

The last day the students write about what they learned from doing the survey, and more importantly what their data tells them about their classmates. The students take turns presenting their work to the class. They discuss the plan that they used to collect the data, their bar graph, and ultimately what they learned from the data they collected. It is an exciting time for the students as they are eager to see how their answers compared to that of their classmates.

The students are engrossed in this lesson for three days and afterwards they ask if they can do more surveys! They are energized to collect more data from their classmates and learn more about each other. Even the youngest minds are eager and able to comprehend and apply statistical concepts! ■

FREE STATISTICS EDUCATION WEBINARS

Recorded webinars (web-based seminars) on K-12 statistics education topics are free to view at *www.amstat.org/education/k12webinars*. This webinar series was developed as part of the follow-up activities for the ASA Meeting Within a Meeting (MWM) workshop for math and science teachers (*www.amstat.org/education/mwm*) held in conjunction with the Joint Statistical Meetings last summer in Salt Lake City. MWM and the webinars are part of ASA's outreach activities to enhance K-12 statistics education. The Consortium for the Advancement of Undergraduate Statistics Education (CAUSE) offers free webinars on undergraduate statistics education topics at *http://www.causeweb.org/webinar/*.

Bridging the Gap Between Standards and the Classroom

Teaching Data Analysis, Probability, and Statistics: A Conference for Pre-K – 12 Mathematics Educators

Friday, June 20, 2008
9:00 a.m. – 3:00 p.m.
The Lawrenceville School
Lawrenceville, NJ

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

The American Statistical Association (ASA)/National Council of Teachers of Mathematics (NCTM) Joint Committee on Curriculum in Probability and Statistics is sponsoring a one-day conference for Pre-K – 12 mathematics educators who are interested in bridging the gap between national standards and classroom practice in the area of data analysis, probability, and statistics. A major goal of the conference will be to introduce participants to the ASA's *Guidelines for Assessment and Instruction in Statistics Education (GAISE): A Pre-K–12 Curriculum Framework*, which was developed to support and further elaborate on the Data Analysis and Probability content strand in NCTM's *Principles and Standards for School Mathematics*. Conference presenters will include authors of the GAISE document, as well as members of the ASA/NCTM Joint Committee.

COST:
$50, which includes conference registration, notebook with handouts, a copy of the GAISE document, continental breakfast, morning snack break, and lunch.

FORMAT:
The conference will open with a general overview of the Curriculum Framework and its connection to the NCTM Standards and the *College Board Standards for College Success in Mathematics and Statistics*. Following the opening session, participants will attend breakout sessions by grade band: Pre-K-4, 5-8, and 9-12. In these interactive sessions, presenters will share instructional activities that support the teaching of data analysis, probability, and statistics in the mathematics classroom. During the lunch break, teachers will have an opportunity to network with colleagues and the presenters. Each teacher will receive a copy of the GAISE document, as well as a notebook containing handouts from the conference sessions.

LOCATION:
The Lawrenceville School
2500 Main Street
Lawrenceville, NJ 08648
(800) 735-2030

REGISTRATION:
To register online or to print out a registration form, visit www.amstat.org/education/gap.

QUESTIONS:
Contact Rebecca Nichols, ASA Assistant Director of K-16 Education Programs, at Rebecca@amstat.org or call (703) 684-1221 ext. 1877

Meeting Within a Meeting (MWM)

K–12 Teachers: Sharpen Your Statistics Skills

The Meeting Within a Meeting (MWM) Workshop for K–12 Teachers Will Be Held in Conjunction with the 2008 Joint Statistical Meetings (JSM)

American Statistical Association Workshop Is Based on the Guidelines for Assessment and Instruction in Statistics Education (GAISE) Report: A Pre-K–12 Curriculum Framework

Date Monday, August 4, and Tuesday, August 5, 2008

Place Metropolitan State College of Denver and Colorado Convention Center, Denver, Colorado

Audience K–12 Mathematics and Science Teachers

Submit applications and letter from principal/district supervisor (template provided). Review of applications to attend MWM **will begin March 1, 2008,** and continue until the course is filled. Space is limited. If interested in attending, apply as soon as possible. Special consideration will be given to multiple math/science teachers from the same school.

See *www.amstat.org/education/mwm* to apply online.

Objectives Enhance understanding and teaching of statistics within the math/science curriculum based on conceptual understanding, active learning, real-world data, and appropriate technology

Content Teachers will explore problems that require them to 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 skill level develops and their experience broadens. Consistent with GAISE recommendations and NCTM Principles and Standards for School Mathematics.

Format Monday: K–4 and 9–12 sessions

Tuesday: 5–8 session

Activity-based sessions, including lesson plan development

Lunch with local ASA chapter members and Monday night dinner with career panel discussion

Optional activities at JSM (statistics education sessions, poster sessions, JSM exhibit hall)

Provided Registration cost

Meals and refreshments

Lodging reimbursement (up to a specified amount)

Handouts

Certificate of participation from the ASA certifying professional development hours

Follow-up Follow-up activities and webinars

ASA chapters network with local teachers to organize learning communities

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

See *www.amstat.org/education/mwm* for more information and to apply online.

BAPS - Beyond AP Statistics

August 5, 2008
8:30 a.m. – 4:30 p.m.

A WORKSHOP FOR EXPERIENCED TEACHERS

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

The ASA/NCTM Joint Committee is pleased to sponsor a Beyond AP Statistics (BAPS) workshop at the annual Joint Statistical Meetings in Denver on August 5, 2008. The BAPS workshop is offered for AP statistics teachers and consists of enrichment material just beyond the basic AP syllabus.

COST:
The course fee for the full day is $50. Lunch will be provided. Please note: Course attendees do not have to register for the Joint Statistical Meetings in order to participate in this workshop.

FORMAT:
The course is divided into four sessions led by noted statisticians presenting on the following topics:

Roxy Peck
CalPoly, San Luis Obispo
Logistic Regression

W. Robert Stephenson
Iowa State University
Experimental Design—To Block or Not To Block?

Tom Short
Indiana University of Pennsylvania
Bootstrap Methods

Stephen M. Miller
U. S. Bureau of Labor Statistics
Joint Program in Survey Methodology
University of Maryland
Topics in Survey Methodology

LOCATION:
Metro State College of Denver
SI Building, Auraria Campus
1150 12th Street
Denver, C0 80204

REGISTRATION:
To register online or to print out a registration form, visit *www.amstat.org/education/baps*.

QUESTIONS:
Contact Rebecca Nichols, ASA Assistant Director of K-16 Education Programs, at *Rebecca@amstat.org* or call (703) 684-1221 ext. 1877