21. THE INTERNET: A NEW DIMENSION IN TEACHING STATISTICS

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INTRODUCTION

The Internet was developed to permit researchers at universities and colleges to freely communicate their ideas and results with others doing similar research. This was accomplished by connecting the universities by an electronic network called the **Internet** and providing a method for sending messages called **Electronic Mail** or **E-mail.**

E-mail works fine for simple text messages. However, transmitting results of research often requires the capability of transmitting formulas, graphics, and pictures and occasionally even sound and video. Tools to accomplish this were developed and the Internet, with these capabilities, is called the **World Wide Web** or, more simply, the **Web.** Instead of directly transmitting this more complex information between two researchers, say John and Mary, it was decided to allow John to deposit his results on a machine at his institution and let Mary obtain them from this machine. This made John's results not only accessible to Mary but also to anyone else in the world who had access to the Web. This resulted in a remarkable new way to share information. Common usage now uses the terms Web and Internet interchangeably; the term Internet will be used here.

The enriched Internet was such a success that it was extended to allow the same kind of transmission of information by the general public and industry. Although the Internet has grown to have all of the best and worst elements of our society, it is still a wonderful way to achieve its original goal: to allow academics to freely share information.

E-mail still works very much like it did in the beginning and continues to be a natural and useful way to communicate. When we write a letter, we imagine this letter may be kept as a permanent record of our thoughts. For this reason, most of us take a some care in the way we express our thoughts in a letter. E-mail is much more informal--it is not a sin to misspell a word or make a grammatical error. You usually are just writing to ask someone a technical question, help a student, give a colleague a reference to a paper, and so forth. Most of the time, when you receive an e-mail message, you reply and never again look at the message.

Somewhat the same philosophy has been applied to putting materials on the Internet. People often put their first thoughts on an issue onto their Web site, almost like a first draft of an article or book. However, unlike e-mail, this material stays where it is and can be viewed by anyone in the world. Thus, if you start searching the Internet, much of what you will find is outdated; you may get pretty discouraged by the quality of the material. Thus, it is important to find ways to help identify interesting material. In this paper

we hope to do this in the area of statistical education. Sources where useful information is shared on the Internet include:

- Course descriptions and materials for teaching a course.
- Datasets.
- Articles and background information on current statistical issues in the news from newspapers such as *The New York Times* and *The Washington Post,* radio programs such as *National Public Radio,* and popular science journals such as *Science*, *Nature*, and *The New England Journal of Medicine.*
- Interactive modules and texts that illustrate basic concepts of statistics and can be run from the Internet.
- Electronic journals such as *The Journal of Statistics Education.*

Methods for putting materials on the Internet are constantly being improved, and materials found on the Internet are constantly changing to take advantage of the new technology. Currently, the rate of transmission is not sufficient to permit the user to see more than a minute or two of video material, but this will soon change.

In this period of development, problems may occur when you attempt to use the Internet. You may find that just as you are about to use the Internet in a class, the network is down or the speed of transmission is too slow. With new applications you will have to learn how to configure your software to accommodate them. Also, materials that are on the Internet today may have been moved or removed altogether by the time you want to use them. Thus, we cannot guarantee that everything presented to you the 1996 conference will be available when you read this. However, we can assure you that what you will find will be even more exciting than what we will tell you about here.

THE CHANCE COURSE

Chance is a course designed to make students better able to read and critically assess articles they read in the newspapers that depend on concepts from probability or statistics. Chance was developed cooperatively by several colleges and universities in the United States: Dartmouth, Middlebury, Spelman, Grinnell, University of California San Diego, and the University of Minnesota. In the Chance course we discuss basic concepts of probability and statistics in the context of issues that occur in the news, such as clinical trials, DNA fingerprinting, medical testing, economic indicators, statistics of sports, and so forth. We use the Internet to provide resources for teaching the Chance course.

To assist in teaching a Chance course, an electronic newsletter called *Chance News* is provided, which abstracts current issues in the news that use probability or statistical concepts. This newsletter is sent out about once every three weeks. Anyone interested in receiving it can send a request to jlsnell@dartmouth.edu.

