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International Journal For Research in Applied Science and Engineering Technology



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 13 **Issue:** VIII **Month of publication:** August 2025

DOI: https://doi.org/10.22214/ijraset.2025.73640

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 13 Issue VIII Aug 2025- Available at www.ijraset.com

A Literature Review on the Applications of Machine Learning in Finance

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Abstract: ***The financial sector has witnessed a transformative shift with the integration of Machine Learning (ML), driving advancements in decision-making, automation, and risk mitigation across various domains [3], [5]. However, the rapid growth of ML research in finance has led to fragmented knowledge, making it difficult for students and researchers to identify trends, challenges, and relevant contributions [1], [4]. This study presents a systematic literature review of 20 peer-reviewed research papers published between 2015 and 2025, focusing on five core domains: Algorithmic Trading & Stock Prediction, Credit Risk & Loan Prediction, AI in Banking & Customer Relationship, Chatbots & AI Adoption, and General ML in Finance. Each paper was analyzed based on application, methodology, dataset usage, and performance evaluation techniques. To further enhance accessibility and engagement, we developed a web-based Literature Review Hub — a user-friendly platform that categorizes and presents the surveyed papers, enabling streamlined access to ML-in-Finance research. This study offers a consolidated understanding of the current landscape, uncovers research gaps, and proposes directions for future innovations in AI-driven financial solutions.***

Keywords: ***Machine Learning, Finance, Stock Prediction, Credit Risk, Chatbots, Literature Review, Financial AI, Research Survey***

I. INTRODUCTION

The financial services industry has experienced a profound transformation over the past decade due to the rapid adoption of Artificial Intelligence (AI) and Machine Learning (ML) technologies [1], [2]. From real-time stock trading to credit scoring, ML models are increasingly being used to improve accuracy, efficiency, and scalability in decision-making processes. Traditional rule-based financial systems are being replaced by adaptive models capable of learning from large, high-dimensional datasets and identifying complex patterns that are often invisible to human analysts [3].

Among the many areas in finance impacted by ML, algorithmic trading, risk assessment, fraud detection, and customer service automation stand out as key domains of innovation [4], [5]. The proliferation of research in these areas has contributed significantly to the development of advanced ML frameworks capable of handling structured financial data, textual news, sentiment signals, and even conversational queries through natural language processing (NLP) techniques. However, the wide dispersion of research across subdomains and the diverse range of methodologies have created a need for a unified understanding of the field's current status and future directions.

This paper aims to bridge that gap by presenting a structured literature review of 20 recent research papers focused on the application of ML in finance. The reviewed studies are categorized into five thematic domains: (1) Algorithmic Trading & Stock Prediction, (2) Credit Risk & Loan Prediction, (3) AI in Banking & Customer Relationship, (4) Chatbots & AI Adoption, and (5) General ML Applications in Finance. For each category, we analyze the ML techniques employed, the types of data used, key findings, and performance metrics reported.To enhance usability and serve as a resource for students, researchers, and practitioners, we also developed a Literature Review Hub — a web-based platform that organizes and presents these research papers in an accessible, filterable interface. This tool complements our survey by enabling users to explore categorized insights without navigating multiple research repositories. The goal of this study is to synthesize the evolving landscape of ML applications in finance, highlight notable trends, and identify underexplored areas that warrant.

II. METHODOLOGY

This study adopts a systematic approach to review and analyze contemporary research on the applications of Machine Learning (ML) in the financial sector. The methodology involves three primary phases: paper selection, categorization, and analysis, all designed to ensure relevance, coverage, and depth across diverse financial subdomains.

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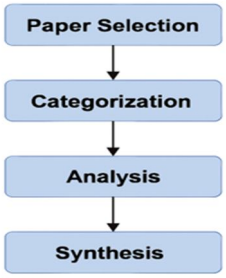


Fig.1. Workflow of the literature review methodology

A. Paper Selection Criteria

To ensure quality and academic rigor, we curated a dataset of 20 peer-reviewed research papers published between 2015 and 2025. The sources include reputable databases such as IEEE Xplore, SpringerLink, ScienceDirect, ACM Digital Library, and Google Scholar. The selection was guided by the following inclusion criteria:

The paper must focus on the application of ML or AI techniques within a financial domain

The paper must be published in an academic journal, conference proceeding, or preprint server with a significant citation footprint. The work must demonstrate clear methodological implementation of ML, including model selection, training, evaluation, or deployment.

