

# DATA MINING AND ANALYSIS OF EARLY MODERN EUROPEAN ENLIGHTENMENT TRENDS IN ACTA ERUDITORUM

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## ABSTRACT

*This paper explored the intellectual and cultural transformations reflected in the Acta Eruditorum, a prominent early modern European scholarly journal published from 1682 to 1735. By analyzing Acta's temporal dataset encompassing more than 7,000 papers, our study examines the time distribution of contributors' expertise across six domains: Law, Literature, Science, Mathematics, Politics, and Religion. Key findings include the increasing rise of publications in Science and Mathematics, aligning with Enlightenment ideals and the Scientific Revolution. Furthermore, the study shows a significant decrease in religious contributions, reflecting a broader shift from religious perspectives to a greater emphasis on scientific thought and beliefs. Our data visualization techniques and statistical analysis reveal intriguing parallels and contrasts between the Acta Eruditorum and the French Academy of Sciences, highlighting their distinct and complementary contributions to the advancement of knowledge. These findings provide valuable insights into how each institution shaped European intellectual history and fostered the exchange of ideas that propelled the Enlightenment era.*

## KEYWORDS

*Acta Eruditorum, Statistical analysis of scientific works, History of Science, Early Science History, Scientific Revolution, Historical Data Analysis*

## 1. INTRODUCTION

The *Acta Eruditorum* is a scientific and scholarly journal published in Leipzig, Germany, from 1682 to 1732 by Otto Mencke and Gottfried Wilhelm Leibnitz [3]. From 1732 to 1782, it was published as *Nova Acta Eruditorum*. In this paper, we will focus on the *Acta Eruditorum*. It was one of the earliest platforms for the distribution of Enlightenment ideas. The journal mirrored the intellectual and cultural priorities of early modern Europe.

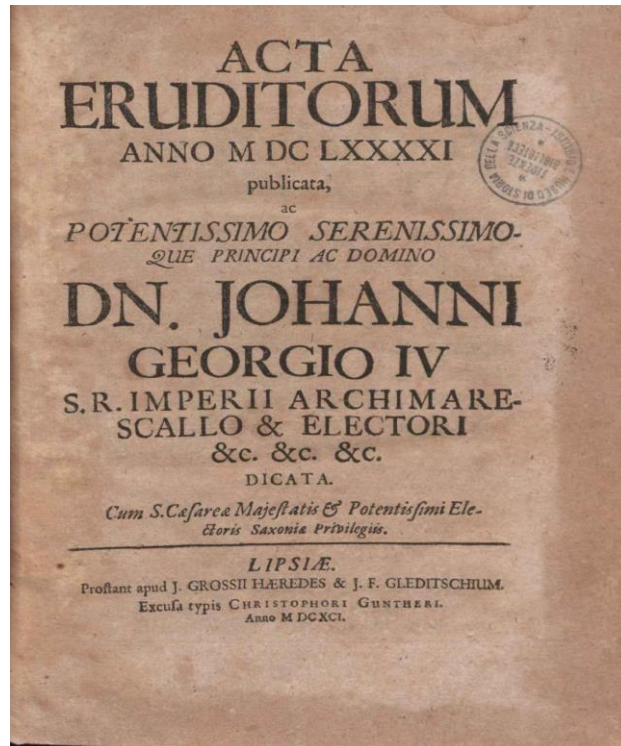


Figure 1: Title page of the First Issue in January 1683

Through a systematic analysis of its contributors and their field of expertise, we can uncover how the journal reflected broader historical, cultural, and scientific shifts over time during this transformative era. Figure 1 shows the title page of *Acta Eruditorum*.

This paper aims to analyze the data from *Acta Eruditorum* between 1683 and 1732, focusing on the changing distribution of authors' field of expertise and comparing these trends with the contemporaneous French Academy of Sciences. Our analysis uses decades as time units.

