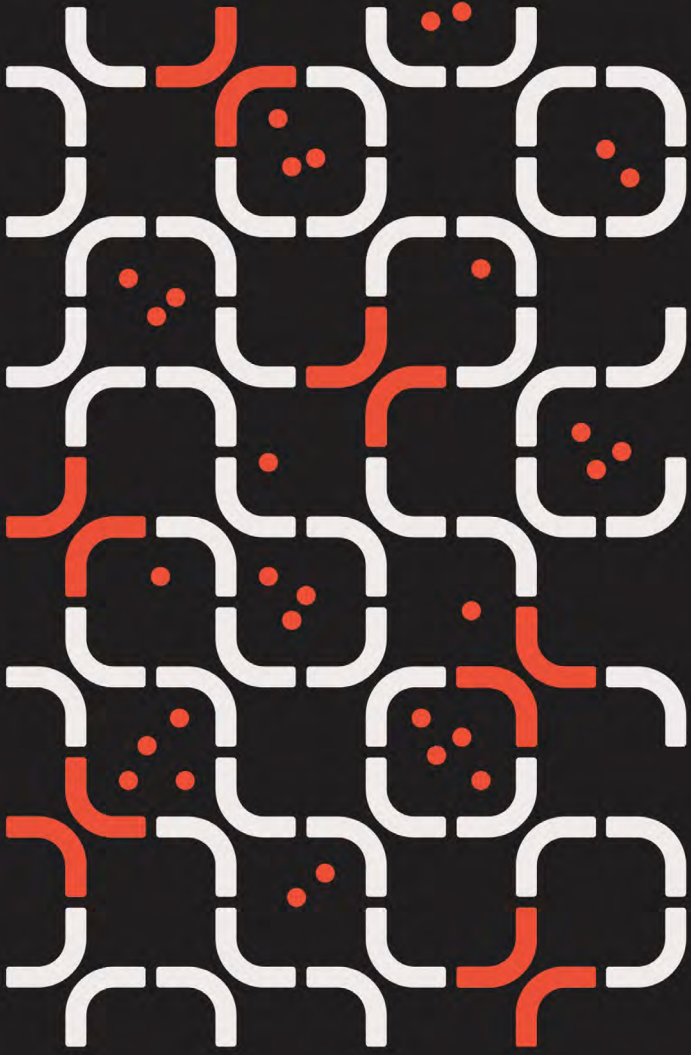
Statistics and Faith

A Christian Guide to Telling the Truth with Data



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ivp | InterVarsity Press
ivpress.com

Published by InterVarsity Press, Downers Grove, IL.

www.ivpress.com

Contents

1

On the History of Statistics

Please inquire of past generations,
And consider the things searched out by their fathers.
For we are only of yesterday and know nothing,
Because our days on earth are as a shadow.
Will they not teach you and tell you,
And bring forth words from their minds?

Job 8:8-10

Characteristically, textbooks of science contain just a bit of history, either in an introductory chapter or, more often, in scattered references to the great heroes of an earlier age. . . . For reasons that are both obvious and highly functional, science textbooks . . . refer only to that part of the work of past scientists that can easily be viewed as contributions to the statement and solution of the texts' paradigm problems. Partly by selection and partly by distortion, the scientists of earlier ages are implicitly represented as having worked upon the same set of fixed problems and in accordance with the same set of fixed canons that the most recent revolution in scientific theory and method has made seem scientific. No wonder the textbooks and the historical tradition they imply

> *have to be rewritten after each scientific revolution. . . . More historical detail, whether of science's present or of its past, or more responsibility to the historical details that are presented, could only give artificial status to human idiosyncrasy, error, and confusion. Why dignify what science's best and most persistent efforts have made it possible to discard?*
>
> Thomas Kuhn, *The Structure of Scientific Revolutions*

While growing up, I usually found history to be a little interesting, but that was about it. It didn't grip me. For example, in eighth grade I remember walking into our classroom confronted with three entire blackboards of notes on US history that we had to write down. We did this four days a week! The payoff was that on Fridays we got to watch an episode from a TV drama that chronicled US history. In twelfth grade my history teacher was the head football coach, and unfortunately he would sometimes save his personal time by taking an entire class day to read out individual students' grades to them ("as a check") while simultaneously calculating their grades on his calculator. (Too bad he didn't have a spreadsheet or stats software.) To me, history seemed like a bunch of old and disconnected facts and stories that may or may not be particularly relevant to my life. I'm not criticizing any of my teachers—they were good—it's just the way I somehow came to view the subject.

Thankfully in college I came to realize that the different parts, peoples, and periods of history were all connected—which I now find fascinating and pointing to a grander purpose for humanity and the world. Unfortunately, as a math major, I had only one semester of world history and a few on biblical history. Later, when my daughters were in high school, we were discussing the deficiencies in my history

education, and they recommended I read the four-volume *The Story of the World: History for the Classical Child*, which my wife had read to them in elementary school.[1] That was the genesis of my historical synthesis journey. As a part of my trek, I hung a forty-foot synchronological timeline of world history from creation to 1900 on my office wall and conceived this chapter.[2]

While researching this chapter, I did a deep dive into the often compelling personal stories and historical contexts of the developers of statistics. But given the need for brevity here, I narrowed my focus to the ideas, omitting much of the personal and cultural background. As explained in this chapter's epigraph by Thomas Kuhn from his classic *The Structure of Scientific Revolutions*, typical history writing must include the cultural context and something of the lives of the figures. By contrast, history of science strips those things out, starts at the beginning of the most recent paradigm, and simply tells the history of the concept.

