

Quantitative Backtesting Report

Trading Strategy

Universe: AAPL, MSFT, GOOGL
Period: 2020-01-01 to 2023-12-31
Initial Capital: \$100,000.00
Final Equity: \$155,882.67
Total Return: 55.88%

Report generated: 2025-09-10 03:50:00

Backtest Configuration

BASIC PARAMETERS

```
=====
Universe: AAPL, MSFT, GOOGL
Start Date: 2020-01-01 00:00:00
End Date: 2023-12-31 00:00:00
Initial Cash: $100,000.00
Trading Interval: 1d
```

STRATEGY CONFIGURATION

```
=====
name: EMA CrossOver Strategy
class: CrossOverStrategy
position_size: 0.3
signal_column: EMA_Signal
```

SIGNAL GENERATORS

```
=====
1. EMASignal (12, 26 periods)
```

BROKER CONFIGURATION

```
=====
class: SimpleBroker
commission: 0
slippage: 0
```

BENCHMARK CONFIGURATION

```
=====
name: BuyAndHoldStrategy
class: BuyAndHoldStrategy
allocation_method: equal_weight
```

Performance Metrics

RETURN METRICS

=====
Total Return: 55.88%
Annualized Return: 11.76%
Final Equity: \$155,882.67

RISK METRICS

=====
Annualized Volatility: 16.81%
Maximum Drawdown: -25.79%
Max Drawdown Duration: 746 days
VaR (5%): -1.77%

RISK-ADJUSTED METRICS

=====
Sharpe Ratio: 0.70
Calmar Ratio: 0.46

TRADING METRICS

=====
Total Trades: 107
Win Rate: 51.40%
Best Day: 5.14%
Worst Day: -6.20%

TIME METRICS

=====
Trading Days: 1006
Years: 4.0

Benchmark Comparison

STRATEGY vs BENCHMARK

Strategy Return: 55.88%
Benchmark Return: 136.63%
Alpha: -12.32%

ANNUALIZED COMPARISON

Strategy Ann. Return: 11.76%
Benchmark Ann. Return: 24.08%

RISK COMPARISON

Strategy Volatility: 16.81%
Benchmark Volatility: 30.27%
Strategy Max DD: -25.79%
Benchmark Max DD: -35.26%

