Using Chance Media to Promote Statistical Literacy

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The OED gives two definitions for literate:
   (a) One who can read and write
   (b) A liberally educated or learned person

According to (a) a statistically literate person might be one who understands the language of statistics. According to (b) it might be one who understands statistical concepts and reasoning.

We think that most people would combine (a) and (b) and interpret statistical literate as a person with the ability to understand statistical concepts and reasoning at the most basic level.

Issues of statistical literacy were discussed at a recent workshop organized by Joan Garfield and Dani Ben-zvi: **The First International Research Forum on Statistical Reasoning (SRTL), Thinking and Literacy** held at the Kibbutz Be'eri, Israel, July 18 - 23, 1999. The papers presented at this workshop as well as background papers can be found at the web site.[1]

In the background papers you can find article by Joan Garfield **Thinking about Statistical Reasoning Thinking and Literacy** that surveys what the experts have said about statistical reasoning, thinking and literacy with emphasis on reasoning and thinking. You will also find an article **Statistical literacy: Conceptual and instructional issues by** Iddo Gal University of Haifa, Israel. In this article Gal gives his ideas on what a course on statistical literacy should be and how it would differ from a standard introductory statistics course. He argues that such a course should be aimed at consumers of statistics rather than at producers of statistics. The basic statistical concepts taught are not different but the emphasis should be different. For example, a much broader discussion of types of experiments is essential to understanding reports in the news on medical experiments. Students need to understand different interpretations of probabilities (subjective and objective) and risk (relative and absolute) etc. than would normally be taught in a first statistics course.

Gal proposes that the student should come away with an ability to read a news article and almost automatically ask a set of questions like:

1. Where did the data (on which this statement is based) come from? What kind of study was it? Is this kind of study reasonable in this context?

2. Was a sample used? How was it sampled? Is the sample large enough? Did the sample include people/things which are representative of the population? Overall, could this sample reasonably lead to valid inferences about the target population?

3. How reliable or accurate were the measures used to generate the reported data?

4. What is the shape of the underlying distribution of raw data (on which this summary statistic is based)? Does it matter how it is shaped?

5. Are the reported statistics appropriate for this kind of data, e.g., was an average used to summarize ordinal data; is a mode a reasonable summary? Could outliers cause a summary statistic to misrepresent the true picture?

6. Is a given graph drawn appropriately, or does it distort trends in the data?

7. How was this probabilistic statement calculated, and are there enough credible data to justify such an estimate of likelihood?

8. Overall, are the claims made here sensible? Are they supported by the data? (e.g., confusing correlation with causation)

9. Should additional information or procedures be made available to enable me to evaluate the sensibility of these arguments? Is something missing?

10. Are there alternative interpretations for the meaning of the findings, different explanations for what caused them, or additional or different implications?

This article was interesting to us since we did not think about these matters very carefully when at Dartmouth College in 1992 a course called Chance aimed at the kind of statistical literacy that Gal considers. We designed the course in a very simple way. In a typical class, we start by having the students in groups of three or four to read an article in the current news that uses

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[1] Was www.beeri.org.il/SRTL. Now http://srtl.stat.auckland.ac.nz/

concepts of probability or statistics and answer a two or three discussion questions relating to the article. It is interesting now to reflect on how well our course meets the requirements set down by Gal for successful statistical literacy course.

One thing Gal stresses that we did realize early was the need to develop ways to find sources of current news articles and to obtain background information relating to such topics as DNA fingerprinting, sampling issues in the census, clinical trials, coincidences, etc.

To help us and others wishing to develop a Chance course we established a Chance web site[2] to provide resources for teaching a chance course or what Joan Garfield has dubbed a "chance enhanced" course: a standard course enriched with discussion of chance news items. In addition, we developed an electronic newsletter called Chance News[3] that abstracts current issues in the news that use probability or statistics concepts and established a web site to archive this newsletter and to provide background information for understanding chance news. We have written some profiles on specific topics that occur regularly in the news but our greatest success in providing background material has come from our annual Chance Lecture series. For the past two years we have invited experts in chance topics that occur regularly in the news to give a lecture that assumes only a newspaper knowledge of their subject. We have put these lectures on the web and recently also on a CD which we can provide you with this talk. We asked the speakers to make their presentation using an overhead projector and transparencies. We then scanned the transparences and embedded them into the video so that they come up at the appropriate time. This is an easy process using the free RealAudio software. The lecturers did a fine job and covered a wide range of topics.[4]

