Truth or Truthiness

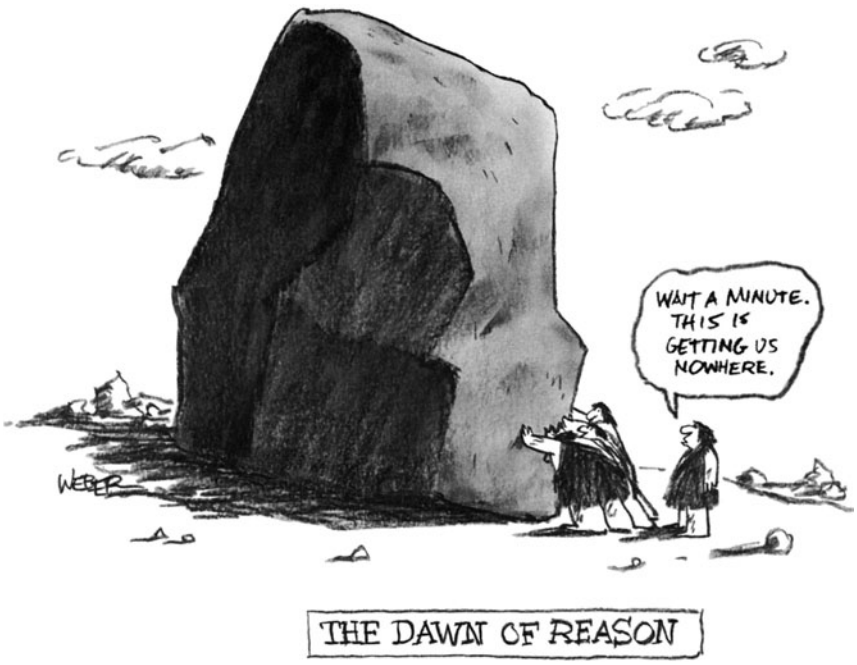
Teacher tenure is a problem. Teacher tenure is a solution. Fracking is safe. Fracking causes earthquakes. Our kids are overtested. Our kids are not tested enough.

We read claims like these in the newspaper every day, often with no justification other than "it feels right." How can we figure out what *is* right?

Escaping from the clutches of truthiness begins with one simple question: "what's the evidence?" With his usual verve and flair, Howard Wainer shows how the skeptical mind-set of a data scientist can expose truthiness, nonsense, and outright deception. Using the tools of causal inference he evaluates the evidence, or lack thereof, supporting claims in many fields, with special emphasis in education.

This wise book is a must-read for anyone who's ever wanted to challenge the pronouncements of authority figures and a lucid and captivating narrative that entertains and educates at the same time.

Howard Wainer is a Distinguished Research Scientist at the National Board of Medical Examiners who has published more than four hundred scholarly articles and chapters. This is his twenty-first book. His twentieth book, *Medical Illuminations: Using Evidence, Visualization and Statistical Thinking to Improve Healthcare* was a finalist for the Royal Society Winton Book Prize.



THE DAWN OF REASON

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Truth or Truthiness

Distinguishing Fact from Fiction by Learning to Think Like a Data Scientist

Howard Wainer

National Board of Medical Examiners

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To Linda
and
Sam & Jennifer
and
Laurent, Lyn & Koa

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Public education touches everyone. We all pay for it through our local property taxes and almost all of us have partaken of it ourselves as well as through our children. Yet it is hard to think of any other area of such a broad-based activity that is so riddled with misconceptions borne of truthiness. In this section we will examine five different areas in which public opinion has been shaped by claims made from anecdotes and not from

evidence. Each chapter describes a claim and then presents widely available evidence that clearly refutes it. This section is meant as a consilience in which the methods introduced and illustrated in sections I and II are used to reinforce an attitude of skepticism while providing an evidence-based approach to assessing the likelihood of the claims being credible.

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In the 2010 U.S. Census, it cost about forty dollars for each person counted. This seems like an extravagant amount because changes in the population of the United States can be accurately estimated by noting that it increases by about one person every thirteen seconds. Yet the price is sensible because of the many small area estimates that Census data provide. In this chapter we examine the costs of testing in this same light and conclude that the opportunity costs of too long tests are likely extensive enough that they may be impeding progress in a serious way.

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Preface and Acknowledgments

There have been many remarkable changes in the world over the last century, but few have surprised me as much as the transformation in public attitude toward my chosen profession, statistics – the science of uncertainty. Throughout most of my life the word *boring* was the most common adjective associated with the noun *statistics*. In the statistics courses that I have taught, stretching back almost fifty years, by far the most prevalent reason that students gave for why they were taking the course was "it's required." This dreary reputation nevertheless gave rise to some small pleasures. Whenever I found myself on a plane, happily involved with a book, and my seatmate inquired, "What do you do?" I could reply, "I'm a statistician," and confidently expect the conversation to come to an abrupt end, whereupon I could safely return to my book. This attitude began to change among professional scientists decades ago as the realization grew that statisticians were the scientific generalists of the modern information age. As Princeton's John Tukey, an early convert from mathematics, so memorably put it, "as a statistician, I can play in everyone's backyard."

