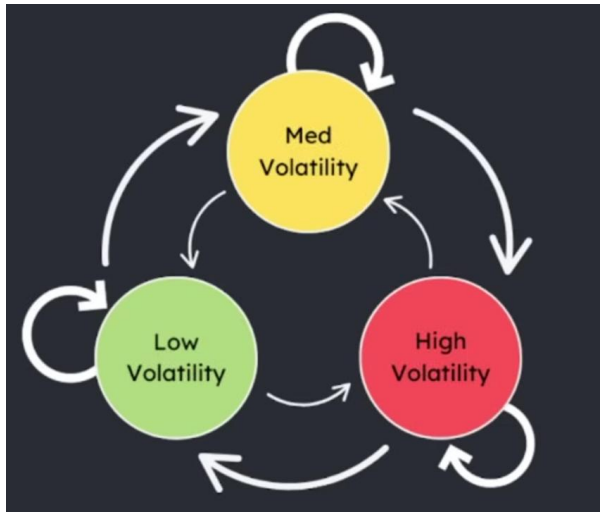
Fall 2025, Daniel S

Volatility-Regime Markov Chain



Returns → States → PTM → Simulation → Price Paths

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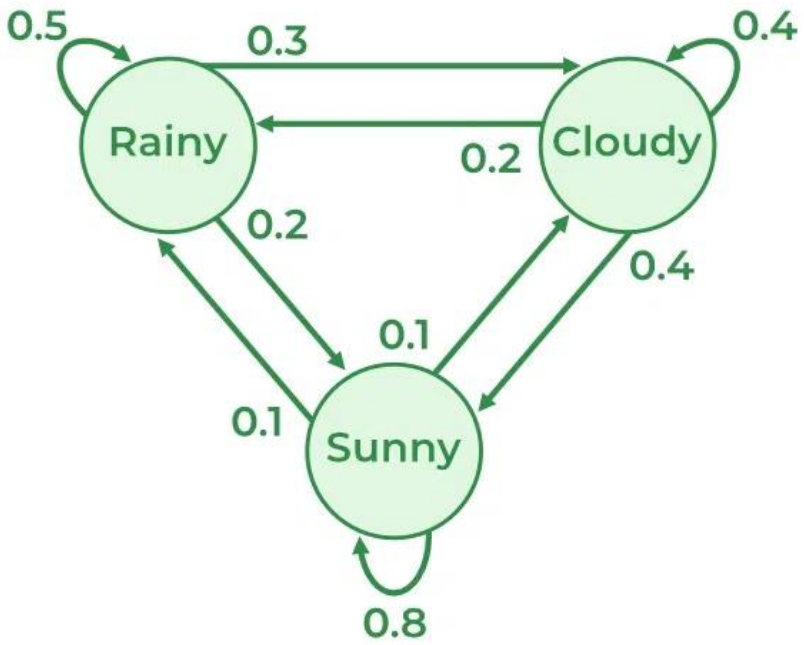
What is a markov chain?



$$P = \begin{array}{c|ccc} & \text{Rainy} & \text{Cloudy} & \text{Sunny} \\ \hline \text{Rainy} & 0.5 & 0.3 & 0.2 \\ \text{Cloudy} & 0.2 & 0.4 & 0.4 \\ \text{Sunny} & 0.1 & 0.1 & 0.8 \end{array}$$

$[\text{Rainy},\ \text{Cloudy},\ \text{Sunny}]$:

