**LONG SHORT-TERM MEMORY:**

**Processing data for AAPL...**

Best AAPL configuration: [(50, False)] w/ MSE: 0.0011 & r^2: 0.8467

Raw stock data:

Open High Low Close Adj Close Volume

Date

2021-01-04 133.520004 133.610001 126.760002 129.410004 126.830078 143301900

2021-01-05 128.889999 131.740005 128.429993 131.009995 128.398163 97664900

2021-01-06 127.720001 131.050003 126.379997 126.599998 124.076096 155088000

2021-01-07 128.360001 131.630005 127.860001 130.919998 128.309982 109578200

2021-01-08 132.429993 132.630005 130.229996 132.050003 129.417435 105158200

Preprocessed stock data:

Open High Low Close Adj Close Volume ... lower\_band MACD MACD\_Signal MACD\_Histogram Stoch\_K Stoch\_D

Date ...

2021-03-16 125.699997 127.220001 124.720001 125.570000 123.250534 115227900 ... -1.816902 -1.042678 -1.287003 0.499891 0.586344 0.075332

2021-03-17 124.050003 125.860001 122.339996 124.760002 122.455490 111932600 ... -1.796313 -0.933439 -1.226754 0.671565 0.381392 0.410221

2021-03-18 122.879997 123.180000 120.320000 120.529999 118.303604 121229700 ... -1.793278 -0.957060 -1.183632 0.465777 -0.688914 0.099573

2021-03-19 119.900002 121.430000 119.680000 119.989998 117.773605 185549500 ... -1.782108 -0.982024 -1.154500 0.297681 -0.825549 -0.401414

2021-03-22 120.330002 123.870003 120.260002 123.389999 121.110794 111912300 ... -1.777957 -0.898330 -1.113205 0.443824 0.282256 -0.436591

[5 rows x 19 columns]

Training with **configuration: [(50, False)]**

Mean Squared Error: 6.666603857436026e-08

Mean Absolute Error: 0.00016628384514306163

R-squared Score: 0.9561352236462047

Training with configuration: [(50, True), (50, False)]

Mean Squared Error: 1.790784197760966e-07

Mean Absolute Error: 0.0003143410729808806

R-squared Score: 0.8821703673826711

Training with configuration: [(50, True), (50, True), (50, False)]

Mean Squared Error: 2.6620943927163746e-07

Mean Absolute Error: 0.0003982072564248779

R-squared Score: 0.8248400869972994

Training with configuration: [(100, True), (50, False)]

Mean Squared Error: 4.346194233536401e-07

Mean Absolute Error: 0.0005750992104145197

R-squared Score: 0.7140300487007625

**Processing data for GME...**

Best GME configuration: [(50, False)] w/ MSE: 0.0016 & r^2: 0.7504

Raw stock data:

Open High Low Close Adj Close Volume

Date

2021-01-04 4.7500 4.7750 4.2875 4.3125 4.3125 40090000

2021-01-05 4.3375 4.5200 4.3075 4.3425 4.3425 19846000

2021-01-06 4.3350 4.7450 4.3325 4.5900 4.5900 24224800

2021-01-07 4.6175 4.8625 4.5050 4.5200 4.5200 24517200

2021-01-08 4.5450 4.5750 4.2700 4.4225 4.4225 25928000

Preprocessed stock data:

Open High Low Close Adj Close Volume ... lower\_band MACD MACD\_Signal MACD\_Histogram Stoch\_K Stoch\_D

Date ...

2021-03-16 50.790001 55.174999 43.087502 52.042500 52.042500 141691600 ... -2.628467 5.694533 4.602103 3.529175 0.258426 0.771927

2021-03-17 54.459999 57.867500 51.000000 52.452499 52.452499 65926400 ... -2.344292 5.428476 4.821950 2.266051 0.281183 0.434359

2021-03-18 53.500000 54.720001 48.912498 50.437500 50.437500 47059600 ... -1.985387 5.073818 4.923096 1.066960 0.054878 0.212936

2021-03-19 48.932499 56.750000 45.665001 50.067501 50.067501 98709200 ... -1.572635 4.722771 4.930044 0.115371 -0.079252 0.090720

2021-03-22 51.314999 52.590000 46.549999 48.622501 48.622501 40246000 ... -1.130565 4.333472 4.853572 -0.727322 -0.177628 -0.075338

[5 rows x 19 columns]

Training with configuration: [(50, False)]

Mean Squared Error: 1.2600438138100005e-06

Mean Absolute Error: 0.0005571417143386539

R-squared Score: 0.5097615785065335

Training with configuration: [(50, True), (50, False)]

Mean Squared Error: 1.2754795534191877e-06

Mean Absolute Error: 0.0005107050028347079

R-squared Score: 0.5037560789059194

Training with configuration: [(50, True), (50, True), (50, False)]

Mean Squared Error: 1.549811567599981e-06

Mean Absolute Error: 0.0006550622959055027

R-squared Score: 0.39702320809370284

Training with configuration: [(100, True), (50, False)]

Mean Squared Error: 9.62032441825052e-07

Mean Absolute Error: 0.00039337829495010454

R-squared Score: 0.6257072487981484

**RANDOM FOREST REGRESSOR:**

**Processing data for AAPL...**

Raw data (AAPL):

Date Open High Low Close Adj Close Volume

2021-01-04 133.520004 133.610001 126.760002 129.410004 126.830063 143301900

2021-01-05 128.889999 131.740005 128.429993 131.009995 128.398178 97664900

2021-01-06 127.720001 131.050003 126.379997 126.599998 124.076088 155088000

2021-01-07 128.360001 131.630005 127.860001 130.919998 128.309967 109578200

2021-01-08 132.429993 132.630005 130.229996 132.050003 129.417450 105158200

Pre-processed data (AAPL):

Date Open High Low Close Adj Close Volume ... lower\_band MACD MACD\_Signal MACD\_Histogram Stoch\_K Stoch\_D ...