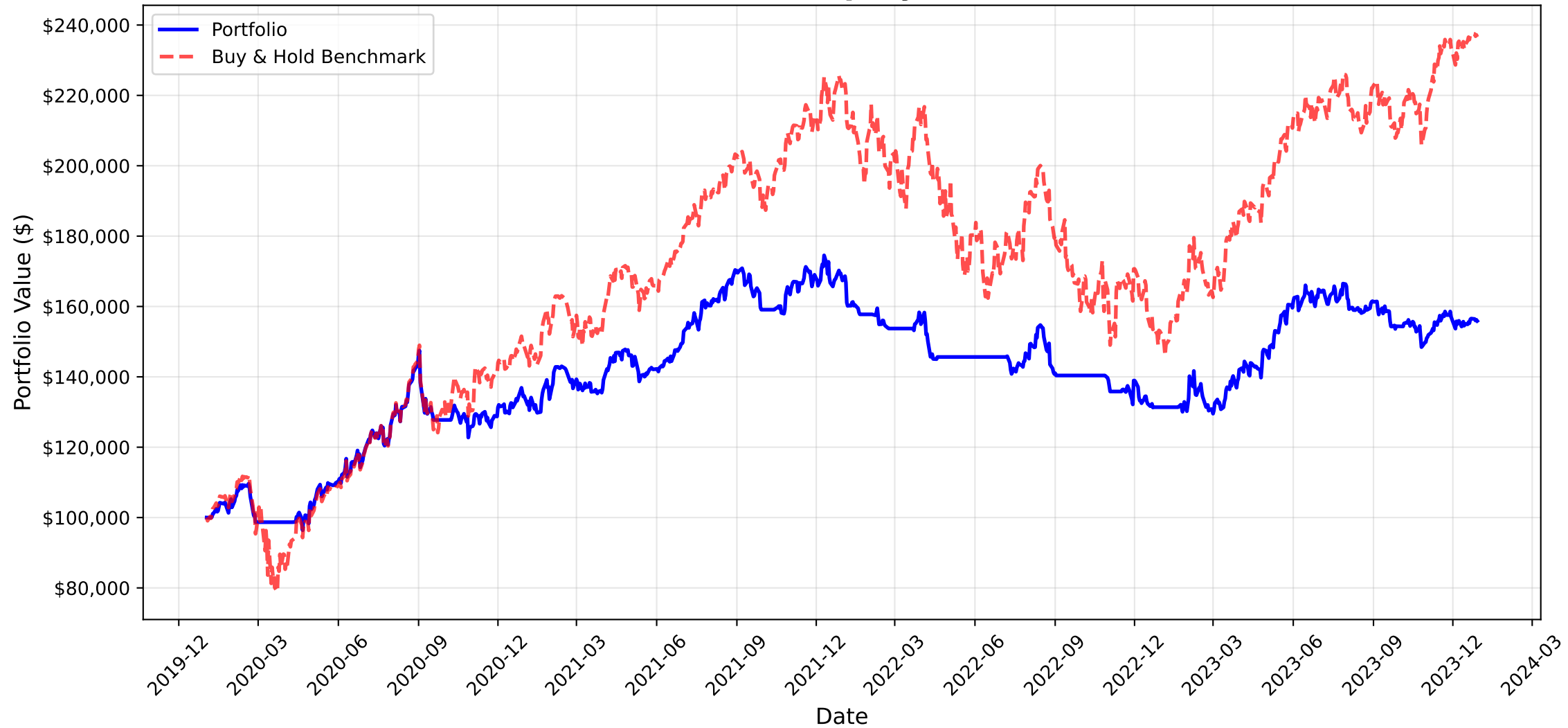
RISK-ADJUSTED COMPARISON

Strategy Sharpe: 0.70
Benchmark Sharpe: 0.80

RELATIVE PERFORMANCE

Beta: 0.37
Tracking Error: 22.89%
Information Ratio: -0.54

Portfolio Equity Curve