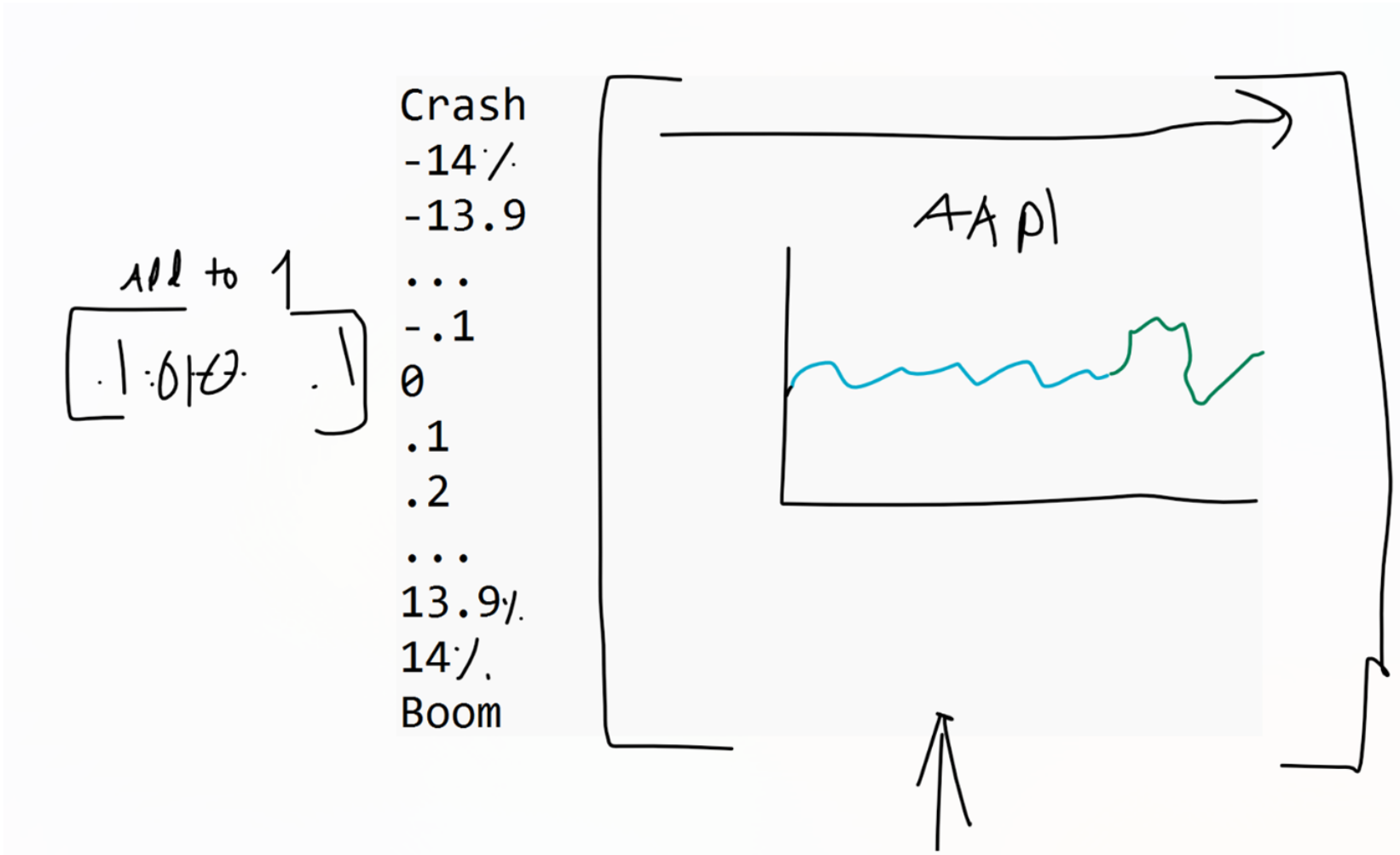
$$\pi_0 = \begin{bmatrix} 0.2 & 0.5 & 0.3 \end{bmatrix}$$

Using the PTM (rows = "from", columns = "to"):

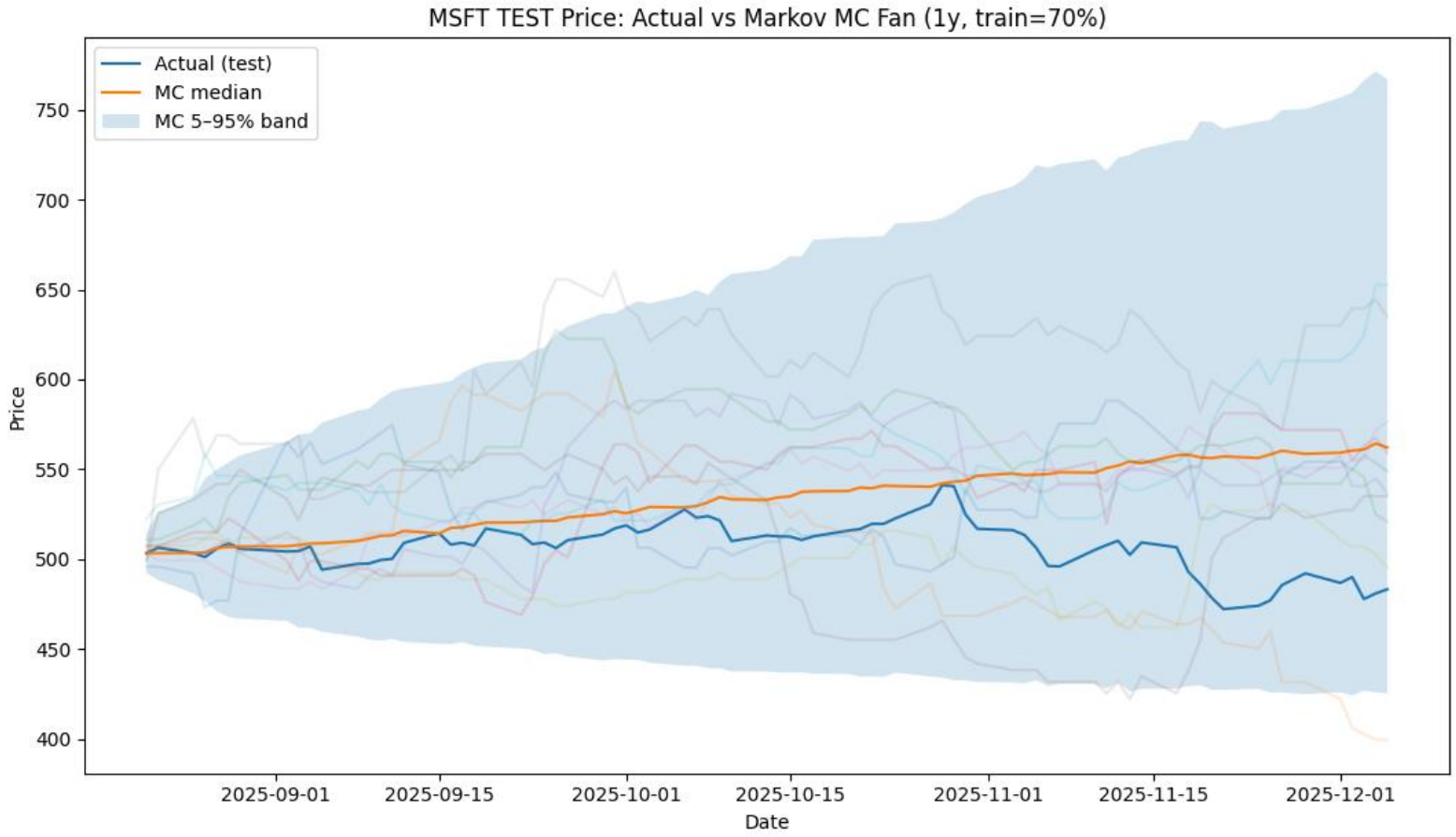
$$P = \begin{bmatrix} 0.5 & 0.3 & 0.2 \\ 0.2 & 0.4 & 0.4 \\ 0.1 & 0.1 & 0.8 \end{bmatrix}$$

