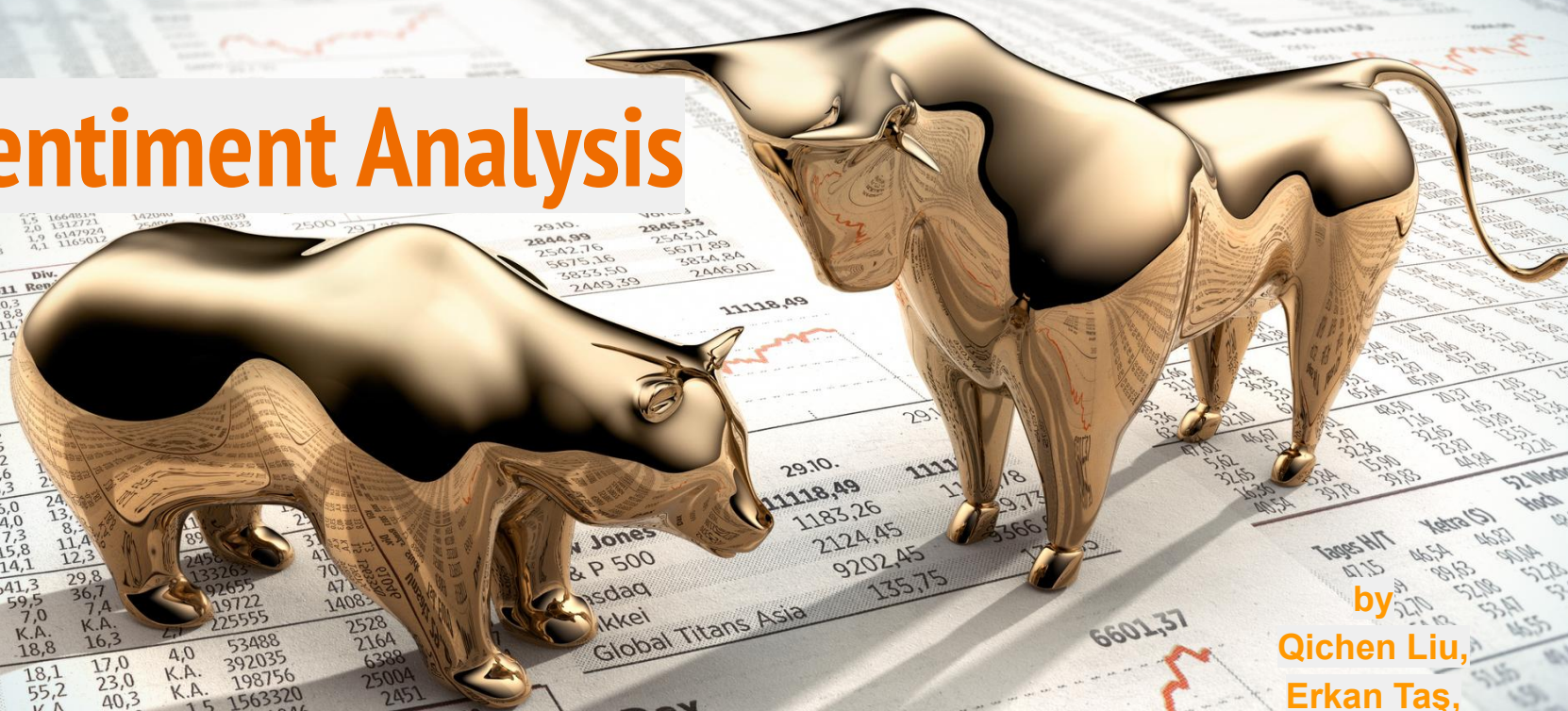


Sentiment Analysis



by
Qichen Liu,
Erkan Taş,
Jing Wen,
Nicholas Xu

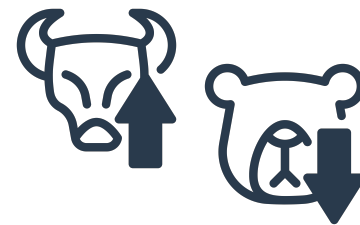
For Financial Markets

Pitch

LLM to analyze unstructured insights and data on financial news and social media.



