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The Editor's Corner

Welcome to Issue 81 of the *Statistics Teacher Network*. There are seven articles which touch on a wide variety of interesting and valuable topics. The four associate editors and I have worked with the authors to provide you timely and useful information for your teaching and classroom. Here's a quick synopsis of what you will find.

Do you know the statistical significance of 2013? *The American Statistical Association (ASA)* and organizations around the world are promoting the valuable contributions of statistics to our society. An *International Year of Statistics website* has been created and Angie Walmsley has identified specific sections of interest to teachers.

Rebecca Nichols describes the ASA's *U.S. Census at School program.* She provides up-to-date numbers and the benefits of using the program to implement a successful statistical literacy project which is aligned with the Common Core State Standards (CCSSM). Tim Jacobbe and Christine Franklin inform us about an NSF-funded project, Levels of Conceptual Understanding in Statistics (LOCUS). The project is pilot testing assessments focused on measuring students' statistical understanding across levels of development as identified in the *GAISE* framework.

This issue even contains an international focus! Read the epic poem explaining confidence intervals written by Daan van Schalkwijk of Amsterdam University College in The Netherlands. I'm sure your AP high school students will find it engaging. Lina Ellis tells us all about teaching AP Statistics to homeschoolers. You may want to adopt some of her suggestions for your regular classroom.

Patrick Hopfensperger, University of Wisconsin–Milwaukee, describes the Core Math Tools, an open-source suite of Java-based software tools designed to support effective implementation of CCSSM. The software is available at no cost from *National Council of Teachers of Mathematics.* Check out what you and your students can do with CMT!

Lawrence Lesser has created a hypothetical and playfully exaggerated vignette. His portrayal can serve as a vehicle to unpack students' misconceptions and gaps about measures of center.

As always, I'm interested in hearing from you with ideas for improving STN, suggestions for articles, new teaching techniques, and/or upcoming events relevant to our cause. Please email me directly at *rpierce@bsu.edu*

Best Regards,
Rebecca Pierce, Editor, Ball State University

Also in this issue …

Articles

2013: The International Year of Statistics

Angela L.E. Walmsley, Northeastern University Seattle Graduate Campus

Do you know the statistical significance of the year 2013? Well, you can find out from *www.statistics2013.org*. The American Statistical Association is promoting the International Year of Statistics, and you may find some intriguing ways to spice up your teaching.

I've taken some time to explore the International Year of Statistics website and want to point you to interesting sections for teachers. For instance, the "Statistic of the Day" is a cute section in which every statistic of the day since January 1 is archived. If you are looking for some "real life" examples of statistics used every day, check out the "Statistic of the Day."

I also really like the "Statistician Job of the Week" section. This section features various people who are statisticians or have types of statistical careers. It clearly gives prospective students good examples of what it might be like to choose a career in statistics.

Next, the "Statisticians at Work" section provides examples of the various industries and areas of employment in which statisticians are needed and/or wanted. It can serve as a great reference for students who like statistics but aren't sure where they might use it in a career, especially if they are interested in other professions or areas of study.

A fun and useful part of the website is a poster about statistics in various languages. Great for classrooms!

And if you need a list of famous historical statisticians, you can find that on the site, too.

Finally, one of the best parts of the website includes the section titled "Teacher Resources." This provides multiple websites as references for classroom ideas and information about statistics that can be used in lessons.

The Census at School program is an interactive and real-world program that teachers may use. A description from the website is as follows:

> "Census at School is a free, web-based classroom project that engages primary and secondary school students in statistical problem solving using their own data. This international educational initiative, launched in 2000 in the United Kingdom by the Royal Statistical Society, has programs operating in several countries.
>
> Under the direction of their teacher, students anonymously complete an online survey consisting of 13 questions common to all children and several questions specific to their country. The students then analyze their class census data and compare the results with those from random samples from other classes in their country and around the world."

See our related article in this edition, "ASA Census at School Program Hits 12,000-Student Milestone," for additional information.

Multiple websites are provided by various organizations and countries. Some that look interesting to teachers and have resources within them include the following:

Teaching Statistics Doesn't Have to Be Murder	*http://www.tes.co.uk/article.aspx?storycode=6312385&s_cid=tesmagazinehome*

Provided by the Australian Bureau of Statistics	*http://www.abs.gov.au/websitedbs/cashome.nsf/Home/EntryPage.es*

Using statistics to help you… get dressed! Provided by SAS	*http://blogs.sas.com/content/sastraining/2013/01/04/using-statistics-to-help-you-get-dressed/*

Finally, there are some statistical videos at the end of the teacher resource section, which also may prove useful.

I highly suggest you take a minute to browse the teacher resources page and the full website for the International Year of Statistics: *www.statistics2013.org*.

ASA Census at School Program Hits 12,000-Student Milestone

Interest in classroom statistical literacy project grows among teachers

The American Statistical Association's (ASA) U.S. Census at School program (*www.amstat.org/censusatschool*), an international classroom project that engages primary and secondary school students in statistical problemsolving, has recorded its milestone 12,000th student.

The program, launched in 2000 in the United Kingdom by the Royal Statistical Society (RSS), promotes statistical literacy among schoolchildren. It is now international, with programs actively operating in Australia, Canada, Ireland, Japan, Korea, New Zealand, South Africa, the United Kingdom, and the United States. In addition, statistics education leaders in other countries are exploring the possibility of offering the Census at School program to their country's students.

Editor's Note: An earlier version of this article appeared in the December 2012 issue of *Amstat News*.

The ASA launched the U.S. version of the program in 2010 in conjunction with that year's decennial count of the country's population by the U.S. Census Bureau. Reaching 12,000 students is gratifying, especially considering this milestone was achieved in a relatively short period. U.S. Census at School is an effective program to teach statistical concepts and principles to American students using their own real data, as well as data of their national and international peers.

The U.S. Census at School program has reached 12,208 students in 478 schools across the country. A total of 550 teachers in 43 states and the District of Columbia have registered to use the program, and 243 are teaching statistical problemsolving to students using the program. Since the beginning of the current school year, the program has grown by nearly 4,000 students.

We invite teachers who are seeking a successful statistical literacy education project aligned with the Common Core State Standards for Mathematics to implement the Census at School program in their classrooms.

Census at School is a free, web-based project that engages students in grades 4–12 in statistical problemsolving using their own data. Under the direction of his or her teacher, each student in a class anonymously completes an online survey. Together, the students analyze their class census data and compare those results with results from random samples of participating students throughout the United States and the world.

The online survey consists of 13 questions common to children in every participating country and a few questions specific to children in each country. The common questions are related to measurement—length (height, arm span, foot length), travel time to school, reaction time to an online applet, time to complete an online memory test—and category—favorite sport or activity. The U.S. questionnaire has additional questions about text messaging, hours of sleep, technology usage, future plans, allergies, and preferences (i.e., foods, music, school subject, their ideal super power). All questions lead to a variety of categorical and quantitative responses.

Students then engage in statistical problemsolving by formulating questions that can be answered with the data, collecting and selecting the appropriate data, analyzing the data and making appropriate conclusions in context.

To teach measurement, data analysis, and statistics, teachers can extract the Census at School data submitted by their students and a random sample of data from other students in the U.S. or any participating country.

Census at School also helps raise awareness of civic duty among students. They learn about the importance of the U.S. Census, conducted every 10 years, to federal and state government planning for education, health, transportation, and other essential public services.

The Census at School program is self-contained and includes detailed instructions, five instructional webinars, a PowerPoint presentation, lesson plans, and other resources. Teachers comfortable with statistical concepts, problemsolving, and data analysis can immediately begin using the program in their classes.

