

# **Sentiment-Based Trading: An NLP analysis of Earnings Transcripts**

Group 5

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# Motivating Statement

*"How can we best utilize our limited knowledge to extract emotionally unbiased insights from earnings call transcripts using NLP, and subsequently trade upon these in a systematic manner?"*

# **Data Sourcing and Cleaning**

Estimated Runtime (debugging excluded)

Approx 200 Hours



# Data Sourcing



# S&P 500®



```
1 def WRDSpuller(year, CIQ = CIQ_list):
2     # Create a sql query string
3     sql_query = '''SELECT a.companyid, a.transcriptid, a.headline, a.mostimportantdateutc, a.companyname,
4     b.word_count, c.componenttext FROM'''
5     sql_query += f'(SELECT * FROM ciq.wrds_transcript_detail WHERE companyid in {CIQ} '
6     sql_query += ''' and date_part('year',mostimportantdateutc)=''''
7     sql_query += f'{year}'
8     sql_query += ''' and keydeveventtypename = 'Earnings Calls' ) as a, ciq.wrds_transcript_person as b, ciq.ciqtra
9     ORDER by a.transcriptid, b.componentorder'''
10    # Run query, result in Pandas dataframe format
11    transcripts = db.raw_sql(sql_query)
12    transcripts.to_pickle(f'S&P{year}.pkl')
13    return transcripts
```

# Data Cleaning



```
def clean_text(text):
    '''Make text lowercase, remove text in square brackets, remove punctuation, remove words containing
    text = text.lower()
    text = re.sub(r"\[\]", " ", text)
    text = re.sub('[%s]' % re.escape('!"#&()*+,-/:;<=>?@^_`{|}~'), ' ', text)
    text = re.sub('\n', ' ', text)
    text = re.sub(r'(?<!\\w)(\\.)(?!\\bcom\\b)\\w)', r' \2', text) # Remove dots except for .com

    return text

cleaner = lambda x: clean_text(x)
```



# Data Cleaning

```
def preprocess(doc):
    # Check if doc is a string
    if not isinstance(doc, str):
        raise ValueError("doc must be a string")

    # Tokenize the document
    tokens = word_tokenize(doc)

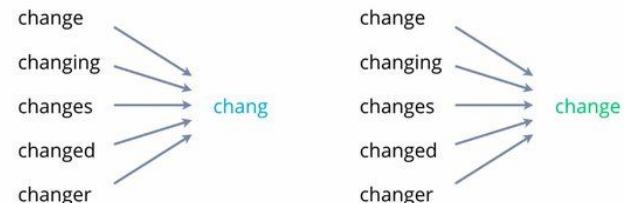
    # Remove punctuation, numbers, convert to lowercase, and remove stop words
    tokens = [lemmatizer.lemmatize(token.lower()) for token in tokens if \
              token not in string.punctuation and not token.isdigit() and \
              token.lower() not in stop_words]

    return tokens
```

```
tic()
processed_list = []
processed_list += docs.apply(preprocess).tolist()
tac()
```

Time passed: 8hour:17min:32sec

## Stemming vs Lemmatization



## Stop Words

[“This”, “is”, “a”, “test”]  
✓ X X ✓

**BERT-VADER**

# BERT (Bidirectional Encoder Representations)

**Brief workflow:**

1. Pretraining: BERT-Base-Uncased
2. Tokenization : Limited to 512 embeddings.
3. Input Representation:
  - a. [CLS] - beginning
  - b. [SEP] - sentence separation
4. Convert and Predict
5. Define entities and extract sentences related to entities

```
# Extract the relevant information from the transcript  
entities = [  
    'positive_indicators': ['growth', 'revenue', 'profit'],  
    'negative_indicators': ['decline', 'loss', 'risk'],  
]
```

Yes. Thanks, Martin. Just to start off here, **Q1 was a challenging but extremely successful quarter for the company**. Despite numerous supply interruptions, including shutdowns at our Shanghai factory and nearby suppliers due to COVID, we've continued making progress and achieved our best-ever vehicle deliveries.

Last quarter, we demonstrated a series of new financial records, including revenue, gross margins, operating margin and bottom line profitability. **GAAP automotive gross margin reached 32.9% and, for the first time, exceeded 30%** when excluding regulatory credits. **Higher pricing continues to positively impact our financials** as we make progress delivering cars in our growing backlog. Note that, for most vehicles, our delivery wait times are quite long. Thus, cars delivered in Q1 generally carried pricing set in prior quarters and at levels lower than cars being ordered today.

**Our per unit vehicle cost increased as well**. Inflation, raw material prices, expedites and logistics costs continue to impact our cost structure. Factory shutdowns also occurred with little to no notice. Hence, we are unable to take action to plan those interruptions in a cost-efficient manner. Additionally, **we saw a slight mix shift towards more profitable vehicles**, including the Model Y. We also recognized a one-time benefit of \$288 million from credit revenue relating to a regulatory change in the U.S. CAFE penalty, without which credit revenue would have declined compared to the same period last year.

**The energy business has continued to be impacted by macro conditions** more severely than the vehicle business. Our storage products, **our need of chip supply and new import processes have impacted supply of certain components for our solar systems**, which is reflected in our solar volume for the quarter.

**OpEx as a percentage of revenue continues to reduce** driven by higher revenue, lower stock-based comp expense and other items. As a result of our ongoing improvements in operating leverage, we achieved a record operating margin of over 19%. Note that commissioning costs for our factories are in R&D as Berlin started production in late March and Austin in early April. These costs will be in automotive COGS going forward given these factories are now producing customer sellable cars.

**Our free cash flows have remained quite strong, yet were impacted by working capital** related to lower-than-planned production. Additionally, **we have reduced our debt**, excluding product financing, to nearly 0.

Looking ahead in the immediate term, a few things to keep in mind for Q2. First, **we've lost about a month of build volume out of our factory in Shanghai** due to COVID-related shutdowns. Production is resuming at limited levels, and we're working to get back to full production as quickly as possible. This will impact total build and delivery volume in Q2. Second, as I've mentioned before, **Austin and Berlin are just starting their ramp, and thus, those inefficiencies** will start to flow through our gross margins in Q2. Third, we do have higher ASPs in our backlog which will help to offset some of these headwinds.

We continue to drive towards further strengthening of our financials in the second half of the year and believe our 50%-or-above growth rate remains achievable for the year.

**I want to conclude by thanking the Tesla team, our suppliers and our new customers for a great first quarter.**

```
[ 'In addition, I would like to remind you that we may make forward-looking statements about the future financial performance of the company that involve risks and uncertainties.  
' These risks and uncertainties could cause Agilent's results to differ materially from management's current expectations',  
' Wire-line test has seen continued softness from the router test business, leading to a 9% year-over-year decline in this business',  
" You have seen end market spending improve out there, a lot of the com equipment guys are seeing some pretty solid results, why are you seeing this year-over-year decline?  
" So that's clearly part of us behind the wire-line year-to-year decline.\n So, it's both the NEM's or the network equipment manufacturers as well as the com equipment guys'
```

# VADER (Valence Aware Dictionary and sEntiment Reasoner)

We utilized Sentiment Intensity Analyzer to gain overall sentiment for Earnings Call Transcripts

```
def sentiment_analysis(data):
    sid = SentimentIntensityAnalyzer()
    subjects = data
    sentiment_score = []
    for i in range(len(data)):
        sentence = "".join(data[i])
        sentiment = sid.polarity_scores(sentence)
        sentiment_score.append(sentiment)
    return sentiment_score
```

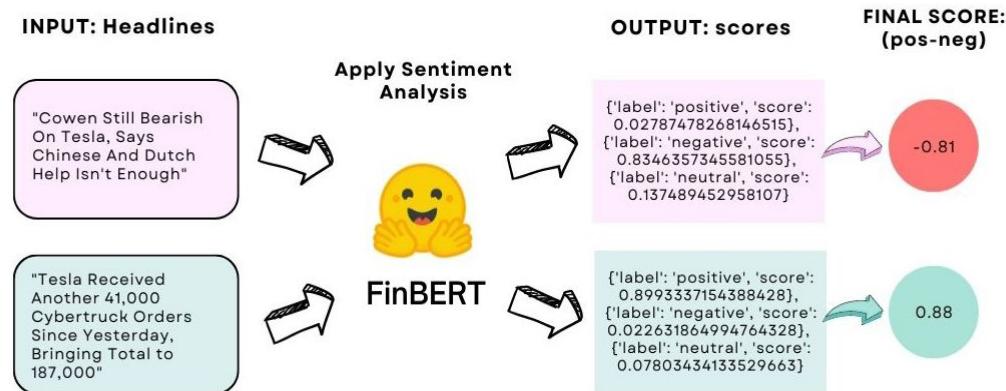
From the output, We extracted neg, pos and the difference between them

```
{'neg': 0.0305, 'neu': 0.854, 'pos': 0.1159999999999999, 'compound': 0.98105}
```

**FinBERT**

# FinBERT workflow/architecture

- Data Preprocessing
- Tokenization
- Word Embeddings
- Transformer Layers
- Fine-tuning
- Output Layer



# FinBERT

- Consists of multiple transformer layers that encode the contextual information of the input text.
- Pre-trained using a masked language modeling (MLM) objective, where random tokens are masked in the input, allowing the model to be trained in a bidirectional manner.
- The model is trained to predict those masked tokens based on the context both before and after the masked word.



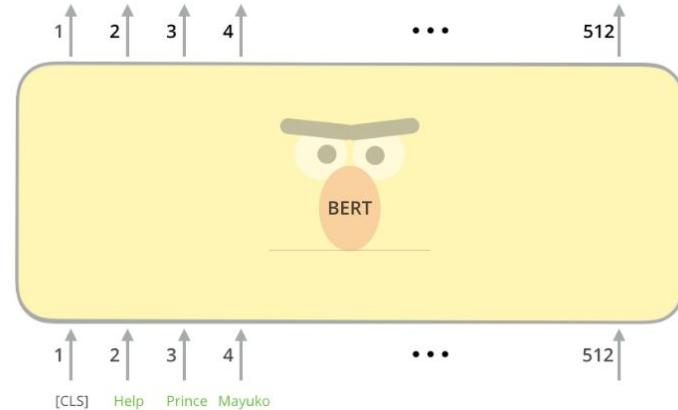
# Data Preprocessing

- The input financial text data, such as news articles, earnings reports, or social media posts, is preprocessed to remove noise, tokenize the text into words or subwords, and convert it into numerical representations that the model can understand.



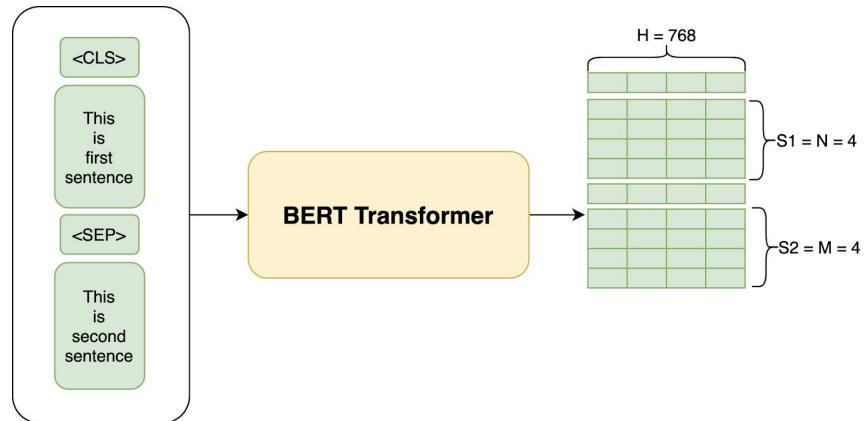
# Tokenization/Word Embeddings

- The text is split into tokens, which are the basic units of input for the model. The tokens can represent individual words or subwords.
- Each token is assigned a word embedding, which is a numerical representation capturing its semantic meaning. The embeddings help the model understand the relationships between words in the text.



# Transformer Layers

- FinBERT employs multiple transformer layers. Each layer consists of attention mechanisms and feed-forward neural networks. The attention mechanism allows the model to focus on important parts of the text while capturing contextual information from the surrounding words.



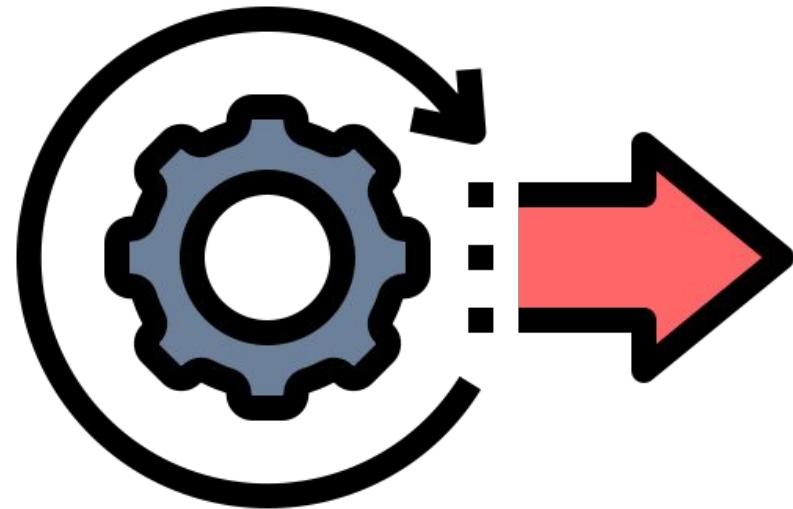
# Fine-Tuning

- After the initial pretraining on a large corpus of text, FinBERT is fine-tuned on financial-specific data. This process involves training the model on a task such as sentiment classification using labeled financial data. This fine-tuning exposes FinBERT to labeled financial data with sentiment annotations, allowing it to learn the nuances of positive sentiment specifically in financial contexts



# Output Layer

- The final layer of the model produces the desired output, such as sentiment scores or predictions related to the financial domain. The output layer is trained to map the learned representations from the previous layers to the specific task at hand.

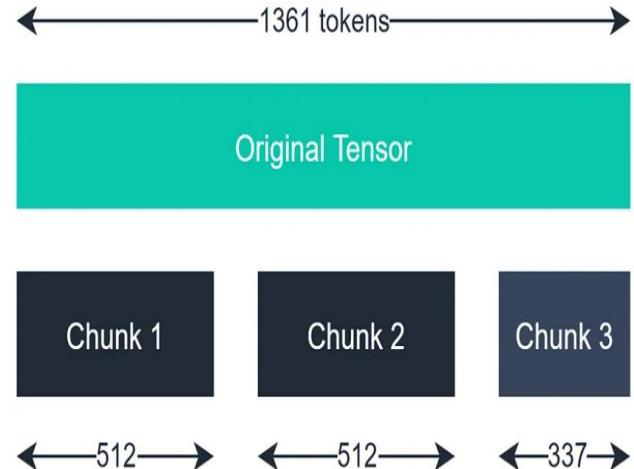


# Problems faced with finBERT

```
# Tokenize the text and return a dictionary of tensors
class_labels = {0: "negative", 1: "neutral", 2: "positive"}
inputs = tokenizer(text, truncation=True, max_length=512, padding='max_length', return_tensors="pt")

# Initialize a list to hold the probabilities for each chunk
chunk_probs = []

# Process the input tensors in chunks of 512 tokens
for i in range(0, inputs["input_ids"].size(1), 512):
    # Create a dictionary for the current chunk
    chunk = {key: tensor[:, i:i+512] for key, tensor in inputs.items()}
```



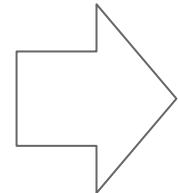
- As the BERT model only accepts 512 tokens, the code has to be dynamic such that all the contents within the earning call transcripts are broken down into chunks of 512 tokens such that there is no information loss.

# BERT Vs FinBERT key differences

BERT model	FinBERT model
<ul style="list-style-type: none"><li>Trained on a general corpus of text data from the internet, covering a wide range of topics.</li><li>Fine-tuned on various tasks but may not have specialized fine-tuning for sentiment analysis in the financial domain.</li><li>Specialized vocabulary helps FinBERT recognize and understand financial language related to positive sentiment more effectively.</li></ul>	<ul style="list-style-type: none"><li>Trained on financial text data, such as financial news articles, earnings call transcripts, and SEC filings.</li><li>FinBERT is fine-tuned on financial-specific tasks, including sentiment analysis in the financial domain.</li><li>General vocabulary built on diverse internet text data, which may not be as attuned to financial-specific terms and nuances.</li></ul>

# Feature Importance

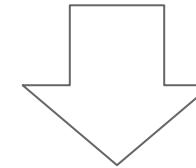
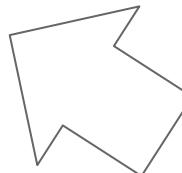
S&P 500  
stocks



30 features & sentiment score

How did  
sentiment rank?

