Preparing Secondary Mathematics Educators to Teach Statistics

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Abstract

In this paper, we address two Roundtable topics: distance education and developing teachers' statistical knowledge. We describe a new professional development program for secondary school mathematics teachers who are preparing to teach statistics. We also discuss what we have learned in our efforts to design a course that has a significant online component and that is relevant and useful from a teacher's perspective. We describe the ways in which our online environment incorporates group work, self-study, concept exploration, and assessments. We also discuss the challenges associated with delivering the necessary content while simultaneously accommodating the practical time constraints of adult students who are, themselves, teaching full-time.

Introduction

In many developed countries a large proportion of the population has underdeveloped quantitative and statistical reasoning skills (Steen, 1997). In the US, one effort to address this problem has been through reform of the elementary and secondary mathematics curriculum. These reforms have advocated integrating statistics and data analysis into the mathematics curriculum. The integration of statistical methods and key concepts of statistical thinking into the K-12 curriculum in the U.S. has been widely discussed over the last decade. For example, the National Council of Teachers of Mathematics (NCTM) introduced a statistics strand into its *Curriculum and Evaluation Standards for School Mathematics* (NCTM, 1989). This strand has been expanded even further in the NCTM 2000 standards (*Principles and Standards for School Mathematics*). Projects such as Quantitative Literacy and Data Driven Mathematics, supported by the National Science Foundation (NSF) and administered by the American Statistical Association (ASA), have developed materials to assist teachers in integrating statistical topics into high school algebra, geometry, and analysis courses. A reviewer reminds us that there are similar projects (e.g., Preparing Mathematicians to Educate Teachers (PMET), www.maa.org/pmet; and Professional Enhancement Program (PREP), www.maa.org/prep) that are supported by the Mathematical Association of America (MAA). However, a number of important statistical concepts, such as sampling variability, survey and experimental design, statistical inference, and the ability to judge the validity of arguments based on data (all now part of the NCTM standards for secondary grades), are not easily integrated into existing mathematics courses. In response, many secondary schools have introduced one-semester statistics courses and, more recently, yearlong Advanced Placement (AP) Statistics courses, into their curriculum. AP Statistics courses are taught using a common course outline provided by The College Board, and offer high ability secondary students the opportunity to take a college level course in introductory statistics while still in high school. Students who complete this course and pass a national exam can obtain college credit and/or advanced placement in statistics at most colleges and universities in the US.

More secondary school students are taking AP Statistics courses. The number of students taking the AP exam in Statistics has grown from 7500 in its first year, 1997, to approximately 65,000 in 2004 (http://apcentral.collegeboard.com). The typical prerequisite for AP Statistics is Algebra II, so this course provides an opportunity to serve a diverse audience of students and continued growth is expected. Anecdotal reports suggest a growing number of non-AP high school courses in statistics are also being taught, and statistical ideas are also being presented in a variety of mathematics courses and laboratory science courses, all of which would be strengthened by improving teachers' knowledge of statistics.

The AP Statistics course has a strong emphasis on data analysis and de-emphasizes probability and computation. A significant part of the course deals with methods for collecting data, including sampling and experimentation. In addition, clear and accurate interpretation of statistical analyses is a focus of the course, and communication is weighted heavily in the scoring of the AP Statistics exam. The exam also includes an investigative task which asks students to integrate statistical ideas and methods from the course to solve a problem of a type that they may not have previously encountered. Because of the clear emphasis on conceptual understanding and communication, teaching this course is a challenge for most secondary teachers. In fact, this and other laudable integration efforts have led to the recognition of a problem parallel to that of the general lack of statistical literacy in the population. This problem is that many, if not most, elementary teachers and even secondary mathematics teachers are not well prepared to teach statistical topics.

In the US, most secondary school teachers of statistics have backgrounds in mathematics with little or no training in statistics, and there is no specific certification in statistics. This is problematic because although statistics is a mathematical science, it differs from mathematics in fundamental ways. Given the emphasis on integration and the increasing popularity of AP Statistics courses, the need for qualified teachers of statistics is large and growing. Currently, workshops (ranging in length from one to five days) are the primary vehicle for professional development available to secondary school teachers, but workshops have several limitations, including the following: most focus on pedagogy over content; the short workshop format is not conducive to the development of full content understanding; and, short workshops lack a mechanism for support that could help sustain participants' continued learning and enthusiasm.