Integrate **market sentiment** into investment decision-making.



Maximized **productivity** and **profits.**



Customers & Market Opportunity



Customer:

- Corporate analysts and investors.
- Individual investors.
- Financial news and media.

Business Model:

- Subscription
- Commission

Global Market: **\$10.7 Billion by 2032**

MVP

On our website: stock-sentiment-analysis-one.vercel.app

1. Create a portfolio by adding stocks.



3. Understand market dynamics.

2. Monitor market sentiment live or over time.



4. Get recommendation on buy, hold, sell.

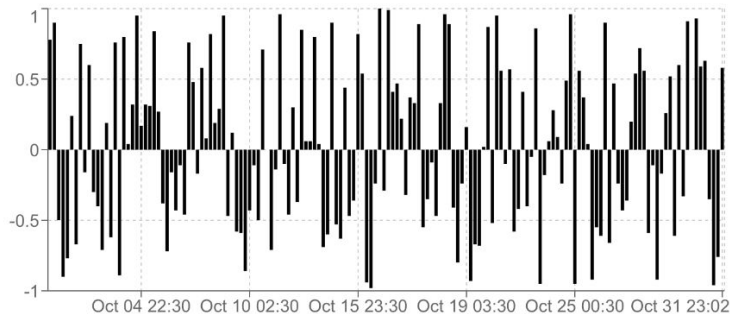
[← Back to Portfolio](#)

Market Sentiment for META

Separate View

Overlaid View

META Hourly Sentiment Scores



META Price



Investor Confidence Level

5.1

Sentiment Score

Hold

Recommendation

Neutral 😐

Sentiment Level

The market is neutral with a confidence level of 51%.

Recent Headlines for META

The table below gives each of the most recent headlines of the stock and the negative, neutral, positive aggregated sentiment score. The news headlines are obtained from Mboom Finance API.

Date Time

Headline

Source

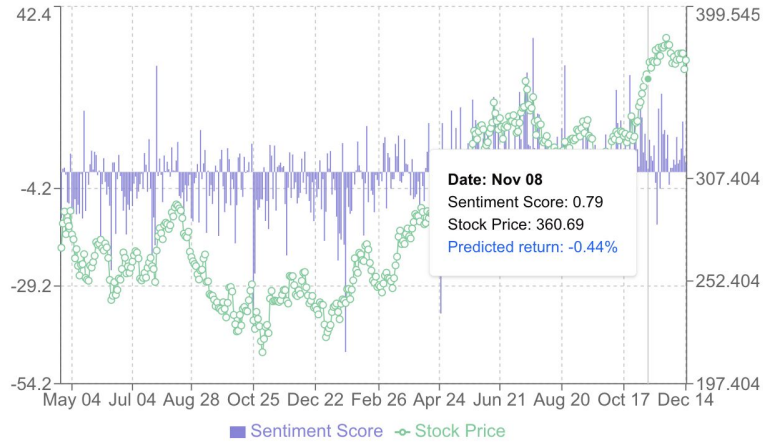
Market Sentiment for MSFT

MVP

Separate View

Overlaid View

Sentiment and Price Analysis



Live Market Insights

Positive

Live Market Sentiment

0.17%

Predicted Return

Strong Buy

Advisory Opinion

Buy

Our Recommendation

Recent Headlines for MSFT

The table below gives each of the most recent headlines of the stock and the negative, neutral, positive aggregated sentiment score. The news headlines are obtained from Mboum Finance API.