Our Chance News comes out about once a month and it is quite amazing how many interesting chance articles occur within this time period. Major newspapers such as the New York Times, Wall Street Journal, Washington Post, Boston Globe and Los Angeles Times are good sources for such articles but then so are regional newspapers. The Dallas Morning Times, for example, has an excellent science page on Mondays. All of these papers – except the Wall Street Journal – have web versions with archives of their articles available at a small cost for at least the past year. Some of the most interesting contributions come from our readers who send us articles from their local papers. We

use the Lexis-Nexis and Dow Jones data bases to search for articles on a particular topic such as Census 2000 that we know are in the news. We also use these to search for articles by science writers such as Richard Morin, Robert Matthews, Gina Kolata and Ivers Peterson who write regularly about chance topics.

It has been estimated that over 70% of the science articles in the news come from a very few journals. These journals are Science, Nature, The New England Journal of Medicine, The Journal of the American Medical Association, Lancet and the British Medical Journal. Other excellent journals are Science News, The New Scientist and The American Scientist. All of these journals have web sites and in most cases you can get the full text of the articles through your libraries subscription to the journal. We include more details on this in the appendix to this article.

Let's look at some recent and forthcoming chance issues to see what degree of statistical literacy is required.

The recent Supreme Court decision that sampling cannot be used for apportionment in the Census 2000 resulting in numerous articles, editorials and letters to the editor. Statistical literacy requires understanding why enumeration may not give a more accurate estimate for the population than sampling. Here the media itself provides simple examples to help understand this. A writer in a letter to the editor in the New York Times gave the following simple example: if you have to find the number of squares on a checker board, noting that a checker board is an 8x8 square and multiplying these two numbers to get 64, might well yield a more accurate answer than enumerating the squares.

Writing in the American Scientist, Tommy Wright asks us to assume that we are required to estimate the number of people at a football game by sending out counters at half-time to enumerate the fans. (You might also want to know the number loyal to each team). People moving around to talk to their friends might be counted twice, those going out for popcorn might not be counted, fans leaving or arriving at half-time may or may not be counted -- all problems familiar to the census counters when they attempt to enumerate the population.

Tomorrow we can hear a lecture by Kenneth Prewitt, Director of the Census, who will almost surely talk about how they plan to carry out the census 2000 taking into account the Supreme Court decision against sampling for re-apportionment.

Background material for understanding the issues involved in the undercount problem can be found in the Chance Lectures by Tommy Wright representing the

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2 www.dartmouth.edu/~chance/index.html
3 www.dartmouth.edu/~chance/chance_news/news.html
4 www.dartmouth.edu/~chance/ChanceLecture/AudioVideo.html

point of view of the Census Bureau and the lecture by David Freedman explaining why he is skeptical that methods to be used by the Bureau of the Census will work.

Bible Codes will again be in the news since the next issue of the Statistical Science which will include an article: "Solving the Bible Code Puzzle", by Brendan McKay, Dror Bar-Natan, Maya Bar-Hillel, and Gil Kalai. This is a refereed rebuttal to the paper "Equidistant Letter Sequences in the Book of Genesis," by Doron Witztum, Eliyahu Rips, and Yoav Rosenberg (WRR), Statistical Science, Vol. 9 (1994) 429-438 that claimed to provide statistically significant evidence for the existence of codes in Genesis – codes which conveyed information about famous Rabbis born well after Genesis was written.

This 1994 article was followed by a best selling book by Michael Drosnin in which Drosnin claimed to have used the methods of WRR to find information about current political events. In particular Drosnin claimed to have found a coded message predicting that Israel Prime Minister Yitzhak Rabin would be assassinated. Drosnin warned Rabin about this danger to no avail and Rabin was assassinated.

Statistical literacy would require an understanding of the difference between finding significant evidence for codes in Genesis by a well designed statistical study at attempted by WRR and the method of Drosnin of just looking for coincidences in the pattern of words that might suggest a coded message. We suspect that most of the millions of people who bought Drosnin's book did not understand this difference. To dramatically demonstrate the difference, Brendan McKay, using the "fishing" method used by Drosnin, found similar codes in Moby Dick predicting the assassination not only of Rabin but also of John F. Kennedy, Indira Gandhi, Martin Luther King, Leon Trosky and Abraham Lincoln.