That is what I have done, in part. However, I am not a historian of science and refuse to be bound by that approach alone. There are many lessons that can and should be learned from the figures in history. This is something I personally aspire to as I continue to read and learn in this area. Indeed, there is one critical lesson I share, a glaring omission from contemporary versions of the history of statistics and twentieth-century history in general. I believe this particular lesson has been excluded largely due to its faith implications, and I am happy to reintegrate the historical record here. In this chapter I begin with a summary of the four eras of Statistics, as summarized in table 1.1. Next is a poignant lesson on the role of ideology on the morality of statistical applications through a look at the dark side of the work of some of the founding fathers of Statistics. To close, we will reflect on the interplay between statistics, truth, and morality and draw lessons.

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[1]Susan Wise Bauer, *The Story of the World: History for the Classical Child*, 4 vols. (Peace Hill, 2001).

[2]Sebastian C. Adams, *Adams' Synchronological Chart or Map of History* (Cincinnati, 1871).

Statistics and Morality

If Statistics seeks to discover truth, and Statistics must follow ethical principles, then is there moral law from which ethics ought to be derived? The Bible, as well as all the major world religions, teach that there is. Society agrees statisticians and data scientists must follow a code of ethics, as with every field. If so, it behooves us to know and understand the moral laws of the universe not only to do statistics properly but to live properly. But it is the purview of faith and philosophy, not Statistics and science, to discover what is moral. *In this chapter, we discuss a tragic episode in history where some of the most famous statisticians lost their moral compass, with devastating consequences.*

The History of Statistics

There is no single, objective history of Statistics. There are only four major authors who cover the critical years from 1750 to 1900, more or less, along with assorted authors who take on narrower slices of the history.[3] None attempts to cover ancient times through modern. None attempts to concisely distill the entire history of statistics into a single diagram. Necessarily, therefore, we must be concise and trace only the key threads. Our guide for deciding what to include will be our working statement about Statistics, "the discipline that seeks to discover the truth about the world through data." To begin, I summarize the history of Statistics into four eras (see table 1.1).

[3]Interestingly, the first two wrote at the end of the second era: Isaac Todhunter, *A History of the Mathematical Theory of Probability: From the Time of Pascal to That of Laplace* (Cambridge, UK, 1865); Karl Pearson, *The History of Statistics in the 17th and 18th Centuries: Against the Changing Background of Intellectual, Scientific and Religious Thought*, ed. E. S. Pearson (University College London, 1921). The second two wrote at the end of the third era: Stephen M. Stigler, *The History of Statistics: The Measurement of Uncertainty Before 1900* (Harvard University Press, 1986). Anders Hald, *A History of Probability and Statistics and Their Applications Before 1750* (Wiley, 1990); Hald, *A History of Mathematical Statistics from 1750 to 1930* (Wiley, 1998); Hald, *A History of Parametric Statistical Inference from Bernoulli to Fisher, 1713–1935* (Springer, 2004).

Table 1.1. The four eras of the history of Statistics

Era	Dates	Name	Description
1	creation–1542	state arithmetic	ancient civilizations taking censuses of populations, births, deaths, etc.
2	1543–1859	mathematical and conceptual transitions	the development of a probability-based mathematical theory for assessing the likelihood of outcomes in any domain of application
3	1860–1959	statistical revolution	the perfection of the mathematical theory into inferential statistics, and its spread to all academic disciplines, areas of business, and branches of government
4	1960–present	computer-powered statistics	the emergence of computers permits the development of more sophisticated and powerful statistical algorithms, the acquisition of more data, and the democratization of data analysis to more people

First era (creation to AD 1542): State arithmetic. The first era starts with our earliest numerical records through the dawn of the scientific revolution. Think of ancient Egypt and the reckoning of laborers and stones and equipment and food necessary for the construction of the great pyramids. Think of Alexander the Great and his armies accounting for the numbers of men, food, weapons, and horses needed to accomplish his military objectives. Think of Roman Emperor Caesar considering the number of provinces, their populations, and their mileage to construct roads and aqueducts. How about the Chinese Han Dynasty and its sophisticated bureaucracy, maintaining comprehensive income records of households, population numbers, land ownership, and wealth distribution? Or ancient India's Gupta Empire and its detailed record keeping and data collection on population, agriculture, and trade to inform decisions about taxation? And let's not forget the medieval church with its

birth and death records to keep track of the population for supplying food and treating disease.

What was common to all these ancient uses is that the mathematical objective was to collect the entire population, a census, with the political objective of effective governance. Whether "effective" was from the perspective of rulers or subjects, benevolent or totalitarian, varied by civilization and age. Although the practice of gathering data for decision-making goes back to the ancients, the term *statistics* = **state arithmetic** did not arise in our sense until the nineteenth century. Statistics was state arithmetic because the only entities collecting data were organized governments. In a curious twist of history, the term was originally coined around 1639 in Germany for things connected with the state. However, that school of thought died out, and in England in 1798 Sir John Sinclair unwittingly "quietly transferred the word statistics to Political Arithmetic [State Arithmetic], where it has stuck."[4]

Second era (1543–1859): Mathematical and conceptual transitions. The scientific revolution of 1543–1687 marks the transition to the second era of Statistics. There was a shift from Aristotelian science to Galilean science, that is, rationalism to empiricism. Aristotle said, "Heavier objects fall faster than lighter objects," and Galileo replied, "No, they don't, and I'll prove it!"[5] He climbed the leaning Tower of Pisa and dropped something like a marble and a bowling ball, and they landed at the same time according to his student Vincenzo Viviani.[6] Two of the numerous effects of the revolution were the development of probability theory and broader applications of mathematics, which ultimately converged into the foundation of modern statistics.

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[4]Pearson, *History of Statistics*, 125-26.

