

Sentiment Analysis of The Financial Market

By: Group 8

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Data & Model

Dataset:

[NickyNicky/finance-financialmodelingprep-stock-news-sentiments-rss-feed](#)

Model:

[mrm8488/distilroberta-finetuned-financial-news-sentiment-analysis](#)

Fine-tuned model:

[msr2903/mrm8488-distilroberta-fine-tuned-financial-sentiment](#)



Hugging Face

Dataset

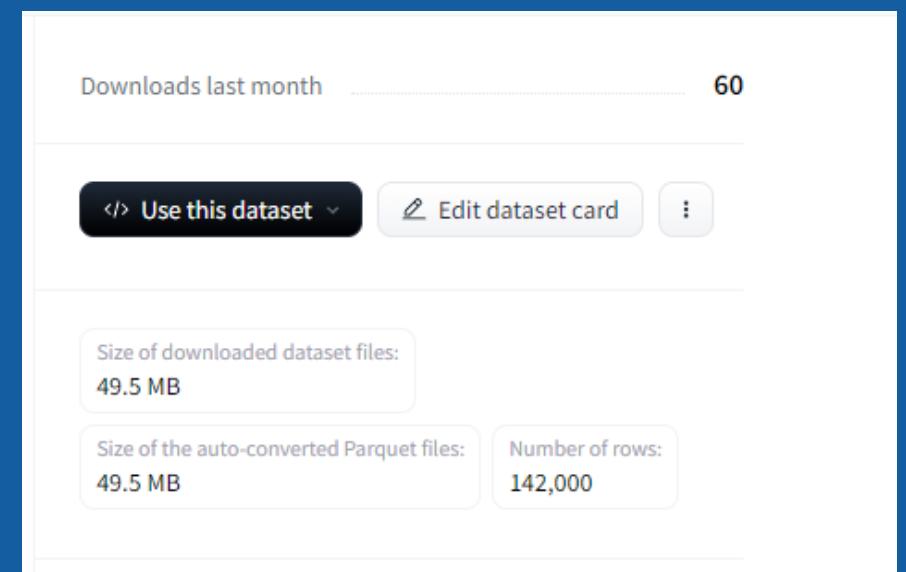
Datasets: NickyNicky/finance-financialmodelingprep-stock-news-sentiments-rss-feed · like 4

Split (1)
train · 142k rows

Search this dataset

SQL Console

symbol	publishedDate	title	image	site	text	url	sentiment	sentimentScore
string · lengths	string · lengths	string · lengths	string · lengths	string · classes	string · lengths	string · lengths	string · classes	float64
2	11	24	7	13 values	0	36	3	-1
HE	2023-10-04T21:54:28.000Z	HE REMINDER: Kessler Topaz Meltzer &...	/next-assets/images/schema-image-default.png	benzinga	RADNOR, Pa., Oct. 04, 2023 (GLOBE NEWSWIRE) -- The law...	https://www.benzinga.com/pressreleases/23/10/g35098825/he-reminder-kessler-topaz-meltzer-check-llp--	Negative	-0.6417
CRS	2023-10-04T21:40:00.000Z	Carpenter Technology Announces Conference...	https://ml.globenewswire.com/Resource/Download/7c5661a-3a49-4ccf-ba73-ce17859753db	globenewswire	PHILADELPHIA, Oct. 04, 2023 (GLOBE NEWSWIRE) --	https://www.globenewswire.com/news-release/2023/10/04/2754991/0/en/Carpenter-...	Positive	0.4767
BB	2023-10-04T21:34:09.000Z	What's Going On With BlackBerry Stock...		benzinga	BlackBerry Ltd (NYSE: BB) shares are trading higher i...	https://www.benzinga.com/news/23/10/35098537/whats-going-on-with-blackberry-stock-after-hours	Positive	0.9895
TECK	2023-10-04T21:17:00.000Z	Teck to Release Third Quarter 2023 Results...	https://ml.globenewswire.com/Resource/Download/4d859d20-8bc0-4aa6-9ff8-006dbd1d33f2	globenewswire	VANCOUVER, British Columbia, Oct. 04, 2023 (GLOBE...	https://www.globenewswire.com/news-release/2023/10/04/2754989/0/en/Teck-to-Release-...	Positive	0.83
AGF	2023-10-04T21:13:38.000Z	AGF Reports September 2023 Assets Under...	/next-assets/images/schema-image-default.png	benzinga	TORONTO, Oct. 04, 2023 (GLOBE NEWSWIRE) -- AGF...	https://www.benzinga.com/pressreleases/23/10/g35098361/agf-reports-september-2023-assets-under-...	Positive	0.9768
AGF	2023-10-04T21:13:00.000Z	AGF Reports September 2023 Assets Under...	https://ml.globenewswire.com/Resource/Download/624b638e-e8de-4533-84a1-624de8827cf1	globenewswire	TORONTO, Oct. 04, 2023 (GLOBE NEWSWIRE) -- AGF...	https://www.globenewswire.com/news-release/2023/10/04/2754986/0/en/AGF-Reports-...	Positive	0.9834
AGF	2023-10-04T21:02:00.000Z	AGF déclare le total de son actif géré et...	https://ml.globenewswire.com/Resource/Download/50199847-86f9-48ba-bcb2-084863a9fa06	globenewswire	TORONTO, 04 oct. 2023 (GLOBE NEWSWIRE) -- La Société de...	https://www.globenewswire.com/news-release/2023/10/04/2754984/0/fr/AGF-d%C3%A9clare-...	Neutral	0
LGIH	2023-10-04T21:00:00.000Z	LGI Homes Reports September and Third...		globenewswire	LGI Homes reports September and third quarter home...	https://www.globenewswire.com/news-release/2023/10/04/2754982/28788/en/LGI-Homes-...	Positive	0.9899
GDL	2023-10-04T21:00:00.000Z	Goodfellow annonce ses résultats pour...	https://ml.globenewswire.com/Resource/Download/346e6760-b69f-4b2f-80bf-b43dc34e0e6	globenewswire	DELSON, Québec, 04 oct. 2023 (GLOBE NEWSWIRE) --	https://www.globenewswire.com/news-release/2023/10/04/2754981/0/fr/Goodfellow-...	Negative	-0.0516
GDL	2023-10-04T21:00:00.000Z	Goodfellow Reports Its Results for the...	https://ml.globenewswire.com/Resource/Download/ad740a03-256c-4714-a3bd-e3de036ae0e9	globenewswire	GOODFELLOW INC. RESULTS FOR Q3 ENDED AUGUST 31, 2023 AN...	https://www.globenewswire.com/news-release/2023/10/04/2754981/0/en/Goodfellow-...	Positive	0.9911
OCEA	2023-10-04T20:56:00.000Z	Updated: Ocean Biomedical Announces...	https://ml.globenewswire.com/Resource/Download/23cba9ce-1bc6-4226-9c6b-e6561047b289	globenewswire	Providence, RI, Oct. 04, 2023 (GLOBE NEWSWIRE) --	https://www.globenewswire.com/news-release/2023/10/04/2754978/0/en/Updated-Ocean-...	Positive	0.9922
WOR	2023-10-04T20:55:00.000Z	Worthington Industries Announces...	https://ml.globenewswire.com/Resource/Download/ceb61b5-d2f9-482f-9c43-7ee9e0938c9a	globenewswire	Public filing of a Form 10 registration statement with...	https://www.globenewswire.com/news-release/2023/10/04/2754977/0/en/Worthington-...	Positive	0.9996
VCYT	2023-10-04T20:52:41.000Z	Veracyte Stock Is Volatile After Hours...		benzinga	Veracyte, Inc. (NASDAQ: VCYT) shares are volatile...	https://www.benzinga.com/news/23/10/35097954/veracyte-stock-is-volatile-after-hours-here-s-why	Positive	0.875



Huggingface Text Classification Model

mrm8488/distilroberta-finetuned-financial-news-sentiment-analysis like 343

Text Classification Transformers PyTorch TensorBoard Safetensors financial_phrasebank roberta Generated from Trainer financial stocks sentiment

Eval Results Inference Endpoints License: apache-2.0

Model card Files and versions Training metrics Community 8 Edit model card

Downloads last month 1,492,693

Safetensors Model size 82.1M params Tensor type I64 · F32

Inference API Warm

Text Classification Examples

Operating profit totaled EUR 9.4 mn , down from EUR 11.7 mn in 2004 .

