

ENHANCING FINANCIAL ECOSYSTEM STABILITY WITH BPNN-BASED RISK ASSESSMENT

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Abstract

Financial stability and growth depend on accurate risk assessment. This study builds a pre-warning system for financial risks using a Backpropagation Neural Network (BPNN). Financial data, economic indicators, and historical information are collected and analyzed by the BPNN to identify potential problems early on. The BPNN is then optimized using a genetic algorithm to improve its accuracy. Compared to existing methods, our system achieves significantly higher accuracy (97.94%), leading to better risk management and promoting a more stable financial ecosystem.

Keywords: Financial risk assessment, Backpropagation Neural Network (BPNN), financial pre-warning system, early risk detection

I. INTRODUCTION

Imagine the financial system as a complex machine. Its smooth operation depends on a healthy environment, influenced by factors like government policies, technological advancements, and even the global economy. As this financial machine grows bigger, so do the potential risks of breakdowns. Strong risk management is crucial to keep things running smoothly and prevent financial crises. The internet has revolutionized how we handle money. Online financial services offer exciting new investment opportunities, but also come with unique risks. Unlike traditional banks, internet finance moves fast, and regulations are still catching up. This rapid pace makes it difficult to predict potential problems using older methods of risk assessment, which often rely on experts' opinions. These methods can be biased and might not capture the full picture in this new digital landscape.

Here's where Artificial Intelligence (AI) steps in. AI is a powerful technology that's changing many fields, including finance. It allows us to analyze data more objectively and identify risks in a smarter way. This research proposes a brand-new early warning system for internet financial investments. This system uses a specific type of AI called a Back propagation Neural Network (BPNN) to detect potential problems before they happen.

This research brings three important advancements to the table. First, we'll analyze how the financial world is adapting to the internet age, offering valuable insights to create a secure and stable online financial system. Second, our study breaks new ground by being the first to apply BPNN technology specifically to internet finance in China. This tackles the unique risks of this sector and fills a critical gap in existing research. Finally, we'll utilize a cutting-edge optimization technique called a genetic algorithm to further refine our pre-alarm system's accuracy. This innovative approach will surpass traditional methods, setting a new benchmark for managing risks in the ever-evolving world of internet finance. Throughout this paper, we'll delve deeper into these areas. We'll explore existing methods of risk assessment and highlight the originality of our approach. We'll then explain how BPNN works and how it forms the foundation of our pre-alarm system. Next, we'll present the results of a simulation experiment to demonstrate its effectiveness. Finally, we'll conclude by summarizing our contribution to internet finance research and suggesting areas for further exploration.

II. RELATED RESEARCH

A. Assessing Risks in the Digital Age

The rise of internet finance has opened exciting opportunities for investment and growth in high-tech industries. However, it also introduces new risks. To navigate this evolving landscape, businesses need effective methods to assess potential risks, especially when evaluating project investments. Financial risk assessment is a broad term used across various industries to analyze the likelihood of losses on investments, loans, or assets. It helps businesses make informed decisions about risk management strategies and investment value. By assessing risks, businesses, governments, and investors can anticipate potential negative impacts on their operations.

This section explores existing research on risk assessment and forecasting in the financial sector. Landi et al. (2022) investigated how corporate social and environmental responsibility (ESG) practices influence investor risk perception for publicly traded companies. Their study examined whether companies with strong ESG performance, measured by environmental, social, and governance factors, experience lower market risk. Another area of research focuses on consumer behavior. Torabi and Bélanger (2022) investigated how online reviews and social media influence consumer purchasing decisions. Their findings suggest that risk tolerance and openness to new information are crucial factors in consumer choices.

Researchers are also exploring cutting-edge techniques for financial risk assessment in the digital age. Liu et al. (2022) and Aslam (2023) utilized Back propagation Neural Networks (BPNN), a type of deep learning model, to analyze and predict internet financial risks. Their studies highlighted the potential of deep learning for early warning systems by analyzing historical data like China's GDP, currency, loan records, and stock market performance. Other research explores the psychological aspects of financial decision-making. Gao et al. (2021) investigated how receiving an IPO allotment in China – a random event – affects investor trading behavior. Their findings suggest that receiving an allotment can lead to overconfidence, causing investors to trade more and experience greater losses.

