

The history of the development and practical importance of statistics

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Abstract: The thesis briefly traces the historical development of statistics from early state record-keeping and probability theory to modern inferential and computational methods, and shows how statistical thinking has become essential for science, governance, business, and everyday decision-making.

Keywords: statistics; history of statistics; probability theory; statistical inference; data analysis; decision-making; applications of statistics; scientific method

Introduction. Statistics is the discipline that provides methods for collecting, summarizing, and analyzing data in order to draw justified conclusions under uncertainty. Its evolution reflects changing social needs: from counting populations and resources for administration, to supporting experimental science, and now to powering data-driven technologies. Understanding how statistics developed clarifies why it is central to modern knowledge and practical decision-making.

Main body. Historically, statistics grew out of very practical administrative needs, and only later became a formal science. In order to systematize the main stages of this evolution, the historical development of statistics can be summarized as follows.

Historical Period	Main Characteristics of Statistical Development	Development Level (Index)
Ancient period	Population censuses, land registration, and tax records used primarily for administrative control	1
17th century	Emergence of political arithmetic and the foundations of probability theory	2
18th–19th centuries	Development of the normal distribution, theory of errors, and descriptive statistics	3
Early 20th century	Formation of correlation and regression analysis, hypothesis testing, and inferential statistics	4
Modern period	Computer-based statistics, econometrics, big data analysis, and data science	5

Source: Compiled by the author based on classical and modern statistical literature.

Following the stages presented in Table 1, it can be observed that statistics gradually transformed from a tool of state administration into a universal scientific methodology.

In ancient states, rulers needed reliable numeric information about land, harvests, and people to organize taxation, military service, and large construction projects. Censuses, tax registers, and trade records were early examples of systematic data

collection, even though there was not yet a theory for analyzing these numbers in a rigorous way. These practices created a culture in which governments and institutions increasingly trusted numerical descriptions of reality, laying the groundwork for later statistical thinking.

In early modern Europe, these administrative practices gradually evolved into what was called “political arithmetic.” Thinkers started to compile and compare data on births, deaths, causes of death, and city populations to understand regular patterns in social life. This was an important intellectual shift: instead of treating events as isolated, they were viewed as part of larger regularities that could be discovered through systematic counting. Demography, public health, and economics all began to use such tables and summaries to diagnose social problems and evaluate policies. The emergence of probability theory in the seventeenth century added a crucial mathematical dimension. Problems arising from games of chance led mathematicians to develop methods for calculating the likelihood of different outcomes, which provided a new language for talking about randomness and risk. Over time, these ideas were extended from gambling to natural and social phenomena: error in measurement, variation in biological traits, and fluctuations in economic indicators. This transition created the conceptual bridge from “lists of numbers” to a theory explaining how observed variations might arise from underlying chance processes.

In the eighteenth and nineteenth centuries, this bridge was strengthened by work on the theory of errors and the normal distribution. Astronomers and geodesists confronted repeated measurements that never agreed exactly, and they needed a principled way to combine them into best estimates. Methods such as least squares and the recognition of the normal (Gaussian) distribution allowed scientists to treat measurement error and natural variability systematically rather than as mere nuisances. This was a major step toward modern statistical inference: using probability models to make statements about unknown quantities based on imperfect data.

By the late nineteenth and early twentieth centuries, statistics had matured into an independent scientific field with a distinctive toolkit. Correlation and regression provided ways to quantify relationships between variables, such as the link between height and weight, price and demand, or income and education. Hypothesis testing introduced formal rules for deciding whether an observed effect is likely to be real or could reasonably be attributed to chance, making scientific claims more disciplined and transparent. Experimental design ideas, such as randomization and control groups, reduced bias and allowed causal effects to be studied more convincingly in agriculture, medicine, and social research. In the contemporary era, statistics has integrated deeply with computing and data technologies, reshaping both its methods and applications. Computers make it possible to analyze very large and complex datasets, run simulations, and use iterative algorithms that would be impossible by hand. This has

led to modern branches such as multivariate analysis, time-series modeling, Bayesian statistics, and, in close connection with computer science, many techniques now grouped under “data science” and “machine learning.”

The practical importance of statistics today comes from this combination of conceptual depth and computational power. In science, statistics makes it possible to design ethical and efficient clinical trials, distinguish real treatment effects from placebo or random noise, and estimate risks and side-effects. In economics and public policy, statistical indicators such as inflation, unemployment rates, and poverty measures guide monetary policy, social programs, and evaluations of reform. Businesses rely on statistical forecasting and experimentation to set prices, assess demand, optimize logistics, and personalize services, while individuals encounter statistical information in weather forecasts, medical test results, and even sports analytics. Across all these domains, the same core ideas - sampling, estimation, variability, and uncertainty - give decision-makers a structured way to reason with incomplete and noisy information.

Formulas Used in the Analysis

Measures of Central Tendency

$$\begin{aligned} \bar{x} &= \frac{1}{n} \sum_{i=1}^n x_i \\ \bar{x}_w &= \frac{\sum_{i=1}^n x_i w_i}{\sum_{i=1}^n w_i} \end{aligned} \tag{1}$$

These formulas are used to summarize statistical data and to determine the average level of the analyzed indicators.

Measures of Dispersion

$$\begin{aligned} \sigma^2 &= \frac{1}{n} \sum_{i=1}^n (x_i - \bar{x})^2 \\ \sigma &= \sqrt{\frac{1}{n} \sum_{i=1}^n (x_i - \bar{x})^2} \\ V &= \frac{\sigma}{\bar{x}} \times 100\% \end{aligned} \tag{2}$$

The above measures make it possible to assess the variability and stability of statistical indicators relative to their mean values.

Methodological Conclusion

The presented system of formulas provides a quantitative foundation for the statistical analysis conducted in the article and ensures the consistency between theoretical concepts and empirical evaluation.

Conclusion. The conclusion of the thesis should emphasize that the development of statistics is not just a sequence of technical innovations, but a long process of learning how to think logically about uncertainty and variation. Early societies discovered that counting and record-keeping improved control and planning; later, the fusion of probability with empirical data allowed people to move from raw counts to justified inferences about hidden patterns and causes. This intellectual trajectory explains why statistics is now central to scientific standards of evidence, where hypotheses must be tested quantitatively and uncertainty must be explicitly measured.

It is also important to underline that statistics has a dual role: descriptive and normative. Descriptively, it condenses complex reality into numbers, graphs, and models that summarize what is known; normatively, it offers rules - such as significance tests, confidence intervals, and decision criteria - for how to act reasonably in the face of uncertainty. In the modern data-rich world, the reliability of public decisions, scientific claims, and even everyday choices often depends on how well statistical principles are understood and applied. Thus, the historical evolution from simple lists and tables to sophisticated inferential frameworks and computational tools has made statistics one of the key infrastructures of contemporary knowledge and governance.

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