Compute

DistilRoberta-financial-sentiment

Model Explanation

DistilRoberta-financial-sentiment

This model is a fine-tuned version of [distilroberta-base](#) on the financial_phrasebank dataset. It achieves the following results on the evaluation set:

- Loss: 0.1116
- Accuracy: 0.9823

Base Model description

This model is a distilled version of the [RoBERTa-base model](#). It follows the same training procedure as [DistilBERT](#). The code for the distillation process can be found [here](#). This model is case-sensitive: it makes a difference between English and English.

The model has 6 layers, 768 dimension and 12 heads, totaling 82M parameters (compared to 125M parameters for RoBERTa-base). On average DistilRoBERTa is twice as fast as Roberta-base.

Training Data

Polar sentiment dataset of sentences from financial news. The dataset consists of 4840 sentences from English language financial news categorised by sentiment. The dataset is divided by agreement rate of 5-8 annotators.

Training results

Training Loss	Epoch	Step	Validation Loss	Accuracy
No log	1.0	255	0.1670	0.9646
0.209	2.0	510	0.2290	0.9558
0.209	3.0	765	0.2044	0.9558
0.0326	4.0	1020	0.1116	0.9823
0.0326	5.0	1275	0.1127	0.9779

Data Preprocessing

```
1 from datasets import load_dataset
2 from transformers import pipeline
3 import pandas as pd
4
5 ds = load_dataset("NickyNicky/finance-financialmodelingprep-stock-news-sentiments-rss-feed", split="train")
6
7 # Show the first 5 rows of the dataset
8 ds[:5]
```

# Dropping unnecessary columns					
ds = pd.DataFrame(ds)					
df = df.drop(columns=["image", "title", "image", "site", "url", "sentimentScore"], axis=1)					
#Filter the symbol					
df = df[df["symbol"] == "INTC"]					
df					
	symbol object	publishedDate o...	text object	sentiment object	
	INTC	100%	2023-10-0... 0.3% 2023-10-0... 0.3% 288 others 99.3%	This article... 0.7% Intel's disa... 0.7% 286 others 98.6%	Positive 84.1% Negative 14.1% Neutral 1.7%
26	INTC	2023-10-04T20:...	Rosenblatt analys...	Positive	
178	INTC	2023-10-04T13:5...	Amid an uninspiri...	Positive	
499	INTC	2023-10-03T20:...	Intel Corp (NASD...	Positive	
1398	INTC	2023-10-02T06:...	It's an understat...	Positive	
1472	INTC	2023-10-01T14:4...	The case for inve...	Positive	
2086	INTC	2023-09-28T19:...	The top Dow stoc...	Positive	
2247	INTC	2023-09-28T14:...	The Dow 30 is a ...	Positive	
2488	INTC	2023-09-28T08:...	In the world of te...	Positive	
2598	INTC	2023-09-27T22:1...	Wall Street has b...	Positive	
4106	INTC	2023-09-25T07:...	There's nothing w...	Positive	

Stock Ticker = INTC
Positive = 244
Negative = 41
Neutral = 5

Inputting Data to Model

```
1 from transformers import pipeline  
2  
3 sentiment_analyzer = pipeline("text-classification", model="mrm8488/distilroberta-finetuned-financial-news-sentiment-a")
```

```
1 def preprocess_text(text):  
2     text = text.lower() # Convert to lowercase  
3     text = text.strip() # Remove leading/trailing whitespace  
4     return text  
5  
6 sample_df_text = df["text"].apply(preprocess_text)  
7  
8  
9 text_list = sample_df_text.tolist()  
10  
11 # Pass the list to the sentiment analyzer  
12 results = sentiment_analyzer(text_list)  
13 results
```

Results

```
1 true_labels = df['sentiment']
2
3 true_labels = true_labels.str.lower()
4
5 predicted_labels = [result['label'] for result in results]
6
7 # Create a DataFrame to compare true and predicted labels
8 comparison_df = pd.DataFrame({
9     'True Label': true_labels,
10    'Predicted Label': predicted_labels,
11    'Confidence Score': [result['score'] for result in results]
12 })
13 comparison_df
```

	True Label	Predicted Label	Confidence Score	
positive	84.1%	positive	0.570750653743...	
negative	14.1%	negative	0.314...	
neutral	1.7%	neutral	0.186...	
26	positive	positive	0.9962813258	
178	positive	positive	0.9995166063	
499	positive	positive	0.9993415475	
13...	positive	positive	0.9996519089	
14...	positive	negative	0.9984500408	
20...	positive	positive	0.9997012019	
22...	positive	neutral	0.9998706579	
24...	positive	positive	0.9988456964	
25...	positive	positive	0.8718595505	
41...	positive	positive	0.9253379107	

290 rows, 3 cols

10 ▾

/ page

« < Page 1 of 29 > »

```
1 from sklearn.metrics import accuracy_score, confusion_matrix
2 accuracy = accuracy_score(true_labels, predicted_labels)
3 f"Accuracy: {accuracy * 100:.2f}%"
```

'Accuracy: 57.93%'

Accuracy: 57.93%

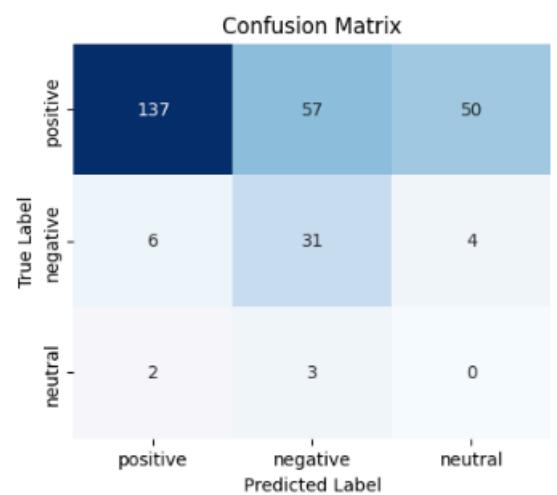
Confusion Matrix

```
1 from sklearn.metrics import confusion_matrix
2 conf_matrix = confusion_matrix(true_labels, predicted_labels, labels=['positive', 'negative', 'neutral'])
3
4 conf_matrix
```



```
[[137  57  50]
 [ 6  31  4]
 [ 2   3   0]]
```

```
1 import seaborn as sns
2 import matplotlib.pyplot as plt
3
4 plt.figure(figsize=(6, 4))
5 sns.heatmap(conf_matrix, annot=True, fmt="d", cmap="Blues", xticklabels=['positive', 'negative', 'neutral'], yticklabels=['positive', 'negative', 'neutral'],
6             xlabel='Predicted Label')
7 plt.ylabel('True Label')
8 plt.title('Confusion Matrix')
9 plt.show()
10
```



