# History of Statistics Paper II

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**Week 3: Early 1800s**



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## The Emergence of Social Statistics in the Early 19th Century

### Introduction

In the early 1800s, the mathematics used to study stars and measure the Earth began showing up in conversations about crime, morality, and human behavior. Thinkers like Adolphe Quetelet and Siméon-Denis Poisson started using tools like the Law of Large Numbers and error theory — originally meant for astronomy and geodesy — to analyze patterns in society (Stigler, 1986, Ch. 5; Sheynin, 2018, Ch. 8). They weren't just looking at numbers; they were trying to understand people in a new way, as part of large, measurable systems.

Quetelet's idea of the "average man" suggested that traits like height, birth rates, or even crime could be modeled statistically, much like physical measurements. Poisson used probability to evaluate jury decisions, aiming to quantify something as complex as justice. And Cournot, recognizing the philosophical implications of all this, tried to draw a line between statistical patterns and human freedom. This period marked a turning point. Probability wasn't just about dice or planets anymore, it was starting to shape how people thought about society itself.

## II. The Law of Large Numbers: From Bernoulli to Quetelet

The Law of Large Numbers (LLN) started as a mathematical observation in the late 1600s, when Jakob Bernoulli proved that repeated trials of a random event tend to produce stable averages over time. But in the early 1800s, this idea took on a new life when Adolphe Quetelet applied it to people instead of coins or dice. For him, the LLN wasn't just a mathematical curiosity, it was a window into human society (Stigler, 1986, Ch. 5; Sheynin, 2018, Ch. 8).

Quetelet believed that in large groups, human traits like height, weight, and even tendencies toward crime or marriage followed regular patterns. These patterns, he argued, were not random noise but signs of deeper social laws. His famous concept of the "average man" was based on the idea that individuals might vary, but large populations behaved predictably. Just as astronomers dealt with observational errors by averaging many readings, Quetelet thought social scientists could do the same with people.

This was a bold shift. Before Quetelet, the idea of applying mathematics to something as messy and unpredictable as human behavior seemed unrealistic. But the growing availability of census data and administrative records made it possible to look for regularities. Quetelet saw consistency in the numbers, crime rates stayed roughly the same year to year, for example, and took this as evidence of social order underneath individual chaos (Stigler, 1986, Ch. 5; Sheynin, 2018, Ch. 8).

Still, not everyone was convinced. Critics argued that reducing people to averages ignored human complexity and risked oversimplifying moral and political issues (Sheynin, 2018, Ch. 8). Even so, Quetelet's use of the LLN helped set the stage for statistics as a tool for understanding society, not just nature.

## III. Poisson and the Probability of Judicial Decisions

While Quetelet was applying statistics to people's physical and social traits, Siméon-Denis Poisson took the theory of probability into the courtroom. In 1837, he published a detailed study on how to calculate the likelihood that a jury would reach a correct verdict (Stigler, 1986, Ch. 6; Sheynin, 2018, Ch. 9). His idea was to treat jurors like imperfect measuring instruments where each with some unknown chance of being right or wrong and to use mathematics to estimate the reliability of the group's decision.

Poisson assumed that each juror had a fixed probability of voting correctly and that these decisions were made independently. From there, he used the binomial distribution to model the overall outcome of a trial. If enough jurors agreed, the verdict was likely to be reasonable; if they were split, the reliability dropped. This wasn't about second-guessing any one juror, but rather about understanding the system as a whole.

One of the outcomes of Poisson's work was a mathematical pattern that would later be named after him — the Poisson distribution (Sheynin, 2018, Ch. 9). Although his version didn't look quite like the modern formula, it described how rare events, like wrongful convictions or surprising swings in verdicts, might occur even in a generally reliable system.

What made Poisson's work stand out wasn't just the math, but the shift in perspective. He treated legal decisions as uncertain outcomes that could be analyzed statistically, a big departure from viewing the law as a domain of logic and certainty. By introducing probability into the justice system, Poisson opened up difficult questions: Can fairness be measured? How do we balance trust in individual judgment with patterns observed across many cases? It wasn't a perfect model since people don't behave like coin flips, but it was a clear step toward seeing legal and institutional processes through a statistical lens.