For these reasons, while many current efforts in K-12 statistics education are themselves addressing important needs, they do not adequately address the need to improve qualifications of secondary school teachers of statistics courses. To meet this need, several institutions and organizations (California Polytechnic State University, the University of California at Los Angeles, and the American Statistical Association) worked closely with professional statisticians and experienced high school statistics teachers to develop a professional development project called *Insight into Statistical Practice, Instruction and Reasoning* (INSPIRE).

The INSPIRE Project

The objective of INSPIRE project was to craft a professional development experience for secondary teachers that would prepare them to:

- Teach an introductory statistics class following the AP Statistics curriculum
- Learn and understand the concepts and methods of introductory statistics as prescribed by the AP Statistics curriculum
- Use real data, active learning techniques, and technology to teach statistics
- Understand statistics as a comprehensive approach to data analysis, and
- Become familiar with a variety of resources for teaching introductory statistics

In addition, an important goal of INSPIRE is to develop a long-term community of learners who advise and support each other about classroom practices, pedagogy, and statistical concepts. The program involves completing a sequence of two year-long courses designed for secondary school teachers. The first course, which has a content focus, was offered for the first time in the 2003-2004 academic year. It combines a week-long workshop with a nine-month online course. The second course is a practicum that starts with a workshop and then pairs each secondary teacher in the program with a statistician from business, industry, or government to work on a yearlong project. This paper focuses primarily on the first of these two courses, called the Content Course. The INSPIRE content, which is divided into 15 units, can be viewed at inspire.stat.ucla.edu/unit_xx (where "xx" is any number from "01" to "15").

Overview of the Content Course

The Content Course consists of a workshop and an online/distance-learning component. The Content Workshop is held in the summer and initiates the course. The purpose of the five-day workshop is to introduce participants to the basic philosophy of statistics and some basic concepts, and prepare them for the distance-learning component. The modern introductory statistics curriculum includes topics such as data analysis, graphical techniques, and experimental design, that may be unfamiliar to teachers trained in mathematics (Cobb, 1992; Cobb & Moore, 1997; Moore, 1997; Moore, 1988; Bryce, Gould, Notz & Peck, 2002; Higgins, 1999; Hogg, 1991; Singer & Willett, 1990). For this reason, the workshop gives special emphasis, beyond that which could be covered in a distance-learning course, to the ways in which teaching statistics differs from teaching mathematics and to the goals and techniques of data analysis. The workshop, as the only opportunity for participants to meet face-to-face before working cooperatively over great distances, also facilitates the distance-learning component. Research has shown that the creation of a community of learners is vital to the success of distance education (Hsi, 1999).

The distance component is the heart of the Content Course and is the primary vehicle through which content knowledge is delivered, skills are acquired, and information is disseminated. This component is an introductory statistics course, enhanced with special attention to pedagogical concerns and paced so that the participants will have time to learn the content before presenting the material to their own students. Materials are delivered primarily online in a structured curriculum involving group work, self-study, concept exploration, exams, and small projects.

In accordance with the research literature on teaching statistics (see Garfield, 1995), the distance component is designed so that participants:

- actively participate in constructing their own knowledge
- practice what they are intended to learn
- confront their misconceptions
- work with real data in realistic contexts, and
- apply statistical analysis software to analyze and visualize data

The Content Course was designed by a development committee and incorporates some common elements found in the successful distance courses that we evaluated. Using these elements as a basis for practice, we assign participants to small groups (where each group is facilitated by an instructor) and provide group discussion questions. These are conceptual questions keyed to a major theme. The questions address content as well as pedagogical concerns. For example, a discussion question might be of the form, "How will you introduce this concept to your students?" Monitored bulletin board forums allow the groups to discuss content and to help each other. In addition, the instructors use the bulletin board to facilitate discussions on pedagogical techniques and to encourage students to think more deeply about concepts. We also assign periodic milestone assignments that give the participants additional opportunities for feedback.

