2009 USCOTS Posters and Beyond Abstracts

USPROC 2009 COMPETITION (ALPHABETICAL ORDER BY LEAD AUTHOR NAME)

Estimation of Allele Frequencies from Quantitative Trait Data
Authors: Kinjal Basu, Sujayam Saha
Institution: Statistics, Indian Statistical Institute, Kolkata, India
Instructor: Saurabh Ghosh, Anil Kr.Ghosh
Abstract: Analyses of quantitative traits, as opposed to binary clinical end-points, are becoming increasingly popular in genetic studies of human disorders. This stems from the fact that quantitative traits carry more information on variability within different genetic profiles than binary end-points. However, estimation of allele frequencies from quantitative trait data is statistically more challenging as the genotype information are unavailable and hence needs to inferred probabilistically. Moreover, the choice of the probability distribution for the underlying quantitative trait poses robustness issues on the estimates of the allele frequencies. In this article, we discuss three estimation procedures: the first is based on cluster analysis while the other two are based on EM and CEM algorithms, respectively using a three component mixture of Gaussian distributions corresponding to the three genotypes at a bi-allelic locus controlling the quantitative trait. Some modifications are also suggested for handling deviations from Gaussian model assumptions, especially for asymmetric and heavy-tailed distributions. Some simulated data sets and one real life data set are analyzed to show the utility of proposed methods.

Hierarchical Linear Modeling of the Effects of Self-Reflection Strategies on Mood
Authors: Gerald Haun, Adrienne Gallo
Institution: Psychology, University of the Sciences in Philadelphia
Instructor: Ralph M. Turner
Abstract: A 3-day experimental study (N = 78) examined the initial trajectory of mood increases resulting from completion of 1 of 2 positive psychology based self-regulation strategies: imagining one's best possible self (BPS) and expressing gratitude (EG). Undergraduate participants were randomly assigned to BPS, EG, or a control condition – detailing morning routine – groups. Participants completed their respective exercises for 3 consecutive days. Mood was measured at baseline and following completion of the exercise each day using the Authentic Happiness Index (AHI). The BPS and EG strategies improved participants' moods in a similar response trajectory, suggesting that they begin to work immediately and progress in a quadratic trajectory in the short-term. Results parallel previous evaluations which have supported the use of self-regulation techniques as a mechanism of increasing positive affect.

Random Forest to Predict a Complete Operon Map of the *Mycobacterium tuberculosis* Genome

Authors: Chee Lee
Institution: Statistics, St. Olaf College
Instructor: Paul Roback

Abstract: Characterization of genes in the *Mycobacterium tuberculosis* (MTB) genome is an essential starting point to understanding the biological pathways and processes of the bacteria, especially those processes that contribute to the bacteria's virulence. Here I use the statistical method random forest to build models that predict operon pairs (OPs) and non-operon pairs (NOPs) on the MTB genome using intergenic distance, coexpression correlations from microarray experiments, and promoter and terminator data. OPs are genes in operons, which are sets of regulated genes that are turned on under certain conditions and are involved in essential biological processes of the bacteria. MTB has 3,999 gene pairs, 1,439 of which have been confirmed as OP or NOP. The remaining unclassified 2,560 gene pairs are potential operon pairs (POPs). Three random forests models were built, two of which incorporated values imputed for missing coexpression correlations, to classify POPs and construct a complete operon map of the MTB genome. The three forests overlapped in over 90% of POP predictions. Sensitivity rates of the models ranged from 86.5-87.2%, and specificity rates were around 90%, which compares well with previously published classification models.

Recent Trends in Methane: A Spacio-Temporal Analysis

Authors: Victor Louie, Maykel Vosoughiazad
Institution: Statistics, University of California – Los Angeles
Instructor: Nicolas Christou, Dave Zes

Abstract: Methane, one of the more significant greenhouse gases, does not get as much attention as other greenhouse gases such as carbon dioxide, especially since the rate at which methane is being released into the atmosphere has leveled off in recent years. However, it has been found that methane is bubbling up from undersea chimneys and that could greatly increase its concentration in the atmosphere, due to the melting of the permafrost layers. Should the concentration of methane spiral out of control, it would greatly exacerbate global warming, thereby causing a positive feedback loop in which the melting of the permafrost layer releases more methane into the atmosphere, which causes the Earth to warm and more of the permafrost layer to melt, and thereby causing more methane to be released into the atmosphere. The rate at which methane is being released into the atmosphere has risen back up in 2007. Is this a cause for concern? In this paper, we intend to answer this question by providing some descriptive statistics, in which we examine the trend of methane through time, spatial prediction through kriging, and inference using hypothesis testing, to investigate the significance of the recent increase in the rate at which methane is being released into the atmosphere. For these statistical analyses, our data included methane recordings from 23 locations across the globe, from the years 1983 to 2007, ice core data, and more recent data which includes measurements from 2008. Our findings show that the increase in the rate at which methane is being released into the atmosphere for the years 2006 to 2007 and 2007 to 2008 are significantly higher than the average increase for the years 1770 to 1990, the years where methane increase was most dramatic.

INVITED BEYOND SESSIONS

Letting Go of the Idea that Stats Class Can't be Fun and FUNctional

Shonda Kuiper, Grinnell College
Larry Lesser, The University of Texas at El Paso
Dennis Pearl, The Ohio State University
Michael Posner, Villanova University

This interactive demonstration focuses on the use of fun in the classroom which is supported as being valuable to student attitudes and learning in the literature of nearly every science education discipline (see, for example, Lesser and Pearl, 2008 JSE). People who stop by our demo area will be able to see at a glance a live sequence of examples from various fun modalities. These will be highlighted by Shonda Kuiper demonstrating game-based learning, Larry Lesser leading a set on songs in the classroom, Dennis Pearl showing how to use cartoons to maximum effect, and Michael Posner demonstrating some statistical magic. Visitors will also have the opportunity to explore supporting guidelines for instructional use and take a tour of the CAUSEweb fun resources collection (www.causeweb.org/resources/fun/).

GVSU Statistics Manipulatives

- **Putt 'er There**
  Presenter: Kirk Anderson, Grand Valley State University
  Supplies: One automatic-return putting device, one putter, several golf balls, tape measure

  Description: Participants will putt golf balls from a specified distance ten times. On the first successful putt (assuming there is one!) the distance the ball travels from the hole will be measured. The categorical data can be used to illustrate the binomial test and the runs test. The quantitative data (as it accumulates) can be used for descriptive statistics, graphs, parametric and nonparametric confidence intervals. A prize will be given for the most putts made, with ties going to the longest putt return. All participants will receive an activity to use in their classes.

- **Just How Accurate Is That Pedometer? Walk – Walk – Walk, Shake Your Booty!**
  Presenter: Phyllis Curtiss, Grand Valley State University
  Supplies: A classroom set of pedometers, containing three or more brands.

  Description: According to **www.thewalkingsite.com**, guidelines say we should walk 10,000 steps per day, which is close to 5 miles. A pedometer will keep track of the number of steps you take, but just how accurate is it? If the pedometer says 200 steps, did you really take exactly 200 steps? Stop by and participate in an experiment to test if the brand of pedometer matters when it comes to accuracy. An activity will be provided to give ideas on how to use this data to illustrate descriptive statistics, the paired t-test and ANOVA.

- **Take That, Tiger Woods! Using GOLO to Illustrate Probability**
  Presenter: John Gabrosek, Grand Valley State University
  Supplies: A classroom set of GOLO games (one game for every two or three students) or access to a computer to play the online version of GOLO (www.igolo.com).

  Description: GOLO is a dice-based golf game that simulates playing a round of golf. GOLO can be used to illustrate basic probability concepts, descriptive summaries for data, discrete probability distributions, order statistics, and game theory. Participants will get a chance to play GOLO with the lowest score being awarded a prize! (No – it's not a set of new Callaway golf clubs.) Participants will leave the session with a ready-to-go GOLO activity.

- **Fire Away! Using Catapults to Illustrate Experimental Design and Statistical Process Control**
  Presenter: Paul Stephenson, Grand Valley State University
  Supplies: Access to materials and a lab to build catapults or a classroom set of statapults (one statapult for every three or four students).

  Description: Catapults (or statapults) are simple "machines" that can provide students with a realistic application in a setting which simulates a product engineering/ manufacturing scenario. The goal of our phased project sequences was to produce a catapult that will propel small objects across the room in a consistent fashion and use the catapults to demonstrate experimental design and statistical process control. Participants will leave the session with a series of phased activities for building a catapult and using that catapult to demonstrate analysis of variance and statistical process control. Participants will also be shown how statapults could be used.

CONTRIBUTED BEYONDS (ALPHABETICAL ORDER BY LEAD AUTHOR NAME)

Letting Go of End-of-Chapter Exercises

James Alloway, EMSQ Associates

The past 25 years have seen a steady shift in the emphasis of end-of-chapter exercises in introductory statistics textbooks. Many of the problems consisting of summary statistics where students performed a test of hypothesis are gone, replaced with mini data sets where students use software to perform the same task, and perhaps plot the data. While this shift is an improvement, it is still inadequate if we are to prepare students to apply statistical methods in the workplace. It implies that data sets are small, of high quality, and contain all the information necessary to answer the question posed. As educators, we must let go of these end-of-chapter exercises and replace them with real, hands-on data collection activities that don't necessarily have neat solutions.

Applied Statistics is a team-based, contact sport. It requires hands-on planning and data collection activities, a fundamental understanding of the measurement process, along with an understanding of cleaning data.

Since students learn better through relevant hands-on activities, it is time to replace the time-honored end-of-chapter exercises with real data collection and processing events prior to teaching the analytical portions of the course.

This poster highlights a kit for data collection exercises that contains a set of nearly universal measuring instruments. Discrete measurements are handled using a tally counter, a digital scale set in count mode, and ring gauges. Continuous measures include time using a stopwatch, temperature using a non-contact thermometer, course distance using cloth and steel tape measures, fine distance using an engineer's scale and four styles of calipers, angles using a protractor, and resistance and voltage using a digital multi meter.

The measuring devices highlight problems with measurement resolution and issues with team-based data collection. The measuring activities may last from one to several sessions, depending upon the intent of the course. Once the data are collected, they form the core data sets used throughout the remainder of the course. The statistical tools portion of the course tends to go better, since the students feel ownership of the data. They are also knowledgeable about the process and the data collected from it, and are thus better able to answer questions that may arise during the formal analysis. This is an opportunity never present in end-of-chapter exercises.

There will be a hands-on demonstration using two of the author's favorite data collection exercises: M&M candy, and the golden ratio.

Math Essentials and StatCat: A Demonstration of Two On-line Practice and Review Tools that Support Learning in the Introductory Statistics Classroom

Taras Gula, George Brown College

As a statistics professor in a community college I am often presented with students who lack the math and statistics skills necessary to success with introductory statistics. In order to address the needs of these students, and with funding from the Inukshuk Foundation, our team developed two review & practice websites (currently existing as prototypes): Math Essentials and StatCat. These websites provide an opportunity for students to review and practice essential mathematics and statistics skills not covered in a typical introductory non-calculus statistics course. The space is designed to be interactive, and to provide the user control of all aspects of their learning.

1. Math Essentials (http://mysql01.georgebrown.ca/~jchung/index.php) provides an interactive and visually rich vehicle within which students can review and practice basic math skills essential for success in an introductory statistics course{e.g., working with fractions, percents, rates, solving equations, basic probabilities}. Students not only control the pace of delivery, but control the mode of delivery as well. For each topic one has the choice of text, video demonstrations, flash visualizations/games and randomly generated practice questions to test one's knowledge.

2. StatCat (www.statcat.ca; login: guest@guestmail.com; password: guest) provides a vehicle wherein students can practice reading univariate and bivariate research scenarios (with or without visual hints) and connect those to distributions by identifying the number of variables and their type. Those of us teaching statistics do this thinking intuitively, and perhaps that is why this topic is usually glossed over in an introductory statistics course, yet it is an aspect of statistics that many students find very difficult.