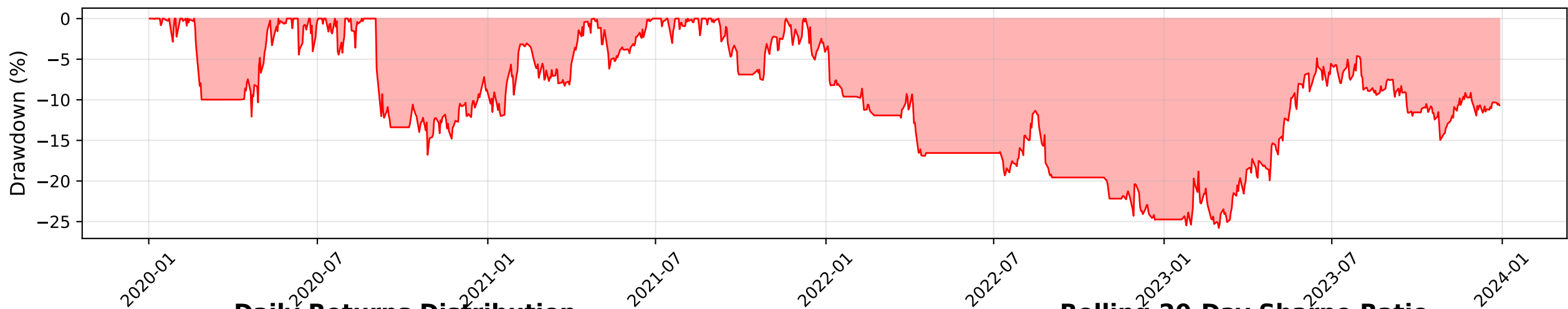


Comprehensive Backtest Analysis

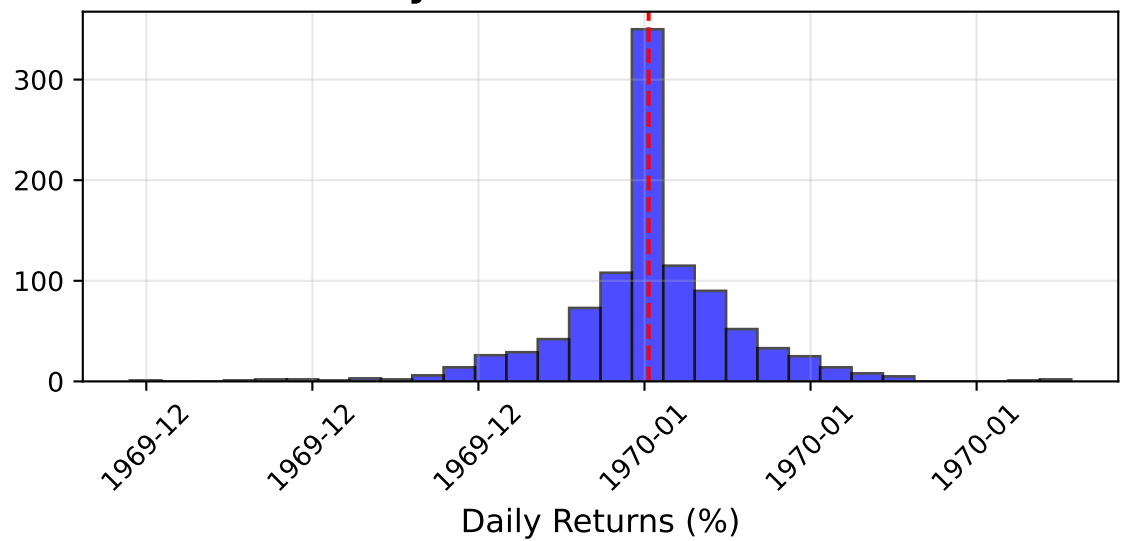
Portfolio Equity Curve



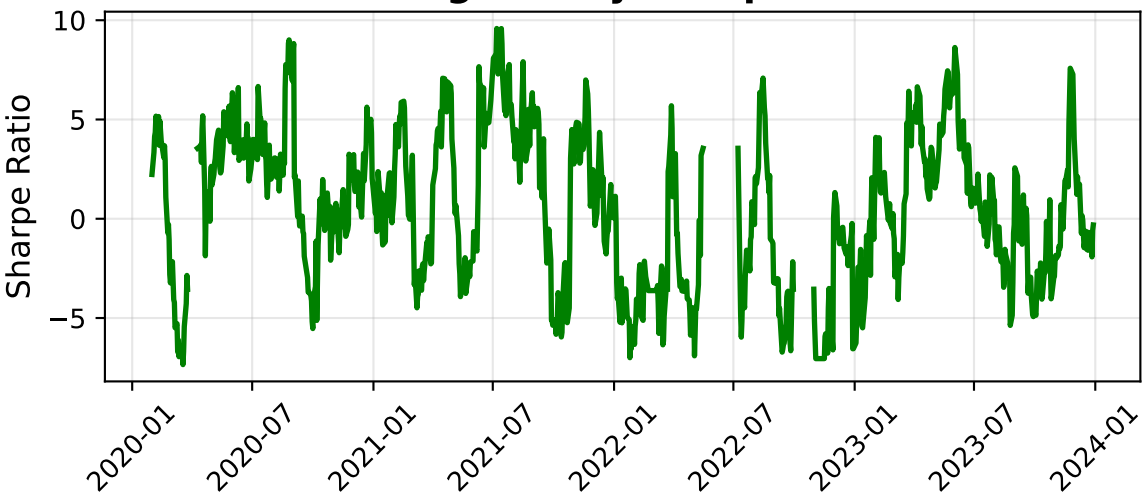
Drawdown



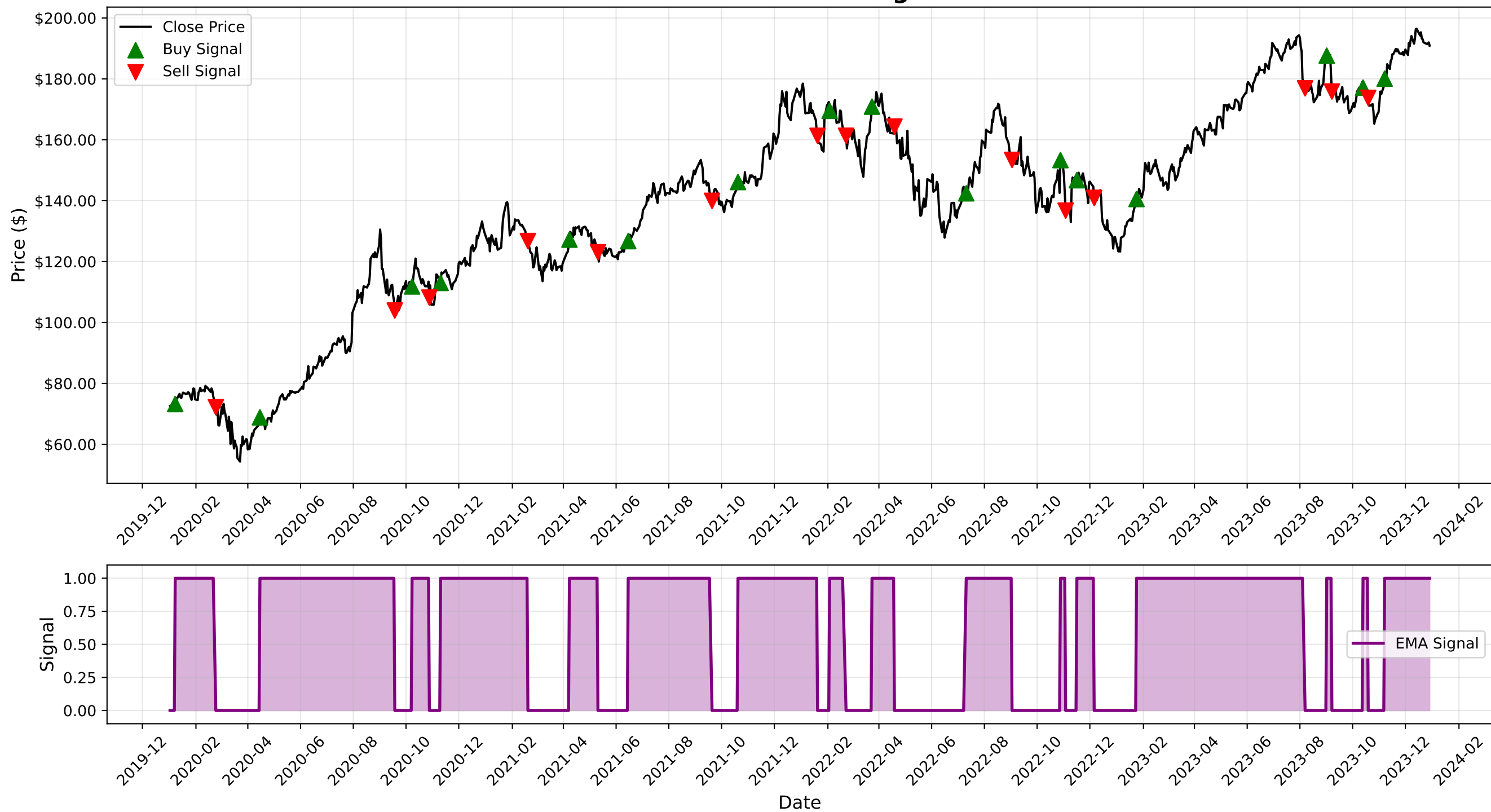