Papers that lacked technical depth, were opinion-based, or focused purely on economic theory without ML implementation were excluded from this study.

B. Keyword Strategy

We used targeted search queries combining terms such as:"machine learning in finance," "AI in banking," "stock price prediction ML," "credit risk scoring," "chatbots in fintech," "financial fraud detection," and "deep learning for financial forecasting." Boolean operators and publication filters (2015–2025, English language, full-text available) were applied to refine results.

C. Categorization Domains

After selection, each paper was manually categorized into one of the following five domains based on its primary application area:

1) Algorithmic Trading & Stock Prediction: Focused on time series forecasting, price prediction, and trading strategy optimization.
2) Credit Risk & Loan Prediction: Addressed borrower risk classification, loan default prediction, and credit scoring.
3) AI in Banking & Customer Relationship: Explored ML use cases in customer retention, segmentation, and personalization.
4) Chatbots & AI Adoption: Investigated NLP models, conversational agents, and AI adoption strategies in finance.
5) General ML Applications in Finance: Covered diverse topics like fraud detection, anomaly detection, and portfolio management.

This taxonomy enables a thematic analysis of trends, data types, algorithms, and business impact across financial subfields.

D. Evaluation Parameters

Each paper was further analyzed using a structured template capturing:

1) ML Models Used: e.g., Decision Trees, SVM, Random Forest, Neural Networks, LSTM, etc.
2) Data Sources: Public datasets, proprietary financial data, simulated data, etc.
3) Performance Metrics: Accuracy, Precision, Recall, F1-score, AUC, RMSE, etc.
4) Challenges Addressed: Model interpretability, data sparsity, latency, privacy, etc.
5) Outcome & Business Impact: Feasibility, improvements over baselines, and real-world relevance.

This structured framework facilitates a comparative view of research approaches and highlights underexplored research avenues.

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III. SYSTEM DESIGN & IMPLEMENTATION

To complement the literature survey and enhance accessibility, we developed a web-based platform named the Literature Review Hub. This platform acts as a digital repository that organizes, categorizes, and presents research findings on the application of Machine Learning (ML) in Finance, covering five core domains. The system is designed to help students, researchers, and professionals navigate the rapidly growing landscape of ML research in finance.

A. System Overview

The Literature Review Hub is designed as a frontend-centric web application that allows users to browse and filter through categorized research papers based on application domains, methodologies, and key insights. The system structure consists of:

1) Frontend Layer: Built using React.js for dynamic rendering and Tailwind CSS for responsive design.
2) Data Storage: Research data is stored as structured JSON objects containing metadata such as title, author(s), publication year, summary, category, and source link.
3) Deployment: Hosted on Vercel, enabling reliable access and fast global delivery.
4) Backend (Scalable): While the current version does not require a backend, scalability is planned using Node.js for future enhancements such as user authentication or cloud data storage.

B. Software & Hardware Requirement

Component	Requirement
Frontend Framework	React.js
Styling Library	Tailwind CSS
Hosting Platform	Vercel (Free tier for deployment)
Development Machine	Laptop with at least 1 GB RAM and 20 GB Storage

C. Key Features

1) Categorized-Filtering
Users can view papers by the following ML-in-finance categories:
- Algorithmic Trading & Stock Prediction
- Credit Risk & Loan Prediction
- AI in Banking & Customer
- Relationship
- Chatbots & AI Adoption
- General ML in Finance

2) Interactive-UI-Components
Each paper is presented in a responsive card layout with:
- Title and publication info
- Short summary
- Research gaps identified
- Source link to full paper

3) Search-Functionality
Users can search by keywords (e.g., "LSTM", "credit", "fraud", etc.) to filter papers in real-time.

4) Dark-Mode-Support
Enhances user experience during extended reading sessions.

