Journal of Research and Innovation in Technology, Commerce and Management
Vol. 2 Issue 7, July 2025, pp. 2752-2761
ISSN: 3049-3129(Online)

Mapping the Research Landscape of AI and ML Applications in Financial Services: Insights from a Bibliometric Study

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Cite as:
Aswini Asokan, & Dr. Valsalachandran K. (2025). Mapping the Research Landscape of AI and ML Applications in Financial Services: Insights from a Bibliometric Study. Journal of Research and Innovation in Technology, Commerce and Management, Volume 2(Issue 7), pp. 2752 –2761. https://doi.org/10.5281/zenodo.15806232

DOI: https://doi.org/10.5281/zenodo.15806232

Abstract

This study maps the global research landscape of Artificial Intelligence (AI) and Machine Learning (ML) applications in financial services through a comprehensive bibliometric analysis. It aims to identify prevailing themes, influential publications, collaborative networks, and emerging trends that are shaping the future of technology-driven financial services. The analysis is based on 140 scholarly documents—including journal articles, books, and conference papers—published in English between 2019 and 2025, and indexed in Scopus. These documents span diverse subject areas such as Computer Science, Engineering, Business, Management and Accounting, Economics, and Econometrics. The Bibliometrix package in R (via the Biblioshiny interface), VOSviewer, and Microsoft Excel, were used for performance analysis and science mapping techniques. VOSviewer was used to visualize keyword co-occurrence networks and thematic clusters. The findings highlight the growing significance of AI and ML in enhancing operational efficiency, improving decision-making, optimizing customer experiences, and strengthening risk management in financial services. The analysis also reveals research gaps and suggests directions for future studies, particularly in areas linking AI and ML applications with sustainable financial service models.This study contributes valuable insights for researchers, industry practitioners, and policymakers by offering a structured overview of the knowledge base and trends in this rapidly evolving field. It serves as a strategic reference point for guiding future research and fostering innovation in the financial services sector through AI and ML technologies.

ISSN: 3049-3129(Online)

Keywords
Artificial Intelligence, Machine Learning, Financial Services and Bibliometric analysis.

1. INTRODUCTION

The financial sector is undergoing significant transformations as a result of the proliferation of Artificial Intelligence (AI) and Machine Learning (ML). Automation in professional financial services and the workplace is being facilitated by artificial intelligence and machine learning. Additionally, the diverse functions of integrating these technologies into the financial sector. Detecting fraud activities and streamlining the overall process are among the most critical responsibilities that have been evaluated [1].These technologies are currently being employed in a variety of capacities, including enhancing the quality of customer service provided by institutions and facilitating the more efficient management of risks by companies. Artificial intelligence (AI) advancements will enable banks and other financial institutions to implement innovative products and services, and, more importantly, to withstand disruptions to their customers' experiences [2].Given their increasing significance, it is imperative to gain a more comprehensive understanding of the evolution of research in this field. Banking and other financial sectors will be able to implement innovative products and services and, more importantly, sustain disruptions to their client experiences as a result of advancements in machine learning (ML)[3].

Regulatory stipulations were identified as critical determinants that affect the integration and impact of AI and ML within financial markets. In response to the changing technological landscape, it is necessary to modify the current regulatory and supervisory frameworks. In order to guarantee the ethical and responsible application of AI and ML technologies, regulators must establish explicit guidelines and norms.[4]. Financial cybersecurity employs artificial intelligence (AI), machine learning (ML), and network tools to safeguard data despite an increase in digital threats. To mitigate cybercrime on unregulated platforms, banks must implement sophisticated technology in response to the increasing volume of online transactions. These technologies are instrumental in the detection of fraud, the protection of sensitive data, and the assurance of safer financial operations[5].Banking services are being enhanced by the implementation of new technologies, which facilitate the management of transactions and enhance their accuracy and efficiency. They assist in the administration of savings, loans, cards, overdrafts, and wealth, thereby bolstering the overall banking system[6].

This study examines published work from a variety of sources to examine global research on AI and ML in financial services. The study emphasises broader research patterns and connections across topics and authors, rather than solely concentrating on technical aspects. It highlights the areas

that have garnered the most attention, those where collaborations are robust, and those that require further exploration. This work endeavours to encourage future research and generate novel concepts regarding the application of AI and ML in the financial services sector by providing a concise summary of current research trends. It also aspires to promote the creation of financial systems that are more accessible, reliable, and efficient in the future.