Random Forest



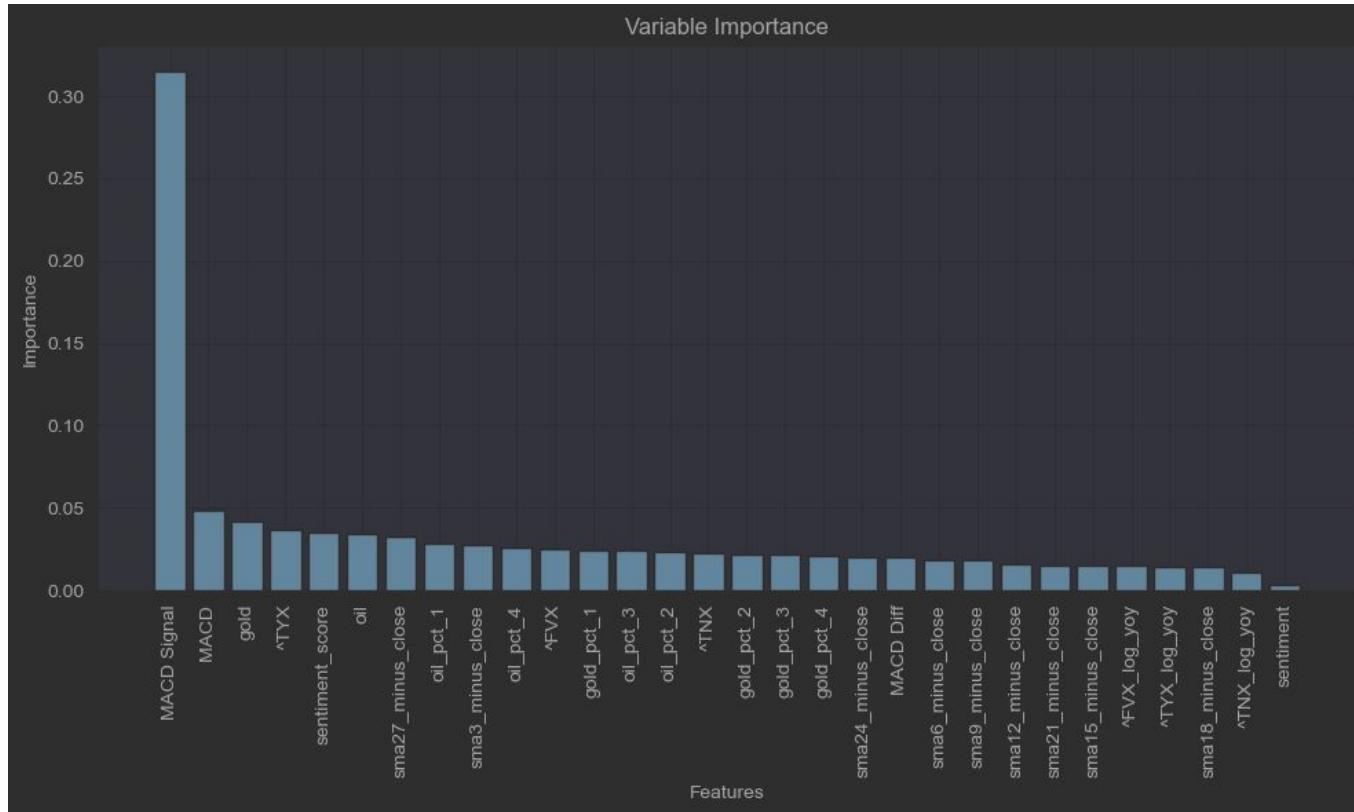
Feature Importance  
score

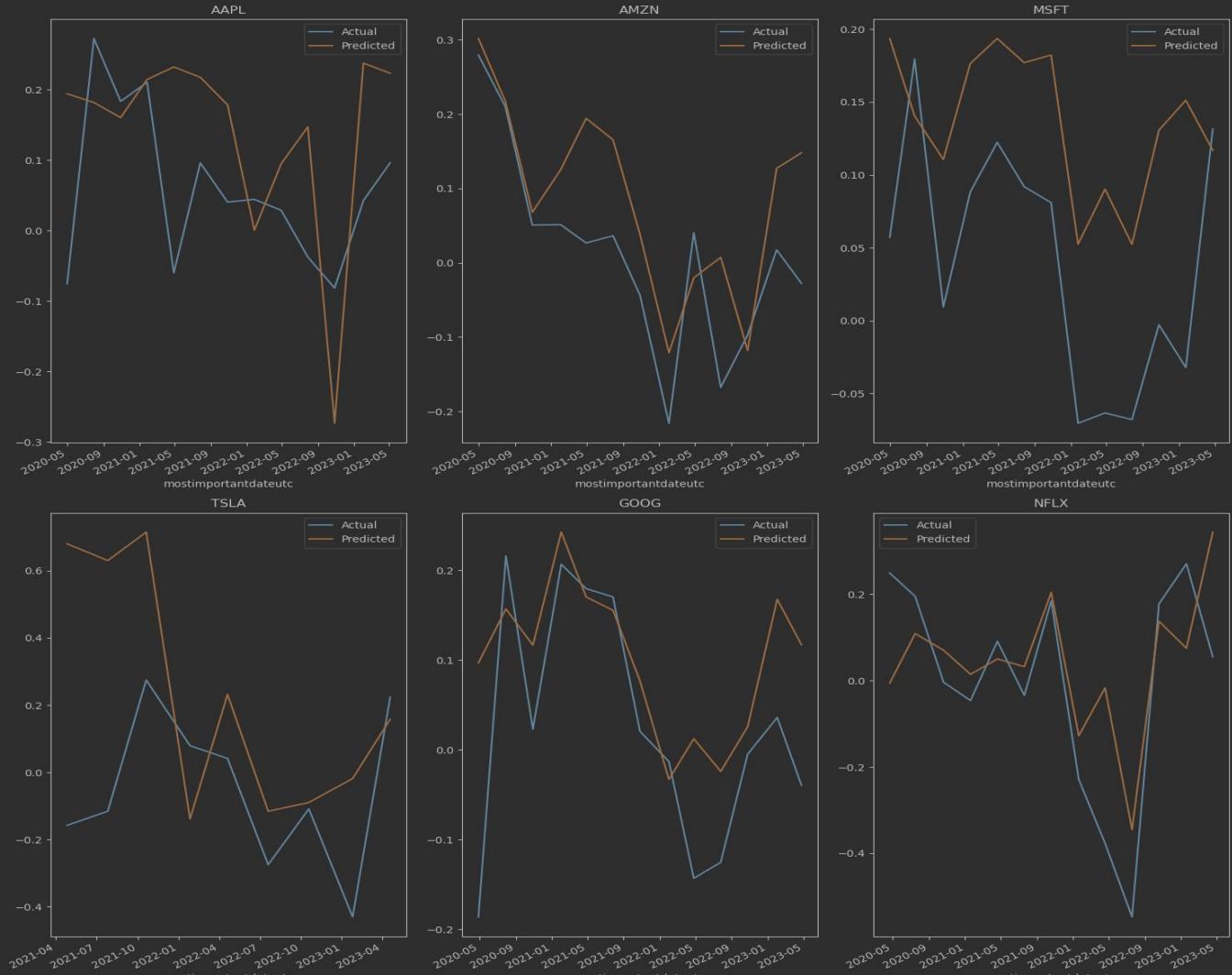
# SENTIMENT SCORE CAME IN 5TH!!!

Symbol	sentiment	sentiment_score	MACD	MACD Signal	MACD Diff	sma3_minus_close	sma6_minus_close	sma9_minus_close	sma12_minus_
HOLX	0.000205	0.056764	0.099989	0.215539	0.067432	0.006299	0.003895	0.006359	0
ORLY	0.000197	0.011086	0.070625	0.355213	0.023415	0.011410	0.048740	0.025375	0
FI	0.003410	0.020163	0.016128	0.114080	0.011501	0.012221	0.003639	0.002031	0
ACGL	0.000396	0.013493	0.083845	0.344032	0.014063	0.007169	0.004160	0.001911	0
WBD	0.000230	0.013764	0.033076	0.242109	0.003581	0.009604	0.003794	0.017436	0
PPL	0.001108	0.009185	0.016625	0.398378	0.009373	0.019726	0.036408	0.036098	0
LYV	0.012838	0.015497	0.027787	0.396784	0.010755	0.018659	0.006711	0.005975	0
PM	0.003620	0.041429	0.072460	0.244428	0.021545	0.010791	0.018853	0.013443	0
WHR	0.003108	0.008771	0.047933	0.523452	0.009185	0.071283	0.045027	0.029547	0
EL	0.019915	0.021760	0.162836	0.138592	0.008465	0.083766	0.006518	0.004253	0

	data
MACD Signal	0.314864
MACD	0.049026
gold	0.042087
^TYX	0.036842
sentiment_score	0.034949
oil	0.034512
sma27_minus_close	0.033140
oil_pct_1	0.028662
sma3_minus_close	0.028051
oil_pct_4	0.026413
^FVX	0.025140
gold_pct_1	0.024507
oil_pct_3	0.024432
oil_pct_2	0.023431
^TNX	0.022698
gold_pct_2	0.021686
gold_pct_3	0.021522
gold_pct_4	0.021034
sma24_minus_close	0.020504
MACD Diff	0.020126
sma6_minus_close	0.018473
sma9_minus_close	0.018401
sma12_minus_close	0.015928
sma21_minus_close	0.015348
sma15_minus_close	0.014976
^FVX_log_yoy	0.014803
^TYX_log_yoy	0.014710
sma18_minus_close	0.014382
^TNX_log_yoy	0.011408
sentiment	0.003922

# Variable Importance Plot





	RMSE	MSE
AAPL	0.159820	0.025543
AMZN	0.105432	0.011116
MSFT	0.112875	0.012741
TSLA	0.439102	0.192810
GOOG	0.115922	0.013438
NFLX	0.173777	0.030198

## **Trading Performance - BERT-VADER**

# Trading Strategies

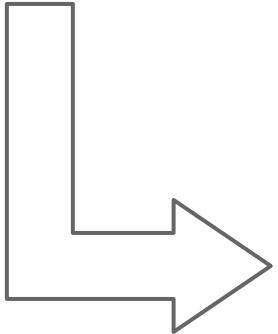
Determining Optimal Holding Period

Method 1 : Train - Test (13 years - 5 years)

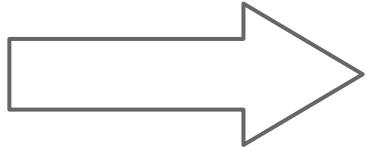
Method 2: Rolling method

## Illustration for Method 1:

mostimportantdateutc	Symbol	0	1	2	3	4	5	6	7	8	9
2006-01-17	IBM	-0.002381	-0.010833	-0.031429	-0.030833	-0.037500	-0.036786	-0.039048	-0.035476	-0.028214	-0.032143
	INTC	-0.011806	-0.020551	-0.048535	-0.066463	-0.069523	-0.072584	-0.060341	-0.052471	-0.053345	-0.070398
2006-01-18	AAPL	-0.048628	-0.084136	-0.065118	-0.084738	-0.106885	-0.129393	-0.133004	-0.097256	-0.091117	-0.092200
	LRCX	0.171207	0.122329	0.134081	0.180823	0.170406	0.213942	0.237180	0.251603	0.240118	0.252404
2006-01-19	MCHP	0.033688	0.040189	0.059102	0.066194	0.103428	0.090426	0.108451	0.108451	0.115248	0.093381

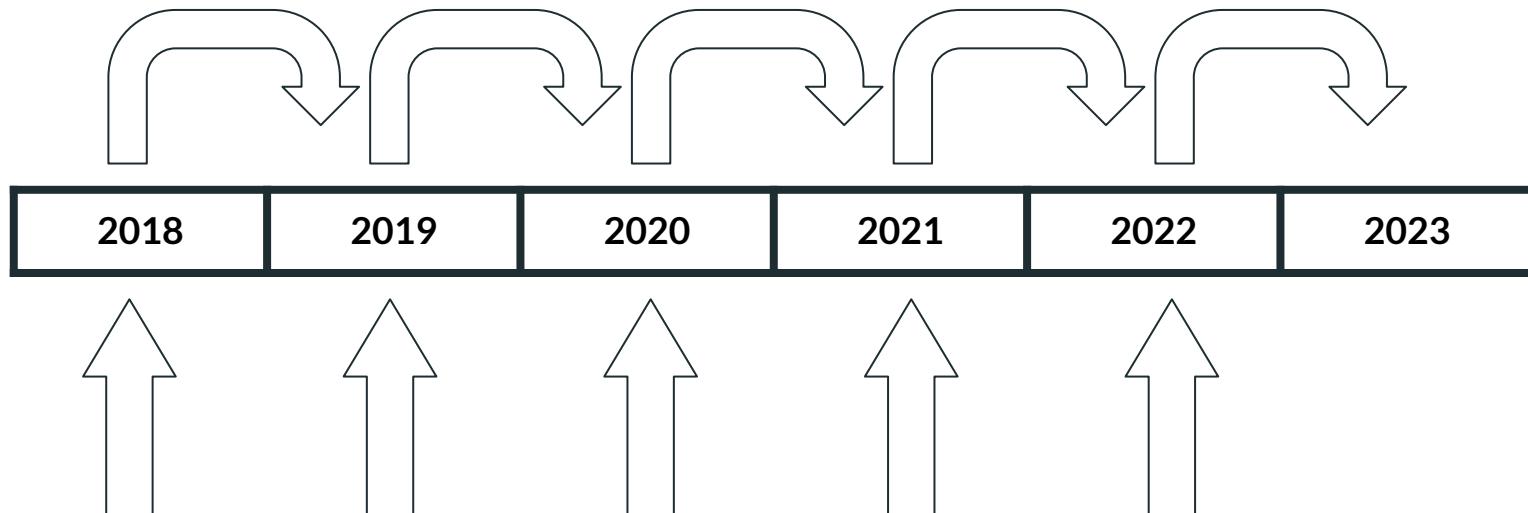


{2006: 58,  
2007: 35,  
2008: 7,  
2009: 62,  
2010: 59,  
2011: 59,  
2012: 50,  
2013: 58,  
2014: 23,  
2015: 9,  
2016: 58,  
2017: 58,  
2018: 27}



(58, 4)

## Illustration for Method 2

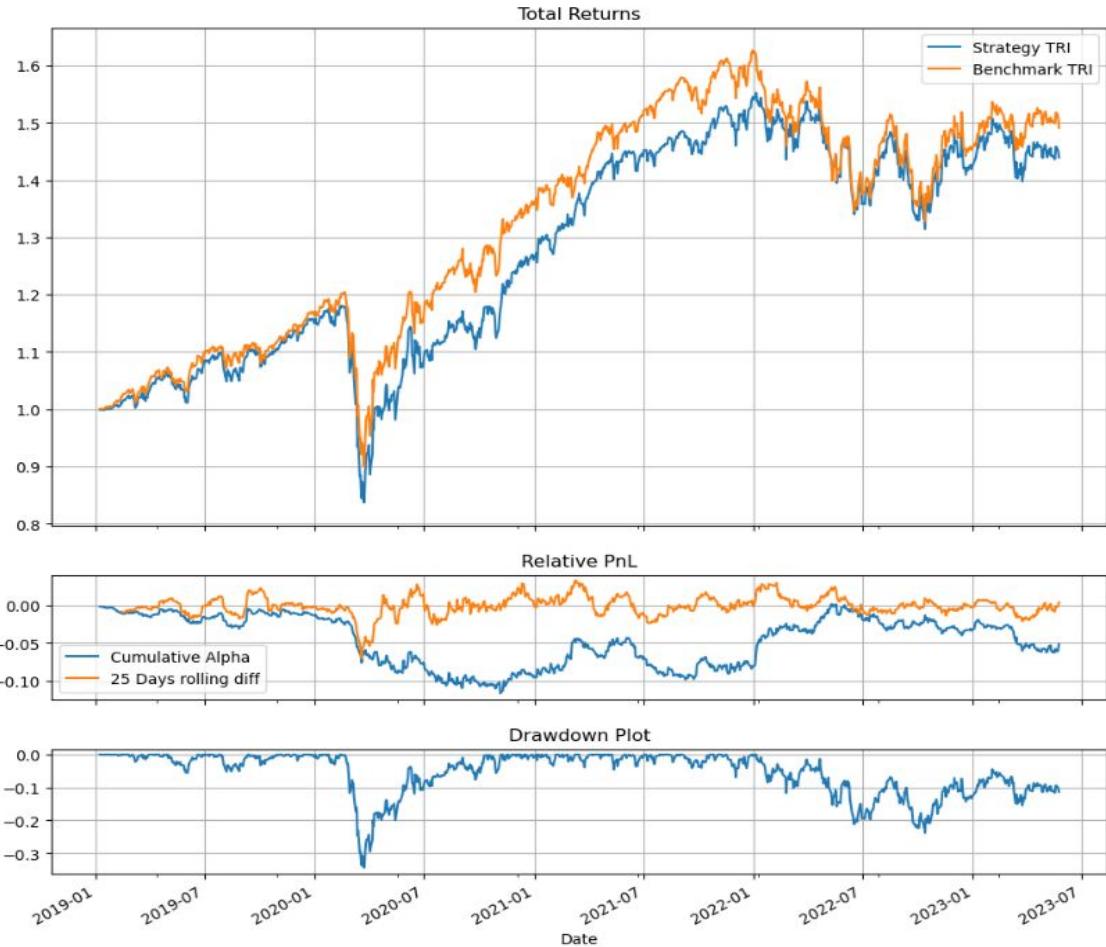


Identify optimal holding period and use it for next year trading

## List of Strategies for BERT-VADER:

- **Strategy 1: Long - Short**
- **Strategy 2: Long only**
- **Strategy 3: Short only**
- **Strategy 4: 25% Percentile**
- **Strategy 5: 50% Percentile**
- **Strategy 6: 75% Percentile**
- **Strategy 7: Value for (50% Percentile - 25% Percentile)**
- **Strategy 8: Value for (75% Percentile - 50% Percentile)**
- **Strategy 9: Grouping by GICS Sector**
- **Strategy 10: Grouping by GICS Sub-industry**