The websites will be available to anyone interested. As part of our ongoing development of these sites, I invite you to visit, provide critical feedback, and discuss to what extent these websites would be useful as a support for your students.

Construction of the Sampling Distribution Using the Nonparametric/Permutation Complete Distribution Package

Timothy Hess, Ripon College

Many authors have advocated the use of permutation approaches in introductory classes. From a constructivist pedagogical point of view, this may aid in understanding given that students can build for themselves the complete sampling distribution of the statistic under the null hypothesis. For example, when comparing the location of two populations with the Wilcoxon Rank-Sum test, students can easily list out all possible permutations if the sample sizes are quite small, and from this, construct the sampling distribution. In contrast, to understand the sampling distribution of the t-test without the use of calculus or more rigorous theory, students are often left simply having to accept the authoritative proclamation of the instructor and/or the text. While both techniques may ultimately lead to knowledge of the underlying process, the literal act of creating the distribution "by hand" may be easier for many students to understand and does not require very much mathematical sophistication. It does, however, become a relatively cumbersome task as sample sizes increase.

This work will present a package written in the R statistical computing environment which displays the complete permutation distribution of a test statistic in both tabular and graphical format using either a command line or graphical user interface. Similar output is obtained for a wide array of statistical procedures including the Sign test, Wilcoxon's Signed-Rank and Rank-Sum tests (with sample sizes of over 50 in each group before simulation is employed), the Kruskal-Wallis test, conditional and unconditional exact binomial tests, and more. With many of the procedures, the option of using the original values, Wilcoxon ranks or normal scores is given. Providing the complete distribution allows students to see this familiar framework in a wide array of testing contexts where the sampling distribution can be constructed by hand. Moreover, providing the graph of the permutation distribution that includes the observed value of the test statistic and shading of the values of the statistic "more extreme" for the calculation of the p-value for all of these tests aids the more visual learners. A qualitative summary of experiences using the software in a liberal arts classroom will also be provided.

It Will Only Take Five Minutes: Time-Efficient Alternative Learning Tools to Enhance Student Understanding

Joseph Nolan, Northern Kentucky University
Jacqueline Wroughton, Northern Kentucky University

One of the biggest challenges we face as statistics faculty at Northern Kentucky University, as well as at many other institutions that emphasize teaching, is a larger class size. With a typical load of four classes containing 120 or more total students, grading of homework can consume 12 or more hours per week of an instructor's time.

Additionally, as such feedback is delayed by as much as a week in many cases, it is less useful to students who have moved on to newer material. As a matter of habit, we believe it important to explore ways of modifying course activities in such a way that feedback is both more immediate for the students as well as time efficient for the instructor. We present two such methods within this poster.

One method involves utilizing Blackboard© to give students online assessments as follow-ups to homework. These self-assessments are graded immediately by the computer, and students are allowed to see their results immediately. Missed questions are accompanied by feedback indicating the correct answer and discussing the error that was made by the student. After further review and study, students are encouraged to take the assessment a second time (with different questions). Statistical evidence combined with written student feedback suggests this is very effective in helping students enhance their conceptual understanding of statistics. It also seems to be effective in helping students practice and become comfortable with basic calculations. The instructor can easily scan results for commonly missed problems to isolate areas of deficiency and thus time that might normally be spent grading may be instead allocated to working with students to improve their understanding of the material.

The other methodology change involves implementation of activities in class. While many students benefit from the more tangible approach made available by in-class activities, it is sometimes hard for the instructor to get students to take them seriously. Focused group write-ups that follow the activity counteract this problem. Well designed questions lead students to identify the purpose of the activity and relate concepts learned in the activity to other parts of the class - with the end result being that they rise to meet its goals. During the activity, with the aid of the instructor and a worksheet guide, students work the problems together, discuss the concepts verbally, and begin to ask questions of each other that they may normally ask of the instructor. Students who understand a concept gain by explaining it to their peers, the instructor is readily available to quickly correct overheard misconceptions, and all of the students benefit from this discussion. They repeat the material as they complete the write-up, and since they do this in a group grading time is reduced by 50-66.7%! The write-up is further beneficial to the instructor who can use it to discover areas where students are still deficient and adjust accordingly.

For an educational method to work, it must be centered on the needs of both students and the instructor. Both of these methods enable the students to play a greater role in their own learning, while at the same time maximizing the benefit of timely feedback from the instructor. It is in these cases, where both parties are able to fully invest in the process, that the greatest amount of learning will take place.

An Early Start on Inference – The Symbiosis Experience

Edith Seier, Eastern Tennessee State University

To introduce inference early in an introductory statistics course has the advantage of providing the students with time to get used to the ideas and language of statistical inference throughout the semester. On the other hand, some classical inference methods require several prerequisites and this fact tends to push the inference topics toward the end of the semester. The solution might be to first teach inference methods for which prerequisites can be covered earlier and faster.

Symbiosis I is a course that integrates statistics and biology for freshmen majoring in biology; however, the material developed is exportable to stand-alone introductory statistics courses. The first three topics we cover in the course are:

- Basic probability and the binomial distribution
- Hypotheses testing using the binomial distribution
- Randomization tests

Soon after that, bootstrapping is introduced.

Hands-on activities are used whenever possible and programs written in R are provided to match those activities. When the classical topics of inference are introduced later in the semester, the students seem at ease with them; by then they already know how to write hypotheses and have an understanding of the definition of p-value and what to do with it.

The poster will display part of the teaching material prepared for those first weeks. For the 'Beyond' part of the presentation we have chosen three hands-on activities using plastic chips. One is about the randomization test, another about bootstrapping and the other is related to the test for proportions using the binomial distribution.

Activity # 1. Darwin's maize plants

Darwin was aware that inbreeding was not good for humans and wondered if it was not good for plants either. In 1857 he published the results of his experiments with maize plants; a data set that has been extensively analyzed in the literature. We have developed a hands-on activity with plastic chips and Darwin's data to allow students to become familiar with the idea and procedure of the randomization test before working with the computer.

Activity # 2. How long are the leaves of this tree?

We want to estimate the median length of the leaves of a given tree or bush. The students take a small random sample of leaves from it, they measure their length and we write each value on a plastic chip. Then each student selects a random sample (of the same size) with replacement from the plastic chips, and annotates the values and the median of those values. We plot the values of the medians obtained by each student. In that way we introduce the idea of 'bootstrapping'. Then we work with the computer to obtain an empirical distribution and a confidence interval for the median of all leaves in the tree. The activity is easily exportable to examples other than the leaves of a tree; we have done it with the length of onion cells that the students had measured in the lab.

Activity # 3. Testing H_0: p = 1/2

In most introductory statistics courses, inference about a population proportion is done using the normal approximation for the large sample case. Students are usually warned not to use the formula for small samples, but they are not given anything to use when *n* is small. We think that they should be taught the exact test based on the binomial distribution and that actually we can use that test to introduce the ideas of hypotheses testing for the first time. Each student is given a two color plastic chip (one side red and one side yellow), asked to toss it 10 times and to keep track of how many times the red side shows up on top . Looking at a binomial table ($n = 10$, $p = 0.5$), the student has to find the probability of getting that number of reds (or a more extreme number) just by chance when the probability of red is 0.5 and then make a decision about the null hypothesis. After the chips experience, the students work two real examples in which H_0: p = 1/2. One is testing for indifference between green and plain bread by female mallards. The other example is to test for 1:1 ratio (males vs. females) in fruit flies. Then we move to exercises in which $H_0: p = p_0$ with p_0 not necessarily equal to 0.5; for example, testing $H_0: p = 0.8$ in the context of germination of seeds.

Is the iPod Shuffle Truly Random? A Fun Activity for Introductory Statistics

Leigh Slauson, Otterbein College

iPod music players have become a part of our everyday lives, especially for college students. One of the most popular features on these devices is the shuffle, a feature that takes songs from the user's music library and plays them in a random order. However, many people have had the experience of hearing songs by the same artist back-to-back or in a short span of time and have questioned whether the shuffle feature is really "random." Steven Levy, the technology writer for *Newsweek* magazine, even wrote an article about this phenomenon in 2005. (http://www.msnbc.msn.com/id/6854309/site/newsweek/print/1/displaymode/1098/)

This activity allows students learn how different sampling techniques work and leads to a demonstration and discussion of what "random" truly means. Each student takes a simple random sample of 15-20 songs (using a computer program, a graphing calculator or simply a random number table) and then using the class' data can judge for themselves whether the iPod shuffle feature is random. If there is access to computer technology, a larger number of simulated playlists can be obtained and the probability of at least one repeated artist out of *n* songs (a complicated probability to calculate otherwise) can be approximated. Students are very interested to learn that Apple (the maker of the iPod) adjusted the shuffle feature because they were receiving so many complaints from users who did not understand the concept of randomness.

This activity also allows instructors to teach some of the other sampling techniques (besides a simple random sample) with a fun, concrete example. For example, a stratified sample can be taught using genres of music as the strata or a cluster sample using artists as the clusters. And certainly, students are always amused to learn what is on their instructor's iPod!

One Data Set for Multiple Topics

Sherwin Toribio, University of Wisconsin – La Crosse

In this poster, I will present my favorite data set that I use to introduce students in my elementary statistics course to a wide range of statistical topics such as graphical displays and descriptive measures, point and interval estimations, hypothesis testing using t-test and Mann-Whitney test, ANOVA, correlation, and regression. This relatively small data set is full of relevant information for undergraduate students and contains variables that are easy for students to understand and relate. I will present how I use this data set to teach students how to use SPSS to perform these commonly used statistical procedures and how to process the information from the SPSS output in order to write their own analysis about the data. All these activities, when put together, give my students a taste of what they can do with statistics. By using a single data set, it is easier for students to see the respective roles of different statistical procedures in analyzing a data set and also how they relate to each other. In addition, I save time from having to introduce new data sets for other topics, and students also benefit from not having to spend time trying to understand the new problem. Some students, especially the ones who are having difficulties in the subject, fail to fully comprehend what is going on in the class discussion mainly because they do not really understand the question and have been trying to follow the different steps in performing the statistical procedure without considering the context of the problem. By using the same data set, students have one less thing to keep in their mind while they try to understand the new statistical idea or procedure, and knowing the context of the problem will help students understand and appreciate more the statistical procedures that they learn. Finally, because I use this data set for multiple topics, I chose to use a data set with raw data from several variables in a spreadsheet format, which is what is commonly used in practice, and not the usual summarized results found in typical elementary statistics textbooks. By having been exposed to a data set in this format early on in the course, students find it easy to understand the concept of variables, and see how different variables relate to each other and to the experimental units. It also teaches them the idea of using indicator or grouping variables to separate responses into different groups, which is seldom discussed in elementary statistics textbooks.

CAUSEMOS RESEARCH CLUSTER POSTERS

Toward an Understanding of Prerequisite Knowledge for Sampling Distributions

Michael Posner, Villanova University
Dale Berger, Claremont Graduate University
Tisha Hooks, Winona State University
Michelle Sisto, International University of Monaco

Sampling distributions play a vital role in understanding how statistical inferences are made, yet students often fail to achieve understanding and demonstrate proficiency of this important topic. The goals of this project are to (1) examine the literature on sampling distributions, with a focus on concepts that may be prerequisite knowledge for sampling distributions, (2) develop an assessment tool that can be used in a timely fashion to provide instructors with quick feedback on the understanding and misconceptions that students have about sampling distributions, and (3) better understand those misconceptions to improve the teaching and learning of basic statistics. Based on previous work by Chance, delMas, and Garfield (2004), we examined prerequisite knowledge for sampling distributions in three categories sampling, variability, and distributions. We developed new assessment items and modified existing tools (primarily from ARTIST (http://app.gen.umn.edu/artist/)) to study the relationship between comprehension of sampling distributions and mastery of each component of prerequisite knowledge. These items were refined through a pilot study conducted in various international classrooms and on the WISE website (http://wise.cgu.edu/). This research team is part of the CAUSEmos research cluster to develop new researchers in statistics education. In addition to the primary research goals, we will present and discuss the process and our experiences in beginning to conduct statistics education research.