Date Time

Headline

Source

Dataset Architecture – News Articles Summarization

Extractive Summarization

FinBERT

- Latent Semantic Analysis (LSA)
- Luhn
- TextRank
- LexRank
- FinBERT - fine-tuned version of BERT

Article_title	Stock_symbol	Url	Publisher	Author	Article	Lsa_summary	Luhn_summary
Interesting A Put And Call Options For August ...	A	https://www.nasdaq.com/articles/interesting-a-...	NaN	NaN	Investors in Agilent Technologies, Inc. (Symbo...	Because the \$125.00 strike represents an appro...	The current analytical data (including greeks ...
Wolfe Research Initiates Coverage of Agilent T...	A	https://www.nasdaq.com/articles/wolfe-research-...	NaN	NaN	Fintel reports that on December 13, 2023, Wolf...	Fintel reports that on December 13, 2023, Wolf...	T. Rowe Price Investment Management holds 10,1...
Agilent Technologies Reaches Analyst Target Price	A	https://www.nasdaq.com/articles/agilent-techno-...	NaN	NaN	In recent trading, shares of Agilent Technolog...	In recent trading, shares of Agilent Technolog...	In recent trading, shares of Agilent Technolog...
Agilent (A) Enhances BioTek Cytation C10 With ...	A	https://www.nasdaq.com/articles/agilent-a-enha-...	NaN	NaN	Agilent Technologies A is enhancing its BioTek...	Per a Grand View Research report, the global m...	Notably, Agilent enhanced the BioTek Cytation ...
Pre-Market Most Active for Dec 7, 2023 : SQQQ,...	A	https://www.nasdaq.com/articles/pre-market-mos-...	NaN	NaN	The NASDAQ 100 Pre-Market Indicator is up 70.2...	ProShares UltraPro Short QQQ (SQQQ) is -0.15 a...	As reported by Zacks, the current mean recomme...

Dataset Architecture – FinBERT

Stock_symbol	Uri	Lsa_FinBERT_sentiment	Luhn_FinBERT_sentiment	Textrank_FinBERT_sentiment	Lexrank_FinBERT_sentiment
A	https://www.nasdaq.com/articles/interesting-a-...	Neutral	Neutral	Neutral	Neutr
A	https://www.nasdaq.com/articles/wolfe-research-...	Positive	Neutral	Positive	Positiv
A	https://www.nasdaq.com/articles/agilent-techno-...	Positive	Positive	Positive	Neutr
A	https://www.nasdaq.com/articles/agilent-a-enha-...	Positive	Neutral	Positive	Positiv
A	https://www.nasdaq.com/articles/pre-market-mos-...	Neutral	Positive	Neutral	Positiv
...
ZTS	https://www.nasdaq.com/articles/zoetis-commenc-...	Neutral	Neutral	Positive	Neutr
ZTS	https://www.nasdaq.com/articles/weekly-recap-m-...	Positive	Neutral	Positive	Positiv
ZTS	https://www.nasdaq.com/articles/pfizers-animal-...	Neutral	Neutral	Neutral	Neutr



Sentiment Labels

- Positive
- Negative
- Neutral

Dataset Architecture – Stock Information



A.csv



AA.csv



AAU.csv



AACG.csv



AA DR.csv



AAOI.csv



AAON.csv



AAP.csv



AAPL.csv



AAT.csv



AB.csv



ABB.csv



ABBV.csv



ABC.csv



ABCB.csv

date	volume	open	high	low	close	adj close		
12/28/23	892600	140.5399932	140.8099975	139.6499938	139.7700042	139.7700042	7246094	
12/27/23	1182300	139.7799987	140.1600036	139.0800018	139.8200073	139.8200073	2421875	
12/26/23	948400	139.3099975	140.4700012	139.0899963	139.8099975	139.8099975	5859375	
12/22/23	1204100	139.6100006	140.3600006	138.7899932	139.5700073	139.5700073	2421875	
12/21/23	1685700	139.3800048	139.6699981		138	138.9400024	138.9400024	140625
12/20/23	2120900	139.7899932	141.2400054	138.1399993	138.1799926	138.1799926	7578125	
12/19/23	1523300	138.5099945	139.8899993	137.3200073	139.7899932	139.7899932	2861328	
12/18/23	1634700	137.5899963	138.1900024	136.8600006	137.5299987	137.5299987	7929688	
12/15/23	4876000	137.2400054	138.8999938	136.2799987	136.7799987	136.7799987	7929688	
12/14/23	2950500		135	138.1699981	135	137.9600067	137.9600067	138672
12/13/23	1731400	129.0899963	134.0399932	128.7700042	133.7400054	133.7400054	9316406	

Dataset Architecture – Filtering

We selected 9 stocks with substantial financial news coverage and a tendency to fluctuate in response to financial news.