Getting Involved

The ASA is seeking champions to expand the U.S. Census at School program. Champions can be teachers who use the program in their classes or statisticians and statistics educators who assist teachers who are not yet comfortable with statistics and statistical problemsolving. There are a variety of ways to get involved, including sharing information about the program with local schools, writing lesson plans, and teaching local workshops for teachers. For those interested in teaching local workshops, the ASA will provide materials.

The ASA is also building online Census at School resources and seeking those interested in writing new U.S. Census at School lesson plans or adapting international Census at School lesson plans for U.S. data. Those teaching grades 4–12 pre-service teachers might consider encouraging them to create lesson plans using U.S. Census at School data and submit them to the STatistics Education Web (STEW), an online bank of peer-reviewed lesson plans for K–12 teachers. STEW lesson plans relating to Census at School will be published on the Census at School website in the resources area.

Educators teaching or advising undergraduate or graduate statistics students might consider encouraging or requiring them to get involved in service learning by working with grades 4–12 teachers and students to incorporate Census at School and enhance their statistical problemsolving skills.

Other ideas to enhance and expand the program are welcome. Contact Rebecca Nichols, ASA director of education, at *rebecca@amstat.org* about these or any efforts regarding service learning or other activities.

LOCUS: Expanding the A in GAISE

Tim Jacobbe, University of Florida, and Christine Franklin, University of Georgia

Despite the attention statistics is receiving in national and state standards, such as the Common Core State Standards for Mathematics (CCSSM), research suggests students are still unlikely to see statistics taught at a level sufficient to become statistically literate citizens. One of the major reasons for this may be that statistics is still taught in the same way it is being assessed on most large-scale assessments: in a procedural, rather than conceptual, manner (Konold, 1995).

The authors of the *Guidelines for Assessment and Instruction in Statistics Education (GAISE)* framework initially set out to address the challenge of assessing statistical understanding; however, the finished document primarily focused on instruction, with the assessment piece left for a future project. The NSF-funded (DRL-1118168) Levels of Conceptual Understanding in Statistics (LOCUS) project aims to fill in the "A" in the *GAISE* framework. This article will provide a brief historical background for the *GAISE* framework and then present how the LOCUS project will assist the statistics education community with assessing statistics in a conceptual manner.

Historical Overview of the Pre-K–12 GAISE Framework

In the December 2002 president's column in *Amstat News*, American Statistical Association (ASA) President Miron Straf wrote, "There is no more important investment we can make in our future than in advancing K–16 statistics education." In the January 2003 issue, Robert Mason suggested goals for promoting and participating in statistics education. At the top of his list was "develop curriculum guidelines for the K–12 statistics strand in the mathematics curriculum."

Building on the recommendations of these two presidents, the ASA Advisory Committee on Teacher Enhancement proposed a strategic initiative grant to develop ASA-endorsed guidelines for assessment and instruction in statistics in the K–12 curriculum. Authors of the pre-K–12 *GAISE* held initial discussions in August 2003 at the Joint Statistical Meetings and realized the enormous task ahead. The writing team proposed that the document would be structured differently than typical pre-K–12 standards.

The second meeting was held at the conclusion of the ASA-sponsored TEAMS conference at the University of Georgia in October 2003. The keynote speaker was Johnny Lott, then president of NCTM. Lott asked the statisticians, "In NCTM's *Principles and Standards for School Mathematics* (2000), the concept of the mean is discussed at the elementary, middle, and secondary levels. What is going on in statistics if you are doing the mean at all three levels? Are you doing the same thing?" The pre-K–12 *GAISE* writing team experienced a "light bulb" moment of how the *GAISE* framework should be structured.

GAISE Framework Goals and Structure

The *GAISE* framework outlines the conceptual structure for statistics education in a two-dimensional model, with one dimension defined by the four-step problemsolving process (formulate questions, collect data, analyze data, and interpret results). The second dimension is comprised of three levels of statistical development (levels A, B, and C) that students must progress through in order to develop statistical understanding. Levels A and B are roughly equivalent to the statistics standards in grades 6–8 in CCSSM, while Level C is equivalent to high school. However, the levels are not intended to be age dependent, but instead based on an individual's conceptual development and ability to reason statistically.

Influence of the GAISE Framework

The *GAISE* framework has been an influential document regarding the curriculum piece of statistics in pre-K–12 grades. It has become an instrumental document in providing guidance to writers of national mathematics documents, writers of state standards, curriculum directors, pre-K–12 teachers, and faculty of teacher preparation colleges. The document covers the essential topics and concepts in data analysis and probability for all students as they progress from kindergarten to graduation from high school. The *GAISE* framework has influenced the statistics components of both the *Mathematics and Statistics College Board Standards for College Success* (College Board 2007) and NCTM's *Focus in High School Mathematics: Reasoning and Sense Making* (NCTM 2008). Most recently, and perhaps most importantly, the *GAISE* framework was the basis for the statistics and probability component included in the CCSSM.

The missing piece of the document has been the issue of assessing statistics in a conceptual manner. Hence, the LOCUS project was conceived to fill in the "A" of the *GAISE* framework for the statistics education community.

LOCUS: Levels of Conceptual Understanding in Statistics

LOCUS is an NSF-funded project focused on developing assessments of statistical understanding across the levels of development as identified in the *GAISE* framework. The intent of these assessments is to provide teachers, educational leaders, assessment specialists, and researchers with a valid and reliable assessment of conceptual understanding in statistics consistent with the CCSSM. Ultimately, there are three intended purposes for the LOCUS assessments:

1. As a model for assessment developers to consider when constructing large-scale assessments
2. As a means of formative assessment for teachers to use when teaching statistics
3. As a valid and reliable instrument for researchers to measure growth in statistical understanding as the result of an intervention

The advisory board for LOCUS recommended assessing statistical understanding across levels A, B, and C of the *GAISE* framework by assessing levels A and B on one assessment and levels B and C on another assessment. Thus, four forms of the assessment are being developed: Level A & B, Form 1; Level A & B, Form 2; Level B & C, Form 1; and Level B & C, Form 2.

Each form of the assessment will have 30 multiple-choice items and six constructed-response items and will take approximately 90 minutes to complete. The items will be representative of the levels of development, as well as the process components identified in the *GAISE* framework. As the development of statistical understanding progresses across the three levels, the emphasis on the process components changes. Table 1 summarizes the percentage of the assessment items that will address each process component at a particular level of development.

Table 1. Prioritization of Process Components by Level

Process/Level	A	B	C
Formulating Questions	10%	15%	20%
Collecting Data	30%	25%	20%
Analyzing Data	35%	30%	25%
Interpreting Results	25%	30%	35%

As can be seen in the table, the emphasis on formulating questions and collecting data remains at a combined 40% across all levels of development. As students progress in their statistical understanding, the expectations shift from teachers posing all questions to students being able to construct their own statistical questions at Level C. Likewise, the emphasis on the analysis and interpretation of data remains at a combined 60% across all levels of development. As students progress, the expectations increase for students' abilities to interpret data appropriately for a given context.

The LOCUS assessments are in the midst of the evidence-centered design process. These assessments are being pilot tested now and will be administered operationally for the first time in spring 2014. It is expected that the assessments will become available to the statistics education community by fall 2014. As part of this development, the project team will create and identify resources for teachers to use in their classrooms.

One goal of the materials will be to allow teachers to assess their students at the beginning of the year so instructional decisions may be made based on where the students are in their statistical understanding. Furthermore, specific examples will be provided, along with item-level data. This information will serve as a powerful resource for professional development.

To keep up to date regarding the current status of the LOCUS project and information about how to obtain access to the Evidence Model and LOCUS assessments, please visit *http://locus.education.ufl.edu*.