In their forthcoming article in Statistical Science, Brendan McKay and his colleagues show that the original Statistical Science article was not a well-designed statistical study. In particular it was not a study that could be replicated. The ability to replicate an experiment is a requirement of science that should be familiar to any statistical literate person. The question of replicability is also at the heart of the controversy over extra sensory perception. The fact that about 70% of Americans believe in extra sensory perception, not based on data but rather on anecdotal evidence again shows a serious lack of statistical literacy.

A good background for reading the latest Bible Code paper is the Chance Lecture by Maya Bar-Hillel. Maya

discusses the history of the problem and how they went about cracking the code.

Of course it is work to trace down these articles but it is also a lot of fun and you learn a lot. We can see some amusing articles by looking at the last three issues of chance news:

Chance News 8.04, Rock Stars, Chance News 8.05 and Chance News 8.06

Much of the information in the news is provided by graphs. A statistically literate person should be able to recognize the difference between good and bad graphs. A classic example of a good graph is provided by the New York Times graph shows the variations in the weather New York over a one year period. Poor graphs are provided regularly in the newspapers. In particular by the "snapshots" in U.S. Today. The snapshot on the day this was written showed the number of times the three tennis balls labeled Steffi Graf 31, Monica Seles 13, and Arantza Sanchezs-Vicario 12 showing the number of times each of these famous women tennis players have won Grand Slam finals. The position of the balls on the graph would suggest that the difference between 12 and 13 is the same as between 13 and 31.

How does the news test our understanding of inferences from data. News accounts of a medical study provide data in the simplest form they can. A recent article reported that men who smoked cigars were twice as likely to die of lung cancer than those who do not smoke and had an elevated risk of dying of a heart attack. Statistical literacy requires an understanding that to assess the significance of this result more information is needed such as: was the study a randomized study? How large was the sample? What is the prevalence of lung cancer in the population? Was the "elevated risk of heart disease" significant? To answer these questions, it is often necessary to go to the article the reported the outcome of the study. In the article, we will find the summary data to answer these questions. Sports articles provide examples where the raw data itself is often available. For example, Berry in the most recent issue of Chance Magazine predicts the top twenty-five home-run hitters and estimates the number of home runs they will get. If we wanted to check on how his predictions are doing at the time of the All Star game it would be easy to get this data.

We will next discuss how to find chance news and in the process show other examples that illustrate the need for statistical literacy to understand chance news.

APPENDIX: CHANCE RESOURCES

Chance resources run the gamut of the media. Daily newspapers remain the best source of current chance news and generally provide a more detailed account of

studies than the television evening news or radio. While there is a good deal of excellent science reporting available for chance news material, getting the whole story can sometimes requires a little bit of detective work, including going to the primary science sources.

In addition, our Chance project has also developed into a growing treasury of chance news materials, including videos, background materials, and news summaries with related classroom activities.

In what follows we discuss the main Chance resources, as well as some examples of how the resources have been used.

FINDING NEWSPAPER ARTICLES

The Lexis-Nexis and Dow Jones databases are the most important tools for locating interesting newspaper articles. These databases allow you to search for articles in newspapers and magazines and to download full text of the articles (without graphics).

Lexis-Nexis has recently made an arrangement with a very large number of Universities and Colleges to permit students to search their database from the web. Unfortunately, while maintaining the same database, Lexis Nexis has restricted the way you can search so it is not as convenient as the older version that you may still find in your library. Using Dow Jones, as was the case for the older version of Nexis Lexis, you are able to put in a word or phrase such as "statistical theory" and get all articles that had this phrase anywhere in the article. With the newer Lexis Nexis you must give your search request at two levels. At the first level you are asked for primary words and you will succeed in finding a article only if these words appears in the headline or the first 50 words. If you happen to know the author you can also assure success at this first level by choosing byline and giving the author's name. In the second level you can put in additional terms to narrow the search.