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D. Implementation Stack

Layer	Technology
UI	React + JSX
Styling	Tailwind CSS
Icons	Lucide-react
Data Format	JSON
Deployment	Vercel
Optional Backend	Node.js (planned)

E. Future Scalability

The system is designed with scalability in mind. Planned enhancements include:

1) Integration with a backend and database for dynamic content updates
2) AI-based summarization of uploaded papers
3) User login and bookmarking features

F. Academic Utility

The Literature Review Hub provides:

1) A centralized platform for curated research
2) A model for similar domain-specific literature tools
3) Support for research projects, thesis writing, and classroom study

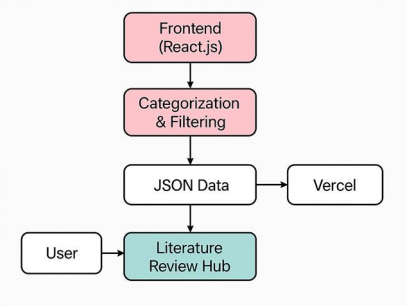


Fig 2 : System Design and Implementation

IV. RESULTS

This section presents the consolidated insights derived from the literature survey of 20 research papers, categorized into five major application areas of Machine Learning (ML) in the financial domain. Each domain is analyzed based on its problem scope, ML techniques used, performance outcomes, and identified research gaps. The results also include observations from implementing the Literature Review Hub as a knowledge dissemination tool.

A. Algorithmic Trading & Stock Prediction

This was the most widely explored domain, with multiple studies applying supervised and deep learning techniques such as LSTM, ANN, SVM, and hybrid models for forecasting stock prices [1]–[10].

Key observations include:

- LSTM and hybrid models combining CEEMDAN+LightGBM consistently outperformed traditional regression-based techniques.
- Most models were trained on historical price datasets without integrating real-time market or geopolitical signals.
- Research gaps include limited interpretability, poor handling of extreme market volatility, and lack of real-time adaptability.

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B. Credit Risk & Loan Prediction

This domain focused on loan default classification and credit scoring, utilizing models such as Logistic Regression, Decision Trees, Random Forest, Naive Bayes, and XGBoost.
Key results include:

- Ensemble methods and feature selection improved prediction accuracy, with some models reaching over 94% accuracy.
- A few studies explored explainable AI using LightGBM and CatBoost, although deep learning adoption was relatively limited.
- Research gaps include lack of fairness evaluation, absence of economic cost analysis (false positives vs. false negatives), and limited use of alternative data sources.

C. AI in Banking & Customer Relationship

ML in customer analytics, churn prediction, and service personalization was addressed using clustering, classification models, and CNN-based sentiment-analysis.
Highlights:

- ML-enhanced digital marketing systems significantly improved customer retention and engagement.
- Adoption of AI in Indian banking remains hindered by privacy concerns, bias in data, and low awareness.
- Studies called for stronger regulatory compliance and ethical AI adoption strategies.

D. Chatbots & AI Adoption

This category focused on NLP-driven financial chatbots and AI adoption challenges, particularly in Indian and global banking systems.
Key findings:

- Barriers to chatbot adoption included lack of trust, poor language handling, and privacy violations.
- Regulatory frameworks like GDPR and CCPA were not sufficiently addressed in many systems.
- There's a strong need for emotion-aware conversational AI and regional language support in financial chatbot development.

E. General ML Applications in Finance

Studies in this group covered fraud detection, risk modeling, and finance-specific NLP tools using a wide variety of algorithms including SVM, Random Forest, and deep learning variants.
Insights:

- These applications show promise in detecting fraudulent behavior and processing unstructured data.
- However, issues such as model transparency, deployment feasibility, and generalizability across sectors remain open research challenges.

F. Impact of the Literature Review Hub

The Literature Review Hub was successfully developed and deployed to complement this study. Key outcomes include:

- Simplified access to categorized and summarized research papers for academic use.
- Improved understanding of ML techniques, gaps, and best practices in finance-focused ML research.
- Provided a scalable foundation for future inclusion of additional papers, AI-powered summaries, and interactive features.

V. CONCLUSION

The integration of Machine Learning (ML) in the financial sector has brought forth significant advancements in predictive modeling, customer personalization, fraud detection, and algorithmic trading. Through this systematic literature review, we examined 20 recent research papers across five key domains: Algorithmic Trading & Stock Prediction, Credit Risk & Loan Prediction, AI in Banking & Customer Relationship, Chatbots & AI Adoption, and General ML Applications in Finance. Each category revealed unique strengths, evolving techniques, and specific research gaps that highlight both the progress and limitations of current ML applications.

