7. TOWARD STATISTICAL LITERACY?

Bad statistics aren't rare. You can probably spot at least one dubious number in this morning's newspaper. Recognizing bad statistics is not all that difficult; it takes clear thinking more than it requires any advanced mathematical knowledge. And most people will agree that we ought to stamp out bad statistics.

Still, bad numbers flourish. Why? Shouldn't we be able to teach "statistical literacy"—basic skills for critically interpreting the sorts of statistics we encounter in everyday life? Why can't statistical literacy be part of the standard high school or college curriculum? Shouldn't we be able to, in effect, immunize young people so that they will be able to think critically about the numbers they encounter and resist bad statistics?

DON'T WE ALREADY TEACH STATISTICS?

Every year, thousands of high school seniors enroll in Advanced Placement statistics classes. (At the end of the year, these students can take the national AP statistics exam, and, if they score well enough, many colleges will give them credit for having completed a basic statistics course.) Many thousands more students will take at least one statistics course in college. We might expect that statistical literacy would be an important part of these courses.

We would be wrong. Statistics textbooks, as well as the AP exam, all but ignore the sorts of issues raised in this book. Rather, statistics instruction, in both high school and college, focuses on what I call matters of *calculation*—on the theory and logic behind particular statistical measures, on the methods of actually computing those measures, and on the interpretation of the results. Introductory statistics textbooks feature chapters on probability theory, on tests of significance, correlation, regression, and so on. That is, these textbooks assume that the students who read them might want to use statistics to interpret data derived from some sort of scientific research. There is nothing wrong with this; those students who do become researchers will indeed need to know how to calculate those statistics.

However, such textbooks and courses say next to nothing about how to interpret the simple statistics—the graphs and numbers—the students might encounter in the morning newspaper. Why? If everyone agrees that statistical literacy is an important skill, why isn't it an important part of statistics instruction?

Statistics is usually understood as a branch of mathematics, hence the focus on calculation. I am sure that most high schools consider the AP statistics class to be a math class and assign a math teacher to teach it. The goal of the course is to make students proficient statistical calculators; the classes are not designed to make them statistically literate. To no one's surprise, math teachers believe that their job is to teach math, to teach students how to calculate correctly so that the students can score well on tests of calculation, such as the AP statistics exam.

Similarly, the statistics courses taught in college—even the basic, introductory courses—devote almost all their attention to matters of calculation. The spread of computers and easily mastered statistical software packages has encouraged the use of highly sophisticated statistics. Before 1970 or so, a person without advanced training in statistics who picked up an issue of a leading social science journal, such as the *American Sociological Review,* could probably understand the data presented in many of the articles. This is no longer true. Today's *ASR* articles feature ordinary least-squares regression, log-linear regression, and other complex, multivariate statistical techniques that probably cannot be understood by anyone who has not taken at least two semesters of statistics in college. Naturally, college instructors believe that their job is to teach students to master these advanced techniques.

Could it be that the kinds of issues I've raised in this book strike most statistics instructors (and textbook authors) as too simple to warrant comment? Perhaps. But more than that, the topics we've covered aren't matters of calculation. We have been less concerned with mathematical processes (calculations) than with a social process. Our focus has been on who counts—who

produces numbers, why they produce them, which audiences consume them, and how those numbers are understood and put to use. That is, we have tried to understand the social construction of numbers more than their calculation.

But statistics classes largely ignore the ways statistics are used as evidence for understanding social issues as well as the ways people count. If the social process by which statistics are brought into being is mentioned, it is probably in relation to the idea of bias—instructors may warn students that "biased" people can devise distorted statistics. But beyond blaming bias—which is treated as a sort of contamination originating outside the mathematically pure realm of calculation—statistics classes rarely explore what this distortion might involve.

In short, even if everyone agrees that it would be desirable for students to improve their ability to think critically about the sorts of statistics found in news coverage, statistics teachers aren't likely to feel that this is their job.