So, You Think You're Confident? Assessing Teachers' Confidence to Teach Statistics

M. Alejandra Sorto, Texas State University
Leigh M. Harrell, Virginia Tech
Rebecca L. Pierce, Ball State University
Teri J. Murphy, Northern Kentucky University
Felicity B. Enders, Mayo Clinic
Lawrence M. Lesser, University of Texas at El Paso
Randall E. Groth, Salisbury University

The statistical community needs to let go of the assumption that content knowledge is sufficient to be able to teach effectively. Based on previous studies (Bandura, 1997; Finney & Schraw, 2003), we conjecture that as a community, we must grow by recognizing that teachers' discipline-specific self-efficacy impacts their ability to facilitate student learning. Pre-service teachers have been the focus of much research, including studies that concentrate on teacher preparation and/or teacher beliefs and attitudes. An idea central to teacher beliefs and attitudes is teacher self-efficacy. Research about teacher self-efficacy in science and mathematics education has shown that levels of self-efficacy are related to content knowledge, pedagogical content knowledge, and beliefs and attitudes regarding the content (Czerniak, 1990; Gresham, 2008; Huinker & Madison, 1997; Swars, 2005).

Self-efficacy to teach statistics is potentially a more complex concept: programs to prepare teachers tend to have methods courses that focus on teaching mathematics, but rarely any that focus exclusively on teaching statistics. Our CAUSE-supported research team has developed a new instrument designed to measure levels of this construct based on the GAISE guidelines (Franklin et al., 2007) for PreK-12 curriculum and those state standards for teacher knowledge and student learning outcomes that have specific statistics requirements.

This interactive poster will engage attendees in a dialogue about the linkages between 1) expectations for student learning from the PreK-12 GAISE guidelines, 2) self-efficacy measures, and 3) related content validity items. Attendees will be encouraged to rate the agreement of the three items and results will be posted as they are collected.

OTHER CAUSEMOS POSTERS

You've got to "Get It" to Grow
Carolyn Cuff, Westminster College

The CAUSEmos GET-IT group has compiled a listing of resources to help the newer instructor of introductory statistics get started. If you are overwhelmed with all the material and wish someone would point you to the minimal covering set, start here. The material is organized by statistical topic. Within each topic, we offer a few words of advice, links to applets, good data sets and activities that we have found particularly useful and easy to use.

The Post-Intro Statistics Course
Shonda Kuiper, Grinnell College

The number of students taking college introductory statistics courses and Advanced Placement statistics courses has risen dramatically in recent years, and this growth has created demand for further coursework in statistics. But unlike in other disciplines, in statistics there is no single, standard, content-driven, "second" course. Moreover, changes in the discipline and changes in pedagogy suggest opportunities for several possible "post-intro" courses. Advances in technology have made both data collection and newer, computationally intensive analysis techniques much more feasible thus facilitating analysis of huge datasets, multidimensional pattern recognition, simulation-based inference, non-parametric methods, less emphasis on classical hypothesis testing, and more emphasis on student research. In this poster we'll examine the challenges in developing a unified post-intro curriculum, review trends among post-intro courses currently offered, and illustrate how statisticians can address recent changes in the discipline with a variety of post-intro statistics courses that would be appropriate for 2-year colleges, 4-year colleges and universities.

CONTRIBUTED POSTERS (ALPHABETICAL ORDER BY LEAD AUTHOR NAME)

Let Go of the Past? No Way, Let's Infuse Some History into Our Courses!
Kirk Anderson, Grand Valley State University

Many of us, while teaching an introductory statistics course, have mentioned some of the history behind the methodology, perhaps just in passing. We might remark that an English chap by the name of R. A. Fisher is responsible for a great deal of the course content. We could further point out that the statistical techniques used in research today were developed within the last century, for the most part. At most, we might reveal the identity of the mysterious "Student" when introducing the t-test to our class. I propose that we do more of this. This poster will highlight some opportunities to give brief history lessons while teaching an introductory statistics course.

Using a Problem-based Approach to Teach Statistics to Postgraduate Science Students: A Case Study
Melanie Autin, Western Kentucky University

The standard approach to teaching statistics is teacher-centered in which the lecturer tries to impose his knowledge onto the students. This method forces a particular learning style and pace on students, and students often fail to recognize which statistical methods are appropriate. In this poster, we present a statistics course for non-specialist postgraduate students at Lancaster University that uses a problem-based learning (PBL) approach. Since statistics is not the primary area of study for these students, we felt that using a PBL approach would allow students to focus on the use of statistical methods rather than the theory behind them, as it will be important for these students to know how to find appropriate statistical methods and interpret the results in their future careers. This poster will describe the structure of the course and the implementation of PBL as well as reflect on the course experiences of both the instructor and the students.

Statistics Education and Online Applets
Michonn Bell, Utah State University

In these times of changing and ever-improving technology, there are multitudes of resources "out there" for teachers of statistics. However, many otherwise useful resources may be confusing, incomplete, or irrelevant to learning objectives. We are working to create a database of instructional materials to complement work with online applets. Access to lesson plans and other resources utilizing statistics applets that statistics teachers can pick up and use saves teachers time and prevents them from feeling overwhelmed as they try to figure out how to work the applets since each lesson plan will come with instructions on how to work the applet. When teachers use these lesson plans that combine the use of some of the best technology available and the implementation of current beliefs about statistics education, the statistics students are able to receive high-quality instruction. Our hope is that as teachers implement the lesson plans we have created, the students will have more of a hands-on learning experience that will increase engagement and foster academic growth.

The International Research Collaboration on Statistical Reasoning, Thinking, and Literacy (SRTL)

Dani Ben-Zvi, University of Haifa, Israel

Over the past decade there has been an increasingly strong call for statistics education to focus more on statistical literacy, reasoning, and thinking. One of the main arguments presented is that traditional approaches to teaching statistics focus on skills, procedures, and computations, which do not lead students to reason or think statistically. The *Statistical Reasoning, Thinking, and Literacy Research Collaboration* (*SRTL)* began in 1999 to foster current and innovative research studies that examine the nature and development of statistical literacy, reasoning, and thinking, and to explore the challenge posed to educators at all levels — to develop these desired learning goals for students.

The SRTL Forums, co-chaired by Joan Garfield and Dani Ben-Zvi, offer scientific gatherings every two years and related publications in journals, CD-ROMs and books. The SRTL Forums have multiple features: small size that allows plenty of time for interaction and discussion; the use of videos of classroom work or interviews with students, as a way to present, discuss and argue about research related to these topics; and a stimulating and enriching format that facilitates the acquaintance with key researchers in this area and viewing their work in progress.

The sixth International Research Forum on Statistical Reasoning, Thinking and Literacy (SRTL-6) is to be held in Brisbane, Australia from July 10 to July 16, 2009. The School of Education at The University of Queensland, will host the Forum. The Forum's focus will build on the work presented and discussed at SRTL-5 (August 2007, Coventry, UK) on informal ideas of statistical inference.

The Forum's focus will build on the work presented and discussed at SRTL-5 on informal ideas of statistical inference. Recent research suggests an important role for developing ideas of informal types of statistical inference even at early educational levels. Researchers have developed instructional activities that encourage students to infer beyond samples of data and use technological tools to support these informal inferences.

The findings of these studies reveal that the context of the data and the use of evidence may be important factors to study further. The role of context is of particular interest because in drawing (informal) inferences from data, “students must learn to walk two fine lines. First, they must maintain a view of data as 'numbers with a context'” (Moore, 1992). At the same time, “they must learn to see the data as separate in many ways from the real-world event they observed” (Konold & Higgins, 2003, p. 195). That is, they must abstract the data from that context. The role of evidence is also of particular interest because in learning how to make data-based claims (argumentation), students must consider the evidence used to support the claim, the quality and justification of the evidence, limitations of the evidence and finally, an indication of how convincing the argument is (Ben-Zvi, Gil, & Apel, 2007).

Based on SRTL-5, we characterize Informal Inferential Reasoning (IIR) as the cognitive activities involved in drawing conclusions with some degree of uncertainty that go beyond the data and having empirical evidence for them. Three principles appear to be essential to informal inference: (1) generalizations (including predictions, parameter estimates, and conclusions) that go beyond describing the given data; (2) the use of data as evidence for those generalizations; and (3) conclusions that express a degree of uncertainty, whether or not quantified, accounting for the variability or uncertainty that is unavoidable when generalizing beyond the immediate data to a population or a process (Makar & Rubin, 2007).

An interesting range of diverse research presentations and discussions have been planned and we look forward to a stimulating and enriching gathering. These papers will address the role of context and evidence when reasoning about informal inference at all levels of education including the professional development of elementary and secondary teachers.

The structure of the scientific program will be a mixture of formal and informal sessions, small group and whole group discussions, and the opportunity for extensive analysis of video-taped research data. There will also be a poster session for exhibiting current research of participants on additional topics related to statistics education. The Forum is co-chaired by Dani Ben-Zvi (University of Haifa, Israel) and Joan Garfield (University of Minnesota, USA), locally organized by Katie Makar and Michael Bulmer (The University of Queensland), and planned by a prestigious international advisory committee. Conference attendance is by invitation only. For more information, visit the SRTL website at: http://srtl.stat.auckland.ac.nz/ or email SRTL2009@gmail.com.

Using Language Examples in an Introductory SAS Programming Class

Roger Bilisoly, Central Connecticut State University

Students today have a variety of backgrounds and interests, and adding some language examples to a statistics class can broaden its appeal. This poster gives several examples of analyzing texts using the SAS package applied to public domain language resources that are freely available over the Web. These have been tested in the class STAT 456, "Fundamentals of SAS," an upper level undergraduate course at CCSU, which ran spring semester, 2009.

One language example is a frequency analysis of consonant clusters. In linguistics this is of interest in *phonotactics*, which is the study of sounds in words. For example, the word *cats* has a *ts* sound, but, in general, this does not appear at the start of a word (except for loanwords from languages without such a restriction, such as the Russian *tsar* or *tsetse fly* from the Bantu language, Tswana). However, groups of consonants can also arise from adjacent syllables, such as *pantsuit*, where the *t* and the *s* are pronounced separately. A simple way to prevent this complication is by studying initial consonant clusters, which makes an interesting exercise in an introductory SAS programming class. There are several sources of words on the Web: for instance, the Moby wordlists are available from Project Gutenberg (http://www.gutenberg.org/); and the American Cryptogram Association (http://cryptogram.org/cdb/words/words.html) also has many wordlists. For analyzing words, SAS has many string functions, and FINDC() can determine where the first vowel appears, so that the preceding letters (if any) are a consonant cluster. Contingency tables can then be easily created and analyzed. In English, for example, the top five initial consonant clusters are *c*, *r*, *m*, *d*, and *s*. Because this does not agree with the top five most frequent consonants: *s*, *r*, *n*, *t*, and *l*, the initial consonant clusters are not just determined by letter frequency, which means that there are non-trivial phonotactic constraints in English.

The above analysis was given as a homework problem in STAT 456, which the students found doable, and provided them the chance to work with a non-trivial data set, though not one that was overly complex since it has only one variable. Several more language problems were given on a take-home midterm. Here students had a choice of picking three of nine problems consisting of four on language, four on random processes, and one challenging problem that no one chose to hand in. All eleven students picked at least one language problem, showing that they were not averse to such a task. From talking with students during and outside of class, one downside of this type of question became clear: non-native speakers felt that this type of problem was more difficult than did native English speakers.

This poster will summarize all the programming problems involving language given in STAT 456 and how they relate to either linguistic questions or to wordplay. By using real wordlists, the computer output reveals truths about English, which interest students who enjoy word games or puzzles. For example, finding all possible words consistent with a partially completed crossword puzzle answer is straightforward. A program to do the same for an ongoing game of hangman is only slightly more difficult.

