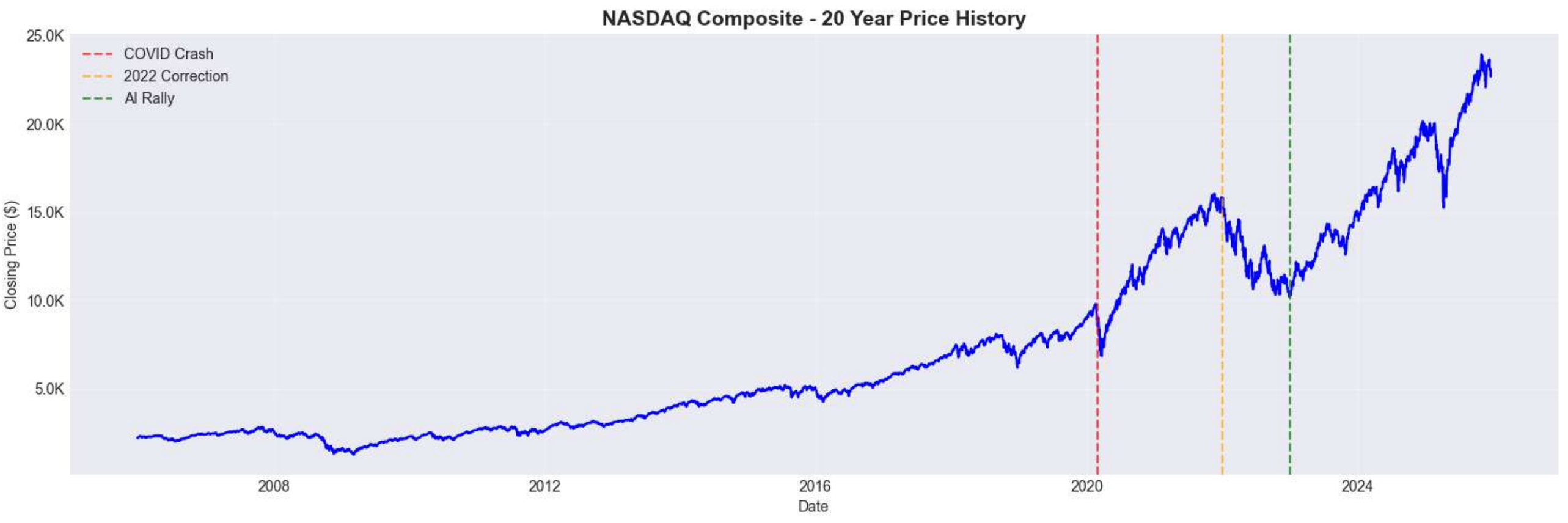