ASSIGNING RESPONSIBILITY FOR STATISTICAL LITERACY

Contemporary educators are beset by competing demands. On the one hand, as new social issues come to public attention, there are often calls to add material to the schools' curriculum; sex education and drug education are obvious examples, among many others. A school district may win a grant for an anti-bullying program. There may be campaigns at the state or school district level to make students aware of various sorts of discrimination. The list goes on and on, and it changes with each passing year. Some of these new special topics become enduring elements in

the schools' curriculum, but others turn out to be short-lived enthusiasms, educational fads.

On the other hand, many grumble that schools are neglecting the basics, the Three Rs. The school accountability movement, at least in part, demands that schools return to emphasizing instruction in basic skills. Schools and teachers, then, find themselves trapped between calls to spend more time teaching basic skills and pressure to add instruction about whatever new special topics currently occupy the public's attention. The school day contains only a limited number of minutes, and all sorts of people want more minutes to be devoted to whatever topics they deem important.

So a first question might be whether statistical literacy ought to be considered an additional special topic or a basic skill. If it is promoted as a special topic—like AIDS education and bullying prevention—its long-term prospects won't be bright. This year's addition to the curriculum easily becomes a candidate for elimination when next year arrives with its calls to teach still other new topics.

Well, what if we call statistical literacy a basic skill? Certainly a plausible argument exists for considering it in these terms. After all, we are talking about teaching people to be more critical, to be more thoughtful about what they read in the newspaper or watch in a news broadcast, to ask questions about claims from scientists, politicians, or activists. Being better able to assess such claims is certainly valuable; we might even argue that it is fundamental to being an informed citizen. Why not consider statistical literacy a basic skill?

But this raises another question: what sort of basic skill is it? The answer matters because both high schools and colleges par-

cel out responsibility for instruction to departments organized to teach topics. A typical high school has separate departments for science, social sciences, mathematics, English, and so on; most colleges subdivide many of these broad categories, for example, assigning the responsibility for teaching to separate departments for biology, chemistry, and so on. In general, the larger the educational institution, the more departments it recognizes.

Departments are natural competitors. While everyone may acknowledge the value of a well-rounded education, each department tends to assume that it plays an especially important role. And because money is always short, departments compete for available funds to hire faculty and purchase equipment. It is the rare department that doesn't want to expand; in particular, many departments would like to offer more advanced training, such as AP courses in high schools or graduate programs in colleges.

This competition means that teaching basic skills often is devalued. For example, almost all of the thousands of first-year students admitted to large universities each year are required to take an English composition class. Those classes need to be small, because the students must write a lot of papers, and those papers need to be graded quickly and carefully. At most universities, the job of teaching those composition classes falls on graduate students or part-time instructors, not on English professors. In part, it is much cheaper to teach composition this way; in part, English professors prefer to teach advanced courses to English majors (because both the subject matter and the students are more interesting). The point is that teaching this basic skill is not considered particularly rewarding. (Some universities' English departments have spun off separate departments

of composition, writing centers, or other programs to handle this unpleasant chore.)

The example of English composition can help us appreciate the problems of teaching statistical literacy. College instructors are well aware that substantial proportions of students have trouble reading—let alone thinking critically about—basic graphs or tables. This is a very important skill because graphs and tables are certain to appear in much of the reading a student will need to do in the course of college. And yet, no one wants to teach this skill, or at least to spend much time doing so. Many have the sense that students should already be proficient in these skills when they get to college (even though it is clear that many are not). To many others, it seems too simple, too basic—a waste of time for professors who would prefer to teach the more advanced topics in their disciplines.

In addition, the spread of personal computers and sophisticated software helps sustain the illusion that students already understand this stuff. Anyone who visits a junior high school science fair will see all manner of eye-catching, computer-generated graphs. As long as no one bothers to ask whether these graphs are clear and useful (they often are neither), it is easy to be impressed by what the students have produced. Similarly, students learn that they can find answers to pretty much any question by searching the Internet. They may not locate particularly good answers, but they find answers all the same. The experience that many students already have in using high-tech methods (albeit to produce low-quality results) helps to justify claims that we don't need to teach basic skills, that we can move on to teaching more interesting, advanced material.