Conclusion

What began as a call to action by two former presidents of the ASA followed by a bit of direction from a president of NCTM has resulted in a document that has informed standards and curriculum developers. What's been missing is the age-old issue of how to assess statistical understanding in a conceptual manner. The LOCUS project is aiming to address this issue and fill in the "A" that was left out of the *GAISE* framework. Collectively, the *GAISE* framework and LOCUS assessments will improve and advance the statistical preparation of K–12 students.

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Creation of a Grand Statistical Poem

By Daan van Schalkwijk, Amsterdam University College, The Netherlands

The current academic year is my second year of teaching basic research methods and statistics at Amsterdam University College (AUC). At AUC, we have a team of statistics teachers, and one of them, Maurits de Klepper, suggested using the p-value not only in the course content, but also in our approach to teaching. In this sense, it would mean the "personal-value": Bring personal elements into your teaching to connect better with your students. That sounded like a good idea.

I like writing poetry, so I showed a few poems I had written in English to the class as a little aside. Most students appreciated the small artistic excursion. I then offered to write a poem for someone if anyone would like. One of the young ladies present was amazed: "Really?" I replied in the affirmative.

The next class, while we were working on confidence intervals, the same student, with a deep sigh, said, "Why don't you write a poem about confidence intervals? Something like, 'Confidence intervals are stupid.' Period." That was a challenge I could not refuse. Since I was reading Beowulf at the time, I came up with the idea of writing an epic poem about confidence intervals. For the next class, I had the poem half finished. The students liked it, but wanted to know how the story ended. So soon after, I finished the poem. At the first opportunity, we performed the poem in class as read theater. The students really enjoyed the show!

Overall, the experience has been gratifying. There were some people in my class especially interested in plays and fantasy stories; one has even written a funny short story in return, which I greatly appreciated. The poem has helped connect with these interested students, and in that way, motivate them for the course. As a side effect, it will also embellish academic life: At the end of this academic year, the poem will be performed at the celebration of the capstone projects, or bachelor theses.

Because the poem was so well received by the students, I decided to publish it as an eBook. I also made PDF handout versions, so other teachers can use it easily. But, above all, I would like to encourage my colleagues to make good use of their *p*-value to connect to their students. It is motivating for the students, but also for the teacher. Keeping motivated as a teacher in turn motivates the students. Therefore, the *p*-value is an important ingredient for a successful class in both meanings of the term.

Confidence Interval - an Epic Poem

'My dearest people, oh my people'
The High King sighed in his high hall,
'Oh, how my heart desires to know you,
But could I count you? Not at all!'

'So I have sent for sage and wizard,
To tell me how to serve you best.
But do my confidence they merit?
Oh my poor heart won't give me rest.'

'Oh Sire, Sire' cried a squire,
-Was sternly told to keep his still-,
But he went on, 'Thy need, so dire,
I can alleviate; I will!'

'Then let him speak' declared the High King,
A kindly smile shone in his eyes,
'For the advice this lad will offer,
May chance be canny, if not wise.'

'With your permission, Royal Highness'
Up stepped the squire, with rev'rend bow,
'If it be confidence thy seeking,
I can provide it, I know how.'

'A valiant promise, master squire,
Then let us have it, we're all ears.'
A hidden grin ran through the courtiers,
But our stout squire knew no fears.

'Then well, for starters, take a sample,
Take it as random as one can,
From all the people in thy country,
May they be woman, child, or man.'

'Then from the sample, we must measure,
Whichever size thou longst to know.
It could be tallness, wideness, deepness,
Strength of arm or width of bow.

‘And now the trick, your Royal Highness,
That thee will grant thy dream so dear:
It from the averaged sample measure,
Will know your people without fear.’

‘I do object, your Royal Highness’
Cried out the kingdom’s senior sage,
‘What madness does this scoundrel tell us,
So hot of blood and young of age?’

‘Have patience, patience, wise advisor,
Let now the young man prove his claim.’
‘Well this is certainly unheard of,’
The sage then muttered, ‘on my fame.’

‘Your Royal Highness,’ said the squire,
‘Let me then liberally expound,
Confiding in your royal mercy,
The one solution I have found…

‘The central claim of my contention:
If now large samples one would make,
Then many means would form a bell curve,
Your people’s mean the top would take.

‘If one now has a single sample,
And wants with confidence to say,
Oh, where the people’s mean is lying:
It is surprising, but one may.

‘Say one wants confidence at level,
Of even ninety-five percent,
Then one finds all thy people’s values,
One may, from sample’s worth, defend.

The high- and lowest of these values,
Give us a bell-curve that lies so:
The sample mean does mark the outskirts,
With two-and-half percent to go.

‘And thus thou hast a range of values,
That people’s value doth contain,
In ninety-five percent of times when
Thou this procedure wouldst ordain.’

‘Onto the gallows’ cried the sage then,
The anger flushing in his face,
‘What blackest magic he expoundeth,
He rings a bell and lifts a haze.

‘Sire even if you found it candid,’
Went on the sage in breathless tone,
‘For all his valiant youthful promise,
Thy getst thy people’s mean alone.’

‘Beloved High King’ cried the squire,
His features raging with alarm.
But now the High King would have silence:
He raised majestically his arm.

‘My sage, thy words have proved thy wisdom
When even angered, all the same,
But then for thy request to hang him:
Well, oh my good Lord, oh for shame!

‘For indeed the boy proved canny,
Though perchance he be not wise.
And though there be some boastful promise,
There’s loyal service in his eyes.’

‘And it’s just this, young master squire,
That all your measures do not show:
For I would gauge my people’s spirit,
Their faithful loyalty to know.

‘And therefore, for your boastful promise,
You from your squire state I’ll fling.
For your intelligence and daring,
You’re now the student of the King.

‘Full well I recognise the promise,
Held by the method that you show.
But it requires a humble spirit,
Its strengths and weaknesses to know.

‘So study numbers, nice and certain,
Of people’s money, strength, and arts.
But let all hearers now remember:
The King cares more for people’s hearts!’

Daan van Schalkwijk—November 11, 2012

Questions to Aid Reflection

These questions can be used for private reflection, but are perhaps most effective as discussion questions in a seminar or in-class discussion.

Could you reproduce in your own words the squire’s explanation on the construction and interpretation of confidence intervals? Do you follow what he says?

The King remarks that the sage has spoken wisely, except for his condemnation of the squire. Do you agree with the sage? Is it true that a confidence interval only gives information about the population’s mean, or is there more to it? What valid point does the sage’s position imply?

The King’s final words point toward the strengths and weaknesses of statistics. How would you formulate the strengths of statistical theory, and how would you formulate its limits?

Resources for Teachers

This poem is also available online as an eBook: *http://goo.gl/xovKp*

A handout for in-class use can be found here: *http://goo.gl/IcsGB*

AP Statistics and Homeschoolers: A Good Fit?

By Lina Ellis, Homeschoolers Excelling in Greater Atlanta

Homeschooling is a concept that is gaining more traction these days. According to the National Center for Education Statistics, the number of homeschooled students has been increasing at an annual rate of approximately 7.4% since 1999. It is estimated that there are more than 2 million homeschooled students in the United States. The number of homeschooled high-school students taking college entrance exams and Advanced Placement (AP) exams is, as a result, growing as well.

Most parents of homeschooled students are not fully qualified or trained to teach AP courses. There are a few AP courses available online, such as *www.aphomeschoolers.com*, *www.apstatsprof.com,* and *muhigh.missouri.edu*. There are also many homeschool cooperative groups springing up across the country, in which experienced teachers are brought in to teach courses that parents are not qualified or able to teach. For the past three years, I have been teaching AP Calculus and Statistics in this type of homeschool setting. I wanted to share my experience for those of you considering teaching homeschooled students, homeschooling your own students, or are just curious about homeschooling.