Daily Returns Distribution



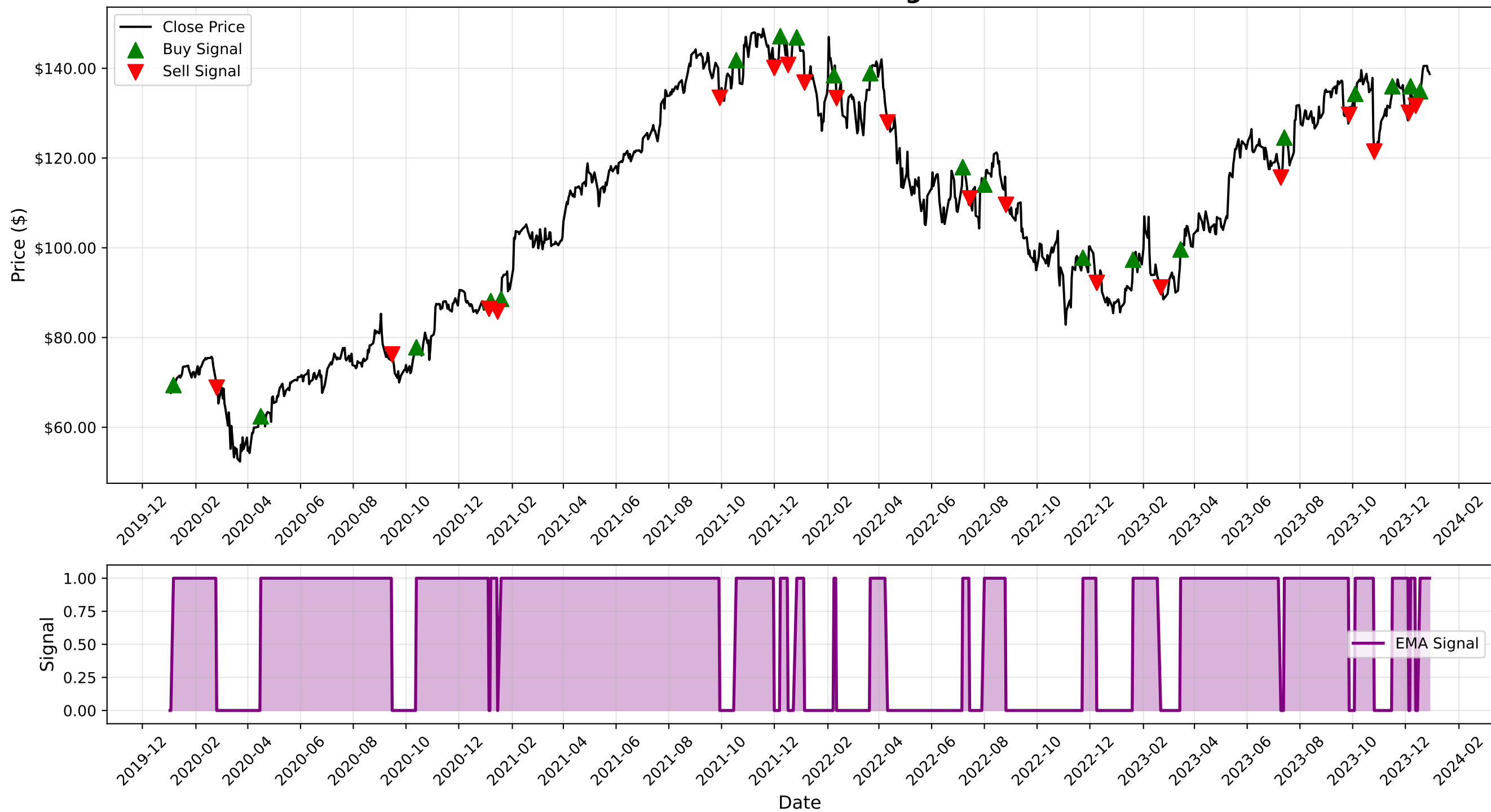
Rolling 20-Day Sharpe Ratio



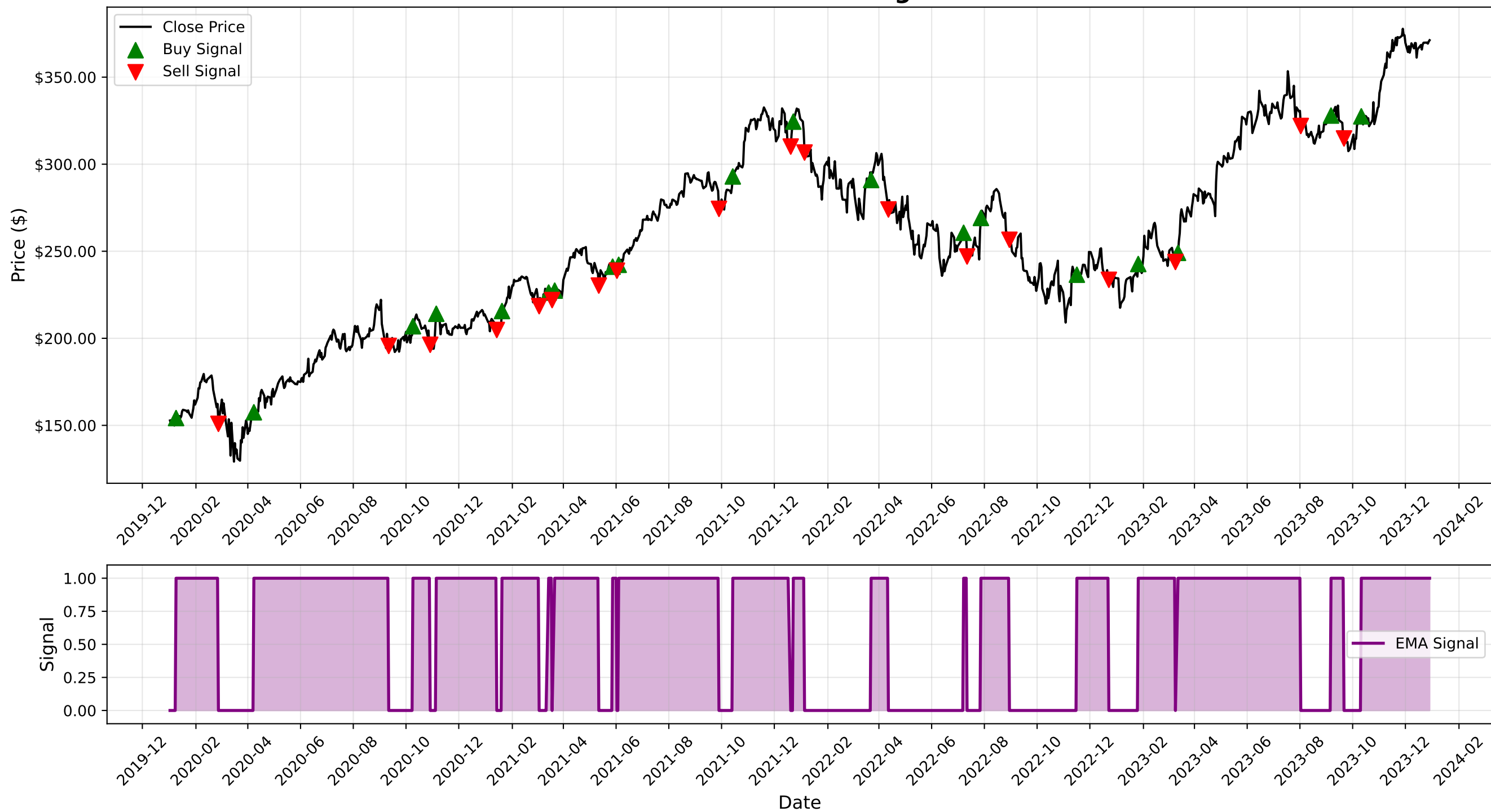
AAPL - Price and Signals



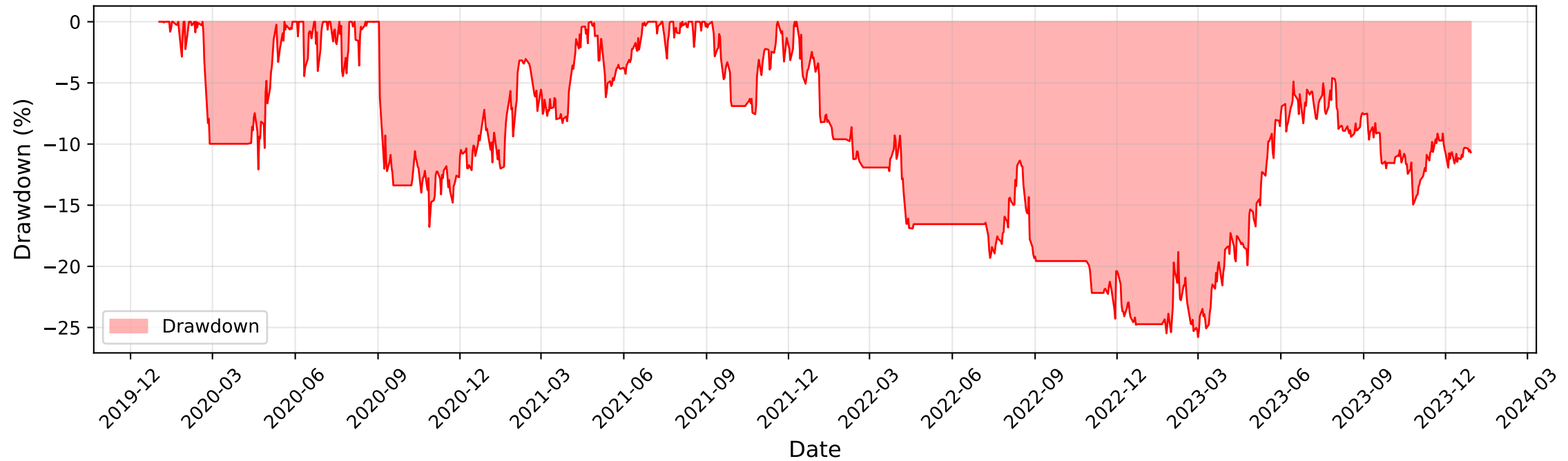
