

NVIDIA

Stock Analysis





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Meet the Team

OBJECTIVES

- Corporation Overview
- Visualize the stock performance
- Comparison between Nvidia & Competitors
- Data Extraction
- Data Preprocessing
- Feature Selection & Importance
- Machine Learning Algorithms (Regression based models & Decision Tree based models)
- Trading rules (Buy & hold, Day Trade)
- Benchmark Study (Garch)



What the Firm Does:

- NVIDIA is a technology company primarily known for its graphics processing units (GPUs) for gaming and professional markets. It also engages in the mobile computing and automotive market sectors, providing GPU technology for mobile devices and AI platforms for self-driving cars.

Major Business Lines:

- Gaming (GeForce GPUs), Data Center (Tesla, DGX Systems), Professional Visualization (Quadro GPUs), Automotive (AI platforms for self-driving technology), OEM & IP (licensing GPU and AI technologies).

Profit Engine:

- The Data Center business line has emerged as NVIDIA's profit engine, particularly due to the increase in cloud computing and AI applications.

Business Outlook:

- The expansion into AI and data center markets aligns with current technology trends, positioning NVIDIA as a leader in AI hardware and parallel computing technology.

Summary & Candlestick Graph of NVIDIA Stock

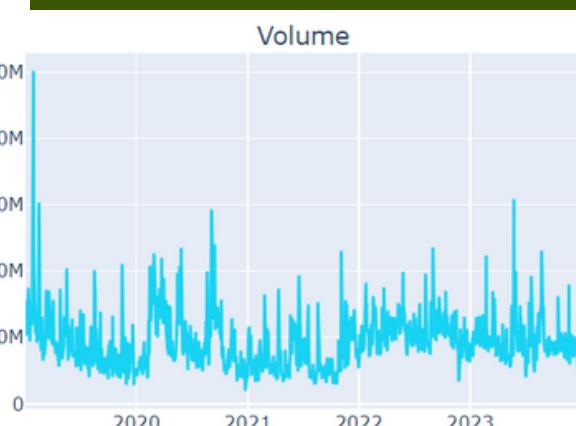
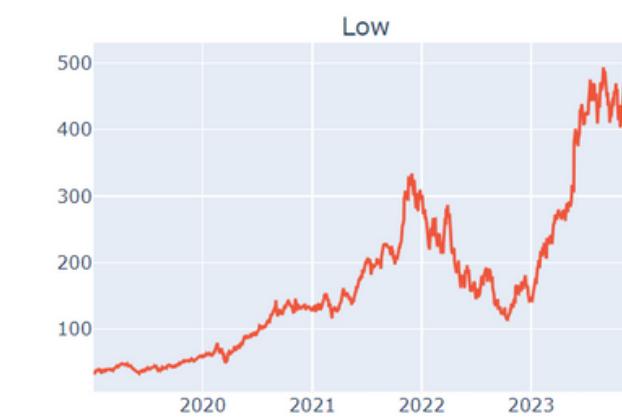
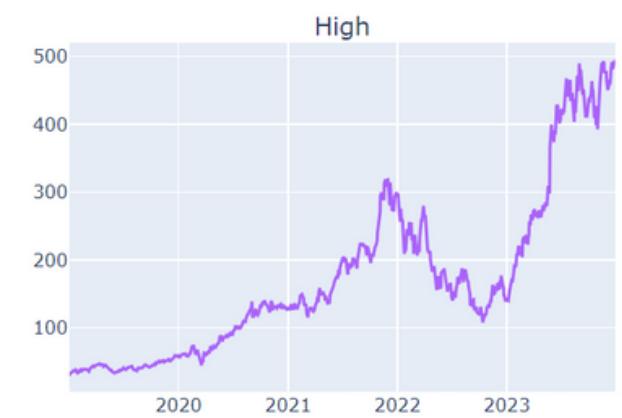
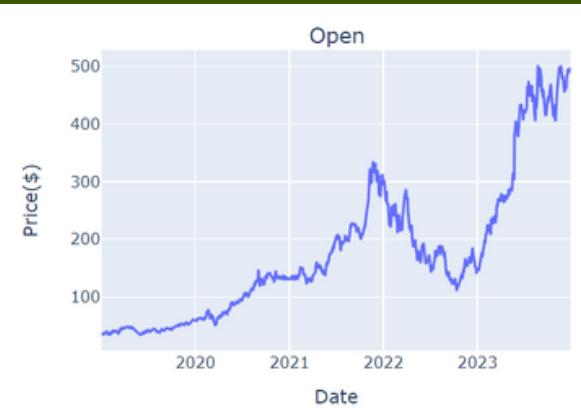
Descriptive Summary of NVDA Stock

Statistics	Open	High	Low	Close	Adj Close	Volume
count	1258	1258	1258	1258	1258	1258
mean	177.35	180.63	173.98	177.46	177.23	46262513.43
std	124.76	126.72	122.53	124.68	124.72	19989356.22
min	32.66	33.79	31.92	32	31.75	9788400
25%	69.15	70.55	67.03	68.32	68.06	32468000
50%	145.78	148.63	142.3	145.82	145.54	43197500
75%	231.9	236.67	225.44	230.93	230.64	56457900
max	502.16	505.48	494.12	504.09	504.02	251152800

Candlestick Graph of NVIDIA



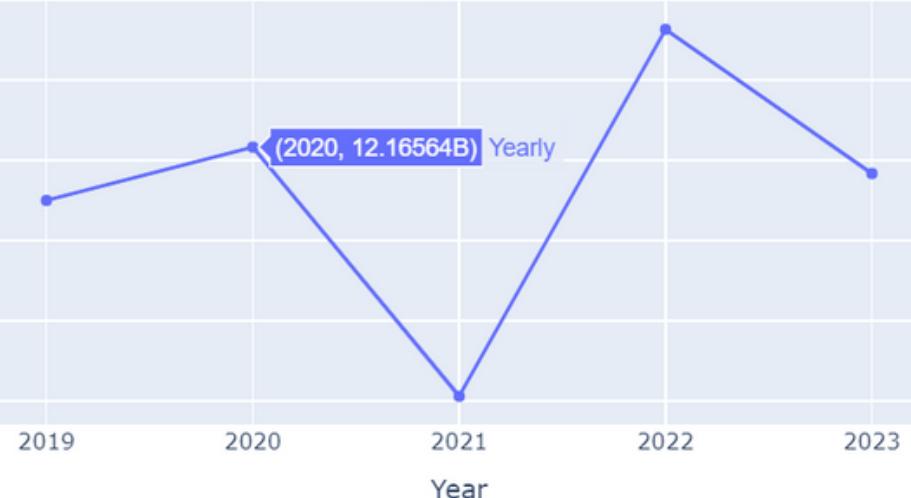
NVIDIA Stock Value Trends: Jan 2019 - Dec 2023