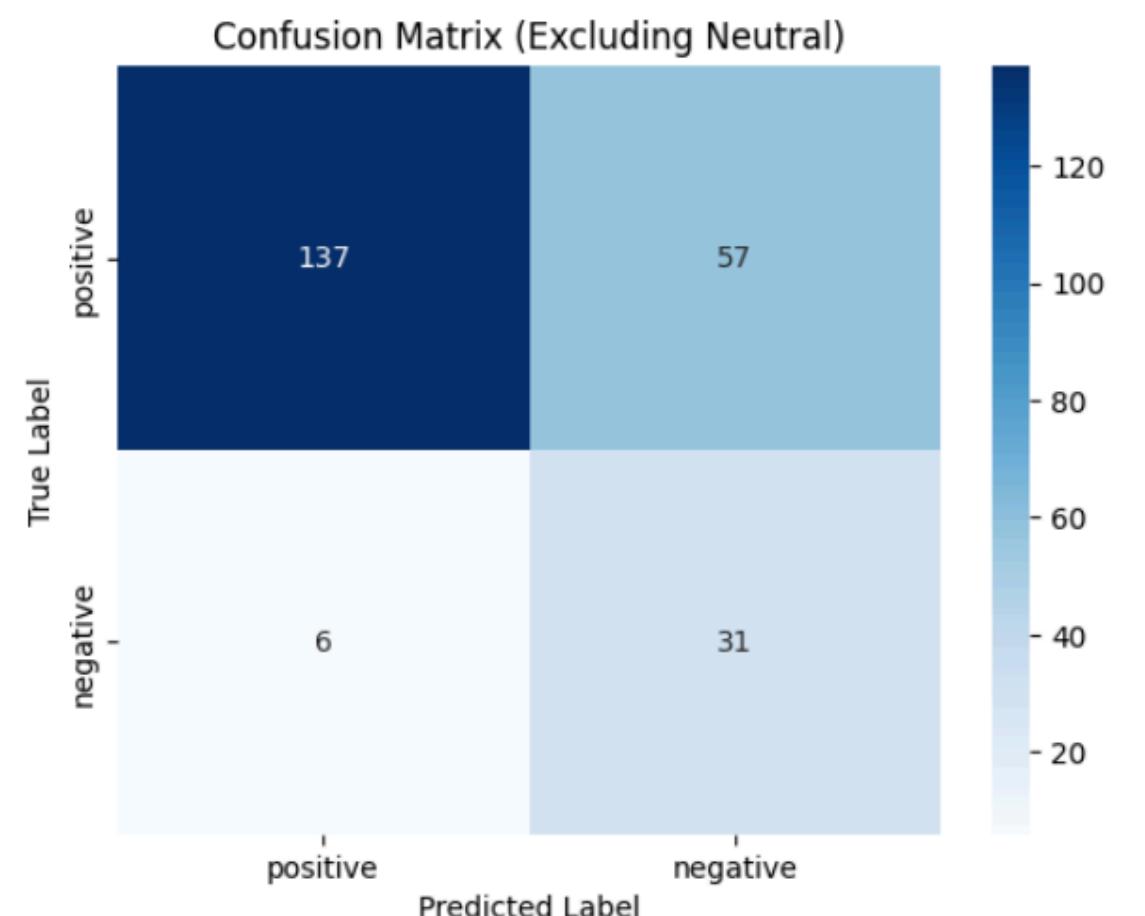
This confusion matrix indicates that the machine learning model performs well at predicting positive sentiments (137 correct predictions) but struggles with neutral sentiment (only 0 correct predictions).

There is also moderate performance in predicting negative sentiments (31 correct predictions), but a significant amount of misclassification exists, especially with positive and negative labels overlapping.

The model needs improvement in distinguishing neutral sentiments and reducing false positives for better financial news sentiment analysis.

Confusion Matrix

```
1 # Confusion Matrix without neutral label
2 filtered_conf_matrix = conf_matrix[:2, :2] # Keep only the first two rows and columns
3
4 sns.heatmap(filtered_conf_matrix, annot=True, fmt="d", cmap="Blues", xticklabels=['positive', 'negative'], yticklabels=['positive', 'negative'])
5 plt.title("Confusion Matrix (Excluding Neutral)")
6 plt.xlabel("Predicted Label")
7 plt.ylabel("True Label")
8 plt.show()
```



Accuracy: 72.7%. The model has a bias toward predicting positive sentiments, as evidenced by the high number of false positives for negative samples. This could indicate a class imbalance or insufficient feature differentiation between positive and negative sentiments.

Confusion Matrix Overview (Excluding Neutral):

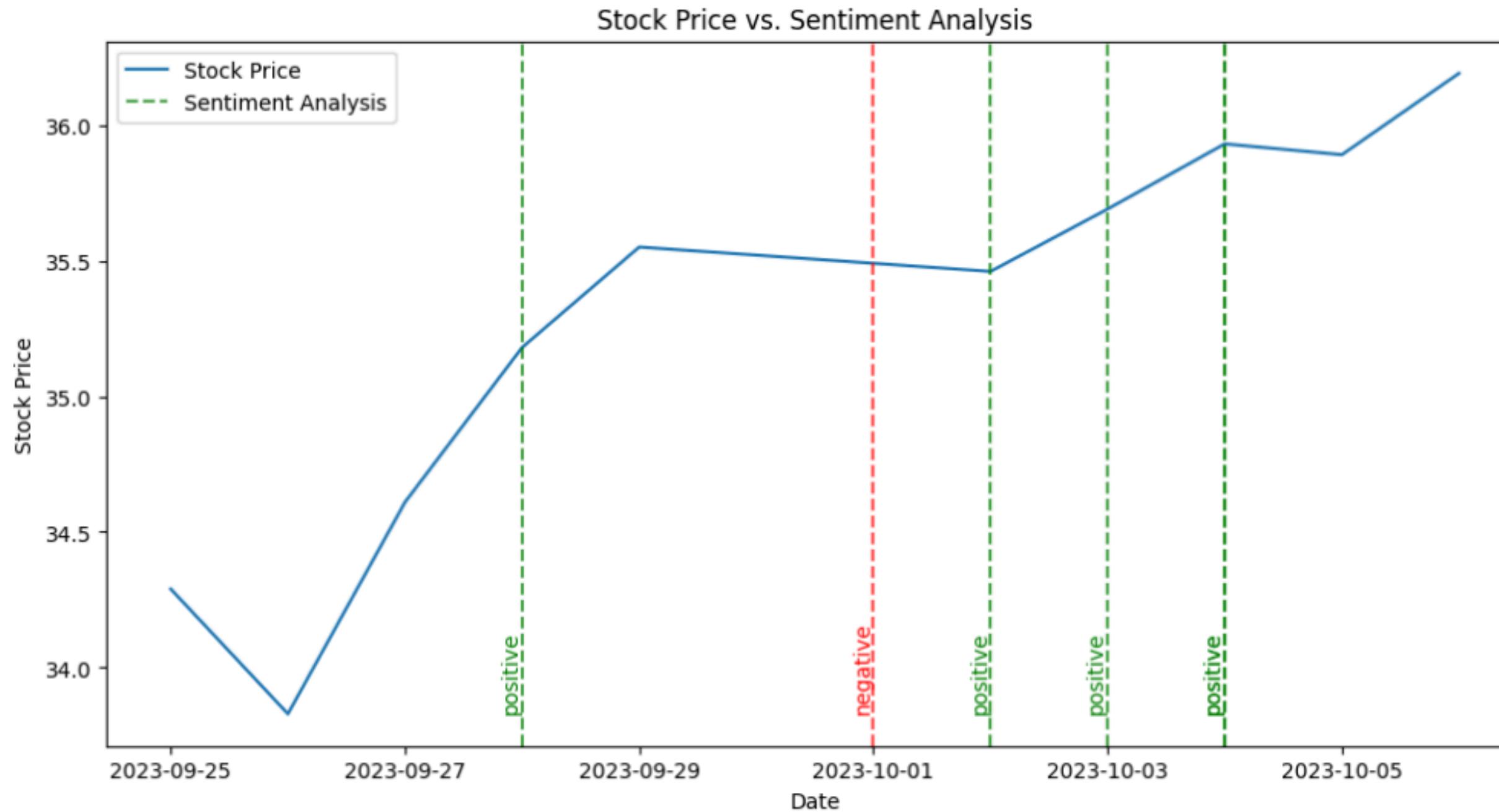
True Positives (TP): 137 (Positive samples correctly classified as positive)