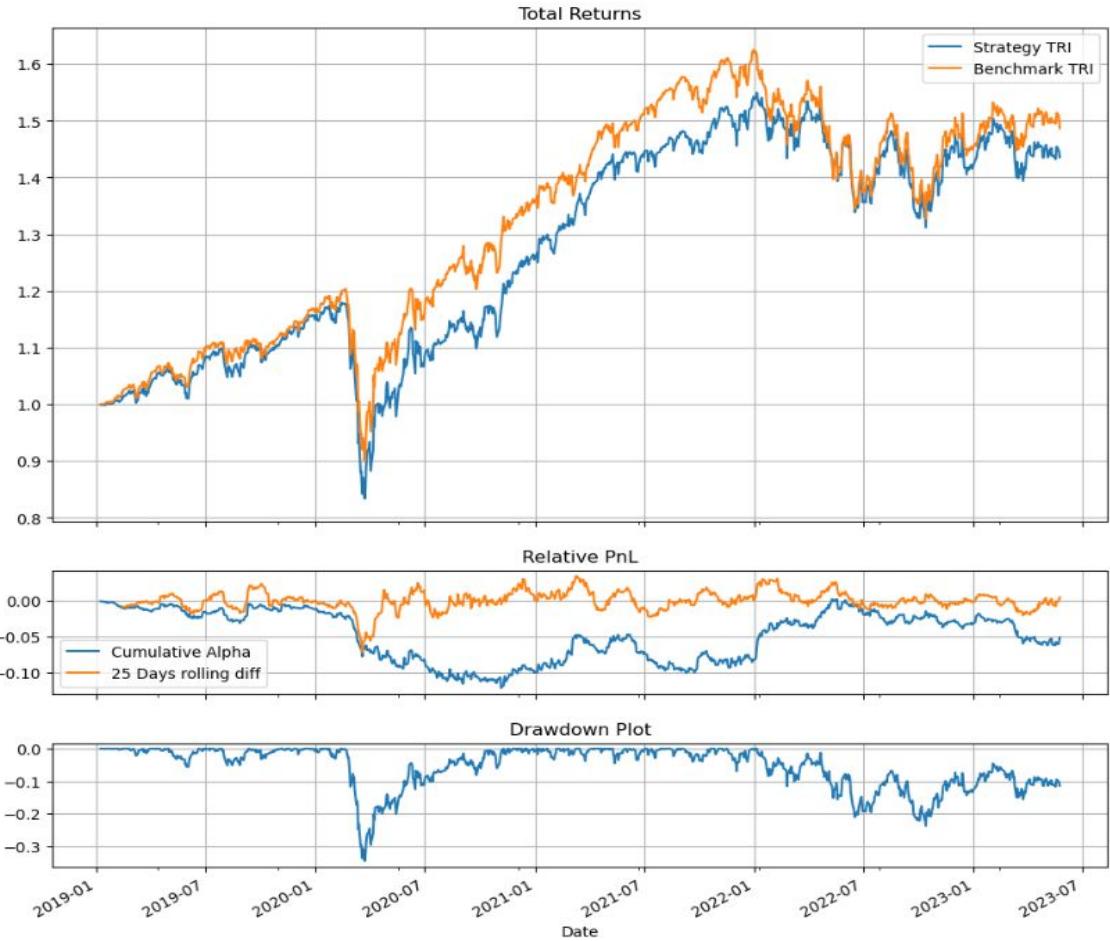
# Strategy 1: Method 1



# Strategy 1: Method 2

		Ann. Sharpe	Ann. Sortino	Avg. Daily Turnover	CAGR	Expected Period Return	Max DD.
2007	Benchmark	1.529458	2.281449	NaN	0.073735	0.000287	-0.046331
	Strategy	1.066782	1.573124	0.013865	0.056991	0.000226	-0.056768
2008	Benchmark	0.096974	0.142853	NaN	0.004907	0.000043	-0.093597
	Strategy	-0.143011	-0.199061	0.032669	-0.019290	-0.000056	-0.088198
2009	Benchmark	-0.693671	-0.958144	NaN	-0.251802	-0.000924	-0.400996
	Strategy	0.260595	0.384974	0.207688	0.028228	0.000371	-0.324226
2010	Benchmark	1.838113	2.895579	NaN	0.300596	0.001093	-0.106646
	Strategy	2.117062	3.431700	0.018968	0.380125	0.001333	-0.121244
2011	Benchmark	1.444491	2.107929	NaN	0.186603	0.000712	-0.116857
	Strategy	1.244768	1.799827	0.020472	0.154011	0.000599	-0.125859
2012	Benchmark	0.484849	0.670703	NaN	0.065128	0.000299	-0.170253
	Strategy	0.516909	0.723768	0.020146	0.068413	0.000307	-0.155696
2013	Benchmark	1.237419	1.919934	NaN	0.124779	0.000488	-0.080322
	Strategy	1.351542	2.098162	0.026164	0.138579	0.000537	-0.074446
2014	Benchmark	2.452095	3.635919	NaN	0.202670	0.000747	-0.050521
	Strategy	2.489351	3.684649	0.021530	0.200697	0.000739	-0.045296
2015	Benchmark	1.926845	3.078989	NaN	0.182968	0.000684	-0.089029
	Strategy	1.960309	3.146642	0.080227	0.165093	0.000626	-0.049902
2016	Benchmark	0.200953	0.259251	NaN	0.020109	0.000097	-0.106960
	Strategy	0.958511	1.302349	0.161290	0.129194	0.000505	-0.118352
2017	Benchmark	2.040237	3.167466	NaN	0.155721	0.000588	-0.042519
	Strategy	2.315453	3.663400	0.020770	0.187846	0.000698	-0.037359
2018	Benchmark	2.712167	3.916594	NaN	0.137007	0.000516	-0.032555
	Strategy	2.593364	3.789534	0.020339	0.134502	0.000507	-0.039023
2019	Benchmark	-0.034847	-0.046549	NaN	-0.011831	-0.000017	-0.117912
	Strategy	0.201590	0.276903	0.051766	0.017723	0.000097	-0.099387
2020	Benchmark	2.045940	3.029323	NaN	0.169840	0.000636	-0.042642
	Strategy	1.835319	2.683932	0.022604	0.155090	0.000592	-0.055894
2021	Benchmark	0.907561	1.258067	NaN	0.176966	0.000731	-0.234819
	Strategy	0.729113	1.027208	0.020753	0.145674	0.000640	-0.261122
2022	Benchmark	1.125071	1.619661	NaN	0.095949	0.000380	-0.078768
	Strategy	1.452188	2.101899	0.019879	0.128707	0.000498	-0.058650
2023	Benchmark	-0.034168	-0.047692	NaN	-0.025994	-0.000026	-0.161746
	Strategy	0.666040	0.967081	0.158085	0.117148	0.000498	-0.128878

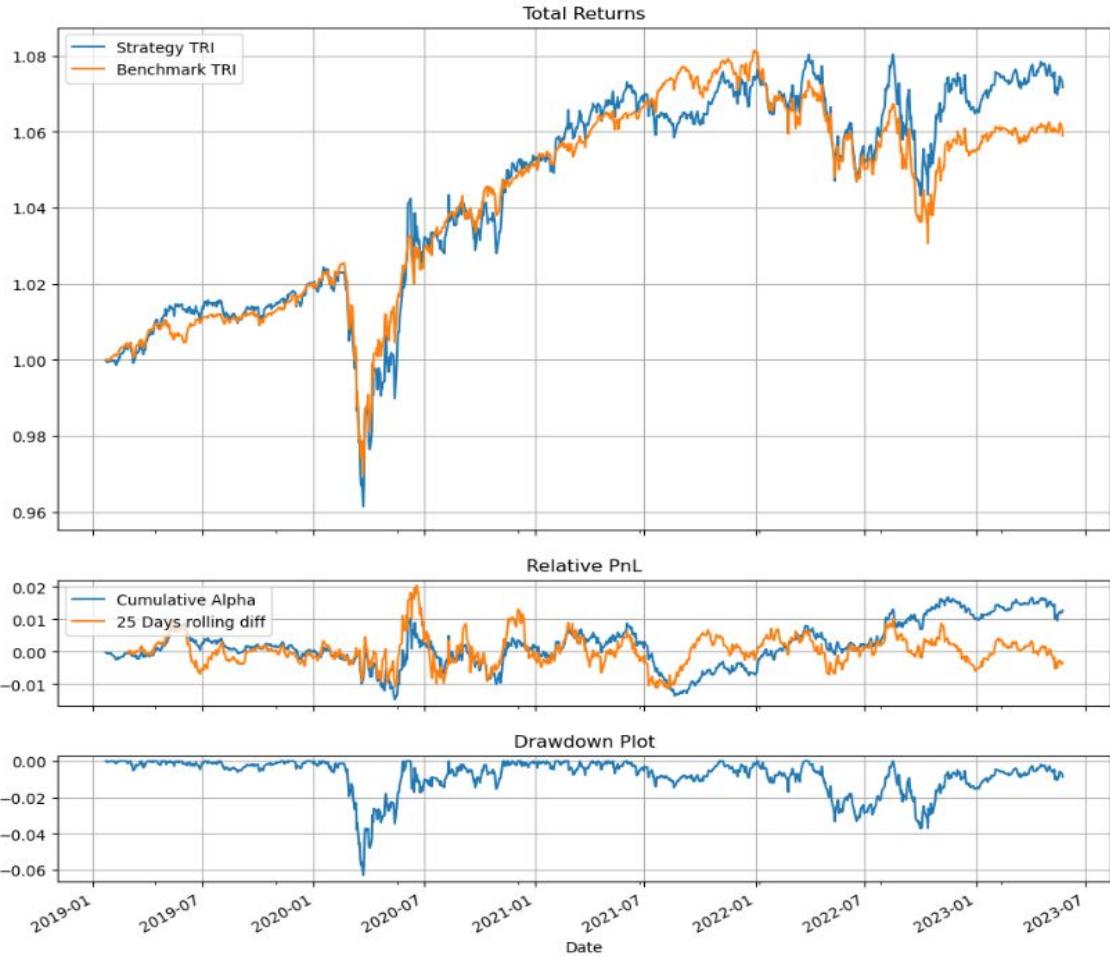
## Strategy 2: Method 1



# Strategy 2: Method 2

		Ann. Sharpe	Ann. Sortino	Avg. Daily Turnover	CAGR	Expected Period Return	Max DD.
2007	Benchmark	1.533883	2.290025	NaN	0.073447	0.000286	-0.045844
	Strategy	1.096857	1.619546	0.013738	0.058612	0.000233	-0.055771
2008	Benchmark	0.144347	0.208255	NaN	0.009410	0.000061	-0.109625
	Strategy	-0.046695	-0.065777	0.025214	-0.009963	-0.000018	-0.104310
2009	Benchmark	-0.688692	-0.951611	NaN	-0.250244	-0.000916	-0.399643
	Strategy	0.233118	0.493164	0.205393	0.055237	0.000472	-0.329053
2010	Benchmark	1.838113	2.895579	NaN	0.300596	0.001093	-0.106646
	Strategy	2.110532	3.417198	0.018970	0.378741	0.001329	-0.120843
2011	Benchmark	1.444491	2.107929	NaN	0.186603	0.000712	-0.116857
	Strategy	1.233472	1.785256	0.020467	0.152330	0.000593	-0.126094
2012	Benchmark	0.484849	0.670703	NaN	0.065128	0.000299	-0.170253
	Strategy	0.501324	0.701299	0.020205	0.066283	0.000300	-0.158501
2013	Benchmark	1.230475	1.907335	NaN	0.122994	0.000481	-0.080322
	Strategy	1.349384	2.087320	0.025944	0.137874	0.000534	-0.074466
2014	Benchmark	2.451481	3.633813	NaN	0.201686	0.000744	-0.050521
	Strategy	2.478357	3.663403	0.021413	0.198698	0.000732	-0.046049
2015	Benchmark	1.956049	3.143910	NaN	0.181985	0.000680	-0.065888
	Strategy	1.978069	3.190106	0.059550	0.163011	0.000618	-0.049943
2016	Benchmark	0.276678	0.361772	NaN	0.028480	0.000126	-0.095740
	Strategy	1.007040	1.382156	0.159498	0.130513	0.000506	-0.107405
2017	Benchmark	2.040237	3.167466	NaN	0.155721	0.000588	-0.042519
	Strategy	2.317085	3.662673	0.020776	0.187635	0.000697	-0.037104
2018	Benchmark	2.712167	3.916594	NaN	0.137007	0.000516	-0.032555
	Strategy	2.589585	3.784516	0.020348	0.134129	0.000506	-0.039009
2019	Benchmark	-0.034847	-0.046549	NaN	-0.011831	-0.000017	-0.117912
	Strategy	0.198460	0.272565	0.051766	0.017313	0.000096	-0.098985
2020	Benchmark	2.044039	3.027943	NaN	0.168837	0.000632	-0.042642
	Strategy	1.814405	2.662968	0.022473	0.152423	0.000582	-0.057385
2021	Benchmark	0.907561	1.258067	NaN	0.176966	0.000731	-0.234819
	Strategy	0.726977	1.021164	0.020791	0.144550	0.000635	-0.261914
2022	Benchmark	1.125071	1.619661	NaN	0.095949	0.000380	-0.078768
	Strategy	1.478659	2.142521	0.019879	0.130685	0.000505	-0.058764
2023	Benchmark	-0.058013	-0.080435	NaN	-0.029906	-0.000043	-0.161746
	Strategy	0.610709	0.881089	0.157182	0.104535	0.000451	-0.125159

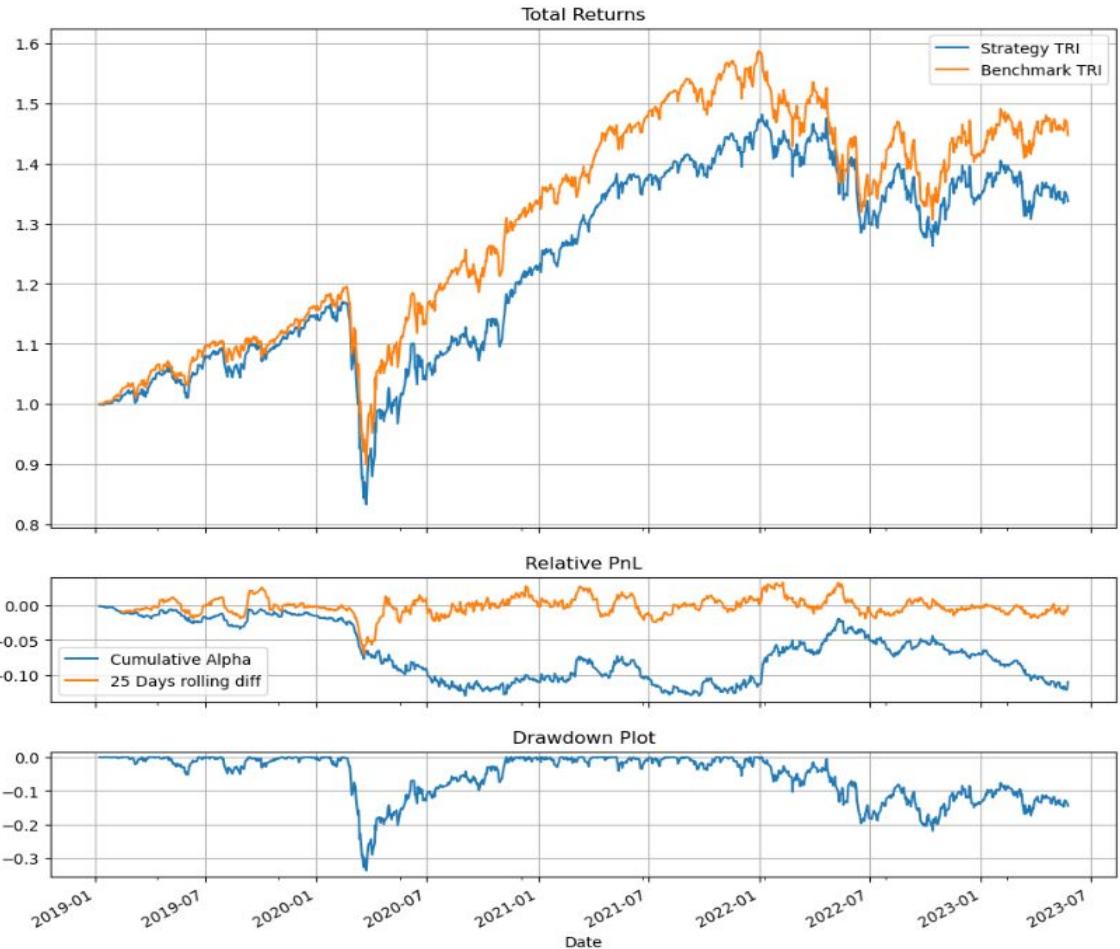
## Strategy 3: Method 1



# Strategy 3: Method 2

		Ann. Sharpe	Ann. Sortino	Avg. Daily Turnover	CAGR	Expected Period Return	Max DD.
2007	Benchmark	0.705453	1.100299	NaN	0.004221	1.527551e-05	-0.002996
	Strategy	-0.857885	-1.192981	0.001128	-0.012226	-5.124970e-05	-0.014804
2008	Benchmark	0.092844	0.134419	NaN	0.001611	6.991031e-06	-0.015671
	Strategy	-0.417571	-0.521791	0.001475	-0.010414	-3.657677e-05	-0.018648
2009	Benchmark	-0.709715	-0.980317	NaN	-0.040939	-1.622297e-04	-0.083961
	Strategy	-0.313399	-0.457969	0.003385	-0.023643	-8.776660e-05	-0.098808
2010	Benchmark	0.302869	0.398593	NaN	0.010709	5.596698e-05	-0.063066
	Strategy	0.399139	0.540132	0.016807	0.020037	1.091434e-04	-0.095229
2011	Benchmark	1.233686	1.768314	NaN	0.025736	1.033053e-04	-0.020483
	Strategy	1.087838	1.524539	0.003238	0.028467	1.139250e-04	-0.021639
2012	Benchmark	0.581386	0.807359	NaN	0.011740	4.649152e-05	-0.020073
	Strategy	0.758924	1.072595	0.002906	0.017037	6.898483e-05	-0.015926
2013	Benchmark	1.829483	2.998241	NaN	0.027112	1.070053e-04	-0.007262
	Strategy	2.070298	3.414237	0.003273	0.037617	1.469295e-04	-0.009225
2014	Benchmark	2.757146	4.196095	NaN	0.029867	1.173587e-04	-0.006027
	Strategy	3.069851	5.095288	0.002763	0.042350	1.649472e-04	-0.007029
2015	Benchmark	1.371601	1.918021	NaN	0.020955	8.378487e-05	-0.008878
	Strategy	0.875764	1.289221	0.003509	0.016207	6.704529e-05	-0.011363
2016	Benchmark	-0.008721	-0.011362	NaN	-0.000400	-6.129180e-07	-0.014095
	Strategy	0.538916	0.759533	0.002471	0.009678	3.735399e-05	-0.010723
2017	Benchmark	2.067664	3.243460	NaN	0.028453	1.125976e-04	-0.006213
	Strategy	1.886054	2.986756	0.003442	0.037099	1.446486e-04	-0.011797
2018	Benchmark	3.206456	4.856125	NaN	0.026962	1.062903e-04	-0.003729
	Strategy	2.983624	4.837250	0.003480	0.037849	1.505598e-04	-0.005882
2019	Benchmark	-0.125666	-0.169494	NaN	-0.002152	-7.774951e-06	-0.019793
	Strategy	0.098555	0.133762	0.002344	0.001720	8.309738e-06	-0.023921
2020	Benchmark	2.025459	2.840122	NaN	0.021296	8.416378e-05	-0.006006
	Strategy	1.322357	1.869478	0.002688	0.019666	7.8777519e-05	-0.006128
2021	Benchmark	0.875743	1.218871	NaN	0.035166	1.403848e-04	-0.048382
	Strategy	0.721077	1.107001	0.003570	0.038432	1.558618e-04	-0.051877
2022	Benchmark	0.812381	1.115781	NaN	0.012543	5.012990e-05	-0.014801
	Strategy	0.601273	0.822104	0.003530	0.012983	5.295396e-05	-0.013818
2023	Benchmark	-0.187104	-0.261208	NaN	-0.007435	-2.525318e-05	-0.040199
	Strategy	0.157451	0.220808	0.003768	0.004486	2.429192e-05	-0.034850