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Our analysis confirms that ML models — especially deep learning and hybrid ensemble approaches — have shown considerable improvements in forecasting accuracy and automation within financial tasks. However, several critical challenges persist, including model interpretability, real-time adaptability, data privacy, and regulatory compliance. These issues must be addressed for ML systems to achieve large-scale, trustworthy deployment in real-world financial environments. In addition to the survey, we developed the Literature Review Hub, a React-based digital platform that enables structured access to the reviewed papers. The tool enhances academic accessibility and provides a scalable foundation for future research exploration and digital resource management. Overall, this study contributes to a consolidated understanding of the ML landscape in finance, offering insights into current methodologies, practical outcomes, and open research questions. It sets the stage for future innovation by encouraging the development of interpretable, ethical, and scalable ML systems tailored to the complexities of modern finance.

VI. LIMITATIONS

Despite the comprehensive nature of this study, several limitations were encountered that may influence the generalizability and scope of the findings.

1) *Limited Dataset of Research Papers*: The literature review is based on 20 selected papers published between 2015 and 2025. While care was taken to ensure diversity across application domains, this number may not fully capture the breadth of global research in ML applications in finance.
2) *Categorical Overlap in Domains*: Some research papers addressed multiple financial use cases, making it challenging to strictly assign them to a single domain. This may have introduced categorization bias during domain-specific analysis.
3) *Lack of Quantitative Meta-Analysis*: This study presents qualitative insights, trends, and challenges but does not include statistical meta-analysis (e.g., effect sizes, cross-paper benchmarking) due to the diversity of datasets, metrics, and ML models across papers
4) *Tool Scalability and Feature Constraints*: The current version of the Literature Review Hub is a frontend-only prototype with static data rendering. It lacks dynamic paper uploading, user interaction tracking, and AI-based summarization capabilities.
5) *Evolving Nature of Financial AI Research*: As the field of ML in finance continues to evolve rapidly, the findings of this review may become outdated unless the tool and dataset are continuously updated. Emerging models like foundation models, LLMs, and agentic AI were not extensively covered.
6) *Regional and Language Bias*: Most of the reviewed studies are from English-language journals and international conferences. Research from non-English or region-specific sources may have been unintentionally excluded.

VII. FUTURE ENHANCEMENTS

Based on the limitations identified and the current state of Machine Learning (ML) applications in finance, several future enhancements are proposed to expand the scope, accuracy, accessibility, and impact of this research and the accompanying Literature Review Hub platform.

A. Expansion of Research Dataset

The literature base can be expanded to include 100+ research papers, covering a broader spectrum of domains such as fraud detection, financial NLP, regulatory compliance models, and sustainable finance. Including more recent work on generative AI, graph-based ML, and LLMs in finance would provide deeper and more current insights.

B. Integration of Quantitative Meta-Analysis

Future iterations of the review can include statistical meta-analysis of model performance across papers, such as:

- Cross-domain comparison of accuracy, precision, recall, RMSE
- Aggregation of dataset usage patterns
- Correlation between model complexity and generalizability

C. Backend-Driven Platform Upgrade

To support real-time updates and dynamic content, the Literature Review Hub can be extended with a backend system (Node.js +MongoDB/PostgreSQL).

This would enable:

- Paper upload and management dashboard
- User authentication and bookmarking

D. AI-Powered Summarization and Tagging

The platform can be enhanced using NLP and LLMs to:

- Auto-generate summaries for newly added papers
- Extract keywords and categorize papers automatically
- Provide sentiment or topic modeling for clustering

E. Mobile and Edge Accessibility

Developing a mobile-optimized or PWA version would improve accessibility for students and researchers on-the-go. Lightweight versions could be made compatible with low-resource environments.

F. Academic Collaboration and Open Access

The Literature Review Hub could be scaled as an open-access academic tool integrated with:

- ResearchGate, arXiv, and Semantic Scholar APIs
- GitHub-based paper repositories
- Student research submission portals

G. Explainability and Visual Insights

Future versions can include interactive visual dashboards showing:

- Citation networks
- Domain distribution maps
- Timeline of ML adoption trends

These would support visual learning and deeper understanding of the evolving research landscape.