You may be wondering how I became involved with teaching homeschooled students. I previously taught high-school mathematics in Nashville and Atlanta for a total of 14 years. When my second child was born, I decided to stop teaching temporarily and be a stay-at-home mom. I remained involved professionally by substitute teaching, tutoring, attending and speaking at conferences, and grading AP Statistics exams in the summers. I have also been a workshop leader and exam reader for AP Statistics since its inception in 1997.

Three years ago, I found out about a homeschooling group, now known as Homeschoolers Excelling in Greater Atlanta (HEGA), from a friend and former colleague. The opportunity to teach only one morning a week appealed to me. The group was looking for an instructor to teach AP math courses, so it was a perfect fit! Since the AP audit process started after I stopped teaching, I did have to go through the accreditation process to become College Board–certified to teach the AP courses.

Teaching AP Statistics in a homeschool setting is very different from teaching it in a traditional school. One of the big differences is the pacing of the course. In preparation, I had to revise my teaching schedule (see *Appendix I*). I would only be meeting with the students for an hour-and-a-half once a week. We would meet for 12 sessions in the first semester, and then have a semester exam. Second semester, we would meet for 16 sessions, and the students would take the AP exam in May. Though it is a fast-paced schedule, it is possible to cover all the topics.

Another difference between the homeschool and traditional settings is the variety in the types of students. I have found that the ability level, mathematics background, and motivation vary widely in homeschooled students. The prerequisite for taking AP Statistics is completion of Algebra II. In a traditional school setting, most—if not all—of my students would have completed Algebra II at the same school and I would be confident they would have covered and mastered the appropriate content. Also, at my previous schools, the Algebra II and pre-calculus teachers recommended students for AP Statistics, so the students I was getting had the ability and motivation to complete the course. However, in a homeschool setting, it is harder to know what the students covered the year before and if they are prepared for the AP curriculum. In the same class, I may have students who took their previous math course online, at home with their parents, or in a classroom setting.

For the past three years, 3–4 students began taking the course, but only one remained after a couple of months. The others realized they were not prepared and decided to drop the class. To prevent drop-outs mid-term, I have started assigning a pre-AP Statistics problem set during the summer, due on the first day of class (see *Appendix II*). I include topics from previous math courses that students need to know to be successful in AP Statistics. This way, they know ahead of time what is expected and will not be surprised later in the year. After completing the problem set, some students will decide not to take the course at all, but I believe this is better than having them drop in the middle of the semester. As a College Board–accredited teacher, I am responsible for upholding the rigor of the AP curriculum.

I also have adjusted my classroom policies and expectations (see *Appendix III*). I have found that I need to be stricter about deadlines in the homeschool setting, especially since I am only seeing the students face-to-face once a week. Since mathematics is like a language, students must practice it every day to be successful—once a week is not enough. I tell my students they should expect to spend at least 4–5 hours outside of the classroom each week working on AP Statistics. I also strongly encourage them to call and/or email me throughout the week when they have questions, and not wait until they get to class. This helps minimize the amount of time spent going over the homework in class each week. Class time is precious, and I want to make the most of it.

A second practice that preserves class time is to assign all tests and quizzes to be taken at home proctored by a parent. I put the test/quiz in an envelope with instructions on the outside and an honor pledge for the students to sign saying that they completed the assignment in the time allotted without receiving any outside help. However, I do not assign the semester exam

this way. I give it in a school setting in order for the students to have practice taking an exam in a more traditional setting.

Finally, I have had to alter the way I teach AP Statistics. Since I have limited class time, I do not do as much active learning, where students discover concepts for themselves through data explorations. Also, due to the small class size, I am not able to assign much cooperative group work. Another drawback is I am not able to get the students to collect data or perform simulations quickly and efficiently.

For example, in a traditional classroom with 15–20 students, we could easily get an idea of what a sampling distribution of sample means looks like by having each student take a sample of a given sample size from a given population and find the sample mean of their sample. Then we would collect all the students' sample means together in a histogram. With only a handful of students, this process is much more tedious and time consuming. Because students are learning about these tasks for the first time, I prefer to have them do the tasks by hand. However, to save time, I find myself relying on applets on the Internet instead, such as *www.rossmanchance.com/applets*.

Another resource that is especially useful for teachers with small class sizes is Census at School. This website, produced by the American Statistical Association, allows students to enter data online and then share that data with students at other schools. That way, even if one has only a few students in class, they can have access to larger data sets that are meaningful to them.

There are many challenges to teaching AP Statistics in a homeschool setting. In many ways, it requires one to adapt pacing, classroom policies and expectations, and teaching strategies. I still believe the optimal way to learn statistics is in a traditional classroom setting in which students have access to the teacher and other students 4–5 times a week. However, with motivated, committed, and prepared students, it is possible to successfully complete an AP Statistics course in a homeschool setting.

Appendix I:
Teaching Schedule

FIRST SEMESTER		SECOND SEMESTER	
Week #	Topics Covered	Week #	Topics Covered
1	Unit 1: Introduction to Statistics	14	Unit 4: Random Variables
2	Displaying Quantitative Data	15	The Normal Distribution
3	Measures of Center and Spread	16	Binomial and Geometric Distributions
4	Transformations of Data	17	Sampling Distributions
		18	Central Limit Theorem
5	Unit 2: Bivariate Data and Regression		
6	Correlation and Residuals	19	Unit 5: Confidence Intervals
7	Nonlinear Data	20	Hypothesis Tests
8	Causation and Association	21	*t* Distribution
		22	Power and Error
9	Unit 3: Data Collection Methods		
10	Experimental Design	23	Unit 6: Two Means
11	Simulations and Probability	24	Proportions
		25	Chi-Square Test
12	Review for Exam	26	Slope of the Regression Line
13	Semester Exam		
		27	Review
		28	Exam Review
		29	Exam Review
		30	Exam Review
			AP Exam

Appendix II:

Pre-Statistics AP Review Problem Set

Show all your work on your own paper. Don't forget to pledge your work!

No Calculators Allowed on this Side!

1. Given $y = 12 - \frac{2}{3}x$.

   a) Sketch the graph.

   b) Find the slope, the y-intercept, and the x-intercept.

2. Given $y = 3(2^x)$.

   a) Sketch the graph.

   b) Find the y-intercept.

3. Solve for x:

   a) $\ln x = 3$

   b) $\log_2(x) + \log_2(x - 2) = 3$

   c) $10^x = 4$

4. A line contains the point (2, 7). Find its equation if:

   a) the slope of the line is $\frac{1}{3}$

   b) another point on the line is (–1, 3).

5. Evaluate:

   a) $4!$

   b) $\frac{8!}{(3!)(5!)}$

   c) 1.99245×10^{-4}

Calculators Allowed on this Side!

6. If you are camping in the woods, one way to predict the temperature is by how quickly the crickets are chirping. The relationship can be modeled by the equation $y = 0.119x + 5.083$ where x represents the number of chirps per minute and y represents the temperature in degrees Celsius.

    a) What is the y-intercept? What does it mean in the context of this problem?

    b) What is the slope? What does it mean in the context of this problem?

    c) At 27°C, how many cricket chirps per minute would you expect to hear?

7. Jerry's golf scores over a 2-month period are 93, 85, 85, 103, 97, 87, 88, 86, 94, 99, 101, 85, and 89.

    a) What is his median score?

    b) What would Jerry have to score in his next game to have an average score of 90?

Appendix III:

AP STATISTICS

"Statistical thinking will one day be as necessary for efficient citizenship as the ability to read and write." — H. G. Wells

COURSE DESCRIPTION:

This course will follow the curriculum set forth by the College Board and is the equivalent of one semester of college-level statistics. The focus will be more on concepts and reasoning, rather than on computation. Reading critically and writing analytically will be much more important than solving equations. The course will be activity-based and project-oriented.

TEXT: *The Practice of Statistics.* Yates, Moore, and McCabe. W.H. Freeman.