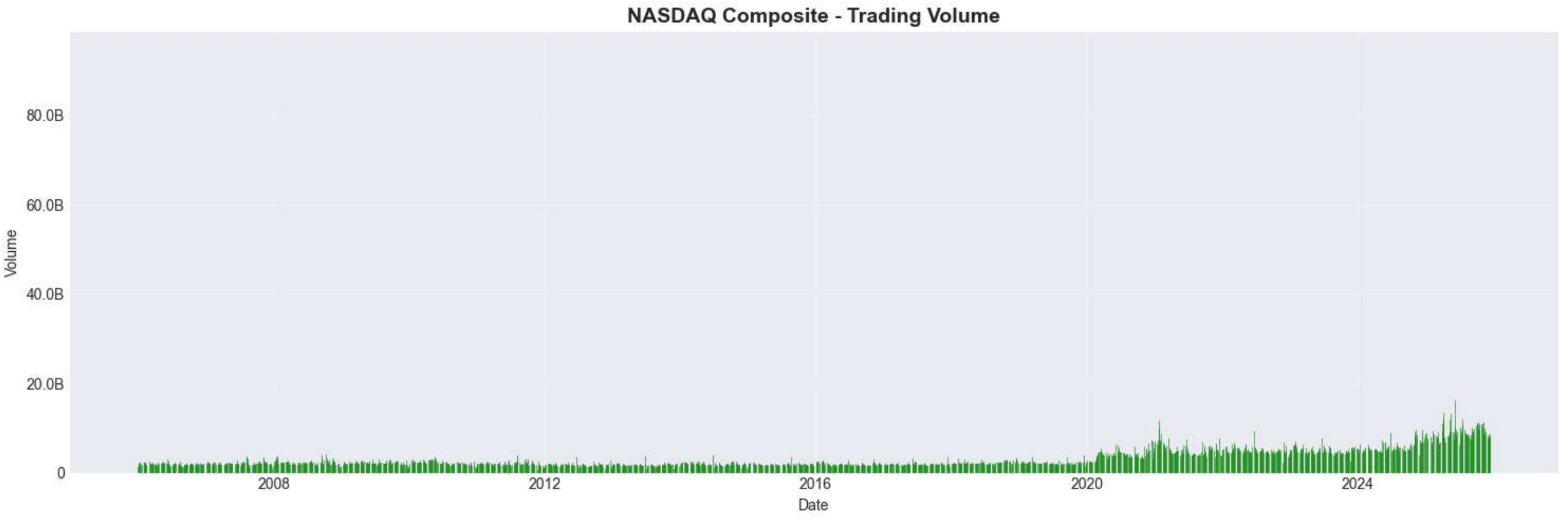