These enhancements aim to transform the Literature Review Hub from a static repository into a dynamic, intelligent research assistant, fostering collaboration, continuous learning, and ethical innovation in ML-driven financial systems.

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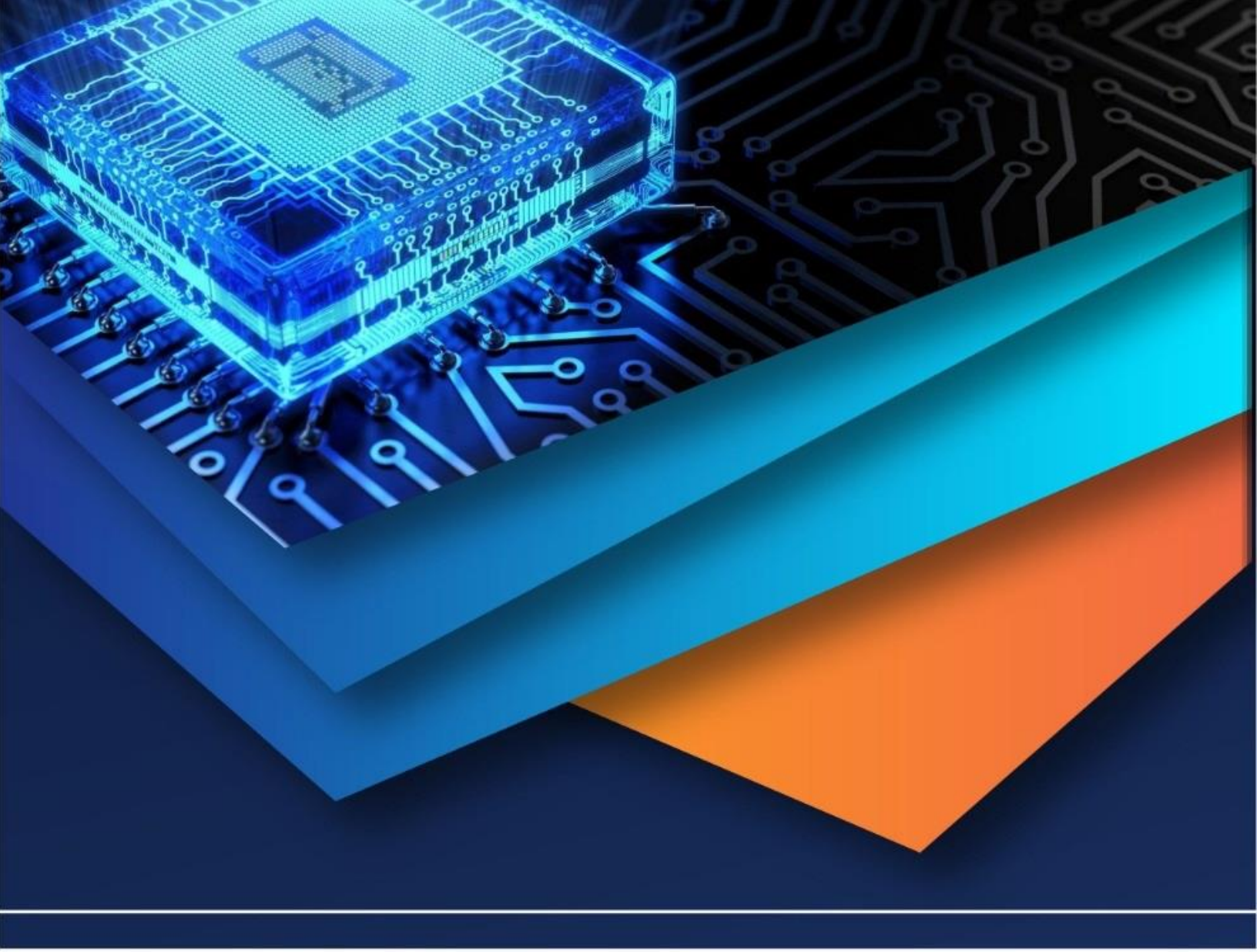
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