2021-03-16 125.699997 127.220001 124.720001 125.570000 123.250526 115227900 ... -1.816902 -1.042678 -1.287003 0.499891 0.586344 0.075332

2021-03-17 124.050003 125.860001 122.339996 124.760002 122.455475 111932600 ... -1.796313 -0.933439 -1.226754 0.671565 0.381392 0.410221

2021-03-18 122.879997 123.180000 120.320000 120.529999 118.303627 121229700 ... -1.793278 -0.957060 -1.183632 0.465777 -0.688914 0.099573

2021-03-19 119.900002 121.430000 119.680000 119.989998 117.773598 185549500 ... -1.782108 -0.982024 -1.154500 0.297681 -0.825549 -0.401414

2021-03-22 120.330002 123.870003 120.260002 123.389999 121.110786 111912300 ... -1.777957 -0.898330 -1.113205 0.443824 0.282256 -0.436591

[5 rows x 19 columns]

Call options data (raw):

contractSymbol lastTradeDate strike lastPrice bid ... openInterest impliedVolatility inTheMoney contractSize currency

0 AAPL240712C00100000 2024-07-05 13:30:05+00:00 100.0 122.02 127.00 ... 9 0.000010 True REGULAR USD

1 AAPL240712C00105000 2024-06-25 14:54:30+00:00 105.0 104.97 122.05 ... 1 0.000010 True REGULAR USD

2 AAPL240712C00120000 2024-07-05 15:38:00+00:00 120.0 105.10 107.05 ... 10 0.000010 True REGULAR USD

3 AAPL240712C00125000 2024-07-05 13:30:04+00:00 125.0 97.07 102.05 ... 2 0.000010 True REGULAR USD

4 AAPL240712C00130000 2024-07-08 17:14:06+00:00 130.0 96.72 97.00 ... 11 1.625002 True REGULAR USD

[5 rows x 14 columns]

Put options data (raw):

contractSymbol lastTradeDate strike lastPrice bid ask ... volume openInterest impliedVolatility inTheMoney contractSize currency

0 AAPL240712P00100000 2024-06-10 19:41:22+00:00 100.0 0.01 0.0 0.01 ... NaN 1 2.125005 False REGULAR USD

1 AAPL240712P00110000 2024-06-21 13:50:16+00:00 110.0 0.02 0.0 0.01 ... 10.0 10 1.875001 False REGULAR USD

2 AAPL240712P00115000 2024-07-03 15:17:15+00:00 115.0 0.01 0.0 0.01 ... 5.0 256 1.812501 False REGULAR USD

3 AAPL240712P00120000 2024-06-03 16:47:15+00:00 120.0 0.01 0.0 0.01 ... 2.0 1 1.687502 False REGULAR USD

4 AAPL240712P00125000 2024-06-11 17:12:17+00:00 125.0 0.02 0.0 0.01 ... NaN 5 1.562502 False REGULAR USD

[5 rows x 14 columns]

Call options data (pre-processed):

contractSymbol lastTradeDate strike lastPrice bid ... contractSize currency expiration mid\_price days\_to\_expiration

0 AAPL240712C00100000 2024-07-05 13:30:05+00:00 100.0 122.02 127.00 ... REGULAR USD 2024-07-12 2.489676 0.0

1 AAPL240712C00105000 2024-06-25 14:54:30+00:00 105.0 104.97 122.05 ... REGULAR USD 2024-07-12 2.357538 0.0

2 AAPL240712C00120000 2024-07-05 15:38:00+00:00 120.0 105.10 107.05 ... REGULAR USD 2024-07-12 1.959795 0.0

3 AAPL240712C00125000 2024-07-05 13:30:04+00:00 125.0 97.07 102.05 ... REGULAR USD 2024-07-12 1.826993 0.0

4 AAPL240712C00130000 2024-07-08 17:14:06+00:00 130.0 96.72 97.00 ... REGULAR USD 2024-07-12 1.694191 0.0

[5 rows x 17 columns]

Put options data (pre-processed):

contractSymbol lastTradeDate strike lastPrice bid ... contractSize currency expiration mid\_price days\_to\_expiration

0 AAPL240712P00100000 2024-06-10 19:41:22+00:00 100.0 0.01 0.0 ... REGULAR USD 2024-07-12 -0.364721 0.0

1 AAPL240712P00110000 2024-06-21 13:50:16+00:00 110.0 0.02 0.0 ... REGULAR USD 2024-07-12 -0.364721 0.0

2 AAPL240712P00115000 2024-07-03 15:17:15+00:00 115.0 0.01 0.0 ... REGULAR USD 2024-07-12 -0.364721 0.0

3 AAPL240712P00120000 2024-06-03 16:47:15+00:00 120.0 0.01 0.0 ... REGULAR USD 2024-07-12 -0.364721 0.0

4 AAPL240712P00125000 2024-06-11 17:12:17+00:00 125.0 0.02 0.0 ... REGULAR USD 2024-07-12 -0.364721 0.0

[5 rows x 17 columns]

Summary Statistics for Stock Data:

Open High Low Close Adj Close ... MACD MACD\_Signal MACD\_Histogram Stoch\_K Stoch\_D

count 828.000000 828.000000 828.000000 828.000000 828.000000 ... 8.280000e+02 8.280000e+02 8.280000e+02 8.280000e+02 8.280000e+02

mean 161.679251 163.420520 160.127548 161.838986 160.457495 ... -5.148860e-17 8.581434e-18 4.290717e-17 4.290717e-18 -4.290717e-18

std 20.664674 20.659059 20.637525 20.626393 21.100182 ... 1.000604e+00 1.000604e+00 1.000604e+00 1.000604e+00 1.000604e+00

min 119.540001 120.400002 118.860001 119.900002 117.685287 ... -2.530888e+00 -2.381744e+00 -2.734792e+00 -1.771039e+00 -1.851390e+00

25% 145.817505 147.534996 144.490002 146.130001 144.297745 ... -7.984016e-01 -7.546203e-01 -6.578705e-01 -9.211889e-01 -9.918136e-01

50% 162.300003 164.980003 160.000000 162.915001 161.029648 ... 2.111026e-03 -9.532067e-02 -7.155230e-02 1.307898e-01 1.465384e-01

75% 176.982506 178.995003 175.302502 177.262501 176.216408 ... 8.142489e-01 8.433181e-01 7.364885e-01 8.935355e-01 9.311209e-01

max 217.589996 220.199997 213.000000 216.669998 216.669998 ... 2.632038e+00 2.371289e+00 2.621794e+00 1.381837e+00 1.464678e+00