About the Participants

The course was designed to anticipate what we felt were the needs of a fairly specialized audience. Participants work full-time jobs (and some would say more-than-full-time) with fairly limited resources and under much pressure to learn a new discipline while simultaneously teaching it. Participants were recruited through an email discussion group of secondary statistics teachers and through the use of a brochure that was mailed to all US high schools currently offering AP Statistics. Thirty-two participants were selected from approximately 160 applicants. Selection was based on statistics teaching experience (with preference given to those with the least experience) and on expressed enthusiasm for the program.

In our first class of 32 participants, the participants were fairly demographically diverse. They were spread across the United States and worked under fairly diverse environments (small private schools to large, inner-city public schools). Eight participants had not taught Statistics before. The median number of years participants had taught Statistics was 1. Although all but one participant had a math background, there was great variety in their experience and comfort with technology. A small number had a background in computer science, but the majority was not accustomed to using the computer for any activity other than email. Many expressed concerns about learning new software and about navigating the course web page.

During the introductory week workshop, participants were asked to list up to three concerns and three hopes about the course. Worries over time management were voiced by nearly every participant. Concerns about using technology were the second most popular concern. Some were concerned they wouldn't have sufficient access to the internet to complete work. Others were concerned that software incompatibilities or computer crashes would prevent them from completing assignments. A small number were concerned that they did not know enough statistics to do well in the course. Interestingly, a Homogenized Alternating Least Squares (HOMALS) analysis (Gifi, 1990) detected a small group of students who were fairly confident in their abilities. They expressed the hope that the course would lead to deeper understanding of statistics (as opposed to others, who expressed the hope that they would master "the basics"). This "deeper understanding" group was also confident about their computer skills and tended not to list technology concerns. People who expressed several concerns about having sufficient time for the course were also concerned about their level of knowledge and their technical skills.

To meet the needs of this diverse group, a number of features were designed into the INSPIRE course.

1. Asynchronous design
2. A variety of approaches towards the content so that participants could "pick and choose" those which worked best
3. Infrequent, but regular, "milestone" assessments for instructors to monitor progress and provide feedback
4. Low-stakes assessments for participants to monitor their own progress
5. Discussion forums to enhance the sense of community and provide quick feedback on problems and concerns, and
6. An easily navigated, intuitive web interface

The Overall Structure

Course activities were organized via Blackboard, a popular, commercially available course management system. After logging to the password protected Blackboard web site, participants could view their grades, participate in on-line discussions, send email, etc. Instructors could use Blackboard to perform such activities as monitoring discussions and posting announcements. Participants could also view a schedule that displayed the course outline, along with homework due dates, and by clicking on the appropriate link, bring up a window to review the course's statistical content. (See Figure 1)