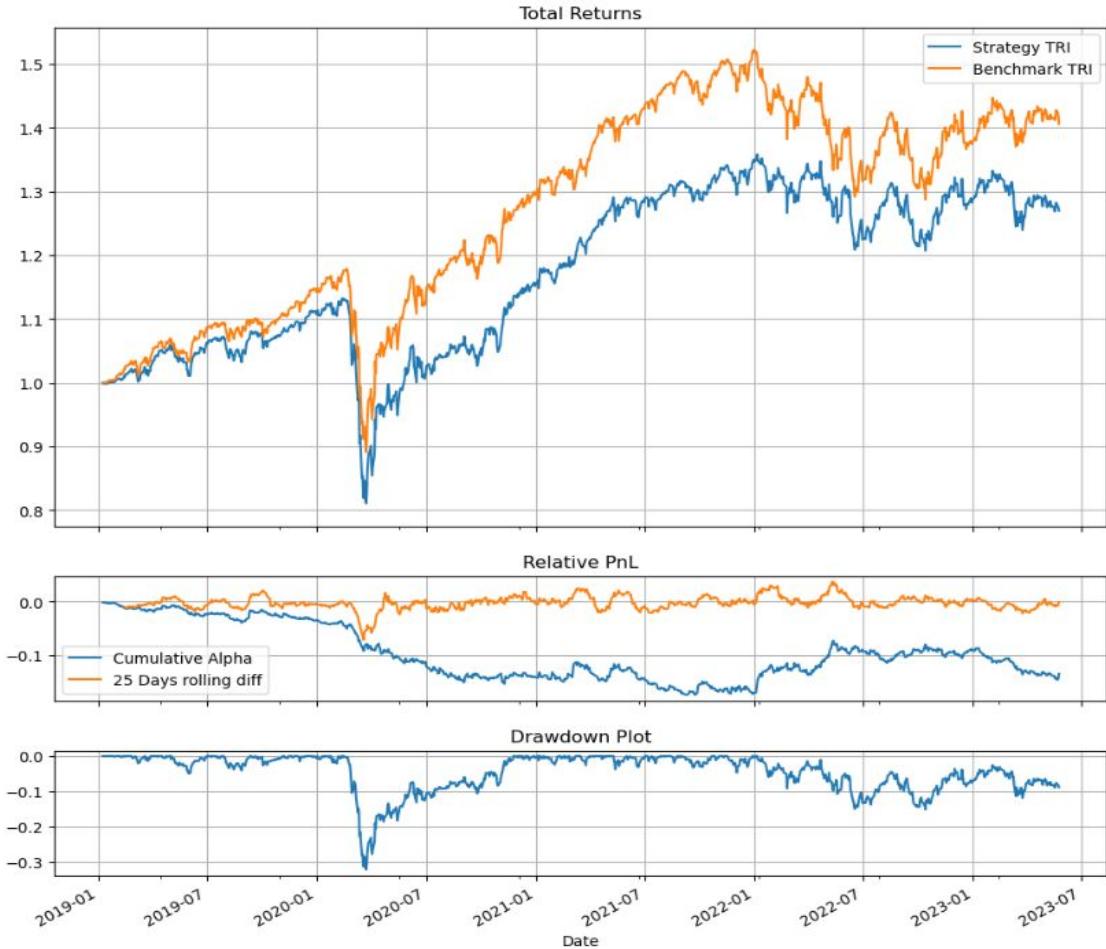
## Strategy 4: Method 1



# Strategy 4: Method 2

		Ann. Sharpe	Ann. Sortino	Avg. Daily Turnover	CAGR	Expected Period Return	Max DD.
2007	Benchmark	1.624107	2.422713	NaN	0.061267	0.000238	-0.036599
	Strategy	1.328944	1.986308	0.011072	0.054862	0.000216	-0.035174
2008	Benchmark	0.148089	0.213850	NaN	0.009452	0.000058	-0.100237
	Strategy	0.120380	0.171236	0.023235	0.005679	0.000042	-0.089504
2009	Benchmark	-0.606563	-0.839437	NaN	-0.220100	-0.000776	-0.373809
	Strategy	0.540719	0.828731	0.192972	0.130948	0.000715	-0.284997
2010	Benchmark	1.760615	2.764798	NaN	0.257799	0.000952	-0.105217
	Strategy	1.878779	3.002213	0.016981	0.279275	0.001018	-0.121102
2011	Benchmark	1.410780	2.055045	NaN	0.175186	0.000671	-0.112885
	Strategy	1.335785	1.939857	0.019712	0.156432	0.000604	-0.120187
2012	Benchmark	0.481434	0.666181	NaN	0.060687	0.000276	-0.159383
	Strategy	0.419948	0.585408	0.018858	0.049938	0.000231	-0.151485
2013	Benchmark	1.255823	1.953340	NaN	0.110263	0.000431	-0.073159
	Strategy	1.442374	2.275070	0.020035	0.125545	0.000485	-0.063077
2014	Benchmark	2.480667	3.696223	NaN	0.187076	0.000692	-0.044129
	Strategy	2.562296	3.859463	0.019841	0.181969	0.000676	-0.038594
2015	Benchmark	1.922529	3.037247	NaN	0.161537	0.000608	-0.051924
	Strategy	1.763750	2.759224	0.037590	0.132684	0.000510	-0.043813
2016	Benchmark	0.384499	0.505997	NaN	0.040143	0.000167	-0.091524
	Strategy	1.129485	1.584070	0.171559	0.146587	0.000560	-0.108238
2017	Benchmark	2.070301	3.219155	NaN	0.150212	0.000568	-0.040373
	Strategy	2.508180	4.032883	0.019704	0.189901	0.000703	-0.033492
2018	Benchmark	2.707639	3.905523	NaN	0.132131	0.000498	-0.031533
	Strategy	2.532253	3.703658	0.019635	0.126073	0.000477	-0.037096
2019	Benchmark	-0.036882	-0.049196	NaN	-0.011011	-0.000017	-0.105266
	Strategy	0.115641	0.156752	0.048665	0.007173	0.000050	-0.084840
2020	Benchmark	2.031890	3.003630	NaN	0.162344	0.000610	-0.040236
	Strategy	1.854124	2.719223	0.021710	0.146636	0.000561	-0.052520
2021	Benchmark	0.884662	1.218221	NaN	0.165408	0.000686	-0.228905
	Strategy	0.651180	0.901592	0.020191	0.120357	0.000540	-0.256251
2022	Benchmark	1.213355	1.755548	NaN	0.102665	0.000404	-0.059441
	Strategy	1.497840	2.158310	0.027028	0.125747	0.000486	-0.052461
2023	Benchmark	-0.115659	-0.159434	NaN	-0.035489	-0.000080	-0.149723
	Strategy	0.551274	0.781824	0.068087	0.077472	0.000340	-0.107994

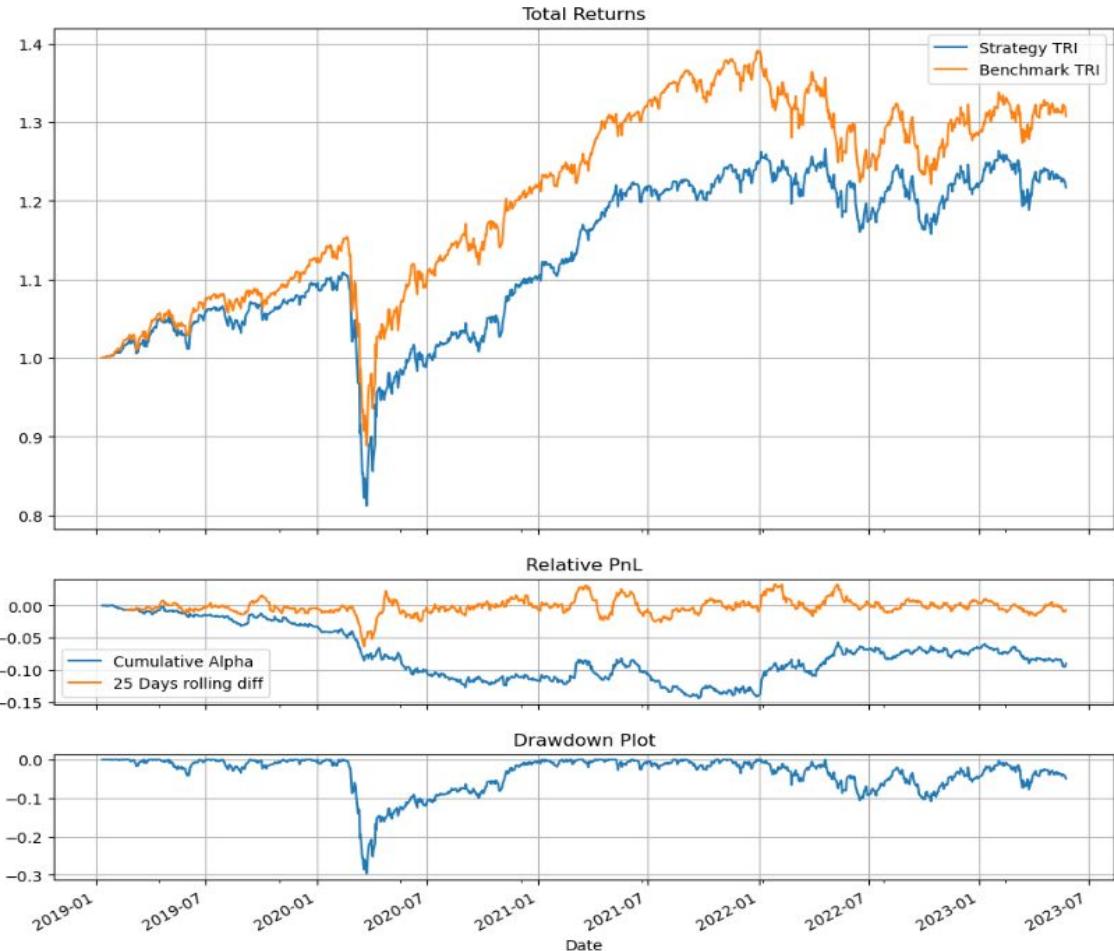
## Strategy 5: Method 1



# Strategy 5: Method 2

		Ann. Sharpe	Ann. Sortino	Avg. Daily Turnover	CAGR	Expected Period Return	Max DD.
2007	Benchmark	1.538524	2.267219	NaN	0.044061	0.000173	-0.028078
	Strategy	1.578685	2.428062	0.008232	0.047256	0.000186	-0.025421
2008	Benchmark	0.142571	0.207207	NaN	0.007895	0.000045	-0.075991
	Strategy	0.025911	0.036837	0.017897	-0.001623	0.000007	-0.068151
2009	Benchmark	-0.463289	-0.638852	NaN	-0.162828	-0.000533	-0.293515
	Strategy	0.541993	0.823089	0.157834	0.120730	0.000629	-0.227099
2010	Benchmark	1.712545	2.687242	NaN	0.221758	0.000829	-0.095296
	Strategy	1.856562	3.085263	0.016219	0.226211	0.000838	-0.099304
2011	Benchmark	1.469679	2.159199	NaN	0.157283	0.000602	-0.094708
	Strategy	1.286193	1.884096	0.017236	0.127162	0.000495	-0.090773
2012	Benchmark	0.502091	0.695533	NaN	0.058708	0.000261	-0.140296
	Strategy	0.644022	0.917431	0.017098	0.072454	0.000306	-0.109934
2013	Benchmark	1.231581	1.909771	NaN	0.095983	0.000377	-0.065007
	Strategy	1.569918	2.493777	0.017873	0.118894	0.000458	-0.053746
2014	Benchmark	2.449806	3.630029	NaN	0.164719	0.000616	-0.040175
	Strategy	2.527846	3.784227	0.017701	0.158062	0.000591	-0.036966
2015	Benchmark	2.075495	3.401769	NaN	0.163821	0.000615	-0.050408
	Strategy	2.112218	3.543338	0.039040	0.147490	0.000555	-0.039472
2016	Benchmark	0.535953	0.716061	NaN	0.047944	0.000212	-0.080596
	Strategy	0.724209	0.965421	0.210562	0.081002	0.000331	-0.109232
2017	Benchmark	2.057172	3.218347	NaN	0.129950	0.000495	-0.035451
	Strategy	2.283131	3.613346	0.017004	0.143546	0.000542	-0.035584
2018	Benchmark	2.781054	4.045997	NaN	0.126616	0.000478	-0.028690
	Strategy	2.319368	3.435199	0.019245	0.106875	0.000409	-0.032342
2019	Benchmark	0.058343	0.078124	NaN	0.000660	0.000025	-0.087790
	Strategy	0.434873	0.596752	0.042471	0.037865	0.000164	-0.078701
2020	Benchmark	2.083438	3.064679	NaN	0.148692	0.000560	-0.036796
	Strategy	1.705882	2.488049	0.020111	0.116452	0.000452	-0.050320
2021	Benchmark	0.803156	1.095891	NaN	0.142186	0.000600	-0.228905
	Strategy	0.463225	0.631703	0.018620	0.074936	0.000367	-0.258193
2022	Benchmark	1.290283	1.870554	NaN	0.101035	0.000396	-0.048487
	Strategy	1.380387	1.976658	0.025066	0.106435	0.000415	-0.046610
2023	Benchmark	0.215913	0.302709	NaN	0.020253	0.000149	-0.165218
	Strategy	0.904707	1.349954	0.171429	0.149000	0.000593	-0.105759

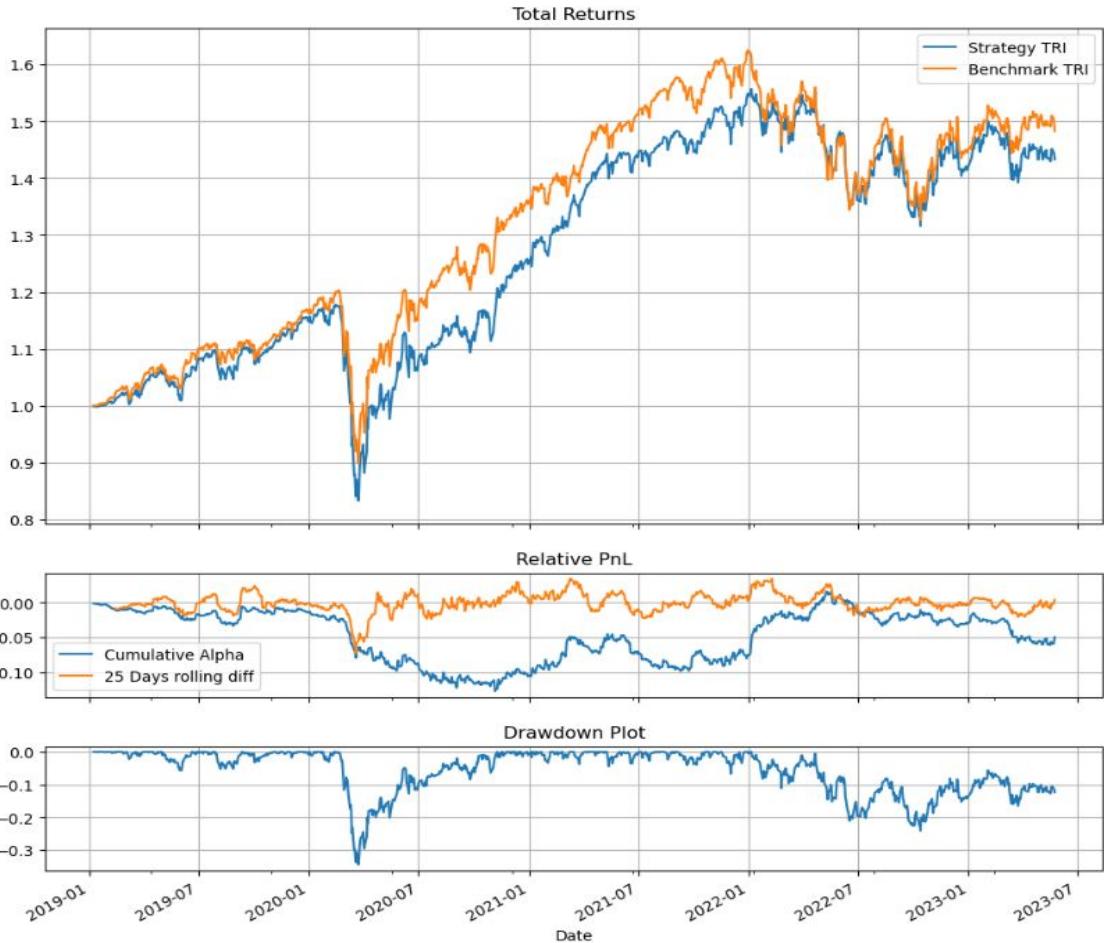
## Strategy 6: Method 1



# Strategy 6: Method 2

		Ann. Sharpe	Ann. Sortino	Avg. Daily Turnover	CAGR	Expected Period Return	Max DD.
2007	Benchmark	1.420850	2.070849		NaN	0.022657	0.000089 -0.015415
	Strategy	2.048191	3.201353	0.004310	0.036172	0.000142 -0.009068	
2008	Benchmark	0.071662	0.104539		NaN	0.002604	0.000016 -0.055789
	Strategy	0.548737	0.798283	0.010936	0.023783	0.000098 -0.040431	
2009	Benchmark	-0.611009	-0.828438		NaN	-0.113191	-0.000422 -0.196511
	Strategy	0.696933	1.040647	0.059972	0.119235	0.000503 -0.102421	
2010	Benchmark	1.700875	2.651739		NaN	0.149120	0.000569 -0.066111
	Strategy	1.791852	2.912889	0.011535	0.151427	0.000572 -0.062974	
2011	Benchmark	1.482499	2.173005		NaN	0.122389	0.000473 -0.072067
	Strategy	1.390831	2.027602	0.013463	0.103334	0.000402 -0.065050	
2012	Benchmark	0.533860	0.742393		NaN	0.054127	0.000234 -0.113113
	Strategy	0.764177	1.094206	0.014117	0.073347	0.000301 -0.083940	
2013	Benchmark	1.254396	1.948403		NaN	0.079318	0.000312 -0.049979
	Strategy	1.170509	1.833677	0.016573	0.068778	0.000272 -0.047356	
2014	Benchmark	2.427052	3.600733		NaN	0.140255	0.000529 -0.033726
	Strategy	2.249397	3.359485	0.016706	0.120438	0.000458 -0.030960	
2015	Benchmark	2.142659	3.496937		NaN	0.141600	0.000535 -0.036033
	Strategy	2.154132	3.556244	0.031250	0.124646	0.000471 -0.024385	
2016	Benchmark	0.496700	0.663887		NaN	0.038317	0.000177 -0.079995
	Strategy	1.035533	1.350634	0.097671	0.094875	0.000384 -0.088697	
2017	Benchmark	2.142636	3.418659		NaN	0.113023	0.000432 -0.025158
	Strategy	2.278189	3.620869	0.014043	0.118270	0.000451 -0.026747	
2018	Benchmark	2.898677	4.271371		NaN	0.109481	0.000416 -0.020302
	Strategy	2.090402	3.106393	0.015830	0.079174	0.000306 -0.024264	
2019	Benchmark	0.126278	0.170277		NaN	0.007753	0.000050 -0.061710
	Strategy	0.521801	0.723923	0.041006	0.042929	0.000180 -0.053046	
2020	Benchmark	2.092775	3.084283		NaN	0.128940	0.000489 -0.032598
	Strategy	1.592471	2.306687	0.017640	0.094191	0.000364 -0.044097	
2021	Benchmark	0.518318	0.678949		NaN	0.077029	0.000353 -0.228172
	Strategy	0.202455	0.263079	0.016370	0.020184	0.000144 -0.266583	
2022	Benchmark	1.188742	1.707670		NaN	0.074589	0.000295 -0.052566
	Strategy	1.472972	2.130466	0.015153	0.090589	0.000353 -0.032011	
2023	Benchmark	0.070153	0.097185		NaN	-0.000630	0.000039 -0.103185
	Strategy	0.331580	0.452314	0.041595	0.034221	0.000156 -0.068803	