INSTRUCTOR: Lina B. Ellis

linaellis@bellsouth.net

(404)351-0595 – home or (404)386-4186 – cell

TECHNOLOGY: We will use technology to explore topics numerically and graphically. You will need a graphing calculator for this course. I will be using the TI-83/TI-84 graphing calculators in class. I will also supplement with applets from the internet, TI-CBL's, and the Decisions through Data video series.

WHAT TO EXPECT:

Homework (10%) – An assignment schedule will be handed out for each unit. There will be homework assigned each class. You are expected to complete the homework and come to class prepared to discuss and present your answers. You are expected and encouraged to contact me during the week by phone or email with questions. Do not wait until class to ask your questions. Homework will be either spot-checked or taken up at the beginning of each class. To receive credit, all work must be shown clearly using correct notation.

Quizzes (10%) – There will be at least one quiz in each unit. Some quizzes will be take-home and some will be pop quizzes in class. Take-home quizzes will require an honor pledge.

Tests (30%) – At the end of each unit, there will be a take-home test. You will be required to show work using correct statistical notation and you will expected to explain concepts and solutions in context using complete, well-written sentences. Honor pledge is required.

Classwork/Participation (5%) – You are expected to participate in all class activities and discussions and to work problems on the board. Attitude, effort, and punctuality will also be reflected in your participation grade. Sometimes, there will be problems or labs to be worked in class for a grade.

AP Review Problem Sets (10%) – One week before the end of each unit, you will be assigned a set of problems from past AP exams. You will be required to show your work and justify your solutions using complete, well-written sentences. These problem sets will be graded using the AP exam rubrics.

Projects (10%) – During each unit, a project will be assigned to be completed on your own. You will have the opportunity to apply the statistics you are learning in class to your other subjects or areas of interest.

Semester Exam (25%) – At the end of first semester, there will be a cumulative exam. All students will take the AP exam on May 16.

WHAT I EXPECT:

Be Prepared – Homework should be completed before class begins and you should be in your seat with all the necessary materials ready to work!

Participate – You are expected to participate in all class discussions and activities.

Be Responsible – It is your responsibility to keep up with your work. All assignments should be turned in at the beginning of class on the day they are due. Your grade will drop a letter grade for each day late. If you have a planned absence, you are to turn in your work before you leave. If it is an unplanned absence, you are to get your work to me by email or fax in a timely manner. (i.e., If you are sick for two days, you have two extra days to complete your work.)

Be on Time – We have much to cover and not much time to cover it, so class will begin on time and you are expected to be there ready to work!

Do Your Own Work – You may work with other students on homework, but quizzes, tests, AP review problem sets and projects should be your own work. You are on your honor to complete these on your own with no outside help. You will be required to sign an honor pledge for these.

Be Organized – You are expected to keep up with all of your assignments, your textbook, your calculator, your work and your notes.

Ask Questions – You are expected to ask questions as soon as you have them and not to wait until the weekly class. Please email or call me with any and all questions you have! I am here to help you!!

UPCOMING CONFERENCES

Recordings are freely available online for the 2012 **Electronic Conference on Teaching Statistics (eCOTS).** The next eCOTS will be held May 19-23, 2014.

The **International Association for Statistical Education (IASE)** will hold their 2013 satellite conference August 22-24 in Macao, China before the ISI meeting in Hong Kong. The theme is Statistics Education for Progress.

Statistics education sessions will be held at the 2013 **Joint Statistical Meetings** on August 3-8, 2013 in Montreal, Quebec, Canada. The conference theme is Celebrating the International Year of Statistics.

The 9th **International Conference on Teaching Statistics (ICOTS 9)**, will be held in Flagstaff, Arizona on July 13-18, 2014. The theme of ICOTS 9 is Sustainability in Statistics Education.

ASA is also involved in graduate education, continuing education, professional development opportunities webinars, and international education outreach through the educational ambassador program. For more information, see *www.amstat.org/education.*

Free Lesson Plans Available on Statistics Education Web for K–12 Teachers

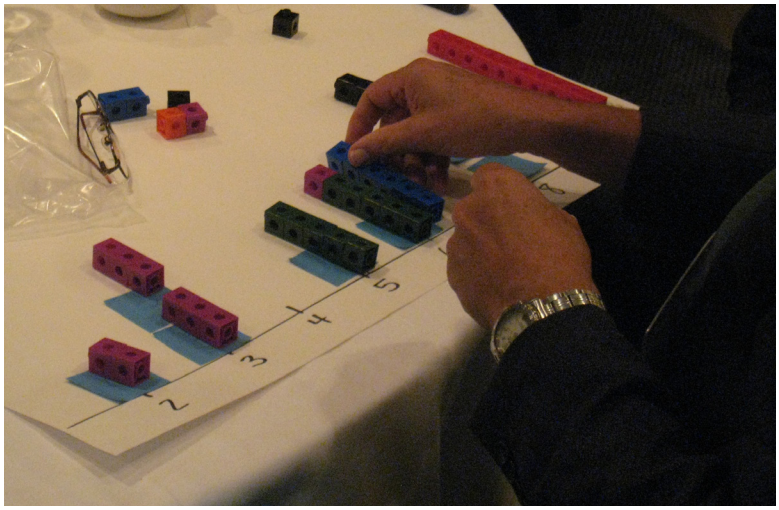
Statistics Education Web (STEW) (*www.amstat.org/education/stew)* is an online resource for peer-reviewed lesson plans for K–12 teachers. The lesson plans identify both the statistical concepts being developed and the age range appropriate for their use. The website resource is organized around the four elements in the GAISE framework: formulate a statistical question, design and implement a plan to collect data, analyze the data by measures and graphs, and interpret the data in the context of the original question. Teachers can navigate the site by grade level and statistical topic. In addition to using the free lessons, please also consider submitting several of your favorite lesson plans according to the STEW template to *steweditor@amstat.org*.

Judges Sought for Statistics Project Competition

The ASA/NCTM Joint Committee on Curriculum in Statistics and Probability is seeking judges for the 2013 Statistics Project Competition (*www.amstat.org/education/poster-projects*). Judging takes place via email during the summer and requires about four hours of your time. If interested, please email Jamis Perrett at *jamis@monsanto.com*.

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. A new webinar on Census at School has recently been posted. The Consortium for the Advancement of Undergraduate Statistics Education also offers free webinars on undergraduate statistics education topics at *www.causeweb.org*.



During the 2010 Mathematics and Science Teacher's Workshop

Statistics Workshop for Middle and High-school Mathematics and Science Teachers

ASA Office, Alexandria, Virginia
August 15-16, 2013

MWM (*www.amstat.org/education/mwm*) will take place in outside the Joint Statistical Meetings this summer in the DC metro area. The workshop is meant to strengthen K–12 mathematics and science teachers' understanding of statistics and provide them with hands-on activities aligned with the Common Core State Standards they can use in their own classrooms. The cost of the workshop is $50. For more information, contact *Rebecca@amstat.org*.

2013 International Year of Statistics and Free International Statistics Education Resources

As part of the International Year of Statistics (Statistics2013), teachers everywhere can access in a a wealth of statistics instruction tools and resources from around the world at *www.statistics2013.org*. Also, you are invited to sign up your school to participate in Statistics2013. Hundreds of schools around the country and the world already are participating. Participation does not create an obligation for your school. To sign up, visit *http://www.statistics2013.org/iyos/join.cfm*.

MWM
Meeting Within a Meeting
a statistics workshop for K-12 teachers

Middle & High School Mathematics and Science Teachers

www.amstat.org/education/mwm

Sponsored by the American Statistical Association (ASA)

◆ ◆ ◆

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

Dates: Thursday, August 15 and Friday, August 16, 2013, 9:00 a.m. to 4:00 p.m.