**IV. Cournot and the Philosophical Response to Statistical Regularity**

As Quetelet and Poisson pushed statistics into new territory, Antoine Augustin Cournot stepped in to ask what all of this meant. If human behavior could be described by regular patterns, did that mean people had no free will? Were we just following laws of probability, like particles or planets?

Cournot didn't think so. He accepted that statistical regularities existed like crime rates, birth rates, and other social numbers really did stay stable over time. But he argued that these patterns reflected tendencies, not strict laws (Sheynin, 2018, Ch. 9). Just because something happens often doesn't mean it's necessary or predetermined. In his view, the Law of Large Numbers was about what happens on average in large groups, not about predicting any one person's actions. This was an important distinction. For Cournot, probability was about uncertainty in the world, not just about ignorance in the mind.

He leaned toward a frequentist interpretation, that probabilities describe how often things happen in repeated experiments or observations (Stigler, 1986, Ch. 6; Sheynin, 2018, Ch. 9). In contrast to the subjective view, which sees probability as a degree of belief, Cournot focused on what can be observed over time. He also warned against reading too much into the numbers. Just because a pattern shows up in the data doesn't mean we've found a cause. Statistical regularities could be shaped by hidden factors, institutional structures, or even coincidence. Treating them as fixed laws could lead to serious mistakes, especially in policy or law.

Cournot helped bring balance to the conversation. He didn't reject the power of statistics, but he reminded others to be cautious, especially when applying mathematical ideas to human lives. His philosophical reflections added depth to the early development of social statistics, showing that it wasn't just about calculation, but also about interpretation and judgment.

**V. From Physical to Social Error: The Theory of Errors and Its Broader Impact**

Long before statistics entered the courtroom or the census bureau, it was a tool for astronomers. Observations of planets, stars, and geographic locations always came with small errors as no two measurements were exactly the same. To deal with this, scientists developed the theory of errors, which focused on how to combine uncertain data in a reliable way.

The turning point came in the early 1800s. In 1805, Legendre introduced the method of least squares, a technique for finding the best estimate by minimizing the total squared error (Stigler, 1986, Ch. 5). Then in 1809, Gauss gave the method a mathematical foundation by connecting it to the normal distribution, the familiar bell-shaped curve. Gauss argued that if measurement errors followed a normal distribution, then least squares was the most reasonable way to combine observations.

At first, these ideas stayed within astronomy and geodesy. But as thinkers like Quetelet began applying statistics to people, the theory of errors followed (Sheynin, 2018, Ch. 8). Instead of measuring the orbit of a planet, researchers started using the same tools to estimate averages for human height, age at marriage, or likelihood of arrest. The idea was similar: individual data points might be noisy or flawed, but the average could still tell us something meaningful.

This move helped turn statistics into a method for drawing conclusions from imperfect data, a major step toward what we now think of as statistical inference (Stigler, 1986, Ch. 6). It also carried over assumptions from the physical sciences, such as the belief that errors were random and centered around a true value (Sheynin, 2018, Ch. 9). But in the social world, that's not always the case. Measurement errors in surveys or records can be systematic, and "true values" aren't always easy to define.

Even so, the legacy of the theory of errors is clear. It introduced the mindset that data should be combined thoughtfully, and that variation can be modeled instead of ignored. That perspective still shapes how we handle uncertainty today, whether we're estimating a population mean or trying to detect bias in a modern algorithm.

**VI. Discussion: Power and Limits of Early Social Statistics**

By the mid-1800s, the idea that society could be studied with the same tools used in astronomy or physics was no longer unaccepted and was gaining serious attention. Quetelet, Poisson, and Cournot helped shape a new vision of statistics as something more than a mathematical curiosity. It became a way to make sense of the world: to summarize populations, evaluate institutions, and explore patterns in human behavior.