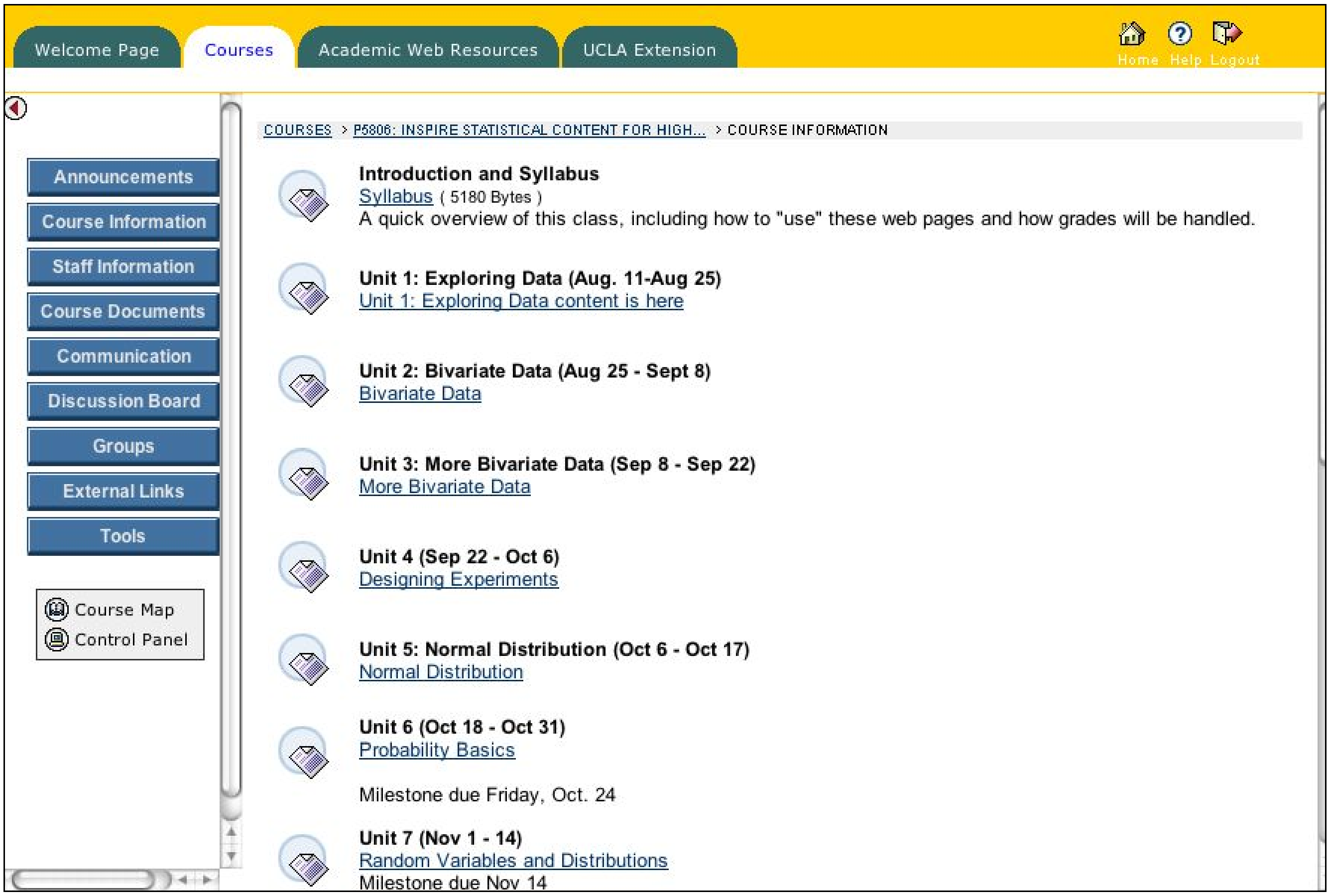

Figure 1: The course outline and schedule was maintained on the Blackboard course management system. Clicking on a title opens a new window that displays the corresponding statistical content.

The statistical content of the course was divided into 15 units, each requiring two to four weeks to complete and roughly corresponding to a chapter in a textbook or a "big idea". The units included, in this order, Exploring Data, Bivariate Data (correlation and simple regression), More Bivariate Data (transformations to achieve linearity, pitfalls with interpreting regression models), Designing Experiments (controlled experiments vs. observational studies), Normal Distribution, Probability Basics, Random Variables, Probability Simulations, Sampling Distributions, The Logic and Construction of Confidence Intervals, The Logic and Construction of Hypothesis Tests, Two-sample Analyses, Chi-square Tests, Inference and Regression, Experimental Design Revisited (blocking, randomizing, various sampling schemes.)

Each of the 15 units was subdivided into seven sections: Main Concepts, Demonstration, Activity, Teaching Tips, Data Collection and Analysis, Practice Questions, and Milestone. The Main Concepts section served as the unit's "homepage"; participants could go there directly by entering the unit's URL into their browser or through accessing the course schedule in the course management system (Blackboard). The other sections appear on the browser as "tabs", and participants could go to any section within the unit by clicking on the corresponding tab (see Figure 2). These pages were deliberately designed so that all visible links connect to material relevant to the current unit. To view other units requires a visit to the course management system. We hoped this would minimize confusion; when studying, say, experimental design, all of the material that a participant needed to study was in view and participants knew that there was no need to look elsewhere for assignments or material on this topic.