## 2. WHAT IS ACTA ERUDITORUM ?

Founded by Otto Mencke (1644-1707), the *Acta Eruditorum* played a crucial role in the exchange of ideas during the Enlightenment era. The journal covered a wide range of subjects, including mathematics, physics, law, natural history, and philosophy. Notable contributors, such as Leibniz and Euler, made groundbreaking contributions to fields like calculus and probability theory, elevating the journal to prominence. Unlike state-supported institutions such as the French Academy of Sciences, the *Acta Eruditorum* offered a broader, more open platform for European scholars to share their findings, thus fostering intellectual diversity.

The journal emphasized quality and rigor, relying on peer review to maintain academic standards. Its influence extended beyond Germany, serving as a model for other European scholarly journals. As a product of its time, the journal reflected the Enlightenment's emphasis on reason, empirical evidence, and the systematic pursuit of knowledge.

### 3. EXAMPLES OF PAPERS IN ACTA ERUDITORUM

Gottfried Wilhelm Leibniz's contributions to Acta Eruditorum included significant papers related to the development of calculus. His papers published in Acta Eruditorum introduced groundbreaking concepts that laid the foundation for modern calculus. In these works, Leibniz presented a revolutionary approach to mathematics, in June 1686, Leibniz created the integral sign for the first time and provided proof of the Fundamental Theorem of Calculus [5]. These groundbreaking ideas laid the foundation for modern calculus, offering a precise framework for solving complex problems in mathematics, physics, and engineering.

The Bernoulli family, particularly Johann and Jakob Bernoulli, also made significant contributions to the Acta Eruditorum, cementing their legacy as pioneers in mathematics and physics. Jakob Bernoulli's work on the catenary curve, published in the journal, explored the mathematical properties of a hanging chain under the influence of gravity. This study advanced the understanding of calculus and showcased the practical applications of mathematical analysis to physical phenomena. Johann Bernoulli further enhanced the journal's prominence by addressing and solving the Brachistochrone problem in the June 1696 issue [3], where he challenged mathematicians across Europe to solve this critical calculus problem. These groundbreaking contributions by the Bernoullis enriched the content of Acta Eruditorum and solidified its role as a central hub for scientific innovation during the Enlightenment.

An example is shown in Figure 3. The image is taken from Leibniz's article "De linea in quam flexile se pondere proprio curvat" which appeared in Acta Eruditorum in June

1691. Leibniz's construction of the catenary curve demonstrates the mathematical analysis of a hanging chain under its own weight. The image highlights Leibniz's application of calculus to solve complex problems in geometry and mechanics [8].

This diagram in Figure 3 represents a geometric solution given by Leibniz to a mathematical problem involving lines and areas. [1] It showcases Leibniz's method of using geometry to visualize relationships between curves, tangents, and specific points, which are labeled to guide the reasoning process [8].

Acta Eruditorum was not just a journal of mathematical breakthroughs and achievements. Figure 4 is a page from Francois Mauriceau's work on obstetrics, specifically *Traité des Maladies des Femmes Grosses* (Treatise on the Diseases of Pregnant Women) [6]. This illustration shows the tools and instruments used to treat pregnant and postpartum women, offering insight into 17th-century medical practices [9]. Mauriceau's work in modern obstetrics showcases the scientific advancements shared through the Acta Eruditorum, making complex medical knowledge accessible to a broader European audience during the Enlightenment period.

### 4. DATASET AND METHODOLOGY

The dataset analyzed in this paper includes authors, editors, publication years, and fields of expertise as categorized into six domains: Law, Literature, Science, Mathematics, Politics,