Singh et al. (2022) and Shamrooz et al. (2021) explored the use of Deep Learning (DL), Reinforcement Learning (RL), and Deep Reinforcement Learning (DRL) techniques for information-based decision-making in finance. These techniques offer new possibilities for areas like market-making, option pricing, and hedging. Several studies have also explored combining machine learning with other methods like fuzzy logic and evolutionary algorithms for a more comprehensive analysis of financial markets. Lin et al. (2021) reviewed the use of machine learning and fuzzy set theory for risk assessment in excavation projects. Their research highlights the potential of these methods for early warning systems in various industries. Kumar et al. (2022) offered a modern perspective on sustainable finance by analyzing research using big data analytics and AI. Their study explores key areas like socially responsible investing, green financing, and impact investing. While existing research provides valuable insights into risk identification and prevention, there is a need for further development of risk pre-alarm systems specifically for internet finance. This paper addresses this gap by utilizing BPNN principles for financial investment risk assessment and proposes an internet financial risk warning system based on BPNN. We further enhance the system's efficiency by incorporating genetic algorithms, a soft computing technique.

B. The Current State and Importance of Financial Ecosystems in China

China's market economy is continuously growing, and internet finance is emerging as a significant player. Unlike traditional finance, internet finance relies on the internet for transactions. As the economy matures, the government plays a crucial role in transforming into a service-oriented entity that integrates seamlessly with market needs. This is essential for fostering a healthy regional financial ecosystem. In the early stages of industrialization, the government played a central role in controlling, owning, and utilizing resources. Profits generated during this resource-to-capital transformation period enabled rapid capital accumulation, essential for industrial growth. However, today's competitive market environment presents challenges. Financially troubled institutions might struggle to exit the market due to "survival of the fittest" dynamics. This can negatively impact the financial ecosystem by perpetuating a flawed financial structure that affects the entire system.

Market-oriented reforms in China's economy were largely driven by government policies and regulations. Traditionally, the government held significant influence over resource allocation, including bank credit issuance. This resulted in unbalanced economic growth between eastern and

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western regions. Differences in economic structure, openness to trade, cultural traditions, and even geography have led to significant variations in regional financial ecosystems.

The quality of a financial ecosystem directly impacts loan risk and the percentage of non-performing loans. A healthy ecosystem is vital for the financial industry's growth. By prioritizing and nurturing financial ecosystem development, the financial sector can establish and implement sustainable development practices. This ensures financial regulations are effectively applied, leading to long-term, stable growth. Unmitigated financial risks can ultimately trigger financial crises, severely impacting social and economic progress. Building a strong financial ecosystem plays a crucial role in ensuring the steady development of the nation, society, and the financial sector itself. A thriving financial ecosystem facilitates the internet financial economies controlled and methodical growth, promoting sustainable and stable financial development.

The financial industry holds the nation's credit resources. Strengthening the financial ecosystem is essential for aligning micro-business activity within the financial sector with the broader needs of the macroeconomy. This improves credit resource allocation efficiency and provides robust financial support for economic and social stability. Financial system reform is currently at a critical stage, with initiatives like the shareholding reform of state-owned banks and pilot programs for rural credit cooperatives. These reforms rely heavily on a favorable financial environment, which a well-constructed financial ecosystem can provide. Therefore, building a healthy financial ecosystem is crucial for the success of financial system reform. The financial industry requires a positive ecological environment to fulfill its role as the core of the modern economy. A strong financial ecosystem promotes efficient allocation of financial resources, safeguards their value, encourages wealth creation, and mitigates financial risks, fostering stability in the financial and economic landscape.

III. METHODOLOGY

A. Building an Early Warning System for Internet Financial Risks

This research proposes a novel approach for financial risk assessment in internet finance, aiming to create a highly accurate pre-alarm system (Zhang et al., 2022). The strategy combines machine learning with Genetic Algorithms (GA) for optimization. The study emphasizes the importance of a healthy financial ecosystem for financial and economic growth. They define a financial ecosystem and its role in a healthy financial landscape.

The image below illustrates the proposed model. First, financial data is collected from 30 different internet platforms. This data includes earning reports, economic indicators, relevant political events, and historical financial data. The data is then preprocessed using techniques like cleaning, normalization, and handling missing values. Next, a Back propagation Neural Network (BPNN) architecture is designed with one input layer, two hidden layers (although this can be adjusted by the GA), and an output layer. The collected data is then split into training and testing sets. The BPNN is trained on the training data. Before testing the trained model, a GA is used to optimize its parameters. Key parameters considered for optimization include the number of hidden layers, the number of neurons in each layer, and the learning rate. Once optimized, the model's performance is evaluated on the testing data set using metrics like accuracy, F1-score, precision, and recall.