With some practice you and your students can do quite well even with the web version of Lexis-Nexis. You will quickly discover science writers who write regularly on chance topics such as Gina Kolata, Robert Matthews, Richard Morin, John Paulos, and Ivars Peterson. Richard Morin writes a weekly column called "Unconventional Knowledge" that reviews studies primarily in the social sciences. Thus you can use the byline feature to find their articles.

We have found the New York Times the best source of chance news. Their Tuesday Science Times section often has in-depth articles on important medical studies and other chance news. Other national newspapers with excellent science coverage include: The Boston Globe,

Wall Street Journal, Washington Post, and The Los Angeles Times.

All these major newspapers have web versions and you can download the current day's articles at no cost and previous day's issues at a modest cost. You can also search for articles in archives of previous issues, typically including at least the past year. To download or print articles from previous papers typically costs about $2. However, once you have identified an article of interest you can easily find it on Lexis Nexis and download it free. Online newspapers generally have limited photos and graphics in the current issue but not in the archived articles. Here are the details on the major papers we have mentioned.

- The New York Times: Today's paper is free. Archives include the past 365 days. You can search for an article at no cost but if you want to print or download it you have to pay $2.50.

- The Boston Globe: You get today's paper and you can search through the last fifteen years of Globe-staff written stories. You can obtain a full text of such stories for $2.50 before between 6:00 A.M. and 6:00 P.M. EST. and for $1.95 at other times.

- Washington Post: You can search and get full text of articles from the past two weeks free. Articles more than two weeks old going back to Sept. 1996 are available for the same prices as the Boston Globe.

- Los Angeles Times: Today's paper is free. Archives go back to 1990. You can search these but to download a story is $1.50.

- Wall Street Journal: The Wall Street Journal is the only major newspaper you cannot read free on the web. The web version costs $59 or $29 if you also subscribe to the paper.

Some of the most colorful examples of chance news occur in local newspapers and so it is useful to at least keep an eye on your own local paper. Read the local papers when you travel also. For example, here is a letter to the editor we noticed in the Dallas Morning Star, Jan 12, 1999, page 8A:

I was really angry when I read the front page article Jan. 9 stating that a poll finds 54% of Texans back a quick vote on Bill Clinton. The Dallas Morning News Poll is not accurate of what people think. A random poll of 514 people does not accurately portray the majority of people in the state who were not asked.

Our independent poll, of people we meet in the metroplex during everyday sales is very different.

The random people we ask are in favor of impeachment and feel that Bill Clinton should be forced from office. This includes people who voted for him one or more times.

I have been thoroughly disgusted with the random polls conducted in New York implying that Americans favor Bill Clinton and think he is doing a good job --- usually polling 500 people. This is propaganda and manipulation of public opinion through public news sources and the information being put out is a lie! Most people do not feel the way polls imply. It is not appreciated by most Americans.

Carol Yocum, Copper Canyon

Of course, local or regional papers are also the source of serious chance news items. For example, the Dallas Morning News (http://www.dallasnews.com/) has an excellent science page on Monday's paper. The Minneapolis Star Tribute has some excellent feature writers and they often have in-depth articles on a chance news topic.

CHANCE NEWS ON THE RADIO AND TV

National public radio (NPR) also covers the major medical studies as well as other chance news. They keep all of their programs in an archive that you can access and listen to with free RealAudio software. Their reports are usually in the form of questions and answers from the researcher who did the work or other experts in the field or both. These questions often anticipate questions readers of the newspaper report might have and so often make a significant contribution. NPR has a good search engine to look for discussions of older articles. We have put links to previous chance programs on the Chance web site under Teaching Aids.

The evening TV news often has discussions of new studies but they are too brief to be very valuable. You will have better luck with the on-line versions of the TV networks, ABC, NBC, CBS, and CNN. You can occasionally find an interesting video clip related to chance news item. For example, the CNN discussion of the study showing that monkeys can do math had a video clip showing the monkeys in action. ABC online has a monthly column written by John Paulos and we suspect that, in time, there will be more such interesting material. Public television has an occasional interesting documentary but you cannot access it from their web site. In summary, at this time, the characterization of TV as a wasteland seems to apply also to chance news on TV.