In addition, we maintain an Internet Chance Database (http://www.geom.umn.edu/locate/chance). This database contains syllabi of previous Chance courses and links to courses others have taught. The database also includes descriptions of activities, datasets, and other materials useful in teaching a Chance course, as well as a teacher's guide for a Chance course. You will also find current and previous issues of *Chance News* with links to the full text of most newspaper articles.

USING THE INTERNET TO TEACH CHANCE

This section illustrates how the Internet is used to teach the Chance course. The following uses of the Internet will be discussed

- E-mail communication between students and instructors.
- Posting daily handouts on a Internet site.
- Posting class data on a Internet site.
- Finding articles from the popular media.
- Finding additional information on articles..
- Gathering of information and data for student projects.

We illustrate these uses in the context of our most recent Chance course taught at Princeton, Winter term 1996. Because Princeton students have access to e-mail, we used e-mail throughout the course to help the students with questions on homework, to arrange appointments, and to send other course information to the students.

Our classes follow the following format: we choose an article that has appeared in the news, usually a very recent article, and prepare some questions relating to this article. The students divide into groups of three or four, read the article, and discuss our questions for about 20 minutes. They then report their conclusions, and we use these as the basis of additional discussion of the article and the statistics and probability issues suggested by it. Occasionally, instead of discussing a current article, we ask the students to conduct, in their groups, an activity designed to help them understand statistical concepts that came up in their reading. For example, when the notion of hypotheses testing came up, we asked them to identify one member of their group who believes that he or she can tell the difference between Pepsi and Coke and to design and carry out an experiment to test this claim.

We put these class handouts on our Internet site. This means that if a student missed a class or lost a handout, there is no problem getting another copy. This also allows teachers at other schools teaching or interested in teaching a Chance course to see exactly how we do it and makes it easy for us to use some of the materials in a later offering of the course. We hope that others teaching a Chance course will share their materials on the Internet. For example, N. Reid at the University of Toronto has shared her materials on the. She keeps a complete account of every class, including articles discussed and activities carried out on her Internet site (http://utstat.toronto.edu/reid/). She uses articles from the Canadian newspapers, which provided another source of interesting articles for our course.

We started our Princeton course with an activity. We asked the students to help us design a questionnaire to gain statistical information about the class, such as intended major, number of hours they watch television, and so forth. We then administrated the questionnaire, tallied the data, and sent it to the students by e-mail. We asked them to get acquainted with the statistical package we were using [JMP (SAS Institute, 1996)] by exploring this dataset. We discovered that the students had difficulty moving the data from their e-mail to the machines in the lab that had the JMP software. To solve this problem, we put the data on our Internet site; the students had no trouble downloading the data from there. We coordinated our efforts with T. Moore at Grinnell who was teaching an elementary statistics course. His students also completed the

informational questionnaire. We put the results of both surveys on our Internet site,which allowed students at either school to make comparisons between the students at the two colleges.

We asked the students to read *Chance News* on the Internet in order to get ideas for articles to use for class discussion. For example, Figure 1 lists the contents of the March issue of *Chance News*.

Contents of *Chance News* 28 February to 28 March 1996

1. In a first, 2000 census is to use sampling.
2. Are all those tests really necessary?
3. The use of IQ tests in special education.
4. The expected value of Windows Vegas Solitaire.
5. A treatment for cancer risks another.
6. Is Monopoly a fair game?
7. Hawking fires a brief tirade against the lottery.
8. On Isle Royale wolves recover from disaster.
9. Silent sperm.
10. Evaluation of the military's ESP program.
11. How safe are Tylenol and Advil?
12. Neyer's stats class back in session.
13. Fetal heart monitor called not helpful.
14. Intelligence: knowns and unknowns.
15. HMO prescription limit results in more doctor visits.
16. Radioactive implants effective for prostate cancer.
17. Unconventional wisdom: Love, marriage, and the IRS.
18. Unconventional wisdom: majoring in money.
19. Why does toast always land butter-side down?
20. Ask Marilyn: Which tire?