Finally, linguists are familiar with numerous statistical techniques. In fact, the field of *corpus linguistics* is devoted to analyzing large text samples constructed to be representative of a language. For example, in 1964 the Brown corpus was released and contained just over a million words. Today, the Cambridge International Corpus consists of over a billion words (a description is at http://www.cambridge.org/elt/corpus/international_corpus2.htm). This allows lexicographers and writers of grammars to use examples based on actual usage, and they can judge relative importance of topics by examining relative frequencies. So language studies and statistics are already intertwined (for example, Michael Oakes' *Statistics for Corpus Linguistics*), and this relationship provides a wealth of statistical examples, some of which were used in STAT 456.

The SATS Project

Marjorie Bond, Monmouth College

Educational research and theories suggest that students' attitudes toward statistics help determine: course completion, course achievement, future course enrolment, and their use of statistical thinking in their lives. The Survey of Attitudes Toward Statistics (SATS) is designed to measure six components of students' attitudes: Affect, Cognitive Competence, Value, Difficulty, Interest, and Effort. Individual researchers and instructors have used the SATS for many years in small projects. These projects are interesting and useful on a limited scale, but there is a need to look more broadly at students' attitudes. The SATS Project was designed: to understand students' attitudes toward statistics, how these attitudes impact statistical thinking in the classroom and in life, and what statistics instructors can do to improve students' attitudes. These goals are being accomplished through web-based data collection of the SATS, instructor, and course information from statistics courses offered in post-secondary institutions located across the United States. This project yields a data warehouse that will allow statistics education researchers and instructors to explore a variety of important questions about students' attitudes toward statistics.

Some Big Ideas for Intro Statistics

Dan Brick, University of St. Thomas
Milo Schield, Augsburg College

The GAISE report calls for more focus on statistical literacy, on practical application of statistics, and on conceptual thinking. This poster presents some of the topics that we feel should be addressed in the Intro Stats course to fully meet the GAISE challenge, and identifies some topics that might be dropped to make room for the additions.

Topics to be added include: awareness of non-sampling errors from the beginning of the course (e.g., measurement error, non-random sampling, etc.), cause & effect considerations (experiments vs. observational studies), confounding (as related to causation, to association, and to modeling choices), and some informal Bayesian thinking (e.g., interpreting 1-sided hypothesis test results as providing some "level of confidence that the alternative hypothesis is true").

Some topics that could be dropped (or coverage reduced): most of the probability material that appears in standard texts, many details related to t-tests (degrees of freedom, pooling), the Binomial distribution (O heresy!!), difference between proportions, etc...

In summary, we aren't training "mini-statisticians"; we're educating consumers and users of statistical results and methods (and not coincidentally, setting the stage better for those who do become interested in further Statistics courses).

We hope to engender spirited conversation!

Statistics Means Never Having to Say You're Certain: Learning to Let Go & Tolerate Ambiguity

Rob Carver, Stonehill College
Carolyn Dobler, Gustavus Adolphus College

Perhaps you've known students to become emotionally distraught over the prospect of a Type I error even after they've *correctly* conducted a hypothesis test, or unhinged by the possibility that μ actually lives outside of the confidence interval that was the "right answer." We hypothesize that some of the extraordinary frustration experienced by some students is rooted in the personality construct known as *ambiguity tolerance (AT).* This poster reports on an on-going empirical investigation of the relationship between AT and students' facility in developing the skills of inferential reasoning. Using data gathered at two colleges combining survey instruments and course-embedded assessments, we examine the impact of AT on student improvement on the ARTIST Comprehensive Assessment of Outcomes in a first Statistics course. What's more—we'll offer to measure *your* tolerance of ambiguity, and see how statistics professors compare to our students on this important dimension of personality.

SOCR: Web-Based Statistical Tools

Nicolas Christou, University of California – Los Angeles
Ivo Dinov, University of California – Los Angeles

Technology-based instruction represents a new recent pedagogical paradigm that is rooted in the realization that new generations are much more comfortable with, and excited about, new technologies. The freely downloadable NSF-funded Statistics Online Computational Resource (www.SOCR.ucla.edu) provides a number of educational materials and interactive tools for enhancing instruction in various undergraduate and graduate courses in probability and statistics using computer generated data. SOCR includes class notes, practice activities, statistical calculators, interactive graphical user interfaces, computational and simulation applets, tools for data analysis and visualization. More specifically, SOCR consists of the following components: analyses, charts, distributions, experiments, games, and modeler.

There are three specific teaching goals that drive the developments of all SOCR materials. These are:

1. Increase the motivation of students by blending conceptual understanding with technological aids.
2. Scientifically evaluate the efficacy of new pedagogical instruments to enhance learning experiences.
3. Promote completely free, Internet-based and integrated development and utilization of the core four SOCR resources (data, learning materials, tools and demonstrations).

In addition SOCR is continually developing more support materials for the K-college curriculum which includes the Wiki Ebook (http://wiki.stat.ucla.edu/socr/index.php/EBook) and SOCR activities (http://wiki.stat.ucla.edu/socr/index.php/SOCR_EduMaterials)

In our poster presentation we will include a demonstration of the SOCR software and its applications.

Mathematics Instructors' Conceptions of Variation

Monica Dabos, University of California – Santa Barbara

The demand for statistics instruction at all levels of education has inundated the educational system in American schools. According the CBMS report, from 2000 to 2005, statistics enrollment at two-year colleges has increased by 60%. The case of two-year colleges is particularly interesting because most research at this level have been concerned with the identification of students' difficulties and understanding of statistics concepts. This project thus builds on that knowledge to examine those teaching these courses. As Shaughnessy (2007) expressed, "Teachers have the same difficulties with statistics concepts as the students they teach" (p.1000). Many of them have not had formal training in the subject and this lack of training in statistics content may help explain why many of those teaching statistics consider it an unrewarding experience (Garfield et al., 2002). Better training could minimize these frustrations; however it is necessary first to understand how their background training may be affecting their conceptions of statistics concepts. Since understanding of variation has been recognized as the core of statistics, the concentration on this topic seems necessary starting point on the investigation of two year college professors' knowledge. The purpose of this study is to research mathematics professors' conceptions of variation at two-year colleges. In this study, part of it focused on the understanding of variation and part will be looking at their ability to deal with students' conceptions and misconceptions of variation. Six two-year college mathematics professors were interviewed. The participants have varied background training as well as diverse teaching experience with statistics. The results provide a valuable insight into understanding how their background may be affecting or influencing their own statistical intuitions and comprehension.

Statistics in Context: Service-Learning in Statistics
Ayesha Delpish, Elon University

This forum will serve as a platform for the exchange of methods, successes and difficulties encountered while incorporating a service learning component into a statistics course. It involves students in a survey sampling course lending statistical assistance to agencies while actively visiting and observing community partners and their clients at work. Based on the data, the projects had social, emotional, civic and academic impact on the students because it offered a first-hand opportunity to apply content while facing real-world challenges. Such challenges included learning to deal with people of various races, nationalities, and abilities. The session will be used to share (a) the design and implementation of the project; (b) the connections made to learning; and (c) the findings of the impact of the projects on the students involved. It is hoped that this session will provide concrete ideas that can be adapted and implemented in other courses.

Engaging Students in Learning Now
Paul Fields, Brigham Young University

It is commonly accepted among educators that active-learning is more effective than passive-learning. However, students are often resistive to fully engaging in active-learning. This seems to be an example of the old adage, "You can lead a horse to water, but you cannot make him drink." If active-learning is better for students, why do many of them not "drink"? We examine possible explanations ranging from student apathy to lack of skills requisite for active-learning. We present ideas for helping students overcome their resistance to full engagement in active-learning so they can achieve maximum personal learning outcomes. Further, we identify resources available within the statistic education community to facilitate student "buy in" to active-learning. We also solicit collaborative efforts to exchange techniques to enhance student engagement in learning now.

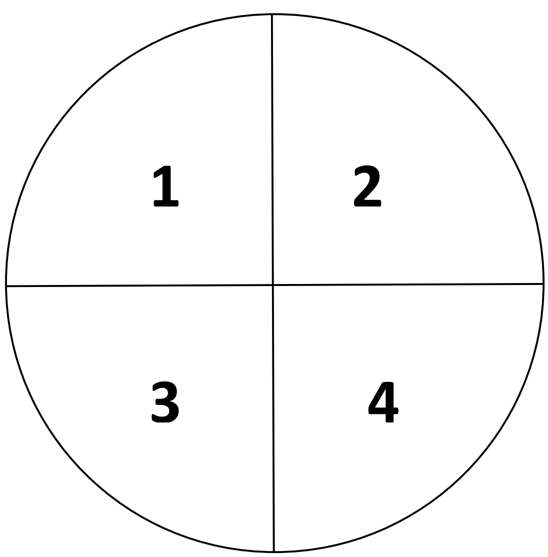
Using Podcasts for Software Instruction
Holmes Finch, Ball State University

As the use of software becomes more prevalent in statistical courses, instructors find themselves devoting ever larger portions of precious instructional time to instruction on using the computer rather than what they may deem as more pertinent statistical issues. While some in-class computer instruction will probably always be required, there are technological tools that may be useful for removing this burden to some extent, freeing up class time for instruction in statistics. One such tool comes in the form of podcasts, which are essentially video and/or audio files that can be viewed on practically any computer or iPod device. Podcasts have proven useful for disseminating information in a wide variety of subject matter areas across universities, but have not been used extensively for instruction in computer use. This presentation will focus on the use of active screen capture technology in conjunction with real time audio recording to demonstrate how fairly complex computer routines in SPSS and SAS can be captured in a podcast and made available to students for viewing at any time. Indeed, because these podcasts are portable, can be saved and watched repeatedly, and can be viewed on virtually any platform, they are particularly useful for students as they work on homework assignments, class projects and other instances where statistical software must be employed. The presentation will also address the time commitment necessary to develop the podcasts as well as their potential benefits to students. The initial start up time devoted to learning how to create the podcasts and edit them properly was not trivial. However, after the basic tools for capturing and recording actions on the screen and the accompanying audio were learned, the time devoted to creating subsequent podcasts was relatively small. In addition, it appears to have reduced the number of student requests for help running the analyses covered by the podcasts. In terms of benefits to students, anecdotal evidence from discussions with them indicates that they find the podcasts particularly useful when they have forgotten how to conduct a particular analysis using software. Several students report making use of the podcasts in the evenings and on weekends when the instructor and classmates were not readily available to ask for help. This poster will include demonstrations of actual podcasts used in classes, as well as discussion of software (most of it free) that was used to produce them.

The Spinner Game: A Probability Activity

Stephanie Fitchett, The University of Northern Colorado

This poster will describe a game used with a junior level probability class. The game can have any number of players, though pairs work well. Each player designs a spinner in which the possible outcomes of a single spin are some finite set of integers. Play begins by each player spinning his or her spinner twice, and recording the sum of the two outcomes. The goal is to achieve all possible sums between 2 and 8, inclusive, so I provide a scorecard, and ask the students to tally their sums from pairs of spins. The player that achieves all seven sums from 2 to 8 in the least number of turns (where each turn involves two spins) wins. This version of the game allows for ties. A sample spinner and scorecard are shown below.



Sum	**Tally**
2	
3	
4	
5	
6	
7	
8	
TOTAL	

The object is to design a winning spinner – one that will have the best chance of winning against any other player's spinner. My strategy has been to explain the game at the end of class one day, show students how they'll use paperclips and a pen or pencil to create the "spinning" part of the spinner, and ask them to bring their (first) spinner to class the next day. We play a couple of rounds of the games, switching pairings between rounds. Students that included values other than those from 1 to 4 on their spinners quickly realize that they'd like to adjust their spinner designs, and those that have created spinners similar to that above also realize they now have better ideas. So I ask them to come to the next class with a redesigned spinner, and we hold a round robin tournament. The student with the winning spinner almost invariably has identified the key idea, and very often has used some sort of analytical process to come up with a spinner design.

