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Empirical methods and the law

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Empirical Methods and the Law

Theodore EISENBERG

For the rational study of the law the black letter man may be the man of the present, but the man of the future is the man of statistics and the master of economics.

Oliver Wendell Holmes, The Path of the Law (1897)

One can divide empirical analysis of legal issues into three major branches: (1) the use of scientific empirical analysis by litigants to attempt to prevail in individual cases, (2) the use of social scientific empirical analysis in individual cases, and (3) the use of empirical methods to describe the legal system's operation. The first two uses present difficulties that reflect a fundamental limitation on using statistical methods in law: the difference between establishing statistical association and establishing actual causation in an individual case filtered through our adversary legal system. The third use encounters no such obstacle and can aid understanding of how the legal system operates and inform policymakers. Accurate description of the legal system's operation can in turn influence the outcome of specific cases. More important, accurate description of the legal system can supply the information necessary for sound policymaking; for example, a substantial body of evidence suggests that our civil justice system performs quite well.

1. "HARD" SCIENTIFIC EMPIRICAL ANALYSIS

Scientific statistical analysis of evidentiary issues in individual cases is common in criminal and civil cases. The most important class of scientific evidence relates to forensic identification. In this field, DNA testing has fostered a revolution. DNA testing has been subjected to levels of rigorous analysis not previously applied to forensic identification reasoning. The debates generated by DNA testing may reverberate back onto more traditional forensic identification methods. Pure statistical questions also arise in a variety of other contexts.

1.1 DNA Testing

DNA matching is now common in criminal and civil cases. Many articles and books on the subject are available

(e.g., Aitken 1995; Roberston and Vignaux 1995; Schum 1994). Likelihood ratios measure the strength of DNA evidence supporting the hypothesis that a suspect is the source of a sample, as against the alternative hypothesis that someone other than the suspect is the source (e.g., Mellen and Royall 1997). Proper execution of DNA analysis has triggered substantial debate (e.g., Aitken 1995, pp. 92–106; Evett 1991) and has led to two National Research Council (NRC) reports (NRC 1992, 1996) and to critiques of the NRC reports (e.g., Donnelly and Friedman 1999; Lempert 1997)

In addition to baseline discussions about DNA evidence, increasing use of DNA databases in England, Wales, and the United States has generated questions about the NRC's approved methods of analyzing and reporting data when a suspect has been identified through a DNA database search and not from independent related evidence. The NRC (1996) recommended that when a suspect is found by a search of a DNA database, the random-match probability "should be multiplied by...the number of persons in the database" (p. 40). Donnelly and Friedman (1999) suggested that the NRC approach is incorrect (p. 944). In their view, the fact that a DNA match is "found only after a search does not diminish the value of the evidence;" the NRC (1996) requires "a testifying expert to drastically understate the value of the evidence" (p. 933). They base their differences with the NRC on the tendency of statisticians "to export to the legal context methods that were developed to assist scientific inquiries and that appear more suitable in that context than in adjudication" (p. 934).

1.2 Implications of the DNA Testing Debates

Notwithstanding the debates, DNA inquiries tend to be regarded as purely scientific. But DNA testing can be viewed as an instance of a larger class of forensic identification techniques. For example, the question whether two fingerprints, handwritings, gun barrels, or hair samples match can be approached through reasoning applied in the DNA

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© 2000 American Statistical Association Journal of the American Statistical Association June 2000, Vol. 95, No. 450, Vignettes context. Of particular importance is quantifying the probability of erroneous matches. But this has not been done. Instead, many forensic scientists are content to assert that no two of these objects can be alike (Saks 1998, p. 1082). Except for DNA-type matching, forensic identification sciences "have not taken the trouble to collect data on populations of forensically relevant objects so that the probability of erroneous matches can be calculated" (pp. 1087–1088). It has been suggested that the data-based and probabilistic approach of DNA typing will become the norm of all forensic identification sciences (Saks and Koehler 1991). Seeds of this theme with respect to human hair comparisons have been given by Fienberg (1989, pp. 64–67).

1.3 Scientific Analysis in Other Contexts

Reasonably pure statistical inquiries arise in many contexts. Illustrations of scientific inquiries include regression estimates of damages in price-fixing cases (Finkelstein and Levenbach 1983), estimates of the quantity of drugs handled using predictive distributions (Aitken, Bring, and Papasouliotis 1997), and other sampling issues, including those relating to tax allocations of sales to different governmental authorities, sampling for public confusion in trademark cases, sampling to measure royalties by the American Society of Composers, Authors & Publishers (ASCAP), and census undercount issues (Finkelstein and Levin 1990, pp. 269–283). The data available in legal cases often are not ideal. Bayesian techniques for dealing with missing data in trial testimony have been proposed (Kadane and Terrin 1997).