2. METHODOLOGY

The Scopus database was utilised to source data for this bibliometric analysis, which covers the period from 2019 to 2025. The keywords "AL" (Artificial Learning), "ML" (Machine Learning), and "financial services" were employed for the search. Articles, book chapters, conference papers, reviews, and volumes (140 documents) were analysed. The data was processed using the Bibliometrix package in R, which was accessed through the Biblioshiny interface. Bibliometrics employs quantitative techniques to analyze bibliographic information, providing valuable methods for organizing and classifying data within a specific scientific domain[7]. This allowed for a detailed performance analysis and scientific mapping. Thematic clusters were identified and keyword co-occurrence networks were visualised using VOSviewer, which provided valuable insights into the relationships between key terms and emerging research areas. Figure 1 shows the 140 documents about the keyword search that were listed in the SCOPUS over the period. Furthermore, the data was organised and refined using Microsoft Excel, which enabled a more comprehensive comprehension of the field's trends and patterns. This method facilitated a thorough analysis of the primary research themes, collaborations, and developments in the field of Artificial Intelligence and Machine Learning, as well as their application in the financial services sector.

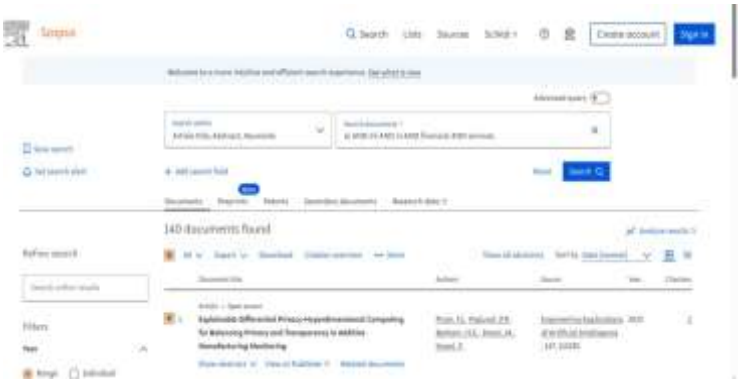


Figure 1. Search result

3. RESULTS AND DISCUSSION

3.1 Main information

Table 1 provides a summary of a dataset, which spans from 2019 to 2025, containing 140 documents retrieved from 117 references. A high annual growth rate of 32.86% is demonstrated by the dataset, which has an average document age of 1.81 years and an average of 7.9 citations per document. The dataset includes 455 "Author's Keywords" and 801 "Keywords Plus." A total of 476 authors contributed, with 15 authors producing single-authored documents. Collaboration is prevalent, with an average of 3.5 co-authors per document and 22.14% international co-authorship. Articles, books, book chapters,

conference papers, conference reviews, and reviews comprise the document categories.

Table 1. Descriptive Statistical Information

Description	Results
MAIN INFORMATION ABOUT DATA	
Timespan	2019:2025
Sources (Journals, Books, etc)	117
Documents	140
Annual Growth Rate %	32.86
Document Average Age	1.81
Average citations per doc	7.9
References	0
DOCUMENT CONTENTS	
Keywords Plus (ID)	801
Author's Keywords (DE)	455
AUTHORS	
Authors	476
Authors of single-authored docs	15
AUTHORS COLLABORATION	
Single-authored docs	16
Co-Authors per Doc	3.5
International co-authorships %	22.14
DOCUMENT TYPES	
article	44
book	6
book chapter	31
conference paper	49
conference review	2
review	8

3.2 Most popular Sources

Table 2 highlights popular 10 significant publications contributing to the field of AI, machine learning (ML), and financial services research, which is undergoing accelerated evolution. The financial industry is being transformed by AI and ML, as explored in The Emerald Handbook of Fintech: Reshaping Finance by Emerald Publishing. Springer Science and Business Media has offered valuable insights into the role of advanced computational techniques in financial services through their Lecture Notes in Networks and Systems and the Communications in Computer and Information Science series. The cutting-edge research on AI and ML in enhancing financial services is highlighted in key conference proceedings, such as the 2024 IEEE 3rd World Conference on Applied Intelligence and Computing and the 4th International Conference on Sustainable Expert Systems. Furthermore, the utilisation of these technologies in the development of innovative financial solutions and the optimisation of capital markets is emphasised in journals such as Applied Sciences and Artificial Intelligence for Capital Markets. The next iteration of financial services is being driven by AI and ML, which is resulting in increased efficiency, automation, and personalisation.