Figure 1: Contents of the March issue of *Chance News*

We discussed several of these articles in our course. For example, Figure 2 shows the discussion questions used for the article "Silent Sperm." For the next class, we asked the students to read the original research articles that were the basis for the newspaper articles. To discuss these papers it would have been a great help to have the raw data for the studies. For example, it was obvious from the results given in the paper that sperm counts are not normally distributed. The authors suggested that the logarithms of the sperm counts are. We would have liked the students to be able to check this and further explore the data after reading the article. We tried to contact the authors, but the relevant person was on vacation. We hope that researchers will begin to make their data available on the Internet.

We also discussed the article on the Census 2000. This article was about the decision of the Census Bureau to use sampling in this survey rather than just enumeration. Here we were helped by being able to query researchers at the Census Bureau by e-mail about their plans. We also found, on the Internet, an

article by D. Freedman relating to his research on some of the difficulties in implementing the methods under consideration by the Census Bureau for the 2000 census.

Class 19: Sperm Count

Discussion

Read the article “What's wrong with our sperm?” by Bruce Conley et. al., *Time Magazine* 18 March 1996, p. 78 and the “Sperm counts: some experts see a fall, others see bad data” by G. Kolata, *The New York Times,* 19 March, 1996, C10.

(1) What are some of the differences in the way the two articles address this topic? Which do you think gives the better description of the problem?

(2) What are some of the problems of meta-analysis (combining data from past and present studies) in order to decide whether sperm count is declining? What factors should you control for?

(3) How would you design a study to test the hypothesis that sperm counts are declining?

(4) *The New York Times* article cites Dr. Sherins as saying that there is no evidence that infertility is on the rise in the United States. If this is so, why worry about sperm count?

(5) If infertility is on the rise, what might be the reasons?

Figure 2: Example of classroom discussion questions

The last article in the March *Chance News* also shows how the Internet can enrich a discussion of a topic in the news. This story starts with the Marilyn vos Savant column in *Parade Magazine*, 3 March 1996, as shown in Figure 3.

A reader writes:

My dad heard this story on the radio. At Duke University, two students had received A's in chemistry all semester. But on the night before the final exam, they were partying in another state and didn't get back to Duke until it was over. Their excuse to the professor was that they had a flat tire, and they asked if they could take a make-up test. The professor agreed, wrote out a test and sent the two to separate rooms to take it. The first question (on one side of the paper) was worth 5 points, and they answered it easily. Then they flipped the paper over and found the second question, worth 95 points: 'Which tire was it?' What was the probability that both students would say the same thing? My dad and I think its 1 in 16. Is that right?

Figure 3: Marilyn vos Savant story

Marilyn answers that the correct probability is 1/4 and explains why. We found, on the Internet, an earlier account of this incident indicating that the professor was a chemistry professor at Duke University named Bonk. A check on the Duke homepage revealed that there was, indeed, a chemistry professor at Duke named Bonk. We sent an e-mail message to Professor Bonk and got the following reply.

> Laurie,
>
> The story is part truth and part urban legend. It is based on a real incident and I am the person who was involved. However, it happened so long ago that I do not remember he exact details anymore. I am sure that it has been embellished to make it more interesting.
>
> J. Bonk

Professor Bonk included an e-mail message he had received from Roger Koppl, an economist at Fairleigh Dickinson University who wrote:

> When I read the story of Professor Bonk, I thought immediately of the right front tire. I was then reminded of something economists call a "Schelling point," after the Harvard economist Thomas Schelling. Schelling had the insight that certain places, numbers, ratios, and so on are more prominent in our minds than others. He asked people to say where they would go to meet someone if they were told (and knew the other was told) only the time and that it would be somewhere in New York. Most chose Grand Central Station. How to divide a prize? 50-50. And so on. The existence of these prominent places and numbers and such permit us to coordinate our actions in contexts where a more "pure" and "formal" rationality would fail. These prominent things are called "Schelling points."
> (http://www2000.ogsm.vanderbilt.edu/baseline/1995.Internet.estimates.html)

Professor Koppl goes on to describe a survey he used that verified that the right front tire would be the most popular answer to the question: “If I told you that I had flat tire and asked you to guess which tire it was, what would you say?” Another e-mail writer stated that he had consulted a tire expert and was told that, in fact, the most likely place to get a flat tire is the rear right tire.