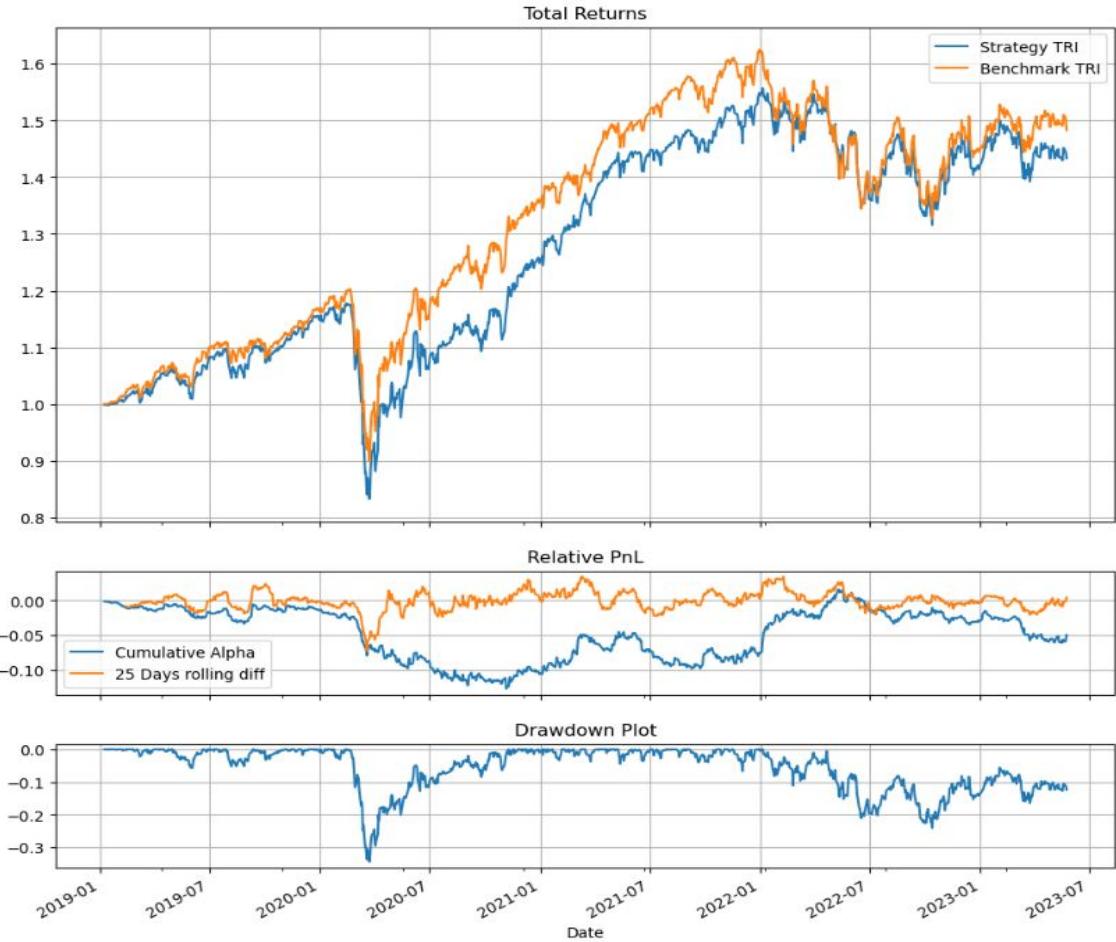
## Strategy 7: Method 1



# Strategy 7: Method 2

		Ann. Sharpe	Ann. Sortino	Avg. Daily Turnover	CAGR	Expected Period Return	Max DD.
2007	Benchmark	1.563189	2.342935		NaN	0.073677	0.000286 -0.044315
	Strategy	1.051617	1.553330	0.013500	0.055063	0.000219 -0.054178	
2008	Benchmark	0.129206	0.186323		NaN	0.007782	0.000055 -0.109441
	Strategy	-0.110076	-0.154751	0.026040	-0.016145	-0.000042 -0.104583	
2009	Benchmark	-0.747216	-1.024002		NaN	-0.258127	-0.000969 -0.409280
	Strategy	0.395721	0.592523	0.203098	0.078619	0.000547 -0.284961	
2010	Benchmark	1.832721	2.887775		NaN	0.296340	0.001079 -0.106646
	Strategy	2.068597	3.338360	0.018766	0.360707	0.001275 -0.123469	
2011	Benchmark	1.453905	2.124579		NaN	0.188450	0.000710 -0.114803
	Strategy	1.253204	1.813962	0.020407	0.154246	0.000599 -0.126977	
2012	Benchmark	0.508719	0.705024		NaN	0.068318	0.000310 -0.167249
	Strategy	0.517838	0.724325	0.020040	0.067737	0.000303 -0.156452	
2013	Benchmark	1.210640	1.871888		NaN	0.118793	0.000466 -0.080322
	Strategy	1.325366	2.048211	0.025481	0.131832	0.000512 -0.072331	
2014	Benchmark	2.472583	3.670295		NaN	0.198178	0.000731 -0.048369
	Strategy	2.406468	3.546895	0.020919	0.185691	0.000688 -0.043902	
2015	Benchmark	2.024095	3.288870		NaN	0.185873	0.000692 -0.063435
	Strategy	2.017964	3.290922	0.058535	0.163222	0.000618 -0.046668	
2016	Benchmark	0.267641	0.350241		NaN	0.027308	0.000122 -0.095755
	Strategy	0.994935	1.364242	0.158154	0.127580	0.000495 -0.107319	
2017	Benchmark	2.038680	3.189070		NaN	0.154538	0.000584 -0.042471
	Strategy	2.325674	3.678970	0.020639	0.186517	0.000693 -0.037044	
2018	Benchmark	2.712167	3.916594		NaN	0.137007	0.000516 -0.032555
	Strategy	2.583415	3.783987	0.020366	0.133559	0.000504 -0.039058	
2019	Benchmark	-0.015226	-0.020315		NaN	-0.009216	-0.000007 -0.111014
	Strategy	0.209504	0.286021	0.053369	0.018442	0.000099 -0.090936	
2020	Benchmark	2.044039	3.027943		NaN	0.168837	0.000632 -0.042642
	Strategy	1.794940	2.622813	0.022488	0.151011	0.000578 -0.057784	
2021	Benchmark	0.907561	1.258067		NaN	0.176966	0.000731 -0.234819
	Strategy	0.727922	1.022438	0.020822	0.144092	0.000633 -0.261583	
2022	Benchmark	1.125071	1.619661		NaN	0.095949	0.000380 -0.078768
	Strategy	1.585901	2.308173	0.019969	0.139866	0.000536 -0.056454	
2023	Benchmark	-0.089622	-0.123692		NaN	-0.035029	-0.000066 -0.161746
	Strategy	0.393247	0.561044	0.154472	0.059966	0.000284 -0.122528	

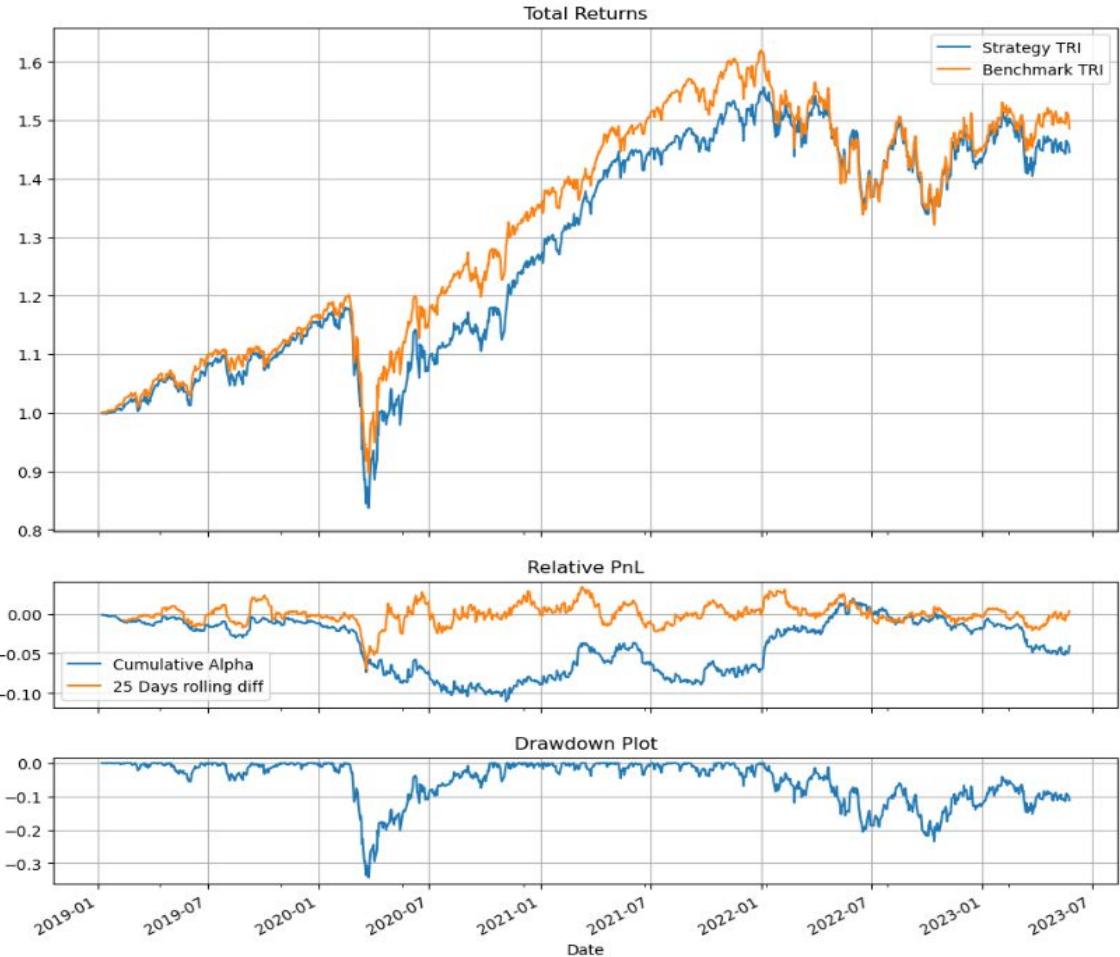
## Strategy 8: Method 1



# Strategy 8: Method 2

		Ann. Sharpe	Ann. Sortino	Avg. Daily Turnover	CAGR	Expected Period Return	Max DD.
2007	Benchmark	1.563189	2.342935	NaN	0.073877	0.000286	-0.044315
	Strategy	1.051617	1.563330	0.013500	0.055063	0.000219	-0.054178
2008	Benchmark	0.129206	0.186323	NaN	0.007782	0.000055	-0.109441
	Strategy	-0.110076	-0.154751	0.025040	-0.016145	-0.000042	-0.104583
2009	Benchmark	-0.747216	-1.024002	NaN	-0.258127	-0.000969	-0.409280
	Strategy	0.395721	0.592523	0.203098	0.078619	0.000547	-0.284961
2010	Benchmark	1.832721	2.887775	NaN	0.296340	0.001079	-0.106646
	Strategy	2.058597	3.338360	0.018766	0.360707	0.001275	-0.123469
2011	Benchmark	1.453905	2.124579	NaN	0.186450	0.000710	-0.114803
	Strategy	1.250818	1.810278	0.020407	0.154008	0.000599	-0.126977
2012	Benchmark	0.508719	0.705024	NaN	0.068318	0.000310	-0.167249
	Strategy	0.517838	0.724325	0.020040	0.067737	0.000303	-0.156452
2013	Benchmark	1.210640	1.871888	NaN	0.118793	0.000466	-0.080322
	Strategy	1.325366	2.048211	0.025481	0.131832	0.000512	-0.072331
2014	Benchmark	2.472583	3.670295	NaN	0.198178	0.000731	-0.048369
	Strategy	2.406468	3.546895	0.020919	0.185691	0.000688	-0.043902
2015	Benchmark	2.024095	3.288870	NaN	0.185873	0.000692	-0.063435
	Strategy	2.017964	3.290922	0.058535	0.163222	0.000618	-0.046668
2016	Benchmark	0.267641	0.350241	NaN	0.027308	0.000122	-0.095755
	Strategy	0.994935	1.364242	0.158154	0.127580	0.000495	-0.107319
2017	Benchmark	2.038680	3.169070	NaN	0.154538	0.000584	-0.042471
	Strategy	2.325674	3.678970	0.020639	0.186517	0.000693	-0.037044
2018	Benchmark	2.712167	3.916594	NaN	0.137007	0.000516	-0.032555
	Strategy	2.583415	3.783987	0.020366	0.133559	0.000504	-0.030558
2019	Benchmark	-0.015226	-0.020315	NaN	-0.009216	-0.000007	-0.111014
	Strategy	0.205796	0.280957	0.053369	0.017998	0.000097	-0.090979
2020	Benchmark	2.044039	3.027943	NaN	0.168837	0.000632	-0.042642
	Strategy	1.794940	2.622813	0.022488	0.151011	0.000578	-0.057784
2021	Benchmark	0.907561	1.258067	NaN	0.176966	0.000731	-0.234819
	Strategy	0.727922	1.022438	0.020822	0.144092	0.000633	-0.261583
2022	Benchmark	1.125071	1.619661	NaN	0.095949	0.000380	-0.078768
	Strategy	1.585901	2.308173	0.019969	0.139866	0.000536	-0.056454
2023	Benchmark	-0.089622	-0.123692	NaN	-0.035029	-0.000066	-0.161746
	Strategy	0.393247	0.561044	0.154472	0.059966	0.000284	-0.122528