[8 rows x 19 columns]

Summary Statistics for Call Options Data:

strike lastPrice bid ask change ... openInterest impliedVolatility expiration mid\_price days\_to\_expiration

count 49.000000 49.000000 49.000000 49.000000 49.000000 ... 49.000000 49.000000 49 4.900000e+01 49.0

mean 203.265306 31.603061 33.393265 33.634286 0.536939 ... 3634.061224 0.389317 2024-07-12 00:00:00 -6.344132e-17 0.0

min 100.000000 0.010000 0.000000 0.000000 -0.120000 ... 1.000000 0.000010 2024-07-12 00:00:00 -8.901409e-01 0.0

25% 170.000000 0.120000 0.120000 0.130000 0.000000 ... 46.000000 0.000010 2024-07-12 00:00:00 -8.868208e-01 0.0

50% 207.500000 19.850000 19.850000 20.150000 0.000000 ... 722.000000 0.237312 2024-07-12 00:00:00 -3.589319e-01 0.0

75% 237.500000 56.800000 57.200000 57.550000 0.600000 ... 3958.000000 0.500005 2024-07-12 00:00:00 6.337648e-01 0.0

max 290.000000 122.020000 127.000000 127.500000 12.520004 ... 23168.000000 1.625002 2024-07-12 00:00:00 2.489676e+00 0.0

std 48.926508 35.310999 37.945078 38.135246 1.800268 ... 5966.062770 0.453529 NaN 1.010363e+00 0.0

[8 rows x 12 columns]

Summary Statistics for Put Options Data:

strike lastPrice bid ask change ... openInterest impliedVolatility expiration mid\_price days\_to\_expiration

count 43.000000 43.000000 43.000000 43.000000 43.000000 ... 43.000000 43.000000 43 4.300000e+01 43.0

mean 190.465116 4.779070 3.820465 3.910930 -0.276744 ... 2712.558140 0.749866 2024-07-12 00:00:00 -6.196594e-17 0.0

min 100.000000 0.010000 0.000000 0.010000 -2.850002 ... 0.000000 0.221443 2024-07-12 00:00:00 -3.647212e-01 0.0

25% 157.500000 0.010000 0.000000 0.010000 -0.225000 ... 12.000000 0.339606 2024-07-12 00:00:00 -3.647212e-01 0.0

50% 197.500000 0.030000 0.030000 0.040000 -0.010000 ... 286.000000 0.562504 2024-07-12 00:00:00 -3.618871e-01 0.0

75% 223.750000 0.955000 0.940000 0.960000 0.000000 ... 4527.000000 1.078130 2024-07-12 00:00:00 -2.754468e-01 0.0

max 290.000000 63.450000 62.550000 63.150000 0.000000 ... 16608.000000 2.125005 2024-07-12 00:00:00 5.572264e+00 0.0

std 44.404981 13.074303 10.626479 10.795656 0.553172 ... 4005.515146 0.523672 NaN 1.011835e+00 0.0

[8 rows x 12 columns]

Mean Squared Error: 0.2842524096385542

Mean Absolute Error: 0.5070481927710843

R-squared: -0.13965654008438788

Feature Importance:

Feature Importance

9 RSI 0.095088

8 Daily Return 0.094877

7 Volatility 0.086390

4 Volume 0.080813

17 Stoch\_D 0.076073

13 MACD 0.061811

15 MACD\_Histogram 0.060935

16 Stoch\_K 0.060221

14 MACD\_Signal 0.055377

10 upper\_band 0.049741

6 MA\_50 0.042759

12 lower\_band 0.041022

0 Open 0.038281

1 High 0.038104

5 MA\_10 0.031623

2 Low 0.030900

3 Adj Close 0.030172

11 middle\_band 0.025812

**Processing data for GME...**

Raw data (GME):

Date Open High Low Close Adj Close Volume

2021-01-04 4.7500 4.7750 4.2875 4.3125 4.3125 40090000

2021-01-05 4.3375 4.5200 4.3075 4.3425 4.3425 19846000

2021-01-06 4.3350 4.7450 4.3325 4.5900 4.5900 24224800

2021-01-07 4.6175 4.8625 4.5050 4.5200 4.5200 24517200

2021-01-08 4.5450 4.5750 4.2700 4.4225 4.4225 25928000

Pre-processed data (GME):

Date Open High Low Close Adj Close Volume ... lower\_band MACD MACD\_Signal MACD\_Histogram Stoch\_K Stoch\_D ...

2021-03-16 50.790001 55.174999 43.087502 52.042500 52.042500 141691600 ... -2.628467 5.694533 4.602103 3.529175 0.258426 0.771927

2021-03-17 54.459999 57.867500 51.000000 52.452499 52.452499 65926400 ... -2.344292 5.428476 4.821950 2.266051 0.281183 0.434359

2021-03-18 53.500000 54.720001 48.912498 50.437500 50.437500 47059600 ... -1.985387 5.073818 4.923096 1.066960 0.054878 0.212936

2021-03-19 48.932499 56.750000 45.665001 50.067501 50.067501 98709200 ... -1.572635 4.722771 4.930044 0.115371 -0.079252 0.090720

2021-03-22 51.314999 52.590000 46.549999 48.622501 48.622501 40246000 ... -1.130565 4.333472 4.853572 -0.727322 -0.177628 -0.075338

[5 rows x 19 columns]

Call options data (raw):

contractSymbol lastTradeDate strike lastPrice bid ... openInterest impliedVolatility inTheMoney contractSize currency

0 GME240712C00005000 2024-07-08 19:04:23+00:00 5.0 19.40 19.15 ... 17 9.335942 True REGULAR USD

1 GME240712C00009000 2024-06-26 17:22:43+00:00 9.0 15.53 15.20 ... 20 6.046877 True REGULAR USD

2 GME240712C00010000 2024-07-08 19:01:56+00:00 10.0 14.55 14.20 ... 166 0.500005 True REGULAR USD

3 GME240712C00011000 2024-07-05 13:40:59+00:00 11.0 12.86 13.25 ... 7 4.968754 True REGULAR USD

4 GME240712C00012000 2024-07-08 17:19:35+00:00 12.0 12.72 12.25 ... 12 4.503911 True REGULAR USD

[5 rows x 14 columns]