Thus, thanks to the wonders of e-mail, a routine probability problem brought out the complexities of applying probability theory in the real world. It also provided an introduction to the interplay of probability and psychology and led naturally to a discussion of the work of Kahneman and Tversky.

As this example shows, e-mail provides a good way for the instructor and students to obtain additional information about a topic that might be rather briefly described in the newspaper. Another source is research articles posted on the Internet. For example, an article in *The New York Times* discussed a debate on the reliability of an estimate for the number of Internet users obtained by Nielsen using a telephone survey. Two market researchers, who helped plan the Nielsen study, disagreed with the way Nielsen handled the data and made available on the Internet a paper in which they explained how they arrived at quite different numbers from the same data. (Their paper can be found at this address: http://www2000,ogsm.vanderbilt.edu/baseline/1995.Internet.estimates.html).

The students in the Chance course also conduct a significant project, which is presented in poster form at the Chance Fair at the end of the course. The Internet was a great help to the Princeton students working on their final projects. Inspired by the "upset" of Princeton over UCLA in the 1996 NCAA College Basketball, two students were interested is seeing how often such upsets occur. To do this they needed the seedings of the teams in the previous tournaments. They easily found this information on one of the basketball Internet sites.

Another student wanted to analyze lottery data consisting of numbers that people actually chose for a lottery. Calls to the state lottery offices led nowhere. Officials gave all kinds of reasons why they could not release data of this kind. However, a few e-mail messages at addresses found on the lottery Internet pages led to a lottery official who was interested in having such data analyzed and was happy to give the student the data he needed.

The success of this project, and the data obtained, led us to write a module on the use of lotteries in teaching probability in a Chance course. You can find this module on the Chance Database under "teaching aids."

Another interesting project that made good use of the Internet dealt with weather prediction. The students wanted to know, for example: How is the probability of rain determined and what does it mean? Are weather predictors rewarded according to the quality of their predictions? To help answer such questions they made a small survey and sent it, by e-mail, to a number of weather forecasters. We next describe other sources on the Internet that are useful for statistics courses.

THE JOURNAL OF STATISTICS EDUCATION

The *Journal of Statistics Education* (JSE) is a refereed electronic journal that deals with post-secondary statistics education, currently edited by E. J. Dietz. The first issue was published on July 1, 1993. A recent issue (Vol. 4, No. 1, 1996) has an article by M. Pfannkuch and C. M. Brown entitled "Building on and Challenging Students' Intuitions About Probability: Can We Improve Undergraduate Learning?" It is well known that students intuitive ideas of determinism, variability, and probability are often not in agreement with formal probability. The authors observe that the proper understanding of the role of probability in statistical reasoning about real world problems requires a resolution of these differences. They report on a pilot study to identify some of the differences in intuitions and formal concepts that students have and to determine how these differences can be resolved.

The JSE has two regular departments. The first, "Data Sets and Stories," is edited by Robin Lock and Tim Arnold. Readers are invited to submit an interesting dataset along with a "story" describing the data. This story includes the source of the data, a description of the variables and some indication of the statistical concepts that are best illustrated by the dataset. The data is put in a form that makes it very easy to download to any statistical package. Each JSE article features a description of one or more of these datasets, but the entire collection of datasets can be considered part of the journal. The dataset in the current issue of JSE was supplied by R. W. Johnson. This computer-based technology allows the student, using multiple regression, to estimate body fat for men using only a scale and a measuring tape. Johnson describes his experiences using this computer-based technology in his classes.

The second department, "Teaching Bits" is edited by J. Garfield and W. Peterson. Garfield provides abstracts for articles in other journals of interest to teachers of statistics including abstracts for articles in the British journal "Teaching Statistics." The current issue features abstracts edited by C. Batanero that appeared

in the January 1996 *Newsletter of the International Study of Group for Research on Learning Probability and Statistics*. Peterson provides abstracts of articles in current journals and newspapers that use statistical concepts to serve as the basis for class discussions similar to those in *Chance News*.