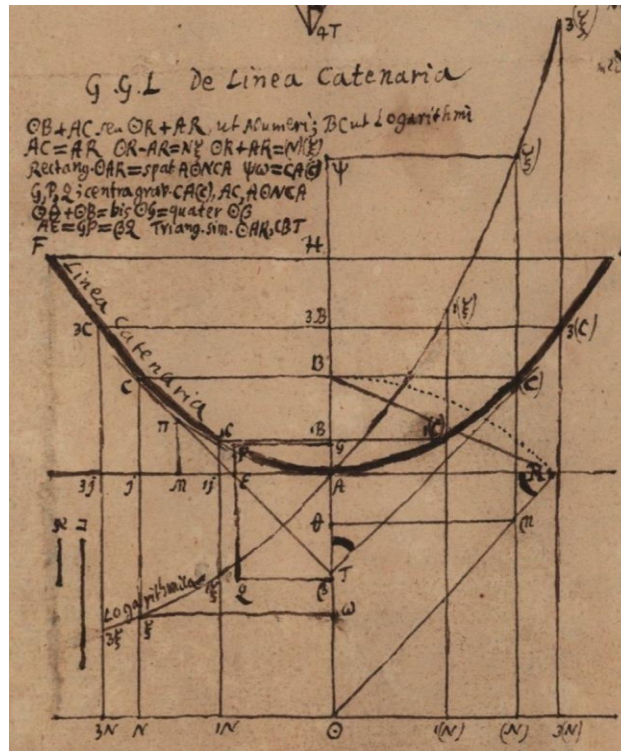


Figure 2: Catenary curve

and Religion. The data was processed using Python and Excel, and visualized through stacked bar charts to reveal trends over time. Questions such as "Which field dominated each decade?" and "How did the distribution of authors' fields change over time?" were explored to contextualize these patterns. The dataset analyzed contains contributions from a total of 4,739 unique authors. Among these, the longest single paper was authored by J. Harduin, spanning 21 pages. This length underscores the depth and rigor some authors dedicated to their research. The dataset includes 7,803 papers, with an average length of 5.3, showcasing a vast amount of academic writing.

Unlike many other academies at the time, Acta Eruditorum did not list authors' names or editors names in the publication itself. A detailed catalog of both authors and reviewers was recently compiled in [3]. An example of such data is given in Figure 5.

Table 1 represents the Excel spreadsheet used to store and interpret data collected from the catalog of publications in Acta Eruditorum. Each row represents an entry from a catalog compiled in [3]. Each entry contains the following information: information (year, page number, Volume, Author, Edition Editor, Author profession, Editor profession) in this order.

Once this data is collected, we can perform statistical analysis of authors in Acta Eruditorum. For example, in Figure 6, we show the top 10 authors that appeared the most frequently. As one can see from Figure 6, Christian Wolff (1679-1754), the most famous German philosopher between Gottfried Leibnitz (1646-1716) and Emmanuel Kant (1724-1804) was one of the most frequent and popular authors of papers published in Acta.

