A course called Chance

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1. Using current news to teach chance concepts.

Dartmouth college has a course called "Chance" that introduces students to probability and statistics in the context of current events in the news. The course, taught since 1992, was developed jointly by Laurie Snell and Peter Doyle, Dartmouth College, Bill Peterson, Middlebury College, Nagambal Shaw, Spellmen College, Joan Garfield University of Minnesota, and Tom Moore, Grinnell college. The Chance course has been taught in several different formats at different schools but I will discuss the course in the way that Peter Doyle and I taught Chance at Dartmouth. The Dartmouth course has always been taught jointly by two faculty. The popularity of the course justifies this, and it is nice, when asked a question you can't answer to be able to say: That question is so easy my colleague Peter can answer it!

For a typical class, we identify a chance topic recently in the news. We found that the students enjoy topics recently reported in the newspapers or on television. Thus, most of the time, we use current news, though we do bring out old favorites to illustrate some specific concepts. At the beginning of a class we provide the students with a newspaper article and two or three questions that arise naturally from reading the article. We ask them to divide into groups of three or four, read the article, and discuss the questions for about fifteen minutes and assign one member of the group to present the group's ideas on the questions.

At the time this was written. the news was dominated by the question of whether the US would go to war against Iraq. Several of the articles dealt with chance issues. *The San Franciso Chronicle* [1] had an excellent article on how protesters, police, and the media ended up with very different estimates for the size of the crowds in San Francisco protesting a war against Iraq. The *Chronicle* did not believe the estimates of either the police or the demonstrators so they hired their own experts who counted the number of protesters with high-tech aerial photography.

Public radio [2], the *New York Times* [3] and *New Yorker* magazine [4] all had articles about websites where you could bet on world events including the propects of war with Iraq. These articles also discussed recent research claiming to show that bets in the form of markets often made better predictions than polls and other statistical techniques. The *New York Times* article reported that at www.betonsports.com you could make the following bet as of Frebruary 28, 2003:

Time frame in which the United States will launch an attack:

March 3-9: odds 2 to 1,
March 10-16: odds 3 to 2:
March 17-23: odds 7 to 4,
March 24-30: odds 5 to 1,
March 31 or after (but before Dec. 31, 2003): odds 3 to 2.

We might ask the students to read this article and answer the following questions:

(1) Express these odds in terms of probabilities. Why do they add up to more than 1?

(2) A similar article in the *Boston Globe* pointed out that a study evaluating the performance of election markets showed that markets based on the outcome of national elections outperformed polls in 9 of 15 cases in predicting the winner. Is this convincing?

(3) Some claim that betting on war is immoral or at least in bad taste. Do you agree?

The *New Yorker* article also described the Hollywood Stock Exchange (HSX). Here you buy stock in movies with the value of the stock linked to its success in the box office. Even though this market uses play-money, the articles states that the stock price as a prediction of the success of a movie are being used by movie companies because they often outperform the experts. The HSX also allows you to buy options on the candidates for Oscars for eight categories. Again we read that predictions based on the price of the options do better than the experts, in this case the movie critics.

After the Oscars are awarded we might ask the students to determine how the HSX did this year compared to the movie critics. Here is what we found (x indicates that the prediction was correct).

Awards 2003	HSX	San Francisco Chronicle	St. Petersburg Times	New York Daily news	The Times (London)	Rocky Mountain News
Best picture	x	x	x	x	x	x
Best actor						
Best actress	x		x	x	x	
Best supporting actor	x	x			x	
Best supporting actress	x	x	x	x		x
Best director						x
Best original screen play		x				x
Best adapted screen play						x

This is not very convincing. In the year 2000 all 8 of the the Oscar predictions of the HSX were correct, and this fact is often mentioned in the press. This is a good example to show the students the need for replicating experiments. A more serious discussion comparing the ability of web bettors' predictions with those of the experts can be found in [5].

Here is an example we used more than once because it was particularly appropriate to illustrate a simple method for determining significance and also because it raised policy issues beyond the statistical issues.

In 1993 there was wide media coverage of a large Euopean study called the "Gusto" study, reported in the *New England Journal of Medicine* [6]. The purpose of the study was to determine if a genetically engineered beta blocker TPA, produced by Genetech, was more effective then the traditional streptokinase administered after a heart attack. Previous smaller studies had suggested there was no difference in the two drugs. Since streptokinase cost $240 a dose and TPA $2400 a dose, most surgeons used strepokinase. Genetech paid for a large study on the gamble that it might prove better in a larger study and if administered with heparin.

The study started with 41,021 patients who had had a heart attack. These patients were randomized into four equal groups. All of the groups were given heparin after their heart attack. In

addition, two of the groups were given streptokinase, one group was given TPA and the last group was given both TPA and streptokinase. This resulted in 20,173 patients being given only streptokinase and heparin and 10,344 given only TPA and heparin. The researchers followed the progress of these subjects for 30 days. In this period of time 1473 (7.3 percent) of those given streptokinase died and 652 (6.3%) of those given TPA died. Is the difference. 6.3% vs 7.3% significant?