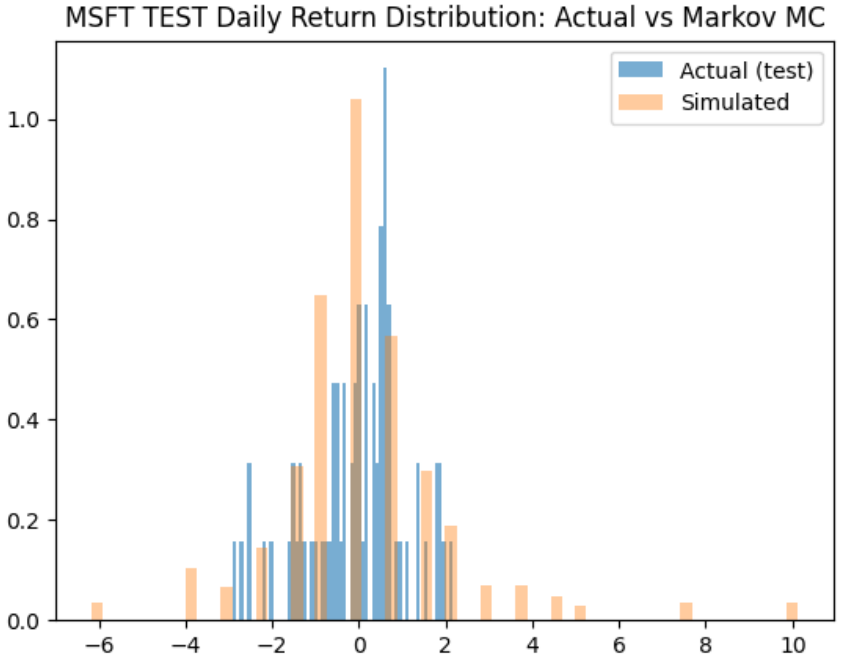
$$\pi_1 = \begin{bmatrix} 0.23 & 0.29 & 0.48 \end{bmatrix}$$