One important feature of an electronic journal such as JSE is that it is possible to search through all previous issues for articles on a given topic. For example, if you are interested in assessment you need only put "assessment" into the JSE search mechanism. You will find, for example, a paper by I. Gal and L. Ginsburg that "reviews the role of affect and attitudes in the learning of statistics, critiques current instruments for assessing attitudes and beliefs of students, and explores assessment methods teachers can use to gauge students' disposition regarding statistics."

JSE is part of the "The Journal of Statistics Information Service." This service provides a number of other interesting resources for statistics teachers. These include archives of discussion groups, free statistical software, and links to other statistical resources.

ELECTRONIC DISCUSSION GROUPS

There are several discussion groups for statistics. The most relevant discussion group for teaching statistics is Edstat-L (sci.stat.edu) maintained by the JSE Information Service. You can be an active member of this discussion group by e-mail or by using one of several Internet news group readers. The archives of this group are kept on the JSE Information Service. These archives can be searched to bring together the discussion on a specific topic. For example, if you plan to discuss Simpson's paradox and want some fresh ideas, a search of the archives will lead to references for real life examples, connections with regression paradoxes, and a suggestion to use the video "Against all Odds." If you are trying to decide which statistical package to use, a search will produce discussions of the merits of any particular package and compare it to others.

FINDING YOUR WAY AROUND THE INTERNET

If you are looking for a fairly specific kind of information on the Internet, the best way to find it is to use one of several different search engines that will search the entire Internet. Our students found the required basketball data by just searching for Internet sites using the word "basketball." It is not always this simple. For example, the lottery data was found by first searching on "lottery" to find a variety of homepages that deal with lottery questions and then sending e-mail messages to the "Webmaster" at three of the most relevant sites asking if they knew how to obtain the required data. One of those recommended turned out to be the lottery expert who sent the student the data. The point is that people who maintain Internet pages on a subject tend to know people who are willing to share resources -- after all that is what the Internet is all about.

In most areas, there are Internet sites that try to provide, in addition to their own resources, a guide to other related Internet sites. To get a more general picture of what is available on the Internet for teaching statistics it is useful to go to one of these sites. A good choice is the Internet site of J. Behrens at Arizona State University called "The Statistical Instruction Internet Palette (SIIP) which can be found at this address: http://seamonkey.ed.asu.edu/~behrens/siip/.

The Statistical Instruction Internet Palette

The home page of the SIIP Internet site displays a palette with several items to choose from. When you click on a particular palette you are taken to a page that provides links to resources related to the topic of the palette. The palettes represent the different kinds of statistical information that would be useful to a student or teacher of statistics. The palettes, and a brief description of each, include:

Data Gallery: Clicking on this palette leads you to a menu where you can choose histograms, boxplots, summary statistics, and other summary information about data from a large study relating to young people. Links are provided to statistics courses at Arizona State illustrating how these graphics are used in their courses.

Graphing Studio: Choosing this palette leads you to an interactive site where you can put in your own data and request graphic representations. For example, you can give data from two variables and ask for a scatter plot.

Computing Studio: Here students can learn to compute statistical quantities like mean, median, standard deviation, and so forth by putting in their own data. The step-by-step calculation is provided along with appropriate comments.

Equation Gallery: It is fashionable to put formulas at the end of chapters or somewhere else out of the way "for those who like formulas." Here the formulas are right up front, and the student need only click on "standard deviation of a population" to get the formula to compute it.

Classroom Gallery: At this palette you are invited to obtain information about statistics classes by clicking on "Classroom" or teaching resources by clicking on the "Teacher's Lounge." If you choose "Classroom" you will find a list of courses that have materials on the Internet. The first one is "Introduction to quantitative methods" taught by G. Glass at Arizona State. Here you find a text for this introductory statistics course provided in a series of lessons.