- AMD: Advanced Micro Devices, Inc.
- NVDA: NVIDIA Corporation
- TSLA: Tesla, Inc.
- AAPL: Apple Inc.
- BA: The Boeing Company
- MSFT: Microsoft Corporation
- GOOG: Alphabet Inc.
- INTC: Intel Corporation
- MRK: Merck & Co., Inc.



Microsoft



nVIDIA



MERCK

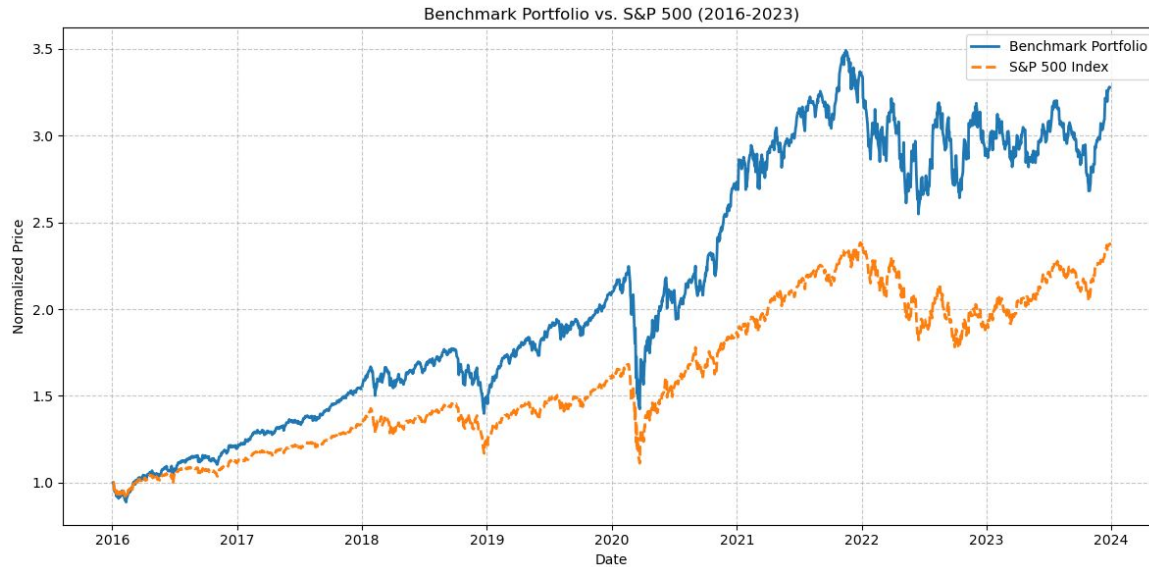
Dataset Architecture – Combined Dataset

	Date	open	close	volume	Stock_symbol	combined_sentiment_score	weighted_sentiment_score	adjusted_sentiment_score	return
0	2022-06-03	146.899994	145.380005	88570300.0	AAPL	-9.0	-8.633226	-8.633226	-0.010347
1	2022-06-06	147.029999	146.139999	71598400.0	AAPL	3.0	1.474340	-0.369538	-0.006053
2	2022-06-07	144.350006	148.710007	67808200.0	AAPL	-2.0	-2.362827	-1.513879	0.030204
3	2022-06-08	148.580002	147.960007	53950200.0	AAPL	-3.0	-3.925914	-2.686765	-0.004173
4	2022-06-09	147.080002	142.639999	69473000.0	AAPL	-7.0	-6.614949	-4.434701	-0.030188