[5]"A given weight moves a given distance in a given time; a weight which is as great and more moves the same distance in a less time, the times being in inverse proportion to the weights. For instance, if one weight is twice another, it will take half as long over a given movement." Aristotle, *On the Heavens*, trans. W. K. C. Guthrie, Loeb Classical Library (Harvard University Press, 1939), 1.6.

[6]Vincenzo Viviani, *Vita Di Galileo Galilei* (Florence, 1717).

On the applicational front, here are five examples of statistical methodologies that were uniquely developed and employed in groundbreaking ways to either found or significantly affect disciplines in ways felt to this day. First, in 1662 English John Graunt and William Petty used the weekly "Bills of Mortality" to calculate the first mortality tables—a record of the proportion of the population living/dying by age.[7] This example of early demography came to be referred to as political arithmetic. It was the genesis of contemporary actuarial science used by insurance companies. Second, this kind of thinking was picked up by famous economist Adam Smith, who published *The Wealth of Nations* in 1776. In it, he drew on available demographic, trade, wage, and fiscal data to support his theories on wealth creation, labor, and markets. Third, in astronomy, in 1740 French Jacques Cassini compiled known observations from two millennia of the inclination of the earth's equator to its orbit about the sun to determine whether the angle had changed over time.[8] This is an example of the kinds of data used by astronomers, who developed the method of least squares and curve fitting for their orbit work.[9] Fourth, Belgian sociologist and statistician Adolphe Quetelet, circa 1850, developed the body mass index (BMI), advocated for the "average man" in measurement, and used statistical techniques to analyze social behaviors such as crime rates and marriage patterns. Fifth, in 1854, John Snow famously used data and a map to identify the source of the cholera outbreak in London as a contaminated water pump on Broad Street, thereby becoming one of the founding fathers of epidemiology. What is common to each of these five applications is that the mathematical techniques developed within these diverse fields stayed within their fields.

[7]Norman L. Johnson and Samuel Kotz, *Leading Personalities in Statistical Sciences*, Probability and Statistics (Wiley & Sons, 1997), 36-40.

[8]Stigler, *History of Statistics*, 5-6. Stigler reproduces the table, which includes measurements from Eratosthenes in 230 BC through the Paris Observatory in AD 1738.

[9]Interestingly, while the mean is intuitive to us today, which combines information across measurements, these astronomers were loath to combine measurements for fear of corrupting their careful work with the impurities of lower quality measurements (Stigler, *History of Statistics*, 4).

Switching from applications to theory, on the probability front, in 1654 French Pierre de Fermat initiated the famous correspondence with Blaise Pascal wherein their discussion of solutions to gambling problems laid the groundwork for probability theory. The famous bell curve (normal distribution) formula was derived by Abraham De Moivre in 1733, with an early version of the fundamental theorem of statistics, which says that arithmetic means tend to the bell curve as the sample size increases.[10] In 1764, a posthumous publication of the English Rev. Thomas Bayes credits him with discovering inverse probability, later to become the celebrated Bayes' theorem. The French Pierre de Laplace independently discovered it in 1774 and developed the initial mathematics of inverse probability.

As previously described, astronomers were attempting to fit their observed data to Keplerian orbits and analyzing the differences, or "errors," using least squares. Laplace in France and Carl Friedrich Gauss in Germany pursued the question of whether there exists a probability distribution whose expected center is the average (i.e., arithmetic mean) according to inverse probability. Gauss discovered the answer is yes—the normal distribution/bell curve—in 1809. Laplace recognized his technology lacked the computational power necessary for practical use of the computationally intensive inverse probability method, so in 1811 he abandoned it and developed what has come to be known as frequentist large-sample theory. Gauss followed suit in 1816, as did their successors, and the frequentist approach is still the dominant approach in use today. They proceeded to develop multivariable estimates for means, standard deviation, correlation, and other statistics. In the next fifty years, other mathematicians systematized and extended their work to what is known as core normal distribution sampling theory.[11]

Third era (1860–1959): Statistical revolution. The third era of Statistics began with men in two different disciplines who for the first time took statistical methods that had been developed in other

[10]In the literature, the fundamental theorem of statistics is called the *central limit theorem*.
[11]See Hald, *History of Mathematical Statistics*, 1-6.

disciplines and applied them to their own. The first was experimental psychology, where in 1860 German Gustav Fechner borrowed astronomers' analysis of measurement errors due to which astronomer was using the telescope and applied it to his research on sensory perception.[12] Next was English Francis Galton, who aspired to do for biology what Newton did for physics. In 1877 Galton took least squares, redeveloped it as linear regression, and applied it to biological problems such as inherited physical traits. He conceptualized and named the "co-relation" (correlation) coefficient. He obtained Karl Pearson's assistance in deriving it, hence "Pearson's correlation coefficient."[13] This was the beginning of the statistical revolution—when Statistics transformed from state arithmetic to the mathematical discipline that could take a mere sample from an entire population and accurately infer its characteristics (inferential statistics).

The next period of the third era was to build out the theory and propagate it. Galton, independently wealthy, funded the first Statistics journal, *Biometrika*. This became a catalyst for collecting and disseminating statistical ideas. The editor of the journal was Galton's friend Karl Pearson, then professor of applied mathematics at University College, London. Upon Galton's death in 1911, he endowed the first Statistics department in the world at University College, chaired by Pearson. Only the name of the chair was not actually Statistics; it was the Galton Chair of National Eugenics (see more in the next section). According to the University College London's website, Galton's "Eugenics Record Office was later combined with Karl Pearson's Biometric Laboratory, to form what came to be the Galton Laboratory."[14] This became the catalyst for the development of statistical theory through the ability to test it on diverse kinds of data. As a prime example, in 1908 William Gossett used Biometric Laboratory data in solving the problem of estimating probabilities when sample sizes

[12]Stigler, *History of Statistics*, 243-44.