Table 2. Popular journals published on AI and MI in Financial Services

Sources	Articles	Publisher
THE EMERALD HANDBOOK OF FINTECH: RESHAPING FINANCE	5	Emerald Publishing
LECTURE NOTES IN NETWORKS AND SYSTEMS	4	Springer Science and Business Media Deutschland GmbH
ACM INTERNATIONAL CONFERENCE PROCEEDING SERIES	3	Association for Computing Machinery
2024 IEEE 3RD WORLD CONFERENCE ON APPLIED INTELLIGENCE AND COMPUTING, AIC 2024	2	Institute of Electrical and Electronics Engineers Inc.
4TH INTERNATIONAL CONFERENCE ON SUSTAINABLE EXPERT SYSTEMS, ICSES 2024 - PROCEEDINGS	2	Institute of Electrical and Electronics Engineers Inc.
APPLIED SCIENCES (SWITZERLAND)	2	MDPI
ARTIFICIAL INTELLIGENCE FOR CAPITAL MARKETS	2	CRC Press
COMMUNICATIONS IN COMPUTER AND INFORMATION SCIENCE	2	Springer Science and Business Media Deutschland GmbH
COMPUTATIONAL INTELLIGENCE FOR AUTONOMOUS FINANCE	2	wiley
FINTECH APPLICATIONS IN ISLAMIC FINANCE: AI, MACHINE LEARNING, AND BLOCKCHAIN TECHNIQUES	2	IGI Global

1.1 Major Contributing Authors based on citation analysis

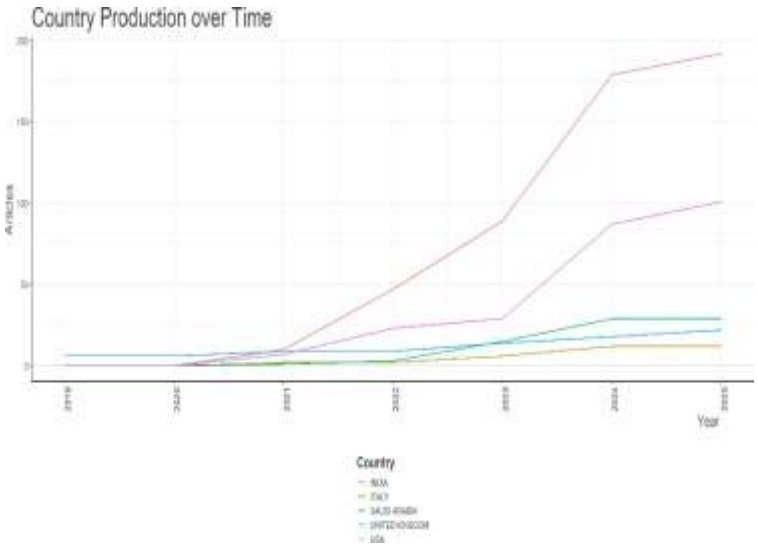
Table 3: List of Major Contributing Authors and Sources based on citation analysis

Authors	Title	Year	Source Title	Cited by
Khan A.A.; Laghari A.A.; Li P.; Dootio M.A.; Karim S.	The collaborative role of blockchain, artificial intelligence, and industrial internet of things in digitalization of small and medium-size enterprises[8]	2023	Scientific Reports	114
Kute D.V.; Pradhan B.; Shukla N.; Alamri A.	Deep Learning and Explainable Artificial Intelligence Techniques Applied for Detecting Money Laundering-A Critical Review[9]	2021	IEEE Access	87
Nguyen D.K.; Sermpinis G.; Stasinakis C.	Big data, artificial intelligence and machine learning: A transformative symbiosis in favour of financial technology[10]	2023	European Financial Management	55
Haldorai A.; Murugan S.; Ramu A.	Evolution, challenges, and application of intelligent ICT education: An overview[11]	2021	Computer Applications in Engineering Education	52
Fritz-Morgenthal S.; Hein B.; Papenbrock J.	Financial Risk Management and Explainable, Trustworthy, Responsible AI[12]	2022	Frontiers in Artificial Intelligence	42
Narsimha B.; Raghavendran C.V.; Rajyalakshmi P.; Kasi Reddy G.; Bhargavi M.; Naresh P.	Cyber Defense in the Age of Artificial Intelligence and Machine Learning for Financial Fraud Detection Application[13]	2022	International Journal of Electrical and Electronics Research	40
Mwase C.; Jin Y.; Westerlund T.; Tenhunen H.; Zou Z.	Communication-efficient distributed AI strategies for the IoT edge[14]	2022	Future Generation Computer Systems	39
Rawindaran N.; Jayal A.; Prakash E.	Machine learning cybersecurity adoption in small and medium enterprises in developed countries[15]	2021	Computers	37
Mahalakshmi V.; Kulkarni N.; Pradeep Kumar K.V.; Suresh Kumar K.; Nidhi Sree D.; Durga S.	The Role of implementing Artificial Intelligence and Machine Learning Technologies in the financial services Industry for creating Competitive Intelligence[16]	2022	Materials Today: Proceedings	36
Pattnaik D.; Ray S.; Raman R.	Applications of artificial intelligence and machine learning in the financial services industry: A bibliometric review[17]	2024	Heliyon	36