Statistics, as a discipline, grew out of the murk of applied probability as practiced in gambling dens to wide applicability in demography, agriculture, and the social sciences. But that was only the beginning. The rise of quantum theory made clear that even physics, that most deterministic of sciences, needed to understand uncertainty. The health professions joined in as *Evidence-Based Medicine* became a proper noun. Prediction models combined with exit polls let us go to sleep early with little doubt about

election outcomes. Economics and finance was transformed as "quants" joined the investment teams and their success made it clear that you ignore statistical rigor in devising investment schemes at your own peril.

These triumphs, as broad and wide ranging as they were, still did not capture the public attention until Nate Silver showed up and starting predicting the outcomes of sporting events with uncanny accuracy. His success at this gave him an attentive audience for his early predictions of the outcomes of elections. Talking heads and pundits would opine, using their years of experience and deeply held beliefs, but anyone who truly cared about what would happen went to FiveThirtyEight, Silver's website, for the unvarnished truth.

After Nate Silver my life was not the same. The response to my declaration about being a statistician became "Really? That's way cool!" The serenity of long-distance air travel was lost.

As surprising as this shift in attitudes has been, it is still more amazing to me how resistant so many are to accepting evidence as a principal component in deciding between conflicting claims. I chalk this up to three possible reasons:

1. A lack of understanding of the methods and power of the Science of Uncertainty.
2. A conflict between what is true and what is wished to be true.
3. An excessive dimness of mind that prevents connecting the dots of evidence to yield a clear picture of likely outcome.

The first reason is one of my principal motivations in writing this book. The other was my own enthusiasm with this material and how much I want to share its beauty with others.

The second reason was reflected in Upton Sinclair's observation, "It is difficult to get a man to understand something, when his salary depends upon his not understanding it!" We have seen how senators from coal-producing states are against clean air regulations; how the National Rifle Association believes, despite all evidence (see Chapter 11), that more guns will lower the homicide rate; and how purveyors of coastal real estate believe that rising seas accompanying global warming are a pernicious myth.

The third reason is a late addition to my list, and would be unfair, if the observed behavior could be explained with reason two. But I was

forced to include it when, on Thursday, February 26, 2015, Senator Jim Inhofe (Republican from Oklahoma, who is Chairman of the Senate Environment and Public Works Committee) brought a snowball onto the floor of the senate as proof that reactions to evidence about global warming are hysterical, and the report that 2014 was the warmest year on record was anomalous. What could explain Senator Inhofe's statements? It could be (1), but as a senator he has been privy to endless discussions by experts with exquisite pedigrees and credentials, which anyone with any wit would be forced to acknowledge as credible. It could be (2) if, for example, his principal supporters were in the petroleum industry, whose future would be grimmer if the nation were to take seriously the role that the burning of such fuels has on global warming. I note that three of the five billionaires in the state of Oklahoma (Harold Hamm, George Kaiser, and Lynn Schusterman) owe their fortunes to the oil and gas industry. That being the case, it isn't surprising that Senator Inhofe might owe some allegiance to the welfare of their financial interests. What makes him a possible candidate for the third category is his apparent belief that his argument would burnish his national reputation rather than making him a punchline on newscasts and late-night TV. I am reminded of Voltaire's prayer "Dear God, make my enemies ridiculous." He knew that politicians can endure anything but the sorts of ridicule that renders them a joke. That Senator Inhofe would purposely place himself into such a position suggests including him in category (3).

Senator Inhofe is not alone on such a list. I would probably want to also include then-senator (now governor) Sam Brownback (Republican from Kansas), former governor Mike Huckabee (Republican from Arkansas), and Representative Tom Tancredo (Republican from Colorado) who, in a 2007 presidential debate all raised their hands to indicate their lack of belief in evolution. It isn't hard to find other possible candidates.[1]

[1] Michelle Bachmann, a six-term congresswoman from Minnesota comes immediately to mind for her avid support of the teaching of creationism in schools, whose appeal to fundamentalist members of her constituency would seem to provide evidence to place her more firmly in (2). Yet, the behavior she exhibited that earned a place on a number of "2013 most corrupt" lists (being under investigation by the Federal Election Commission, House Ethics Committee, and Federal Bureau of Investigation for violating campaign finance laws while running for president by improperly paying staff from her leadership Political Action Committee and using her campaign resources to promote her memoir) suggests she holds a belief in her own invincibility that makes (3) a more likely explanation

I thoroughly understand that no presentation, no matter how lucid, no matter how compelling, can have a direct effect on diminishing either (2) or (3). However, I have hopes that some indirect help can be had by improving the statistical literacy of the general population. The greater the proportion of the population that can detect deceptive, fact-free arguments and hence not be swayed by them, the less effective such arguments will become. I do not believe that this will result in those people whose arguments are based on truthiness changing to another approach. My hopes lie in an educated electorate choosing different people. Paraphrasing Einstein, "old arguments never die, just the people who make them."