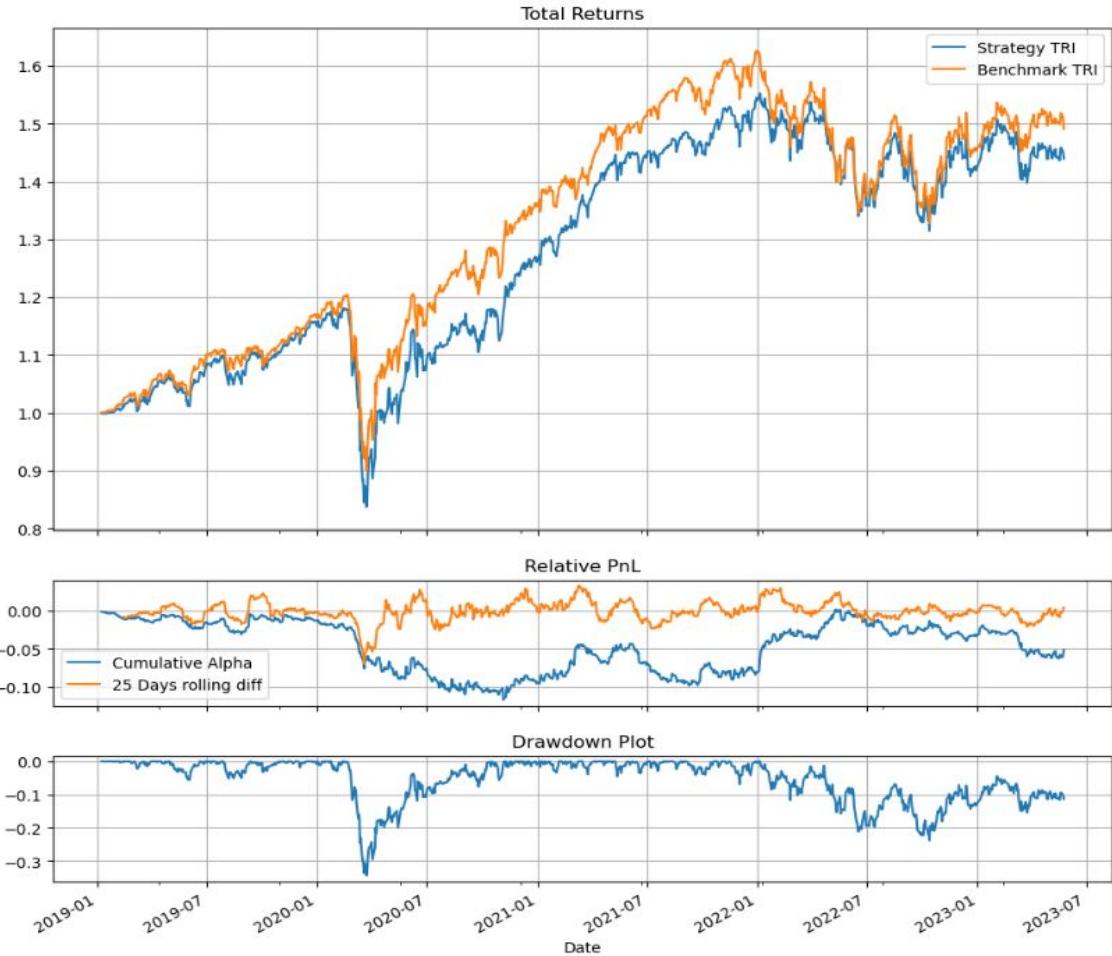
## Strategy 9: Method 1



# Strategy 9: Method 2

		Ann. Sharpe	Ann. Sortino	Avg. Daily Turnover	CAGR	Expected Period Return	Max DD.
2007	Benchmark	1.375361	2.039172	NaN	0.117151	0.000429	-0.079722
	Strategy	0.136176	0.201871	0.576271	0.005165	0.000119	-0.265787
2008	Benchmark	0.150456	0.229251	NaN	0.011400	0.000067	-0.111611
	Strategy	-0.058115	-0.081592	0.024607	-0.010486	-0.000022	-0.106599
2009	Benchmark	-0.694946	-0.952423	NaN	-0.244740	-0.000901	-0.419851
	Strategy	0.398230	0.579878	0.119854	0.079597	0.000539	-0.348644
2010	Benchmark	1.838113	2.895579	NaN	0.300596	0.001093	-0.106646
	Strategy	2.117062	3.431700	0.018968	0.380135	0.001333	-0.121244
2011	Benchmark	1.444491	2.107929	NaN	0.188603	0.000712	-0.116857
	Strategy	1.244768	1.799827	0.020472	0.154011	0.000599	-0.125859
2012	Benchmark	0.484849	0.670703	NaN	0.065128	0.000299	-0.170253
	Strategy	0.516909	0.723768	0.020146	0.068413	0.000307	-0.155696
2013	Benchmark	1.237419	1.919934	NaN	0.124779	0.000488	-0.080322
	Strategy	1.351542	2.096162	0.026164	0.138579	0.000537	-0.074446
2014	Benchmark	2.452095	3.635919	NaN	0.202670	0.000747	-0.050521
	Strategy	2.489351	3.684649	0.021530	0.200697	0.000739	-0.045296
2015	Benchmark	1.926845	3.078989	NaN	0.182968	0.000684	-0.089029
	Strategy	1.960309	3.146642	0.060227	0.165093	0.000626	-0.049902
2016	Benchmark	0.372656	0.486071	NaN	0.040540	0.000181	-0.110413
	Strategy	0.917901	1.246956	0.102000	0.115702	0.000459	-0.119335
2017	Benchmark	2.051778	3.192924	NaN	0.155773	0.000588	-0.041959
	Strategy	2.326564	3.691937	0.020267	0.188233	0.000699	-0.037925
2018	Benchmark	2.712167	3.916594	NaN	0.137007	0.000516	-0.032555
	Strategy	2.593364	3.789534	0.020339	0.134502	0.000507	-0.039023
2019	Benchmark	0.013874	0.018604	NaN	-0.005646	0.000007	-0.120065
	Strategy	0.220881	0.304698	0.048011	0.018944	0.000106	-0.103147
2020	Benchmark	2.045940	3.029323	NaN	0.169840	0.000636	-0.042642
	Strategy	1.835319	2.683932	0.022604	0.155090	0.000592	-0.055894
2021	Benchmark	0.907561	1.258067	NaN	0.178966	0.000731	-0.234819
	Strategy	0.729113	1.027208	0.020753	0.145674	0.000640	-0.281122
2022	Benchmark	1.125071	1.619661	NaN	0.095949	0.000380	-0.078768
	Strategy	1.452188	2.101899	0.019879	0.128707	0.000498	-0.058650
2023	Benchmark	-0.034168	-0.047692	NaN	-0.025994	-0.000026	-0.161746
	Strategy	0.668040	0.967081	0.158085	0.117148	0.000498	-0.128878

## Strategy 10: Method 1



# Strategy 10: Method 2

		Ann. Sharpe	Ann. Sortino	Avg. Daily Turnover	CAGR	Expected Period Return	Max DD.
2007	Benchmark	1.375361	2.039172		NaN	0.117151	0.000429 -0.079722
	Strategy	0.136176	0.201871	0.576271	0.005165	0.000119 -0.255787	
2008	Benchmark	0.108668	0.156817		NaN	0.005071	0.000047 -0.099624
	Strategy	-0.295264	-0.408422	0.028994	-0.033133	-0.000114 -0.101317	
2009	Benchmark	-0.682872	-0.934053		NaN	-0.242898	-0.000889 -0.430204
	Strategy	0.278129	0.398025	0.131112	0.036359	0.000375 -0.389146	
2010	Benchmark	1.838113	2.895579		NaN	0.300596	0.001093 -0.106646
	Strategy	2.117062	3.431700	0.018968	0.380135	0.001333 -0.121244	
2011	Benchmark	1.444491	2.107929		NaN	0.186603	0.000712 -0.116857
	Strategy	1.244768	1.799827	0.020472	0.154011	0.000599 -0.125859	
2012	Benchmark	0.484849	0.670703		NaN	0.065128	0.000299 -0.170253
	Strategy	0.516909	0.723768	0.020146	0.068413	0.000307 -0.155696	
2013	Benchmark	1.237419	1.919934		NaN	0.124779	0.000488 -0.080322
	Strategy	1.361542	2.096162	0.026164	0.138579	0.000537 -0.074446	
2014	Benchmark	2.452095	3.635919		NaN	0.202670	0.000747 -0.050521
	Strategy	2.489351	3.684649	0.021530	0.200697	0.000739 -0.045296	
2015	Benchmark	1.926845	3.078969		NaN	0.182968	0.000684 -0.089029
	Strategy	1.960309	3.146642	0.060227	0.165093	0.000626 -0.049902	
2016	Benchmark	0.372656	0.486071		NaN	0.040540	0.000181 -0.110413
	Strategy	0.917901	1.246956	0.102000	0.115702	0.000459 -0.119335	
2017	Benchmark	2.034567	3.168397		NaN	0.160978	0.000607 -0.042109
	Strategy	2.269935	3.569584	0.023834	0.191022	0.000709 -0.040687	
2018	Benchmark	2.712167	3.916594		NaN	0.137007	0.000516 -0.032555
	Strategy	2.593364	3.789534	0.020339	0.134502	0.000507 -0.039023	
2019	Benchmark	-0.075236	-0.100143		NaN	-0.017001	-0.000038 -0.115566
	Strategy	0.139966	0.191133	0.056342	0.010244	0.000069 -0.096601	
2020	Benchmark	2.057235	3.048142		NaN	0.171308	0.000641 -0.042716
	Strategy	1.845652	2.707899	0.023087	0.156628	0.000598 -0.056354	
2021	Benchmark	0.907561	1.258067		NaN	0.176966	0.000731 -0.234819
	Strategy	0.729113	1.027208	0.020753	0.145674	0.000640 -0.261122	
2022	Benchmark	1.127986	1.624190		NaN	0.096149	0.000381 -0.077703
	Strategy	1.461339	2.097836	0.020300	0.128674	0.000497 -0.056349	
2023	Benchmark	-0.097289	-0.134909		NaN	-0.034665	-0.000071 -0.155804
	Strategy	0.581807	0.828296	0.072682	0.090475	0.000398 -0.124252	

## Table Summary for Method 1

	<b>Expected Period Return</b>	<b>Ann. Sharpe</b>	<b>Ann. Sortino</b>	<b>Max DD.</b>	<b>CAGR</b>	<b>Avg. Daily Turnover</b>
Benchmark	0.000406	0.687230	0.952779	-0.304819	0.095553	NaN
Long-short	0.000380	0.612578	0.846716	-0.343558	0.086771	0.023210
Long	0.000377	0.610506	0.842044	-0.345385	0.086073	0.023198
Short	0.000066	0.465541	0.669390	-0.063028	0.016079	0.003531
25%	0.000307	0.530559	0.722096	-0.337322	0.068630	0.022297
50%	0.000254	0.476903	0.643287	-0.321288	0.056140	0.020436
75%	0.000204	0.451221	0.599940	-0.296373	0.046026	0.017187
50% -25%	0.000375	0.611905	0.843017	-0.344503	0.085702	0.023106
75% -50%	0.000375	0.611905	0.843017	-0.344503	0.085702	0.023106
Sector	0.000384	0.619907	0.857239	-0.342688	0.087848	0.022885
Sub-Industry	0.000380	0.612578	0.846716	-0.343558	0.086771	0.023210

## Table Summary for Method 2

	<b>Expected Period Return</b>	<b>Ann. Sharpe</b>	<b>Ann. Sortino</b>	<b>Max DD.</b>	<b>CAGR</b>	<b>Avg. Daily Turnover</b>
Benchmark	0.000372	1.134205	1.701843	-0.114851	0.094550	NaN
Long-short	0.000513	1.271523	1.909064	-0.108253	0.128749	0.052777
Long	0.000516	1.281019	1.923010	-0.108868	0.129577	0.051977
Short	0.000068	0.881310	1.382351	-0.026545	0.016313	0.003752
25%	0.000483	1.307817	1.967401	-0.098872	0.121016	0.044522
50%	0.000432	1.314655	2.003130	-0.086330	0.107809	0.049037
75%	0.000327	1.314127	1.986985	-0.062990	0.082094	0.025775
50% -25%	0.000502	1.266602	1.904792	-0.105072	0.126000	0.051533
75% -50%	0.000502	1.266244	1.904277	-0.105075	0.125960	0.051533
Sector	0.000516	1.229271	1.846832	-0.122791	0.128600	0.076481
Sub-Industry	0.000494	1.195768	1.796039	-0.124377	0.122855	0.073131

## **Trading Performance - FinBERT**

# Generation of signals/Fine tuning for backtesting

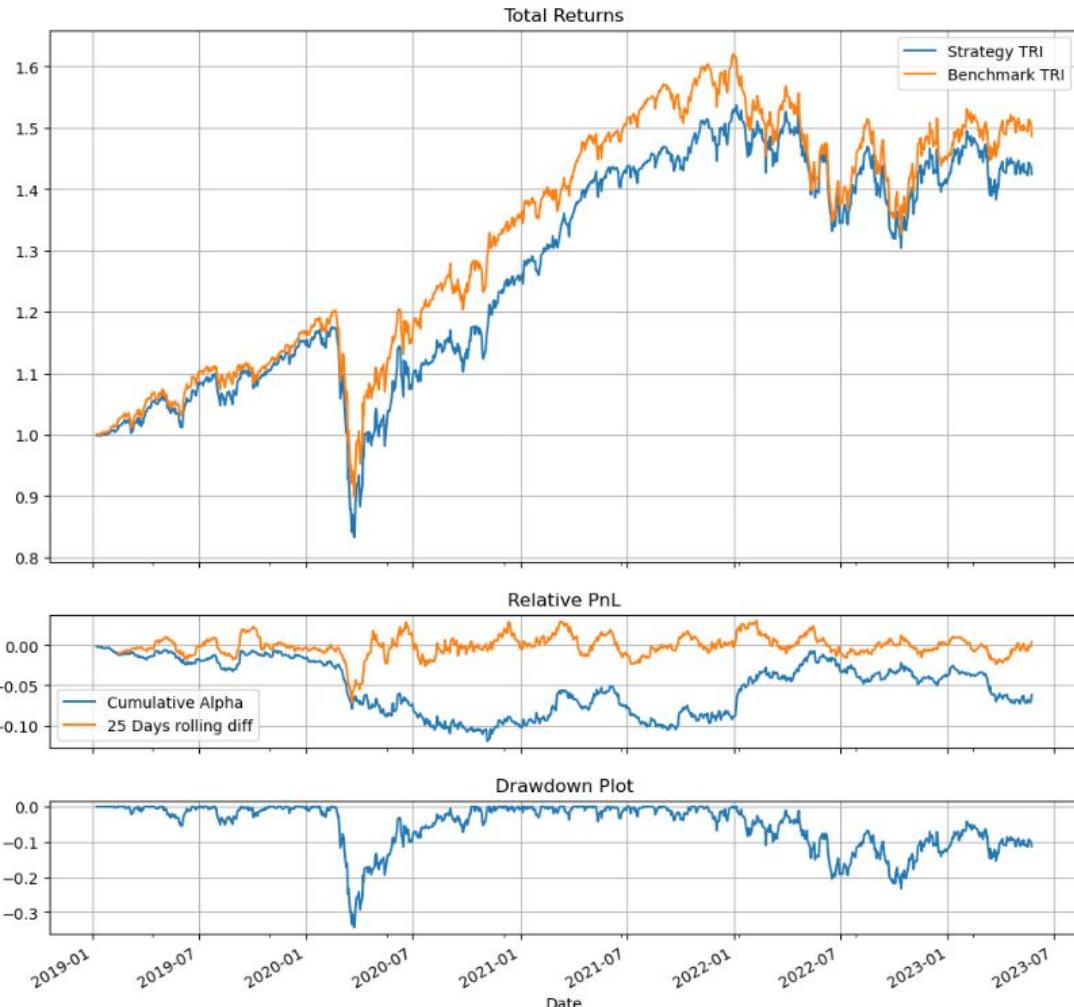
- Positive sentiment - Long signal
- Negative sentiment - Short signal
- Training period - 2006 to 2018
- Testing period - 2019 to 2023
- Fine tuning data by taking difference between positive and negative probability scores (diff score)
  - Provides insights about sentiment polarity of the input text
  - Positive sentiment dominance (positive difference)
  - Negative sentiment dominance (negative difference)
- Rolling window

# Fine tuned data for Backtesting

- Tuned\_data
  - Diff score greater than 25 percentile of the dataset
- Tuned\_data2
  - Diff score greater than 50 percentile of the dataset
- Tuned\_data3
  - Diff score greater than 75 percentile of the dataset

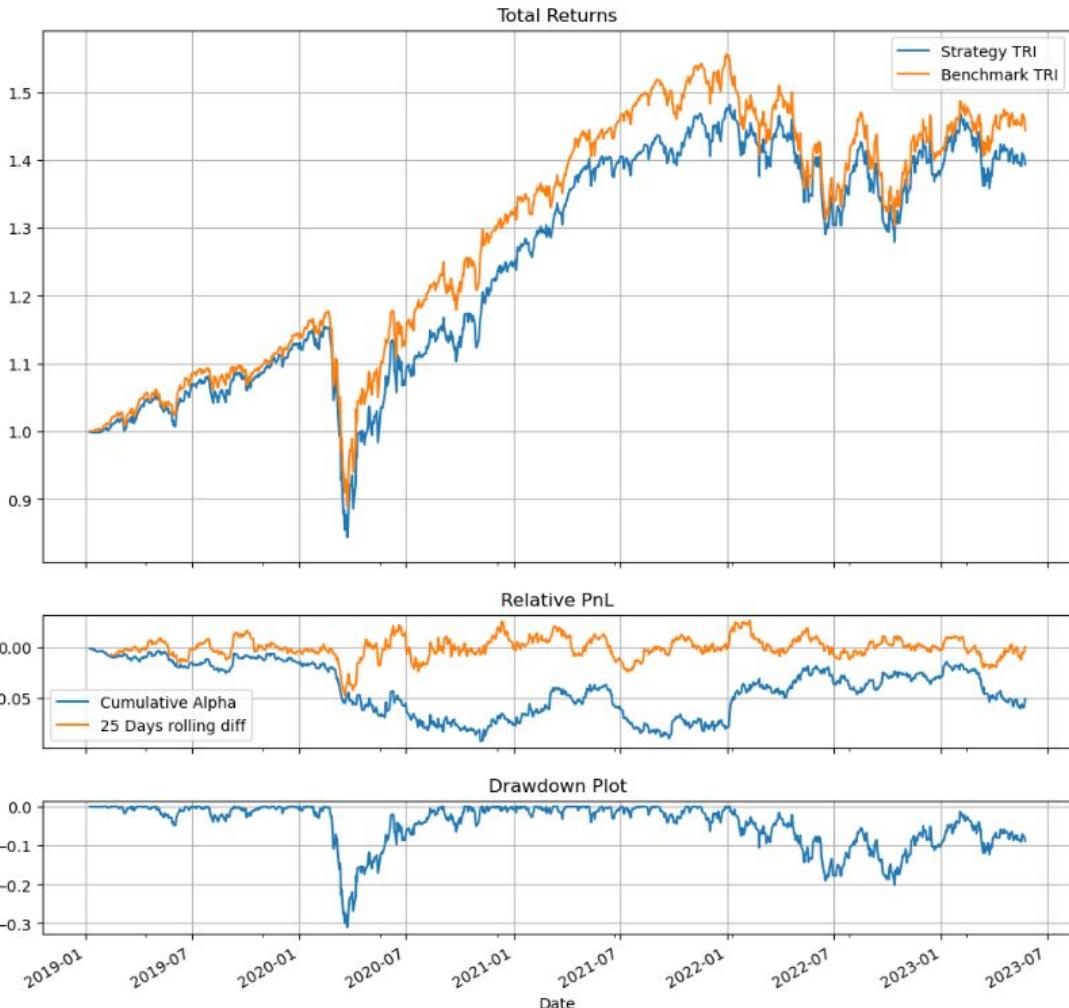
# Backtesting original data

	Strategy	Benchmark
Expected Period Return	0.000370	0.000403
Ann. Sharpe	0.600534	0.685651
Ann. Sortino	0.830008	0.950970
Max DD.	-0.342775	-0.303773
CAGR	0.084176	0.094767
Avg. Daily Turnover	0.023907	NaN