[13]Johnson and Kotz, *Leading Personalities in Statistical Sciences*, 109-10.

[14]Johnson and Kotz, *Leading Personalities in Statistical Sciences*, 110. See the modern department's concise history statement on its webpage, "Our Early History," University College London, www.ucl.ac.uk/mathematical-physical-sciences/our-early-history.

were too small and the fundamental theorem of statistics didn't apply. The result was his famous paper under the pseudonym "Student."[15]

In the 1920s, R. A. Fisher discovered the principles of experimental design—how to extract the optimum amount of information from an experiment for the given resources. These principles were codified in his famous *Statistical Methods for Research Workers* and *The Design of Experiments*.[16] The above developments were specific instances of inferential statistics methods. Karl's son, Egon Pearson, and Polish Jerzy Neyman formulated the modern hypothesis testing and confidence interval paradigms, which provided a general probability theoretical framework for those methods that had been developed as well as many more to come.[17]

Definitions of Statistics

Adolphe Quetelet, 1849: "Statistics has then for its object that of presenting a faithful representation of a state at a determined epoch."[a]

Karl Pearson, 1921: "Statistics is the application of mathematics to the interpretation of mass observations."[b]

R. A. Fisher, 1925: "Statistics may be regarded as (i) the study of populations, (ii) as the study of variation, (iii) as the study of methods of the reduction of data."[c]

M. J. Moroney, 1951: "Historically, Statistics is no more than State Arithmetic, a system of computation by which differences between individuals are eliminated by the taking of an average."[d]

[a]Adolphe Quetelet, *A Treatise on Man and the Development of His Faculties*, trans. Robert Knox (William and Robert Chambers, 1842), 179.
[b]Karl Pearson, *The History of Statistics in the 17th and 18th Centuries: Against the Changing Background of Intellectual, Scientific and Religious Thought*, ed. E. S. Pearson (University College London, 1921), 126.
[c]R. A. Fisher, *Statistical Methods for Research Workers* (Oliver & Boyd, 1925), 1.
[d]M. J. Moroney, *Facts from Figures* (Penguin Books, 1951), 1.

[15]Johnson and Kotz, *Leading Personalities in Statistical Sciences*, 327-28.
[16]R. A. Fisher, *Statistical Methods for Research Workers* (Oliver & Boyd, 1925); Fisher, *The Design of Experiments* (Oliver & Boyd, 1935). There were thirteen subsequent editions of *Statistical Methods for Research Workers* published from 1928 to 1970.
[17]Johnson and Kotz, *Leading Personalities in Statistical Sciences*, 138-39.

The period from the 1930s through the end of the century saw valuable niche developments in statistical theory but not major new paradigms or branches.[18] The explosive progress was application of the methods to the academic disciplines, industry, business, and government. There was scarcely an academic discipline that did not have substantive penetration of statistical applications. Industry saw the development of such things as quality improvement through designed experiments and quality control through control charts. Businesses increasingly collected data in spreadsheets and used it to calculate statistics and make graphs for decision-making. In the US government there arose thirteen independent statistical agencies.[19]

Fourth era (1960 to present): Computer-powered statistics. The fourth era of Statistics began with the widespread availability of computers. Around 1960, mainframe computers became widely available for academic and private researchers. In 1975, the first personal computer became available.[20] There had previously been developed certain algorithmic methods to solve statistics problems that were previously infeasible due to the lack of fast and accurate computing capabilities. With computers in play, statisticians dusted off those methods and began to develop them as well as new ones. Remember Bayes' theorem of inverse probability? Statisticians picked up where Laplace and

[18]For those interested in reading about the developments within Statistics in the twentieth century, I highly recommend the fun and readable account of someone who lived it and knew many of the figures: David Salsburg, *The Lady Tasting Tea: How Statistics Revolutionized Science in the Twentieth Century* (Holt Paperbacks, 2002).

[19]The agencies are designed to be independent and therefore apolitical and unbiased, able to contribute to the health of the government and society. By contrast, most other countries with statistical agencies have one central agency. The thirteen statistical agencies in the US government are each related to a larger department. They are the Bureau of Economic Analysis; Bureau of Justice Statistics; Bureau of Labor Statistics; Bureau of Transportation Statistics; Census Bureau; Energy Information Administration; Economic Research Service; National Agricultural Statistics Service; National Center for Education Statistics; National Center for Health Statistics; National Center for Science and Engineering Statistics; Office of Research, Evaluation, and Statistics; and Statistics of Income. The American Statistical Association monitors the health of these agencies at "Assessing the Health of the Principal Federal Statistical Agencies," American Statistical Association, www.amstat.org/policy-and-advocacy/assessing-the-health-of-the-principal-federal-statistical-agencies.

[20]See "Dates in History," Center for Computing History, accessed December 4, 2024, www.computinghistory.org.uk/cgi/computing-timeline.pl.

Gauss left off, and the paradigm of Bayesian statistics has become, for some, an alternative to the classical frequentist paradigm.[21]

The power of iterating algorithms was exploited to solve otherwise intractable problems, such as curve fitting. The law of large numbers was exploited with simulation-based methods, commonly referred to as "Monte Carlo methods," named after the famous gambling district in the city-state of Monaco, bordering France (see chap. 3 for a description of the law of large numbers and how it is applied). In 1979 Stanford's Brad Efron unveiled the bootstrap method, which is a Monte Carlo approach to finding confidence intervals and hypothesis test results (p-values) for not only the classical cases but also cases in which the usual conditions are not met.[22] Efron was awarded the National Medal of Science by President George W. Bush in 2005 for this discovery.