Place: American Statistical Association, 732 N. Washington Street, Alexandria, VA 22314 (street parking available and metro accessible via the blue and yellow lines to Braddock Road station)

Audience: Middle and High School Mathematics and Science Teachers. Multiple mathematics/science teachers from the same school are especially encouraged to attend.

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, Virginia standards, *GAISE recommendations*, and *NCTM Principles and Standards for School Mathematics*.

Presenters: *GAISE Report* authors and prominent statistics educators

Format: Middle school and high school statistics sessions

Activity-based sessions, including lesson plan development for teaching statistical concepts at the middle school and high school levels.

Provided: Lunch and refreshments

Workshop activity handouts

Certificate of participation from the ASA certifying professional development hours

Optional graduate credit available

Cost: The course fee for the two days is $50.

Follow up: Follow-up activities and webinars (*www.amstat.org/education/k12webinars*)

Network with statisticians and teachers to organize learning communities

Registration: More information and online registration is available at *www.amstat.org/education/mwm*. Space is limited. If interested in attending, please register as soon as possible. The Washington Statistical Society (WSS) has generously offered to reimburse the $50 registration fee for the first forty K-12 teachers teaching in the Washington, DC-MD-VA-WV Metropolitan who register and attend the MWM statistics workshop. The 40 sponsorships are available on a first come, first served basis.

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

Competition for Best STatistics Education Web (STEW)/ Census at School Lesson

Rules and Guidance

OBJECTIVE

Write a STEW lesson plan that incorporates data from the Census at School website. The lesson plan should:

Demonstrate statistics concept(s) from the Grades 4-12 Curriculum using Census at School data

Generate excitement about statistics

Follow the STEW template, GAISE guidelines (www.amstat.org/education/gaise), and Common Core State Standards (*www.corestandards.org*)

PRIZES

Grand Prize: $500

Silver Medal Prize: $300

Bronze Medal Prize: $200

**ASA reserves the right to present fewer awards should entries not be of sufficient quality.*

ELIGIBILITY AND ENTRY DATES

Eligibility: ASA Members, K-16 teachers, and students (K-12, undergraduate, graduate)

Entries are due by July 15, 2013

Winners will be announced in October 2013

TO ENTER

Submit a Word version of the completed STEW lesson to *steweditor@amstat.org*

All entries will be considered for publication on the STEW website and Census at School resources website

JUDGING

Entries will be judged on the following:

Completeness of STEW lesson plan (including compliance with the STEW format)

Originality of the incorporation of Census at School data

Incorporation of the GAISE guidelines (www.amstat.org/education/gaise), and Common Core State Standards (*www.corestandards.org*)

Judging will be done by the STEW Editor, STEW Associate Editors and U.S. Census at School Representatives

FURTHER GUIDANCE

For a description of STEW, the STEW lesson plan template and example STEW lessons, see: *http://www.amstat.org/education/STEW/*

The Census at School website is at: *http://www.amstat.org/censusatschool/index.cfm*

Census at School participant instructions, see *http://www.amstat.org/censusatschool/participantinstructions.cfm*

Census at School resources, see *http://www.amstat.org/censusatschool/resources.cfm*

Any additional questions can be directed to Mary Richardson, STEW Editor *steweditor@amstat.org* or (616) 331-3364

STatistics Education Web

STEW

online journal of K-12 statistics lesson plans

Core Math Tools: Supporting Effective Implementation of CCSSM

Patrick Hopfensperger, University of Wisconsin-Milwaukee

The Common Core State Standards for Mathematics (CCSSM) includes Standards for Mathematical Practice in addition to content standards. The eight practices include processes and proficiencies, one of which is "use appropriate tools strategically." At the middle- and high-school levels, these tools are listed as "a spreadsheet, a computer algebra system, a statistical package, or dynamic geometry software." Proficient students "are able to use technological tools to explore and deepen their understanding of concepts." (CCSSM p. 7) There are also specific references to use of technology cited in the content standards for algebra (A-APR.6, A-REI.9, A-REI.11), functions (F-IF.7, F-BF.3, F-LE.4, F-TF.7), geometry (G-CO.5, G-CO.12), statistics and probability (S-ID.4, S-ID.7), and modeling.

Putting the Common Core State Standards into practice will require curriculum that includes rich mathematical tasks based on real-life scenarios and supported by emerging technology. Core Math Tools (CMT) is an open-source suite of Java-based software tools designed to support effective implementation of CCSSM. CMT was developed to provide access to tools identified in CCSSM. Students and teachers can download the software at no cost from the National Council of Teachers of Mathematics website at *www.nctm.org/coremathtools*.

CMT is an integrated software package organized around three major tools, as illustrated in Figure 1.

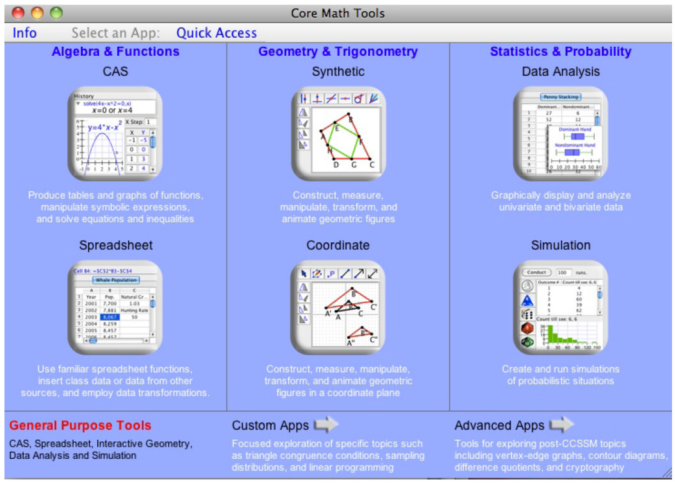


Figure 1

Algebra and Functions includes an electronic spreadsheet and a computer algebra system (CAS) tool that produces tables and graphs of single- and two-variable functions; manipulates algebraic expressions, including those involving matrices; and solves equations and inequalities. Included in the CAS tool are the algebra commands of simplify, expand, factor, and solve. Within this tool, there are many examples of different types of functions that can be graphed and analyzed. As shown in Figure 2, students can use sliders to investigate the effect each parameter has on the graph. Students also can use the trace feature to find relative minimums and maximums, as well as the zeros of the function and the y-intercepts. Students can use the CAS solve command to find the zeros of the function, as shown in Figure 3.