3.4 Countries' production over Time

The total number of articles published by different countries from 2019 to 2025 is depicted in Figure 2. India has experienced a substantial increase in the number of article publications, from 0 in 2019 to 192 by 2025. This is particularly noteworthy. Additionally, the United Kingdom exhibits a consistent increase, with 22 articles published in 2025. The United States experiences the most significant increase in publications, with a sudden jump from seven in 2021 to 101 in 2025, while Saudi Arabia and Italy demonstrate gradual growth.

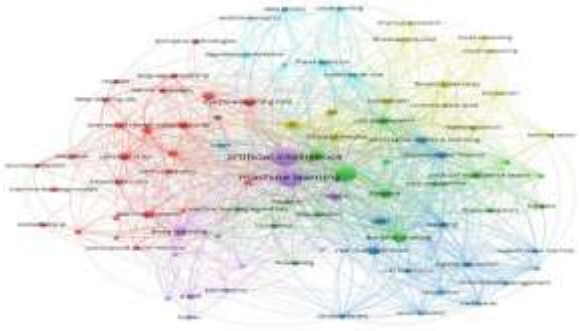
Figure 2: Major Countries with publications



3.5 Co-Occurrence Analysis

Co-occurrence analysis is a method that enables researchers to identify and visualize the relationships between key terms within a body of literature, offering valuable insights into emerging research trends and thematic connections [18]. The co-occurrence analysis map (Figure 3) of "AI and ML in Financial Services" research illustrates key themes and their interrelationships, shedding light on the central topics and their links within the field.

Figure 3 – Co-occurrence -Keyword network visualisation



In its analysis, Cluster 5 emphasises the significant connections between AI and machine learning (ML). AI is referenced in 85 links and occurs 53 times, suggesting a robust presence in the research landscape. In the same vein, ML is represented in 83 links and appears 52 times, resulting in a total link strength of 295. These metrics illustrate the growing influence of AI and ML in the field, which is indicative of their central role in shaping current research trends. In general, the map emphasises the cross- disciplinary nature and emerging trends in financial services, AI, and ML research.

3.6 Country collaboration Map

The international trend of academic research collaboration is reflected in the global research patterns in co-authorship[19], as illustrated by the Country Collaboration Map (Figure 4). It is essential to foster information exchange and facilitate expert interactions through collaborative efforts between countries and research organisations. These international partnerships enhance the visibility, exposure, and citation impact of research initiatives[20]. Furthermore, the map underscores the significance of collaborating with countries that have lower levels of co-authorship in order to expand the purview of global academic engagement and produce new research articles. The country collaboration data indicate a wide variety of international research partnerships, including co-authorship among countries such as Australia and Malaysia, Canada and Qatar, and China and Finland. The global reach and interdisciplinary nature of academic research is demonstrated by these collaborations, which each occur once. It is worth noting that countries such as India, Egypt, and China are frequently involved in the development of international research connections, which in turn leads to the rise of global knowledge exchange.

Figure 4: **Country Collaboration Map**

3.7 Word Cloud /Key Word Analysis

It is clear from Figure 5 that "machine-learning" (32) is the most frequently mentioned term in the word cloud data, underscoring its pivotal role in the current technological discourse. This is closely followed by "artificial intelligence" (24) and "machine learning" (21), underscoring the pervasive importance of intelligent systems. The emphasis on sophisticated computational models is further emphasised by technologies such as "deep learning" (13) (14). It is important to note that the terms "decision making"
(13) and "investments" (12) are indicative of the practical implementations of these technologies, particularly in fields that necessitate analytical precision. The financial industry is being significantly