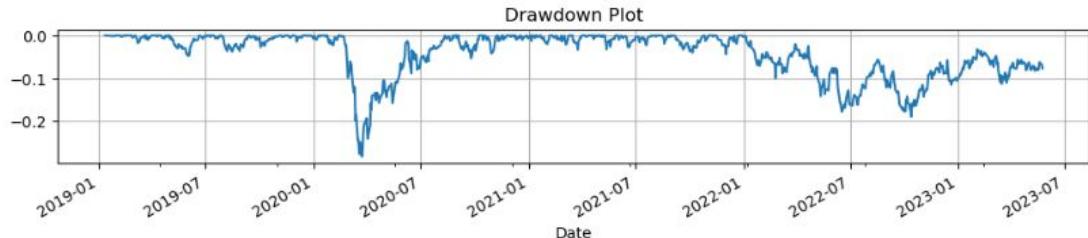
# Backtest tuned data

	Strategy	Benchmark
Expected Period Return	0.000343	0.000372
Ann. Sharpe	0.598638	0.671871
Ann. Sortino	0.825518	0.929839
Max DD.	-0.310513	-0.287205
CAGR	0.078667	0.087529
Avg. Daily Turnover	0.021443	NaN



# Backtest tuned data 2

	Strategy	Benchmark
Expected Period Return	0.000322	0.000328
Ann. Sharpe	0.612116	0.653672
Ann. Sortino	0.847516	0.902838
Max DD.	-0.282884	-0.262082
CAGR	0.074871	0.077378
Avg. Daily Turnover	0.019016	NaN



# Backtest tuned data 3

	Strategy	Benchmark
Expected Period Return	0.000262	0.000218
Ann. Sharpe	0.649860	0.590384
Ann. Sortino	0.899851	0.807630
Max DD.	-0.217426	-0.209421
CAGR	0.062596	0.051924
Avg. Daily Turnover	0.013912	NaN



# Rolling window on original data

	Benchmark	Strategy
Ann. Sharpe	1.188379	1.268316
Ann. Sortino	1.777755	1.905126
Avg. Daily Turnover	NaN	0.081280
CAGR	0.103534	0.127022
Expected Period Return	0.000418	0.000518
Max DD.	-0.108219	-0.118388

		Ann. Sharpe	Ann. Sortino	Avg. Daily Turnover	CAGR	Expected Period Return	Max DD.
2007	Benchmark	1.506271	2.231540	NaN	0.072080	0.000281	-0.046585
	Strategy	1.187487	1.760968	0.012618	0.063028	0.000249	-0.053562
2008	Benchmark	0.128719	0.186218	NaN	0.008156	0.000055	-0.093546
	Strategy	-0.145734	-0.203610	0.031223	-0.019125	-0.000056	-0.089983
2009	Benchmark	-0.129493	-0.186786	NaN	-0.104597	-0.000185	-0.334513
	Strategy	0.409280	0.607082	0.650407	0.080684	0.000729	-0.493187
2010	Benchmark	1.806571	2.837006	NaN	0.286211	0.001046	-0.105923
	Strategy	1.999957	3.246586	0.018382	0.347437	0.001236	-0.120283
2011	Benchmark	1.456732	2.130236	NaN	0.186640	0.000711	-0.113935
	Strategy	1.163199	1.669499	0.021494	0.141919	0.000557	-0.127864
2012	Benchmark	0.473012	0.654200	NaN	0.063098	0.000292	-0.167934
	Strategy	0.535852	0.752261	0.021367	0.071366	0.000318	-0.151519
2013	Benchmark	1.254098	1.948568	NaN	0.125201	0.000489	-0.079524
	Strategy	1.257422	1.941015	0.026737	0.127803	0.000499	-0.080675
2014	Benchmark	2.497566	3.719570	NaN	0.198118	0.000731	-0.046767
	Strategy	2.526400	3.763038	0.020820	0.195286	0.000720	-0.042550
2015	Benchmark	1.884092	3.020338	NaN	0.175449	0.000658	-0.069300
	Strategy	1.905085	3.077631	0.056848	0.158956	0.000604	-0.049706
2016	Benchmark	0.377144	0.500870	NaN	0.038490	0.000162	-0.085169
	Strategy	1.014156	1.364669	0.158602	0.126945	0.000491	-0.107095
2017	Benchmark	2.047848	3.175011	NaN	0.153933	0.000581	-0.042446
	Strategy	2.297385	3.621431	0.020550	0.183923	0.000684	-0.037305
2018	Benchmark	2.731474	3.952837	NaN	0.137470	0.000517	-0.031306
	Strategy	2.685368	3.938658	0.021163	0.138566	0.000520	-0.037454
2019	Benchmark	0.054215	0.073196	NaN	-0.000549	0.000026	-0.122130
	Strategy	0.179847	0.248137	0.042864	0.014727	0.000084	-0.110834
2020	Benchmark	2.054095	3.049787	NaN	0.167415	0.000627	-0.042642
	Strategy	1.804318	2.645806	0.022211	0.149727	0.000573	-0.056177
2021	Benchmark	0.893447	1.237935	NaN	0.172830	0.000716	-0.234619
	Strategy	0.691240	0.972321	0.020511	0.135151	0.000602	-0.260555
2022	Benchmark	1.193710	1.729092	NaN	0.105573	0.000416	-0.056147
	Strategy	1.436970	2.081702	0.033058	0.130550	0.000505	-0.065248
2023	Benchmark	-0.027051	-0.037776	NaN	-0.025446	-0.000021	-0.167038
	Strategy	0.613160	0.900541	0.202915	0.112435	0.000486	-0.128597

# Rolling window on tuned data

	Benchmark	Strategy
<b>Ann. Sharpe</b>	1.204629	1.310887
<b>Ann. Sortino</b>	1.808035	1.988721
<b>Avg. Daily Turnover</b>	NaN	0.081736
<b>CAGR</b>	0.101007	0.141873
<b>Expected Period Return</b>	0.000409	0.000561
<b>Max DD.</b>	-0.102273	-0.107172

		Ann. Sharpe	Ann. Sortino	Avg. Daily Turnover	CAGR	Expected Period Return	Max DD.
2007	Benchmark	1.468344	2.175465	NaN	0.063580	0.000248	-0.042557
	Strategy	0.863096	1.264164	0.013139	0.042729	0.000172	-0.050081
2008	Benchmark	0.120648	0.175328	NaN	0.007114	0.000048	-0.079867
	Strategy	-0.137172	-0.191990	0.028424	-0.016972	-0.000050	-0.080884
2009	Benchmark	-0.047737	-0.068104	NaN	-0.069803	-0.000064	-0.331892
	Strategy	1.059513	1.813651	0.565041	0.420464	0.001759	-0.350246
2010	Benchmark	1.797389	2.826810	NaN	0.276949	0.001015	-0.105923
	Strategy	2.035022	3.315199	0.017821	0.346291	0.001230	-0.124017
2011	Benchmark	1.446978	2.114906	NaN	0.176607	0.000675	-0.109903
	Strategy	1.191195	1.714132	0.019265	0.140405	0.000549	-0.120058
2012	Benchmark	0.523774	0.724641	NaN	0.066296	0.000296	-0.154175
	Strategy	0.440338	0.612293	0.018926	0.052406	0.000240	-0.148428
2013	Benchmark	1.218102	1.893797	NaN	0.111409	0.000437	-0.074705
	Strategy	1.217605	1.879298	0.023847	0.114203	0.000446	-0.075360
2014	Benchmark	2.494554	3.724619	NaN	0.183680	0.000681	-0.042003
	Strategy	2.515741	3.747070	0.019338	0.180187	0.000668	-0.039304
2015	Benchmark	2.049921	3.355313	NaN	0.178718	0.000668	-0.058164
	Strategy	1.996777	3.263729	0.053295	0.157412	0.000598	-0.042218
2016	Benchmark	0.283879	0.372933	NaN	0.027445	0.000118	-0.082905
	Strategy	1.041801	1.399020	0.147401	0.127433	0.000492	-0.108338
2017	Benchmark	2.085077	3.242473	NaN	0.150949	0.000570	-0.040011
	Strategy	2.402535	3.831105	0.019796	0.186393	0.000692	-0.034019
2018	Benchmark	2.752346	3.991730	NaN	0.132286	0.000499	-0.029296
	Strategy	2.859769	4.198944	0.020331	0.144641	0.000545	-0.035242
2019	Benchmark	0.004159	0.005576	NaN	-0.006022	0.000002	-0.115912
	Strategy	0.251758	0.348979	0.040385	0.023294	0.000117	-0.117295
2020	Benchmark	2.033800	3.003112	NaN	0.146162	0.000552	-0.038049
	Strategy	1.862875	2.749185	0.019647	0.136058	0.000522	-0.047840
2021	Benchmark	0.898803	1.247563	NaN	0.168641	0.000696	-0.225177
	Strategy	0.771187	1.082156	0.019941	0.147802	0.000635	-0.240307
2022	Benchmark	1.193751	1.729736	NaN	0.098775	0.000389	-0.052145
	Strategy	1.323004	1.914689	0.030646	0.110150	0.000431	-0.059697
2023	Benchmark	0.154910	0.220492	NaN	0.004325	0.000119	-0.155961
	Strategy	0.589697	0.866642	0.332278	0.096937	0.000484	-0.148592

# Rolling window on tuned\_data2

	Benchmark	Strategy
Ann. Sharpe	1.235315	1.334957
Ann. Sortino	1.854984	2.028332
Avg. Daily Turnover	NaN	0.089756
CAGR	0.097109	0.129798
Expected Period Return	0.000394	0.000514
Max DD.	-0.093137	-0.104795

		Ann. Sharpe	Ann. Sortino	Avg. Daily Turnover	CAGR	Expected Period Return	Max DD.
2007	Benchmark	1.538116	2.275472	NaN	0.058509	0.000228	-0.036525
	Strategy	0.621991	0.893224	0.011025	0.028741	0.000118	-0.052393
2008	Benchmark	0.106537	0.154644	NaN	0.005318	0.000039	-0.069601
	Strategy	-0.065654	-0.091154	0.026481	-0.010230	-0.000022	-0.064375
2009	Benchmark	-0.078647	-0.109460	NaN	-0.063918	-0.000092	-0.311474
	Strategy	0.533969	0.844501	0.528926	0.169977	0.000801	-0.393874
2010	Benchmark	1.731566	2.734508	NaN	0.248980	0.000923	-0.107260
	Strategy	2.036058	3.327199	0.017008	0.322899	0.001158	-0.122148
2011	Benchmark	1.460924	2.138508	NaN	0.174818	0.000668	-0.107380
	Strategy	1.348959	1.949809	0.018900	0.155895	0.000601	-0.112863
2012	Benchmark	0.476944	0.658194	NaN	0.054697	0.000245	-0.141163
	Strategy	0.343694	0.477168	0.017115	0.036209	0.000173	-0.147781
2013	Benchmark	1.240941	1.937215	NaN	0.099686	0.000391	-0.065935
	Strategy	1.202242	1.850634	0.020196	0.099709	0.000391	-0.063264
2014	Benchmark	2.556294	3.842324	NaN	0.168347	0.000628	-0.035298
	Strategy	2.711322	4.139574	0.017774	0.176505	0.000655	-0.031340
2015	Benchmark	2.140952	3.504002	NaN	0.169170	0.000633	-0.049977
	Strategy	2.163952	3.504814	0.049419	0.160592	0.000607	-0.039436
2016	Benchmark	0.331663	0.442340	NaN	0.028444	0.000123	-0.072117
	Strategy	1.345849	1.876739	0.136649	0.155119	0.000584	-0.085076
2017	Benchmark	2.100775	3.278985	NaN	0.137950	0.000523	-0.035360
	Strategy	2.495538	3.995369	0.018034	0.177429	0.000660	-0.031156
2018	Benchmark	2.697628	3.881308	NaN	0.117563	0.000446	-0.028863
	Strategy	2.958505	4.368820	0.018195	0.139374	0.000524	-0.034259
2019	Benchmark	-0.100555	-0.132141	NaN	-0.016983	-0.000046	-0.087357
	Strategy	0.106509	0.144821	0.055415	0.005679	0.000052	-0.086574
2020	Benchmark	2.019739	2.975660	NaN	0.130189	0.000494	-0.034607
	Strategy	1.826213	2.679049	0.017735	0.123870	0.000475	-0.046579
2021	Benchmark	0.907228	1.266870	NaN	0.159242	0.000654	-0.207964
	Strategy	0.814773	1.149243	0.018406	0.149454	0.000631	-0.219492
2022	Benchmark	1.185690	1.715860	NaN	0.086419	0.000341	-0.046006
	Strategy	1.274924	1.882971	0.026798	0.094290	0.000372	-0.049729
2023	Benchmark	0.684557	0.970448	NaN	0.092416	0.000497	-0.146443
	Strategy	0.975420	1.488867	0.527778	0.221063	0.000964	-0.201172

# Rolling window on tuned\_data3

	Benchmark	Strategy
Ann. Sharpe	1.289131	1.474613
Ann. Sortino	1.952743	2.255788
Avg. Daily Turnover	NaN	0.053877
CAGR	0.083896	0.127632
Expected Period Return	0.000335	0.000498
Max DD.	-0.074873	-0.087258

		Ann. Sharpe	Ann. Sortino	Avg. Daily Turnover	CAGR	Expected Period Return	Max DD.
2007	Benchmark	1.723843	2.586185	NaN	0.054483	0.000212	-0.026282
	Strategy	0.905054	1.334839	0.009788	0.035901	0.000144	-0.033092
2008	Benchmark	0.015936	0.023218	NaN	-0.002122	0.000005	-0.051562
	Strategy	-0.169904	-0.235012	0.024099	-0.015463	-0.000047	-0.044759
2009	Benchmark	-0.190036	-0.269304	NaN	-0.074280	-0.000193	-0.256593
	Strategy	0.740612	1.193901	0.299040	0.228684	0.000961	-0.384817
2010	Benchmark	1.755795	2.773668	NaN	0.221582	0.000824	-0.092784
	Strategy	1.978011	3.214450	0.014833	0.271065	0.000988	-0.114098
2011	Benchmark	1.534620	2.269053	NaN	0.151512	0.000579	-0.084172
	Strategy	1.382604	2.013281	0.017072	0.134681	0.000519	-0.085979
2012	Benchmark	0.494016	0.681744	NaN	0.050376	0.000225	-0.121855
	Strategy	0.501778	0.698373	0.015942	0.051240	0.000224	-0.119846
2013	Benchmark	1.363163	2.163079	NaN	0.093658	0.000366	-0.053801
	Strategy	1.323060	2.100228	0.018266	0.095236	0.000372	-0.050804
2014	Benchmark	2.517480	3.773072	NaN	0.147054	0.000553	-0.031828
	Strategy	2.775095	4.162092	0.015761	0.161494	0.000602	-0.027554
2015	Benchmark	2.374590	4.035288	NaN	0.169820	0.000633	-0.036527
	Strategy	2.351774	3.906010	0.046533	0.164490	0.000620	-0.031984
2016	Benchmark	0.595971	0.829766	NaN	0.047979	0.000194	-0.061157
	Strategy	1.625211	2.352491	0.116487	0.166033	0.000616	-0.066718
2017	Benchmark	2.194234	3.475729	NaN	0.123366	0.000467	-0.028236
	Strategy	2.373548	3.805724	0.015912	0.144933	0.000545	-0.026287
2018	Benchmark	2.752225	3.968063	NaN	0.097327	0.000372	-0.020557
	Strategy	3.143356	4.655358	0.015105	0.126168	0.000476	-0.025927
2019	Benchmark	0.108013	0.145221	NaN	0.005903	0.000037	-0.054308
	Strategy	0.557333	0.796622	0.034661	0.045715	0.000193	-0.058565
2020	Benchmark	2.066829	3.054471	NaN	0.090358	0.000345	-0.021614
	Strategy	1.869715	2.740715	0.012217	0.090167	0.000348	-0.026716
2021	Benchmark	0.702350	0.957494	NaN	0.093078	0.000394	-0.179741
	Strategy	0.733032	1.010996	0.012887	0.107999	0.000459	-0.184332
2022	Benchmark	1.029174	1.469995	NaN	0.052489	0.000210	-0.030296
	Strategy	1.409687	2.046064	0.018411	0.080181	0.000312	-0.029863
2023	Benchmark	0.877030	1.259891	NaN	0.103646	0.000471	-0.121523
	Strategy	1.568458	2.552258	0.228898	0.281218	0.001136	-0.172043

# **Afterthoughts via Topic Modelling**

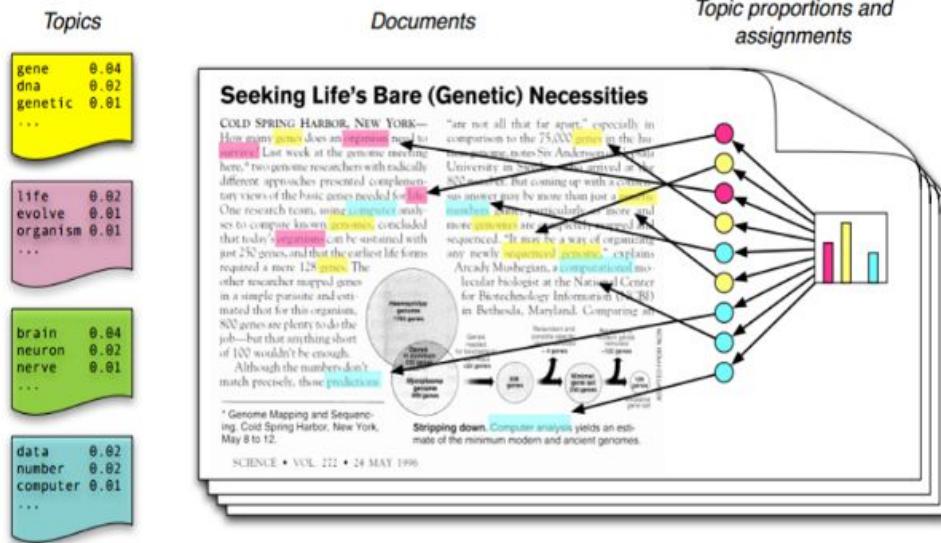
# Questions Left Unanswered

- Why do we observe positive sentiment mean scores across all sectors in our study?
- How can we improve the quality of insights by exploring sector themes?
- How do we identify “in-the-money” transcripts through a systematic process?