The lessons provide questions for the students to answer. The student can then call up the answers and additional comments. Students are often asked to download a computer-based technology to conduct an analysis of some aspect of the data. In the first lesson, Glass provides a paragraph about himself and a form for the students to do the same. He then makes the students responses available to the class on the Internet site.

The second course is "Basic statistical analysis in education" taught by J. T. Behrens. Here you will find a discussion of each week's work organized in terms of the questions, such as What did we do last week? What are we going this week? What did we do last week? Where are we going in the future? How will we get there? On each weeks' page, links are made to other resources such as the data gallery or perhaps to material from another course such as that of G. Glass.

If you choose "Teachers Lounge" from the palette you are provided links to resources for teaching statistics. These include links to courses at other institutions that use the Internet to keep materials for their

classes on the Internet, sites with datasetsappropriate for teachings statistics, the Chance database, and so forth.

Wide World of Internet Data: This palette describes a large number of sites where data is available. These sources are classified by field and you will find brief comments about what you can expect to find at each site. Some data sites make special efforts to present data in a form that is easy to use in a classroom setting.

We have already mentioned the “Data Sets and Stories” column in the *Journal of Statistical Education.* Another source of good datasets to use in statistics courses is the "The Data and Story Library" (DASL; http://lib.stat.cmu.edu/DASL/) maintained on Statlib (http://lib.stat.cmu.edu/) at Carnegie Mellon. These datasets are accompanied by stories telling how the data arose and how they can be used. The datasets are classified by methods as well as subjects. Thus, if you are looking for a dataset to illustrate the chi-squared test you can easily get a list of datasets appropriate for this. Similarly, if you are interested in examples from economics, you can find these using the subject classification. StatLib itself is a wonderful source of datasets useful for teaching purposes.

This palette also has links to sites that indicate how interactive data will be available in the future. For example, you can find a book on AIDS that has a mathematical model built in that allows a reader to provide data relevant for a particular area or country. The model will compute future estimations for ways that AIDS will spread in this location. Or you can find the current rate of traffic at any point on any of the major highways is Los Angeles at the very time you are looking at the site. You will also find data available by video that shows, for example, how a glacier changes over several years.

Collaboration Gallery: This palette provides students with their own listserve. It is “Run by and for students learning statistics at all levels and from all fields to share questions, concerns resources and reflections with other students.” It also has a link to a student forum that uses special software to allow a more interactive form of communication.

WHAT ABOUT THE FUTURE?

What can we expect for the future of the Internet? Just by examining what is already happening we can expect the following:

- Increased use of the Internet to share teaching and research materials including traditional and new forms of interactive textbooks.
- Increased "bandwidth" that makes video materials and full multi-media documents accessible.
- Increased development of computer programs and statistical packages that are run by the Internet browsers.
- Improved methods for paying for materials used on the Internet with resulting commercialization of the Internet.
- Increased interest in developing text material and computer programs that are in the public domain to allow users to freely use them and to contribute to making them better.

We are already beginning to see course notes turning into text books on the Internet. A place to see what the textbook of the future on the Internet might look like is the "Electronic Textbook" provided by J. Deleeuw on the UCLA statistics department Internet site (http://www.stat.ucla.edu/). This book is far from

complete, but it has a number of examples to show how standard text materials can be enhanced by special features of the Internet. For example, a student reading about correlation can click at the appropriate point and a scatterplot and regression line will appear. The student is then invited to vary the regression coefficient to see, for example, what happens to a scatterplot when the correlation is .7 as compared to .2. Another such demo allows the student to move points in a scatterplot and see what effect this has on the regression line.

These interactive graphics are produced in two different ways. One method uses programs written in Xlisp-Stat. This is a statistical package developed by L. Tierney at the University of Minnesota. It is free and available on the standard platforms: Mac, PC, and Unix. For interactive graphics produced this way, you must first download the Xlisp-Stat package (Tierney, 1990) onto your machine. This is easy to do. A good description of how to do it can be found on the home page for Statistics 1001 at Minnesota (http://www.cee.umn.edu/dis/courses/STAT1001_7271_01.www/). Of course, many other kinds of computations are possible using the Xlisp-Stat language and you can, if you wish, write your own.