Put options data (raw):

contractSymbol lastTradeDate strike lastPrice bid ask ... volume openInterest impliedVolatility inTheMoney contractSize currency

0 GME240712P00005000 2024-07-08 14:47:44+00:00 5.0 0.01 0.01 0.02 ... 1198.0 1081 5.500003 False REGULAR USD

1 GME240712P00009000 2024-06-28 19:24:41+00:00 9.0 0.01 0.00 0.01 ... 10.0 114 3.125002 False REGULAR USD

2 GME240712P00010000 2024-07-08 19:20:16+00:00 10.0 0.01 0.00 0.01 ... 1.0 6865 2.875003 False REGULAR USD

3 GME240712P00011000 2024-07-02 13:33:26+00:00 11.0 0.01 0.00 0.01 ... 1.0 453 2.500004 False REGULAR USD

4 GME240712P00012000 2024-07-08 16:06:29+00:00 12.0 0.01 0.00 0.01 ... 21.0 403 2.250004 False REGULAR USD

[5 rows x 14 columns]

Call options data (pre-processed):

contractSymbol lastTradeDate strike lastPrice bid ... contractSize currency expiration mid\_price days\_to\_expiration

0 GME240712C00005000 2024-07-08 19:04:23+00:00 5.0 19.40 19.15 ... REGULAR USD 2024-07-12 3.814550 0.0

1 GME240712C00009000 2024-06-26 17:22:43+00:00 9.0 15.53 15.20 ... REGULAR USD 2024-07-12 2.920295 0.0

2 GME240712C00010000 2024-07-08 19:01:56+00:00 10.0 14.55 14.20 ... REGULAR USD 2024-07-12 2.706574 0.0

3 GME240712C00011000 2024-07-05 13:40:59+00:00 11.0 12.86 13.25 ... REGULAR USD 2024-07-12 2.475980 0.0

4 GME240712C00012000 2024-07-08 17:19:35+00:00 12.0 12.72 12.25 ... REGULAR USD 2024-07-12 2.251010 0.0

[5 rows x 17 columns]

Put options data (pre-processed):

contractSymbol lastTradeDate strike lastPrice bid ... contractSize currency expiration mid\_price days\_to\_expiration

0 GME240712P00005000 2024-07-08 14:47:44+00:00 5.0 0.01 0.01 ... REGULAR USD 2024-07-12 -0.690407 0.0

1 GME240712P00009000 2024-06-28 19:24:41+00:00 9.0 0.01 0.00 ... REGULAR USD 2024-07-12 -0.691098 0.0

2 GME240712P00010000 2024-07-08 19:20:16+00:00 10.0 0.01 0.00 ... REGULAR USD 2024-07-12 -0.691098 0.0

3 GME240712P00011000 2024-07-02 13:33:26+00:00 11.0 0.01 0.00 ... REGULAR USD 2024-07-12 -0.691098 0.0

4 GME240712P00012000 2024-07-08 16:06:29+00:00 12.0 0.01 0.00 ... REGULAR USD 2024-07-12 -0.691098 0.0

[5 rows x 17 columns]

Summary Statistics for Stock Data:

Open High Low Close Adj Close ... MACD MACD\_Signal MACD\_Histogram Stoch\_K Stoch\_D

count 828.000000 828.000000 828.000000 828.000000 828.000000 ... 828.000000 8.280000e+02 8.280000e+02 8.280000e+02 8.280000e+02

mean 28.823659 30.094218 27.633970 28.780990 28.780990 ... 0.000000 -4.290717e-18 2.145359e-17 -5.148860e-17 1.287215e-16

std 12.725347 13.466419 11.983822 12.634722 12.634722 ... 1.000604 1.000604e+00 1.000604e+00 1.000604e+00 1.000604e+00

min 10.000000 10.280000 9.950000 10.010000 10.010000 ... -2.110840 -2.100463e+00 -3.556751e+00 -1.436823e+00 -1.521298e+00

25% 18.635000 19.257500 18.187500 18.572500 18.572500 ... -0.488286 -4.911755e-01 -3.774653e-01 -8.656036e-01 -8.932270e-01

50% 25.302500 26.425000 24.271250 25.139999 25.139999 ... -0.114666 -1.299303e-01 7.452991e-03 -1.266258e-01 -1.207568e-01

75% 38.248749 39.897499 36.591251 38.213749 38.213749 ... 0.409324 4.096203e-01 3.964045e-01 7.988135e-01 8.269954e-01

max 75.779999 86.165001 72.877502 75.639999 75.639999 ... 5.694533 4.930044e+00 4.678323e+00 2.205666e+00 2.256556e+00

[8 rows x 19 columns]

Summary Statistics for Call Options Data:

strike lastPrice bid ask change ... openInterest impliedVolatility expiration mid\_price days\_to\_expiration

count 78.000000 78.000000 78.000000 78.000000 78.000000 ... 78.000000 78.000000 78 7.800000e+01 78.0

mean 35.782051 2.597051 2.503077 2.735256 0.021795 ... 1361.038462 2.261860 2024-07-12 00:00:00 -1.138690e-17 0.0

min 5.000000 0.010000 0.010000 0.020000 -0.600000 ... 7.000000 0.500005 2024-07-12 00:00:00 -5.858587e-01 0.0

25% 21.125000 0.060000 0.040000 0.070000 -0.080000 ... 116.000000 1.223637 2024-07-12 00:00:00 -5.757351e-01 0.0

50% 30.750000 0.190000 0.180000 0.205000 -0.040000 ... 361.500000 2.218754 2024-07-12 00:00:00 -5.459266e-01 0.0

75% 47.750000 3.450000 3.130000 3.725000 0.015000 ... 1107.500000 2.968753 2024-07-12 00:00:00 1.818505e-01 0.0

max 95.000000 19.400000 19.150000 20.000000 0.550000 ... 14464.000000 9.335942 2024-07-12 00:00:00 3.814550e+00 0.0

std 19.776608 4.434300 4.329469 4.619545 0.206188 ... 2681.599191 1.431138 NaN 1.006473e+00 0.0