Thus, statistics and mathematics instructors are unlikely to

have any more interest in teaching statistical literacy than English professors have in teaching first-year composition. Nor are other departments eager to teach this material. I teach sociology courses, but I know that most sociology professors tend to dismiss statistical literacy as "not really sociology"; faculty in psychology and other disciplines probably have the same reaction. Statistical literacy falls between the stools on which academic departments perch.

There is precedent to support my pessimism. During the late 1980s and early 1990s, "critical thinking" became a buzzword on college campuses. This should have been the perfect slogan around which to rally support for educational reform. Virtually all professors consider themselves critical thinkers, and most would agree that students must learn to think more critically—another highly desirable basic skill. But because all those professors believed that they already were teaching their students to think critically (even though they simultaneously complained that many students were poor critical thinkers), and because no department wanted to take on the responsibility for teaching the topic across the campus, interest in improving critical thinking peaked, and the strength of the idea as an educational slogan has begun to fade.

What happened to critical thinking? Why didn't that good idea become an enduring part of education in all schools? The lack of a departmental "owner," a department that would house, protect, and nurture critical thinking, meant that teaching the skill remained everyone's responsibility—and therefore no one's.

This example suggests that a specific department needs to take responsibility for teaching statistical literacy. As we have

already established, this is not likely to be a mathematics or statistics program, however logical that might seem at first glance. The social sciences might offer an alternative home. After all, issues of statistical literacy often emerge around discussions of social issues. But again, sociology professors are likely to dismiss statistical literacy as not being "real sociology" (and other departments may react the same way).

Departmental organization offers considerable advantages for educational institutions, but it also carries costs. It is difficult to teach subjects that do not fit neatly within what a department considers its proper instructional domain. This helps to explain why many graduates of high schools and colleges remain uncomfortable when confronted with even basic statistics—and why this situation will not change easily. The lessons involved in teaching statistical literacy are not so terribly difficult; rather, the difficulty lies in finding someone willing to teach them.

THE STATISTICAL LITERACY MOVEMENT

Despite these obstacles, a small educational movement advocating statistical literacy has emerged. Professor Milo Schield, director of the W. M. Kleck Foundation Statistical Literacy Project at Augsburg College in Minneapolis, is the movement's leading voice. Schield operates the Statistical Literacy Web site (www.StatLit.org); for those interested in statistical literacy as an educational movement, the site includes a section on teaching. Although this is a promising development, the campaign to promote formal instruction in statistical literacy is in its early phases.

But perhaps statistical literacy doesn't have to be taught in

classrooms. Recently, there seem to be increasing calls to promote statistical literacy outside the educational establishment. Consider, for example, these resources:

• The Statistical Assessment Service (www.stats.org) has been criticizing the media's handling of statistics since 1995. SAS published newsletters until 2002, when it converted to distributing its reports on its Web site. A book based on SAS analyses is both readable and available in paperback; see David Murray, Joel Schwartz, and S. Robert Lichter, *It Ain't Necessarily So: How Media Make and Unmake the Scientific Picture of Reality* (2001).

• Various Web sites from around the world feature discussions of bad statistics. Some of these contain mostly original material; others are little more than links to specific discussions around the Web. Numberwatch (www.numberwatch.co.uk) is a British site; its operator, John Brignell, is the author of *Sorry, Wrong Number! The Abuse of Measurement* (2000). The Social Issues Research Centre (www.sirc.org) is another British site presenting analyses of issues that often involve critiques of statistics. Pénombre (www.penombre.org) is a French site, which also contains some materials in English. The Canadian Statistical Assessment Service (www.canstats.org) resembles its U.S. counterpart, while another Canadian site, Innumeracy.com (www.innumeracy.com), is basically a catalog of links. Numeracy in the News, an Australian site, is aimed at educators and students; it features sample articles, graphs, and so on, each accompanied by study questions and commentary (http://ink.news.com.au/mercury/mathguys/mercury.htm). Many of these organizations also offer links to more specialized sites, including official statistics (many government agencies now provide sites where one can access their statistical

reports) and sites devoted to particular social issues or types of data—for example, Quackwatch (www.quackwatch.org) on medical claims, Junkscience.com (www.junkscience.com) on media coverage of scientific news, and the Center for Media and Democracy (www.prwatch.org) for critiques of industry and government public relations campaigns. As might be expected, such sites vary in their concerns and underlying ideologies, and their critiques should be examined critically rather than simply being accepted.