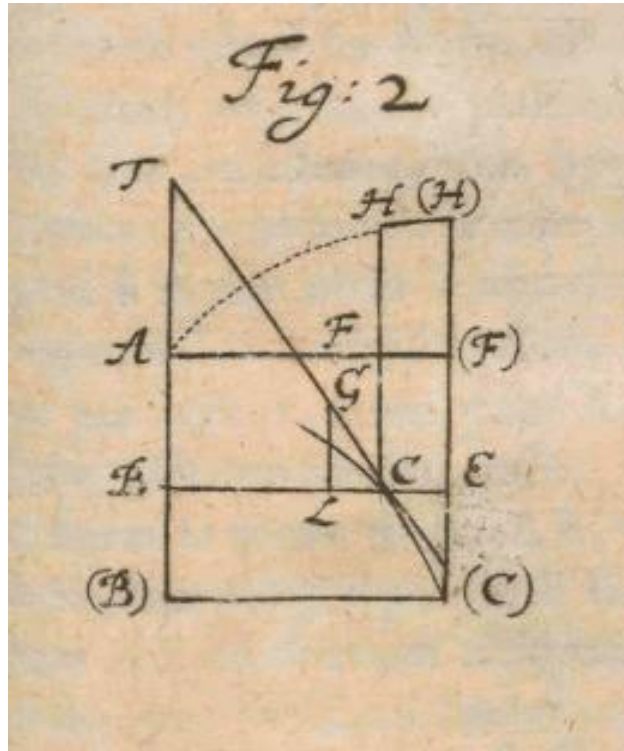


Figure 3: An Excerpt from a mathematical paper



Figure 4: An excerpt from a medical article

<b>1691</b>	<b>1</b>	<b>C.C. Malvasia</b>	<b>VI</b>	<b>C. Wagner</b>
	<b>2</b>	<b>E. Gee</b>	<b>I</b>	<b>C. Wagner</b>
	<b>5</b>	<b>J. Overall</b>	<b>I</b>	<b>C. Wagner</b>
	<b>23</b>	<b>F. Deseine</b>	<b>VI</b>	<b>O. Mencke</b>
	<b>24</b>	<b>T.P. Blount</b>	<b>VI</b>	<b>O. Mencke</b>
	<b>25</b>	<b>A. Varillas</b>	<b>I</b>	<b>V.L. von Seckendorf</b>
	<b>37</b>	<b>J.C. Wagenseil</b>	<b>IV</b>	<b>C. Pincker</b>
	<b>43</b>	<b>P. Spindler</b>	<b>III</b>	<b>J.W. Pauli</b>
	<b>49</b>	<b>B.L. Schwendendörffer</b>	<b>II</b>	<b>C. Pincker</b>
	<b>52</b>	<b>C. Grubel</b>	<b>VI</b>	<b>J. Feller</b>
	<b>56</b>	<b>J. Hoornbeek</b>	<b>I</b>	<b>O. Mencke</b>
	<b>56</b>	<b>S. Bochart</b>	<b>I</b>	<b>O. Mencke</b>

Figure 5: Data Set of Authors and Editors in Acta Eruditorum

Table 1: An excerpt from the dataset used to analyze Acta Eruditorum contributions.

Year	Page	Author	Vol.	Editor	Field of Author	Field of Editor
1691	24	T.P. Blount	VI	O. Mencke V.L.von Seckendorf	Writer Lawyer Historian	Philosopher Literary Historian Statesman Scholar
1691	25	A. Varillas	I			
1691	37	J.C.Wagenseil	IV	C. Pincker	Polymath	Jurist

## 5. ANALYZING ACTA ERUDITORUM CONTRIBUTIONS (1680-1730)

The stacked bar charts illustrate the percentage distribution of authors' fi by decade, offering insights into the intellectual priorities of the era.

Figure 7 is a chart produced by the data collected from our Excel spreadsheet. it is a Stacked Bar chart representing the percentages of different profession categories per decade.

### 5.1. Dominance of Law from 1680 To 1735

Law has consistently appeared as the dominant field across all decades. This trend reflects the broader socio-political context of the Holy Roman Empire. The aftermath of the Thirty Years' War (1618–1648) and the Peace of Westphalia (1648) established the modern concept of state sovereignty and codification of laws. Furthermore, Enlightenment thinkers, including contributors to the journal, used Westphalian ideas as a foundation for discussions on natural rights, justice, and governance.