Approach Number 1

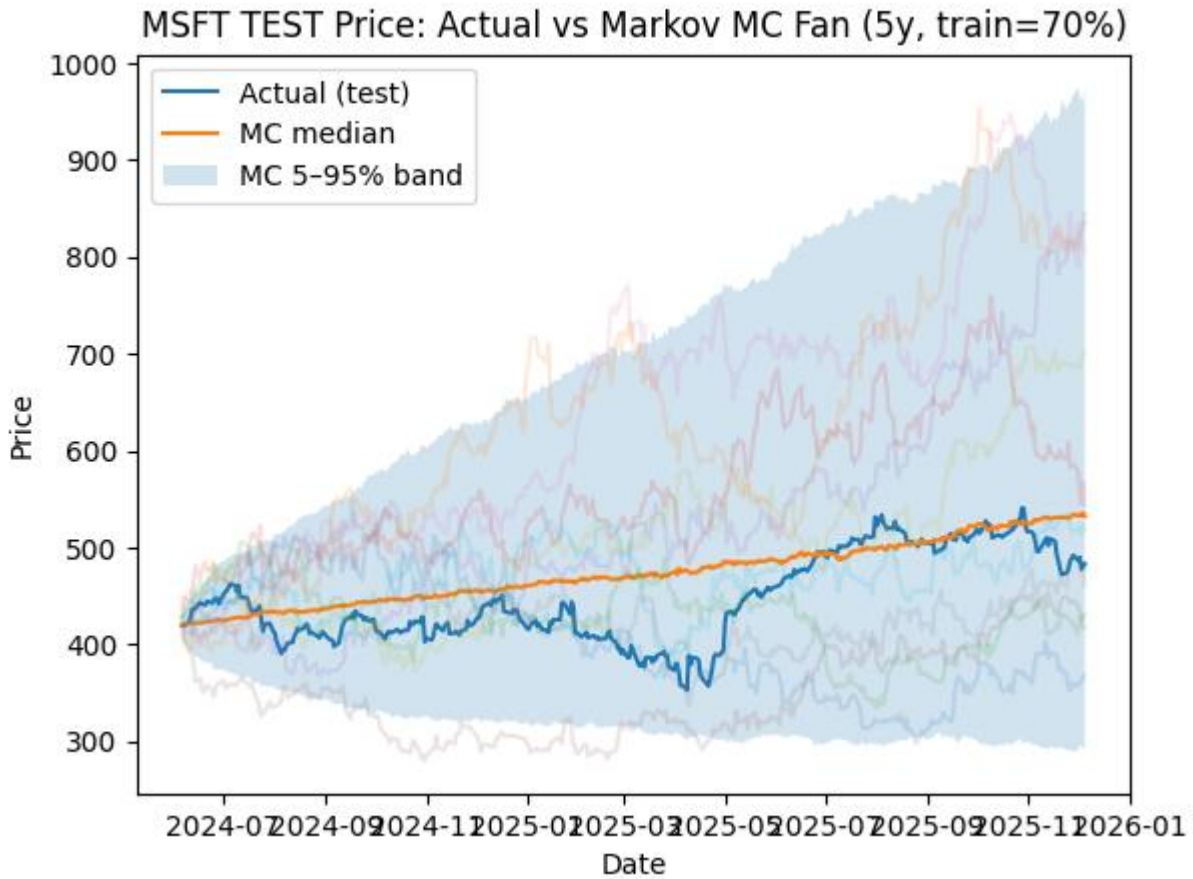


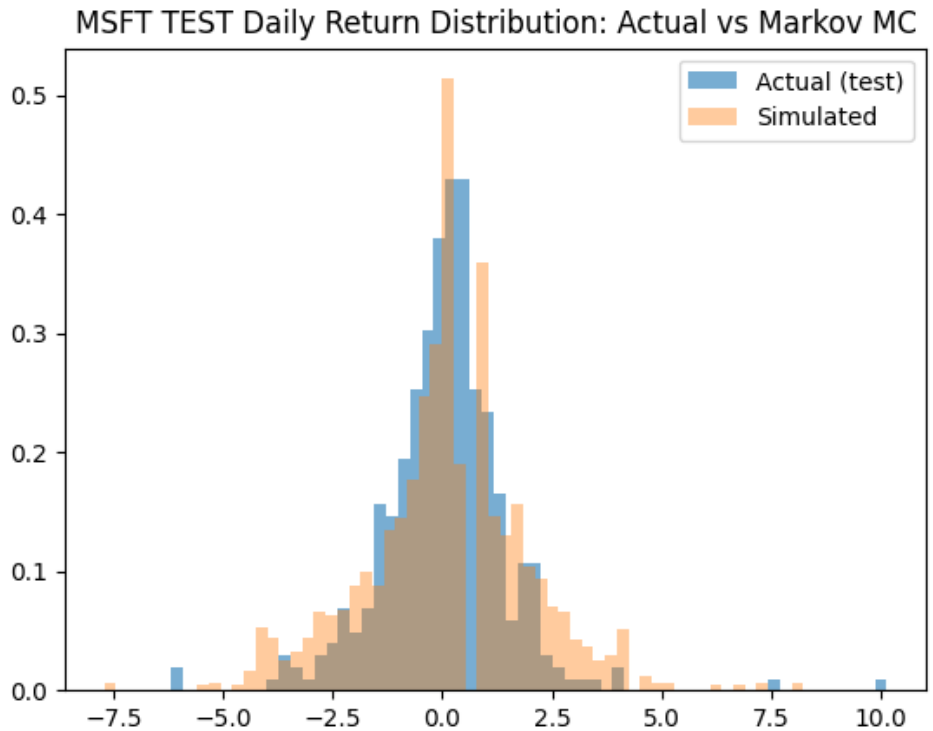
Results 1 Year



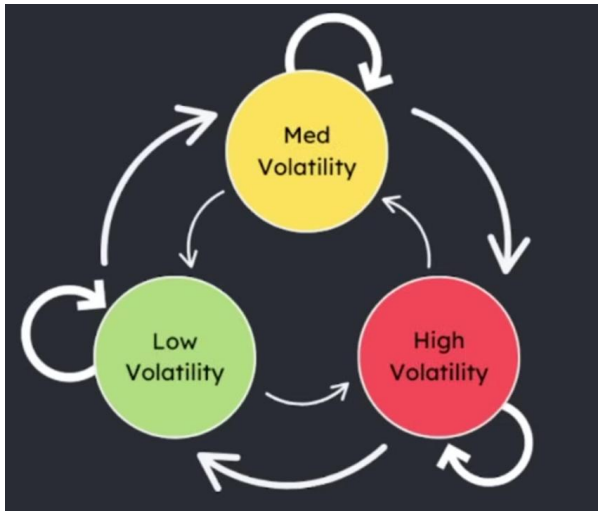


Results 5 Years





Change of Plans lol



current \ next	-0.25|lowvol	0.00|lowvol	0.25|lowvol	crash|lowvol
-0.25|lowvol	18.00	55.00	22.00	5.00
0.00|lowvol	12.00	66.00	20.00	2.00
0.25|lowvol	10.00	52.00	35.00	3.00
crash|lowvol	25.00	50.00	15.00	10.00