Total Volume of Stocks Traded by Year, Month, and Weekday

Yearly Volume

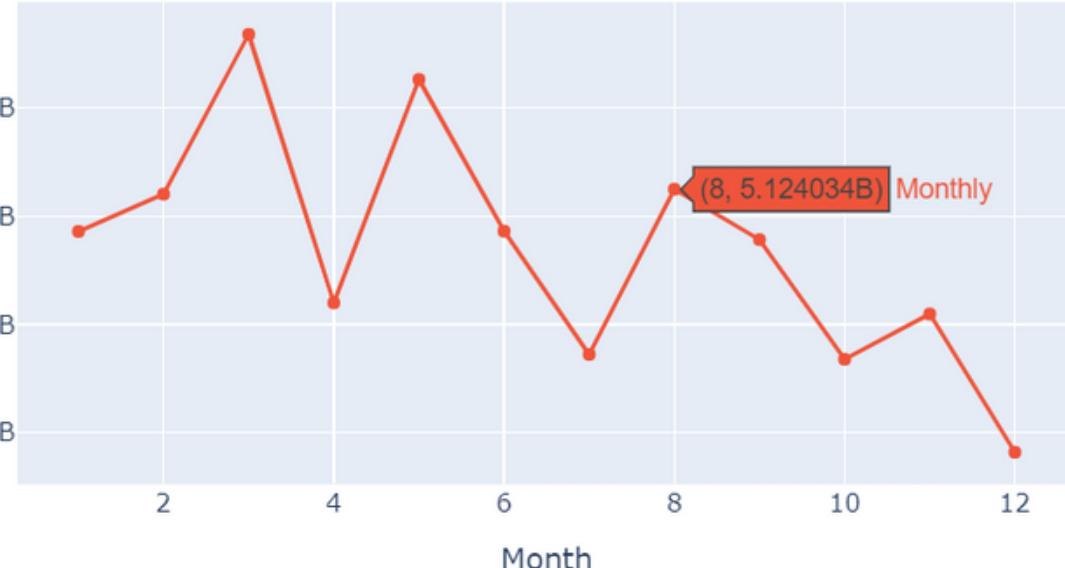
Total Stock Volumes



Yearly
Monthly
Weekday

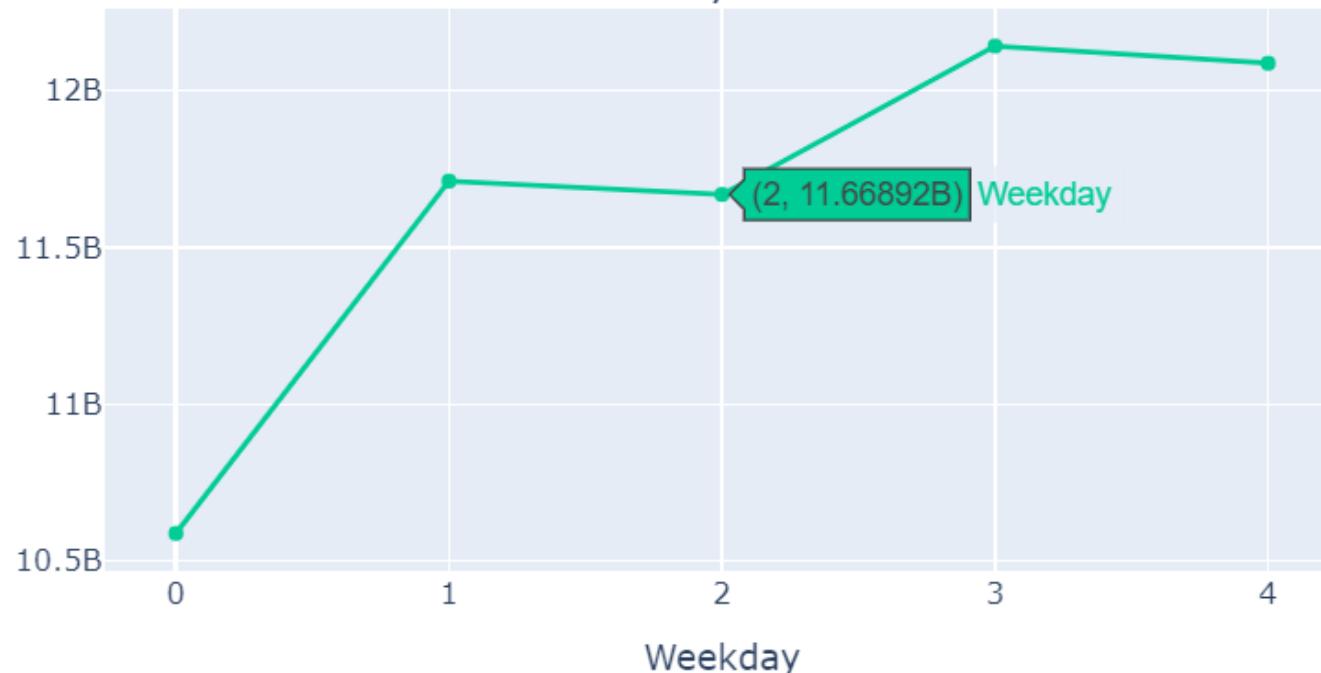
Monthly Volume

Total Stock Volumes