GOING TO THE SOURCE

The job of the newspaper is to tell the story of a new study or other chance news in a very general way without using technical jargon and formulas. Science writers often include comments from both the authors of the studies and other experts on the implications of the results of the study. Thus they provide an excellent place to start. However, for more details you will often have to go to the source of the articles. Fortunately, most of the articles reported in the press come from a very small number of Journals. In a recent lecture Curt Suplee, of the Washington Post, estimated that 75% of the science articles in their paper come from 5 sources: Science, Nature, New England Journal of Medicine, Journal of the American Medical Association, and the Hubble telescope. Our own list of important journals would be a bit larger and include at least Lancet and the British Medical Journal.

Science writers obtain copies of important new results a week in advance under an "embargo" system. This gives them time to prepare their articles. It also means that the article often appears before your library has the issue of the magazine or journal that includes the work they are writing about. Fortunately, your library is likely to have access to the electronic version of the journals.

Here are the journals that news articles are typically based on with information about their electronic versions.

- Science: You can register free and obtain contents, search, and staff-written summaries of research papers and news stories back to Oct. 1995. Full text of the articles is available only to subscribers of "Science" for an additional $12. Libraries can obtain site licensees for the whole school ($1500 to $5500 depending on size of school) or workstation licenses at $25 each

- Nature: You can freely access table of contents of current issues and back issues of "Nature" back to June 1997. Subscribers of "Nature" have access to search and full text. The library can have one ID number for each subscription that they have to Nature. These can be used by any library patron at any machine but only one person can use a particular ID number at a time.

- Science News: Table of contents of current issue and back issues of "Science News" back to May 1996. Some articles available in full text. Access is free.

- New Scientist: Table of contents of current issues and back issues of "New Scientist" back to 5 April 1997. Some articles (about 30%) available in full text. Access is free.

- New England Journal of Medicine: Abstracts of articles are available for all users. Subscribers to the journal can access full text of articles back to Jan. 1993. These also use GenMed to access many of the references that occur in articles.

- Journal of American Medical Association (JAMA): Here you will find contents and abstracts of all articles in JAMA back to July 5 1995. Articles that JAMA considers newsworthy are summarized in JAMA's Science News Update. Full text of articles are not available here, but access is free.

- Lancet Interactive: You can register free to obtain table of context and selected full text of articles in Lancet back to 6 Dec. 1997. Subscribers of Lancet can obtain full text of articles back to this date. Libraries that subscribe to Lancet can activate online subscriptions on behalf of their users. They can register as many users as they wish, but only three users per subscription can have simultaneous access to The Lancet Interactive.

- British Medical Journal: This site contains the full text of all articles published in the weekly BMJ from January 1997. Access is free at least until the end of 1998.

All of these web versions of journals enhance their web sites with information not available in the printed journal. This will often include links to other sources related their articles. They will also have summaries of important articles prepared for science writers and others. Increasingly, they are trying to establish links with other journals so that you can access references to their articles. In general, this will only work if you or your institution has the right to access the other electronic journal.

Science is published by the American Association for the Advancement of Science (AAAS). On the AAAS homepage (www.aaas.org) you will find a service Eureka (go to "what's new") which is used by science writers to find news that researchers feel they might interest them. Science writers have access to the full text under the embargo system. You will typically only find abstracts of the articles but often you will also often find links to the full text or information about how to obtain the full text of the article.

Studies from the social sciences often come from journals not listed above. Usually in these cases we are able to find the journal in our library. When this is not been possible we have e-mailed the author who often will provide an electronic version or fax a copy of his or her paper.

CHANCE NEWS

To help others identify current chance news, the Chance Project publishes and (for now) freely distributes an electronic newsletter, called "Chance News". Chance News abstracts relevant articles and provides associated discussion questions. As we have remarked you will sometimes have to go to the original source to see what is really going on. Here is a recent example where we had to do this.

In Chance News 8.05 we discuss the article "Eating anger: Blowing your top isn't the same as blowing off steam" which appeared in the Boston Globe, 3 May 1999, written by Judy Forman. Forman's article was based on a study reported in the March issue of the Journal of Personality and Social Psychology. The Globe article stems from the folklore that it is a good idea to "blow off steam" when angry by doing something like hitting a pillow or a punching bag or engaging in some other such harmless activity (called catharsis) to diffuse our anger and prevent us from taken it out on innocent bystanders. As explained by the article, in this study the subjects (students) were randomly divided into two groups: half the subjects read an article saying that the catharsis hypothesis was verified and the other half read an article saying it was not true. The goal of the study was to test whether those students who read that catharsis worked were more apt to act on this than were those who read that catharsis did not work.

