

Gold Price Prediction Using Deep Learning: A Hybrid Approach

Master's Thesis Proposal Presentation

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Abstract

Gold's role in the global marketplace is that of a crucial financial commodity, serving as a safeguard against market turmoil. Yet, predicting its price remains a challenge due to intricate economic and psychological factors. This work aims to address this issue by proposing a novel deep learning architecture based on LSTM and XGBoost which incorporates Sentiment Analysis. Focusing on gold's historical price data, macroeconomic variables like inflation and unemployment and sentiment analysis from current financial news, the model intends to surpass the limits of existing prediction approaches. Enhanced accuracy will serve as a result in the design of gold trading systems for gold traders and investors.

Introduction

Gold has offered a security measure and a way of protection in uncertain times economically. A variety of aspects impact gold including its price, currency volatility, sentiment in market, currency change, and international conflicts.

Gold prices react to varying conditions. XGBoost is also expected to outperform all of 'traditional' machine learning models when constituted with adequate data.

In gold price prediction, conventional methods like ARIMA and linear regressions do not encompass the complexity of gold price movements and relationships between factors.



Numerical and sentiment data could provide additional predictive contexts to get accuracy needed, thus enhancing traditional economic frameworks.

Using deep learning through multi-layer perceptron neural networks, gold price trends and patterns can be identified, hence improving prediction effectiveness.

The focus is placed on constructing a model that streamlines forecasting through implemented approaches such as integrating LSTM with XGBoost along with sentiments-based analytics.



Problem Statement

The prediction of gold prices is an extremely challenging due to a wide variety of factors, such as economic indicators, geopolitical changes, and investor behavior due to their nonlinear and volatile nature.

Traditional static models like linear regression and ARIMA do not attend to the nonlinear relationships and the lags or dependencies in time series data.

Over reliance on quantifiable data means even modern machine learning models miss out on the market's emotional and psychological sides.



This research has tried to fill in the gap with a hybrid model that combines:

- Sentiment analysis directed towards the psychology of the market's movement and the impact of timely news on gold prices.
- LSTM for time series analysis
- Feature based forecasting with XGBoost

The objective is to create a system which improves context in accuracy while supporting real-world investment situations.



Objectives



This research focuses on building a hybrid deep learning model capable of accurately predicting gold prices. The main objectives are:

- ✓ Create a hybrid prediction model with LSTM, XGBoost, and sentiment analysis.
- ✓ Gather gold price history and macroeconomic indicators, then perform data preprocessing.
- ✓ Calculate sentiment scores from financial news to model investor behavior.
- ✓ Analyze model precision through descriptive accuracy measures: RMSE, MAE, and MAPE.
- ✓ Prove the model's utility in practical investment decisions.

Research Questions

This study seeks to address the following key questions:

- 1.Can gold prices be accurately predicted using a hybrid model** that combines LSTM, XGBoost, and sentiment analysis?
- 2.How does the performance of the proposed model compare** to traditional forecasting methods such as ARIMA and linear regression?
- 3.What is the impact of sentiment analysis** on the overall prediction accuracy of gold prices?
- 4.Which evaluation metrics** (RMSE, MAE, MAPE) are most effective in measuring model performance?
- 5.To what extent can the model improve investment decisions** in real-world financial environments?

Significance of the Study

◆ Theoretical Contribution



This research contributes to the academic field by integrating deep learning with sentiment analysis, addressing a gap in existing models that rely solely on numerical data. It adds a new layer of understanding by combining economic and psychological market dimensions.

◆ Practical Impact



The hybrid model helps investors, traders, and financial institutions make better decisions by offering more accurate, real-time predictions. It enhances risk management, market timing, and investment strategies.

◆ Bridging the Gap



This study bridges the gap between AI-based modeling and real-world application by creating a model that reacts dynamically to both structured and unstructured data.

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Literature Review – Key Research Streams



LSTM-Based Models

- LSTM outperformed ARIMA and SVM in capturing sequential patterns in gold price data (Khan et al., 2021)
- CNN-BiLSTM architecture showed strong performance but high computational cost (Ahmed et al., 2023)
- LSTM and GPU were sensitive to market volatility but lacked robustness in unpredictable conditions (Sharma & Das, 2022)



Hybrid Models

- LSTM + XGBoost improved structured data prediction but lacked sentiment inputs (Sharma & Patel, 2022)
- Random Forest with macroeconomic data enhanced accuracy but suffered from overfitting
- Attention-based models reduced forecasting errors but lacked external validation (Jain et al., 2023)