False Positives (FP): 57 (Negative samples incorrectly classified as positive)

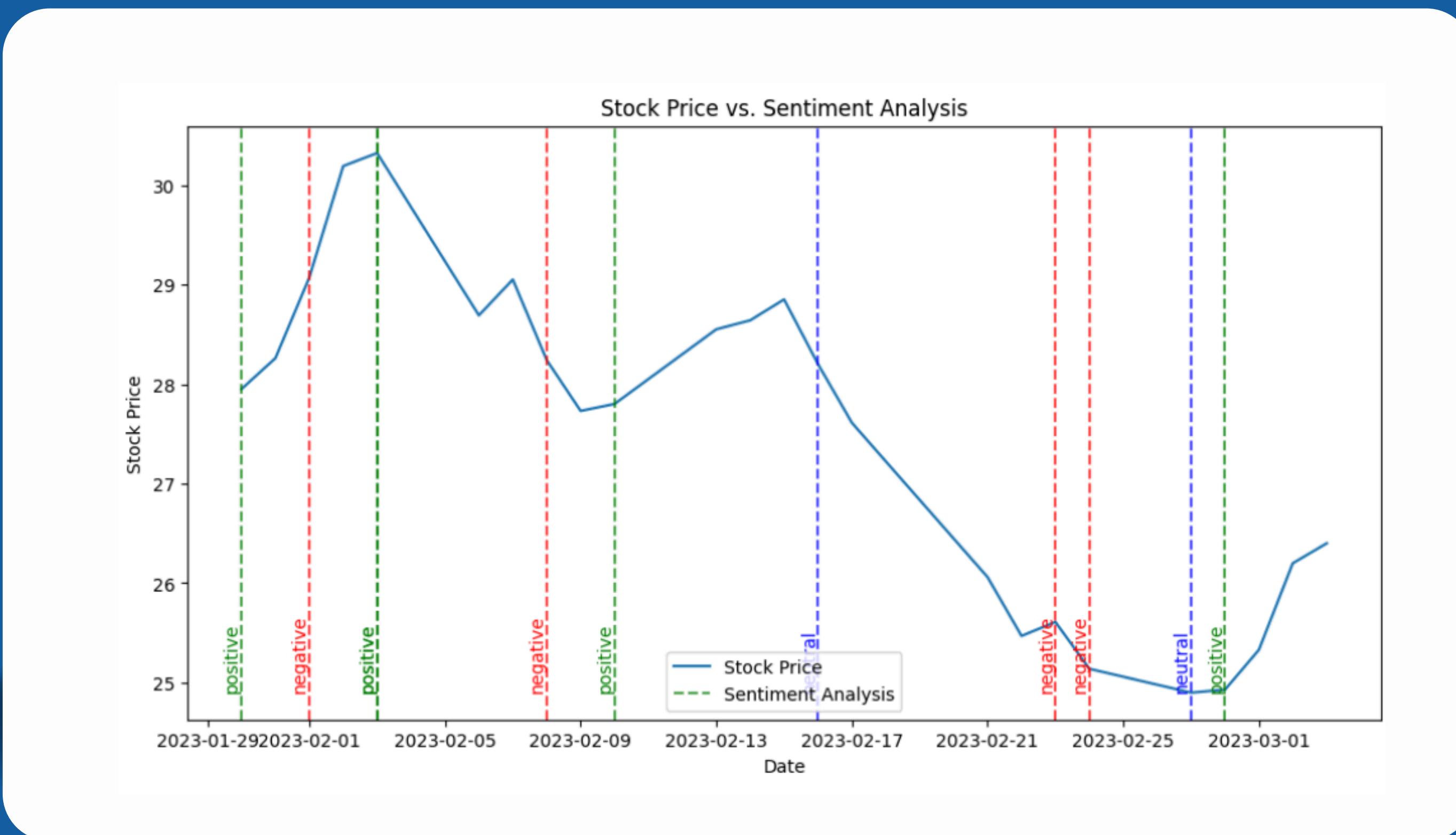
False Negatives (FN): 6 (Positive samples incorrectly classified as negative)

True Negatives (TN): 31 (Negative samples correctly classified as negative)

Analysis #1



Analysis #2



Model Training

The screenshot shows a Jupyter Notebook interface for PyTorch Lightning. The notebook is titled "Distilroberta-Finetune.ipynb". The code cell contains the following Python code:

```
from sklearn.metrics import accuracy_score

def compute_metrics(eval_pred):
    predictions, labels = eval_pred
    predictions = predictions.argmax(axis=1) # Convert logits
    acc = accuracy_score(labels, predictions)
    return {"accuracy": acc}

results = trainer.evaluate()
results
```

The output of the cell shows training progress:

```
[71000/71000 00:43:14, Epoch 5/5]
```

Epoch	Training Loss	Validation Loss
1	0.318500	0.294045
2	0.281700	0.298364
3	0.250100	0.302255
4	0.186400	0.380530
5	0.179100	0.409072

The output also includes:

```
... TrainOutput(global_step=71000, training_loss=0.2511198636981803, m
```

The status bar at the bottom indicates:

Spaces: 4 LF Cell 12 of 15 Layout: US ✓ Continue ✎ ⌂

The right side of the interface shows a "Choose a GPU machine" panel with the following table:

Quantity	Model	Speed (TFLOPs)	Memory (GB)	CPUs	Cost (hour)	Wait time (min)
1 4	T4	65	16	8	0.68	2
1 4 8	A10G	125	24	32	1.80	1
1 4 8	L4	121	24	16	0.70	2
1 4 8	L40S	362	48	16	2.17	2
8	A100	312	40	96	14.97	3
8	H100	1979	80	192	39.93	180
8	H200	1979	141	192	43.92	Unavailable

A red box highlights the L40S row.