Our text for the Chance course, *Statistics* by Freedman, Pisani and Purvis, suggests a simply way to test significance for such studies. There were 2125 deaths in the three groups we are considering. One third of these were given TPA and 2/3 were given streptokinase. If the two drugs had the same effect, each of the deaths would have a 1/3 chance of being in the group given TPA and a 2/3 chance of being in the group given streptokinase. Thus the question of significance amounts to asking if you toss a biased coin that comes up tails with probability 1/3 and heads with probability 2/3, what is the probability of getting tails 652 or fewer tails? Carrying out this calculation gives p = .005 so the difference is significant.

In teaching the Chance course we found the coin-tossing model to be incredibly useful in giving simple explanations for many chance issues that occur regularly in the news such as coincidences, test of hypotheses , and streaks in sports.

If we asked the students to read the May 1, 1993 *New York Times* article by Lawrence Altman describing the Gusto study study, we might ask the following discussion questions:

> (1) The *Times* article reported out that the 6.3$ and 7.3% death rates translated into a 14% decrease in the risk of death. Another newspaper article said that it meant that using TPA instead of streptokinase would save1 life for every 100 heart attacks. Which do you think is a better way to describe the outcome of the study? Why?
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> (2) The article states that the authors of the study estimated that changing to TPA would cost $22,000 for every year saved. How do you think they made this estimate?
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> (3) A cardiologist at one hospital estimated that the cost of changing to TPA would be about $400,000 a year and stated that this would have to come from cutting back other services. Do you think the cost of a drug should be taken into account in the decision to use it?

The Chance course is really a statistical literacy course. At the *First International Research Forum on Statistical Reasoning* Iddo Gal discussed how a statistical literacy course should differ from a standard introductory statistics course.

Gal argued that such a course should be aimed at a consumer of statistics rather than a producer of statistics. The basic statistical concepts taught are mostly the same but the emphasis should be different. For example, a much broader discussion of types of experiments than is normally taught in a beginning statistics course is essential to understanding reports in the news on medical experiments. Students need to understand the different interpretations of probabilities (subjective and objective) and risk (relative and absolute). They need to know not only that correlation does not imply causation but also how causation is demonstrated.

A recent book by Gird Gigerenzer *Calculated Risks* [7] addresses these issues with lots of excellent examples, especially for issues related to making medical decisions. Anyone teaching a statistical literacy course would find this book a great asset.

The Chance course is ideally suited to use ideas from the current statistics reform movement. In particular, we do not lecture and we use experiments and activities regularly to illustrate basic concepts. Our favorite activity is the Pepsi-Coke experiment to illustrate test of hypothesis. Students do a final project on a subject of their choice.

As you can imagine, Chance is not an easy course for the students or for the teachers, but it is a lot of fun and both the students and teachers learn something new at every class. As a reward for the students we have a Chance fair to let them show off their projects and play roulette and blackjack with play-money and prizes.

When we developed the course, we also developed a website to help others who wish to teach the course. At the same time we started an electronic newsletter called *Chance News* in which we discuss current issues in the news that could be used in a Chance course. We also provide discussion questions relating to the articles. This newsletter has also been used by teachers who want to introduce current events in traditional courses. Joan Garfield dubbed these "Chance Inhanced" courses.

The current and previous issues of Chance News are kept on the Chance website. You will also find there teaching aids, including a *Guide for Teaching Chance,* and Chance videos. The Chance videos are lectures by experts in topics that occur frequently in the news such as DNA fingerprinting, clinical trials, estimating risk, etc.

So TAKE A CHANCE ON CHANCE!

REFERENCES

(1) *San Francisco Chronicle*, Counting Protesters, February 4, 2003, B7.
(2) NPR, All Things Considered, March 4, 2003.
(3) *The New York Times*, March 2, 2003, Section 4, Page 2.
(4) *The New Yorker*, March 24, 2003, Page 33.
(5) http://artificialmarkets.com/
(6) *New England Journal of Medicine*, Vol. 329:673
(7) Gerd Gigerenzer *Calculated Risks*: *How To Know When Numbers Deceive You*, Simon & Schuster; (June 2002).

RÉSUMÉ

Nous décrirons un cours appelé Hasard qui a été enseigné à Dartmouth Collège de dans les Etats-Unis pendant la décade passée. Il est un cours qui enseigne la probabilité et les concepts statistiques dans le contexte de nouvelles actuelles. Nous décrirons comment le cours est enseigné et les ressources que nous avons développées pour aider les autres qui souhaitent utiliser les nouvelles actuelles dans leurs cours.