GOOGL - Price and Signals



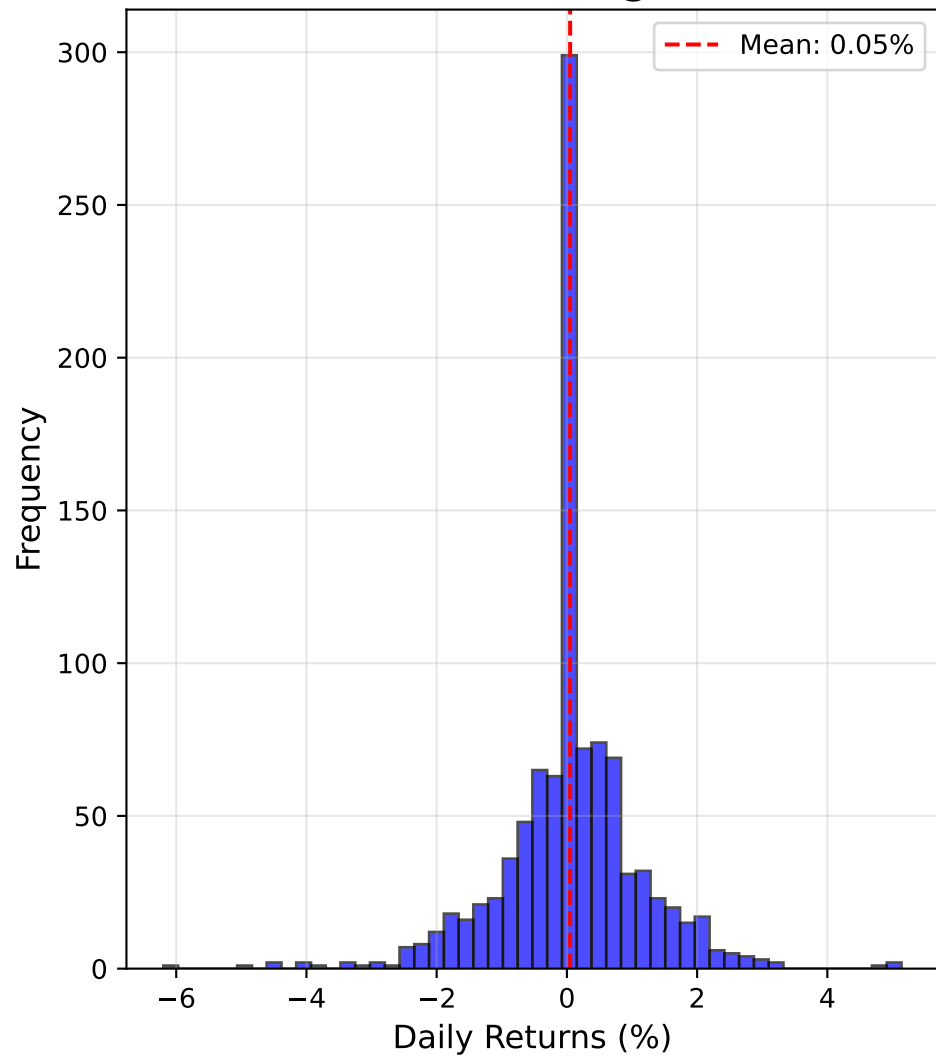
MSFT - Price and Signals



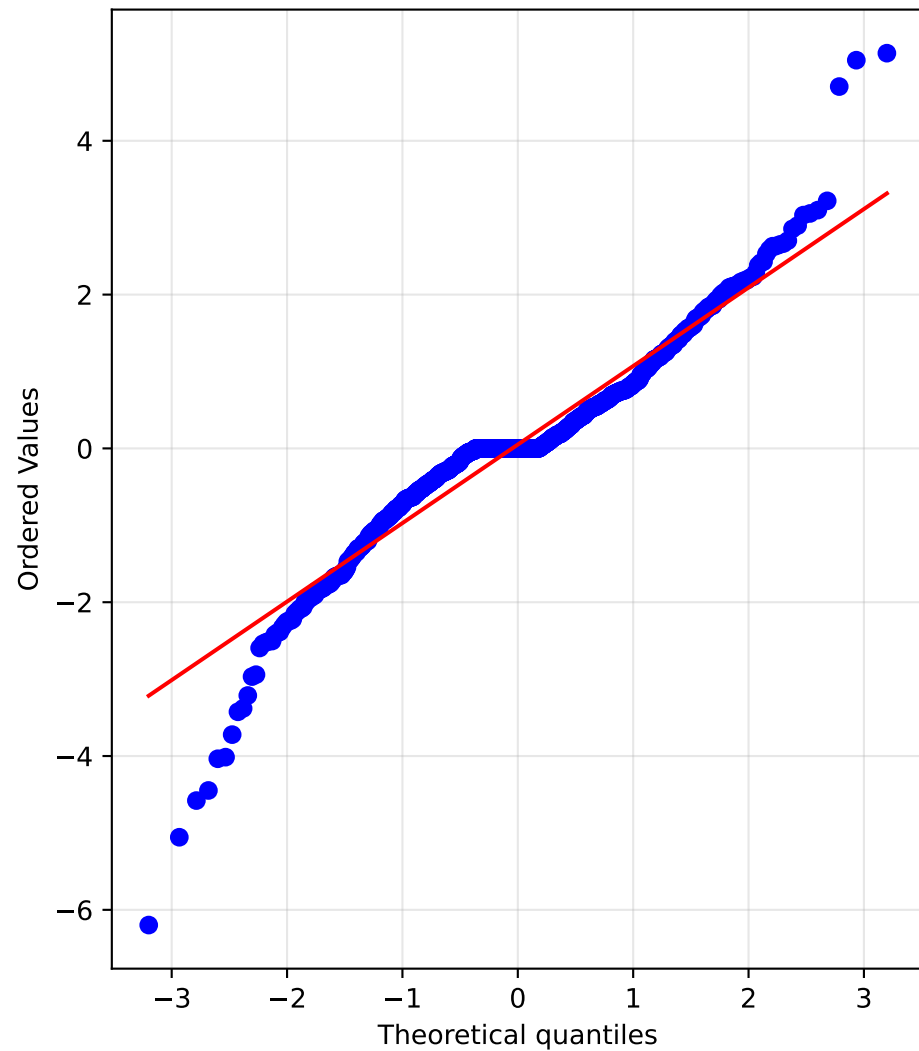
Portfolio Drawdown



Returns Histogram



Q-Q Plot vs Normal



Order History (Page 1 of 3)