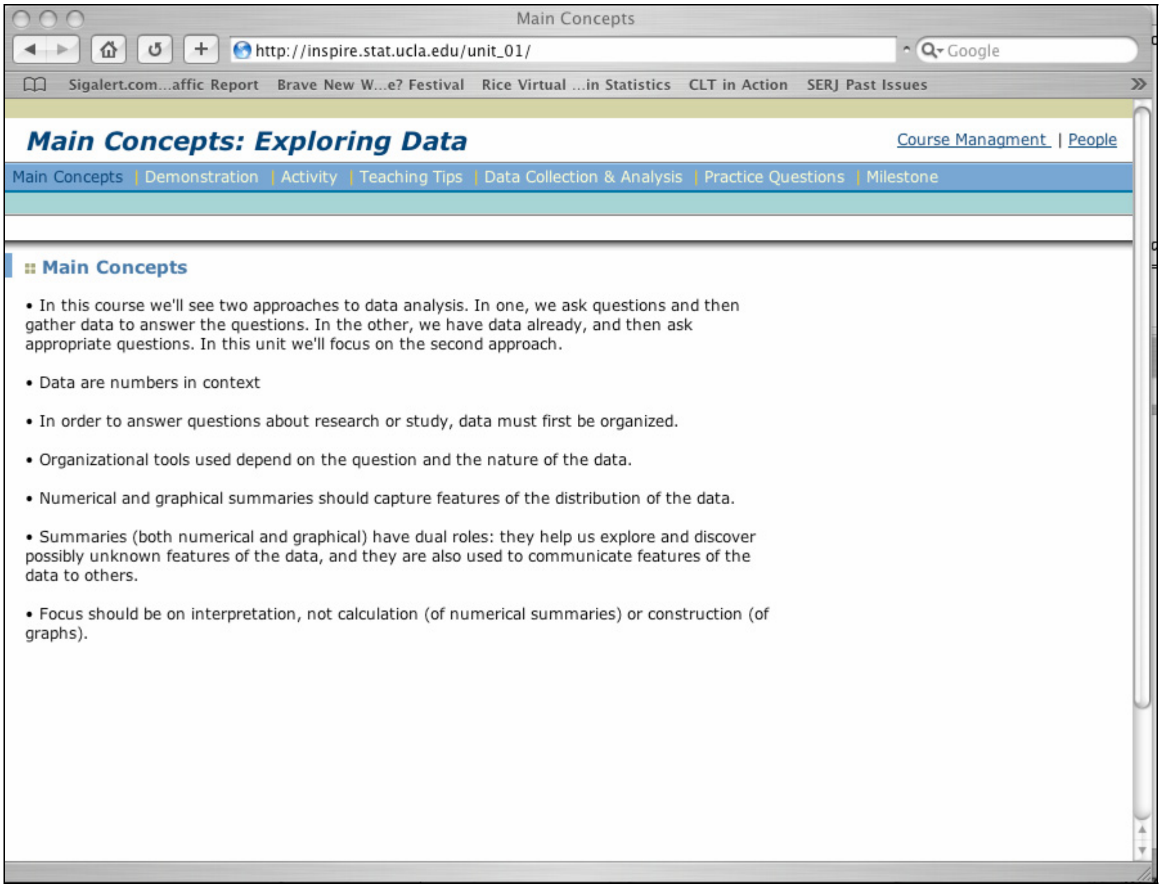

Figure 2: The Main Concepts page for Unit 1. The eight sections are listed in the tabs below the title of the unit. Clicking on any tab changes the content of the main window.

We assumed that the participants would read their classroom textbooks before beginning the chapter and explicitly told them so. Participants were encouraged to visit the sections in any order they preferred. Indeed, only the “Milestone” section was required. Still, there was an implicit order to the sections reinforced by the fact that the Main Concepts page is the first page visible and by the fact that most readers tend to scan the tabs from left to right. Still, most participants developed “favorite” sections that they referred to more frequently than others.

Not all sections had content in all units. For example, the "Data Collection and Analysis" section in Unit 5 (The Normal Curve) was left empty. This was a fairly technical unit, in which the main idea was to learn to use the normal curve to calculate probabilities. We did not think a data analysis activity would be particularly helpful. Instead of an exercise, this section read “There is no data collection activity for this unit. However, if you're disappointed by this, we recommend returning to earlier data sets and comparing the normal probability plots with the histograms to help you develop a sense for what is 'normal.'”

Unit Design

Our motivation in designing the content pages was to "look over the shoulder" of the participant as he or she read the textbook used in the classroom. We did not want to re-iterate or review what the participant had already read. Instead, we wanted to enhance the reading by providing the participants with experience that would enhance their conceptual understanding. Although the course was not designed to teach pedagogy, we were none the less quite aware that most participants would be thinking, "How can I teach this?" while they studied the material.