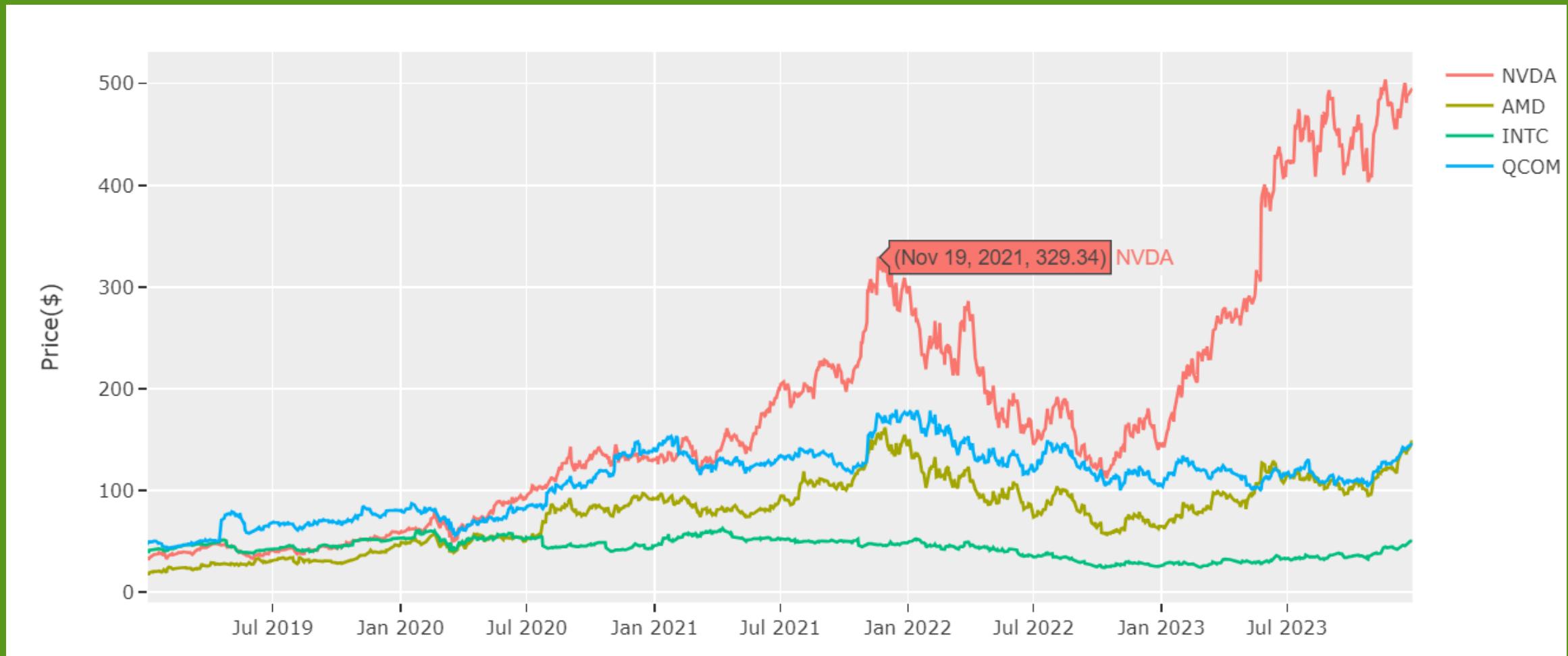
Weekday Volume

Total Stock Volumes

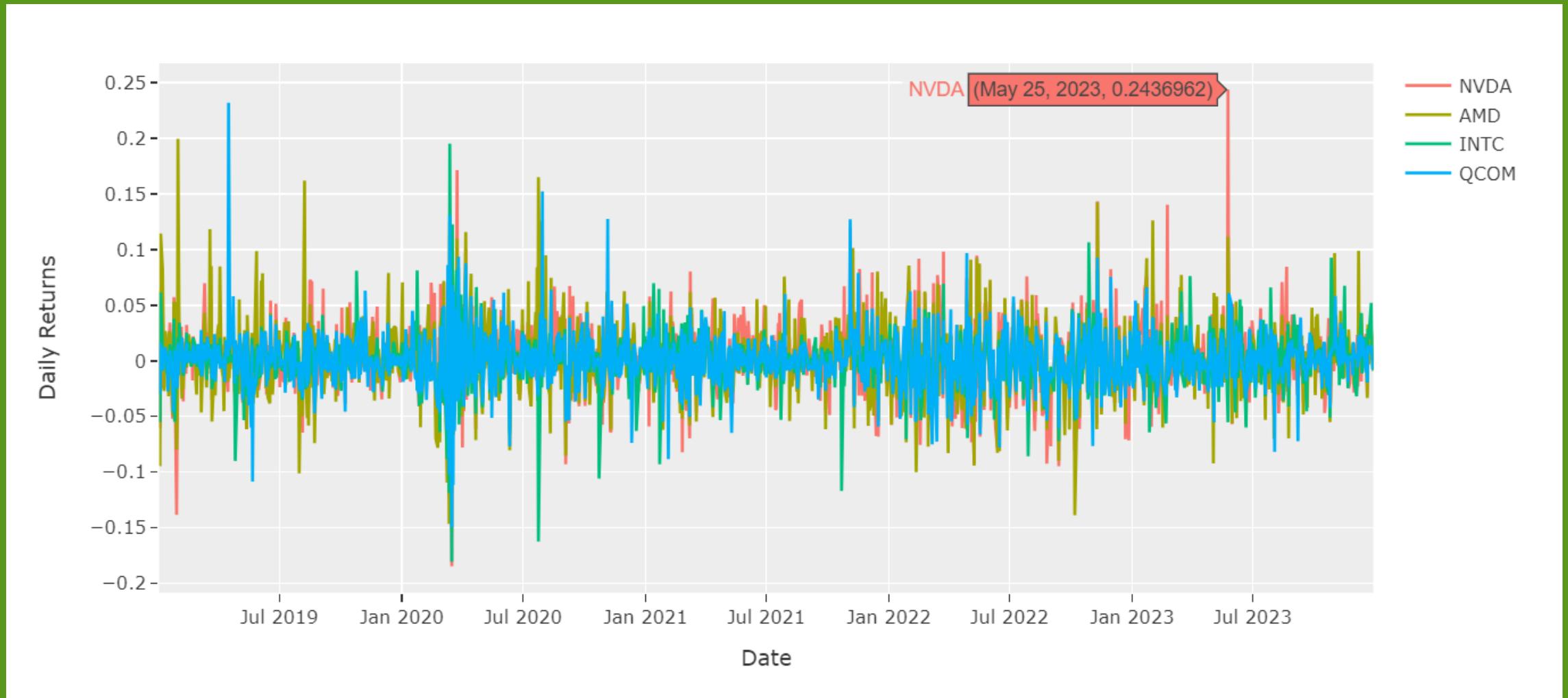


Comparison between Competitors and Nvidia Stocks

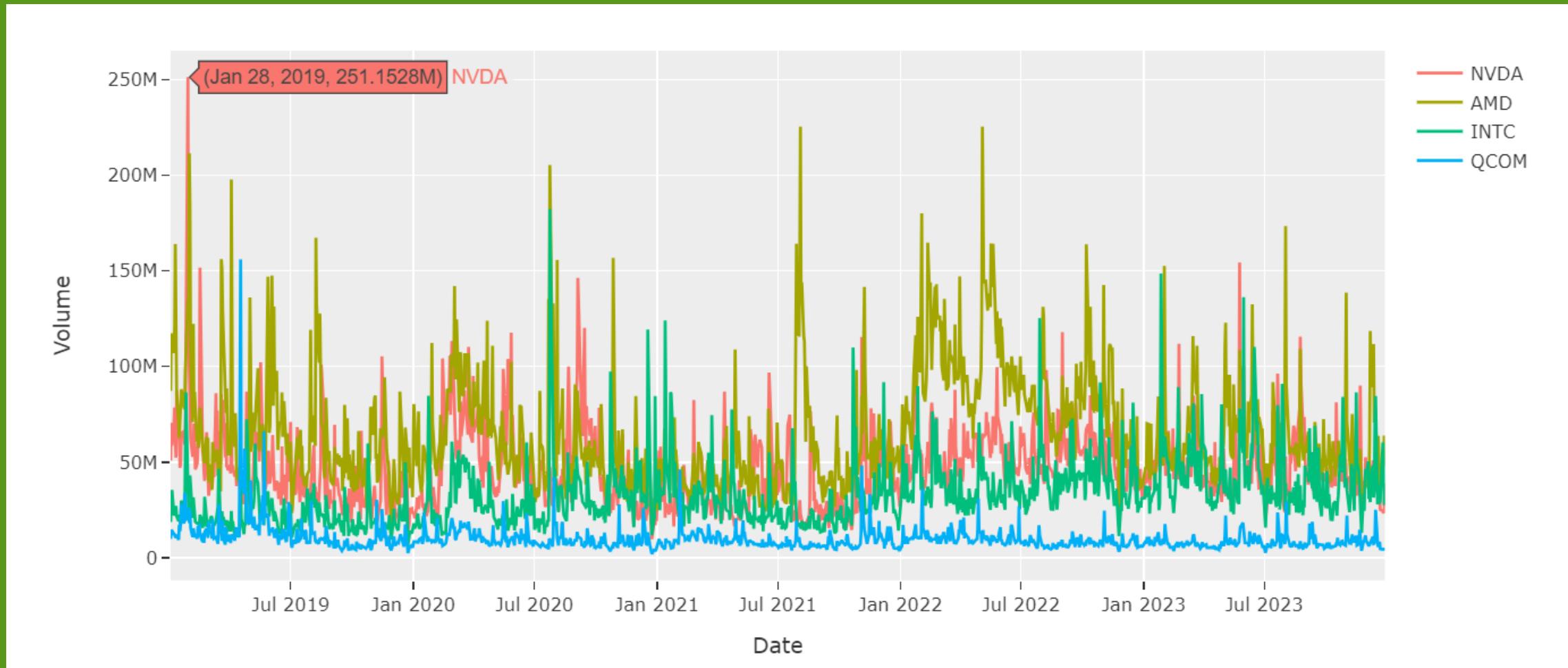
1. Adj Close Price:



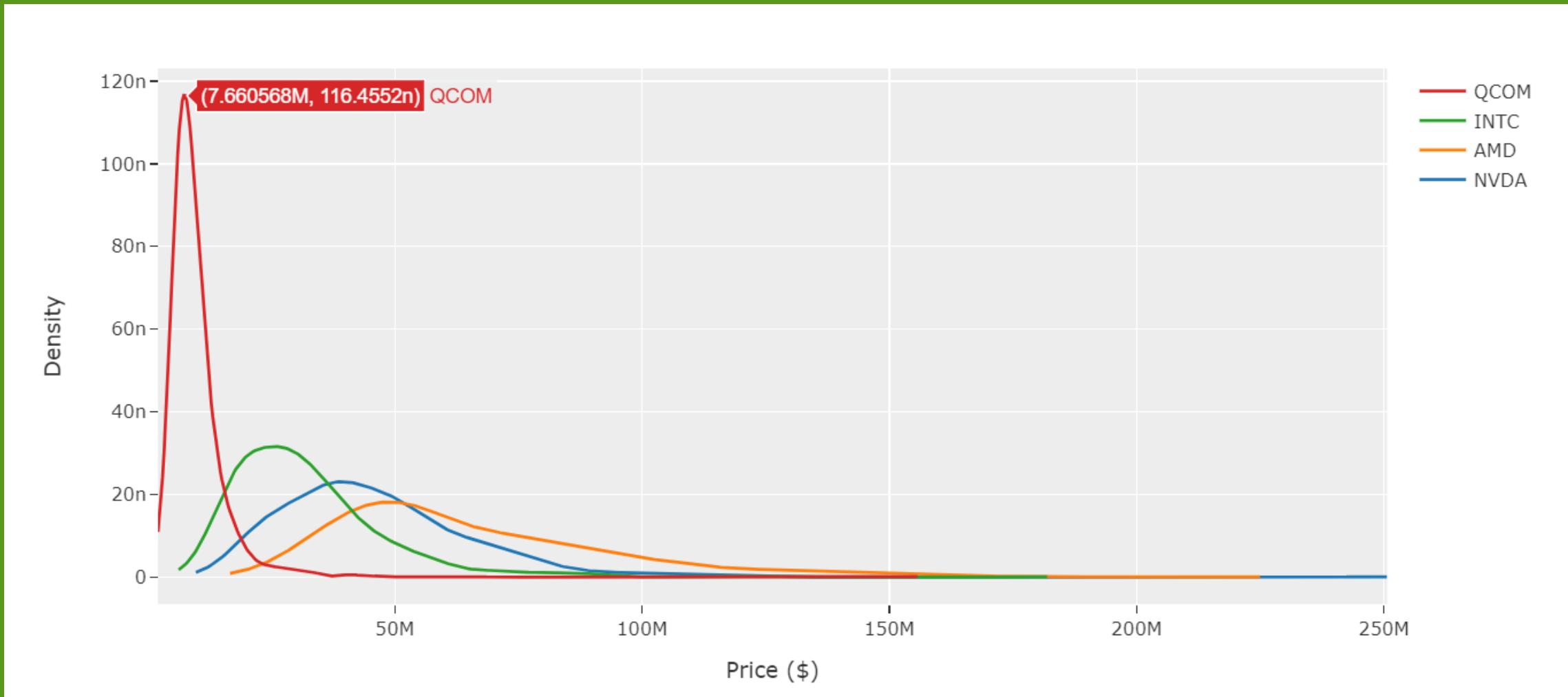
2. Daily Percentage Change Comparison:



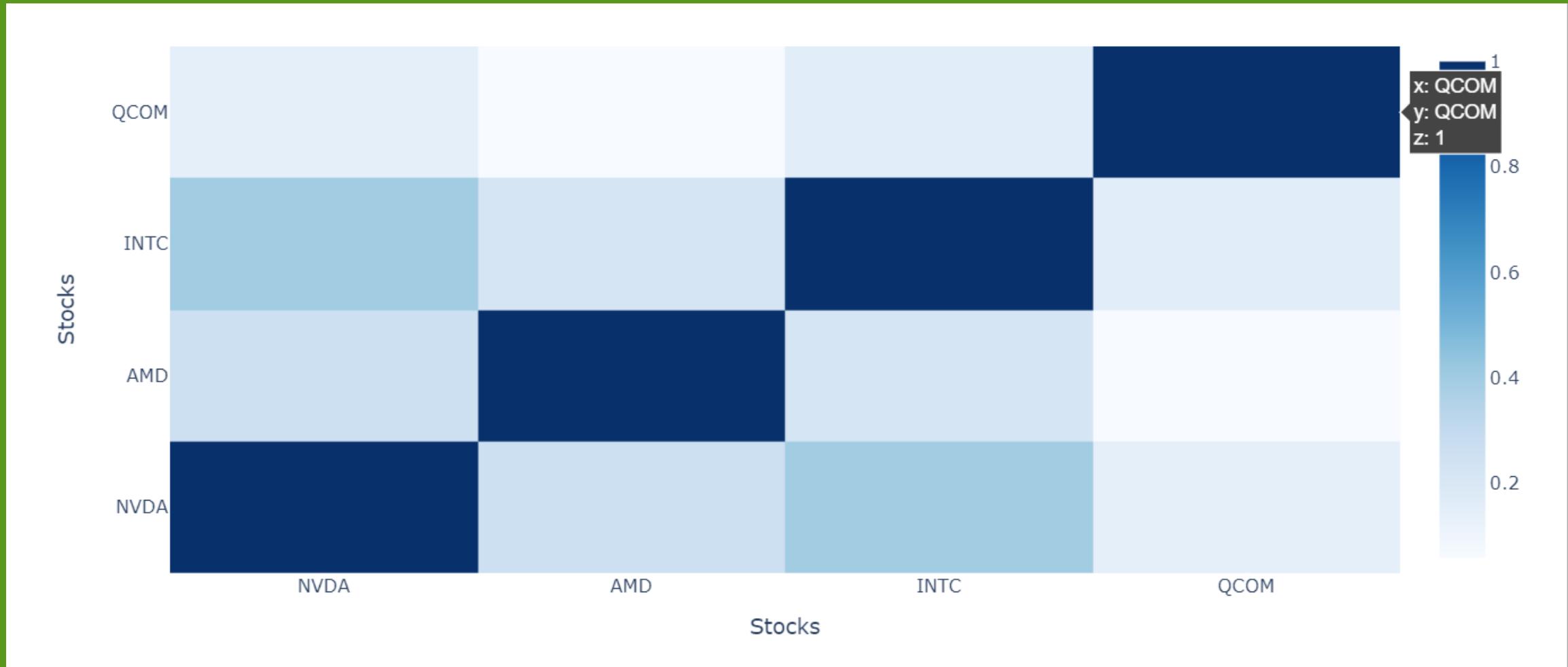
3. Competitors & Nvidia Stock Volume:



4. Kernal Desity Estiamtes of adj closing price for NVDA, AMD, INTC, QCOM



5. Correlation Matrix of Stocks Closing Prices



Data Extraction & Preprocessing

- We have extracted data from Fama-French (five factors model), ADS Index, and from the FRED website, utilizing the FRED API.