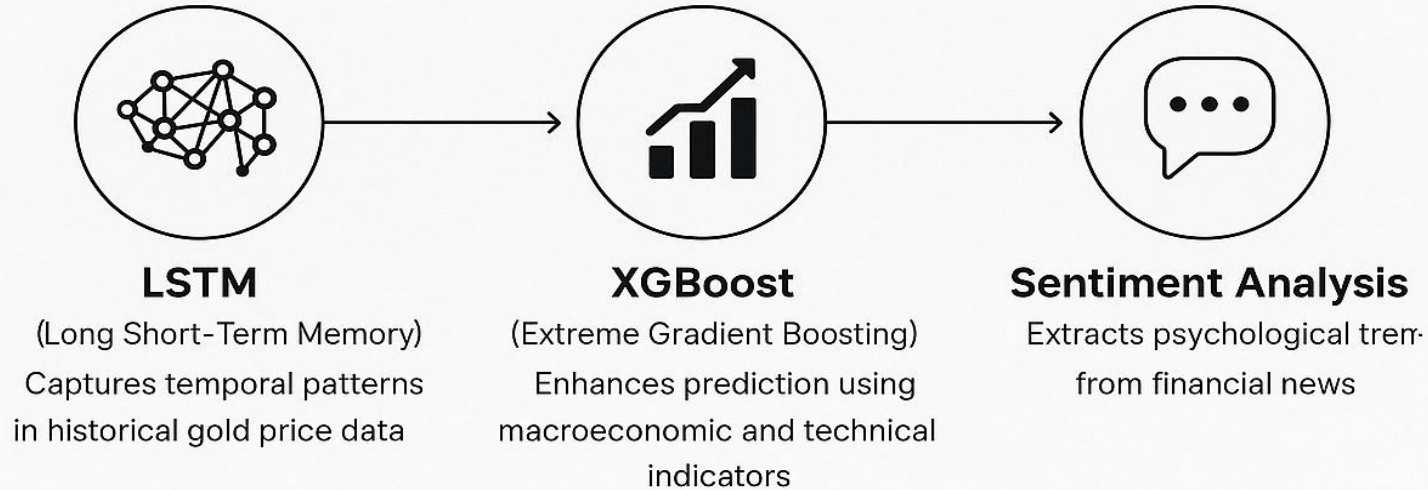
Sentiment-Enhanced Models

- BERT-based sentiment scores improved market mood tracking (Wang et al., 2023)
- Social media sentiment boosted forecasting during volatile periods (Li et al., 2022)
- Reddit-based models captured crowd behavior but lacked price structure integration (Fernandez & Rao, 2023)

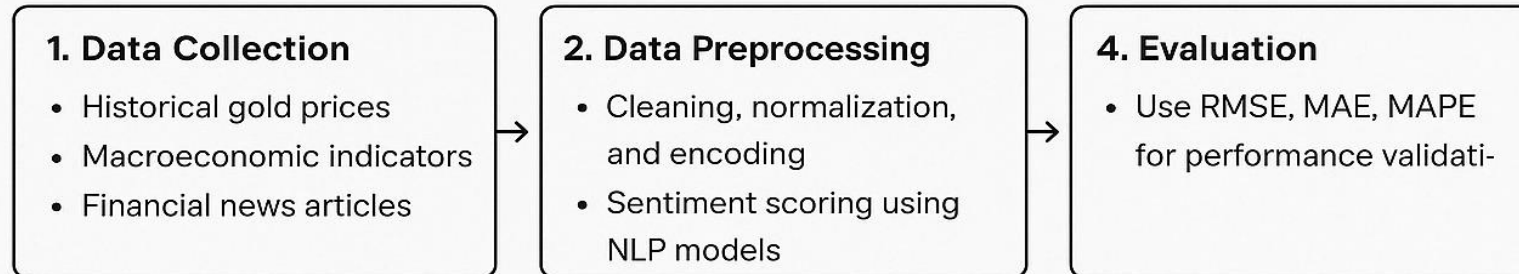
Research Gap

- ◆ Most prior models depend on either historical numerical or sentiment data — never both at the same time.
 - ◆ To the best of our knowledge, not too many have merged sophisticated deep learning techniques, like LSTMs, with ensemble methods such as XGBoost in gold price forecasting.
 - ◆ There are still gaps and a lack of literature where real-time sentiment analysis of financial news is integrated into AI-driven forecasting models.
 - ◆ Current models do not have the capability to adapt to changes in underlying sentiment that reflect psychological and market conditions.
- ➡ This research aims to fill this gap by developing a model that incorporates LSTM networks for time-series data sentiment analysis of gold prices, feature-learning using XGBoost, and market psychology to improve accuracy.

Methodology Overview



Workflow:



Expected Result

The hybrid model is expected to surpass the performance of classical techniques such as ARIMA and Linear Regression as well as solo ML implementations like LSTM on forecasting accuracy.

- ✓ Responsiveness to market shocks should improve with the addition of real-time sentiment data.
- ✓ A combination of exogenous unstructured and underlying structured data yields improved aggregate prediction performance.
- ✓ Better accuracy will be shown through lower RMSE, MAE, and MAPE values resulting from less precision errors.
- ✓ The model is intended to help decision-making for investors and analysts who operate in the highly volatile gold markets.

Scope and Limitations

◆ Scope

- The research only aims at predicting global gold prices with hybrid modeling based on Artificial Intelligence.
- The data sources include:
 - Financial market data (gold prices from 2014 –12/2024)
 - Macroeconomic data
 - Financial articles (written in English)
- The model uses both structured (numeric) and unstructured text sentiment data.

◆ Limitations

- Sentiment analysis uses English only and therefore does not capture the psychology of the market for many countries.
- Significant computational investment required could diminish cost-effectiveness for instantaneous decision-making scenarios.
- Does not consider other commodities (silver, oil) or high-frequency/intra-day trading.
- Optimization of the model is still vulnerable to black swan events and other unforeseen disruptions to the market.

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Contribution & Innovation

Hybrid Intelligence

An uncharted combination of the temporal dynamics of LSTM, the structural learning capabilities of XGBoost, behavioral insight from sentiment analysis, and synergy for more advanced approaches from earlier studies.

Emotion + AI = Market sophistication

Incorporating socio-financial deep learning improves forecasting precision for estimating the price of gold.

Data Fusion on Dimensions

The combination of structured numerical data and unstructured real-time text like news sentiment enables a more complete understanding of the dynamics of the market.

A Tool for Practitioners

The model is designed for the practical world, not just academic exercises: it should enhance portfolio management and crisis prediction.