Main Concepts

The main concepts page lists ideas and concepts that we felt were of particular importance. We hoped that this list would help direct the participants' reading and re-reading of the topic in their textbook. We took care to point out concepts that we felt were important but likely to be missed in a first reading of a textbook. For example, for the random variables unit: "Probability density functions (pdfs) and random variables are joined at the hip. You can't mention one without, at least implicitly, mentioning the other. When you meet a random variable for the first time, you should ask it 1) What's your pdf? 2) What's your expected value? 3) What's your standard deviation? and 4) What physical situations can you model? "In some units the list was quite succinct whereas in others the list was more extensive. For example, the unit on probability simulations had only two main concepts, while that on inference and regression had ten.

Demonstration

Demonstration is not a lecture, but instead an example showing how concepts are used to analyze data or solve problems. Sometimes trickier points were explained or worked out in more detail. The demonstrations were recorded and delivered via Caststream, commercially available software that streams and syncs audio and power-point slides. This software proved to be problematic. The learning curve to prepare and deliver presentations was extremely high and many participants reported problems in viewing the presentations. As an alternative, participants could view the slides (without audio) using their web browser and could download a text file of the commentary. This was not, apparently, a satisfying experience for many participants, and is potentially an aspect of the course that most needs technological improvement.

The demonstrations were an opportunity to push somewhat beyond the curriculum. For example, one of the last demonstrations on the subject of inference and regression analyzed data with a multiple regression problem and demonstrated how confounding can affect the linear model. The first demonstration on the topic of descriptive statistics walked the listeners through a graphical analysis of a data set without explaining how the graphs were formed or what they meant, assuming the participants had already studied this information and, instead, needed guidance on how these topics were applied.

Activity

Activities are intended to help participants deepen their understanding of a topic. Usually participants were asked to report their discoveries on the discussion board, but sometimes the activities were worked into the Milestones so that a report was turned in and reviewed by the instructors. The activities were popular among the participants, possibly because, as some participants reported, they could be easily imported into the participants' own classrooms. In fact, on occasion participants reported on their students' discoveries while doing the activity, rather than reporting on their own. One of the more enthusiastically received activities was in Unit 10 on confidence intervals. The activity made use of an applet from UC Berkeley (www.stat.berkeley.edu/users/stark/ Java/Ci.htm) that simulated random samples to allow the participants to see the effect of changing various parameters on the confidence intervals.

Teaching Tips

The section on teaching tips provided a list of helpful hints for how to teach the material and what to teach. It offered advice on what topics were particularly difficult to teach, and provided some ideas for how to make teaching easier. When necessary we offered warnings not to dwell on some items (for example, not to spend too much time on probability and not to teach combinatorics) and noted what deserved particular emphasis (such as being very picky about language and writing when describing graphical output.) The unit on basic probability (Unit 6) had fairly extensive teaching tips, in part because of our concern that math teachers would over-emphasize this topic. The teaching tips are:

- We do not care one whit about the probability of getting a straight flush or winning at craps. Probability is taught as an aid to statistical inference and nothing more.
- If the question you are asking can't be done with a two-factor table or a tree diagram, then it is too complicated a problem for this course. Your students must be comfortable solving problems with two-factor tables and tree diagrams, but do not need to know counting rules or combinatorics. (A "factor" is another word for "categorical variable".)
- Venn diagrams are not terribly useful, except maybe for understanding unions and intersections. We recommend using two-factor tables to understand unions and intersections.
- As elsewhere, don't focus on formulas, but on understanding.
- Some books define independence in terms of a product: two events are independent if and only if the probability of A and B happening is the probability of A times the probability of B. However, we feel you'll develop stronger intuitive understanding of independence if you use the definition in terms of conditional probability: two events are independent if and only if the probability of A happening, given that B has happened, is the same as the probability of A happening. In other words, knowledge that B has or has not occurred has no effect on whether or not A will happen.
- Beware of the amazing and astounding paradoxes of probability, as tempting and entertaining as they are. The take-home message for some students will be that no matter how much they think they understand probability, they really don't, so why should they bother?
- A classic probability problem that can be fun to try with your students is the birthday problem (assuming you have over 30 students in your class). One possible moral of this problem is that coincidences are more likely than one might think. Which leads us to think that we sometimes what we perceive as meaningful patterns are actually simply due to chance.
- Be careful to distinguish between mutually exclusive events and independent events. Students often confuse the two, but they are very different ideas.