It seemed to us that they were just testing the effect of being told that catharsis worked. This seemed strange to us so we went to the original study.. It turned out that the explanation for our puzzlement was very simple. The authors reported that previous studies had already shown that catharsis did not generally work and indeed often did more harm than good. Their study was designed to see if the fact that we hear this study so often on TV and other media would cause people to believe the theory and perhaps by a kind of placebo effect, this believe would make it really work. Their study showed that this was not the case.

The Globe article, as in other news reports of this study, makes no mention of the role of the media in their discussion of the study. For example in the Globe article, we read:

The research, published recently in the Journal of Personality and Social Psychology, shows that catharsis - verbal or physical venting - is "worse than useless," says the lead author, Iowa State University psychologist Brad J. Bushman. In the original article, we read in their conclusion: "Our findings suggest that media messages advocating catharsis may be worse than useless."

Other times we need to be more than diligent detectives in order to understand what's going on and we may need to do some of our own statistical research. Here is such an example from Chance News 8.04

In Chance News 8.03, we mentioned that a reader sent us the URL of a web page where we find a list of about 300 rock stars who have died, along with the date of death, age at death, and cause of death. At the top of the page we read in large print:

Average Age at Death of Included Rock Stars 36.9 Years, Average Age at Death of Americans 75.8 Years

There are obvious problems with this comparison. The average age at death for Americans refers to a random sample of children born at the time the life-table used was constructed. To be in the rock star dataset a person must have already lived long enough (say 16 years) to be identified as a rock star and have died by 1998. Giving rock music as this second factor causes a significant bias.

The reasons for death given for the rock stars certainly suggested that their average age of death is less than a random sample of the population. For example, of the 317 listed, 40 died of drug overdose, 36 committed suicide, 22 died in airplane accidents, and 18 were murdered. These do not seem to be typical risk factors. However, we asked ourselves how we could convincingly show that rock stars do die young. Here is how we did this.

For each rock star we associate a fictional twin. We assume that these twins, along with their rock star twin, reached age 16. We then simulated the age of death for these twins using an appropriate life table. A life table starts with 100,000 persons at birth and estimates how many of these would be alive after one year, after two years, after three years etc. Using this table it is easy to compute the conditional probability that a 16-year-old will die at age x: From the table we find how many of the 100,000 are predicted to die between age x-1 and x and divide this number by the number predicted to be still alive at age 16.

We used these conditional probabilities to simulate the age of death for our twins. We then select those who died by 1998 and compute their average age of death. We repeat this simulation a large number of times to estimate the average age of the twins. Carrying this out we found the average age of death for the twins was 48 with a standard deviation of 2.2. Thus the average age of death of 36.9 years for the rock stars is significantly lower than their more typical twins. However, the average value of 48 years for the twins is a far cry from the 75.8 years listed for Americans.

Of course much of what we do in trying to understand the news in writing Chance News could be carried out by the students themselves possibly with suggestions from the instructor how to go about doing this.

USING THE CHANCE PROJECT AS A DATABASE

In trying to really understand a current news article it might be necessary to find background material on the topic being discussed. For example, statistical issues in the Census 2000 are reported regularly in the news. Discussion of this topic will require understanding topics such as the recent court rulings on the legality of using sampling rather than enumeration, political issues such as current rulings of congress on how the census can be carried out, as well as statistical issues such as the how the "capture-recapture" method is adapted to estimate the "under-count" problem.

The Chance Project has developed several different methods to help instructors with this.

One way to get started is to search on previous issues of Chance News. Our search mechanism allows you to ask for articles which have the words "census 2000" in the review. (Just put in "census 2000 2", where the "2" means we want both words to appear.) Doing this yields the following articles (among others):

Chance News 7.06. "Sampling and Census 2000: The Concepts", American Scientist, May-June 1998, pp. 495-524 Tommy Wright. Tommy Wright is a statistician for the Census Bureau. Wright shows the problems involved in enumeration by asking us to consider trying to estimate the number of people at a football game during the break at halftime. He then shows, in terms of simple examples, how the Census Bureau plans to estimate the undercount.