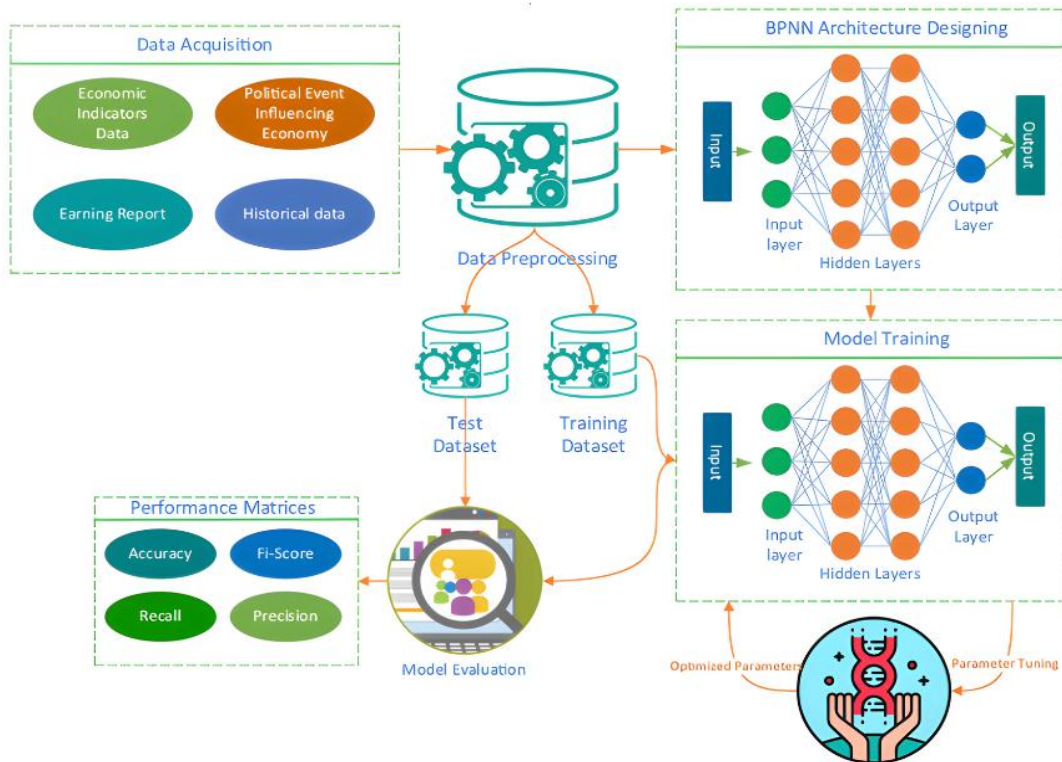


Fig. 1 Proposed financial risk pre-alarm mechanism

B. Why BPNN?

BPNNs have unique functionalities compared to general artificial neural networks. They can handle complex, non-linear relationships between input and output data. Through training on historical data, BPNNs can learn from the data and retrieve valuable information. This makes them well-suited for tasks like pattern recognition, classification, and data compression. Once trained, the model can be used to predict the risk of new data by feeding it into the model.