5 Years

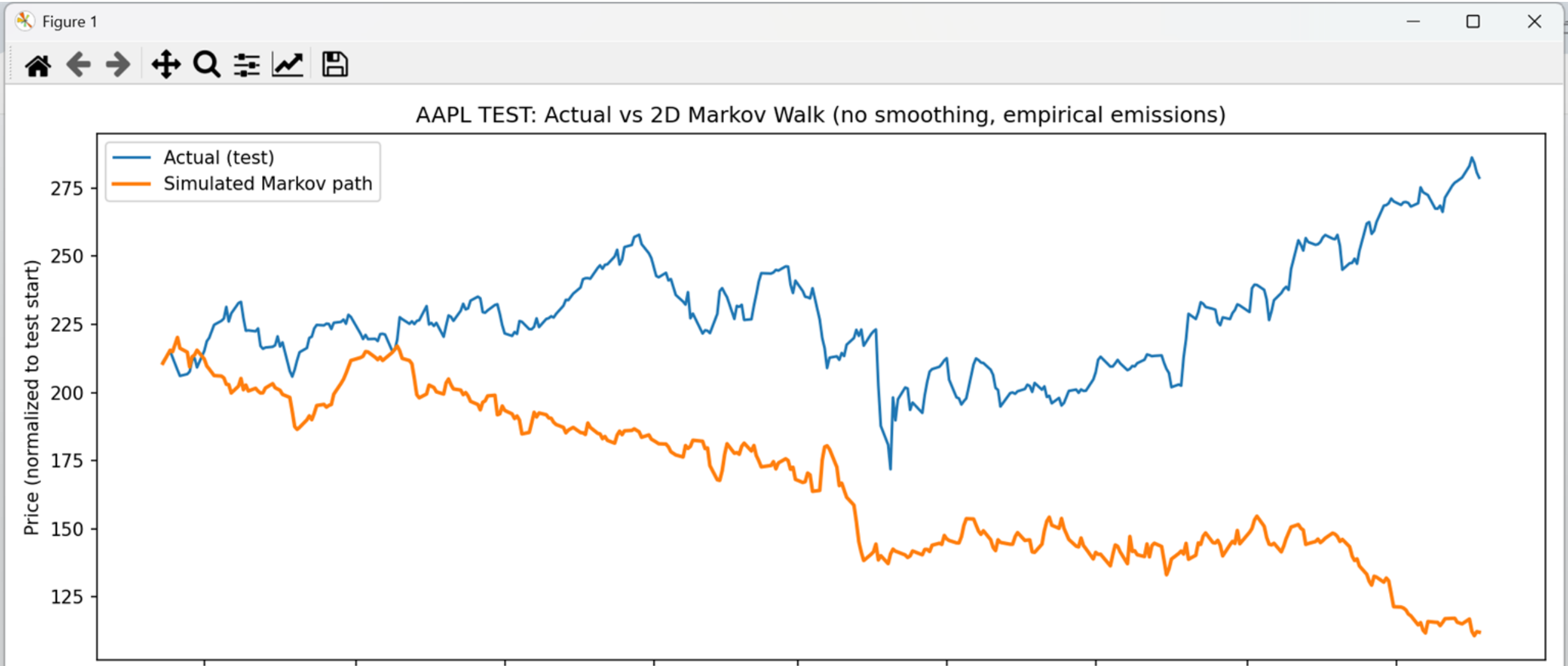


Figure 1
AAPL TEST: Actual vs 2D Markov Walk (no smoothing, empirical emissions)
Actual (test)
Simulated Markov path
Price (normalized to test start)
275
250
225
200
175
150
125