The strength of this early movement was its ambition. Quetelet's "average man" made the messy details of society feel manageable (Stigler, 1986, Chs. 5–6; Sheynin, 2018, Chs. 8–9). Poisson's legal models introduced a formal way to think about fairness and decision-making. Cournot added the philosophical caution needed to keep these ideas grounded. Together, they created a foundation that would influence everything from public health to economics to modern data science.

But these early approaches also had limits. Treating people as interchangeable data points risked ignoring the very things that make human life complex like context, intention, inequality. The use of averages could hide variation that mattered, and regularity in statistics was sometimes taken as evidence of fixed laws, rather than outcomes shaped by institutions or history (Sheynin, 2018, Ch. 8).

There were also ethical concerns. Quetelet's work, for example, later influenced thinkers like Francis Galton, who took the idea of statistical norms into eugenic territory (Stigler, 1986, Ch. 7). While Quetelet didn't intend this outcome, the link between early social statistics and problematic social theories can't be ignored.

Still, the early 19th century remains a key chapter in the development of modern statistics. It was a period when thinkers saw the potential of mathematics to describe the social world and began addressing the consequences of doing so (Stigler, 1986, Ch. 6; Sheynin, 2018, Ch. 9). That mix of optimism and caution still feels relevant today, especially as we use statistical models to shape policies, allocate resources, or make predictions about human behavior.

**VII. What I've Learned**

What stood out most from this week's readings was how quickly early 19th-century thinkers applied mathematical tools to human behavior and how their ideas continue to shape statistics today. I had always assumed that social statistics developed slowly from demographics or economics, but knowing that techniques from astronomy, like the method of least squares and the Law of Large Numbers, were directly used in the study of society was surprising. It made me think differently about how we draw inferences from data today, not just as a technical process, but as something rooted in much older questions about order, variation, and uncertainty.

I also felt surprised by the different roles that Quetelet, Poisson, and Cournot played. Quetelet's "average man" helped me see how averages can be powerful and misleading at the same time. Poisson's attempt to model legal judgments encouraged me to consider what kinds of systems are appropriate for probabilistic analysis, and where that analysis might oversimplify. Cournot's response reminded me that statistics isn't just about numbers, it's also about interpretation, and about recognizing the philosophical questions behind our models.

One lasting takeaway that I have gained is how early statisticians were already dealing with some of the challenges we still face today: How much can we rely on regularities in data? When do patterns reflect underlying causes, and when do they just reflect social structure or bias? And how should we treat the difference between individual unpredictability and group-level stability?

This week gave me a deeper understanding of the history behind the tools I've used in UofT classes and research. Understanding where these ideas came from and how they were first used made me more aware of both their power and their limitations.

## Week 4: Late 1800s

## Statistics, Regression, and the Logic of Eugenics in the Late 19th Century

### Introduction

By the late 1800s, statistics had become more than a tool for describing populations, it was starting to shape how people thought about heredity, intelligence, and the future of society. Francis Galton, building on Quetelet's concept of the "average man," began to ask not just how people differed, but how those differences passed from one generation to the next. His experiments with measuring human traits led to the development of regression and correlation, techniques that remain central to statistics today (Stigler, 1986, Ch. 7).

But these technical advances weren't neutral. Galton's interest in heredity grew into a commitment to eugenics, the idea that social progress could be engineered by encouraging the reproduction of people with "desirable" traits. Karl Pearson, Galton's intellectual successor, gave these methods a more rigorous mathematical foundation, turning them into tools for scientific authority while keeping the same ideological framing (Stigler, 1986, Ch. 8). Behind the equations was a vision of society that treated variation not just as something to be understood, but as something to be managed or even eliminated.

Histories by both Sheynin and Porter emphasize that these developments were tightly connected to state interests and institutional goals. The expansion of state recordkeeping and demographic surveillance helped statistical methods gain influence, but also reinforced their use in defining and managing populations (Sheynin, 2018, Ch. 10–11; Porter, 2020). Understanding this history means thinking critically about what statistics was used for, and what it continues to be used for now.