Even though the students have learned something about discrete probability models and "know" how to create a probability model for a sum of two dice, only a few immediately make the connection between the spinner game probabilities and what they "know" about probability models, presumably because they haven't "experienced" the model. At the end of the tournament, when the winning student explains how and why the winning spinner was designed the way it was, most other students will have discovered at least the basic idea of the strategy as well. Then the interesting debate begins. While everyone is convinced that the spinner should give more space to 1 and 4 than to 2 and 3, only a few students have usually thought about exactly how to divvy up the space to get the best spinner. Several ideas are proposed and compared, and then we talk about how we might find a "best" solution analytically. Turned loose on this task, students quickly run into the problem of a system of equations with no solution. For some, the idea that there isn't one and only one answer to such a seemingly simple question is enough to grapple with for the day. I usually wrap up by going back to our examples, discussing how we might decide which is "best." Finally, I offer a variety of "extensions" of the spinner game, some of which involve writing a program to simulate the spinners and games, as a bonus project.

The Use of TurningPoint (Clicker) Technology for Formative Assessment in Introductory Statistics

Ulrike Genschel, Iowa State University
Amy Froelich, Iowa State University
Kim Mueller, Iowa State University

At many public universities, introductory statistics courses are often taught in large classroom environments with enrollments of 80 or more students. Unfortunately, this environment often inhibits immediate feedback between students and instructor as students feel reluctant to ask questions or to participate in classroom discussions.

During the Spring 2009 semester, we explored the use of TurningPoint (clicker) technology in conducting formative assessment in two introductory statistics courses taught at Iowa State University. TurningPoint is a student response system allowing instructors to obtain, evaluate and record students' responses to questions and discussion topics instantly. We will provide insight into our experiences using the clicker technology in the introductory statistics classroom, including potential sources for questions, considerations in developing a scoring structure for these assessments, and the effectiveness (or lack thereof) of certain types of questions in this format.

Multiple Regression Without the Math: a Metaphor-driven Approach

Ken Gerow, University of Wyoming

I describe the use of a metaphor (teams of people working on a project) for multiple regression, which metaphor has many strong, pedagogically revealing analogies to aspects of multiple regression, including model selection, multicollinearity, interactions between predictors. Students understand from their lifetime of experience the vagaries of teams of people; this metaphor enables them to fairly directly translate that understanding to their learning of sometimes difficult concepts in multiple regression.

The Tools for Retooling: What Do Our Textbooks Offer?

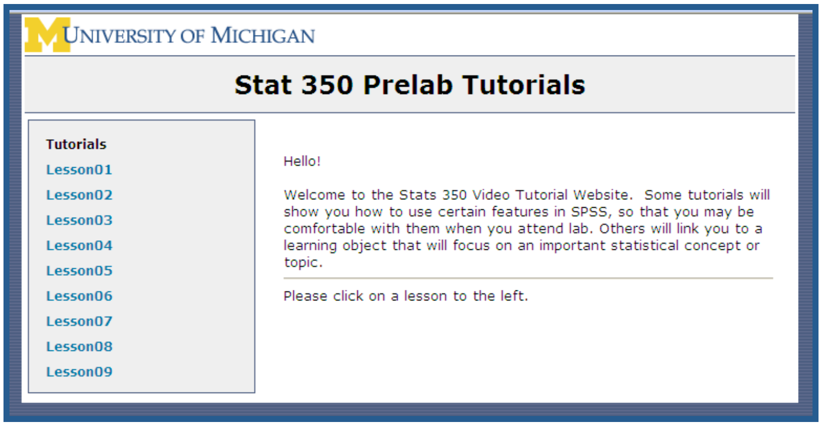
Deborah Gougeon, The University of Scranton

Before we can retool and rethink the teaching of statistics in order to better meet our goals, it would be helpful to see what kinds of tools are available in dealing with such a project. The number of topics and depth and breadth of coverage provided by current textbooks is an indicator of where we have been and where we might be going. Focusing on statistics courses in the business curriculum, this "Posters and Beyond" presentation provides a detailed, quantitative analysis of topical coverage of 31 currently available college Business Statistics textbooks. While there is general agreement among business educators that the development of quantitative skills, especially in statistics, should be a core requirement in all business curricula, there is very little that is certain about what the specific content of such courses should be. Because there is little agreement on the specific content of Business Statistics courses, it is often difficult for teachers to find a text that actually "fits" in terms of topics taught, and that is also pedagogically satisfying in terms of organization, numbers, and types of problems, levels of difficulty, etc. Analyses of the results of this topical survey are provided along with suggestions for future research.

Letting Go and Moving It out of the Classroom with PreLabs

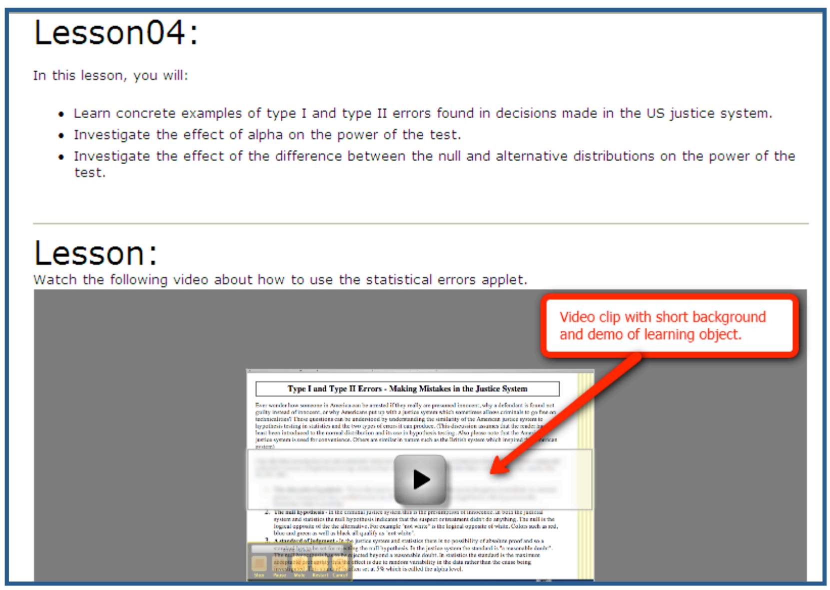
Brenda Gunderson, University of Michigan
Dave Childers, University of Michigan
Joel Vaughan, University of Michigan

Many introductory Statistics courses consist of two main components: lecture sections and computer laboratory sections. In the computer labs, students often review fundamental course concepts, learn to analyze data using statistical software, and practice applying their knowledge to real world scenarios. Lab time could be better utilized if students arrived with 1) prior exposure to the core statistical ideas, and 2) a basic familiarity with the statistical software package. To achieve these objectives, PreLabs have been integrated into an introductory statistics course. A simple screen capture software (Jing) was used to create videos. The videos and a very short corresponding assignment together form a PreLab and are made available to students to access at appropriate times in the course.



Some PreLabs were created to expose the students to statistical software details. Other PreLabs incorporate an available online learning resource or applet which allows students to gain a deeper understanding of a course concept through simulation and visualization. Not all on-line learning resources are ready to use 'as is' in a course. Some may be lacking a preface or description on how they are to be used; others may use slightly different notation or language than your students are accustomed to; a few may even contain an error or item that needs some clarification. One solution to such difficulties was to create a video wrapper so students can see how the applet works while receiving guidance from the instructor.

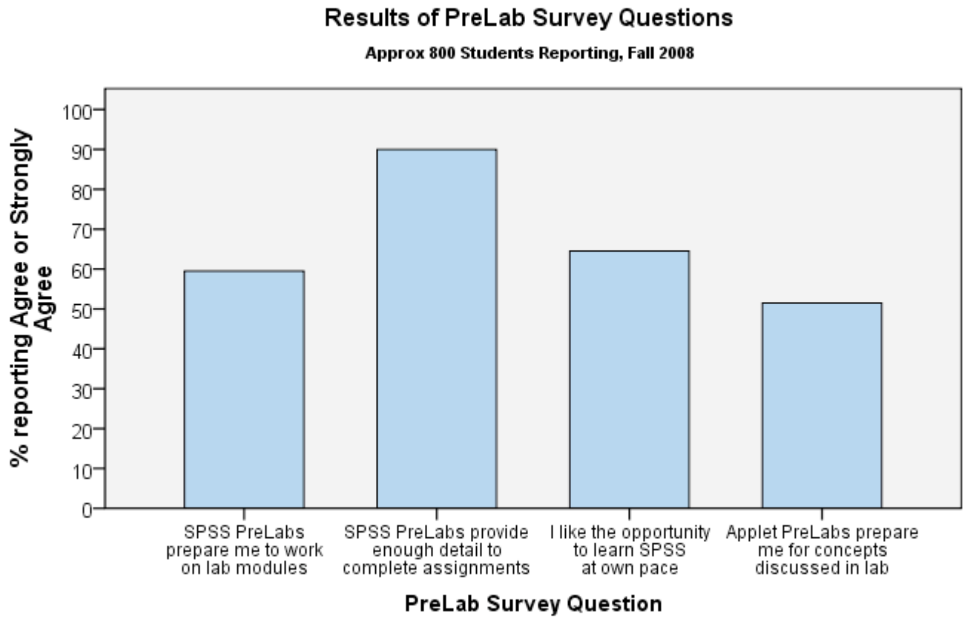
The PreLabs were first used in the Fall 2008 term. A total of nine PreLabs were created, and students were assigned one for each non-exam week. The first few PreLabs took approximately 3-4 hours to create as we were new to the Jing software and to the platform that we used to 'house' the videos (UMLessons - an extensible web-based tool for instructional quizzes and more). But the joy of recording is that you can stop, delete, and try it again. Later PreLabs were developed more quickly, with fewer 'retakes' on the recordings.



Initial PreLab assessment took place as a series of questions that were included in the midterm feedback survey given in labs (using Survey Monkey). A summary of some results are shown in the bar graph below. We also asked the text response question of "What would you recommend to make the PreLabs more useful?" Here are a few responses:

- The PreLabs utilize what we talk about in class and the homework assignments.
- They are pretty useful as they are, but the applet based ones are the most useful.

- PreLabs are currently fine the way they are because they are meant to familiarize the person with SPSS and that is what they do.
- Put an electronic dropbox on our course management site so we don't have to print them out. (We did add this for Winter 2009, so they are now completely paperless.)



These PreLabs match well with many of the interpretations of "Letting Go":

(1) These PreLabs allow the lab instructors to let go of some of the lab course content – in particular, the 'statistical software training' part, in order to better align with course goals and allow students to focus on concepts and getting right to the task of working with data in the labs.
(2) These PreLabs are made possible by letting go of some old ideas about pedagogy in order to use more effective methods – rather than reading through an instruction guide for the statistical software, they can 'see' the steps, review them when needed, and come to the labs more prepared having already gone through the steps once on their own.
(3) These PreLabs moves more responsibility of the learning on to the students, allowing them to take the time they need based on their own computer skills and comfort level --- to better facilitate student's learning and better facilitate the lab instructor's teaching.

Along with the poster, we would have a laptop to demonstrate the making of these PreLabs and some of the actual PreLabs to those interested.

A Simple Questionnaire Shows that Students' Knowledge, Experience, and Confidence with Experimental and Quantitative Biology Changes after Problem-Based Writing with Peer Review

Ellen Gundlach, Purdue University – Department of Statistics
Allison Cummins, Purdue University – Department of Statistics
Samiksha Neroorkar, Purdue University – Department of Biological Sciences
Nancy Pelaez, Purdue University – Department of Biological Sciences

Statistics teaches science students about experimental design, but students seem to have difficulty transferring that knowledge across disciplines. Experimental design is implied but not explicitly taught in biology. Both life scientists and statisticians currently see a need to emphasize experimental and quantitative aspects of biology. Yet in the recent past, many biological discoveries did not rely on tests of statistical significance and the current trend is toward a diversification of investigative approaches. There is a need to position the experimental and quantitative aspects of biology instruction within a shifting historical context. Similarities in pedagogical recommendations for biology and statistics instruction convince us that we can solve these problems by working together in ways that neither discipline can accomplish alone.