"SOFT" SOCIAL SCIENTIFIC EMPIRICAL ANALYSIS

Often the empirical question in a case is not of the form typified by whether DNA matches are the proper way to estimate damages. Rather, it is whether human beings have behaved in a particular manner that cannot be proven by reference to physical evidence. In analyzing human behavior in legal disputes, statisticians need to be aware of their own limitations and the special nature of the adversary process (Fienberg 1997).

Much of the law relating to the use of social scientific statistics in individual cases has developed in discrimination cases. Some of the crudest forms of discrimination can be identified through simple description, without the need for statistical analysis. For example, the absence over a period of years of any blacks on juries in counties with substantial black populations establishes the existence of discrimination in juror selection. (Norris v. State of Alabama 1935). But modern discrimination cases are rarely so simple.

2.1 The Leading Modern Empirical Case: McCleskey v. Kemp

The most visible modern case relating to use of social scientific statistical proof in specific cases is a death penalty case, McCleskey v. Kemp (1987). McCleskey, a Georgia death row inmate, relied on one of the most comprehensive

law-related social science studies ever performed to claim that race had played an improper role in his case. The study, led by Dr. David Baldus, examined more than 2,000 murders that occurred in Georgia and considered 230 variables that could have explained the data on nonracial grounds. The study concluded that defendants charged with killing white victims were 4.3 times more likely to receive the death penalty than defendants charged with killing blacks and that black defendants were 1.1 times more likely to receive the death penalty than other defendants. (Baldus, Woodworth, and Pulaski 1990). Thus a black defendant who killed a white victim had the greatest likelihood of receiving a death sentence. Given the many other studies finding a relation between race of capital case decision making (U.S. General Accounting Office 1990), McCleskey's case presented the Supreme Court with a plausible vehicle in which to rely on empirical social science methodology to influence judicial decision making in a vitally important

Despite the evidence, the McCleskey case foundered on the difference between a statistical tendency and the legal system's demand for proof of causation in each case. The legal system claims to deal in certainty, or at least in direct causation. Social scientists and statisticians often rely on statistical association without substantial concern about whether the association corresponds with actual causation in a particular observation.

The Supreme Court relied on this difference to discount McCleskey's statistical showing. In a 5–4 decision, in an opinion authored by Justice Powell, the Court held that general statistical evidence showing that a particular state's capital punishment scheme operated in a discriminatory manner does not establish a constitutional violation. The Court found that the empirical study established "at most...a discrepancy that appears to correlate with race" (481 U.S. at 291 n. 7). The majority opinion stated that "even a sophisticated multiple-regression analysis such as the Baldus study can demonstrate only a *risk* that the factor of race entered into some capital sentencing decisions and a necessarily lesser risk that race entered into any particular sentencing decision."

Because the Supreme Court had sometimes found in jury selection cases that statistics standing alone were sufficient proof of discriminatory intent, Justice Powell's opinion had to distinguish these cases. He explained that the prior jury selection case had involved less complicated decisions and fewer decision makers. The many actors and factors in a capital sentencing case increased the likelihood that other factors were responsible for racial effects, and thus rendered the jury selection precedents inapplicable. Moreover, this complexity would increase the rebuttal burden intolerably if the state were required to explain statewide statistics. Because the statistical did not constitute a pattern as stark as in early jury discrimination cases, the Court dismissed the statewide statistics as insufficient to support an inference that the decision makers in the McCleskey case acted with a discriminatory purpose.

The ruling's effect on later race-based claims in capital cases has been devastating. No race-based challenge to a

capital sentence has been sustained in the 13 years since the McCleskey case. In a poignant change of view, Justice Powell reported that he wished that he could change his deciding vote in the McCleskey case (Von Drehle 1994). In the post-McCleskey era, it has been suggested that analyzing individual prosecutorial offices' decision making, rather than statewide data, could overcome the Court's concerns in McCleskey (Blume, Eisenberg, and Johnson 1998).

2.2 Voting Rights and Employment Cases

The legal standard applicable to race-based constitutional challenges rendered the empirical showing in the McCleskey case vulnerable. In two other classes of discrimination cases, voting discrimination and employment discrimination, litigants use sophisticated statistical methods, including regression, with somewhat greater success. One form of voting discrimination, racial dilution claims, usually involves establishing that black voters are less able than white voters to elect the candidate of their choice or to otherwise influence the political process. The standard method of proof in such cases, referred to by the Supreme Court in Thornburg v. Gingles (1986) and widely relied on by lower courts, is ecological regression. Despite its acceptance in court, this technique remains controversial within the statistical community (Freedman, Ostland, Roberts, and Klein 1999; King 1999).