Before Preprocessing

	Date	Date_x	Mkt-RF	SMB	HML	RMW	CMA	RF	Date_y	\
13971	13971	2019-01-02	0.23	0.74	1.11	-0.12	0.27	0.010	1998-06-01	
13972	13972	2019-01-03	-2.45	0.48	1.20	-0.22	0.89	0.010	1998-06-02	
13973	13973	2019-01-04	3.55	0.36	-0.70	-0.11	-0.59	0.010	1998-06-03	
13974	13974	2019-01-07	0.94	0.87	-0.75	-0.72	-0.45	0.010	1998-06-04	
13975	13975	2019-01-08	1.01	0.44	-0.63	0.31	-0.09	0.010	1998-06-05	
...
15224	15224	2023-12-22	0.21	0.61	0.09	-0.64	0.19	0.021	2001-11-05	
15225	15225	2023-12-26	0.48	0.81	0.46	-0.34	-0.15	0.021	2001-11-06	
15226	15226	2023-12-27	0.16	0.16	0.12	-0.31	-0.14	0.021	2001-11-07	
15227	15227	2023-12-28	-0.01	-0.38	0.03	-0.32	0.15	0.021	2001-11-08	
15228	15228	2023-12-29	-0.43	-1.13	-0.37	0.68	-0.07	0.021	2001-11-09	
ADS_Index ... DGS1 RIFSPFFAAD90NB DCPN3M DCPF1M DCOILWTICO \										
13971	0.004238	...	5.16		5.34	5.34	5.3		87.24	
13972	-0.032800	...	5.16		5.34	5.34	5.3		87.24	
13973	-0.069725	...	5.16		5.34	5.34	5.3		87.24	
13974	-0.106551	...	5.16		5.34	5.34	5.3		87.24	
13975	-0.143292	...	5.16		5.34	5.34	5.3		87.24	
...
15224	-0.704450	...	5.16		5.34	5.34	5.3		87.24	
15225	-0.7222956	...	5.16		5.34	5.34	5.3		87.24	
15226	-0.740778	...	5.16		5.34	5.34	5.3		87.24	
15227	-0.757922	...	5.16		5.34	5.34	5.3		87.24	
15228	-0.774395	...	5.16		5.34	5.34	5.3		87.24	
DHHNGSP USRECD USRECDM USRECDP SP500										
13971	1.83	0.0	0.0	0.0	5061.82					
13972	1.83	0.0	0.0	0.0	5061.82					
13973	1.83	0.0	0.0	0.0	5061.82					
13974	1.83	0.0	0.0	0.0	5061.82					
13975	1.83	0.0	0.0	0.0	5061.82					
...
15224	1.83	0.0	0.0	0.0	5061.82					
15225	1.83	0.0	0.0	0.0	5061.82					
15226	1.83	0.0	0.0	0.0	5061.82					
15227	1.83	0.0	0.0	0.0	5061.82					
15228	1.83	0.0	0.0	0.0	5061.82					

After Preprocessing

	Date_x	Mkt-RF	SMB	HML	RMW	CMA	RF	ADS_Index
0	2019-01-02	0.23	0.74	1.11	-0.12	0.27	0.010	0.004238
1	2019-01-03	-2.45	0.48	1.20	-0.22	0.89	0.010	-0.032800
2	2019-01-04	3.55	0.36	-0.70	-0.11	-0.59	0.010	-0.069725
3	2019-01-07	0.94	0.87	-0.75	-0.72	-0.45	0.010	-0.106551
4	2019-01-08	1.01	0.44	-0.63	0.31	-0.09	0.010	-0.143292
...
1253	2023-12-22	0.21	0.61	0.09	-0.64	0.19	0.021	-0.704450
1254	2023-12-26	0.48	0.81	0.46	-0.34	-0.15	0.021	-0.722956
1255	2023-12-27	0.16	0.16	0.12	-0.31	-0.14	0.021	-0.740778
1256	2023-12-28	-0.01	-0.38	0.03	-0.32	0.15	0.021	-0.757922
1257	2023-12-29	-0.43	-1.13	-0.37	0.68	-0.07	0.021	-0.774395

Feature Engineering

Lag

LAG

```
In [330]: nvda_data['Lag_1'] = nvda_data['NVDA_Returns'].shift(1)
nvda_data['Lag_2'] = nvda_data['NVDA_Returns'].shift(2)
nvda_data['Lag_3'] = nvda_data['NVDA_Returns'].shift(3)

In [331]: nvda_data
Out[331]:
```

	NVDA_Returns	Lag_1	Lag_2	Lag_3
Date				
2019-01-02	0.000000	NaN	NaN	NaN
2019-01-03	-0.060417	0.000000	NaN	NaN
2019-01-04	0.064067	-0.060417	0.000000	NaN
2019-01-07	0.052941	0.064067	-0.060417	0.000000
2019-01-08	-0.024895	0.052941	0.064067	-0.060417
...
2023-12-22	-0.003266	0.018270	-0.030098	-0.009445
2023-12-26	0.009195	-0.003266	0.018270	-0.030098
2023-12-27	0.002800	0.009195	-0.003266	0.018270
2023-12-28	0.002125	0.002800	0.009195	-0.003266
2023-12-29	0.000000	0.002125	0.002800	0.009195

1258 rows × 4 columns



Momentum Factor

MOMENTUM FACTOR

```
In [332]: lookback_period = 3

# Calculate the momentum factor as the sum of returns over the lookback period
nvda_data['Momentum_factor'] = nvda_data['NVDA_Returns'].rolling(window=lookback_period).sum()

In [333]: nvda_data
Out[333]:
```

	NVDA_Returns	Lag_1	Lag_2	Lag_3	Momentum_factor
Date					
2019-01-02	0.000000	NaN	NaN	NaN	NaN
2019-01-03	-0.060417	0.000000	NaN	NaN	NaN
2019-01-04	0.064067	-0.060417	0.000000	NaN	0.003650
2019-01-07	0.052941	0.064067	-0.060417	0.000000	0.056591
2019-01-08	-0.024895	0.052941	0.064067	-0.060417	0.092113
...
2023-12-22	-0.003266	0.018270	-0.030098	-0.009445	-0.015094
2023-12-26	0.009195	-0.003266	0.018270	-0.030098	0.024200
2023-12-27	0.002800	0.009195	-0.003266	0.018270	0.008730
2023-12-28	0.002125	0.002800	0.009195	-0.003266	0.014120
2023-12-29	0.000000	0.002125	0.002800	0.009195	0.004925