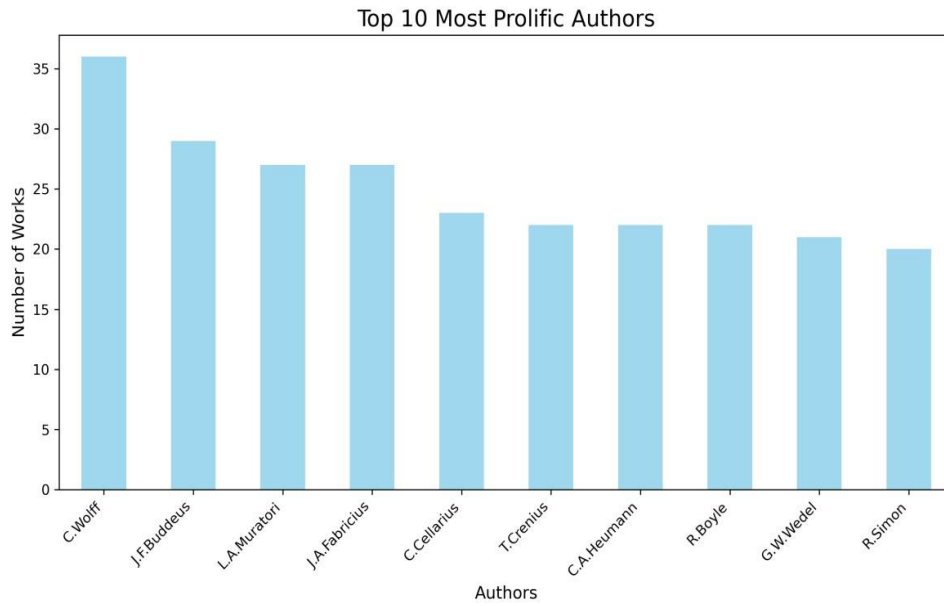


Figure 6: Top 10 authors

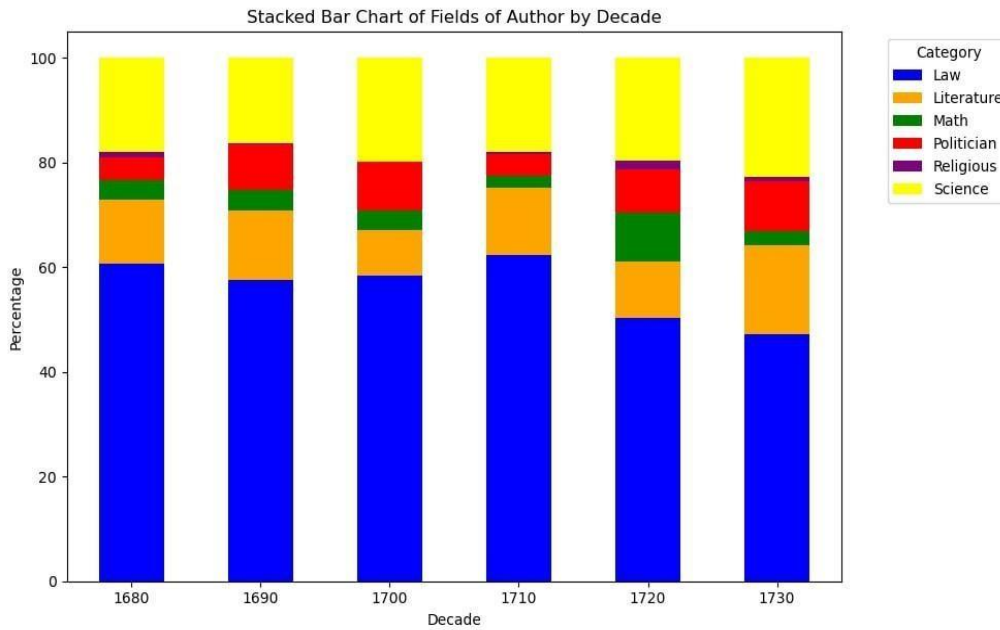


Figure 7: Fields of Authors in Acta by Decade

## 5.2. Trends in Science and Mathematics from the 1700s

Science and Mathematics show a noticeable rise in prominence in the early 18th century. This trend aligns with the Scientific Revolution and Enlightenment. Figures such as Isaac Newton and Leibniz contributed to this intellectual period by introducing ground-breaking concepts in physics, natural philosophy, and the discovery of calculus. The increase in these fields also reflects societal needs, such as advancements in medicine, navigation, and technology.

### 5.3. Decline in Religious Contributions from 1680

The decline in religious contributions over the decades highlights the gradual secularization of intellectual discourse during the Enlightenment period. As Enlightenment ideals gained popularity, the focus shifted from theological debates to scientific and legal inquiries. This shift mirrors the rise of Deism, which emphasized reason and natural law over traditional religious beliefs.

### 5.4. Comparative Analysis of Pages and Authors

A comparison of the percentage distribution of pages and authors by category reveals similar patterns. However, the slightly larger proportion of pages devoted to Science suggests that scientific contributions required more detailed analysis and explanation, reflecting the complexity and novelty of the topics.