In employment discrimination cases brought under federal statutes such as Title VII of the Civil Rights Act of 1964, the plaintiff need only establish a statistical disparity to put the burden on the defendant of justifying its hiring practices. In employment discrimination cases, the Supreme Court has articulated a sensible attitude about the use of statistics and regression analysis. Under Bazemore v. Friday (1986), an employment discrimination plaintiff need not find information about all possibly relevant variables in a statistical model. The Court stated the following:

While the omission of variables from a regression analysis may render the analysis less probative than it otherwise might be, it can hardly be said, absent some other infirmity, that an analysis which accounts for the major factors "must be considered unacceptable as evidence of discrimination." ... Normally, failure to include variables will affect the analysis' probativeness, not its admissibility.

Importantly, it is clear that a regression analysis that includes less than "all measurable variables" may serve to prove a plaintiff's case. A plaintiff in a Title VII suit need not prove discrimination with scientific certainty; rather, his or her burden is to prove discrimination by a preponderance of the evidence... [478 U.S. at 400-01 (footnote & citations omitted)].

Cases that seek to establish violations of Title VII using statistics are called disparate impact cases. However promising the disparate impact standard as articulated in Bazemore sounds, it is not so easy to prevail in such cases in practice. The Supreme Court has not approved a showing of disparate impact in an employment case in many years, although plaintiffs have prevailed in cases in lower courts.

2.3 Empirical Methods in Nondiscrimination Cases

Although discrimination cases receive most of the legal system's attention, social scientific statistical analysis plays an important role in other litigation contexts. For example, with the growing use of trial consultants, defendants who believe that they cannot obtain a fair trial in the plaintiff's venue of choice, or who merely wish to delay proceedings, usually try to demonstrate to the court the existence of local bias. Statistical analysis using logistic regression suggests that forum in litigation does matter (Clermont and Eisenberg 1995, 1998). Attempts to demonstrate bias can be done through statistical analysis of public opinion polls showing the existence of bias through analysis of simple tables and hypothesis tests using chi-squared distributions. Such polls are paid for and conducted by the defendant and can be highly suspect. Published opinions suggest that successful motions based on such polls are difficult to obtain (First Heights Bank, FSB v. Gutierrez 1993; Rutledge v. Arizona Board of Regents 1985; State v. Rice 1993). But much of the activity in this field occurs in preliminary motions that are unlikely to be published and may not be discussed on appeal.

The dearth of thoroughly reported proceedings enhances the opportunities for gamesmanship. Leading litigation consulting firms have been known to change the order and phrasing of questions to elicit the paying client's desired response. These results are presented to the court without noting the prior inconsistent practice (Poe, d/b/a Lake Guide Service v. PPG Industries, Inc. et al. 1994).

3. EMPIRICAL ANALYSIS OF THE LEGAL SYSTEM

Legal, economic, sociological, psychological, and other scholars regularly use social science methodology to describe and analyze the legal system. One can confidently forecast increasing use of law-related empirical and statistical analysis. Scholars unconstrained by the need to satisfy legal standards applicable to individual cases have broad and inexpensive resources available. Growth in online databases, their increasingly facile availability over the internet, and the availability of inexpensive and sophisticated commercial statistical programs promise to improve statistical training at the undergraduate level and to facilitate empirical legal research at all levels.

The most important contribution of empirical legal research will not be statistical analyses that help determine individual cases. Rather, by providing an accurate portrayal of how the legal system operates, empirical legal analysis can influence not only individual cases, but also larger policy questions. Much room for progress exists, because misperceptions about the legal system are common.

3.1 A Nonlitigious Citizenry

Recent studies reveal much about how the system of civil justice works, often with surprising results. Contrary to popular and professional belief, our legal system is not dominated by a highly litigious citizenry. Surveys of the general

public and detailed analysis of hospital records show that fewer than 10% of malpractice and product liability victims initiate legal action (Danzon 1985; Hensler et al. 1991; Report of the Harvard Medical Practice Study 1990).