Data Collection and Analysis

This was meant to provide a somewhat directed data analysis exercise using a real or realistic data set. For example, in one of the regression units, students were given a fairly complex data set (provided by the software package *Fathom*) that provides the value of houses in several California cities along with potential predictors for the houses' value (for example, number of bedrooms and size of the lot.) A set of questions helps them see the need for transformations of the data to improve the fit of the linear model. In other sections, these exercises simply helped illustrate potential applications of the concepts. For example, in the probability section, results from a survey were provided and participants were asked whether male or female college students were more likely to drink alcohol (see below). Because the sample had a much larger proportion of women than men (which is an accurate reflection of the survey population of UCLA dorm residents), answering this question illustrates an application of conditional probabilities. In the Hypothesis Test unit, participants collected their own data on the proportion of heads that results when "spinning" (as opposed to flipping) a coin and shared these in the discussion forum with the other participants so that data could be pooled.

Rather than turn their work in, participants were asked to post their conclusions on the discussion board and to comment on other participants' conclusions.

Example of Data Analysis Exercise for Unit 6

In 2000, the UCLA Student Health Center surveyed a simple random sample of UCLA dorm residents about various health and lifestyle habits. One question they asked was "Have you ever drunk alcohol, other than a sip or two?" The results, by gender, are below:

Gender	Yes	No
Male	150	47
Female	332	106

a) (5 pts) Suppose we select one of these students at random. Find the probability that the selected person is female or has drunk alcohol.

b) (10 pts) Are male UCLA dorm residents more likely to have drunk alcohol than female UCLA dorm residents? Support your answer with the data in this table.

Practice Questions

Practice questions were a series of short, "homework-like" problems designed to help participants assess whether they were using basic skills correctly. After working the problems, participants could view their answers and get immediate feedback. (In fact, in many cases they could get the feedback before working the problems, or could go back and re-do the exercises if necessary.) The exercises ranged from very straight-forward calculation problems to more complex "stumpers". Unit 9, Sampling Distributions and Inference, had questions such as

> "If you wanted to estimate the range of heights of people in a population (tallest height minus shortest height) you might decide to take a sample of five people and use the sample range. Would this be an unbiased estimator of the population range? Explain."

And

> "Suppose that 29% of all high-school seniors are regular smokers. (This is approximately true, according to a recent Gallup poll.) If you were to take a random sample of 100 high school seniors, what would be the approximate distribution of the sample proportion of regular smokers among them?"

Participants could then check their solutions with ours by clicking on the "solutions" link.

Milestone

The milestone was the only required section and the only section that was graded. The milestones were open-ended problems that covered one or several of the more important concepts of the unit. For example, in one of the regression units, participants were not simply asked to do a regression, but instead were given a data set with many predictors and asked to choose one or two that they felt told the best "story" with respect to high school performance scores. The very first milestone, in the unit on summarizing data, presented results from a survey of the 32 participants and asked them to describe the class.

<u>Example of a Milestone from the Unit on Sampling Distributions</u>

1. To ensure water safety, quality control engineers take six water samples every hour and compute the mean of their arsenic contents. If the mean exceeds a certain predetermined amount, then the purification process is declared faulty. The engineers know that the arsenic content of water from this purification plant is normally distributed with a mean of 25 micrograms per liter (μg/l) and a standard deviation of 5. μ g/l.
   a) Devise a mathematical simulation that will generate the six water samples from the original water supply and calculate the mean of their arsenic content. Repeat the simulation 100 times and plot the means. Describe the distribution; its shape, center, and spread.
   b) Suppose a new arsenic source adds 8 μg/l to all water samples. How will the distribution of arsenic levels in the water change?
   Now describe a mathematical simulation that will generate the six water samples from the new water supply that has the higher arsenic level and calculate the mean of their arsenic content. Repeat the simulation 100 times and plot the means.
   c) Describe the differences in the two distributions. Was it easy to detect the change in arsenic content?