[8 rows x 12 columns]

Summary Statistics for Put Options Data:

strike lastPrice bid ask change ... openInterest impliedVolatility expiration mid\_price days\_to\_expiration

count 67.000000 67.000000 67.000000 67.000000 67.000000 ... 67.000000 67.000000 67 6.700000e+01 67.0

mean 31.537313 10.003582 9.808657 10.192985 -0.152239 ... 736.522388 1.973869 2024-07-12 00:00:00 5.302558e-17 0.0

min 5.000000 0.010000 0.000000 0.000000 -1.449999 ... 0.000000 0.500005 2024-07-12 00:00:00 -6.914442e-01 0.0

25% 19.750000 0.020000 0.015000 0.030000 -0.325000 ... 13.500000 1.027349 2024-07-12 00:00:00 -6.897157e-01 0.0

50% 28.000000 3.750000 3.600000 3.850000 0.000000 ... 114.000000 1.550783 2024-07-12 00:00:00 -4.339024e-01 0.0

75% 39.500000 14.935000 14.600000 15.400000 0.000000 ... 476.000000 2.570316 2024-07-12 00:00:00 3.456370e-01 0.0

max 95.000000 67.030000 70.000000 70.600000 0.100000 ... 6865.000000 5.710940 2024-07-12 00:00:00 4.169009e+00 0.0

std 17.133680 14.183216 14.448271 14.698505 0.256366 ... 1450.350985 1.271530 NaN 1.007547e+00 0.0

[8 rows x 12 columns]

Mean Squared Error: 0.29062771084337347

Mean Absolute Error: 0.5102409638554216

R-squared: -0.2267979779411764

Feature Importance:

Feature Importance

4 Volume 0.102099

7 Volatility 0.087785

8 Daily Return 0.084198

9 RSI 0.074399

16 Stoch\_K 0.071401

17 Stoch\_D 0.065995

15 MACD\_Histogram 0.065889

14 MACD\_Signal 0.063305

13 MACD 0.058187

12 lower\_band 0.051762

6 MA\_50 0.051605

10 upper\_band 0.036997

11 middle\_band 0.034132

3 Adj Close 0.034046

0 Open 0.033540

1 High 0.033031

5 MA\_10 0.031568

2 Low 0.020061

**RANDOM FOREST CLASSIFIER:**

**Processing data for AAPL...**

Raw data (AAPL):

Date Open High Low Close Adj Close Volume

2021-01-04 133.520004 133.610001 126.760002 129.410004 126.830078 143301900

2021-01-05 128.889999 131.740005 128.429993 131.009995 128.398178 97664900

2021-01-06 127.720001 131.050003 126.379997 126.599998 124.076088 155088000

2021-01-07 128.360001 131.630005 127.860001 130.919998 128.309967 109578200

2021-01-08 132.429993 132.630005 130.229996 132.050003 129.417465 105158200

Pre-processed data (AAPL):

Date Open High Low Close Adj Close Volume ... lower\_band MACD MACD\_Signal MACD\_Histogram Stoch\_K Stoch\_D ...

2021-03-16 125.699997 127.220001 124.720001 125.570000 123.250519 115227900 ... -1.816902 -1.042678 -1.287003 0.499891 0.586344 0.075332

2021-03-17 124.050003 125.860001 122.339996 124.760002 122.455505 111932600 ... -1.796313 -0.933439 -1.226754 0.671565 0.381392 0.410221

2021-03-18 122.879997 123.180000 120.320000 120.529999 118.303612 121229700 ... -1.793278 -0.957060 -1.183632 0.465777 -0.688914 0.099573

2021-03-19 119.900002 121.430000 119.680000 119.989998 117.773598 185549500 ... -1.782108 -0.982024 -1.154500 0.297681 -0.825549 -0.401414

2021-03-22 120.330002 123.870003 120.260002 123.389999 121.110802 111912300 ... -1.777957 -0.898330 -1.113205 0.443824 0.282256 -0.436591

[5 rows x 19 columns]

Pre-processed stock data saved to CSV.

Call options data (raw):

contractSymbol lastTradeDate strike lastPrice bid ... openInterest impliedVolatility inTheMoney contractSize currency

0 AAPL240712C00100000 2024-07-05 13:30:05+00:00 100.0 122.02 126.55 ... 9 3.496095 True REGULAR USD

1 AAPL240712C00105000 2024-06-25 14:54:30+00:00 105.0 104.97 121.35 ... 1 3.105471 True REGULAR USD

2 AAPL240712C00120000 2024-07-05 15:38:00+00:00 120.0 105.10 106.60 ... 10 2.806644 True REGULAR USD

3 AAPL240712C00125000 2024-07-05 13:30:04+00:00 125.0 97.07 101.60 ... 2 2.644535 True REGULAR USD

4 AAPL240712C00130000 2024-07-08 15:01:56+00:00 130.0 95.69 96.40 ... 11 2.339848 True REGULAR USD

[5 rows x 14 columns]

Put options data (raw):

contractSymbol lastTradeDate strike lastPrice bid ask ... volume openInterest impliedVolatility inTheMoney contractSize currency

0 AAPL240712P00100000 2024-06-10 19:41:22+00:00 100.0 0.01 0.0 0.01 ... NaN 1 2.125005 False REGULAR USD

1 AAPL240712P00110000 2024-06-21 13:50:16+00:00 110.0 0.02 0.0 0.01 ... 10.0 10 1.875001 False REGULAR USD

2 AAPL240712P00115000 2024-07-03 15:17:15+00:00 115.0 0.01 0.0 0.01 ... 5.0 256 1.750001 False REGULAR USD

3 AAPL240712P00120000 2024-06-03 16:47:15+00:00 120.0 0.01 0.0 0.01 ... 2.0 1 1.687502 False REGULAR USD

4 AAPL240712P00125000 2024-06-11 17:12:17+00:00 125.0 0.02 0.0 0.01 ... NaN 5 1.562502 False REGULAR USD

[5 rows x 14 columns]