Comparing Accuracies (Before & After Fine Tuning)

v. Accuracy

```
1 from sklearn.metrics import accuracy_score, confusion_matrix
2 # Calculate accuracy
3 accuracy = accuracy_score(true_labels, predicted_labels)
4 f"Accuracy: {accuracy * 100:.2f}%"
```

✓
'Accuracy: 57.93%'

Before

iii. Accuracy (Fine-tuned)

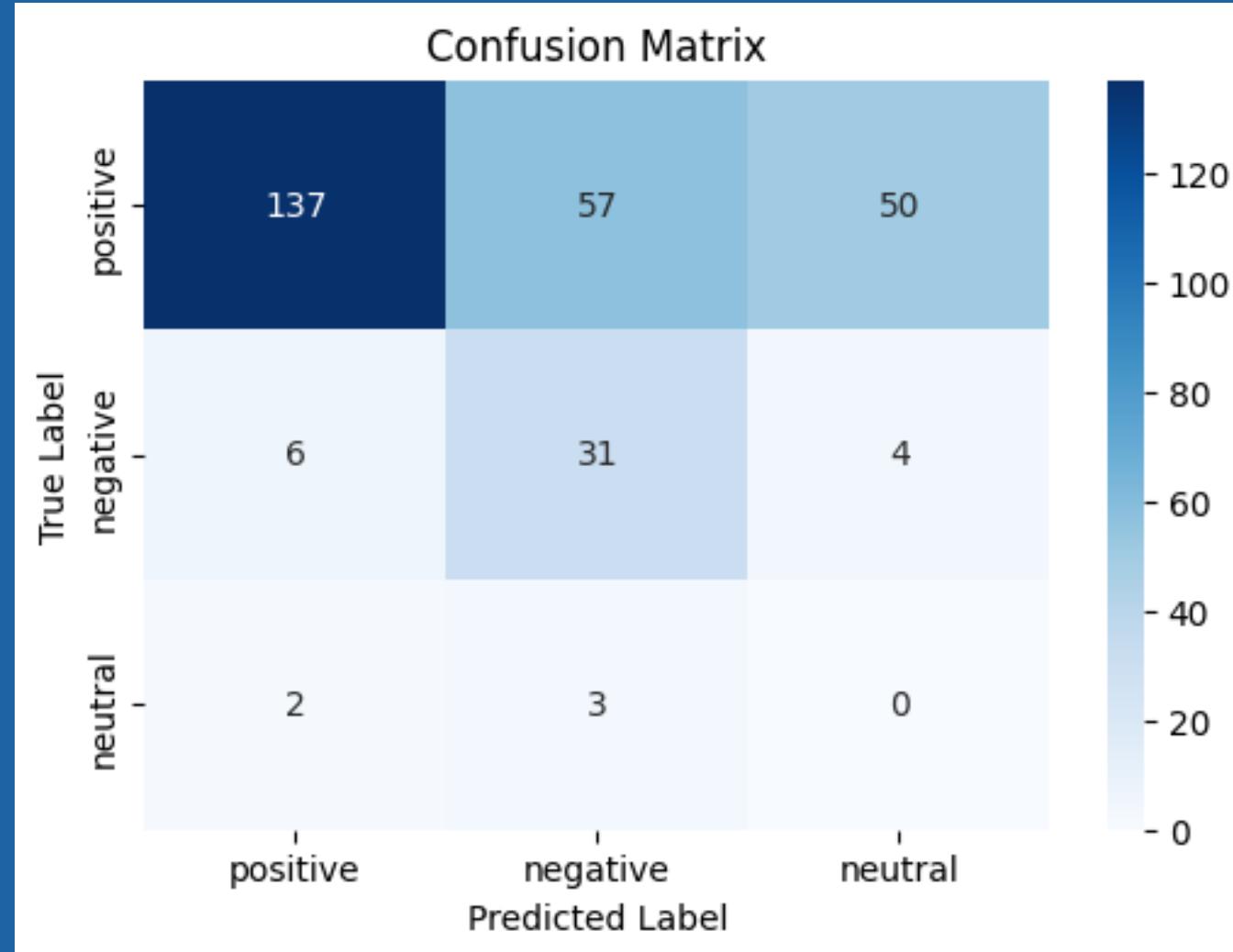
```
1 from sklearn.metrics import accuracy_score, confusion_matrix
2 accuracy_ft = accuracy_score(true_labels_ft, predicted_labels_ft)
3 f"Accuracy: {accuracy_ft * 100:.2f}%"
```

'Accuracy: 94.48%'

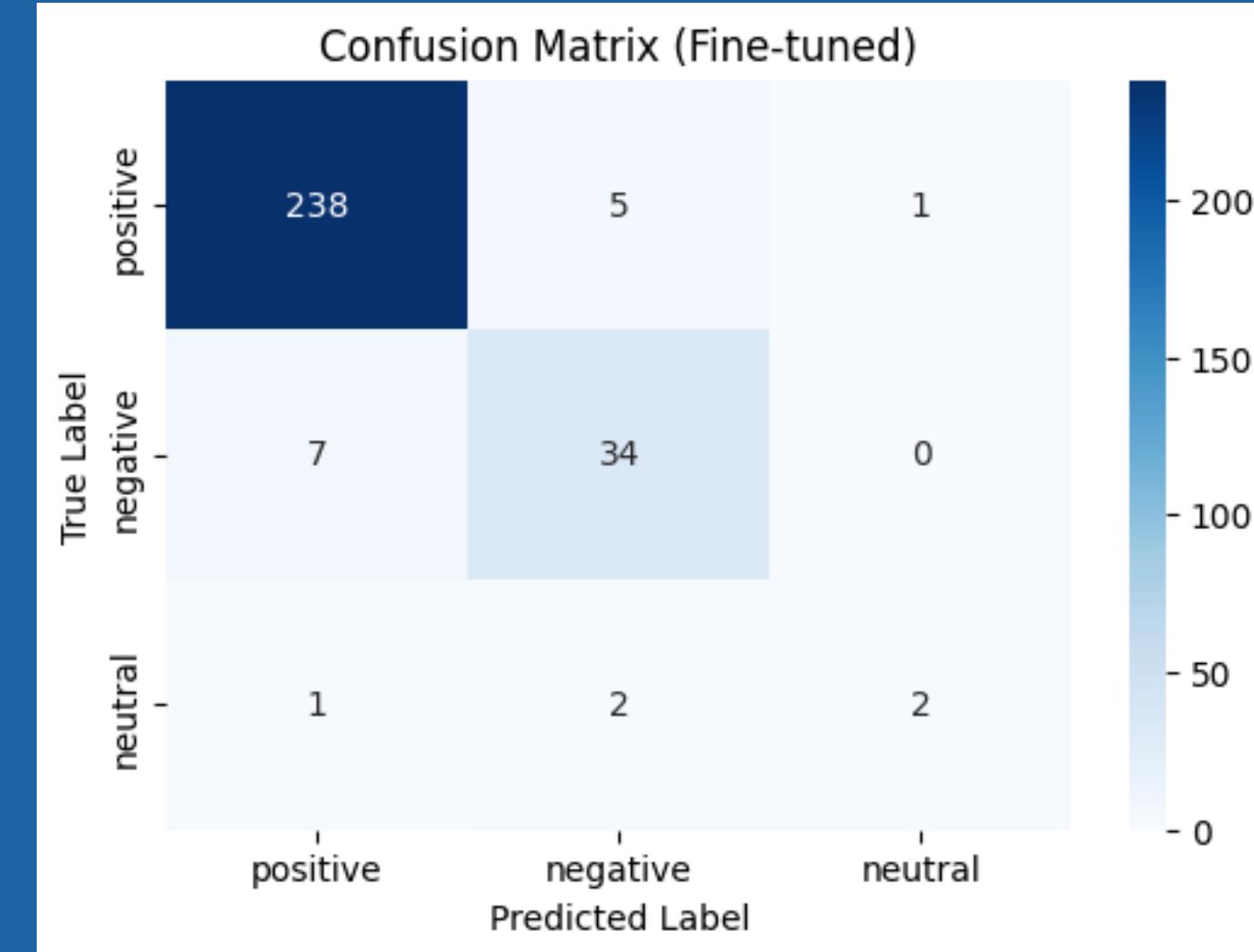
After

Your paragraph text

Comparing Confusion Matrix (Before & After Fine Tuning)