In the early 2000s, technology had progressed to the point where ever larger quantities of data were being captured. There were microarrays, which could record the level of expression of every gene in an organism on 1 or 2 cm^2 wafers. There was the burgeoning internet, with its millions of sites and traffic flows. There was the proliferation of sensors on machines in factories that could monitor output and function at thousands of time points per second. Then came cellphones and social media and diverse apps including personal monitoring. I could go on—but these technological developments led to our present era of **big data**, when the size of the data set is too large for your computer to process. One of the often overlooked characteristics of big data is that for the most part, it is not designed. This is in stark contrast to the breakthrough theory and methodologies for designed experiments pioneered by Fisher in the third era.

Big data has multiple implications. Statisticians responded to it by pursuing enhanced, or new, methodologies.[23] They also studied the limitations, pitfalls, and quantification of the uncertainty due to this

[21] Many, including me, pragmatically apply the most suitable method to the problem at hand, whether frequentist or Bayesian.

[22] Bradley Efron, *Bootstrap Methods: Another Look at the Jackknife* (Springer, 1979).

[23] That includes my own dissertation research: Jason Wilson, "On the Probability of Correct Selection When k Is Large" (PhD diss., University of California, Riverside, 2008).

kind of data. Such solutions were not entirely satisfactory to the end users. At the same time, the increased quantity and number of data possessors in need of analysis meant there were not enough statisticians to meet the need. This is where computer scientists entered the scene, and their offspring, the **data scientist**, was born. A data scientist is one whose training is in this broad data space but definitively includes some statistics and some computer science.

In the third era, statistical training occurred primarily in graduate programs, and Statistics was done by master's students and PhDs. In the fourth era, the statistical revolution having been completed, introductory Statistics courses came down to the undergraduate level and spread through the disciplines—biostatistics, business statistics, psychological statistics, sociological statistics, engineering statistics, and the non-domain-specific Introduction to Probability and Statistics for anyone else who wanted to take it. In the United States in the early 1990s, Statistics began to trickle down into the K-8 curriculum. In 1997 the first AP Statistics course began.

On November 30, 2022, ChatGPT was made publicly available to the world by OpenAI for free. It is an artificial intelligence (AI) program that runs on a statistical algorithm called a neural network. Others have since followed, and the race is on among the tech industry and wealthy governments to see who can gain dominance in the AI field. Neural networks were conceived in the 1940s but weren't viable until a conceptual breakthrough in the 1980s. They basically take multiple regression, the fruit of second-era classical Statistics, and repeatedly iterate it on a computer so that it is not one regression but dozens of layers of nested regressions that permit literally trillions of parameters as of the writing of this book. As amazing and powerful as AI programs are, they are merely highly sophisticated algorithms that use really powerful computers to do tons of calculations really fast and therefore use a lot of energy.

We have just completed a thirty-thousand-foot view of the four eras of the history of Statistics, which are summarized in table 1.1. With the contours of history in place, and Kuhn's quotation about divorcing histories of science from their context in mind, we now fly

down and take a closer look at the culture and thinking of some of the leading statisticians of the third era in order to make some faith observations and discuss the interplay of statistical practice, truth, and morality. As we are flying down, I'd like to note that Galton, Pearson, and Fisher were all geniuses, they all have fascinating stories, and they were some of my statistical heroes whom I loved to teach about before I learned about their dark side. . . .

The Early 1900s and Eugenics

In 1858 Charles Darwin published his famous *The Origin of Species*. Although the idea was not new, it reflected the Enlightenment pushback on traditional Christianity by providing a scientific theory that different species were not created by God but rather emerge naturally through "survival of the fittest" over long periods of time. With the rediscovery of Mendelian genetics around 1890, the previously fuzzy idea that traits were inherited from parents gained a scientific footing. These ideas became the foundation for a scientific theory of social Darwinism called **eugenics**. If you haven't heard of eugenics, it may be because of a corporate cultural desire to forget it ever happened.

Darwinism bore the seeds of a scientific version of racism that blossomed into eugenics. Here are a few quotes:

> The Western nations of Europe now so immeasurably surpass their former savage progenitors, that they stand at the summit of civilisation. . . . The remarkable success of the English as colonists compared to other European nations has been ascribed to their "daring, practical energy, and undaunted spirit of enterprise," and these are mainly the results of natural selection.[24]

> At some future period, not very distant as measured by centuries, the civilised races of man will almost certainly exterminate and replace the savage races throughout the world. At the same time the anthropomorphous apes . . . will no doubt be exterminated. The break between man and his nearest allies will then be wider, for it will

[24]Charles Darwin, *The Descent of Man, and Selection in Relation to Sex*, 2nd ed. (London, 1874), chap. 5.

> intervene between man in a more civilised state . . . and some ape as low as a baboon, instead of as now between the negro or Australian and the gorilla.[25]

Darwin's cousin, our statistical cofounder Francis Galton, advanced thinker that he was, applied his intellectual and scientific and statistical abilities to help found and lead the eugenics movement. He became known as the father of eugenics, and some eugenics societies were even named after him. In Galton's words, eugenics is "the science which deals with all influences that improve the inborn qualities of a race; also with those that develop them to the utmost advantage." After describing ways of presenting it to the public, he writes,

> It must be introduced into the national conscience like a new religion. It has, indeed, strong claims to become an orthodox religious tenet of the future, for eugenics co-operate with the workings of nature by securing that humanity shall be represented by the fittest races. What nature does blindly, slowly, and ruthlessly, men may do providently, quickly, and kindly.[26]

The idea was that all traits—not only physical but intellectual, moral, and so on—are inherited from one's parents. On this point, R. A. Fisher was persuaded that the larger birthrates of poor families (less fit) and the smaller birthrates of wealthy families (more fit) posed a national problem of the degradation of the gene pool.[27] Therefore, eugenicists argued, if humans were to advance, then the passing on of traits should be guided. There are two ways: negative and positive. Negative is through preventing reproduction of "those persons socially inadequate because of defective inheritance," and positive is by promoting the reproduction of those "endowed richly with the

[25]Darwin, *Descent of Man*, chap. 6.