Date	Symbol	Quantity	Price	Fees	Total Cost
2020-01-06	GOOGL	432	\$69.41	\$0.00	\$29985.88
2020-01-08	AAPL	410	\$73.22	\$0.00	\$30022.01
2020-01-09	MSFT	196	\$154.19	\$0.00	\$30221.14
2020-02-24	AAPL	-410	\$72.19	\$0.00	\$29595.98
2020-02-25	GOOGL	-432	\$68.84	\$0.00	\$29739.39
2020-02-27	MSFT	-196	\$150.88	\$0.00	\$29572.69
2020-04-08	MSFT	187	\$157.51	\$0.00	\$29454.43
2020-04-15	AAPL	435	\$68.86	\$0.00	\$29952.64
2020-04-16	GOOGL	485	\$62.44	\$0.00	\$30283.81
2020-09-11	MSFT	-187	\$195.63	\$0.00	\$36582.65
2020-09-15	GOOGL	-485	\$76.23	\$0.00	\$36971.66
2020-09-18	AAPL	-435	\$103.93	\$0.00	\$45207.46
2020-10-08	AAPL	342	\$111.83	\$0.00	\$38247.01
2020-10-09	MSFT	186	\$206.92	\$0.00	\$38487.88
2020-10-13	GOOGL	505	\$77.82	\$0.00	\$39297.48
2020-10-28	AAPL	-342	\$108.17	\$0.00	\$36992.85
2020-10-29	MSFT	-186	\$196.29	\$0.00	\$36510.08
2020-11-05	MSFT	181	\$214.10	\$0.00	\$38751.40
2020-11-10	AAPL	336	\$113.00	\$0.00	\$37968.24
2021-01-05	GOOGL	-505	\$86.41	\$0.00	\$43635.31
2021-01-07	GOOGL	452	\$88.11	\$0.00	\$39825.41
2021-01-14	MSFT	-181	\$204.78	\$0.00	\$37065.86
2021-01-15	GOOGL	-452	\$85.79	\$0.00	\$38776.77
2021-01-19	GOOGL	440	\$88.61	\$0.00	\$38989.42
2021-01-20	MSFT	185	\$215.67	\$0.00	\$39898.22
2021-02-19	AAPL	-336	\$126.73	\$0.00	\$42582.59
2021-03-04	MSFT	-185	\$218.47	\$0.00	\$40416.14
2021-03-15	MSFT	181	\$226.25	\$0.00	\$40951.45
2021-03-19	MSFT	-181	\$221.95	\$0.00	\$40173.62
2021-03-22	MSFT	179	\$227.39	\$0.00	\$40702.48
2021-04-08	AAPL	338	\$127.21	\$0.00	\$42997.68
2021-05-11	AAPL	-338	\$123.08	\$0.00	\$41600.44
2021-05-12	MSFT	-179	\$230.29	\$0.00	\$41221.63
2021-05-28	MSFT	176	\$241.13	\$0.00	\$42439.69
2021-06-02	MSFT	-176	\$238.84	\$0.00	\$42035.14
2021-06-04	MSFT	176	\$242.21	\$0.00	\$42628.36
2021-06-15	AAPL	342	\$126.72	\$0.00	\$43339.72
2021-09-20	AAPL	-342	\$139.93	\$0.00	\$47857.61
2021-09-28	MSFT	-176	\$274.34	\$0.00	\$48283.95
2021-09-29	GOOGL	-440	\$133.43	\$0.00	\$58710.61
2021-10-14	MSFT	162	\$292.95	\$0.00	\$47457.58
2021-10-18	GOOGL	338	\$141.80	\$0.00	\$47928.40
2021-10-20	AAPL	327	\$146.12	\$0.00	\$47781.79
2021-12-01	GOOGL	-338	\$140.09	\$0.00	\$47348.84
2021-12-08	GOOGL	350	\$147.17	\$0.00	\$51510.01
2021-12-17	GOOGL	-350	\$140.75	\$0.00	\$49263.97
2021-12-20	MSFT	-162	\$310.12	\$0.00	\$50239.25
2021-12-23	MSFT	155	\$324.45	\$0.00	\$50289.20
2021-12-27	GOOGL	347	\$146.89	\$0.00	\$50971.99
2022-01-05	GOOGL	-347	\$136.83	\$0.00	\$47480.45

Order History (Page 2 of 3)