Call options data (pre-processed):

contractSymbol lastTradeDate strike lastPrice bid ... contractSize currency expiration mid\_price days\_to\_expiration

0 AAPL240712C00100000 2024-07-05 13:30:05+00:00 100.0 122.02 126.55 ... REGULAR USD 2024-07-12 2.498060 0.0

1 AAPL240712C00105000 2024-06-25 14:54:30+00:00 105.0 104.97 121.35 ... REGULAR USD 2024-07-12 2.360022 0.0

2 AAPL240712C00120000 2024-07-05 15:38:00+00:00 120.0 105.10 106.60 ... REGULAR USD 2024-07-12 1.965246 0.0

3 AAPL240712C00125000 2024-07-05 13:30:04+00:00 125.0 97.07 101.60 ... REGULAR USD 2024-07-12 1.831876 0.0

4 AAPL240712C00130000 2024-07-08 15:01:56+00:00 130.0 95.69 96.40 ... REGULAR USD 2024-07-12 1.693838 0.0

[5 rows x 17 columns]

Put options data (pre-processed):

contractSymbol lastTradeDate strike lastPrice bid ... contractSize currency expiration mid\_price days\_to\_expiration

0 AAPL240712P00100000 2024-06-10 19:41:22+00:00 100.0 0.01 0.0 ... REGULAR USD 2024-07-12 -0.372104 0.0

1 AAPL240712P00110000 2024-06-21 13:50:16+00:00 110.0 0.02 0.0 ... REGULAR USD 2024-07-12 -0.372104 0.0

2 AAPL240712P00115000 2024-07-03 15:17:15+00:00 115.0 0.01 0.0 ... REGULAR USD 2024-07-12 -0.372104 0.0

3 AAPL240712P00120000 2024-06-03 16:47:15+00:00 120.0 0.01 0.0 ... REGULAR USD 2024-07-12 -0.372104 0.0

4 AAPL240712P00125000 2024-06-11 17:12:17+00:00 125.0 0.02 0.0 ... REGULAR USD 2024-07-12 -0.372104 0.0

[5 rows x 17 columns]

Pre-processed options data saved to CSV.

Summary Statistics for Stock Data:

Open High Low Close Adj Close ... MACD MACD\_Signal MACD\_Histogram Stoch\_K Stoch\_D

count 828.000000 828.000000 828.000000 828.000000 828.000000 ... 8.280000e+02 8.280000e+02 8.280000e+02 8.280000e+02 8.280000e+02

mean 161.679251 163.420520 160.127548 161.838986 160.457495 ... -5.148860e-17 8.581434e-18 4.290717e-17 4.290717e-18 -4.290717e-18

std 20.664674 20.659059 20.637525 20.626393 21.100183 ... 1.000604e+00 1.000604e+00 1.000604e+00 1.000604e+00 1.000604e+00

min 119.540001 120.400002 118.860001 119.900002 117.685272 ... -2.530888e+00 -2.381744e+00 -2.734792e+00 -1.771039e+00 -1.851390e+00

25% 145.817505 147.534996 144.490002 146.130001 144.297749 ... -7.984016e-01 -7.546203e-01 -6.578705e-01 -9.211889e-01 -9.918136e-01

50% 162.300003 164.980003 160.000000 162.915001 161.029663 ... 2.111026e-03 -9.532067e-02 -7.155230e-02 1.307898e-01 1.465384e-01

75% 176.982506 178.995003 175.302502 177.262501 176.216408 ... 8.142489e-01 8.433181e-01 7.364885e-01 8.935355e-01 9.311209e-01

max 217.589996 220.199997 213.000000 216.669998 216.669998 ... 2.632038e+00 2.371289e+00 2.621794e+00 1.381837e+00 1.464678e+00

[8 rows x 19 columns]

Summary Statistics for Call Options Data:

strike lastPrice bid ask change ... openInterest impliedVolatility expiration mid\_price days\_to\_expiration

count 49.000000 49.000000 49.000000 49.000000 49.000000 ... 49.000000 49.000000 49 4.900000e+01 49.0

mean 203.265306 31.378776 33.059796 33.287551 0.312653 ... 3634.061224 0.989462 2024-07-12 00:00:00 -5.664403e-17 0.0

min 100.000000 0.010000 0.000000 0.000000 -0.369999 ... 1.000000 0.235359 2024-07-12 00:00:00 -8.848762e-01 0.0

25% 170.000000 0.140000 0.130000 0.140000 -0.060000 ... 46.000000 0.364020 2024-07-12 00:00:00 -8.812752e-01 0.0

50% 207.500000 18.920000 19.150000 19.600000 0.000000 ... 722.000000 0.631840 2024-07-12 00:00:00 -3.680665e-01 0.0

75% 237.500000 56.730000 56.600000 56.800000 0.100000 ... 3958.000000 1.330081 2024-07-12 00:00:00 6.275424e-01 0.0

max 290.000000 122.020000 126.550000 127.100000 11.490006 ... 23168.000000 3.496095 2024-07-12 00:00:00 2.498060e+00 0.0

std 48.926508 35.311584 37.787344 37.968956 1.654122 ... 5966.062770 0.852815 NaN 1.010363e+00 0.0

[8 rows x 12 columns]

Summary Statistics for Put Options Data:

strike lastPrice bid ask change ... openInterest impliedVolatility expiration mid\_price days\_to\_expiration

count 43.000000 43.000000 43.000000 43.000000 43.000000 ... 43.000000 43.000000 43 43.000000 43.0

mean 190.465116 4.857907 3.936977 4.030698 -0.197907 ... 2712.558140 0.663199 2024-07-12 00:00:00 0.000000 0.0

min 100.000000 0.010000 0.000000 0.010000 -2.850002 ... 0.000000 0.000010 2024-07-12 00:00:00 -0.372104 0.0

25% 157.500000 0.010000 0.000000 0.010000 -0.165000 ... 12.000000 0.214852 2024-07-12 00:00:00 -0.372104 0.0

50% 197.500000 0.040000 0.030000 0.040000 -0.010000 ... 286.000000 0.507817 2024-07-12 00:00:00 -0.369299 0.0