For this project, we developed a five-point scaled questionnaire with 33 items to address students' knowledge, experience, and confidence about basic experimental and statistical concepts in a bioscience context. The instrument was used in a freshman biology course, Biology 131, during the Spring 2009 semester before and after a series of writing assignments about experimental methods and quantitative approaches in biology. The assignments were written for Calibrated Peer Review (CPR), developed at the University of California at Los Angeles (UCLA), as a mechanism for presenting students with a problem and background information and then having them write about it. Then, after guiding questions from faculty help the student demonstrate competence as a reviewer, the program delivers three peer documents for the student to review. The student answers guiding questions and assigns scores. Finally, the student does a self-review. The student's grade is based on both writing and reviewing explanations of experimental methods and quantitative approaches in biology. In addition to new problem-based writing assignments with peer review for BIOL 131, biological problems were incorporated with writing assignments for peer review in the Statistics 301 service course to help students understand how new knowledge accumulates in the biosciences and what ethical constraints that must be considered such as predictions of the expected number of animals for a research study. Assignments in both courses expose bioscience students to the ideas of variability, population vs. sample, causation vs. association, experimental design, experimental ethics, and the logic behind hypothesis tests. Results on the questionnaire show significant improvement in all of these areas with medium or large effect sizes and less variability in the post-test than in the pre-test for all racial/ethnicity groups in the freshman biology course. The survey instrument will be adapted to an online format for use in STAT 301 during the Fall 2009 semester.

Independent Interactive Inquiry-Based Learning Modules

Lisa Green, Middle Tennessee State University
Scott McDaniel, Middle Tennessee State University

This poster describes the implementation and evaluation of the Independent Interactive Inquiry-based (I^3) Learning Modules, which use existing open-source Java applets, combined with audio-visual instruction. Research has shown that using online simulations can improve student understanding, but that students must be guided in the use of these simulations. Modules were created to address this issue by combining a simulation with audio-visual instruction in its use and with questions that guide the students to construct meaning in the topic at hand. These modules cover important ideas in statistics, such as the binomial distribution, confidence intervals, randomization, statistical significance and sampling variability. Pretests and posttests for each module show that this format can be used independently by students. We found that the number of students answering correctly on posttests was larger than that for pretests, for seven of the eight modules in this project. This lack of improvement on one module demonstrates that the format alone is not enough for student learning, that the questions and audio track should be carefully constructed using sound pedagogical techniques. It was also shown, not surprisingly, that the previous preparation of the students affected how well they learned the concepts in the modules.

Guidelines for Instruction of Statistical Reporting in an Introductory Statistics Class

Matthew Hayat, Johns Hopkins University

Undergraduate statistics education usually includes coverage of significance testing, analysis of skewed data, and defining measures of dispersion for continuous data. Lang (2007) reported on the three most common statistical reporting errors in the biomedical literature. These include 1) confusing statistical significance with clinical importance, 2) describing the dispersion of skewed data with the standard deviation, and 3) inappropriately reporting the standard error of the mean. In regards to these three errors, the mistaken interpretation of a p-value as a measure of effect size leads to confusion between statistical significance and clinical or practical importance. A clear illustration of the standard deviation as a poor measure of dispersion for skewed data emphasizes the need for use of another measure. Finally, a detailed description of one standard error of the mean as a 68% confidence interval clarifies its appropriate use and misuse. In this work, we provide examples of each reporting error and provide guidelines for correct reporting of these statistics. Recommendations are provided for instruction of statistical reporting in an introductory statistics course.

I Hear, I Forget. I Do, I Understand: R as the Centerpiece of a Moore-method Mathematical Statistics Course

Nicholas Horton, Smith College

Moore introduced a method for graduate mathematics instruction that consisted primarily of student solutions and presentation of challenging problems. Cohen (1982) described an adaptation for undergraduate students in mathematics at a liberal arts college.
We describe the experience of using this method to teach mathematical statistics.

Each group of 3 students worked a set of 3 challenging problems every two weeks. Class time was devoted to coaching sessions with the instructor, group meeting time, and class

presentations. R was used to estimate solutions empirically where analytic results were intractable, as well as an environment to undertake simulation studies to deepen understanding and complement analytic solutions.
Each group created comprehensive solutions (distributed as pdf's) to complement 20-minute oral presentations to the class as a whole.

The method fostered deeper understanding by illustrating the power of empirical estimation in R to augment (and check) analytic solutions. It also communicated the excitement of statistics as more than a set of procedures. The group problem solving component also allowed students to tackle more challenging questions than they could solve analytically, which also fostered engagement.

Intelligent Tutors and Worked Examples for Statistics Education

Ryung Kim, Worcester Polytechnic University
Rob Weitz, Seton Hall University
Neil Heffernan, Worcester Polytechnic University

Intelligent tutoring systems have been used in a variety of domains with a demonstrated record of success. The goal of intelligent tutors is to emulate the behavior and performance of human tutors; intelligent tutors work alongside students as they solve problems, offering guidance and remediation. A good deal of research has also been done on the design and use of structured worked examples as an aid in student learning. We created online intelligent tutorials and equivalent worked examples for several topics typically covered in an introductory college-level statistics course. These subject areas were the binomial and Normal probability distributions and one-sample confidence interval for the mean. The material to be learned included both procedural and conceptual knowledge. We conducted two experiments comparing the efficacy of the two approaches. Among our results, we found statistically significant evidence of learning benefits, both in terms of amount learned and rate of learning, from assigning worked examples to conceptual problems and tutoring to procedural problems. In this presentation we discuss these results with a focus on the issues involved in building these automated systems and their place in statistics education.

Does Understanding the Randomization Test Impact Reasoning about P-values and Statistical Significance?

Sharon Lane-Getaz, St. Olaf College

The objective for the proposed poster is to summarize preliminary results of statistics students' inferential understanding after taking one (or more) of three statistics courses at Saint Olaf College. Course-1 is an introductory service course designed to meet a range of needs for liberal arts students. Students in Course-1a have some exposure to randomization and simulation tests before formal inference is introduced. Course-1b, designed for students in the sciences, uses a curriculum in which randomization tests and simulations are used repeatedly throughout the course to introduce a variety of statistical tests as well as inference for regression. Course-2 is a second course in statistics. Students who have taken Course-1a, Course-1b, Advanced Placement statistics, and some with no statistical preparation at all take this second course. Course 2 begins with a review of randomization tests and builds toward multiple regression, ANOVA, and logistic regression. Student gains in inferential understanding will be measured in each of these courses using the Reasoning about P-values and Statistical Significance (RPASS) scale. RPASS results will be used to explore whether understanding randomization and simulation distributions is linked to inferential reasoning; whether there are inconsistencies in students' responses; and to highlight students' explanations on selected items.

Preparing Middle and Secondary Teachers to Use Technology in Statistics

Hollylynne Lee, North Carolina State University

This poster will share the work done on developing and researching teacher education curriculum materials for helping preservice and in-service teachers learn to teach statistical ideas with technology tools such as Excel, Fathom and TinkerPlots. Sample materials will be available and participants will be engaged in activities from the materials.

Using Data from a Student Questionnaire in an Introductory Statistics Class

Jimin Lee, University of North Carolina – Asheville
Cathy Whitlock, University of North Carolina – Asheville
Seunggeun Hyun – University of South Carolina Upstate

It is important to us to capture our students' attention when we teach. We cannot anticipate that every student in our classes will love statistics as we do. We've found that the students of "Generation Me" are more motivated to learn when they are given problems and data sets that relate to their lives. We have our Introductory Statistics classes fill out questionnaires on day one. We use this questionnaire to gather basic demographic data such as gender, age, major, year of college status, but we also ask them questions which we will use to pique their interest later. For example…

1. Do you consider yourself to be a Vegetarian, Vegan, Omnivore or Other?
2. Do you have a tattoo?
3. How many hours a week do you typically spend on Facebook?
4. Approximately how much money will you spend on your textbooks this semester?

We then combine data sets from two or more sections of the class, sans names, and post portions of this data set on our course websites for use in class later. This allows us to motivate the introduction of a new topic by asking questions like… "Do women really spend more time on Facebook than men?" "Are vegetarians more likely to have tattoos?" We also can use this data to show various graphic displays made by statistical packages such as Minitab, SAS, or R.

By using student data to introduce concepts, we avoid the kind of confusion that sometimes results when using "real data" derived from experiments or surveys that students do not understand. Students have no difficulty interpreting answers to simple questions that they, themselves, have already answered.

We will invite attendees at the poster session to submit their favorite questions for such a survey. We will then compile a master list of possible questions to be shared with all conference attendees.

We will demonstrate a data visualization using XGobi, a system for viewing high-dimensional data.

Integrating Multiple Teaching Tools into a Unified Lesson

Andre Lubecke, Lander University

This "lesson" was designed for an algebra-based introductory statistics course. It integrates the use of three teaching tools: a video from the Decisions Through Data series (on the NO_x emissions of GM vehicles), an active learning experience (on sampling and estimating population proportions) using the statistics package JMPIntro, and an interactive applet for simulating sampling distributions.

The motivation for exploring sampling, estimation, and sampling distributions comes from GM's need to estimate the level of NO_x emissions from a prototype engine in order to determine its compliance with EPA regulations. The video includes an interview with one of GM's statisticians discussing using the normal distribution to model NO_x emissions and then estimating the proportion of engines that would exceed the EPA standard.

USES of the video:

- motivation by introducing a real problem involving automobiles
- practice with the normal distribution as I pause the video for students to do the appropriate calculations
- introduction of the question of interest: "Why is GM not satisfied with their estimate of 33% exceeding the EPA standard when the EPA will allow up to 40% of the vehicles to exceed the NO_x emission standard? Why does GM 'shoot for between 10-20%' of the engines exceeding the standard?"

USES of the statistics package:

- students use the built-in feature of random sampling from a data set to discover that
    - sample proportions vary
    - sample proportions 'gather around' the population proportion
    - some samples exceed 40% even though the population proportion is 33% (meaning GM would NOT be allowed to sell the vehicles)
- student results are posted on the board using sticky notes so that the sampling distribution of a sample proportion is revealed

USES of the applet:

- students see the differences in the sampling distribution of the sample proportion as the population proportion is set at different values
- behavior of the sampling distributions is connected to GM's passing or failing the EPA inspection based on a sample of vehicles

Using Exact Tests to Bridge the Gap between Sampling Distributions and Inference

Chris Malone, Winona State University
Dason Kurkiewicz, Winona State University
Tisha Hooks, Winona State University

Sampling distributions have proven to be one of the more difficult concepts to learn and teach in statistics. Sampling distributions are typically presented about midway through an introductory statistics course and are centered on the normal distribution. Cobb (2007) has suggested that the curriculum is needlessly complicated because of this. A recent CAUSE webinar presented by Rossman, Chance, and Holcomb (April 2009) suggests building sampling distributions through the use of hands-on activities and simulations to introduce the concept of inference. This leads directly to common exact tests (binomial and Fisher's) that permit students to more easily compute a p-value and understand its use as a measure of extremeness. This poster will include outcomes from assessing students' understanding of sampling distributions. In addition, suggestions for connecting exact tests to more traditional normal theory methods will be presented.

A Knowledge Structure for the Arithmetic Mean: Relationships between Statistical Conceptions and Mathematical Concepts

Mark Marnich, Point Park University

The arithmetic mean has both mathematical and statistical characteristics. This study examined cognitive relationships between two conceptions of the arithmetic mean, fair-share and center-of-balance, and their possible role in linking mathematical and statistical ideas. To do this, the study investigated the effects of fair-share or center-of-balance instruction on knowledge of fair-share, center-of-balance, and mathematical concepts regarding the arithmetic mean.