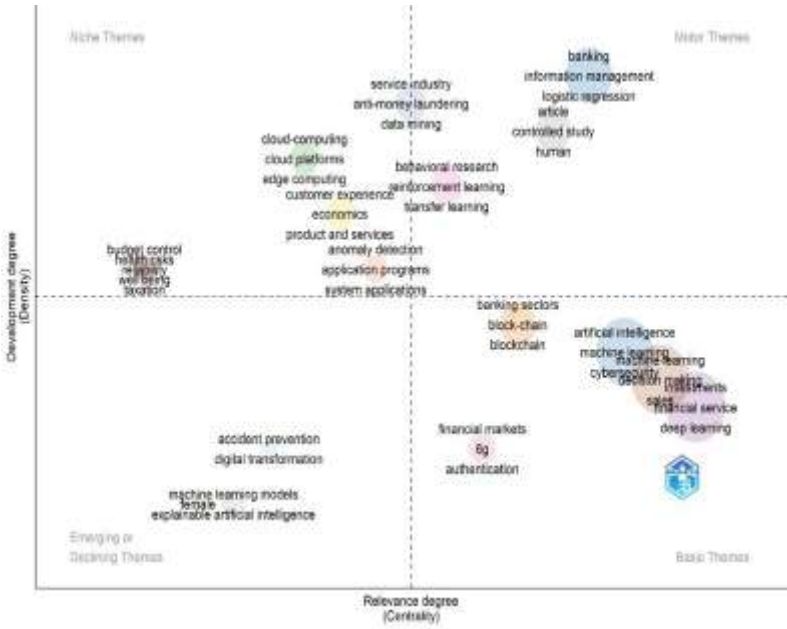
influenced by the integration of AI and machine learning, particularly in the optimisation of investment strategies and the enhancement of decision-making processes, as evidenced by the prominent appearance of the term "financial service" (10).

Figure 5: Word Cloud

3.8 Thematic Map

Thematic maps are organized into four thematic typologies, determined by their position within specific quadrants[21]. The classification of these themes is guided by two key criteria: centrality, which reflects the degree of interaction with other themes, and density, which indicates the theme's internal development and cohesion[22]. Figure 6 emphasises that "machine-learning" (32 occurrences) is the most central and influential term, located in Cluster 6. It has the highest betweenness centrality (3,306.510) and PageRank centrality (0.04), suggesting that it plays a significant connective role across a variety of topics. The extensive applicability of the concept is underscored by its close association with concepts such as "decision making" (13), "sales" (10), "adversarial machine learning" (8), and "risk management" (8), particularly in the financial sector. Furthermore, Cluster 2 includes "machine learning" (20) under the "artificial intelligence" classification, indicating a robust correlation between these disciplines. In general, the analysis indicates that machine learning is a critical factor in the advancement of AI applications, particularly in the areas of financial services, risk assessment, and decision-making processes.

Figure 6: Thematic Map



4. CONCLUSION

In conclusion, the transformative impact of Artificial Intelligence (AI) and Machine Learning (ML) in the financial services sector is demonstrated by the analysis of keywords and clusters. It is evident that ML is at the core of current innovations, as "machine-learning" has emerged as the

most frequently cited and centrally positioned term. This technology enables improved decision-making, risk management, fraud detection, and customer service. The synergistic impact of AI and ML is underscored by their close association, in which AI provides a broader framework and ML provides computational tools for real-time insights and automation. Financial institutions are progressively employing these technologies to enhance operational efficiency, enhance investment strategies, and ensure superior customer experiences. Through the lens of various clusters such as "artificial intelligence," "investments," and "machine-learning models," the incorporation of advanced and explainable ML algorithms is facilitating the development of more secure, inclusive, and intelligent financial systems. This development represents a substantial advancement in the direction of finance that is both resilient and adaptive, being driven by data and technology.

This study further substantiates the central role of machine learning and artificial intelligence in determining the technological evolution of financial services, leveraging the insights obtained from the bibliometric analysis. The practical relevance and interdisciplinary impact of these technologies are underscored by the high frequency and centrality of keywords such as machine-learning, decision making, risk management, and fraud detection, as visualised through VOSviewer. Thematic clustering also demonstrates a significant convergence between AI/ML tools and financial domains, suggesting their pervasive use in customer engagement, credit assessment, and investment strategies. The study highlights the increasing interest in scholarly and industrial solutions that are propelled by AI and ML by identifying prominent research themes and collaborations. This analytical approach not only validates the ongoing digital transformation in finance but also underscores the necessity of ongoing research and cross-sectoral collaboration to resolve emerging challenges and construct resilient, intelligent financial systems.

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