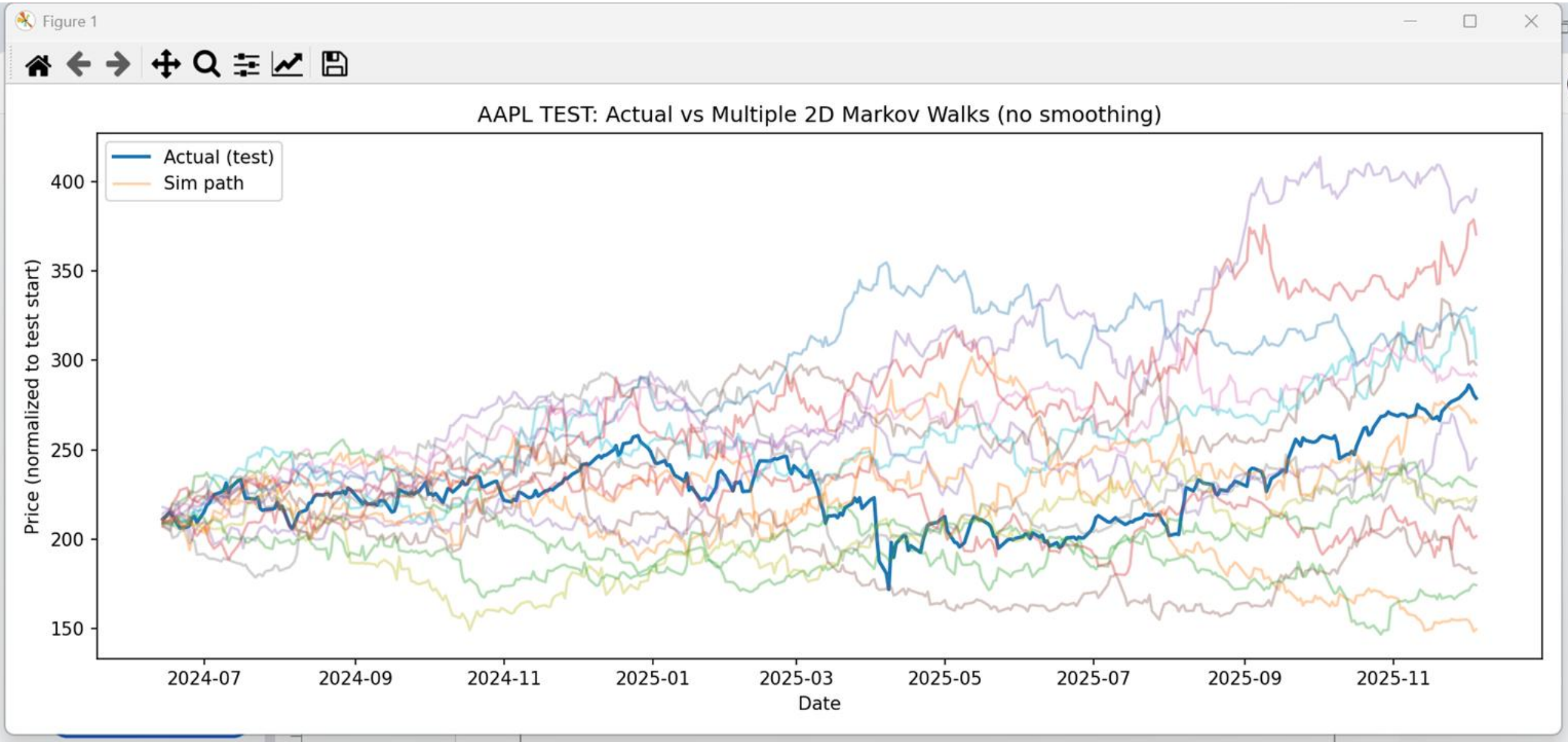


Figure 1
AAPL TEST: Actual vs Multiple 2D Markov Walks (no smoothing)
Actual (test)
Sim path
Price (normalized to test start)
400
350
300
250
200
150
2024-07
2024-09
2024-11
2025-01
2025-03
2025-05
2025-07
2025-09
2025-11
Date