Twenty-nine undergraduate liberal arts students were asked to "think aloud" while they solved arithmetic mean problems that emphasized either the fair-share or center-of-balance conception, or purely mathematical concepts related to the arithmetic mean. Between pre- and post-tests, participants received instruction related to fair-share, *or* center-of-balance, *or* general problem-solving (control group).

Statistical methods used to analyze the data included contingency tables and ANCOVA. A qualitative analysis of the verbal protocols helped explain any statistically significant connection between the fair-share and center-of-balance conceptions, or between either conception and mathematical concepts related to the arithmetic mean.

Results of the statistical analyses indicated that participants' knowledge of the fair-share conception increased after center-of-balance-focused instruction, and, similarly, participants' knowledge of the center-of-balance conception increased after receiving instruction that was focused on fair-share. Qualitative analyses indicated that in both cases, the mathematical concept, 'the sum of the deviations from the mean is zero,' served as a link between the conceptions.

In addition, instruction in either the fair-share or center-of-balance conception increased knowledge of the mathematical concepts related to the arithmetic mean. However, only specific mathematical concepts were impacted by each of the conceptions.

The results suggest that both the fair-share and center-of-balance conceptions are pertinent to pedagogical decisions regarding the arithmetic mean. Furthermore, the concept, 'the sum of the deviations from the mean is zero,' is a viable cognitive connection between the fair-share and center-of-balance conceptions.

Just-in-Time-Teaching via Muddiest Points in an Introductory Statistics Course for Business Student

John McKenzie, Babson College

In the late 1980s Fred Mosteller introduced the instructors of statistics to an innovative method to improve upon their understanding of what their students learned or didn't learn after a lecture. It was a modification of the minute paper, attributed to Schwartz who used such a technique in his physics courses. Here are the three questions that Mosteller asked his students:

1. What is the most important thing that you learned in class today?
2. What is the main, unanswered question you leave class with today?
3. What was the muddiest point in the lecture?

These questions were to be answered on pieces of paper or index cards by the entire class or a subset of the class for the instructor to analyze in preparation for his next lecture. In recent years instructors have asked their students to answer such questions electronically. A related method, that requires more time, is to have the students take a quiz at the end of each class. Minute papers, or minute questions, have also been used during a lecture by using index cards or personal response systems (clickers).

A related method is Just-in-Time Teaching (JiTT). It has been described by Gregor Novak as an active learning method designed to facilitate student engagement with and reflection on course material prior to arriving in the classroom and to provide the instructor with a measure of student understanding of that material before class begins. He developed this technique, which uses computer feedback, along with fellow physicists Andrew Gavrin and Evelyn Patterson. See www.jitt.org for more information.

This poster presentation combines the Mosteller's muddiest point question and JiTT in an easy-to-implement method to assess student difficulties with the reading assigned for each class. It builds upon related work in economics by Brown (2001) and in engineering statistics by Bruff (2009) for business students. At midnight before each class each student is asked to provide his or her muddiest point in the reading (and the most interesting point if there is no muddiest point) electronically. The next morning another instructor and I analyze the responses from the students in each of our two sections in preparing the lecture for that day. Students receive credit for any meaningful response with responses counting 2% of their total grade. It is our belief that this approach will accomplish the following three JiTT learning and teaching goals: to encourage students to prepare for class regularly by reading required material beforehand; to assist instructors in identification of students' difficulties in time to adjust lesson plans; and to help the instructor develop more precise and tailored explanations to address student misconceptions about the course material. This poster will present the number of students responding to each reading assignment along with a Pareto analysis of their muddiest points for that assignment. (Presenting these analyses to the authors of our text is another benefit from this approach.) There will also be examples of how each of our lectures was changed by these muddiest points. Longitudinal analyses of the responses and the relationship to students' grades on exams, quizzes, homework, and class participation will be shown. Finally, there will be a summary of the students' opinions about this technique.

Outcomes of the Experimental Workshop Statistics Sections of an Introductory Stats Class

Igor Melnykov, Colorado State University – Pueblo

"Introduction to Statistics" is a service class taken by many students in CSU-Pueblo to gain basic knowledge of statistics. The students learn about the normal distribution, correlation and regression, confidence intervals, statistical tests, etc. There are 6-8 sections of this class that meet in a traditional lecture-based format. In the Fall of last year, an experimental workshop approach was implemented in two sections. In this format, students learned mostly through performing activities during class. A typical workshop class started with a 5-10 minute mini-lecture, then the students worked in small groups, and finally the class was concluded with the summary of the day's work. The outcomes of the experiment will be presented along with the comparison of workshop sections with traditional ones based on the end of semester results.

Statistics as a Language: Distributed Practice vs. Massed Practice

Nyarazo Mvududu, Seattle Pacific University

The premise for the study was that some students view statistics as a foreign language. This was discussed in a previous presentation at the previous USCOTS. As such we can use strategies designed to acquire language help students become statistically literate. In the review of studies in language acquisition, there was a discussion of massed practice versus distributed practice. Several questions guide the discussion of distributed vs. massed practice. One relates to the amount of practice required to gain proficiency, and another is whether there is a relationship between the type of initial training and retention. Distributed practice is defined as practice that has a measurable time lag between study episodes for a given item. In contrast, study time is not interrupted in massed practice (Cepeda et. al., 2006). Results from studies in language acquisition suggest increased retention with distributed practice. In a review of several studies, Cepeda et. al. (2006) found that in 80% of the cases this benefit was evident. However, there seemed to be diminishing returns (as measured by effect size) as the time lag increases. The average benefit of distributed practice over massed practice was 15%. It is not clear what the optimal time lag is in distributed practice but separation of at least a day was found to be beneficial. Distributed practice would appear to be better suited for long term memory whereas masses practice seems more suited to short term memory. Furthermore, the effect of potential confounding variables such as presentation styles was not discussed.

In statistics education, this may be a consideration in deciding the sequencing of courses. For example, in my university, we have two statistics and research courses that are a required series. However, the students have a choice on when to take each course. It may be worth thinking about the time lag between the courses to reduce the onset of diminishing returns. Would taking the courses in consecutive terms be more beneficial?

Additionally, there may be implications for the spacing of the classes for the course. Some courses are offered once a week for an extended period and others are offered more frequently for shorter periods. Studies comparing performance and other outcomes (e.g., attitude, anxiety) in the two settings would provide useful information. There may also be implications for spacing of assessments. In this study I sought to compare two classes taught in one of the two formats. The variables of interests were attitudes towards statistics, level of anxiety and students' efficacy to learn statistics.

Conceptions of Statistical Variation

Susan Peters, The Pennsylvania State University

The need to think statistically stems from the presence of variation. Statistical thinking embodies understanding how and why to engage in the statistical problem-solving process and understanding the fundamental concepts that underlie the process (Ben-Zvi & Garfield, 2004)—a process in which variation plays a crucial role (Franklin et al., 2007). This poster presents results of a qualitative research study that examined experienced secondary statistics teachers' conceptions of statistical variation, articulated across design, data-centric and modeling perspectives. Data analysis revealed that these advanced learners of statistics hold three distinctly different types of conceptions of variation: Expected but Explainable and Controllable, Noise in Signal and Noise, and Expectation and Deviation from Expectation.

Cost-Effective, Real-Time Interactive Approaches to Statistical Education

Pramod Pathak, Michigan State University

In this poster and demonstration we will illustrate examples of some of the cost-effective interactive teaching tools we have developed using public domain tools rather than (often) expensive and proprietary commercial systems. We have implemented these techniques over the last few years in large introductory statistics courses with great success. Some of the applications include:

* Online RDD Telephone Surveys
* Online Data Collection and its Analysis
* SMS Technology as an Alternative to Clickers
* Real-time Online Q&A Techniques
* Sampling and Resampling Methods
* Time and Place Sensitive Student Participation

We will provide live examples and list the public domain tools used to implement these techniques. Further, we will show how they make large classes more personal to students, increase student interest in statistical education, and ultimately improve student performance. A principal benefit of these techniques is that they enable greater student use of personal electronic tools (laptops, cell phones, PDAs, etc.) while learning statistical concepts.

Statistical Investigation and Students' Motivation toward Statistics

Caroline Ramirez, University of California – Davis

The purpose of this study is to explore the role of motivation in students' engagement in the process of statistical investigation to develop their statistical reasoning and literacy. I argue that students' motivation toward math and statistics can be enhanced by engaging in statistical investigation; and that by having positive motivation in an academic context, students can deepen their understanding of statistical reasoning and literacy. Although motivation has been widely recognized for its importance in education, its relationship with statistical investigation remains unclear. I will present students' excerpts of their essays or sample narratives (pre and post) in the following motivational constructs: how they value math and statistics; their vision of math and statistics; and their perceived level of self-efficacy. Instead of thinking about statistical reasoning, literacy, investigation and motivation as making separate contributions to the development of a students' statistics education, it is more productive to think about the dynamic and reciprocal influences of these elements. Thus, it is critical to extend the collective knowledge on how students learn statistics at the cognitive and psychological levels.

Phelps vs. Spitz: A z-Score Activity That Goes Swimmingly

Alan Reifman, Texas Tech University

Many, if not most, introductory statistics students appear to find the concept of a *z-score* difficult to grasp intuitively. A common way to motivate students' understanding of z-scores is to explain that they potentially can take scores from different distributions of data – even when on a different metric – and render them comparable. The present teaching activity provides a concrete example, grounded in relatively recent events, to solidify the comparability argument for using z-scores.

Michael Phelps, with eight gold medals in the 2008 Beijing Olympics (on top of six golds from the 2004 Athens games), and Mark Spitz, with seven gold medals in the 1972 Munich Olympics, are swimming's two greatest champions. The two swam many of the same events (e.g., 200-meter freestyle, 200-meter butterfly). When comparing these swimmers' *absolute* times in the same events, Phelps's are several seconds faster than Spitz's. However, 36 years (1972-2008) are a long time for advances in training, technique, nutrition, and facilities.

The value of the z-score is that it allows us to put aside differences between eras in athlete-development technology and see which swimmer was faster (i.e., more dominant) *relative to his contemporary peers*. The present activity invites students to compute z-scores for Phelps and Spitz in the same events. The activity was inspired by a 2003 article in the *Baseball Research Journal* by Kyle Bang, which used z-scores to compare the home-run statistics of sluggers from different eras, such as Babe Ruth and Barry Bonds.

In preparation for the activity, I compiled the swimming times for all competitors in the following events (not just those who made the finals, but also those eliminated in earlier rounds): 200 men's freestyle (2008); 200 men's freestyle (1972); 200 men's butterfly (2008); and 200 men's butterfly (1972). One comparison of Phelps's and Spitz's z-scores arises from the first two of the listed events, whereas another arises from the last two. The raw data to conduct these analyses are available from me upon request.

I used this activity with my Fall 2008 introductory graduate statistics class in Human Development and Family Studies (HDFS). Undergraduate HDFS programs do not always require a statistics course, so the present course tends to be the first statistics course for some students. Given the size of my class, I divided it into four groups of three or four students each, with each group receiving a different event to analyze. Results of the calculations are posted on my class blog: http://reifmanintrostats.blogspot.com (see entry of September 23, 2008).

This activity presents students with several data-management and conceptual issues. Times must be converted from minutes and seconds into total seconds to facilitate computation. A single time must be selected for analysis if a competitor has swum the same event in multiple qualifying rounds (we used his fastest time). Outliers must be identified (i.e., one swimmer's time lagging the next-slowest racer's by a huge margin, 20 seconds), given their implications for an event's mean and SD. Finally, a key assumption of z-score comparisons must be considered, namely that the 1972 and 2008 Olympics had similar selection mechanisms and thus comparable populations (e.g., neither year was more likely than the other to have excluded swimmers who might comprise the slower tail of the distribution). Classroom discussion of these issues is expected to enhance students' statistical, conceptual, and data-analytic savvy.

