

Predictive Modeling of Financial Markets Using Neural Networks: Architectures, Challenges, and Empirical Analysis

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Abstract – Financial markets are highly unstable and dynamic thereby offering a challenging task, which financial prediction tries to conquer, but correct forecasting stands out as the key point in risk management, algorithmic trading, and investment planning. In this research paper, an inquiry will be made into the neural network (NN) in applying predictions to financial data using neural networks instead of the traditional statistical models and to take advantage of the ability of deep learning to foresee non-line trends and time constraints in high-dimensional data. We give a full Taxonomy of neural Architectures (Multilayer Perceptrons (MLPs), Recurrent Neural Networks (RNNs), Long Short-Term Memory (LSTM) networks, Convolutional Neural Networks (CNNs), and hybrid networks), and we compare and contrast them in terms of their suitability in Stock price forecasting, market trend classification and volatility prediction. The article integrates concepts and results related to existing literature in the field of anomaly detection, time-series analysis, and responsible AI in order to have a strong predictors framework. The main implementation issues that we discuss consist of: preprocessing of noisy financial series data, feature engineering (including technical indicators and other data), the interpretability of models, and overfitting in non-stationary contexts. Empirical study is done and it proves that the model based on LSTM with attention mechanisms can make better predictions of the movements of the S&P 500 index than some benchmark models such as ARIMA and the classic SVM. Nevertheless, constraints, such as being sensitive to hyperparameters, cost, and the black-box problem are also critically observed in the paper. It concludes with a message stating that although neural networks present useful tools to do financial prediction, their practical application must be attentively intertwined with subject matter expertise, sound testing on whether the implementation fulfills market efficiency, and conscientiousness to ethical principles to avoid unwanted systemic hazards.

Keywords - Financial Prediction, Neural Networks, Deep Learning, LSTM, Time-Series Forecasting, Algorithmic Trading, Market Efficiency, Explainable AI (XAI).