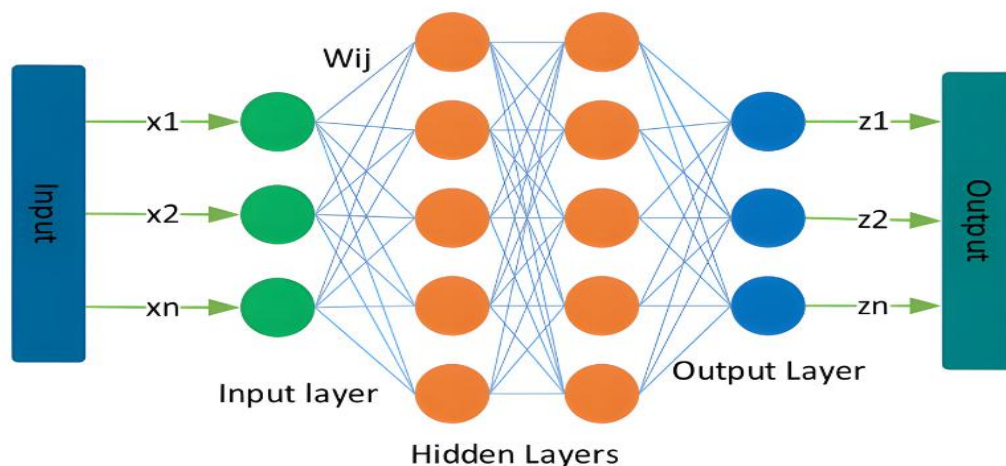


Fig. 2 Basic architecture of BPNN

The BPNN works by adjusting weights and thresholds between layers to minimize the difference between the predicted and actual output. Mathematical formulas are provided to explain how these weights and thresholds are calculated and updated during training.

Internet finance is a rapidly growing sector, but it also faces challenges due to the lack of mature credit reporting and supervision systems. This makes pre-alarm systems for internet financial risks crucial. From a pattern recognition perspective, risk warning can be seen as a process of identifying and classifying patterns. Since internet finance carries greater risks than traditional finance, the pre-alarm method needs to be constantly evolving and dynamic to adapt to the changing market landscape. Neural networks, like BPNNs, can mimic the experience, knowledge, and intuition of human experts, leading to more objective pre-alarm results.

IV. ANALYSIS AND DISCUSSION

This research examined the effectiveness of a new approach for assessing financial risks in internet finance, aiming to create a highly accurate pre-alarm system (Zhang et al., 2022). The approach combines machine learning with Genetic Algorithms (GA) for optimization. The study emphasizes the growing popularity of internet finance, especially among younger demographics. However, the rapid development of this sector has outpaced the establishment of efficient regulatory and oversight frameworks, leading to potential financial risks.

We analyzed data from 30 different internet platforms. This data included financial reports, economic indicators, relevant political events, and historical financial information. After preprocessing the data, they designed a Backpropagation Neural Network (BPNN) architecture with one input layer, two hidden layers (although this can be adjusted by the GA), and an output layer. A Genetic Algorithm (GA) was then used to optimize the BPNN's parameters, such as the number of hidden layers, the number of neurons in each layer, and the learning rate. The model's performance was evaluated using metrics like accuracy, F1-score, precision, and recall. The results showed that the BPNN successfully learned from the training data and achieved good accuracy in matching the actual financial data. It was also effective in predicting short-term trends. This is likely because BPNNs are complex systems with strong adaptability and self-learning capabilities.

The study acknowledges that the selection of the sample data is crucial for building an effective model. Additionally, there is a lack of standardized risk classification for financial institutions, making risk assessment a complex task. Future research could focus on improving the model's generalizability by using even larger and more diverse datasets. Additionally, collaboration with financial institutions could help to establish more standardized risk assessment procedures.

This research demonstrates the potential of BPNNs combined with Genetic Algorithms for creating highly accurate financial risk pre-alarm systems in internet finance. This is crucial for ensuring a healthy financial ecosystem and protecting investors from potential risks. The proposed model outperforms existing methods and offers a promising approach for early risk detection in the rapidly evolving world of internet finance.

V. CONCLUSION

This study introduces a novel method for assessing financial risks in internet finance through a Back propagation Neural Network (BPNN) optimized with a genetic algorithm. The BPNN-based system achieves an impressive accuracy rate of 97.94%, significantly surpassing traditional risk assessment methods. This high level of accuracy makes the system an effective tool for early detection of potential financial risks, thereby enhancing overall risk management. The integration of Artificial Intelligence, particularly BPNNs, offers substantial improvements in addressing the complexities and rapid changes inherent in internet finance. Optimizing the BPNN with genetic

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algorithms further enhances the system's accuracy and efficiency, setting a new benchmark in the field of risk assessment. The research highlights the critical importance of a robust financial ecosystem for promoting sustainable economic growth and stability. Developing and implementing such advanced systems enables financial institutions to align better with broader economic objectives, improve resource allocation, and mitigate risks more effectively. Looking ahead, future research should focus on incorporating larger and more diverse datasets and collaborating with financial institutions to establish standardized risk assessment procedures. These steps will enhance the model's generalizability and practical application. Overall, this study makes a significant contribution to internet finance by providing a reliable tool for early risk detection, thereby fostering a more secure and stable financial environment.

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