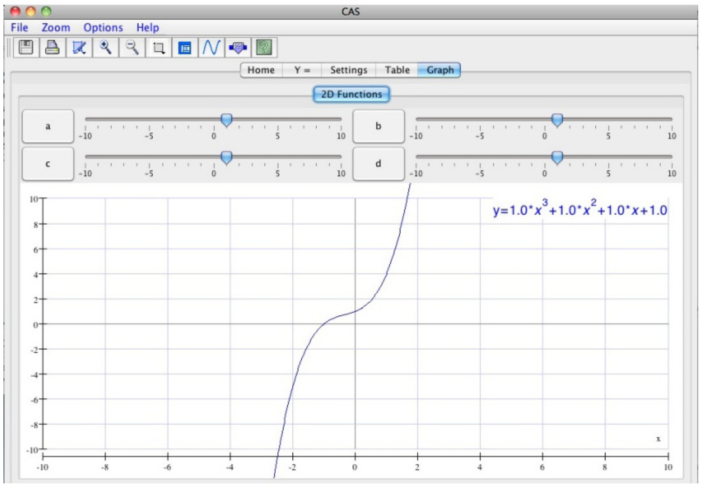


Figure 2

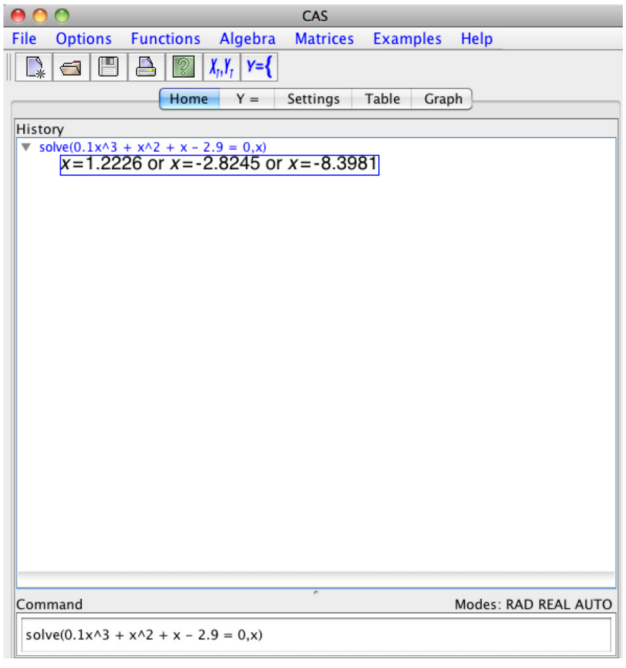


Figure 3

Geometry and Trigonometry includes an interactive drawing tool for constructing, measuring, manipulating, and transforming geometric figures; a simple object-oriented programming language for creating animation effects; and a set of custom apps for studying geometric models of physical mechanisms, tessellations, and special properties of geometric figures. For example, illustrated in Figure 4, students can investigate the reflection of a triangle over the x- and y-axes.

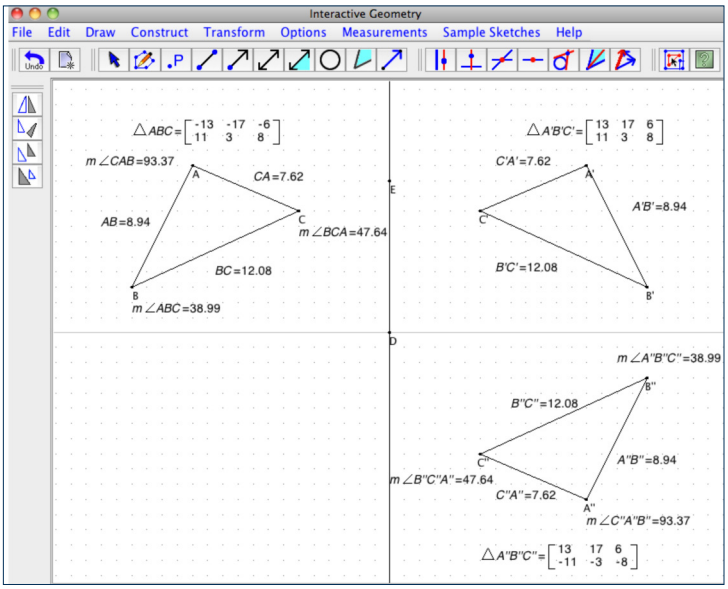


Figure 4

Statistics and Probability includes tools for graphic display and analysis of univariate and bivariate data, simulation of probabilistic situations, and mathematical modeling of quantitative relationships. The software contains an extensive collection of pre-loaded data sets that have been carefully selected to promote learning of specific content involving data and chance.

The description and suggested uses for each of these data sets can be found on the Core Tools website at *www.nctm.org/coremathtools.*

The data analysis tool allows the user to construct histograms and box plots of univariate data. A histogram of the greatest drop in feet of 55 USA roller coasters is shown in Figure 5.

Students can investigate the measures of center and spread by using moveable sliders that allow the students to estimate the mean, median, and standard deviation.

Figure 6 shows an analysis of bivariate data—grams of fat versus calories for hamburgers from several fast food restaurants. A moveable line has been fit to the data. The squared residuals and their sum also are shown, along with the slope and intercept. Students can use this feature to develop a deeper understanding of the least squares regression line. In addition to the linear model, CMT includes quadratic, cubic, quartic, power, exponential, logarithmic, polynomial, and sinusoidal models.

Another tool is simulation, which allows students to use standard simulation devices such as coins, dice, random numbers, and cards. Custom simulations can be designed to help understand problems like waiting-time scenarios. Figure 7 shows the design of a simulation to answer the question: In the United States, approximately 10% of the population has type B blood. On a certain day, a blood center needs 1 donor with type B blood. How many donors, on average, should they have to see to obtain exactly 1 with type A blood? Figure 8 shows the results of 101 trials.

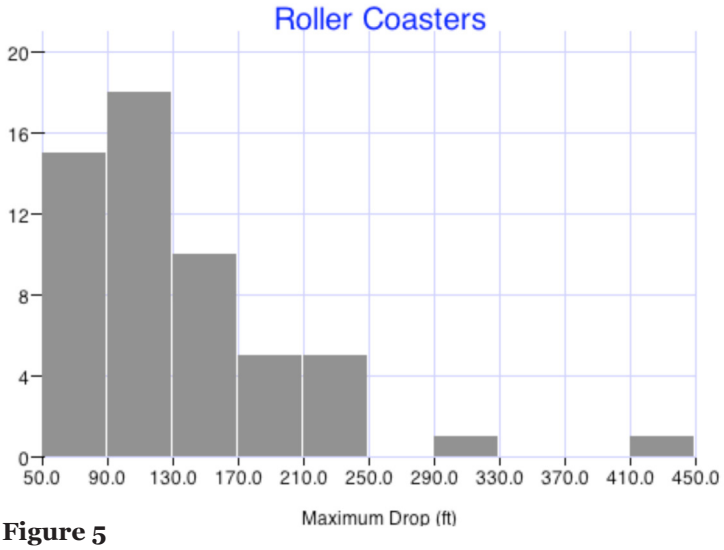


Figure 5

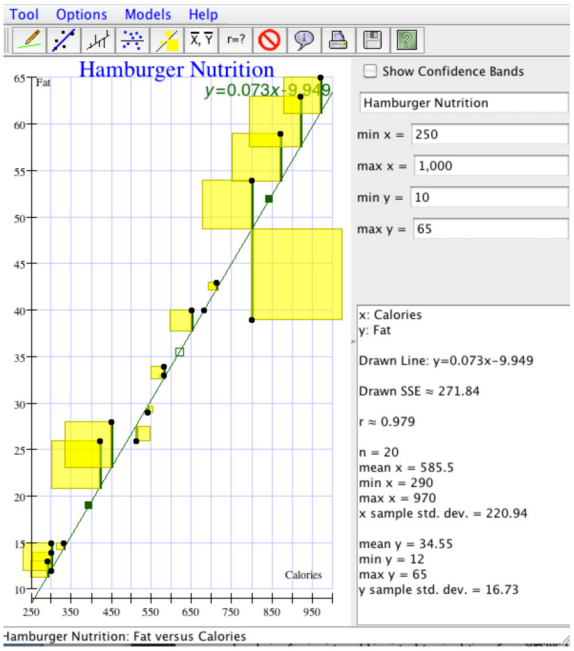


Figure 6

While Core Math Tools does not have any formal inference tests (e.g., the t-test), the data analysis tool includes two tools: distribution of a sample and randomization distribution.