 Features

 Target

Sentiment Portfolio Performance



Real Time Financial News



Architecture Flow

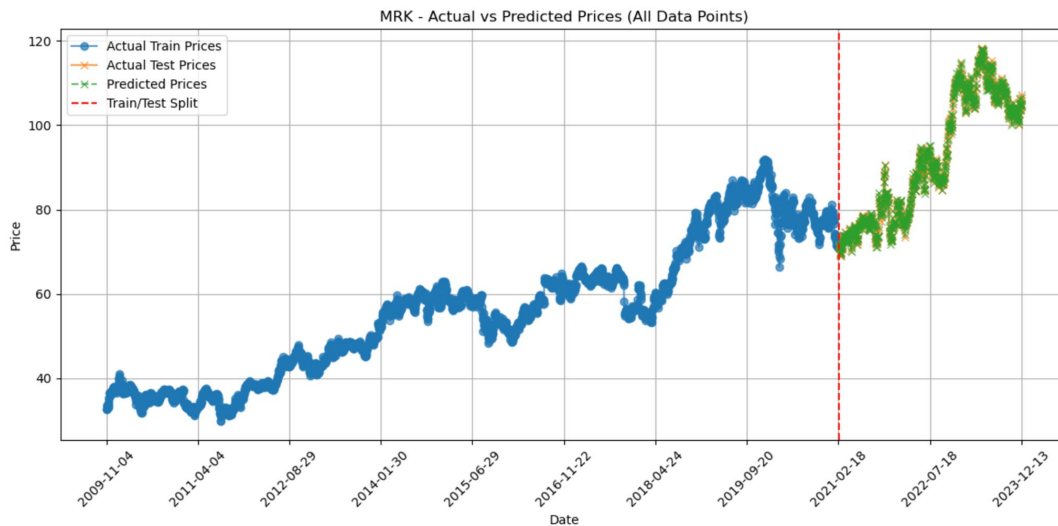


Technical Architecture – Model

- **ARIMA:**
 - Autoregressive integrated moving average
 - predict future values in time series data by capturing trends, seasonality, and patterns over time.
- **Hyperparameters:**
 - p : the number of past values used in the model
 - d : the level of differencing to make the time series stationary
 - q : the number of lagged forecast errors

Technical Architecture – Model

- **Y:** return — $\frac{\text{close} - \text{open}}{\text{open}}$
- **X:** Date, Open, Volume, **Weighted Sentiment Score**



Technical Architecture – Weighted Score

Weighted Sentiment Score Calculation:

- If sentiment_label == "positive":
 - **weighted_score** += confidence_score
- If sentiment_label == "negative":
 - **weighted_score** -= confidence_score

Sentiment Score Evolvement

Attempt 1

Sentiment Score: Mode

Confidence Score:
Avg of Mode

Attempt 2

Sentiment Score: Label
Count

Confidence Score:
Average of Each Label

Attempt 3

Weighted Sentiment
Score



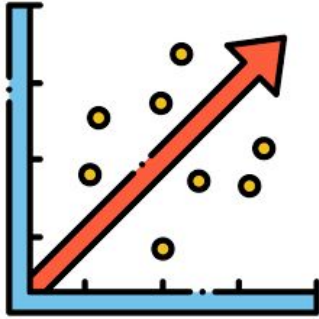
Attempt 4

Current Date's Weighted
Sentiment Score
+
Decayed Weighted
Sentiment Score from
Previous Days

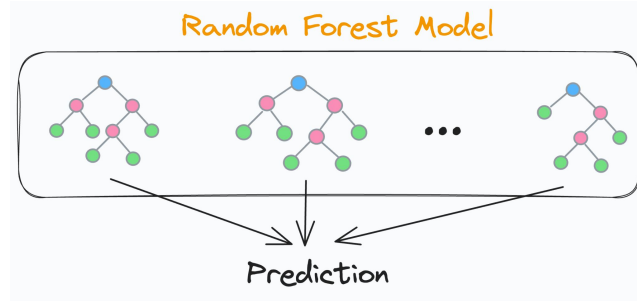
Technical Architecture – Using Weighted Score and Fine Tuned Hyperparameters