1 Year

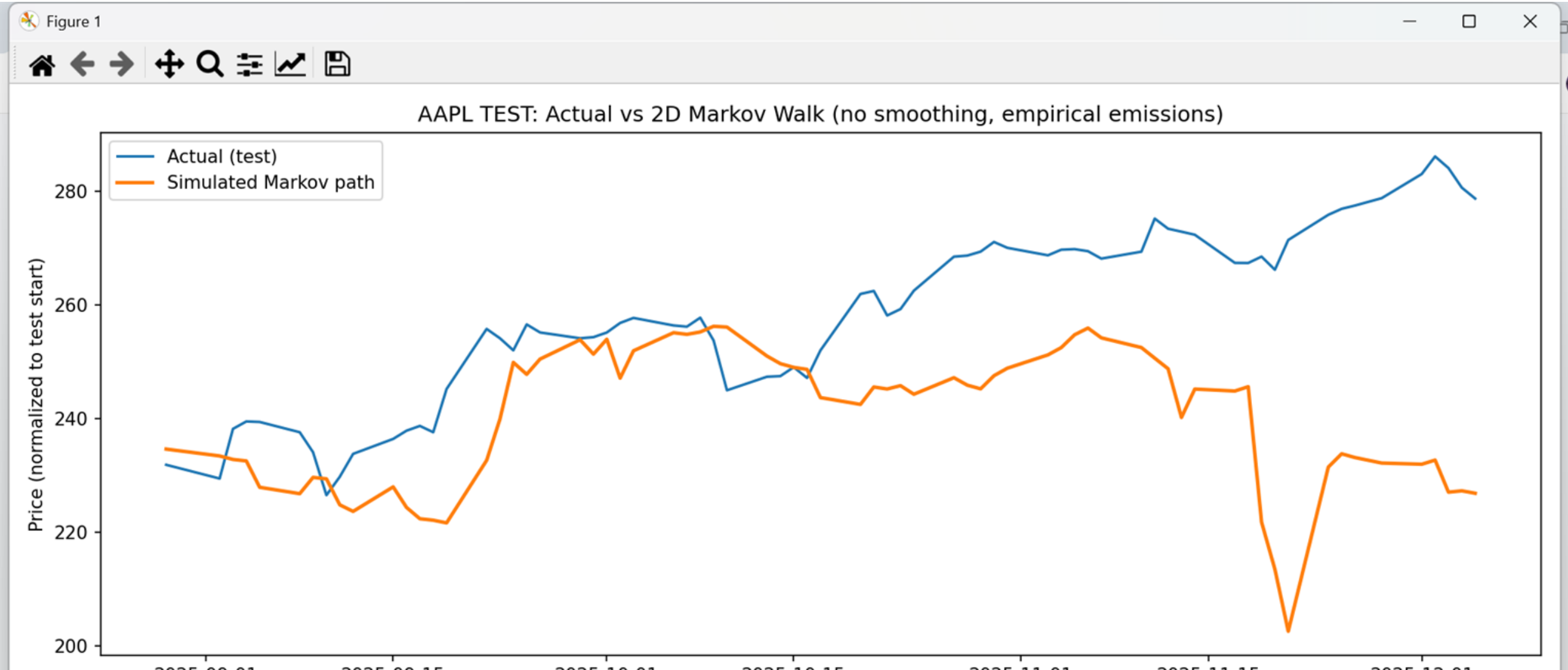


Figure 1
AAPL TEST: Actual vs 2D Markov Walk (no smoothing, empirical emissions)
Actual (test)
Simulated Markov path
Price (normalized to test start)
280
260
240
220
200