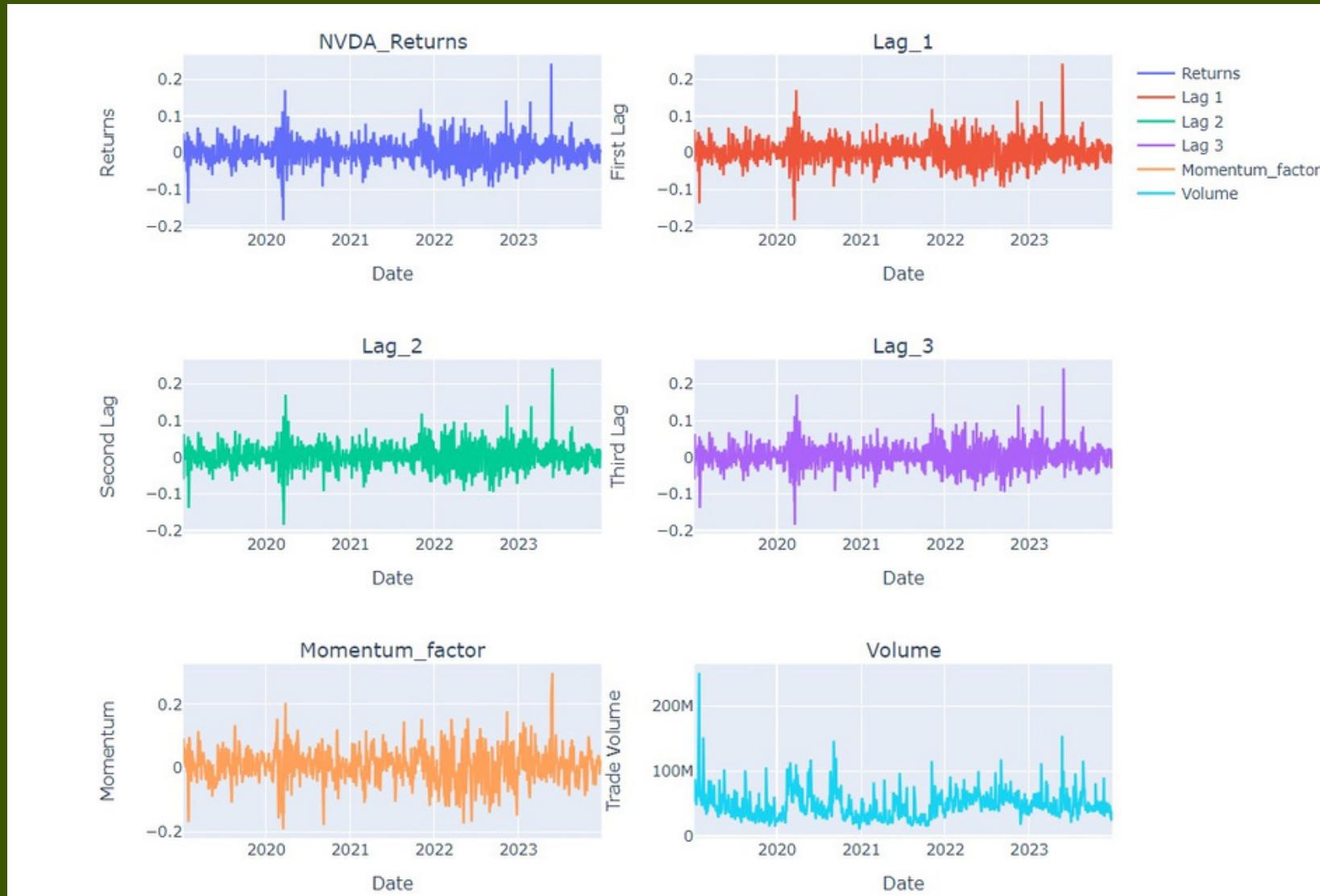
1258 rows × 5 columns

4:]

Date	NVDA_Returns	Lag_1	Lag_2	Lag_3	Momentum_factor
2019-01-07	0.052941	0.064067	-0.060417	0.000000	0.056591
2019-01-08	-0.024895	0.052941	0.064067	-0.060417	0.092113
2019-01-09	0.019667	-0.024895	0.052941	0.064067	0.047712
2019-01-10	0.018586	0.019667	-0.024895	0.052941	0.013358
2019-01-11	0.024788	0.018586	0.019667	-0.024895	0.063041
...
2023-12-22	-0.003266	0.018270	-0.030098	-0.009445	-0.015094
2023-12-26	0.009195	-0.003266	0.018270	-0.030098	0.024200
2023-12-27	0.002800	0.009195	-0.003266	0.018270	0.008730
2023-12-28	0.002125	0.002800	0.009195	-0.003266	0.014120
2023-12-29	0.000000	0.002125	0.002800	0.009195	0.004925

1255 rows × 5 columns

Vizualization of Lag, Momentum Factor, NVDA returns & Volume

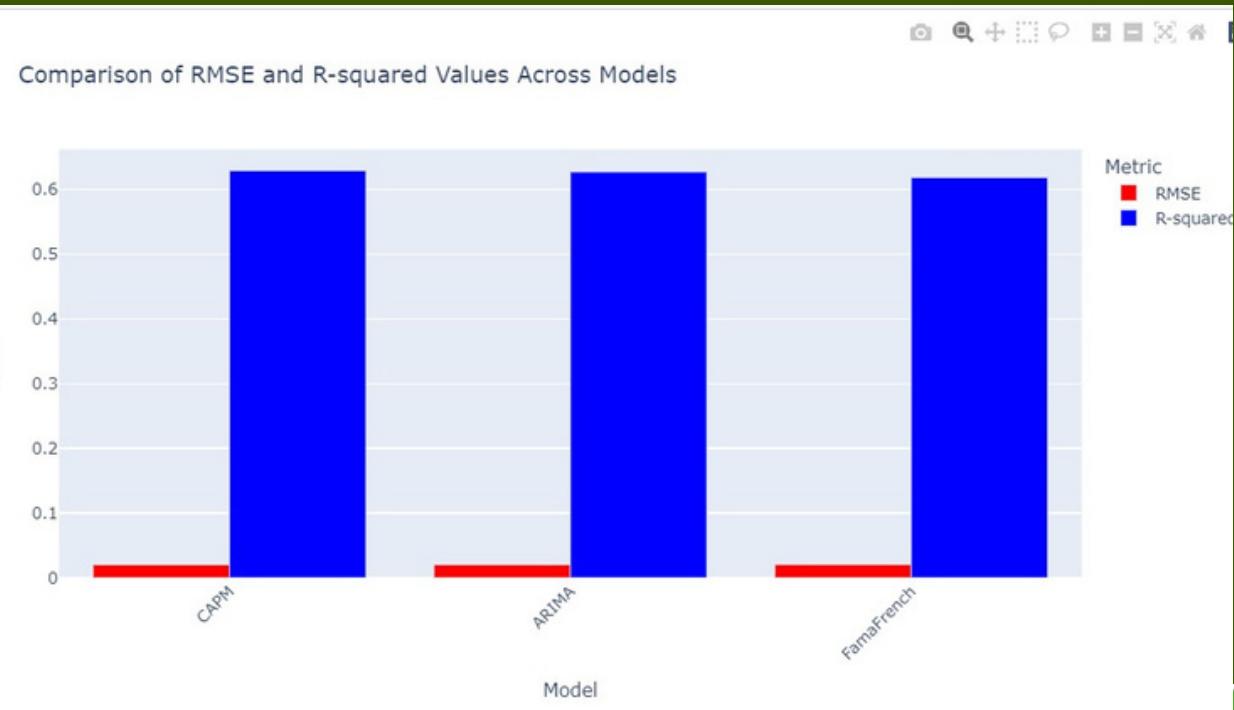


Feature Database

	NVDA_Retruns	Lag_1	Lag_2	Lag_3	Momentum_factor	Volume	Mkt-RF	SMB	HML	RMW	CMA	RF	ADS_Index
Date													
2019-01-07	0.052941	0.064067	-0.060417	0.000000	0.056591	70916000	0.94	0.87	-0.75	-0.72	-0.45	0.010	-0.106551
2019-01-08	-0.024895	0.052941	0.064067	-0.060417	0.092113	78601600	1.01	0.44	-0.63	0.31	-0.09	0.010	-0.143292
2019-01-09	0.019667	-0.024895	0.052941	0.064067	0.047712	61726000	0.56	0.50	0.10	0.08	-0.20	0.010	-0.179962
2019-01-10	0.018586	0.019667	-0.024895	0.052941	0.013358	52315600	0.42	0.00	-0.46	-0.06	-0.04	0.010	-0.216575
2019-01-11	0.024788	0.018586	0.019667	-0.024895	0.063041	87476400	-0.01	0.20	0.22	0.23	0.25	0.010	-0.251807
...
2023-12-22	-0.003266	0.018270	-0.030098	-0.009445	-0.015094	25213900	0.21	0.61	0.09	-0.64	0.19	0.021	-0.704450
2023-12-26	0.009195	-0.003266	0.018270	-0.030098	0.024200	24420000	0.48	0.81	0.46	-0.34	-0.15	0.021	-0.722956
2023-12-27	0.002800	0.009195	-0.003266	0.018270	0.008730	23364800	0.16	0.16	0.12	-0.31	-0.14	0.021	-0.740778
2023-12-28	0.002125	0.002800	0.009195	-0.003266	0.014120	24658700	-0.01	-0.38	0.03	-0.32	0.15	0.021	-0.757922
2023-12-29	0.000000	0.002125	0.002800	0.009195	0.004925	38869000	-0.43	-1.13	-0.37	0.68	-0.07	0.021	-0.774395