· It's often fun to explore bad statistics, but for sheer entertainment, it is hard to beat Cecil Adams's column, "The Straight Dope," which appears in alternative weekly newspapers. Its motto is "Fighting Ignorance Since 1973 (It's Taking Longer Than We Thought)." Each week, Adams addresses one or more questions—often on topics that good taste leads other media to ignore; some, although by no means all, involve sorting out statistical claims. The Web site (www.straightdope.com) offers an index for and access to all the columns. If you're interested in exotic topics, this is a wonderful resource.

· Other media commentators also promote statistical literacy. The mathematician John Allen Paulos, author of *Innumeracy: Mathematical Illiteracy and Its Consequences* (2001) and other books for general readers, has a Web site (http://euclid.math.temple.edu/~paulos/) that links to his various works, including his columns for ABC.com. The British Broadcasting Corporation has several mathematically themed radio programs, including "More or Less," which features frequent commentaries on statistical issues. Broadcasts are archived at http://news.bbc.co.uk/1/hi/programmes/more_or_less/archive/default.stm.

· The American Statistical Association publishes *Chance,* a quarterly magazine devoted to interesting uses of statistics. Some of the articles require considerable background in statistics, but others are more accessible. As an introduction to what professional statisticians do, it is a valuable resource.

· Many books on statistical topics are available, ranging from textbooks that teach students how to calculate different statistics to volumes—such as this one—that offer critiques of how statistics are used and misused in contemporary society. (Several of these books are listed in the notes to earlier chapters of this volume.)

These various sources form a chorus of voices promoting the cause of statistical literacy. Of course, disagreements arise within the movement. Some advocates have ideological agendas: conservatives concentrate on exposing liberals' misuse of statistics, while liberals attack dubious numbers promoted by conservatives. Some critics seem to blame "the media" for irresponsibly publicizing bad statistics, but journalists—not unreasonably—respond that they often have no good way to assess the numbers their sources offer. Some statisticians advocate better mathematical training to improve our understanding of calculation, while social scientists (such as myself) argue that it is important to locate numbers within the social context that creates and disseminates them.

In short, it may be true that "everyone" agrees that improving statistical literacy is desirable, but it isn't clear that they can agree on what statistical literacy means, what improving it might involve, or what the consequences of this improvement might be.

Even if no one opposes statistical literacy, serious obstacles remain. There is disagreement about which skills need to be taught, and, at least so far, no group has offered to take responsibility for doing the necessary teaching. Plenty of information is out there—any interested individual can learn ways to think more critically about statistics—but the statistical literacy movement has yet to convince most educators that they need to change what the educational system is doing.

Many of us kid ourselves that bad statistics come from people with whom we disagree, and we fantasize that improving statistical literacy will inevitably swell the ranks of people who agree with us, that all critical thinkers will recognize the flaws in our opponents' arguments, while finding our claims convincing.

I wouldn't count on things working out that way. Statistical literacy is a tool, and, like most tools, it can be used for many purposes. If more people think more critically about statistics, they are likely to use that skill to criticize our numbers as well as those of our opponents. When everyone's numbers come under scrutiny, we are all held to higher standards.

But that's not bad. As things stand, we constantly find ourselves exposed to lots of statistics. Some of those numbers are pretty good, but many aren't. As a result, we worry about things that probably aren't worth the trouble, even as we ignore things that ought to warrant our attention. Improving statistical literacy—if we can manage it—could help us tell the difference and, in a small way, make us wiser.