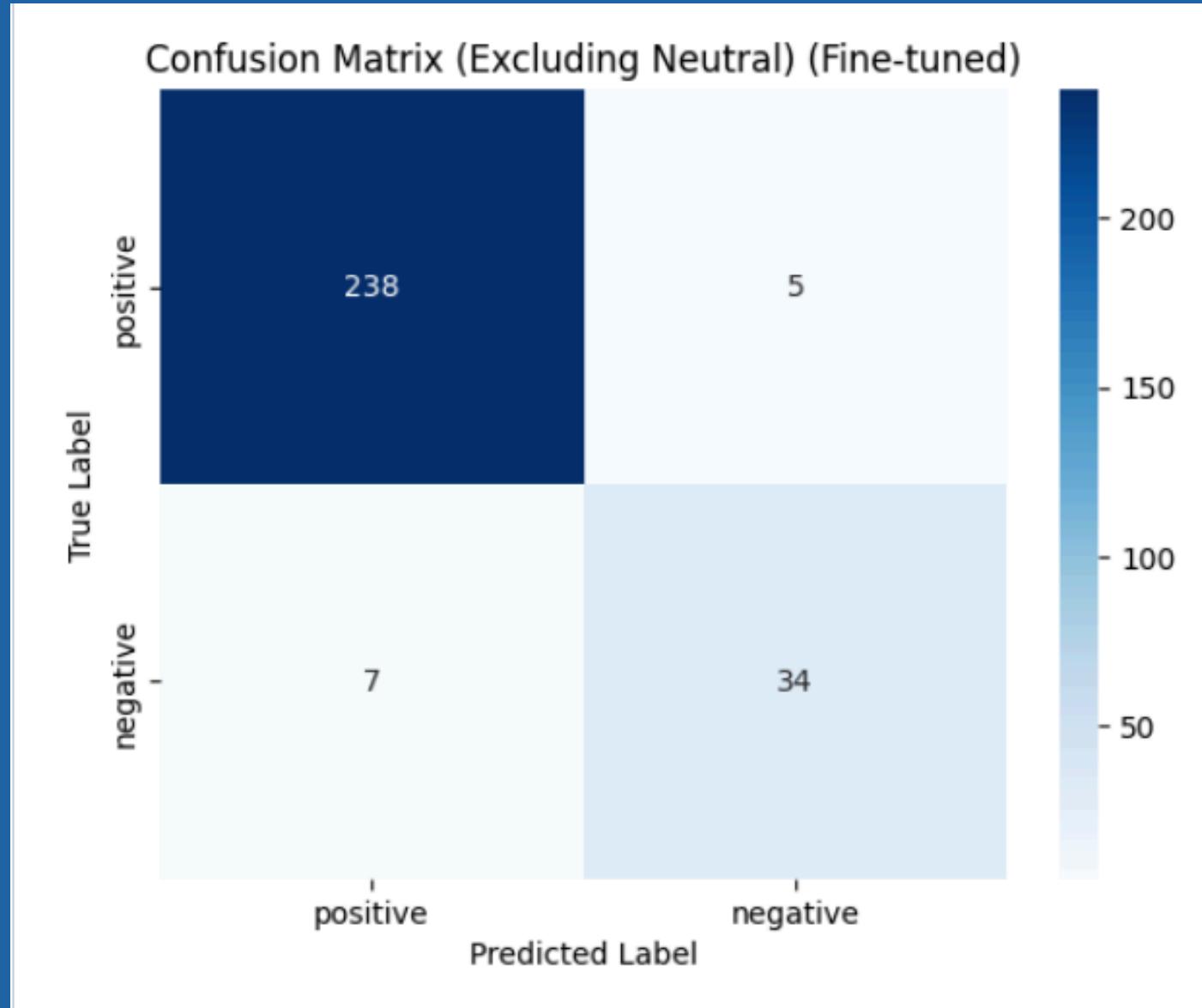


Before



After

CONFUSION MATRIX (FINE-TUNED)