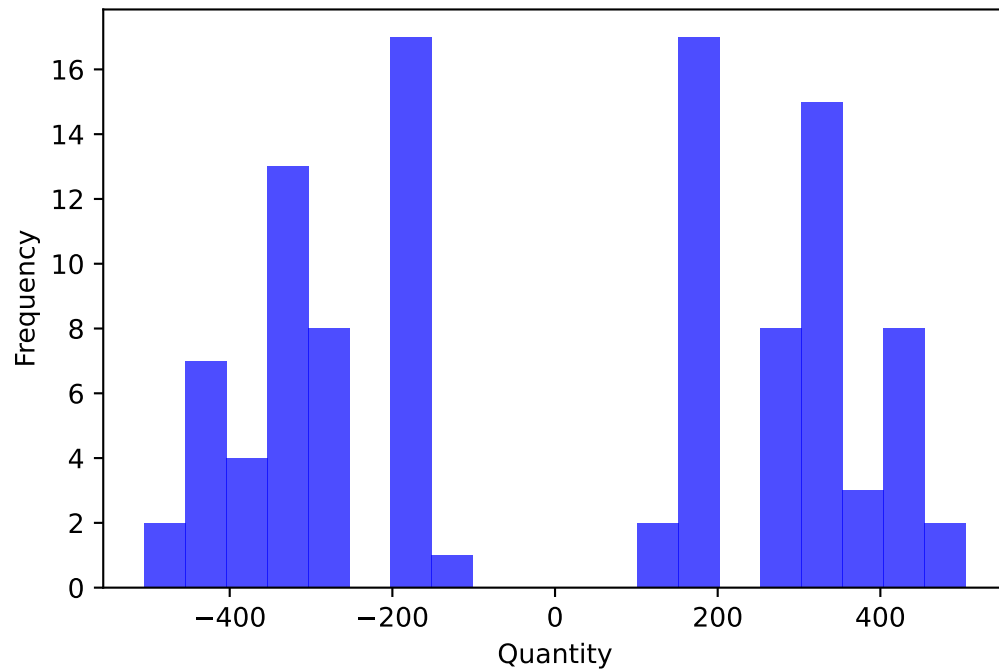
Date	Symbol	Quantity	Price	Fees	Total Cost
2022-01-05	MSFT	-155	\$306.70	\$0.00	\$47538.01
2022-01-20	AAPL	-327	\$161.29	\$0.00	\$52740.54
2022-02-03	AAPL	279	\$169.51	\$0.00	\$47293.76
2022-02-08	GOOGL	343	\$138.44	\$0.00	\$47486.34
2022-02-11	GOOGL	-343	\$133.36	\$0.00	\$45743.40
2022-02-22	AAPL	-279	\$161.31	\$0.00	\$45004.11
2022-03-22	GOOGL	332	\$138.91	\$0.00	\$46118.09
2022-03-23	MSFT	157	\$290.92	\$0.00	\$45675.08
2022-03-24	AAPL	272	\$170.88	\$0.00	\$46478.32
2022-04-11	GOOGL	-332	\$127.94	\$0.00	\$42476.44
2022-04-12	MSFT	-157	\$273.99	\$0.00	\$43016.84
2022-04-19	AAPL	-272	\$164.33	\$0.00	\$44697.36
2022-07-07	GOOGL	370	\$117.97	\$0.00	\$43648.66
2022-07-08	MSFT	167	\$260.61	\$0.00	\$43521.88
2022-07-11	AAPL	303	\$142.42	\$0.00	\$43153.52
2022-07-12	MSFT	-167	\$246.99	\$0.00	\$41247.08
2022-07-15	GOOGL	-370	\$111.01	\$0.00	\$41074.38
2022-07-28	MSFT	161	\$269.13	\$0.00	\$43329.86
2022-08-01	GOOGL	383	\$114.07	\$0.00	\$43690.05
2022-08-26	GOOGL	-383	\$109.58	\$0.00	\$41970.74
2022-08-30	MSFT	-161	\$256.59	\$0.00	\$41310.51
2022-09-02	AAPL	-303	\$153.39	\$0.00	\$46476.77
2022-10-28	AAPL	274	\$153.32	\$0.00	\$42009.62
2022-11-03	AAPL	-274	\$136.72	\$0.00	\$37461.77
2022-11-16	AAPL	277	\$146.72	\$0.00	\$40641.66
2022-11-16	MSFT	172	\$236.53	\$0.00	\$40682.70
2022-11-23	GOOGL	421	\$97.79	\$0.00	\$41167.72
2022-12-06	AAPL	-277	\$140.92	\$0.00	\$39035.55
2022-12-09	GOOGL	-421	\$92.19	\$0.00	\$38813.73
2022-12-23	MSFT	-172	\$233.59	\$0.00	\$40177.80
2023-01-20	GOOGL	404	\$97.35	\$0.00	\$39328.82
2023-01-24	AAPL	280	\$140.55	\$0.00	\$39353.39
2023-01-26	MSFT	162	\$242.66	\$0.00	\$39311.30
2023-02-21	GOOGL	-404	\$91.16	\$0.00	\$36829.15
2023-03-10	MSFT	-162	\$243.85	\$0.00	\$39503.53
2023-03-13	MSFT	158	\$249.08	\$0.00	\$39354.21
2023-03-16	GOOGL	410	\$99.63	\$0.00	\$40849.46
2023-07-10	GOOGL	-410	\$115.65	\$0.00	\$47417.45
2023-07-14	GOOGL	393	\$124.56	\$0.00	\$48952.43
2023-08-02	MSFT	-158	\$321.96	\$0.00	\$50869.08
2023-08-07	AAPL	-280	\$176.88	\$0.00	\$49525.37
2023-09-01	AAPL	257	\$187.62	\$0.00	\$48218.92
2023-09-06	MSFT	145	\$327.94	\$0.00	\$47551.01
2023-09-07	AAPL	-257	\$175.84	\$0.00	\$45190.29
2023-09-21	MSFT	-145	\$314.79	\$0.00	\$45644.00
2023-09-27	GOOGL	-393	\$129.65	\$0.00	\$50950.80
2023-10-04	GOOGL	344	\$134.31	\$0.00	\$46203.89
2023-10-11	MSFT	143	\$327.48	\$0.00	\$46830.33
2023-10-13	AAPL	261	\$177.12	\$0.00	\$46227.06
2023-10-19	AAPL	-261	\$173.76	\$0.00	\$45350.86

Order History (Page 3 of 3)

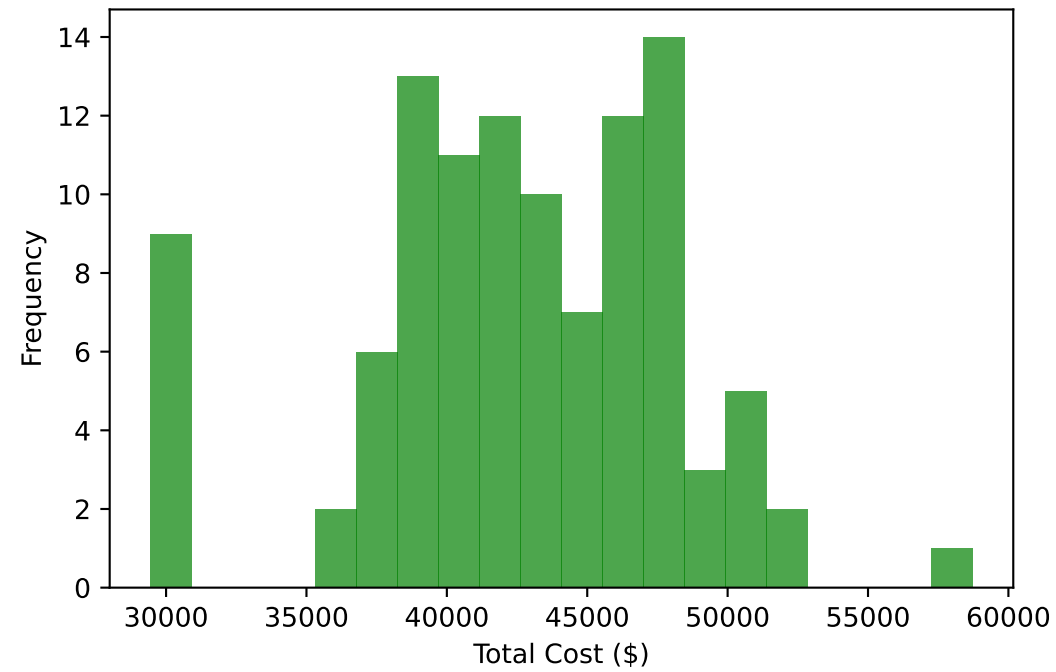
Date	Symbol	Quantity	Price	Fees	Total Cost
2023-10-26	GOOGL	-344	\$121.44	\$0.00	\$41776.18
2023-11-07	AAPL	254	\$180.06	\$0.00	\$45734.32
2023-11-16	GOOGL	347	\$135.99	\$0.00	\$47189.24
2023-12-05	GOOGL	-347	\$130.09	\$0.00	\$45142.18
2023-12-07	GOOGL	343	\$135.99	\$0.00	\$46645.27
2023-12-13	GOOGL	-343	\$131.66	\$0.00	\$45160.04
2023-12-18	GOOGL	344	\$134.87	\$0.00	\$46395.20