75% 223.750000 1.150000 1.145000 1.160000 0.000000 ... 4527.000000 0.984378 2024-07-12 00:00:00 -0.264789 0.0

max 290.000000 63.450000 63.000000 63.550000 0.000000 ... 16608.000000 2.125005 2024-07-12 00:00:00 5.544962 0.0

std 44.404981 13.089299 10.739464 10.900207 0.482837 ... 4005.515146 0.572878 NaN 1.011835 0.0

[8 rows x 12 columns]

Accuracy: 0.4759036144578313

Classification report:

precision recall f1-score support

0 0.50 0.38 0.43 87

1 0.46 0.58 0.51 79

accuracy 0.48 166

macro avg 0.48 0.48 0.47 166

weighted avg 0.48 0.48 0.47 166

Feature Importance:

Feature Importance

9 RSI 0.070477

7 Volatility 0.069075

4 Volume 0.068340

8 Daily Return 0.064036

17 Stoch\_D 0.062075

10 upper\_band 0.058907

16 Stoch\_K 0.057590

13 MACD 0.054993

1 High 0.051069

12 lower\_band 0.050850

15 MACD\_Histogram 0.050679

5 MA\_10 0.050327

0 Open 0.050272

14 MACD\_Signal 0.049756

2 Low 0.049124

6 MA\_50 0.048931

3 Adj Close 0.047939

11 middle\_band 0.045559

**Processing data for GME...**

Raw data (GME):

Date Open High Low Close Adj Close Volume

2021-01-04 4.7500 4.7750 4.2875 4.3125 4.3125 40090000

2021-01-05 4.3375 4.5200 4.3075 4.3425 4.3425 19846000

2021-01-06 4.3350 4.7450 4.3325 4.5900 4.5900 24224800

2021-01-07 4.6175 4.8625 4.5050 4.5200 4.5200 24517200

2021-01-08 4.5450 4.5750 4.2700 4.4225 4.4225 25928000

Pre-processed data (GME):

Date Open High Low Close Adj Close Volume ... lower\_band MACD MACD\_Signal MACD\_Histogram Stoch\_K Stoch\_D ...

2021-03-16 50.790001 55.174999 43.087502 52.042500 52.042500 141691600 ... -2.628467 5.694533 4.602103 3.529175 0.258426 0.771927

2021-03-17 54.459999 57.867500 51.000000 52.452499 52.452499 65926400 ... -2.344292 5.428476 4.821950 2.266051 0.281183 0.434359

2021-03-18 53.500000 54.720001 48.912498 50.437500 50.437500 47059600 ... -1.985387 5.073818 4.923096 1.066960 0.054878 0.212936

2021-03-19 48.932499 56.750000 45.665001 50.067501 50.067501 98709200 ... -1.572635 4.722771 4.930044 0.115371 -0.079252 0.090720

2021-03-22 51.314999 52.590000 46.549999 48.622501 48.622501 40246000 ... -1.130565 4.333472 4.853572 -0.727322 -0.177628 -0.075338

[5 rows x 19 columns]

Pre-processed stock data saved to CSV.

Call options data (raw):

contractSymbol lastTradeDate strike lastPrice bid ... openInterest impliedVolatility inTheMoney contractSize currency

0 GME240712C00005000 2024-06-27 18:15:16+00:00 5.0 20.00 19.3 ... 17 5.687503 True REGULAR USD

1 GME240712C00009000 2024-06-26 17:22:43+00:00 9.0 15.53 15.3 ... 20 5.921878 True REGULAR USD

2 GME240712C00010000 2024-07-08 15:07:35+00:00 10.0 15.00 14.3 ... 166 5.750003 True REGULAR USD

3 GME240712C00011000 2024-07-05 13:40:59+00:00 11.0 12.86 13.3 ... 7 4.867191 True REGULAR USD

4 GME240712C00012000 2024-07-08 14:55:01+00:00 12.0 12.73 12.3 ... 12 4.414067 True REGULAR USD

[5 rows x 14 columns]

Put options data (raw):

contractSymbol lastTradeDate strike lastPrice bid ask ... volume openInterest impliedVolatility inTheMoney contractSize currency

0 GME240712P00005000 2024-07-08 14:47:44+00:00 5.0 0.01 0.01 0.02 ... 1198.0 1081 5.500003 False REGULAR USD

1 GME240712P00009000 2024-06-28 19:24:41+00:00 9.0 0.01 0.00 0.01 ... 10.0 114 3.125002 False REGULAR USD

2 GME240712P00010000 2024-07-02 16:01:49+00:00 10.0 0.01 0.00 0.01 ... 3.0 6865 2.875003 False REGULAR USD

3 GME240712P00011000 2024-07-02 13:33:26+00:00 11.0 0.01 0.00 0.01 ... 1.0 453 2.500004 False REGULAR USD

4 GME240712P00012000 2024-07-08 16:06:29+00:00 12.0 0.01 0.00 0.01 ... 21.0 403 2.250004 False REGULAR USD

[5 rows x 14 columns]

Call options data (pre-processed):

contractSymbol lastTradeDate strike lastPrice bid ... contractSize currency expiration mid\_price days\_to\_expiration

0 GME240712C00005000 2024-06-27 18:15:16+00:00 5.0 20.00 19.3 ... REGULAR USD 2024-07-12 3.778643 0.0

1 GME240712C00009000 2024-06-26 17:22:43+00:00 9.0 15.53 15.3 ... REGULAR USD 2024-07-12 2.916406 0.0

2 GME240712C00010000 2024-07-08 15:07:35+00:00 10.0 15.00 14.3 ... REGULAR USD 2024-07-12 2.703646 0.0

3 GME240712C00011000 2024-07-05 13:40:59+00:00 11.0 12.86 13.3 ... REGULAR USD 2024-07-12 2.468490 0.0

4 GME240712C00012000 2024-07-08 14:55:01+00:00 12.0 12.73 12.3 ... REGULAR USD 2024-07-12 2.244532 0.0

[5 rows x 17 columns]

Put options data (pre-processed):

contractSymbol lastTradeDate strike lastPrice bid ... contractSize currency expiration mid\_price days\_to\_expiration

0 GME240712P00005000 2024-07-08 14:47:44+00:00 5.0 0.01 0.01 ... REGULAR USD 2024-07-12 -0.689389 0.0

1 GME240712P00009000 2024-06-28 19:24:41+00:00 9.0 0.01 0.00 ... REGULAR USD 2024-07-12 -0.690081 0.0

2 GME240712P00010000 2024-07-02 16:01:49+00:00 10.0 0.01 0.00 ... REGULAR USD 2024-07-12 -0.690081 0.0

3 GME240712P00011000 2024-07-02 13:33:26+00:00 11.0 0.01 0.00 ... REGULAR USD 2024-07-12 -0.690081 0.0

4 GME240712P00012000 2024-07-08 16:06:29+00:00 12.0 0.01 0.00 ... REGULAR USD 2024-07-12 -0.690081 0.0

[5 rows x 17 columns]

Pre-processed options data saved to CSV.