Chance News 7.10. "Sampling and Census 2000", SIAM News, November 199 8, p. 1 and 10 Morris L. Eaton, David A. Freedman, Stephen P. Klein, Kenneth W. Wachter, Richard A. Olshen, and Donald Ylvisaker. Freedman and his colleagues review the proposed by the Census Bureau to estimate the undercount. They explain why they believe that the methods proposed are subject to so many possible errors that the resulting estimate will cause more problems than it will solve.

Chance News 8.02. Department of Commerce v. United States House of Representatives Supreme Court of the United States, October term, 1998 No. 98-404. Argued November 30, 1998--Decided January 25, 1999. A link to the text of the recent Supreme Court ruling that sampling cannot be used in census 2000 for the purpose of apportioning congressional seats among the states. In addition to

providing the reasoning of the court members on both sides of this decision, you will find here an excellent history of the evolution of the Census Act since the first Congress in 1790.

You can learn about the current political issues involved in Census 2000 by going to the Census homepage and reading the recent testimony of director Kenneth Prewitt before congressional committees. Of course you will also hear more about this when Prewitt gives the Deming Lecture on Thursday at 4:00.

We have also made available on the Chance web site under Teaching Aids, profiles of important chance issues based on our experiences using these issues in a Chance Course. For example, you will find here a profile on the Census written by Bill Peterson. This is based on his experiences discussing the Census 1990. Included is a discussion of how he illustrated the capture-recapture method by an activity using Pepperidge Farm goldfish crackers.

Other issues that come up regularly in the news for which such background information is highly desirable are: medical trials, DNA fingerprinting in the courts, political polls, economic indicators, lotteries, casino games, and statistics in sports, and probability puzzles, extra sensory perception, stock market behavior , coincidence, the bible codes, etc.

The best over-all source for this kind of background information is Chance Magazine produced by the ASA and published by Springer-Verlag. Indeed, Chance Magazine articles tend to be written about current events relating to these topics but with much more detailed information than you would find in a newspaper article. Regular columns on sports, graphics etc. also provide a wealth of timely chance information.

Finally, background material on chance issues is provided by Video material. Of course the classic example of this is the two video series: *Against all Odds* provided by the Annenberg Corporation and the closely related series, *Decisions through Data,* provided by COMAP.

The Dartmouth Chance Project has also provided a series of videos on chance topics. Here is a description of this project.

Each year we have invited a group of experts in a variety of subjects, ranging from casino gambling to insurance policy redemption, to give one hour lectures on the way in which probability and/or statistics impacts their work. The lectures are intended for a scientifically literate and interested audience with no more than a ``newspaper-knowledge'' of the subject at hand.

The lectures are videotaped and made publicly available on the web via streamed video for viewing using the ``RealAudio'' application. The format of the videos is such that they are accompanied by displays of the speaker's overheads which update automatically as the video proceeds. The web site contains twenty-six lectures in all, seventeen of which are from the two lecture series. Viewing these requires at least a 58kbs connection and a computer with a clock speed of at least 150 megahertz. To make them easier to use in the classroom we have made these lectures available on a CD-ROM that requires a browser but not a network connection.

Each lecture is long enough that it would be possible to devote an entire class to the analysis of a single one. When the speaker makes a particularly difficult or controversial remark, the teacher can stop and discuss it with the class before going on. An accompanying indexing scheme also makes it easy to use only segments of a video.

The subject matter runs the gamut, from playing fields to planetary science: For instance, in our first lecture series Hal Stern, Professor of Statistics at the University of Iowa (and Editor of *Chance* Magazine) gives a beautiful lecture on the probability and statistics which can be found every day in the sports pages. He considers three quite different examples to show how probability and statistical theory, when applied to real sports data, can enhance the understanding of a sport and help determine optimal game strategies. These examples are: the use of Mark chain theory to determine baseball strategies, the use of regression to rate college football teams, and the use of data and the normal distribution to estimate, at a given point during the game, the probability that a particular team wins -- shedding light on the folk theory that the final outcome of a basketball game is determined by what happens in the last quarter, and by the first seven innings for a baseball game.