### II. Galton: From Heredity to Regression

Francis Galton's contributions to statistics began with a personal fascination: why were some families more "gifted" than others? Drawing on detailed family records and biometric measurements, Galton aimed to understand how traits like height, intelligence, and ability were passed from parent to child. His early observations led him to an important finding: children of exceptionally tall or short parents tend to be closer to the average height. This idea became known as regression toward the mean, and Galton was the first to describe it formally (Stigler, 1986, pp. 251–257).

To visualize these relationships, Galton created the bivariate scatterplot and began informally reasoning about what would later be called correlation. He noticed that the strength of association between parent and child traits could be summarized by the shape and spread of the plotted points. While Galton lacked a full mathematical formulation, his visual and empirical work paved the way for Karl Pearson to later define the correlation coefficient more precisely.

Galton also popularized the normal distribution as a model for inherited traits, which he saw as evidence that heredity followed predictable, measurable laws. His “quincunx” machine demonstrated how random variation could still produce a bell-shaped curve, a metaphor for how genetic randomness, over generations, might still yield statistically stable traits (Sheynin, 2018, Ch. 11).

What makes Galton’s work so significant is how seamlessly he moved from scientific curiosity to social ideology. He wasn’t just describing variation, he believed it could be used to rank people and guide policy. His writings on eugenics proposed that society should encourage reproduction among the “fit” and discourage it among the “unfit.” The statistical tools he developed were soon entangled with this vision. As Salsburg (2002) notes, Galton’s legacy is inseparable from the moral ambiguity of using numbers to define human worth.

Galton’s early statistical thinking helped launch modern quantitative social science, but it also left behind a troubling precedent: that mathematical precision could lend authority to social hierarchy.

**III. Pearson: Formalizing Statistical Science**

While Galton laid the groundwork, it was Karl Pearson who transformed statistical reasoning into a structured discipline. Pearson took Galton’s informal ideas and built them into a system of mathematical statistics, complete with formulas, distributions, and generalizable tools. His goal was to turn the study of biological and social variation into a rigorous science, one that could support claims about heredity, race, and social policy with quantitative backing (Stigler, 1986, Ch. 8).

One of Pearson’s major contributions was to refine the correlation coefficient, which he defined algebraically and used to quantify linear relationships between variables. He also advanced regression analysis and introduced the chi-square test as a method for evaluating goodness-of-fit in categorical data. These tools allowed for more systematic comparisons across traits, populations, and experiments, furthering Galton’s vision but giving it stronger technical foundations.

Pearson was not just a statistician but also a philosopher of science. In The Grammar of Science (1892), he argued that science should concern itself only with observable phenomena, not metaphysical explanations. This empiricist perspectives aligned well with his statistical methods: correlation without necessarily causation, description without requiring deeper theoretical mechanisms. But it also gave him a framework for promoting statistical modeling as objective and neutral, even when applied to highly value-laden subjects like race and heredity (Porter, 2020).

Importantly, Pearson didn’t see a contradiction between mathematical rigor and social ideology. He viewed statistics as a tool for understanding and improving society. That meant identifying superior traits, ranking populations, and using statistical evidence to justify selective breeding programs. Pearson's biometric laboratory became a center for eugenics research, reinforcing a vision of human difference as both measurable and politically actionable (Sheynin, 2018, Ch. 11).

As Salsburg (2002) points out, Pearson's influence was immense: he trained the first generation of professional statisticians and helped institutionalize the field. But the purposes his tools served were never just academic. His work reminds us that technical innovation can be shaped by the goals and assumptions of its time and that mathematical sophistication doesn't guarantee ethical neutrality.

**IV. Eugenics and the Authority of Numbers**

The statistical methods developed by Galton and Pearson were not merely tools for scientific analysis, they were also used to justify eugenic ideology, a movement that aimed to "improve" the human race through selective reproduction. At the heart of this effort was the belief that traits like intelligence, morality, and criminality were heritable and measurable, and that statistical regularities could guide decisions about who should or should not reproduce.

Both Galton and Pearson viewed statistics as a way to reveal the hidden order of human variation. By quantifying heredity, they believed they could identify patterns that were not just biological facts, but also guidelines for public policy. Galton envisioned a society where marriage and reproduction would be shaped by statistical insight, and Pearson argued that the future health of the population depended on regulating birth rates among different social classes and racial groups (Stigler, 1986, Ch. 7–8).