To assess students' perceptions of what they gained from the activity, how interesting they found it, etc., a brief survey was administered to them in the semester after the course was completed (the survey received human-subjects/ethics approval). A number of student comments are shown below. Two themes that emerged from student comments were: (a) how the activity brought into focus the z-score's ability to make different populations comparable, and (b) how the content area of Olympic sports made the activity more palpable than other types of data might have been.

- *It helped illustrate that you cannot compare raw scores. Although one time was technically lower than the other the exercise showed how this is deceiving. Also, since the exercise was using a recent current event it helped make the concept easier to understand.*

- *This exercise helped solidify in my mind the concept of a z-score. Assessing performance at two different places in time allowed for greater understanding of how valuable a z-score can be.*

- *The Spitz/Phelps exercise allowed me to see how the z-score concept worked with a realistic example and something I have heard of before. By using an example of how the z-score translated to what we see and experience, even if it was on TV, we were able to grasp and retain the concept.*

- *Who hasn't heard of Michael Phelps? It was really interesting data to use because anyone who watched the Olympics this summer, heard the debate on who was a better swimmer and if the competition was harder for Spitz or Phelps.*

- *Simply talking about numbers with no "story" behind them is always dry and boring. The Olympics was such a big thing that summer, and Phelps was the biggest story of the games. I think everyone in America knew about Phelps and was interested in his story, so studying stats based on his story just made it more fun.*

- *I think it would be helpful when explaining to non-statisticians and also to help explain to people as they need to understand the concept of why a z-score is useful. I told a friend who is on faculty at Ole Miss about the example and she found it extremely interesting (she teaches Research Methods and Statistics courses).*

A Follow-Up on the Juarez Lincoln Marti International Education Project

Jorge Romeu, Syracuse University

The Juarez Lincoln Marti (JLM) International Education Project, http://web.cortland.edu/matresearch has operated since 1994 in Latin America, teaching many faculty development workshops, donating hundreds of textbooks to dozens of universities and writing a bimonthly educational E-Newsletter to scores of faculty and researchers. In the first USCOTS, an overview of the JLM Project was presented as a Poster. In this, third USCOTS, we propose to provide an update with the many activities we have been developing in the years since, including a new "solidarity" program for delivering clothing, school materials and toys to children in the areas where are located the institutions where we give our workshops.

Including Undergraduates in the Scholarship of Teaching and Learning Statistics
Alan Russell, Elon University

As part of a Scholarship of Teaching and Learning (SoTL) project, our group uses "Think Alouds" to study differences between novice and expert notions of standard deviation and spread. Aside from sharing the preliminary results of that work, we will share our efforts to incorporate an undergraduate student as one of our principal investigators. This session will share portions of Amanda's journey along with some of the stumbling blocks professors should be aware of before beginning a similar endeavor. As the focus of this conference is "letting go," we invite you to let go of old notions of what is possible with undergraduate research.

Using File Uploads to Monitor and Improve the Classroom Laptop Experience
Bill Rybolt, Babson College

When a new technology such as laptops in the classroom emerges, it carries with it a host of both positive and negative possibilities. After the initial positive enthusiasm, negative side effects often emerge. Being a believer in the benefits of laptops in the classrooms, I was disappointed when articles began to appear about professors that had banned their use. In my classes I encourage students to use the laptops almost all of the time in all of my classes. At Babson College our undergraduate classes average 30 students in our introduction to probability and statistics classes. All incoming students are issued laptops when they enter as freshmen; these laptops are currently running Windows XP with Office 2007 for general use and Minitab as our statistical package. In this environment I felt a responsibility to make optimum use of the laptops and was surprised to find that some of my colleagues thought it best to have the students frequently close their laptops during class or even ban their use. My philosophy is that students are responsible for managing their time and if they are not disruptive to each other they can use it as they see fit.

Because the students were using their laptops to participate in the classroom experience, a key question was how could one capture and analyze their work to answer questions about this experience. This was an attempt to apply recommendations five and six of the GAISE College Report. At the end of each class, I have students save their Minitab project and session window files on their local machines and upload their session files to a class server. This presentation examines the ways in which I have used this information to study the relationship between laptop usage patterns and the students' understanding of course material.

Since I typically teach three classes, I receive just under one hundred files on a day in which we have class. At the most trivial level I have used the presence of the uploaded files to track student attendance. I have used this information to study the relationship between such attendance and performance in the course. At the other extreme I have examined each student's individual file to better understand how they were using their laptop and where they were having difficulties. This information can used either to help individual students or identify instances where the entire class is having trouble.

The latter method, while ideal, is too time intensive to use on a daily basis. Hence I sought a quick and dirty method in the spirit of Mosteller (Mosteller and Tukey, 1949-1950). I selected file length as a crude index of student behavior. The hypothesis is that students' with files deviating from the norm are the ones where attention should be focused. In this presentation I begin by describe my techniques for collecting and analyzing the files. This is followed by describing what I have learned about the relationship between information extracted from the files and student learning in the course. Finally I make suggestions about how this information can be used to improve the educational experience.

Using an Online Discussion Component in an On-Campus Introductory Statistics Course
Sean Simpson, Westchester Community College

In the typical introductory statistics course, a significant amount of material is covered each week. When the class meets with the instructor often (at least two times per week), a student has the ability to ask questions of the instructor on a regular basis, which should help the student keep up with the material. However, in a course that meets only once a week, the risk of falling behind due to difficult material and large time gaps between class meetings is great.

During the Spring 2009 semester, the presenter is teaching a section of Introductory Statistics that meets only once a week for four hours (four credit course). To help combat the issue of meeting with students just one time per week, he has utilized the discussion capabilities of Blackboard CE to reach out to his students throughout the week. Similarly, the students reach out to the instructor in the discussion area with their questions on the material. In this poster presentation, the specifics about how the set-up of the discussions used this semester will be given, the requirements for the students along with feedback from the students and ideas to enhance the process in future semesters.

As of this writing, the majority of the postings are about the material and tend to appear on Thursday evening, Friday or Saturday morning. The best student discussions were initiated by a project regarding the Central Limit Theorem.

Some Examples from "Statistics for Social Justice"
Jeff Spielman, Roanoke College

The General Education Program at Roanoke College has recently been changed; the new courses are scheduled to go "on-line" in the Fall of 2009. The specific change that has affected me the most is that the Introductory Statistics Course (STAT 101) is being replaced by a context-based data analysis course (called INQ 240) in which the statistics topics are essentially the same but are driven by a specific set of related applications. It is also required that the course contain a significant writing component, although the main focus will still be on the quantitative reasoning associated with analyzing statistical data. A statement on the Roanoke College home page says this about the new curriculum: "Roanoke College's Intellectual Inquiry curriculum will be implemented beginning in Fall 2009. This general education curriculum will engage students in rigorous inquiry while developing their abilities to use the tools of different disciplines to address important issues. Communication and critical thinking skills are emphasized in all courses."

I was one of two faculty members at Roanoke College who had the opportunity to try out my new course material a year in advance. During this academic year I have taught three sections of STAT 101 with an emphasis on examples from social justice. The course which I have developed for the new curriculum is called “Statistics for Social Justice.” My choice of topic was mainly influenced by the article, “*Critical Values and Transforming Data: Teaching Statistics with Social Justice”* by Lawrence M. Lesser. (This article can be found in Volume 15 of the ***Journal of Statistics Education*** *(2007))*. I was asked to write an article for the *Faculty Newsletter* at Roanoke College about my experiences in teaching these sections. In case it can provide useful background, the article can be found at the following link:

http://web.roanoke.edu/x28720.xml?refurl=x28720.xml

What I plan to put in my poster presentation is a sampling of the social justice applications that were used in the courses this academic year along with some of the changes that I needed to make in the presentation of the statistical material so that genuine quantitative reasoning could be taking place from the beginning of the course. One very important change was an increased reliance on simulations in order to generate estimated significance levels, well before formal methods of inference were covered.

I have not done any formal measuring of what these changes have meant to my students, but I do have some informal observations that I can share. The biggest difference that I have noticed in using this new approach is that it is easier to get students to participate during class. A student may not want to answer a question concerning the construction of confidence intervals, but many will have an opinion about whether or not minorities are treated fairly by law enforcement agencies or whether or not people in all parts of the world have similar advantages. By emphasizing social justice issues, I have been able to get a lot more responsiveness during class discussion that can eventually become centered on data analysis techniques. It is also fairly clear from responses that by using related examples and simulation-based techniques early in the course, the ideas associated with formal inference are much easier to introduce when they come up later in the course.

The courses that I taught this year are not yet the courses that will be in our new curriculum. We still are teaching STAT 101 and we must remain faithful to that course description. In particular, the “writing component” mentioned earlier will not become a part of the course until next year’s courses begin. My plans for this part of the course include:

(1) a short research paper, early in the course, in which students attempt to define what is meant by a “social justice” issue.

(2) a final project using data from the campus community or the nearby local community; the students would choose the data and would need to justify the project as one that is related to “social justice.” This project would be a major writing assignment requiring multiple rewrites.

(3) a criticism of one or more of the indices that are used by various groups to classify groups of people or regions of the world. As in the previous example, this assignment would also include a quantitative reasoning component. (Examples of indices: The *USA Today* **Diversity Index**, the United Nations Human Development Project **Human Development Index**.) Some references to these assignments with writing components will be a part of the planned poster.

Illustration of Humor and ‘Strange News’ Used in Two Statistics Courses

Amitra Wall, SUNY – Buffalo State
Sarbani Banerjee – Buffalo State

The purpose of this poster is to illustrate the use of humor and strange news used in two undergraduate statistics courses at SUNY Buffalo State College. As the largest comprehensive college located in an urban setting, Buffalo State College tends to attract non-traditional commuters. A majority of the students work full-time and raise a family while attending school on a full-time basis. Time constraints, influence of gender, and fear about the subject matter of statistics require teaching strategies that engage and motivate students. Two departments, Sociology, where statistics is a required course for students in the major, and Computer Information Systems will be used as case studies. The poster will depict examples used in SOC 301: Social Statistics and in CIS 435: Data Mining.

Developing Statistical Intuition While Learning About the CLT and Hypothesis Testing

Aaron Weinberg, Ithaca College

This poster and demonstration describes data collection activities and associated reflective experiences that are designed to introduce students to the Central Limit Theorem (CLT) and formal hypothesis testing while simultaneously helping them develop intuitive reasoning for these statistical concepts.

In the CLT activity, each student is given a deck of cards and each card is assigned a value. In the T-test activities, each student is given a bag of bingo chips of several colors, and each color is assigned a value. In the proportion test activities, each student is given a bag of bingo chips of two colors. In each of these activities, students draw multiple samples, compute averages and proportions, and combine their data with that of their classmates to describe the shape of various distributions and to make and test predictions about the contents of the bags.

According to modern theories of learning, students play an active role in constructing their own understanding of concepts; this understanding is based on their intuition and experiences. When a student encounters a new idea or phenomenon, they relate it to what they already know and understand. If the new idea fits in with what they already know, they integrate it into their current knowledge base, and if it doesn't, they adjust their understanding to accommodate the new idea. Based on this theory, the activities incorporate four steps: prediction, collection, reflection, and connection.

Students begin by predicting what their data will look like, which helps establish and clarify their knowledge base. For example, in the T-test activity, students predict the value of their personal average and predict the distribution of the class averages when they draw multiple chips from their bags. After they make predictions, they collect data and then compare the results to their predictions. During the reflection stage, they make observations about the data and begin the process of constructing new knowledge. For example, they describe how close each student's personal average was to the class average and discuss the role of sampling variation. After completing the activity and follow-up questions, students work on traditional CLT and hypothesis testing problems, drawing explicit connections between these problems and their reflective experience.

These hands-on activities engage students in actively constructing knowledge. By reflecting on their own experiences, students develop both an intuition for statistical ideas and a deeper understanding of the formal computations