# Topic Modelling



- **LDA** - Latent Dirichlet Allocation
  - **ELDA** - Ensemble LDA
  - **HDP** - Hierarchical Dirichlet Process
  - **LSI** - Latent Semantic Indexing



INFO : topic #0 (0.250): 0.003\*"foxtel" + 0.002\*"theft" + 0.002\*"battlefield"  
0.002\*"corp" + 0.002\*"fifa" + 0.002\*"rockstar" + 0.001\*"madden" + 0.001\*"gran

INFO : topic #1 (0.250): 0.002\*"wireless" + 0.002\*"google" + 0.001\*"client" + 0.001\*"customer" + 0.001\*"agency" + 0.001\*"disney" + 0.001\*"postpaid" + 0.001\*

# Topic Modelling - Choice of Corpora

	the	red	dog	cat	eats	food
1. the red dog →	1	1	1	0	0	0
2. cat eats dog →	0	0	1	1	1	0
3. dog eats food →	0	0	1	0	1	1
4. red cat eats →	0	1	0	1	1	0



OR

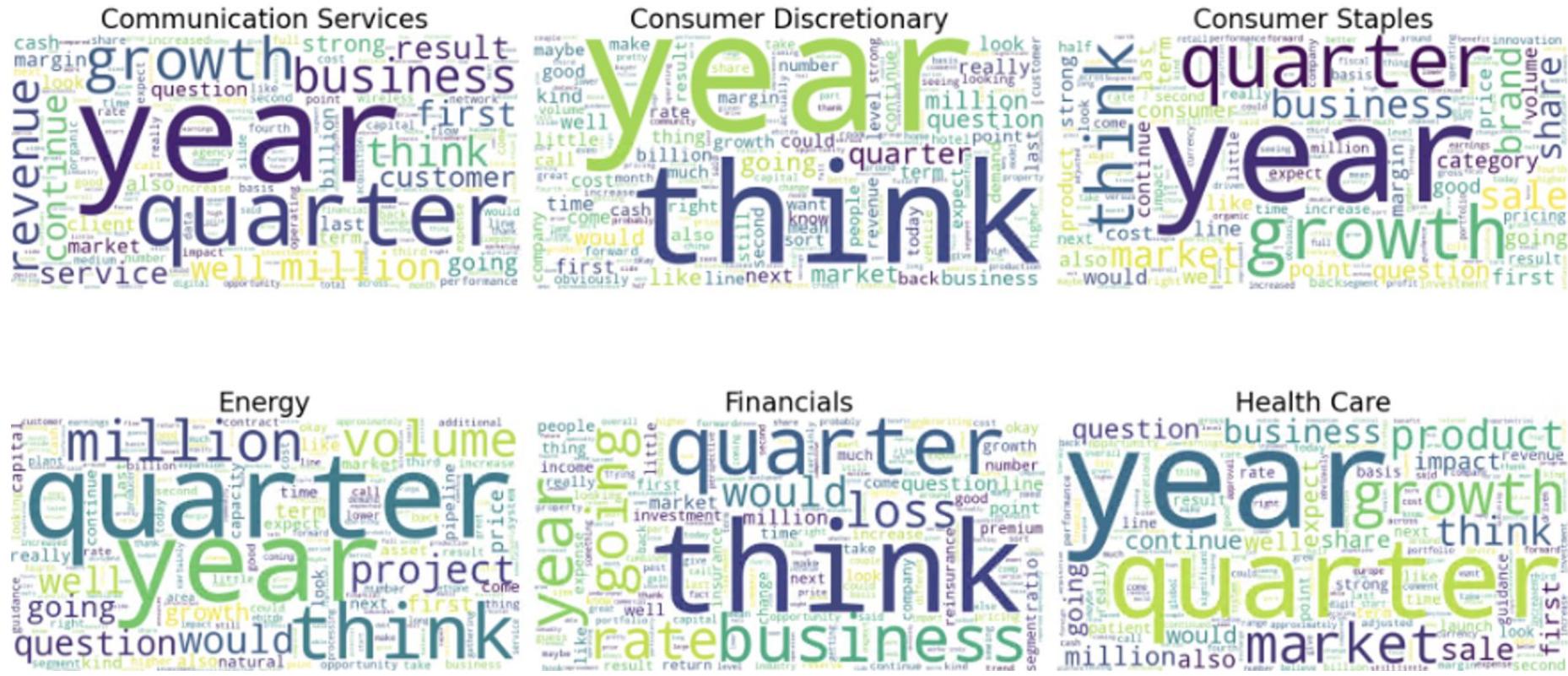
$$w_{x,y} = \text{tf}_{x,y} \times \log \left( \frac{N}{df_x} \right)$$

**TF-IDF**

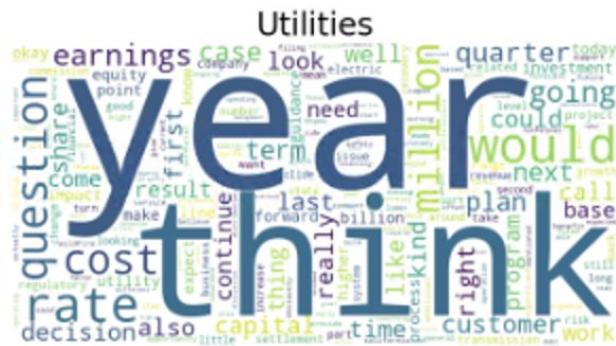
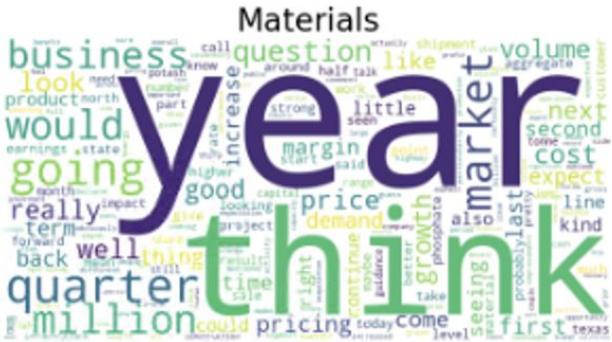
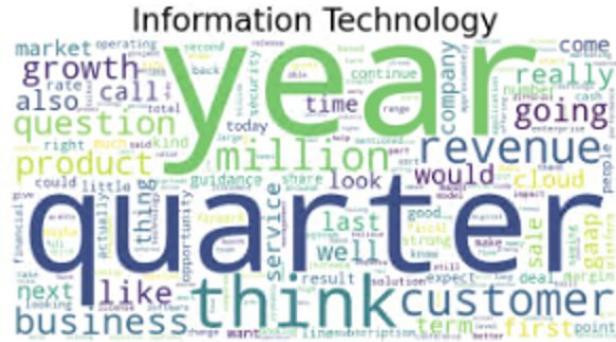
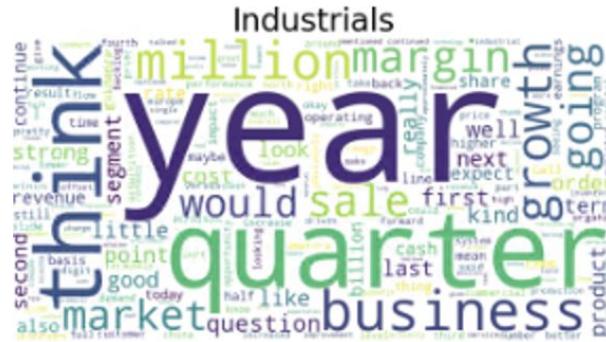
Term  $x$  within document  $y$

$\text{tf}_{x,y}$  = frequency of  $x$  in  $y$   
 $df_x$  = number of documents containing  $x$   
 $N$  = total number of documents

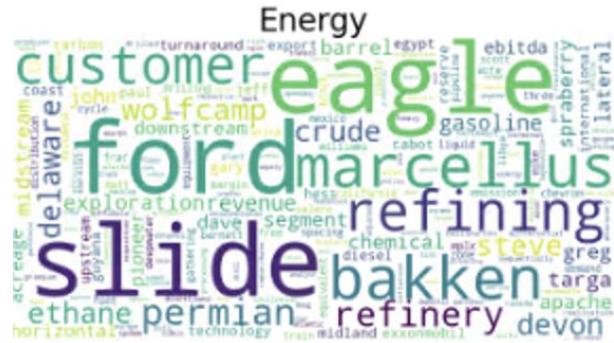
# Topic Modelling - WordCloud LDA + Bag of Words



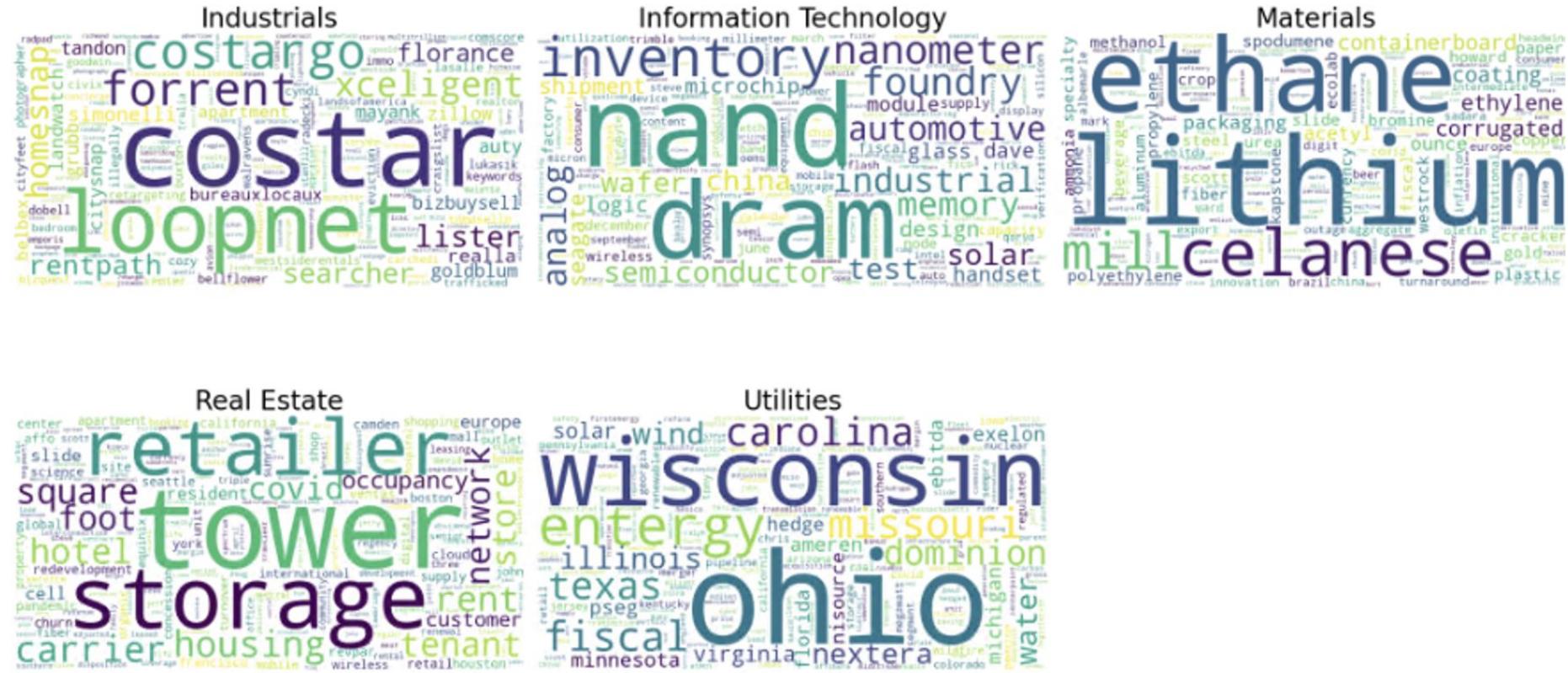
# Topic Modelling - WordCloud LDA + Bag of Words



# Topic Modelling - WordCloud LDA + TF-IDF



# Topic Modelling - WordCloud LDA + TF-IDF



# Topic Modelling - WordCloud LSI + TF-IDF



# Topic Modelling - WordCloud LSI + TF-IDF



# Topic Modelling - Metrics

## Perplexity

$$PP(W) = P(w_1 w_2 \dots w_N)^{-\frac{1}{N}} \longrightarrow \text{exponentiation of the entropy}$$

UMass Topic Coherence Mimno, 2011

$$\text{score}_{\text{UMass}}(w_i, w_j) = \log \frac{D(w_i, w_j) + 1}{D(w_i)} \longrightarrow p(\text{rare word} \mid \text{common word})$$

# Topic Modelling - Metrics

## LDA with TF-IDF

	Sector	Perplexity	UMass Topic Coherence
0	Communication Services	-10.182527	-10.963493
1	Consumer Discretionary	-10.074001	-2.824383
2	Consumer Staples	-10.151637	-9.451269
3	Energy	-10.109707	-9.457807
4	Financials	-9.904092	-5.046544
5	Health Care	-10.287624	-7.235433
6	Industrials	-10.068239	-2.822220
7	Information Technology	-10.186142	-6.843736
8	Materials	-10.114136	-9.335436
9	Real Estate	-10.072756	-10.711736
10	Utilities	-9.991063	-7.237534

## LDA with Bag of Words

	Sector	Perplexity	UMass Topic Coherence
0	Communication Services	-7.258235	-0.399866
1	Consumer Discretionary	-7.286412	-0.133427
2	Consumer Staples	-7.236561	-0.484886
3	Energy	-7.197077	-0.283686
4	Financials	-7.189867	-0.147903
5	Health Care	-7.327315	-0.232591
6	Industrials	-7.249155	-0.136890
7	Information Technology	-7.226172	-0.145436
8	Materials	-7.211896	-0.176992
9	Real Estate	-7.222409	-0.286343
10	Utilities	-7.295890	-0.014896

# Conclusion

# Summary - Method 1 Backtesting

Expected Period Return Ann. Sharpe Ann. Sortino Max DD. CAGR Avg. Daily Turnover

Benchmark	0.000406	0.687230	0.952779	-0.304819	0.095553	NaN
Long-short	0.000380	0.612578	0.846716	-0.343558	0.086771	0.023210
Long	0.000377	0.610506	0.842044	-0.345385	0.086073	0.023198
Short	0.000066	0.465541	0.669390	-0.063028	0.016079	0.003531
25%	0.000307	0.530559	0.722096	-0.337322	0.068630	0.022297
50%	0.000254	0.476903	0.643287	-0.321288	0.056140	0.020436
75%	0.000204	0.451221	0.599940	-0.296373	0.046026	0.017187
50% -25%	0.000375	0.611905	0.843017	-0.344503	0.085702	0.023106
75% -50%	0.000375	0.611905	0.843017	-0.344503	0.085702	0.023106
Sector	0.000384	0.619907	0.857239	-0.342688	0.087848	0.022885
Sub-Industry	0.000380	0.612578	0.846716	-0.343558	0.086771	0.023210

Expected Period Return Ann. Sharpe Ann. Sortino Max DD. CAGR Avg. Daily Turnover

Benchmark	0.000403	0.685651	0.950970	-0.303773	0.094767	NaN
25%	0.000343	0.598638	0.825518	-0.310513	0.078867	0.021443
50%	0.000322	0.612116	0.847516	-0.282884	0.074871	0.018016
75%	0.000262	0.649860	0.899851	-0.217426	0.062596	0.013912
Sector	0.000370	0.600534	0.830008	-0.342775	0.084176	0.023907
Sub-Industry	0.000362	0.589004	0.813512	-0.341276	0.082084	0.022977

VADER-BERT

FinBERT

# Summary - Method 2 Backtesting

Expected Period Return Ann. Sharpe Ann. Sortino Max DD. CAGR Avg. Daily Turnover

Benchmark	0.000372	1.134205	1.701843	-0.114851	0.094550	NaN
Long-short	0.000513	1.271523	1.909064	-0.108253	0.128749	0.052777
Long	0.000516	1.281019	1.923010	-0.108868	0.129577	0.051977
Short	0.000068	0.881310	1.382351	-0.026545	0.016313	0.003752
25%	0.000483	1.307817	1.967401	-0.098872	0.121016	0.044522
50%	0.000432	1.314655	2.003130	-0.086330	0.107809	0.049037
75%	0.000327	1.314127	1.986985	-0.062990	0.082094	0.025775
50% -25%	0.000502	1.266602	1.904792	-0.105072	0.128000	0.051533
75% -50%	0.000502	1.266244	1.904277	-0.105075	0.125980	0.051533
Sector	0.000516	1.229271	1.846832	-0.122791	0.128800	0.078481
Sub-Industry	0.000494	1.195768	1.796039	-0.124377	0.122855	0.073131

Expected Period Return Ann. Sharpe Ann. Sortino Max DD. CAGR Avg. Daily Turnover

Benchmark	0.000418	1.188379	1.777755	-0.108219	0.103534	NaN
25%	0.000561	1.310867	1.988721	-0.107172	0.141873	0.081736
50%	0.000514	1.334957	2.028332	-0.104795	0.129798	0.089756
75%	0.000498	1.474613	2.255788	-0.087258	0.127632	0.053877
Sector	0.000461	1.152762	1.719503	-0.124404	0.113500	0.081712
Sub-Industry	0.000474	1.177431	1.759406	-0.124352	0.115674	0.096496

VADER-BERT

FinBERT

# Closing Thoughts

- Earnings Call Transcripts Sentiment do possess predictive powers in quarterly framework
- FinBERT edges out BERT - VADER in OOS performance by virtue of specialized corpora
- Topic Modelling with:
  - LDA identified why the transcript sentiments are generally positive
  - LSI identified the most common topic amongst the sector constituents

# Areas of Improvement

- Expansion of entities to extract more accurate representation of the transcripts
- Ensemble other NLP models (i.e. NMF for Tweets, GPT for comprehensive insights)
- Utilize Topic Modelling to identify trends and universe selection in addition to sentiment

**Thank you for your attention!**