3.2 Surprisingly Sober and Predictable Juries

Studies also show that the law functions in a sober and predictable manner in important and controversial areas. Medical malpractice studies using contingency tables and regression models find that the quality of medical care is an important determinant of a defendants' medical malpractice liability and that care quality and injury severity are extremely important in determining expected settlements (Farber and White 1991, 1994; Vidmar 1995). Time trend analysis of product liability cases shows no pro-plaintiff trend during a period when the product liability system was said to be out of control in favor of plaintiffs (Eisenberg 1999; Eisenberg and Henderson 1992). Regression analysis of the relation between punitive damages and compensatory damages shows that punitive awards are strongly tied to the level of compensatory awards and that not only are jurors not pulling numbers out of the air, but they also are behaving about the same as judges do in punitive damages cases (Eisenberg, LaFountain, Ostrom, Rottman, and Wells 2000; Eisenberg, Goerdt, Ostrom, Rottman, and Wells 1997). Interview evidence and controlled experiments suggest that jurors are far from being out-of-control Robin Hoods seeking to steal from the rich and give to the poor (Hans and Lofquist 1992; Hans and Vidmar 1986; MacCoun 1996).

3.3 Deeper Understanding of Capital Cases

Statistical, psychological, and empirical legal work is yielding deeper understanding of behavior in capital cases. Widespread beliefs about states' propensity to impose the death penalty are shaped by states with large death row populations, such as California, Florida, and Texas. Yet none of these states imposes a high number of death penalties per murder (Blume and Eisenberg 1999, p. 500). Nevada and Oklahoma impose the death penalty at more than twice the rate per murder than any of these larger states. And, despite the belief of many that the judiciary is largely politicized, Cox proportional hazard models of which defendants obtain relief from death row show no effects based on a state's method of selecting judges.

Empirical studies at the case level also have been revealing. Using Bayesian hierarchical models, Stasny, Kadane, and Fritsch (1998) reported support for the belief that jurors who would be excluded from death penalty juries behave differently from other jurors in non–capital offense trials. Surveys and experiments yield similar results (Cowan, Thompson, and Ellsworth 1984; Fitzgerald and Ellsworth 1984; Haney, Hurtado, and Vega 1994). Eisenberg and Wells (1992) used simple hypothesis tests to show that jurors' misperceptions about how long a murderer will actually serve in prison can lead them to impose the death penalty when they otherwise would not, a result partly relied on by the Supreme Court in Simmons v. South Carolina (1994).

Eisenberg, Garvey, and Wells (2000) analyzed survey data based on interviews with actual capital case jurors to construct ordered probit models that explain the influence of race, religion, and attitude toward the death penalty on jurors' first votes in capital cases.

3.4 Interpreting Case Outcomes

A persistent issue in interpreting even sound legal system data is that the vast majority of cases settle and that most settlements are not publicly available. Observation often is limited to cases that reach trial or appeal. Yet such cases need not be random samples of all cases. Drawing inferences about the system as a whole can be difficult when one tends to observe a small and biased subset of cases (Priest and Klein 1984). Despite this selection effect, substantial progress can be made in interpreting the mass of case outcomes. Iteratively reweighted least squares analysis using delta method linearization shows a strong correlation, by subject area, between plaintiff win rates at trial and plaintiff win rates in pretrial stages of adjudication (Eisenberg 1991). A similar correlation exists between adjudicated and settled cases (Eisenberg 1994, pp. 292-293). Thus observers of case outcomes in a subject area at one procedural stage can make informed assessments of how that category fares at other stages. Sensitivity to the selection effect does not necessarily preclude the drawing of reasonable conclusions from observing win rates in adjudicated cases (Clermont and Eisenberg 1998).

A further selection effect arises because only a small fraction of the vast number of potential claims result in the filing of a lawsuit. Yet the process through which cases are selected for litigation cannot be ignored because it does not yield a random selection of claims. Probit, bivariate probit, and competing risk models that account for case selection confirms that plaintiff win rates and trial rates can be viewed as partly a consequence of the selection of disputes for filing (Eisenberg and Farber 1997, 1999).

4. DESIRABLE STATISTICAL CONTRIBUTIONS

Both case-specific and system-wide statistical analysis of legal issues would benefit from advances in statistical methodology. Because many law-related datasets have sparse cells, there is a need for advances in inferences involving small samples. Legal data are often categorical, and models often suffer from problems of endogeneity. Advances in the ease of use of tools for factor analysis of categorical data and for solving systems of equations involving ordered and categorical response variables are also needed. Data often cluster on more than one variable; readily accessible methods for estimating hierarchical models with random coefficients are needed. These methodological improvements need to be accompanied by greater determination on the part of government authorities to collect systematic data about the legal system.

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