[26]Francis Galton, "Eugenics: Its Definition, Scope, and Aims," *The American Journal of Sociology* 10, no. 1 (1904): 1, 5, www.journals.uchicago.edu/doi/10.1086/211280.

[27]Johnson and Kotz, *Leading Personalities in Statistical Sciences*, 100. While Galton and Pearson were atheists, Fisher was an Anglican, and some have puzzled over his simultaneous commitment to Darwinism and eugenics. Moore addresses the topic in James Moore, "R. A. Fisher: A Faith Fit for Eugenics," *Studies in History and Philosophy of Biological and Biomedical Sciences* 38, no. 1 (March 2007): 110-35, https://doi.org/10.1016/j.shpsc.2006.12.007.

hereditary traits of demonstrated desirability."[28] The negative form was thought to have been instinctively practiced by primitive cultures' practices of infanticide and euthanasia. The positive form was to guide marriage arrangements and encourage reproduction. These core concepts tended to be agreed on by proponents. The third co-founder of Statistics, Galton's friend Pearson, was also an enthusiastic proponent of eugenics even after Galton's death in 1911, as stated on his former department's webpage:

> For example in 1925 he founded the Annals of Eugenics and published in it many articles whose racist content would shock most modern readers. Pearson retired in 1933, handing over the headship of the Statistics Department to his son, Egon Pearson, who also made major contributions to statistical methodology, most notably in his work with Jerzy Neyman on hypothesis testing. Karl Pearson died in 1936, so we will never know what he would have thought of the Nazis' final solution, but he is on record as expressing enthusiasm for Germany's "great experiment" as late as 1933.[29]

One piece of "evidence" cited as justification for racial eugenics conclusions was Samuel George Morton's cranium measurements correlating brain sizes with race. Statistics enters here. Craniometry, the study of skull measurements to infer intelligence and racial differences, was a popular "scientific" pursuit in the nineteenth and early twentieth centuries. Its roots trace back to earlier phrenological studies, but craniometry gained formal legitimacy through the work of researchers such as George Morton and Paul Broca. When Morton, a nineteenth-century American physician, "died in 1851 the *New York Tribune* wrote that 'probably no scientific man in America enjoyed a higher reputation among scholars throughout the world, than Dr. Morton.'"[30] He collected hundreds of skulls from around the world, believing without argument or evidence that cranial capacity

[28]W. S. Evans, *Organized Eugenics* (American Eugenics Society, 1931); Steven Seldon, *Inheriting Shame: The Story of Eugenics and Racism in America* (Teachers College Press, 1999), 23.
[29]"Our Early History."
[30]Stephen Jay Gould, *The Mismeasure of Man* (W. W. Norton, 1981), 51.

directly correlated with intelligence. In his *Crania Americana* (1839), Morton meticulously measured skull volume and claimed that Caucasians had the largest brain capacity, followed by Native Americans and then Africans. His data appeared to support notions of racial superiority. There was one problem. According to Stephen Jay Gould in 1981, "[There are] no significant size differences among the craniums of the differing races. . . . Morton did not lie. He presented all his data; he just misinterpreted them."[31] Cherry-picking the right samples for each group is evident when looking at the published data.[32]

Paul Broca, a prominent French physician and anthropologist, expanded on Morton's work, further cementing craniometry's place in the scientific community. He then emphasized precise measurements and statistical methods, using skull size and brain weight, to argue that intellectual capacity was biologically determined and the larger-brained White European (and male!) was inherently superior. Unfortunately, predetermined conclusions clouded Broca's interpretations. For example, he retained Morton's assumption that higher intelligence correlated with larger brain size. However, when he found larger average brain sizes in some non-Whites, rather than conclude they were superior, he wrote, "A lowly race may therefore have a big brain," and concluded the reasoning worked at the low end but not the upper end.[33] Morton and Broca's data and interpretations provided supposedly statistical and scientific evidence for early eugenics thinking. Their work was used to legitimize policies that sought to control populations based on racial and intellectual criteria.

When the time came to put theory into practice through public policy, disagreements and varying approaches emerged. In the United States, there were the "ugly laws," outlawing the public appearance of people who were "diseased, maimed, mutilated, or in any way deformed, so as to be an unsightly or disgusting object" (in Chicago, 1881). There were forced castrations of psychiatric patients (in Kansas,

[31]Gould, *Mismeasure of Man*, 53-67.
[32]Gould, *Mismeasure of Man*, 54-55.
[33]Gould, *Mismeasure of Man*, 87.

1893). There were also forced sterilization laws passed in many US states, from Indiana in 1907 to Georgia in 1937. I had never heard of these laws in my country and wouldn't have believed it had I not seen the documentation. The online *Eugenics Archives* documents eugenics around the world and includes a detailed timeline with clickable articles.[34] Another public-policy impact came from the birth control movement, led by Margaret Sanger, who founded the American Birth Control League in 1921, which later became Planned Parenthood. She wrote, "Birth control itself, often denounced as a violation of natural law, is nothing more or less than the facilitation of the process of weeding out the unfit, of preventing the birth of defectives or of those who will become defectives."[35]