Two other interesting interactive projects that use Xlisp-Stat are the "Teach Modules" (http://www.public.iastate.edu/~sts/lesson/head/head.html) provided by the statistics department at Iowa State University and the "Visual Statistics System" (ViSta), developed by F. W. Young at the Department of Psychology, University of North Carolina which can be found at this address:

http://forrest.psych.unc.edu/research/ViSta.html.

Teach Modules provide modules on several important statistical concepts including the central limit theorem, confidence intervals, sample means, and regression. The modules include written descriptions of these basic concepts and suggestions for ways for the student to explore these concepts with the interactive Xlisp-Stat programs. They also provide exercises for the students.

ViSta is a much more ambitious project that provides a statistical package that can serve both as a research tool and a learning tool. In its learning mode the student is provided guided tours on how to use the package to explore datasetssupplied by ViSta or by the student. ViSta is designed to allow the user to choose the appropriate level of expertise and includes extensive graphical tools. Documentation that will one day be a published book is provided in the friendly Acrobat PDF format.

A second method for producing interactive pictures is by using the language JAVA. The language JAVA permits programs to be written that the Internet browser itself, in effect, runs. JAVA has the advantage that you do not need any additional software, other than the Internet browser, on your machine. Such JAVA programs are called "applets." You will find in the UCLA textbook an applet that illustrates the meaning of confidence intervals. It does this by first asking the student to put in the relevant information: population mean, desired confidence level, sample size, and the number of confidence intervals. The applet then computes the confidence intervals and plots them as lines so the student can see how these lines vary and can verify that approximately the proportion corresponding to the confidence level will include the true population mean.

At the moment, JAVA is gaining in popularity. You can find links to a wide variety of applets on the Chance Database under "teaching aids." Running applets on the Internet is riskier than running programs on your machine using Xlisp-Stat. The developers could solve this by providing the sources for the applets that would allow users to run them independent of the Internet using an Applet Viewer. However, the concept of freely sharing the language and programs that we find with the Xlisp-Stat developers seems not to have developed within the JAVA community.

A third method of computing on the Internet is illustrated by a "power calculator" found at the UCLA site. The power calculator calculates the power of a statistical test when you input the information needed to determine the power. For this computation, the power calculator sends the information it receives back to the UCLA computer, which calculates the power and sends the answer back to your machine.

The demos described above were constructed by people working at different universities who shared them with J. Deleeuw for his project. The Internet was started as a way to freely distribution information worldwide. The UCLA textbook demonstrates how developers of statistical materials are freely sharing them with the statistical community.

Another project along these lines is an introductory probability book by Grinstead and Snell (http://www.geom.umn.edu/docs/education/chance/teaching_aids/probability_book/book.html). This is a traditional book in its present form, but we are working on making it interactive using JAVA. We hope that, by putting our book on the Internet, others will want to make links to parts of our book to assist them in teaching a probability course. For example, we have a treatment of the recent results by Diaconis and his colleagues that seven shuffles are needed to reasonably mix up a deck of cards. This is a self-contained unit and would be useful for someone teaching a probability course who would like to include this new and interesting topic. We hope also that they will contribute to improving the book as it appears on the Internet.

The next big improvement in the Internet over standard textbook materials will come soon when it is possible to transmit information fast enough to make audio and video materials routinely available. Actually, this is already the case for audio. In particular, *National Public Radio* keeps most of its programs, current and previous. on their Web site (http://www.npr.org/). This includes interesting discussions with the researchers who are the authors of studies reported in the news as well as with other experts in the field. It is quite effective to use these in a class to enhance discussion of the news.

The well known video series "Against all Odds" is currently used in the classroom to supplement text material by showing statistics as it is carried out in the real world. The use of such materials will be greatly improved when they can be integrated into text material on the Internet.

I hope I have convinced you that there are terrific resources on the Internet to enhance the teaching of statistics. Of course, much of this is still in the experimental stage so not everything works as it should; however, by the time you read this, much of what I have talked about will be working smoothly and new and better things will be in the experimental stage.

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