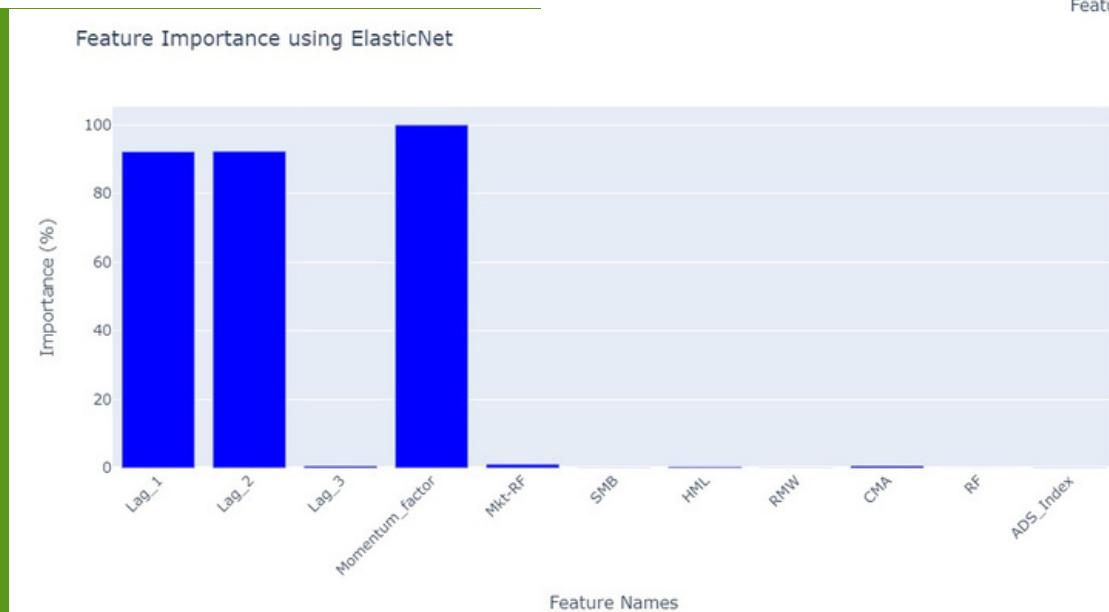
1255 rows × 13 columns

Comparison of RMSE & R-Squared value across model



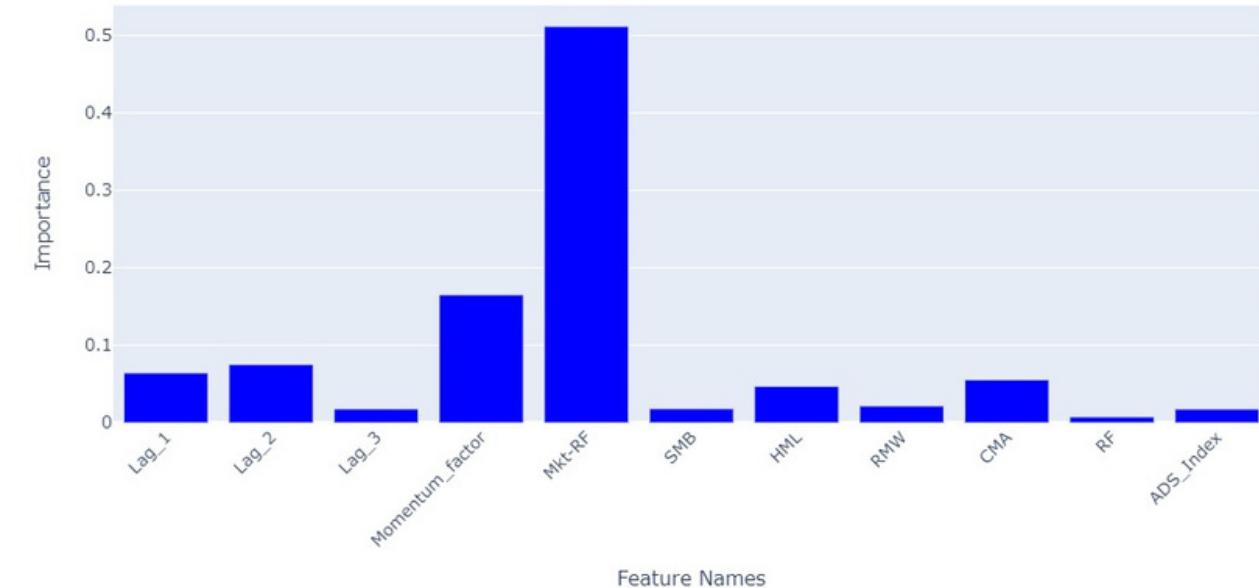
Model	RMSE	R2-SQUARED
CAPM	0.0198	0.628
ARIMA	0.0198	0.626
FAMA FRENCH (3 FACTOR)	0.020	0.618

Feature Importance (Regression based Model)

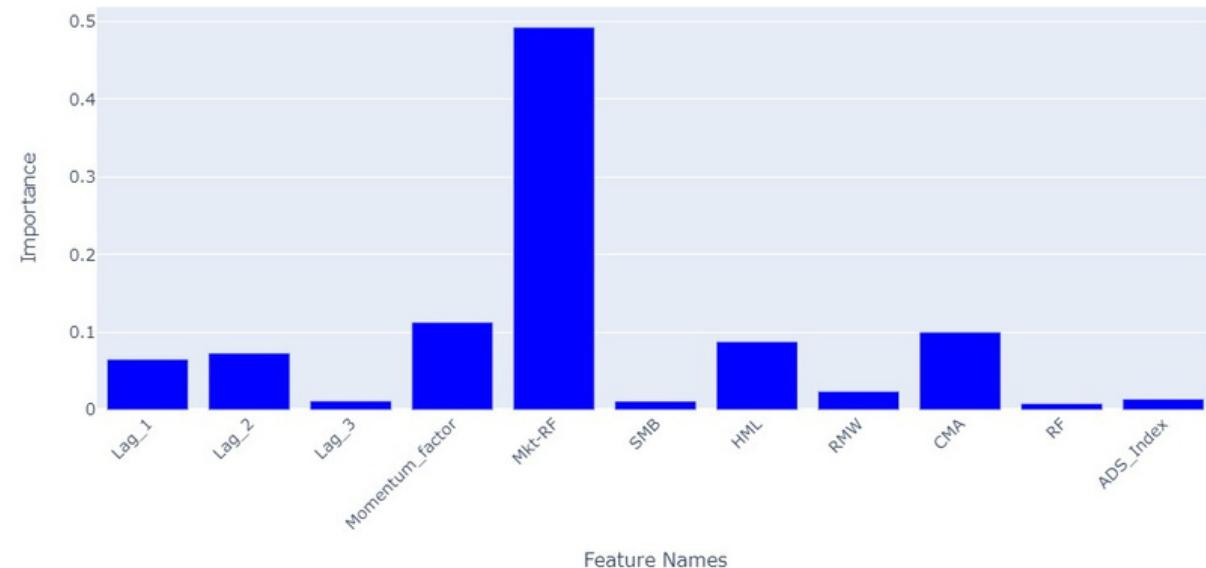


Feature Importance (Decision Tree based Model)