## 6. HISTORICAL CONTEXT AND BROADER IMPLICATIONS OF DATA MINING FINDINGS

The trends observed in *Acta Eruditorum* reflect the intellectual and cultural transformations of early modern Europe:

- **Enlightenment Influence:** The rise of Science and Mathematics journals aligns with Enlightenment ideals during that period, emphasizing empirical evidence and rationality.
- **Legal Reforms:** The dominance of Law throughout the 5 decades *Acta* covers aligns with the need for legal and administrative stability in the post-Westphalian order.
- **Decline of Religion:** The diminishing focus on religious topics illustrates the secularization of intellectual life during the Enlightenment.

Figure 8 is another chart produced by the data collected from our Excel spreadsheet. This time, a Stacked Bar chart represents the percentage distribution of pages containing each profession category per decade.

Figure 9 is the chart produced by the French Academy of Science data. It is a Stacked Bar chart representing the percentages of different profession categories per decade.

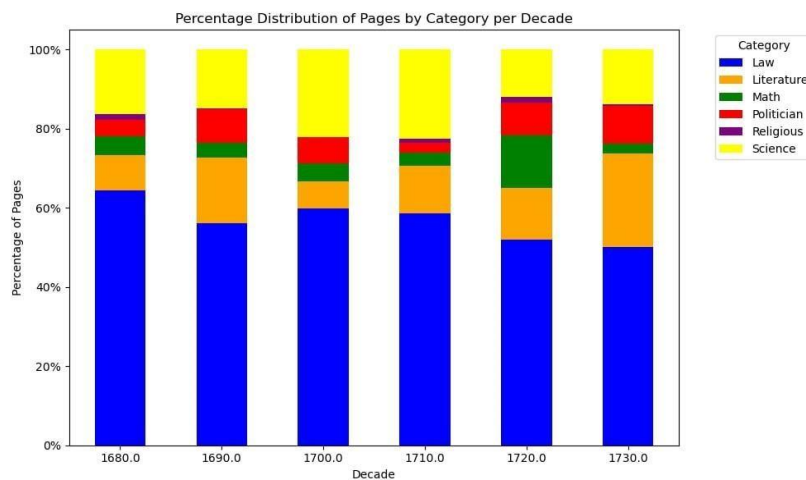


Figure 8: Percent Distribution of Pages by Category in Acta



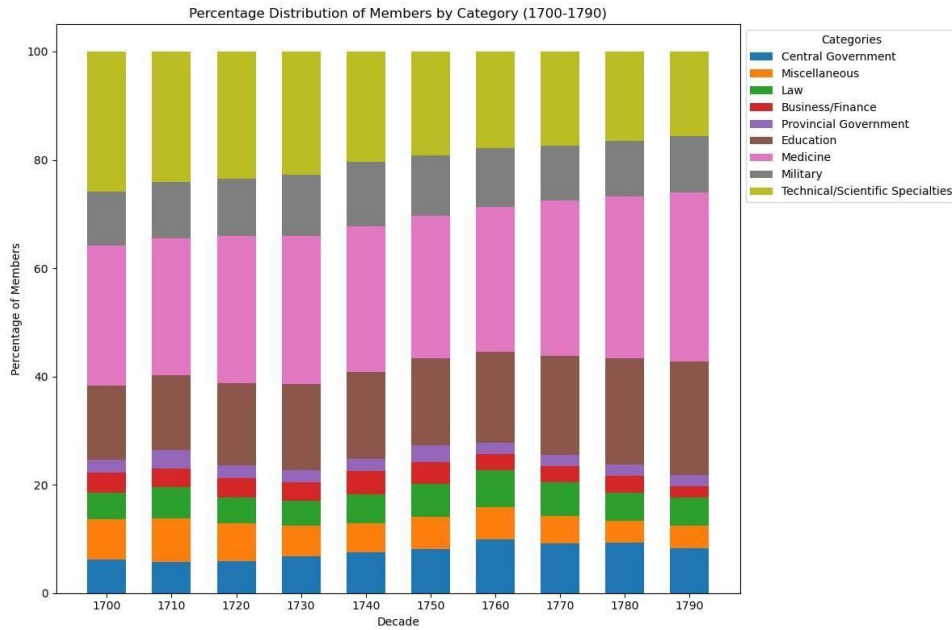


Figure 9: Percent Distribution of French Academy by Category

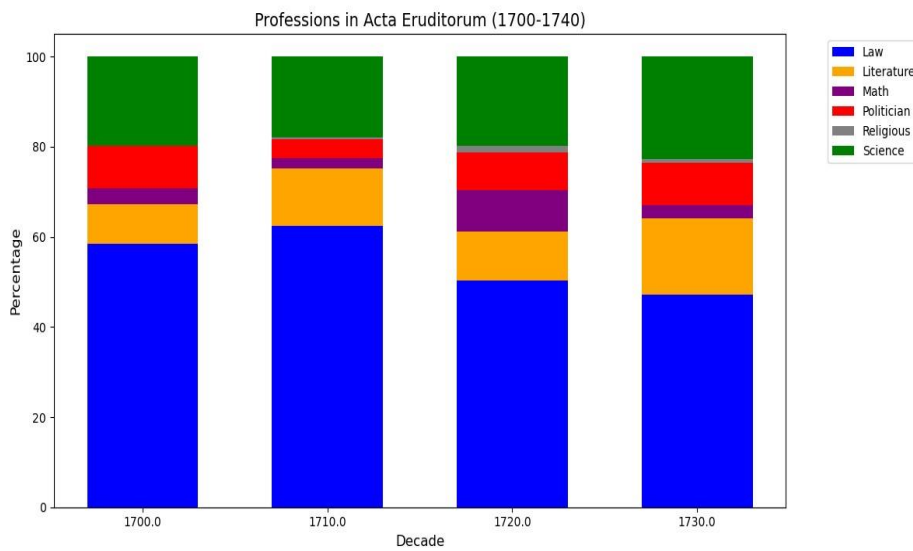


Figure 10: Percent Distribution of profession in Acta by Category

## 7. UNCOVERING SIMILARITIES AND DIFFERENCES BETWEEN GERMAN AND FRENCH ACADEMIES

The French Academy of Sciences, established in 1666, offers a useful point of comparison. Unlike the *Acta Eruditorum*, the Academy focused more on natural and applied sciences, reflecting state interests in fields such as