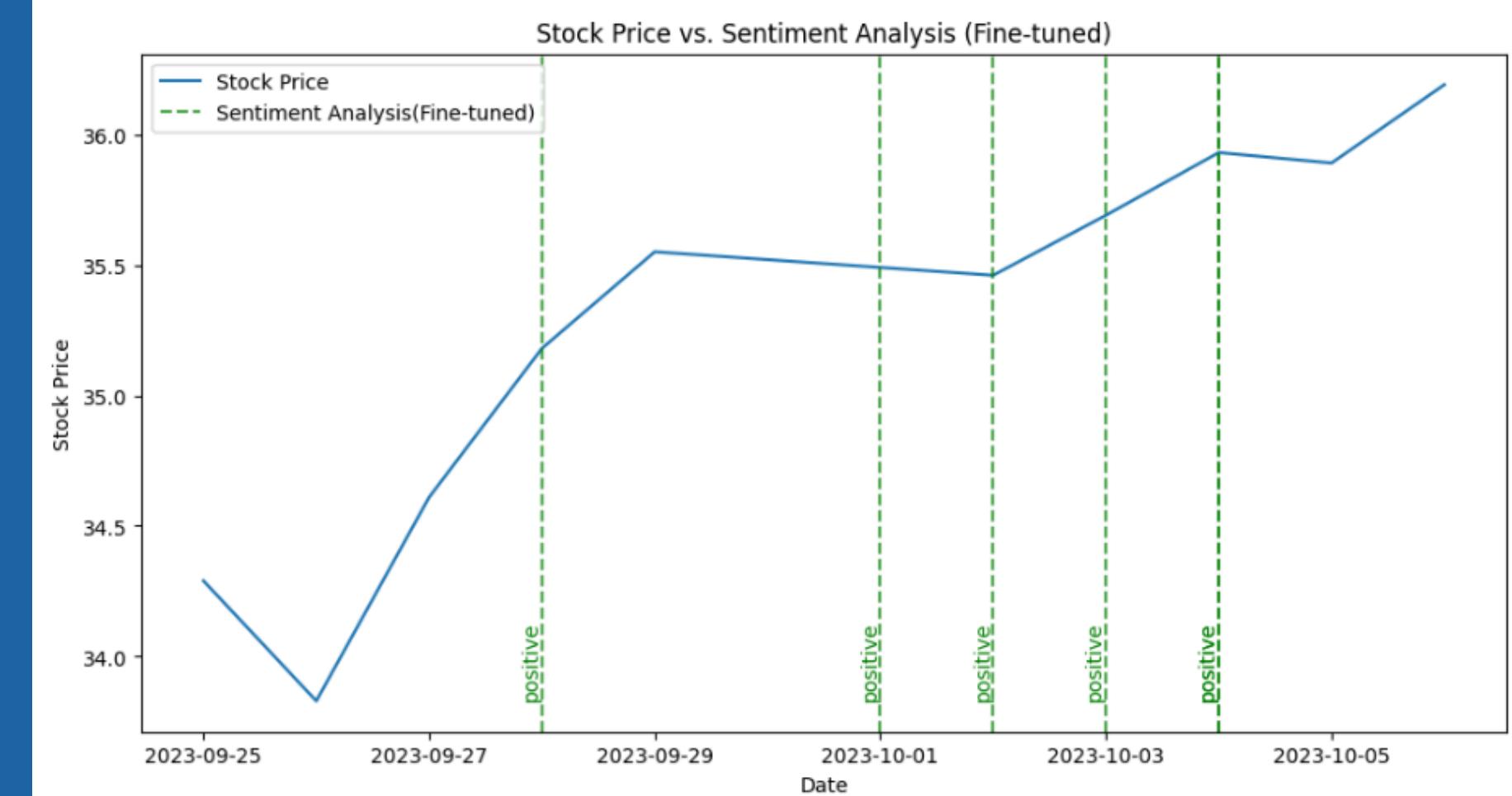
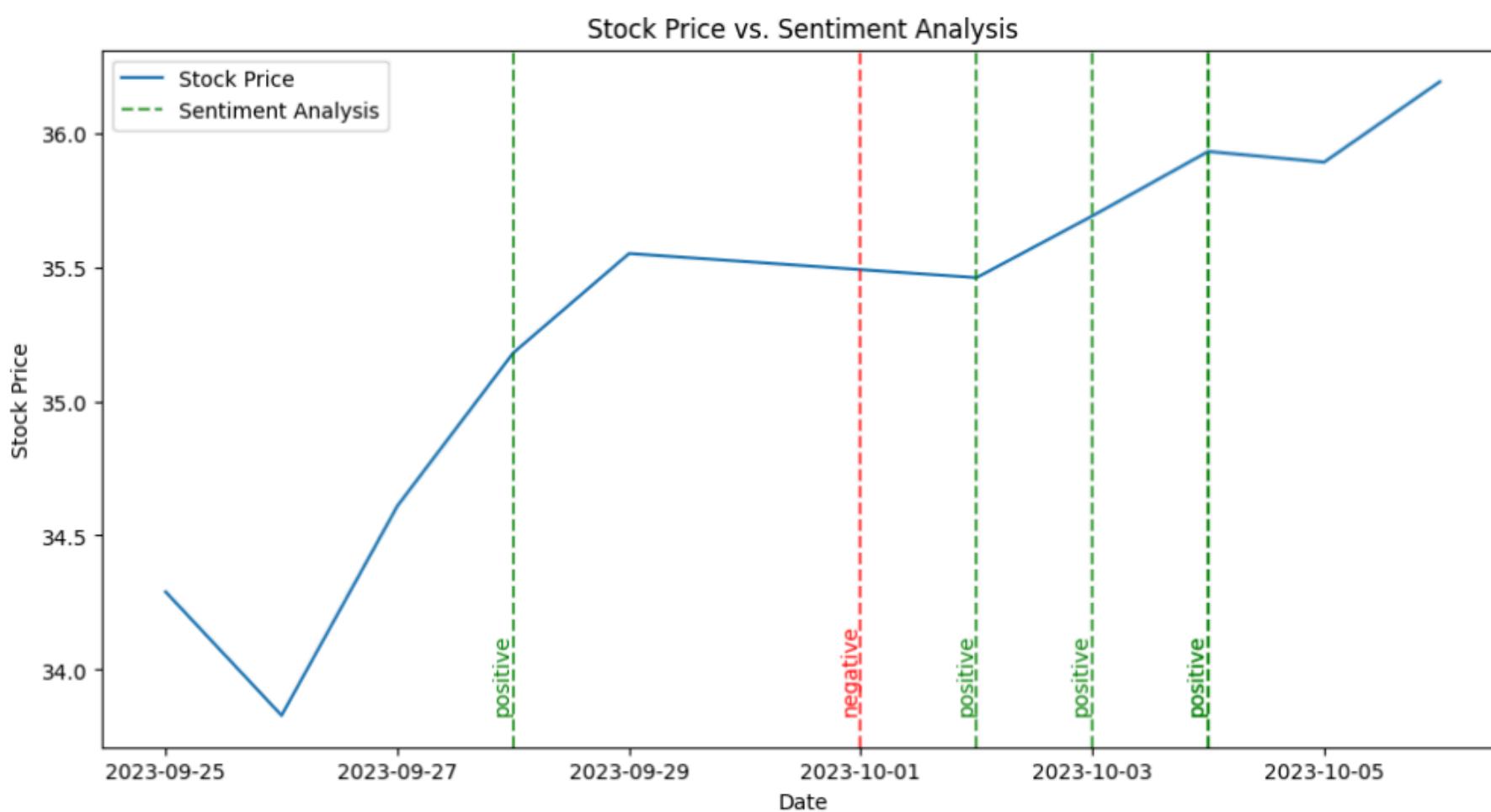


Confusion Matrix Overview (Excluding Neutral):