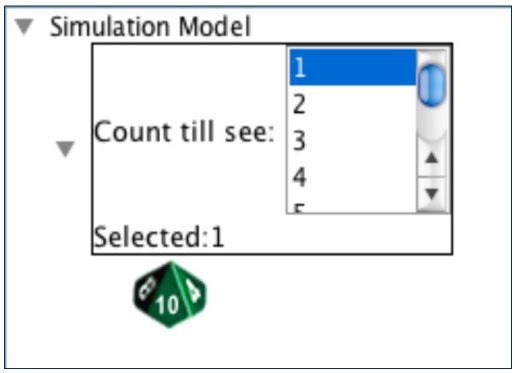


Figure 7

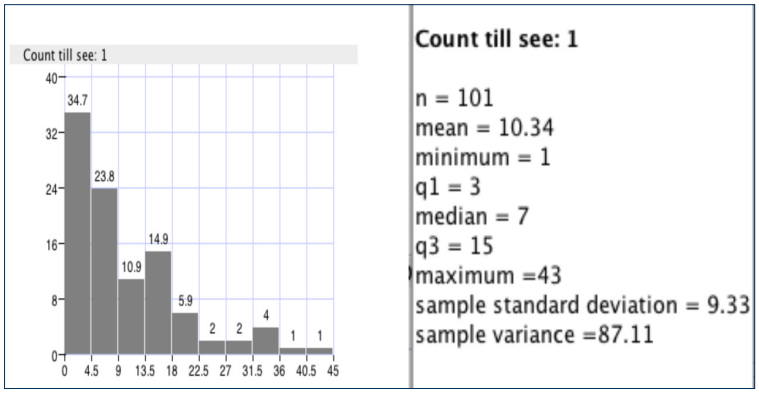


Figure 8

Here is an example of using the randomization distribution. Researchers at the Smell & Taste Foundation randomly assigned volunteers to wear an unscented mask or a floral-scented mask. The subjects then completed two pencil-and-paper mazes. The time (in seconds) to complete the two mazes was recorded. Data were recorded separately for smokers and nonsmokers because smoking affects the sense of smell. The results for 13 nonsmokers on their first attempt are given in the table. (Source: *www.nctm.org/coremathtools*)

Unscented Masks (sec)	Scented Masks (sec)
38.4	38.0
72.5	35.0
82.8	60.1
50.4	44.3
32.8	47.9
40.9	46.2
56.3	

The difference between the two means is 8.19. Is this a significant difference, or could this or a larger difference occur by chance? Figure 9 shows the results of 1,000 trials.

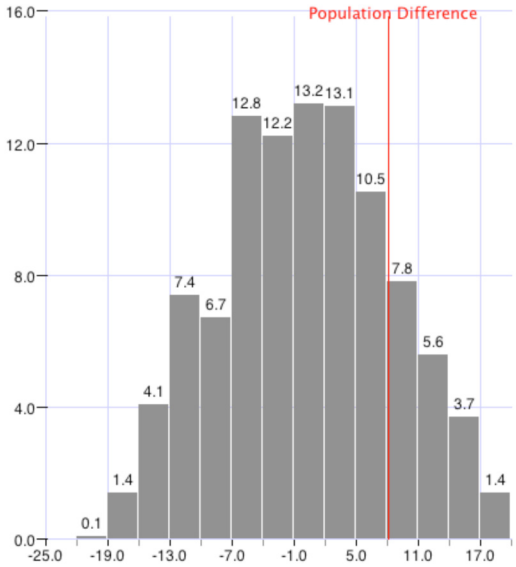


Figure 9

The histograms show that about 18% of the time, there is a mean difference of 8.19 or greater by chance. It appears the difference between the two means is not a significant result.

Summary

CMT was developed to provide equitable access to tools identified in the CCSSM. CMT can be saved on computers and USB drives, making it possible to use them without Internet access. Its files can be saved and reloaded by students and teachers. Its portability allows easy access outside the classroom by students, teachers, and parents. CMT will automatically check for updates when launched and Internet access is available. CMT is available at no cost to teachers and students and can be downloaded from *www.nctm.org/coremathtools*.

Further Reading

Common Core State Standards Initiative (CCSSI). 2010. *Common Core State Standards for mathematics*. Washington, DC: National Governors Association Center for Best Practices and the Council of Chief State School Officers.

Hirsch, Christian. 2012. Core Math Tools: Responding to the opportunity gap. *Michigan Council of Teachers of Mathematics Newsletter*, September.

Keller, Brin A., Christian R. Hirsch, Nicole L. Fonger, and Alden J. Edson. Core Math Tools: Supporting equitable implementation of the Common Core State Standards for Mathematics. In *Common Core Mathematics Standards and Implementing Digital Technologies*, edited by Drew Polly, Hershey, PA: IGI Global, in press.

One 'Mean' Class

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

Written as part of a breakout session for USCOTS 2013, this vignette depicts a teacher (T) covering mean, median, and mode for students S1 and S2. While the depiction is hypothetical (and playfully exaggerated in places), it can serve as a vehicle to unpack misconceptions and gaps related to this common topic.

T: Okay, we begin today's class covering our book's section on measures of center: mean, median, and mode.

S1: Is that like "average"?

T: Well, the word average can mean many things.

S2: So how do you know what it means on a package of light bulbs?

S1: And how does Excel know which one you want when you type the command 'AVERAGE'?

T: Let's use technology after we go through the concepts. We'll start with mode. Mode means the most frequent value.

S2: Is the most frequent value near the center?

T: No, it might be out on the far end.

S2: Then why does our book call it a measure of center?

S1: And what if two numbers tie as most frequent—are there two modes or no modes?

T: Good questions … I'll get back to you on them. Let's proceed to the mean.

S2: My favorite Taylor Swift song!

S1: Mine, too! My iPod plays a Taylor series of songs.

T: The mean means add up all the values and divide by the number of values. For example, if you make a 70 on two tests and 100 on one test, the mean would be 80.

S1: Wait, why can't you just average 70 and 100 and get 85?

S2: Can you give us a hands-on model?

T: Sure. It's a balance point for the data.

S2: A balance point? What do you mean?

T: Imagine a weightless board with markings. You could put one block at 100 and stack two blocks at 70 and the board would balance with the fulcrum right at 80.

S1: A weightless board?

S2: How would you know where to put the fulcrum in the first place? Just random guessing?

S1: Last year's teacher said the mean is the number that's an equal share for everyone. So is your balance point model better?

T: Let's move on for now. The median means the number that's in the center. So what's the median of this data set: {6, 3, 9}?

S1: 3. That's the number in the middle.

T: Sorry, I should have said the middle number after the numbers are sorted, so the answer is 6, not 3. Actually, the median is the number where half the data is below it and half the data is above.

S1: Half?? But only a third of the data is bigger than 6.

S2: And how do you find the median of an even number of data numbers, like {2, 4, 6, 8}?

T: Then the median would be 5.

S1: How can 5 be the middle number? It's not even in the data set!

S2: Is 5 the median because it's halfway between 2 and 8?

T: No, it's because 5 is the mean of the two middle numbers 4 and 6.

S1: Wait, why are we using the mean if we're finding the median?

S2: Aren't there zillions of medians 'cause any number between 4 and 6 would have half the data above it, right? So why should the mean determine the median?

S1: Is there a physical model for the median like there was for the mean?

T: I don't know if there is a physical model … I'll look into that. I recall something about minimizing absolute distances. …

S2: Absolute value? But the numbers are already positive!

T: … And this connects to something in the Common Core called "mean absolute deviation."

S1: Here we go again, using "mean" when we're looking for the median.

S2 [as an aside to S1]: All these M-words are so confusing—feels like our teacher's just being mean!

T: Class, we're almost out of time, so let's end with some practice. I overheard someone say 'mean,' so we'll start there. What's the mean of this data set, {3, 4, 5, 5, 8}?

S1: 5

T: What's the mode?

S2: 5

T: What's the median?

S1: 5

T: Great job, everyone! Today we covered a wide range of problems.

S2: Range? Hey, that's also 5!

S1: If measures of center are always about the same, how do you know which to use, or does it even matter? [school bell sounds in the hallway]

T: That's the bell. We'll continue tomorrow … I mean the day after tomorrow, because we're on block scheduling.

S2 [as an aside to S1]: I know I've got a mental block from this …

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