IOCRF 2025 Conference

The 1st International Online Conference on Risk and Financial Management

17–18 June 2025 | Online

MDPI

Comparing the predictive abilities of artificial intelligence and traditional econometric models

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INTRODUCTION & AIM

- Background: Predicting stock prices is crucial for investors, analysts, and policymakers.
- Motivation: While traditional econometric models have been widely used, they often rely on strong assumptions that may not hold in real-world financial data. For data containing complex nonlinear patterns and relationships, neural networks may be able to provide better predictive performance.
- Aim: Investigates the forecasting accuracy of stock prices and indices in developed and developing countries, covering a range of market capitalisations.

METHOD

- Country selection: for the purpose of ensuring data quality and data completeness: Two developed markets: UK, US; Two emerging markets: China, India.
- Data source: LSEG.
- Data Types: Open prices, High prices, Low prices, Close prices.
- Time range: from 30 June, 2010 to 30 June, 2023
- In this study, I focus on neural network models, particularly Radial basis function networks
- Benchmark model: ARIMA, Holt-Winters

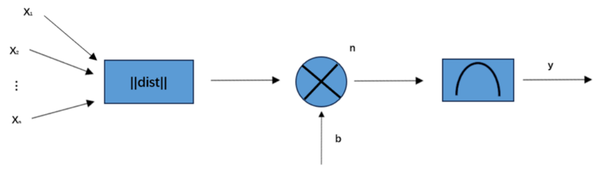

Fig.1: The neuron model of RBFNN, where ||dist|| represents the distance between the input vector and the weight vector; b represents the threshold, which is used to adjust the sensitivity of neurons.

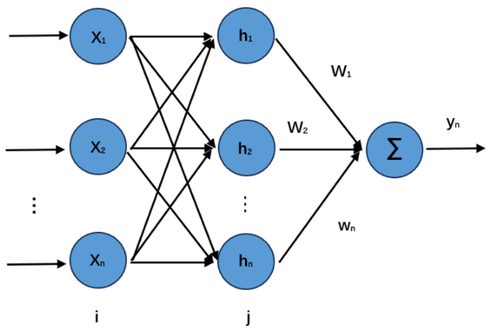

Fig. 2: Structure of RBFNN model with n inputs.

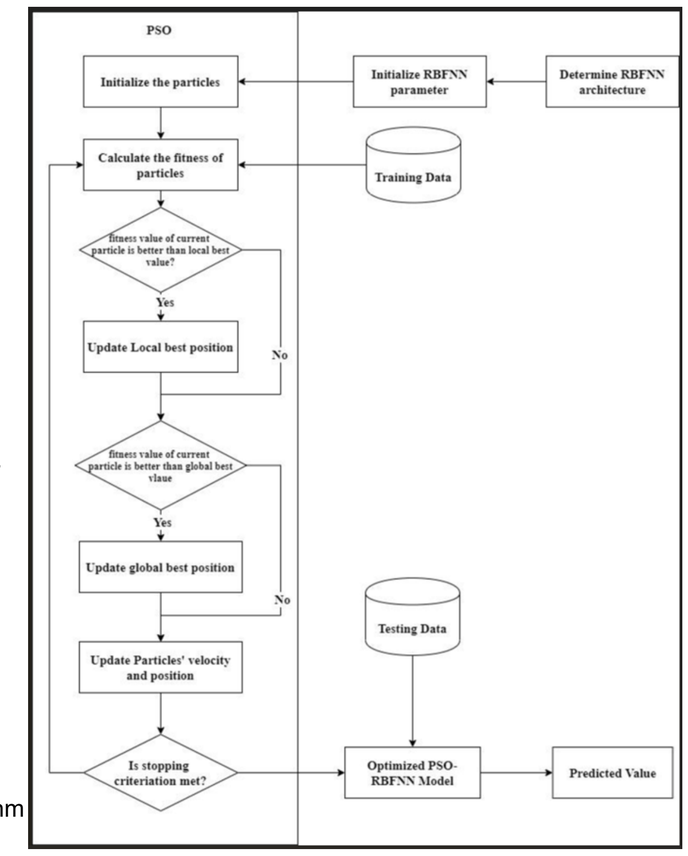

Fig. 3: The Particle Swarm Optimisation algorithm

RESULTS & DISCUSSION

- Error term: MAE, RMSE, MAPE, R-Squared, MaxAE, and normalised BIC;
- From the company's perspective:
  - Developed countries: econometrics models often perform better than neural network models, while the PSO-RBFNN model outperforms the traditional RBFNN model in the vast majority of cases;
  - Emerging markets: neural network models outperform econometrics models, PSO-RBFNN performs better or similarly than RBFNN in the vast majority of cases.
- From the indices' perspective: neural networks are able to provide better predictive performance, except for the S&P 600, and all of the selected indices for India.
- According to the Efficient Market Hypothesis (EMH), developed markets exhibit relatively high information efficiency, which reduces the presence of detectable nonlinear patterns. In such environments, econometric models may offer a competitive advantage. In contrast, emerging markets are often less efficient, and this inefficiency can introduce exploitable nonlinearities. These nonlinear structures tend to favour neural network models.
- Additionally, in this study, the PSO-RBFNN model consistently outperforms or matches the performance of standard RBFNN across most cases, suggesting that parameter tuning plays a key role in enhancing the RBFNN model's stability and accuracy.

CONCLUSION

- Neural networks are able to provide better predictive performance for data containing complex nonlinear patterns and relationships to some extent.
- While markets in developed countries are generally more efficient, small-cap indices tend to exhibit less efficient due to their high volatility and lower trading volumes. These characteristics are frequently linked to certain time-series patterns in prices that can be captured and used in forecasting by time-series econometrics models.

FUTURE WORK / REFERENCES

Future work includes incorporating alternative features (e.g., news sentiment), testing advanced architectures (e.g., Transformers), and expanding to other markets.