Why am I writing about all this in a statistics book? Because statistics were used to justify these dehumanizing and racist policies, and some statisticians were the leaders. That is what I mean by the "interplay between statistics, truth, and morality." The story of Carrie Buck furnishes a specific example of the forces in play around that time. Carrie was the daughter of a prostitute who was held in the Colony for Epileptics and Feebleminded. Carrie was pregnant as the result of rape at age seventeen, and her "foster family, close relatives of the assailant in the rape, hoped to hide the attacker's identity from the general public and initiated her commitment." Carrie and her mother tested on the Stanford-Binet IQ test at the mental ages of nine and seven, respectively. Carrie was forcibly sterilized in 1927 under the state's eugenics program, as was her sister Doris. Her case, *Buck v. Bell*, went to the US Supreme Court, where Justice Oliver Wendell Holmes Jr. delivered the opinion, stating, "It is better for all the world, if instead of waiting to execute offspring for crime [that] society prevent those who are manifestly unfit from continuing their kind." The court ruled eight-to-one in favor of the state's right to sterilize individuals deemed unfit to reproduce, a decision that justified

[34]Rob Wilson and Moyra Lang, "Eugenics Archive," August 23, 2024, www.eugenicsarchive.ca.
[35]Margaret Sanger, "Birth Control and Racial Betterment," *The Birth Control Review* (February 1919): 11-12.

thousands of forced sterilizations in the United States. Not only is this a moral tragedy, but we now know that Buck was intentionally falsely diagnosed precisely for the purposes of making a national US test case to promote eugenics policy.[36]

What was so striking to me as I read through the literature was how widespread the movement was. In 1914 *Eugenics: Twelve University Lectures* was published,

> selected among a number given in various universities and colleges throughout the country in the scholastic year of 1912–1913. They were arranged for in the belief that the most necessary step to be taken towards the end of awakening a eugenical conscience, and thus paving the way to an effective operation of public opinion and to wise legislation along eugenical lines, must be that of education. Therefore, the purpose has been to have the subject of eugenics—what it means, what the necessities for it are, and what are its aims—put clearly and forcefully before as many undergraduate student bodies as possible.[37]

Conferences were held, with papers presented by leading intellectuals of the day, including the International Eugenics Congresses of 1912, 1921, and 1932.[38] The third meeting was at the American Museum of Natural History in New York. In the United States in 1914 the first National Conference on Race Betterment was held, with a second the following year.[39] Skimming through the papers, one senses an elitist mindset and an infatuation with an ideology over a truly scientifically verified theory.

The greatest tragedy of all, which woke many people up and finally brought a sharp decline to the movement, was Hitler's Third Reich. It advocated for the logical conclusion of eugenicist thinking: the

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[36]Drawn from Seldon, *Inheriting Shame*, 128-31, and Gould, *Mismeasure of Man*, 335-36.

[37]Lucy James Wilson, *Eugenics: Twelve University Lectures* (Dodd, Mead, 1914), v.

[38]The publications were *Problems in Eugenics: Papers Communicated to the First International Eugenics Congress Held at the University of London, July 24th to 30th, 1912* (Eugenics Education Society, 1912); *Scientific Papers of the Second International Congress of Eugenics: Held at American Museum of Natural History, New York, September 22-28, 1921* (Williams & Wilkins, 1923); *A Decade of Progress in Eugenics: Scientific Papers of the Third International Congress of Eugenics, Held at the American Museum of National History, New York, August 21st-23rd, 1932* (Williams & Wilkins, 1934).

[39]Seldon, *Inheriting Shame*, 7-9.

preservation of a superior race and the eradication of inferior races—the Jews and other "unfit."

> The demand that defective people be prevented from propagating equally defective offspring is a demand of the clearest reason and if systematically executed represents the most humane act of mankind.[40]

> The Reich Citizenship Law aims to ensure the purity of German blood by prohibiting marriages and extramarital relations between Jews and citizens of German or related blood.[41]

> The result of this war will be the complete annihilation of the Jews.[42]

For all its momentum, eugenics was not without its opponents. The Catholic Church was a significant religious force opposing eugenics. The church viewed eugenics as a violation of human dignity and condemned forced sterilization and interference with natural procreation.[43] Franz Boas, an anthropologist, criticized eugenics from a scientific perspective. He rejected the idea of immutable racial differences and emphasized the role of culture and environment in shaping human behavior.[44] Some progressive reformers, particularly those focused on labor rights, social welfare, and civil liberties, opposed eugenics because they saw it as an infringement on individual rights and personal liberty. Figures such as Jane Addams and Clarence Darrow criticized eugenics for its classist and coercive nature.[45] Many African American leaders and intellectuals, including W. E. B. Du Bois, were skeptical of eugenics, seeing it as a tool of White supremacy. Socialists and labor activists often rejected eugenics, viewing it as a capitalist tool to justify inequality and exploitation. English writer and Christian apologist G. K. Chesterton was one of the most vocal critics of eugenics. He argued against it from a religious and ethical

[40] Adolf Hitler, *Mein Kampf*, vol. 1 (Franz Eher Nachfolger, 1925), chap. 10.
[41] "The Nuremberg Laws," 1935, www.archives.gov/publications/prologue/2010/winter/nuremberg.html.
[42] Adolf Hitler, "Speech at the Sportpalast," January 30, 1942.
[43] Pope Pius XI, "Casti Connubii," 1930, www.vatican.va/content/pius-xi/en/encyclicals/documents/hf_p-xi_enc_19301231_casti-connubii.html.
[44] Franz Boas, *The Mind of Primitive Man* (Macmillan, 1911).
[45] Clarence Darrow, *The Story of My Life* (Charles Scribner's Sons, 1932).

standpoint, emphasizing the dignity of all human beings and the dangers of state control over reproduction.[46] I am sorry to report, however, that although eugenics may have suffered setback, its ideas are not dead, and it has contemporary proponents.[47]

Conclusion

To conclude this chapter, we draw the two major threads of abstracted history and an abominable application together and make six observations:

1. The nature of history. History is messy. I tried to incorporate a diversity of sources in describing the inflammatory history of eugenics so we might feel the crosscurrents, tension, and whiplash of that scandalous cultural and intellectual phenomenon. But what do we do with it? What is its purpose? It seems that the Darwinist must hold that history has no purpose, since there is no Creator. By contrast, the person of faith sees God's hand guiding history—HisStory. As a Christian, I believe the Bible's teaching that God has been working throughout history to reveal himself to humankind, bringing salvation to those who desire it, and judgment on evil (see Mt 13:24-30; Eph 1:9-11; Rev 20:11–21:8).