Summary Statistics for Stock Data:

Open High Low Close Adj Close ... MACD MACD\_Signal MACD\_Histogram Stoch\_K Stoch\_D

count 828.000000 828.000000 828.000000 828.000000 828.000000 ... 828.000000 8.280000e+02 8.280000e+02 8.280000e+02 8.280000e+02

mean 28.823659 30.094218 27.633970 28.780990 28.780990 ... 0.000000 -4.290717e-18 2.145359e-17 -5.148860e-17 1.287215e-16

std 12.725347 13.466419 11.983822 12.634722 12.634722 ... 1.000604 1.000604e+00 1.000604e+00 1.000604e+00 1.000604e+00

min 10.000000 10.280000 9.950000 10.010000 10.010000 ... -2.110840 -2.100463e+00 -3.556751e+00 -1.436823e+00 -1.521298e+00

25% 18.635000 19.257500 18.187500 18.572500 18.572500 ... -0.488286 -4.911755e-01 -3.774653e-01 -8.656036e-01 -8.932270e-01

50% 25.302500 26.425000 24.271250 25.139999 25.139999 ... -0.114666 -1.299303e-01 7.452991e-03 -1.266258e-01 -1.207568e-01

75% 38.248749 39.897499 36.591251 38.213749 38.213749 ... 0.409324 4.096203e-01 3.964045e-01 7.988135e-01 8.269954e-01

max 75.779999 86.165001 72.877502 75.639999 75.639999 ... 5.694533 4.930044e+00 4.678323e+00 2.205666e+00 2.256556e+00

[8 rows x 19 columns]

Summary Statistics for Call Options Data:

strike lastPrice bid ask change ... openInterest impliedVolatility expiration mid\_price days\_to\_expiration

count 78.000000 78.000000 78.000000 78.000000 78.000000 ... 78.000000 78.000000 78 7.800000e+01 78.0

mean 35.782051 2.637436 2.540385 2.765385 0.062179 ... 1361.038462 2.306355 2024-07-12 00:00:00 -1.138690e-17 0.0

min 5.000000 0.020000 0.010000 0.020000 -0.310000 ... 7.000000 0.511724 2024-07-12 00:00:00 -5.907751e-01 0.0

25% 21.125000 0.060000 0.040000 0.072500 -0.070000 ... 116.000000 1.339847 2024-07-12 00:00:00 -5.804170e-01 0.0

50% 30.750000 0.200000 0.185000 0.235000 -0.035000 ... 361.500000 2.068364 2024-07-12 00:00:00 -5.499028e-01 0.0

75% 47.750000 3.497500 3.347500 3.775000 0.127500 ... 1107.500000 3.054690 2024-07-12 00:00:00 2.034356e-01 0.0

max 95.000000 20.000000 19.300000 19.750000 0.950000 ... 14464.000000 5.921878 2024-07-12 00:00:00 3.778643e+00 0.0

std 19.776608 4.487604 4.367451 4.622081 0.235613 ... 2681.599191 1.243386 NaN 1.006473e+00 0.0

[8 rows x 12 columns]

Summary Statistics for Put Options Data:

strike lastPrice bid ask change ... openInterest impliedVolatility expiration mid\_price days\_to\_expiration

count 67.000000 67.000000 67.000000 67.000000 67.000000 ... 67.000000 67.000000 67 6.700000e+01 67.0

mean 31.537313 10.003284 9.783731 10.163433 -0.152537 ... 736.522388 1.973126 2024-07-12 00:00:00 -1.325639e-16 0.0

min 5.000000 0.010000 0.000000 0.000000 -1.449999 ... 0.000000 0.500005 2024-07-12 00:00:00 -6.904275e-01 0.0

25% 19.750000 0.025000 0.010000 0.035000 -0.300000 ... 13.500000 1.089848 2024-07-12 00:00:00 -6.886968e-01 0.0

50% 28.000000 3.600000 3.500000 3.950000 0.000000 ... 114.000000 1.707033 2024-07-12 00:00:00 -4.325620e-01 0.0

75% 39.500000 14.915000 14.550000 15.300000 0.000000 ... 476.000000 2.496098 2024-07-12 00:00:00 3.427650e-01 0.0

max 95.000000 67.030000 69.950000 70.700000 0.100000 ... 6865.000000 5.500003 2024-07-12 00:00:00 4.177865e+00 0.0

std 17.133680 14.202693 14.435396 14.674722 0.265435 ... 1450.350985 1.212020 NaN 1.007547e+00 0.0

[8 rows x 12 columns]

Accuracy: 0.4879518072289157

Classification report:

precision recall f1-score support

0 0.59 0.57 0.58 102

1 0.34 0.36 0.35 64

accuracy 0.49 166

macro avg 0.46 0.46 0.46 166

weighted avg 0.49 0.49 0.49 166

Feature Importance:

Feature Importance

7 Volatility 0.068887

4 Volume 0.067339

8 Daily Return 0.065546

16 Stoch\_K 0.064547

14 MACD\_Signal 0.062260

13 MACD 0.060269

17 Stoch\_D 0.059921

9 RSI 0.059625

15 MACD\_Histogram 0.058784

10 upper\_band 0.052435

0 Open 0.050892

12 lower\_band 0.050839

6 MA\_50 0.050533

5 MA\_10 0.048781

1 High 0.047032

11 middle\_band 0.046008

3 Adj Close 0.043408

2 Low 0.042893