Trade Analysis

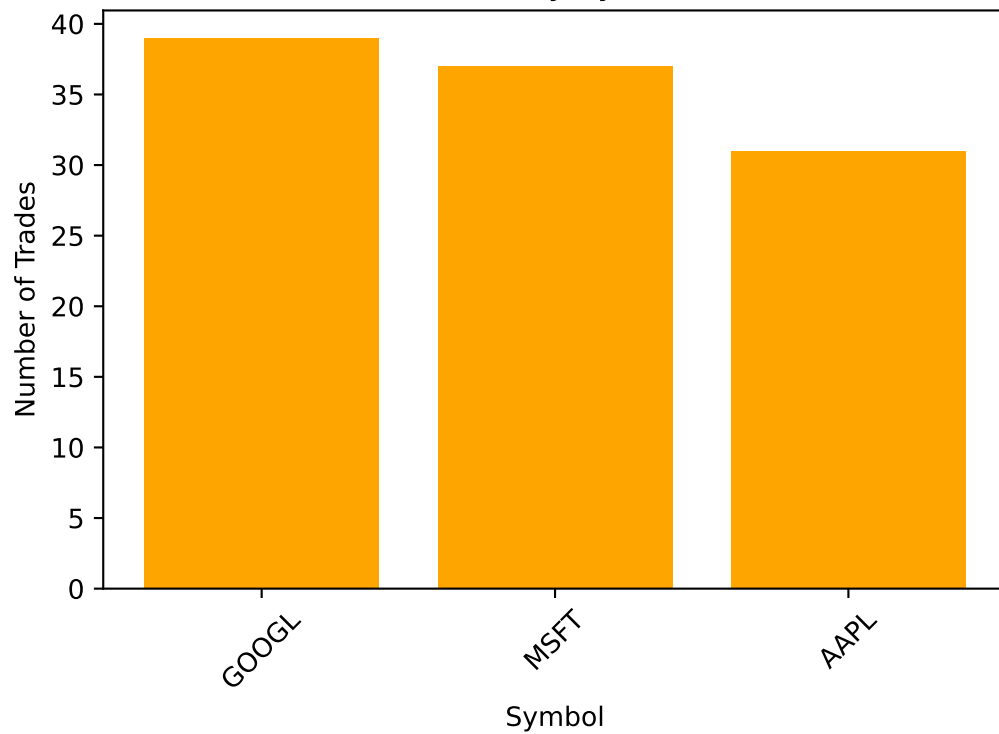
Trade Size Distribution



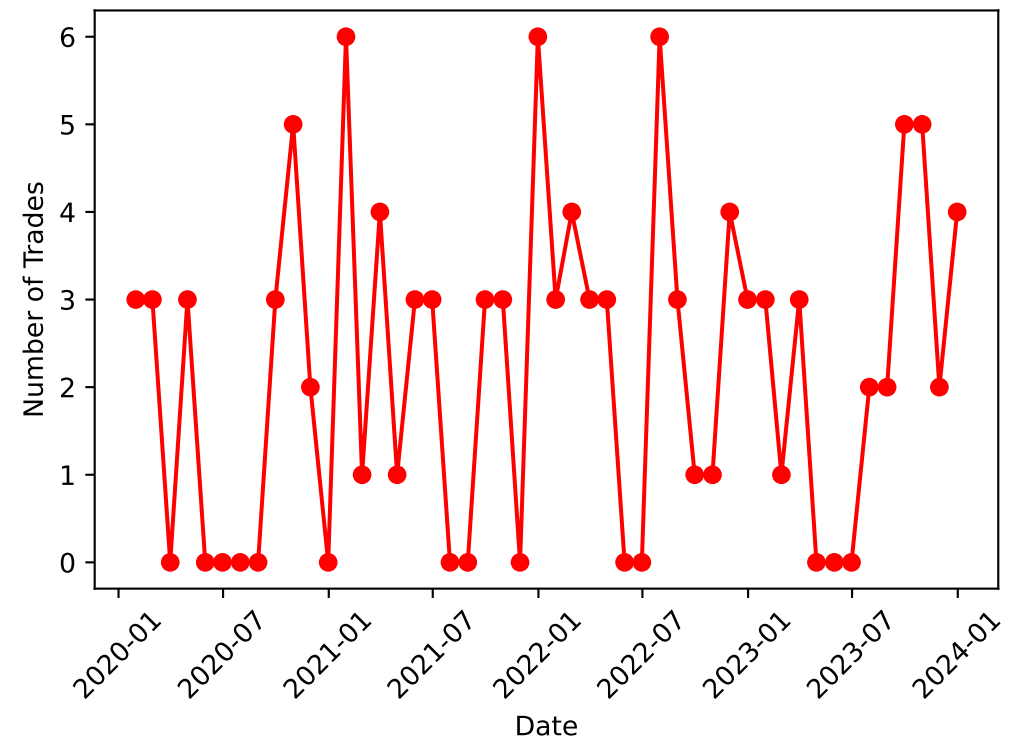
Trade Cost Distribution



Trades by Symbol



Trades Over Time



Monthly Returns Heatmap