Stock	Experiment RMSE	Control RMSE	Best Params Experiment	Best Params Control
BA	0.01531	0.01554	(3, 2, 4)	(1, 0, 6)
MRK	0.01073	0.01079	(1, 0, 2)	(2, 0, 3)
INTC	0.02136	0.02194	(1, 1, 2)	(1, 0, 6)
MSFT	0.01211	0.01252	(2, 0, 2)	(4, 0, 4)
AMD	0.02558	0.02649	(3, 2, 5)	(2, 0, 2)
NVDA	0.02283	0.02275	(5, 2, 4)	(6, 0, 6)
TSLA	0.02398	0.02495	(5, 0, 4)	(3, 0, 4)
GOOG	0.01258	0.01284	(5, 1, 5)	(5, 0, 6)
AAPL	0.01091	0.01021	(6, 0, 6)	(3, 0, 5)

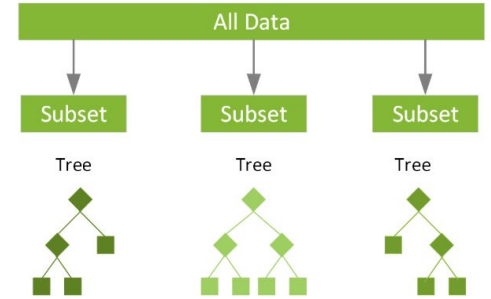
Technical Architecture – Other Models Explored



Linear Regression



Random Forest



XGBoost

Technical Architecture – Predicted Return



Real Time
Financial News



Pre-trained Model

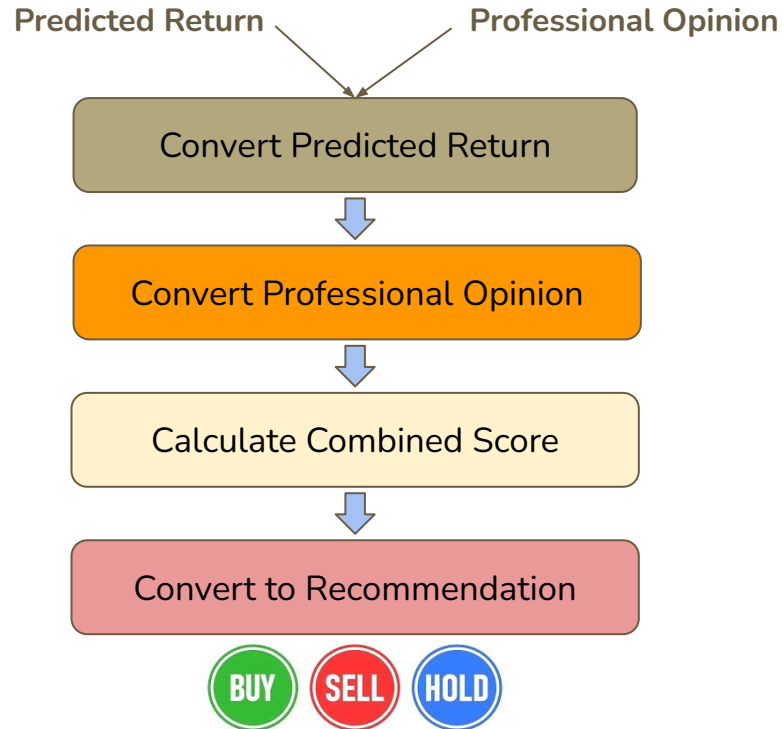


Predicted
Return



Real Time
Stock Data

Technical Architecture – Combined Recommendation



Limitation

- Historical Datasets:
 - Lack the latest data.
- Historical Financial News:
 - The dates in the dataset may not accurately match the actual dates of the news events.
- Real-Time Financial News API:
 - Retrieves irrelevant news for non-relevant stocks.

Mission

Stock markets are often driven by mass sentiment rather than rationality.

Our objective is to **capitalize on market irrationality** by developing a website that assesses the sentiment of **real-time financial news** in order to maximize investors' returns.