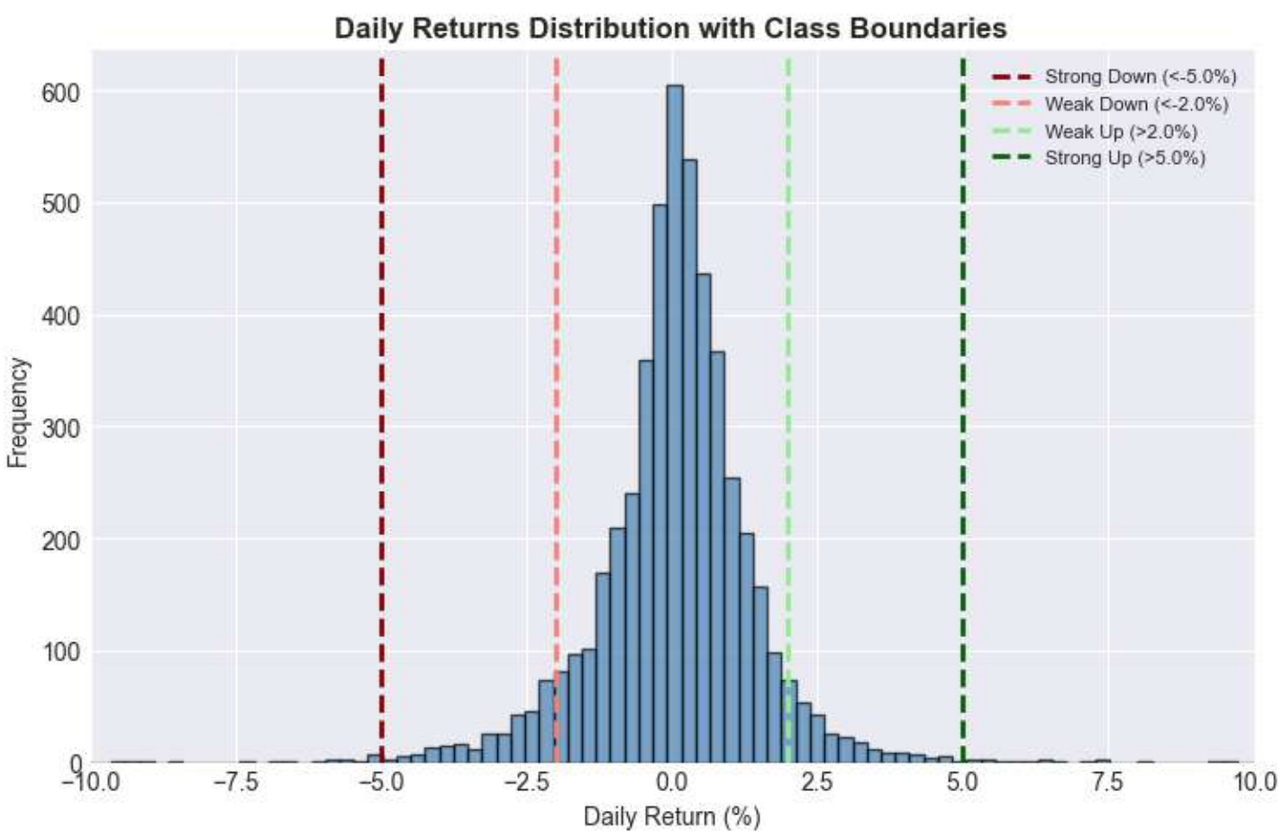
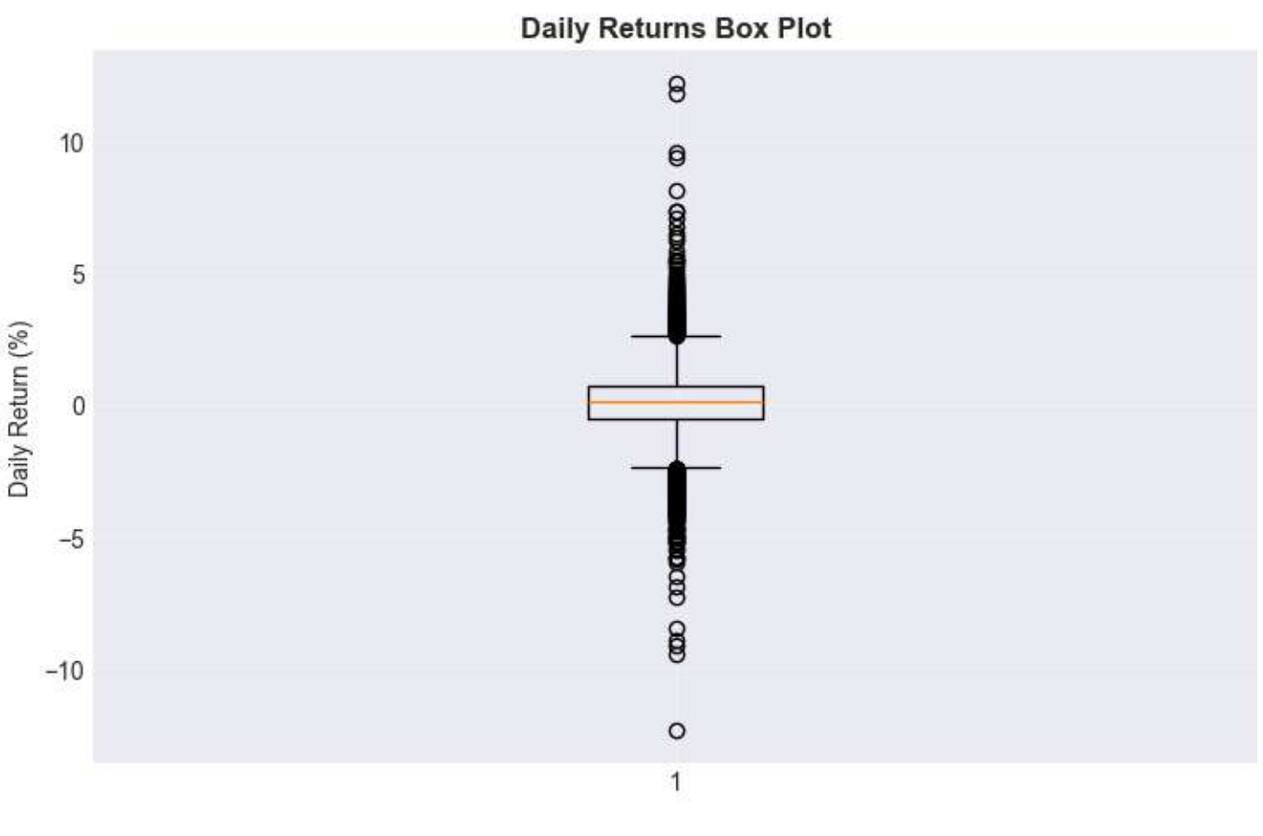