2. A second group of engineers at the same water treatment plant takes six water samples every hour and computes the maximum of their arsenic content.
   a) Devise a mathematical simulation that will generate six water samples from the original water supply and calculate the maximum of their arsenic content. Repeat the simulation 100 times and plot the maximums.
   b) Suppose a new arsenic source adds 8 μg/l to all water samples. How will the distribution of arsenic levels in the water change?
   Now describe a mathematical simulation that will generate the six water samples from the new water supply that has the higher arsenic level and calculate the maximum of their arsenic content. Repeat the simulation 100 times and plot the maximums.
   c) Describe the differences in the two distributions? Was it easy to detect the change in arsenic content?

3. Was it easier to detect the difference when we used the mean or when we used the maximum? Explain your reasoning.

Evaluation

One of the greatest disappointments of the course was the lower than anticipated level of student-to-student interaction. Indeed, even the interaction between students and instructors was sometimes disappointingly low. Some of this can be accounted for by the sort of random occurrences that any actuary could predict would occur during a course as long as ours. During the year, two students had surgery, one moved away, another had the AP Stats program at her school cancelled. But a major difficulty was the students' different work schedules. Some taught their own classes at different paces. Some studied a little each week, others would try to cover several units in a weekend. This made the discussions disjointed. Another reason for this, though, is that it is perhaps even more difficult to lead a discussion of substance on a "discussion board" than it is in a real classroom. While multiple participants might respond to a question in multiple ways, it is difficult for the moderator to get them to examine each other's answers critically. There were some exceptions, however.

A discussion on the purported safety of SUVs provoked by a New Yorker article (Gladwell, 2004) brought several "quiet" participants to the discussion, and also gave the instructors the chance to discuss some subtle misconceptions about the use of rates to compare groups. In general, discussions about experimental designs were the liveliest, and often discussions about other issues led back to experimental design. The SUV discussion, again, was intended to illustrate how different views of the data could produce different conclusions. However, none of the participants examined the posted data (or if they did, did not wish to discuss it.) Instead, they were primarily interested in criticizing the study's methodology.

Technical glitches were another reliable source of frustration. We had (and continue to have) problems sharing files. Participants send instructors files that are unreadable, and vice-versa. Caststream, the software used to view and listen to the Demonstrations, was never completely successful for about 1/4 of the participants. Also, it had an extremely steep learning curve for the instructors.

Next Year

A new cohort of 32 students will begin the course in August 2004. (The workshop will be in late July.) We are considering several changes which we hope will improve the class. A primary goal is to synchronize participants to some extent so that they will get more support from each other and be more likely to stay on schedule.

We might assign students to small teams of two to three and give them weekly (or bi-weekly tasks in which the division of labor is fairly clear.) This, we hope, will help keep participants on pace and strengthen the community bonds. If done well, it could also help more students cover more material. For example, most, if not all, students skipped some parts of the units at one point. If working in teams, the team members could divide and conquer and report to each other. Also, joint projects might provoke deeper reflection which in turn could lead to more substantive discussions on the discussion board. One possible way of forming teams it is to pair students with strong computer skills with those who are less experienced with the computer. This might reduce much of the initial anxiety over using the computer to complete assignments. In this pilot year, students were grouped into groups of 8 and assigned an instructor at random. It might be more efficient to group them by their teaching schedule. For example, those on "block" schedules would be in their own group. This would ensure that a group of students was working at the same pace.

To date, eighteen of the original 32 participants have decided to participate in the Practicum component of the course. In late July they will meet in San Luis Obispo for a "Beyond AP Statistics" workshop, after which they will be assigned to a mentor statistician working in government or industry. They will work with this statistician on an actual data analysis project.

Acknowledgements

The INSPIRE project would not be possible without the dedication of a large number of statisticians and educators who assisted in a variety of roles. In addition to the authors of this paper, these include Beth Chance, Mary Mortlock, Chris Olsen, Alan Rossman (workshop); Floyd Bullard, Matt Carleton, Gretchen Davis, Kim Robinson, Dan Teague (development of on-line material); Floyd Bullard, Gretchen Davis, Chris Olsen, Katie Tranbarger (instructors for on-line course); Carolyn Morgan, Judith O’Fallen (development of Practicum).

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