What gave these views power wasn't just their content, but the mathematical form they took. Regression coefficients, chi-square tests, and scatterplots made these arguments look precise and objective. As Theodore Porter (2020) emphasizes, numbers conferred scientific authority, they seemed to offer evidence that was above politics or bias. This made statistical reasoning especially appealing to administrators and policymakers, who increasingly relied on data to make decisions about education, welfare, and public health.

However, as Porter and Salsburg both point out, this authority could be misleading. The assumptions embedded in the models about normality, stability, and the fixity of traits often reflected social prejudices more than biological realities. Moreover, the language of statistical regularity made it easier to overlook individual variation and systemic inequality. Averages could obscure as much as they revealed.

The link between statistics and eugenics also reminds us that data analysis is never neutral. The decision about what to measure, how to model it, and how to interpret results is always shaped by context. The tools of regression and correlation were and still are powerful, but their earliest uses show how numbers can be used to serve political and moral agendas.

**V. Institutions, State Power, and Critique**

By the late 19th century, statistics was no longer just a tool for scientific research, it had become deeply embedded in the bureaucratic structures of modern states. Governments across Europe were gathering data on everything from birth and death rates to school performance and crime. This administrative appetite for numbers gave statistics a new kind of influence: it became central to how societies understood themselves, governed their populations, and justified interventions.

Theodore Porter (2020) argues that the rise of statistical thinking cannot be separated from this institutional expansion. Statistical methods gained legitimacy because they provided a language of control and rationality, a way to make decisions seem objective, even when they reflected deep social and political biases. Whether applied to public health or education, statistical models helped shape not just how data was interpreted, but what kinds of data were seen as worth collecting in the first place.

Oscar Sheynin (2018) shows that this era also witnessed a growing concern with stability and regularity in population-level statistics. Scholars like Wilhelm Lexis tried to distinguish between ordinary variation and meaningful deviation, developing early ideas about randomness and overdispersion. These efforts reflect an emerging awareness that not all regularities are natural laws, some may be artifacts of data collection, institutional constraints, or social norms.

Yet while the technical foundations of statistics were becoming more sophisticated, the broader implications of its use remained under-examined. As Salsburg (2002) and Porter both note, early statisticians rarely questioned who was being left out of the data, or whose experiences were being averaged away. The language of means and deviations had power, but it could also flatten difference and justify unequal treatment under the banner of scientific precision.

This section of the history helps clarify an important lesson: statistical reasoning gains authority not only from its methods, but from the institutions that support it and the purposes it serves. Understanding the roots of modern statistical thinking means recognizing its deep entanglement with state power, social categorization, and the desire to manage populations through numbers.

**VI. What I've Learned**

This week's readings changed how I think about the origins of statistical methods I've taken for granted, especially regression and correlation. We have talked about these tools in many statistics classrooms without thinking much about where they came from or why they were first developed. Learning that Galton introduced regression as part of a larger project to study heredity and eventually promote eugenics made me more aware that statistical techniques are never just technical. They emerge from specific historical contexts and are often driven by certain social goals.

I also came to see how mathematical tools gain authority through the institutions that adopt them. Pearson's formalization of Galton's work helped statistics become a professional science, but it also tied it more tightly to a vision of society that aimed to rank and improve populations. The critiques raised by Porter and Sheynin helped me realize that the "objectivity" of statistics can be misleading. Every choice from what to measure to how to average reflects a judgment about what matters and what doesn't, and I am curious to explore how sociologists approach these choices.

Another key takeaway was the role of the state in shaping statistical practice. It wasn't just scientists who used these methods; governments and bureaucracies relied on them to make decisions that affected millions of lives. That connection between data and power still feels relevant today, especially when thinking about how algorithms and machine learning systems are being used to automate decisions in areas like policing, hiring, and healthcare.

Most of all, I've learned to be more cautious and more reflective. The early statisticians made major contributions, but they also made moral mistakes. Knowing that history helps me approach data analysis with a stronger sense of responsibility.

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