2. Abstraction. I opened with the quote by Kuhn and attempted to demonstrate how indeed science history is abstracted for the purity of its ideas, much in the same way that math and science are taught. This is a very powerful and effective, even beautiful, method. However, it is as incomplete as giving a mathematical or scientific theory without an application. Enjoy the pure history, but take time to learn how it connects to the rest of your knowledge as well.

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[46]G. K. Chesterton, *Eugenics and Other Evils* (Cassell, 1922).

[47]See John Glad, *Future Human Evolution: Eugenics in the Twenty-First Century* (Hermitage, 2006). Glad is a retired professor and human-rights advocate and makes his pro-eugenics books available free at http://whatwemaybe.org/. That said, it is nice to know that one of the leading contemporary scientific journals has published an article both explicitly stating and condemning the racist and sexist implications of Darwinism. Agustín Fuentes, "'The Descent of Man,' 150 Years On," *Science* 372, no. 6544 (2021): 769, https://doi.org/10.1126/science.abj4606.

3. History in a nutshell. I believe we can remember things better by making more connections between them in different ways. That is one of the purposes of this chapter. Table 1.1 should be referenced, as needed, when reading the rest of the book to locate a particular idea in its era. Additionally, we will see several of the figures from this chapter appear later in the book.

4. Eugenics and fundamentalism. The period of the rise of eugenics coincides with the rise of the Protestant fundamentalist movement of the early 1900s. This is important because it represents a historical shift where a major part of the Christian church took on an anti-intellectual stance and withdrew from cultural engagement.[48] Those reactions a century ago affect my choice of the content and mode of this book today.

5. Statistics and morality. Statistics is laden with both moral and ethical issues. With eugenics, we saw how a false assumption, that intelligence must be correlated with brain size, colored Morton's interpretation of otherwise correctly calculated statistics. We saw how a predisposition biased the interpretation of Broca's data. We saw how, when ethical issues collide, like the eugenicists' belief that reproduction should be guided by the state versus the traditional right to self-determination, the right approach is free debate in the public square and not the truth twisting in the court that got Carrie Buck sterilized. Even today, the American Statistical Association identifies eight broad ethical guidelines for statistical practice, each of which is elaborated in specific detail in order to aid statisticians and data scientists in keeping within the boundaries.[49] It is an excellent and helpful document, but it is not enough. Galton, Pearson, and Fisher's statistical work on eugenics arguably satisfied the ethical guidelines because it follows the statistical rules, but it was morally wrong. The

[48]See, for example, the outstanding study by George M. Marsden, *Fundamentalism and American Culture* (Oxford University Press, 1980).

[49]"Ethical Guidelines for Statistical Practice," American Statistical Association, January 2022, www.amstat.org/your-career/ethical-guidelines-for-statistical-practice.

problem wasn't their statistical work itself but the assumptions behind it and what it was used for. (This is one reason research today must be approved by institutional review boards, but immoral statistical work still slips through.)

5. Good versus evil. Like the difference between a knife in the hand of a surgeon versus a murderer, or a gun of a police officer versus a gang member, Statistics is a tool that can be used for good or evil. We saw how it was used for good: to analyze human lifespans to improve public policy and create insurance, to make discoveries in astronomy, to guide economic theory and aid in the creation of wealth, to prevent the spread of disease, and so on. However, we also saw how it was used to justify scientific racism and promote antihuman policies of forced sterilization and even genocide.

Indeed, Statistics is a very powerful tool. It is my aim with this book to inspire and help you use it for good as well as oppose evil. Lady Wisdom beckons us to the former, and the woman of folly beckons us to the latter. While Statistics is a tool for discovering truth, it is not inherently moral, and both Wisdom and Folly expertly use it to direct us toward their own houses (Prov 9:1-6, 13-18). Wisdom won't manipulate, but Folly will. Faith is a compass pointing to Wisdom's house and away from Folly's. It does so by illuminating the assumptions behind the statistics and the end toward which they're used.

Reflection Questions

1. What is the nature of history? What is its purpose? What should we do with history? (See the first observation under "Conclusion.")
2. What do you make of Kuhn's quote about writing a history of science? Think back on your knowledge of the history of science. Discuss how it confirms or disconfirm Kuhn's observation. (See the second observation under "Conclusion.")
3. What are the four eras of Statistics? What do you think of their distinctions and basic concepts? Which one most interests you?

Why? Where do you see the fourth era concluding? Do you think there will be a fifth era? If so, what might it look like?

4. What is one statistical development or figure that stood out to you from the history? Why?
5. How did eugenics begin? What do you think of it? Do you see any effects of eugenics that remain today? What should we do to guard from future strains of eugenics or its equivalents?
6. Find the American Statistical Association's Ethical Guidelines for Statistical Practice. Read the eight main principles in the headings, along with any of the descriptions, as your instructor directs. Which principles have you encountered in your experience with statistics, even if indirectly? Are the guidelines complete? If not, what is missing?
7. Discuss the following quotation from the sixth concluding observation: "Like the difference between a knife in the hand of a surgeon versus a murderer, or a gun of a police officer versus a gang member, statistics is a tool that can be used for good or evil."