botany, chemistry, and astronomy. Membership was exclusive and closely tied to state funding, in contrast to the broader and more open platform of *Acta Eruditorum*. The research carried out by the French Academy of Sciences and the professions they focused on was more influenced by the needs of the government. Acta was the

opposite and was more of a textbook for sharing knowledge. Its change in professions focused on nongovernmental needs and more on intellectual change in the 18th century [7]

Both institutions prioritized science during the overlapping period of 1700-1730, but the French Academy displayed greater variability in smaller categories, such as Medicine and Provincial Government as seen in Figure 9. This difference underscores the role of the Academy in advancing state-driven scientific research, whereas *Acta Eruditorum* served as a hub for a wider range of intellectual pursuits.

The *Acta Eruditorum* textbook covers a shorter timeframe (1680-1730) compared to the French Academy of Science graph (1700-1790). For the **Acta Eruditorum**, in Figure 9 Science (yellow) and Law (blue) are consistently prominent across the decades. However, for the **French Academy of Science**, Technical/Scientific Specialties (yellow), Medicine (pink), and Provincial Government (brown) categories are more significant contributors overall.

Figure 10 is similar Figure 7. However, it is comprised to show only 1700-1730. This is to compare the overlapping years of *Acta* and the French Academy. Figure 11 is the same chart for the French Academy as Figure 10 for the German Academy. However, it is comprised to show only 1700-1740. This is to compare the overlapping years of *Acta* and