In our second lecture series, Clark Chapman of the Southwest Research Institute speaks on "The risk to civilization from extraterrestrial objects". Chapman, a leading researcher on planetary cratering, discusses the science behind the determination of the rate at which extraterrestrial objects strike the earth as well as the different types of collisions which can and do occur. He explains the computation of the odds that any individual on earth will die due to such an event and justifies his claim that "It's as likely that your epitaph will read that you died of an asteroid collision, as by an airplane crash". If the odds of these disasters are the same, then should we devote similar amounts of energy and money to preparing for asteroidal collisions as we do for airline

safety? This leads naturally to discussions of the larger topic of risk and resource management.

Of course, you might be more interested in finding articles on a specific topic that you are covering in your course. For example, consider the topic of correlation. One way to find such topics would be to search on Lexis Nexis. Another would be to search on correlation in the archives of Chance News. If you do the latter you will find our favorite example:

Chance News 7.06 "Investing it; duffers need not apply" The New York Times, 31 May 1998, Section 3, p. 1, Adam Bryant. This was a full page spread intended to show that the stock performance for companies whose CEO's have a high golf rating is better than those where the CEO's have a low rating. All the data is given and when you use it all you get essentially no correlation. The author takes out "according to good statistical practices" those CEO's who do not fit his theory and gets a strong correlation.

A chance news collection which exploits the idea of classifying articles according to both the news topic and the statistical topic being illustrated can be found at the web site: "Chance and Data in the News" (www.ni.com.au/mercury/mathguys/mercindx.htm)

Finally, we mention some classic sources that that while not current can contribute enormously to students understanding of real world problems.

The segment in the video series, *Against all Odds*, on the history of statistical issues in the dangers of smoking. The researchers who made the original studies tell how they went from associations to causation relating to smoking and lung cancer.

The segment in which Steven Jay Gould explains why he thinks there are no more 400 hitters. A more complete discussion of this topic together with similar to issues in evolution can be found in Gould's book "Full House", published by Harmony Books 1997, See Chance News 5 11 for a review of this book. The basic idea is to study the effect of a "wall" on one side on variation. This is a beautiful example of how a simple statistical idea can be applied to diverse areas of knowledge. Still another application of the same principle is provided in the next example.

"The Median is not the Message" by Steven Jay Gould, Discover Magazine, June 1985. Gould describes how he reacted to the news he received in 1982 that he was suffering from abdominal mesothelioma, a rare and serious cancer with a median mortality of 8 months after it is diagnosed. Gould describes how he cheered himself up by realizing the distribution of lifetimes for those diagnosed with his disease could not have a left tail of more than 8 months and probably had a very large right tail. He assumed that he was far out in this tail. Evidently he was.

The basic ideas on good and bad graphics as discussed in Tufte classic books. For a discussion of good and bad graphics in newspapers we would recommend the recent book by Howard Wainer as well as his Chance Lecture on this topic.

John Snow and the Cholera Epidemic and The Decision the Launch the Space Shuttle Challenger chapter 2 of Tufte's book "Visual Explantions: Images and Quantities, Evidence and Narrative. This chapter is available separately from Graphics Press for $5. These two articles convey to students better what statistics is all about than most of us do in a full course.

Decisions Decisions, by Keven McKean, Discover Magazine, June 1965. A great discussion of how Kaneman and Tversky came to establish their classic theory of the role heuristics and biases in judgments under uncertainties. All the famous examples, the Linda problem, the hot hand etc. are beautifully explained.

Tversky and Gilovich, in their famous article (The cold facts about the "hot hand" in basketball, Chance Magazine, Winter 1998, pp. 15-21) challenged the common belief that basketball players have streaks of successful shots, or "hot hands". They studied data from basketball players shooting free throws as well as the performance of players on the Philadelphia 76ers basketball team and found no evidence for streak shooting. This is a useful example of a statistical truth that the public will never accept.

Note: This talk with links to all URL's mentioned will be on the Chance web site[5] under "what's new". You will find there also two other recent articles on the topic of this talk: "To Teach, per Chance To Dream", by Dan Rockmore and, Notices of the AMS September 1999, and "What are the chances of that!?!" by Richard Morin J. The Washington Post, 4 April, 1999, B5.

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Note: This paper was presented at the 1999 Joint Statistical Meeting of the American Statistical Association. It is not included in the 1999 ASA Proceedings of the Section on Statistical Education.

[5] www.dartmouth.edu/~chance