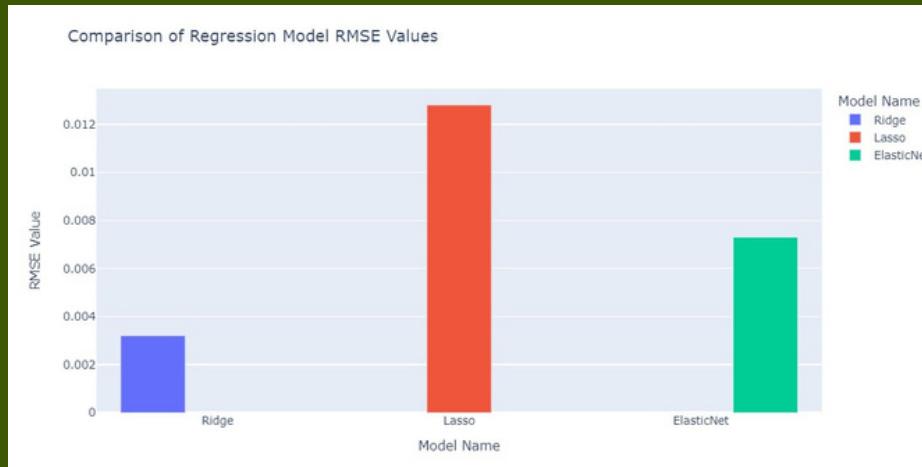
Feature Importance using Random Forest Regressor



Feature Importance using XGBOOST Regressor



Regression Based Model



MODEL	RMSE VALUES
RIDGE REGRESSION	0.0032
LASSO REGRESSION	0.0128
ELASTICNET REGRESSION	0.0073

VS

MODEL	RMSE VALUE
RANDOM FOREST REGRESSOR	0.0144
XGBOOST REGRESSOR	0.0114



Decision Based Model

Trading rules and generating Signals (PnL)

Initial Investment = \$10,000

MODEL	BUY AND HOLD (\$)	DAY TRADE (\$)
RANDOM FOREST REGRESSOR	19262	40816
XGBOOST REGRESSOR	19262	42328

Model	BUY AND HOLD (\$)	DAY TRADE (\$)
RIDGE REGRESSION	19262	43384
LASSO REGRESSION	19262	40383
ELASTICNET REGRESSION	19262	42693

Strategy (Moving Avg)

In [32]: stats

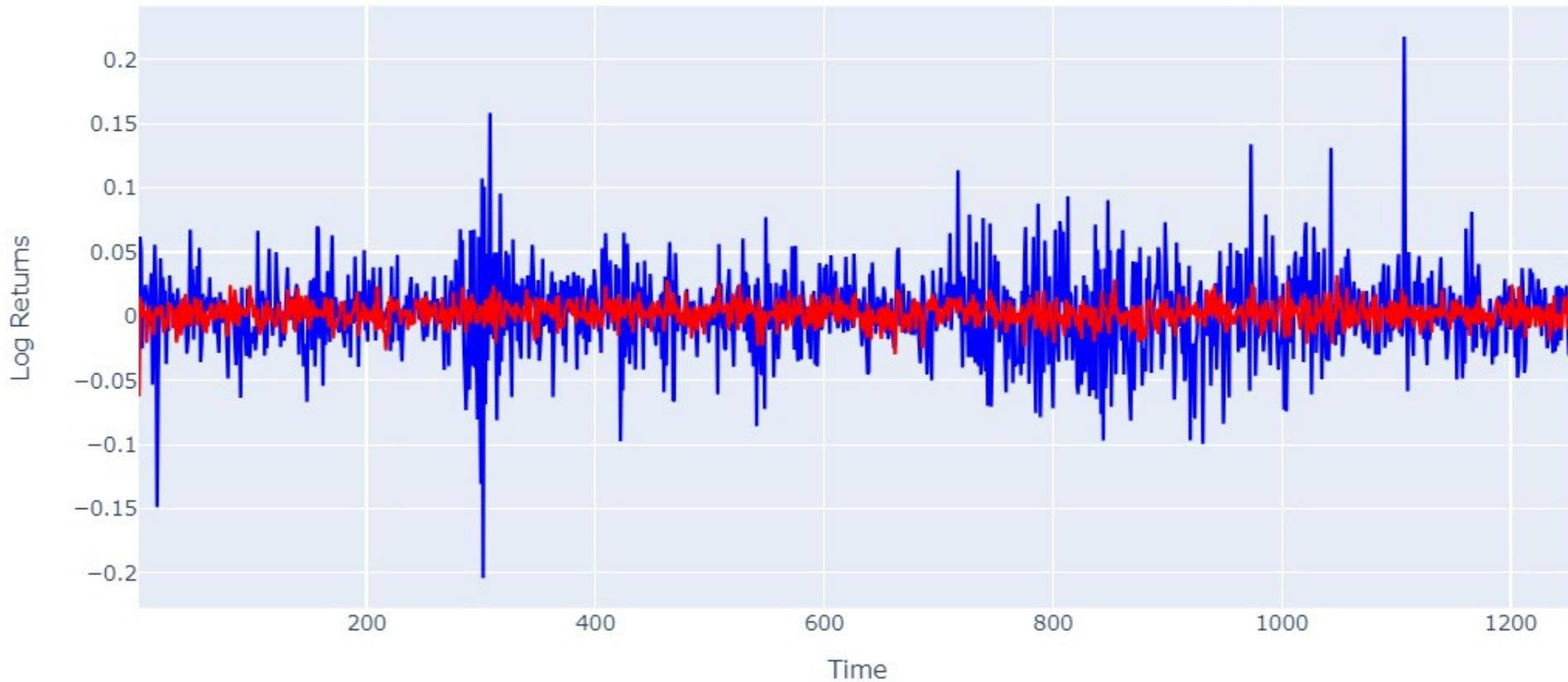
```
Out[32]: Start          2019-01-02 00:00:00
          End            2023-12-29 00:00:00
          Duration        1822 days 00:00:00
          Exposure Time [%]    91.653418
          Equity Final [$]     46927.392803
          Equity Peak [$]      65654.086834
          Return [%]           369.273928
          Buy & Hold Return [%] 1354.177057
          Return (Ann.) [%]     36.300916
          Volatility (Ann.) [%] 70.822888
          Sharpe Ratio          0.512559
          Sortino Ratio          1.126145
          Calmar Ratio           0.631171
          Max. Drawdown [%]     -57.513625
          Avg. Drawdown [%]      -9.163013
          Max. Drawdown Duration 378 days 00:00:00
          Avg. Drawdown Duration 36 days 00:00:00
          # Trades              16
          Win Rate [%]           31.25
          Best Trade [%]          156.676061
          Worst Trade [%]         -19.321368
          Avg. Trade [%]           10.151122
          Max. Trade Duration     318 days 00:00:00
          Avg. Trade Duration      105 days 00:00:00
          Profit Factor            3.369583
          Expectancy [%]           18.025264
          SQN                      0.877578
          _strategy                DualMACrossover
          _equity_curve             ...
          _trades                  ...
          dtype: object
```



Benchmark Study - Garch

Volatility Prediction for NVDA

Original Data GARCH Model



RMSE value = 0.033