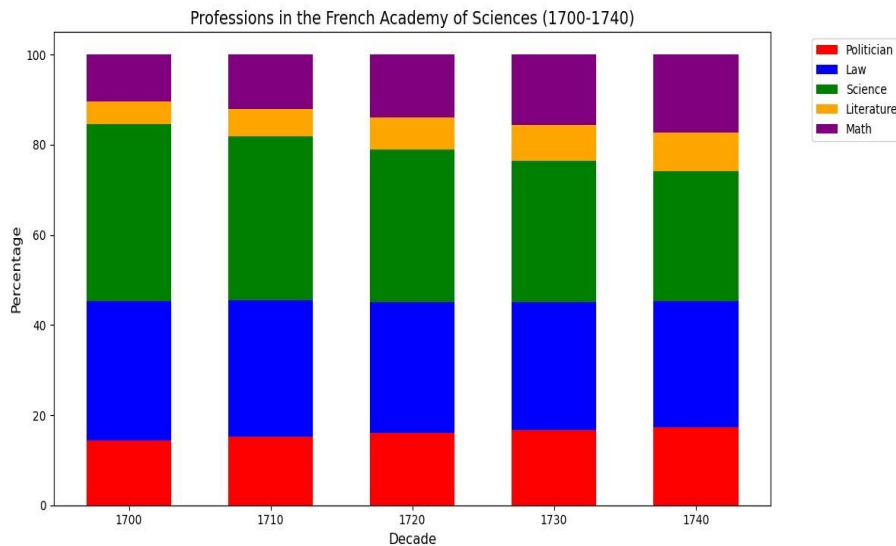


Figure 11: Percent Distribution of Pages by Category

the French Academy. Let's compare Figure 10 and Figure 11. We can see the frequency distribution of professions of *Acta Eruditorum* and the French Academy of Sciences from 1700 to 1730, highlighting the significant focus of both institutions on science, with scientific contributions consistently being prominent in their publications. We can further prove this point by showcasing two separate papers published by *Acta Eruditorum* and the French Academy. In *Acta Eruditorum*, Christian Wolff's paper "Vernunftige Gedanken von Gott, der Welt und der Seele des Menschen" [10], provided a framework for understanding natural laws and the structure of the universe, emphasizing logical reasoning and mathematical principles [2]. Meanwhile, Jean le Rond "d'Alembert's *Traité de l'équilibre et du mouvement des fluides*" published by the French Academy in the mid-18th century, applied analysis to fluid mechanics. In this work, d'Alembert examined the fundamental principles that dictate fluid equilibrium and motion, which addressed issues such as pressure, resistance, and the behavior of fluid particles under various

conditions [4]. His work not only advanced the theoretical understanding of fluid dynamics but also provided a foundation for practical applications in hydraulic engineering and physics. Both papers reflect their respective institutions' shared dedication to advancing science. Even though both institutions' approaches are different, this comparison also underscores how both institutions contributed to the Enlightenment's broader scientific progress, which, as mentioned before, supports the belief that *Acta Eruditorum's* concentration evolved over the 17th century.

## 8. CONCLUSION

What we found particularly interesting about the *Acta Eruditorum* is its wide variety of focuses. While often associated with mathematics due to its famous contributors like Leibniz and the Bernoulli family, the journal served as a platform for diverse intellectual pursuits, like physics, natural philosophy, and even theology. It embodied the intellectual ideas of the Enlightenment, showcasing empirical evidence and rational inquiry across disciplines. Another interesting aspect of *Acta* is its shift toward more diverse content marked a clear break from its earlier focus on theology, reflecting the cultural changes of the time.

## DECLARATIONS

**Conflict of Interest:** We declare that there are no conflicts of interest regarding the publication of this paper.

**Author Contributions:** All the authors contributed equally to the effort.

**Funding:** This research was conducted without any external funding. All aspects of the study, including design, data collection, analysis, and interpretation, were carried out using the resources available within the authors' institution.

**Data Availability (including Appendices):** All the relevant data, Python code for analysis, detailed annual tables and graphs are available via:

[https://drive.google.com/drive/folders/1Qo7X2p3nJN\\_nliUKmxnJUFRAKxIhJc6w?usp=sharing](https://drive.google.com/drive/folders/1Qo7X2p3nJN_nliUKmxnJUFRAKxIhJc6w?usp=sharing)

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