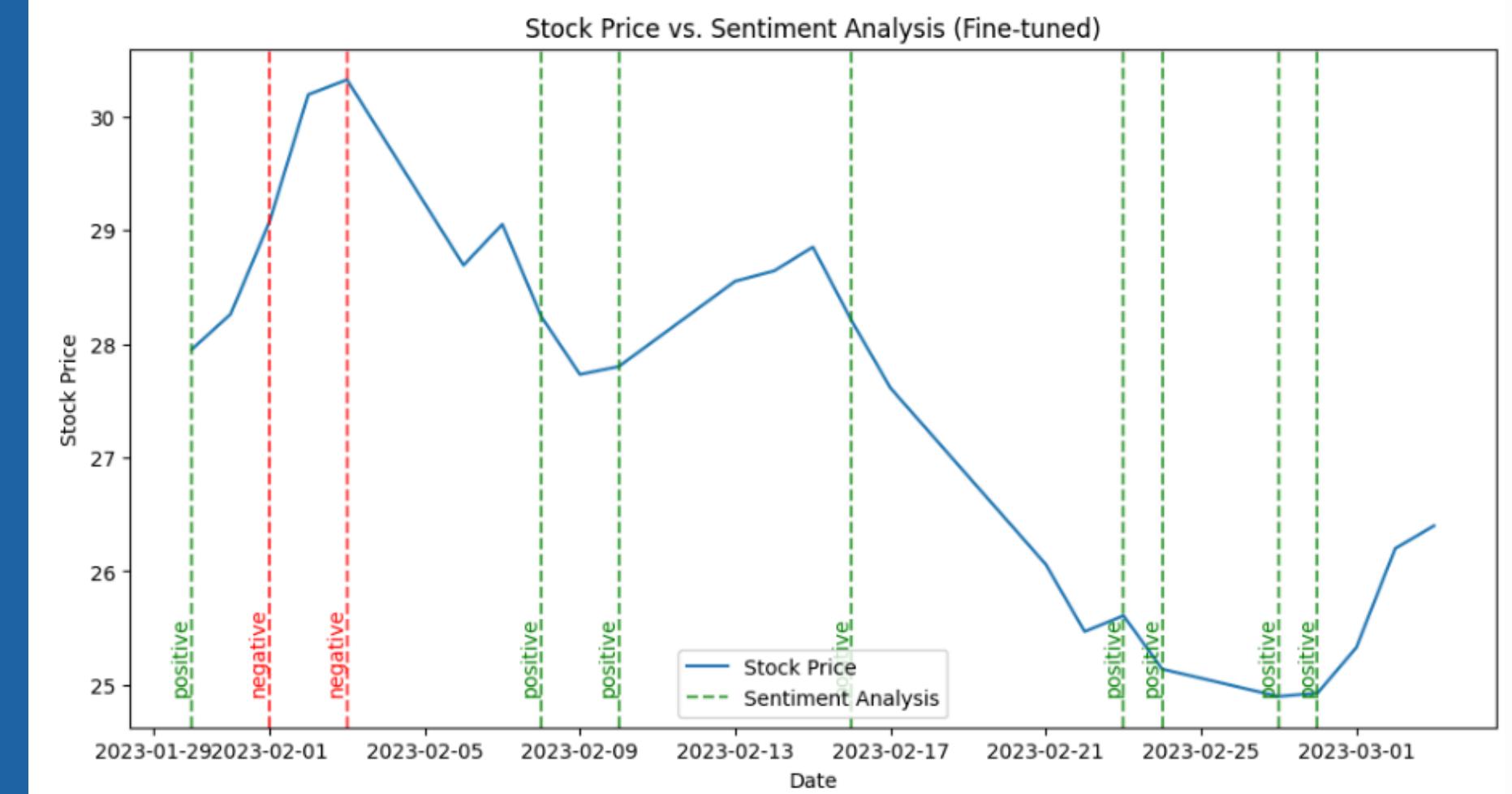
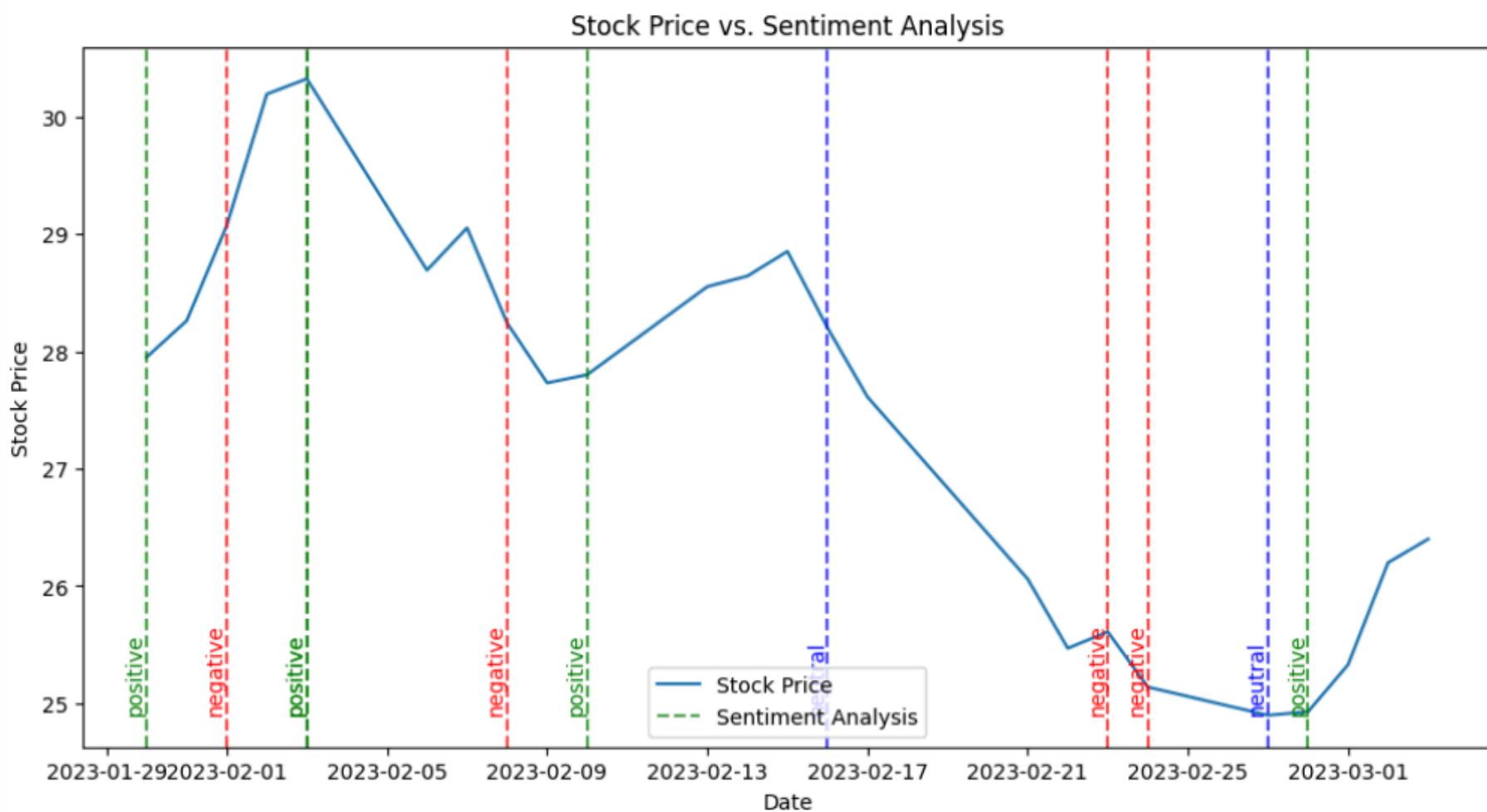
True Positives (TP): 238 (Positive samples correctly classified as positive)
False Positives (FP): 7 (Negative samples incorrectly classified as positive)
False Negatives (FN): 5 (Positive samples incorrectly classified as negative)
True Negatives (TN): 34 (Negative samples correctly classified as negative)

The model that has been trained is now better at predicting the dataset. However, needs to be noted that the model is trained using this dataset itself that has 88% positive sentiments. The model itself can be good at predicting positive sentiments in other dataset even though the result shows that there's also an improvement in predicting the negative.

Comparing Analysis #1 (Before & After Fine Tuning)



Comparing Analysis #2 (Before & After Fine Tuning)



Conclusion

In conclusion, positive news does not always correlate with rising stock prices, and the reverse holds true as well. We found that including the "neutral" label in LLM predictions results in an accuracy of 57.93%. However, excluding "neutral" and focusing on "positive" and "negative" labels boosts accuracy to 72.7%. Fine-tuning the model significantly improves performance, achieving 94.48% accuracy with the "neutral" label and 95.8% without it. Despite these improvements, the confusion matrix reveals a bias toward the "positive" label, likely due to the dataset's imbalance towards the positive label.

References

Lightning AI. (n.d.). Lightning AI. Retrieved November 27, 2024, from <https://lightning.ai/>

OpenAI. (2023). ChatGPT (version 4) [Large language model]. OpenAI. Retrieved November 27, 2024, from <https://chat.openai.com/>

Hugging Face. (2023). NickyNicky/finance-financialmodelingprep-stock-news-sentiments-rss-feed [Dataset]. Hugging Face. Retrieved November 27, 2024, from <https://huggingface.co/datasets/NickyNicky/finance-financialmodelingprep-stock-news-sentiments-rss-feed>

Hugging Face. (2023). mrm8488/distilroberta-finetuned-financial-news-sentiment-analysis [Model]. Hugging Face. Retrieved November 27, 2024, from <https://huggingface.co/mrm8488/distilroberta-finetuned-financial-news-sentiment-analysis>

THANK YOU!