I have recently become haunted by lasts. We are usually immediately aware of the firsts in our lives: our first car, first love, first child. We typically become aware of lasts only well after the event; the last time I spoke with my father, the last time I carried my son on my shoulders, the last time I hiked to the top of a mountain. Usually, at least for me, the realization that a last has occurred yields a sense of loss, a deep regret. Had I known it was the last time I would ever speak with my grandfather there are some things I would have liked to have spoken about. Had I known it was the last time I would see my mother I would have told her how much I loved her.

As you read this, I will be well passed the biblically prescribed life span of three-score and ten. Although this is surely my latest book, it might very well be my last. To minimize my future regrets, I want to be especially careful to thank all of those who have contributed both to this specific work and to the more general, and more difficult, task of shaping my thinking.

I begin with my employer, the National Board of Medical Examiners, which has been my professional home since 2001 and has provided a place of peace, quiet, and intellectual stimulation. The modern character of the National Board, a century-old institution, has largely been set by Donald Melnick, its longtime president, whose vision of the organization included room for scholarship and basic research. My gratitude to him and to the organization he leads is immense.

Next, I must thank my colleagues at the National Board beginning with Ron Nungester, senior vice president, and Brian Clauser,

vice president, who have always provided support and a thoughtful response to any questions I might have had – both procedural and substantive. In addition, my colleagues Peter and Su Baldwin, Editha Chase, Steve Clyman, Monica Cuddy, Richard Feinberg, Bob Galbraith, Marc Gessaroli, Irina Grabovsky, Polina Harik, Michael Jodoin, Peter Katsufrakis, Ann King, Melissa Margolis, Janet Mee, Arden Ohls, and Peter Scoles have all endured frequent visits in which I either inquired their opinion on some matter of concern to me at the moment, or sat through my explanations of one obscure thing or another. These explanations would typically continue until I decided that I had, at long last, understood what I was talking about. Sometimes this took a long time. I thank them all for their ideas and their forbearance.

Over the course of the past half-century many intellectual debts have accumulated to friends and colleagues who have taught me a great deal. I have neither space nor memory enough to include everyone, but with those limitations in mind, my major benefactors have been: Leona Aiken, Joe Bernstein, Jacques Bertin, Al Biderman, Darrell Bock, Eric Bradlow, Henry Braun, Rob Cook, Neil Dorans, John Durso, Steve Fienberg, Paul Holland, Larry Hubert, Bill Lichten, George Miller, Bob Mislevy, Malcolm Ree, Dan Robinson, Alex Roche, Tom Saka, Sam Savage, Billy Skorupski, Ian Spence, Steve Stigler, Edward Tufte, Xiaohui Wang, Lee Wilkinson, and Mike Zieky.

A very special thinks to David Thissen, my once student, longtime collaborator, and very dear friend.

Next, a mystery. I spent three years as a graduate student at Princeton University acquiring my academic union card. Under ordinary circumstance one would expect that those three years would not have a very different effect on my life than any number of other time periods of similar length. But, that does not seem to have been the case. On a regular basis in the forty-seven years since I left her campus I have been in need of guidance of one sort or another. And unfailingly, before I could flounder for too long, a former Tiger appeared and gave me as much assistance as was needed. Those most prominent in my continued education and productivity are:

John Tukey *39, Fred Mosteller *46, Bert Green *51, Sam Messick *56, Don Rubin ‘65, Jim Ramsay *66, Shelby Haberman ‘67, Bill Berg *67,

Linda Steinberg S*68 P07, Charlie Lewis *70, Michael Friendly *70, Dave Hoaglin *71, Dick DeVeaux '73, Paul Velleman *75, David Donoho '79, Cathy Durso '83, and Sam Palmer '07.

What's the mystery? A quick glance through this list shows that only about four or five were on campus at the same time I was. How did I get to meet the others? For example, I have collaborated with Hoaglin and Velleman for decades and we have yet to be able to recollect where, when, or how we met despite a fair amount of discussion. The only theory that seems to hold water is that Mother Princeton, has decided to take care of her progeny and has somehow arranged to do so. Whatever the mechanism, they and she have my gratitude.

Last, to the staff at Cambridge University Press, the alchemist who has transformed the digital bits and pieces of my manuscript into the handsome volume you hold in your hand now. *Primus inter pares* is my editor, Lauren Cowles, who both saw the value in what I was doing and insisted that I continue rewriting and revising until the result lived up to the initial promise that she had divined. She has my sincerest thanks. In addition, I am grateful for the skills and effort of copy editor Christine Dunn, indexer Lin Maria Riotta and Kanimozhi Ramamurthy and her staff at Newgen Knowledge Works.