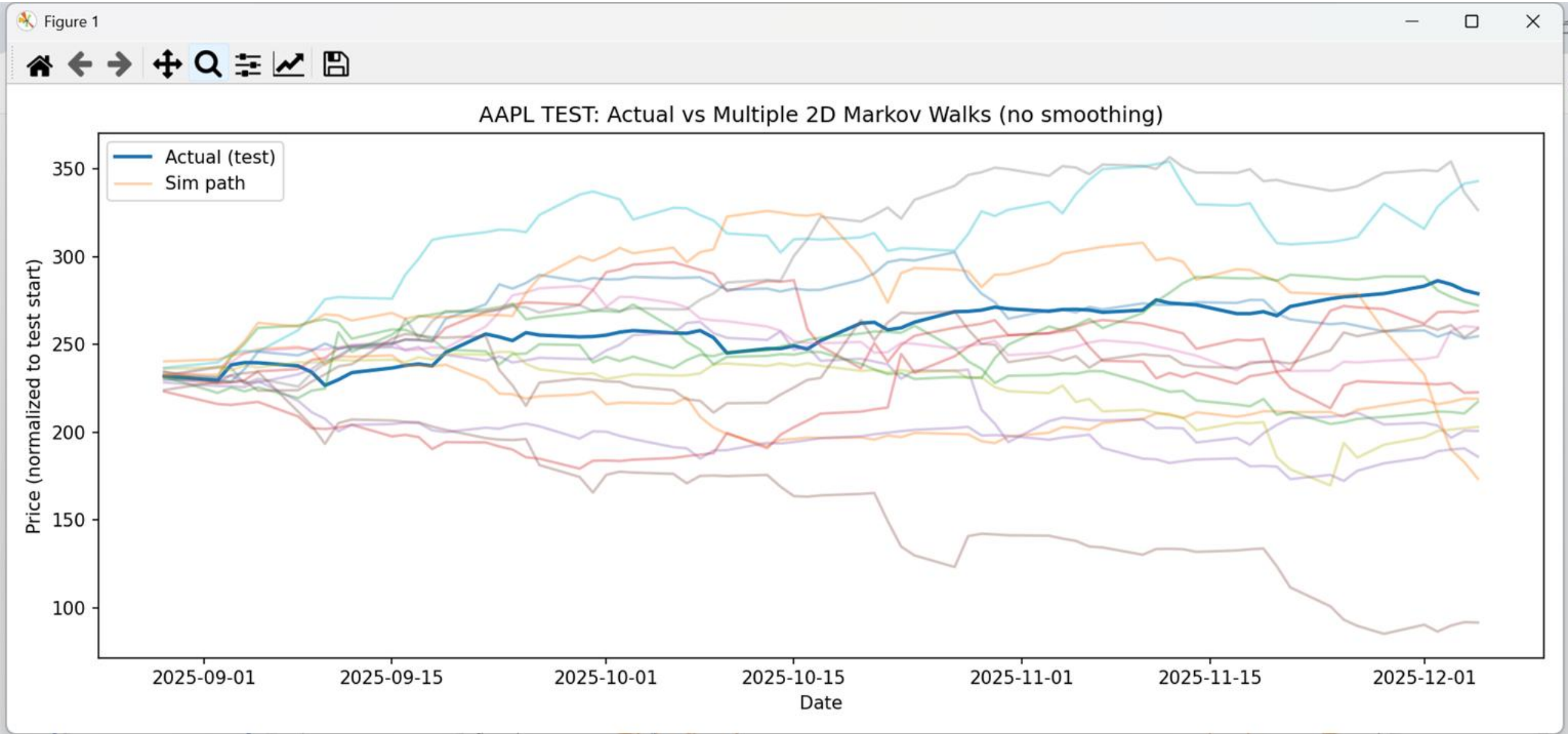


Figure 1
AAPL TEST: Actual vs Multiple 2D Markov Walks (no smoothing)
Actual (test)
Sim path
Price (normalized to test start)
350
300
250
200
150
100
2025-09-01
2025-09-15
2025-10-01
2025-10-15
2025-11-01
2025-11-15
2025-12-01
Date

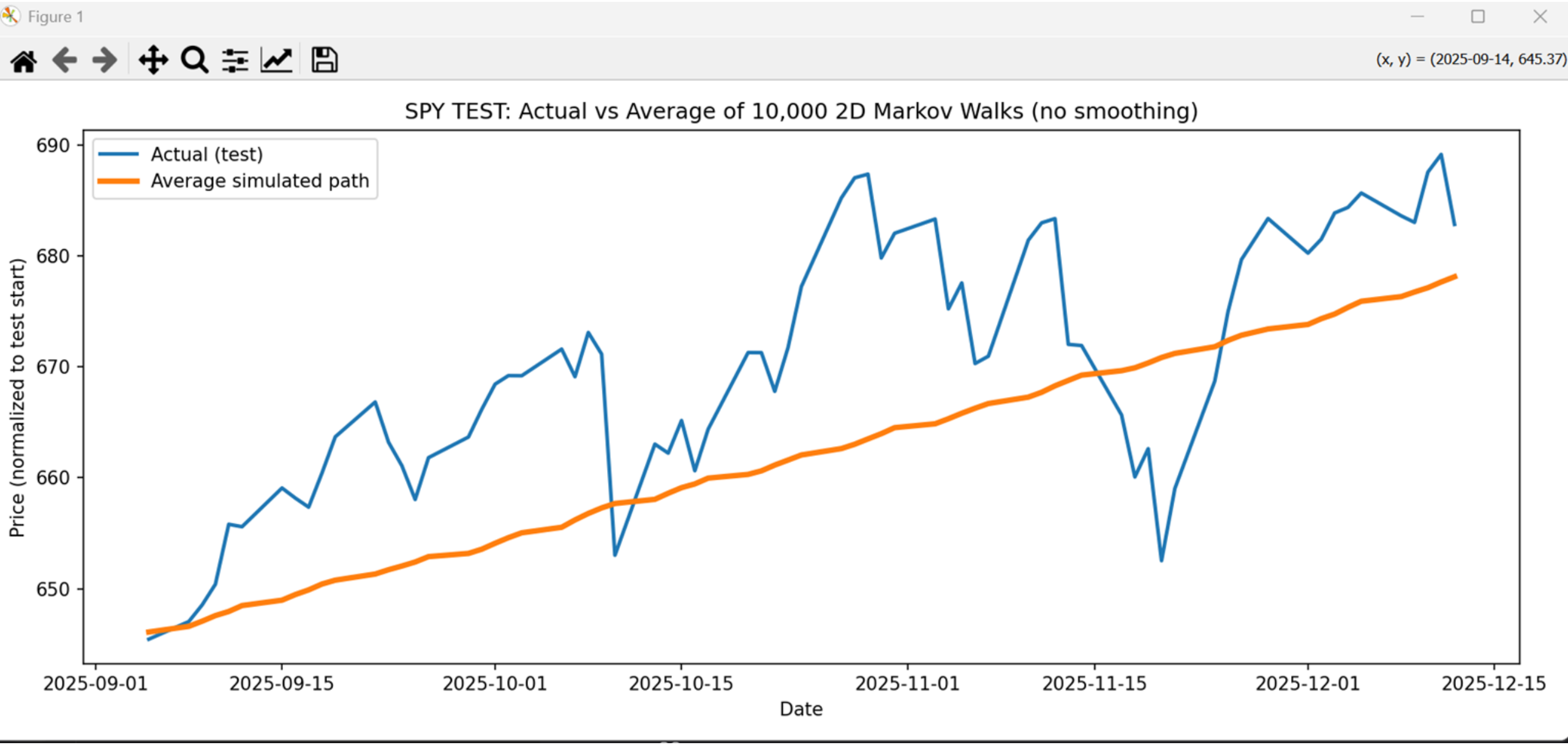


Figure 1
(x, y) = (2025-09-14, 645.37)
SPY TEST: Actual vs Average of 10,000 2D Markov Walks (no smoothing)
Actual (test)
Average simulated path
690
680
670
660
650
Price (normalized to test start)
2025-09-01
2025-09-15
2025-10-01
2025-10-15
2025-11-01
2025-11-15
2025-12-01
2025-12-15
Date

Q&A

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