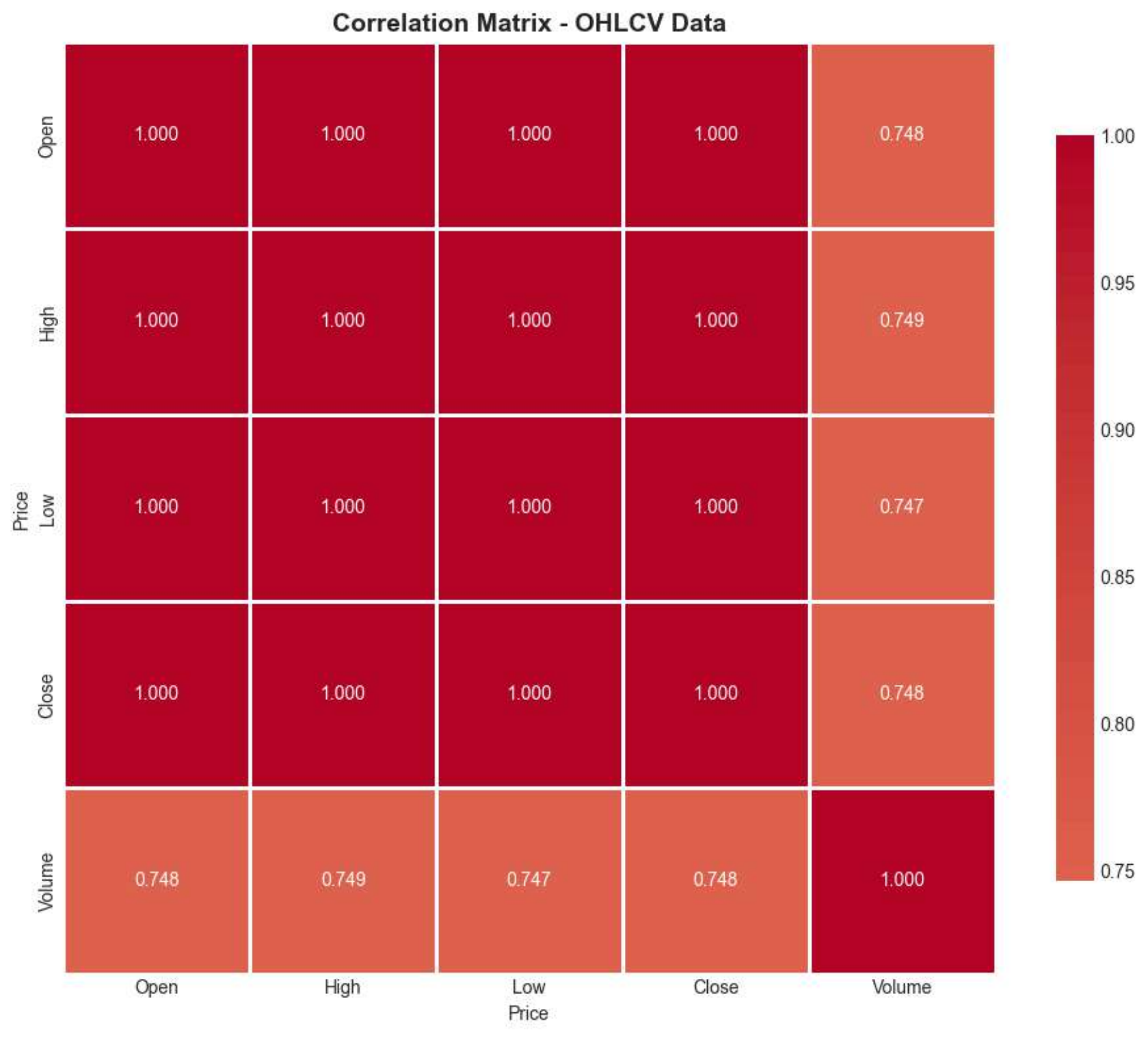
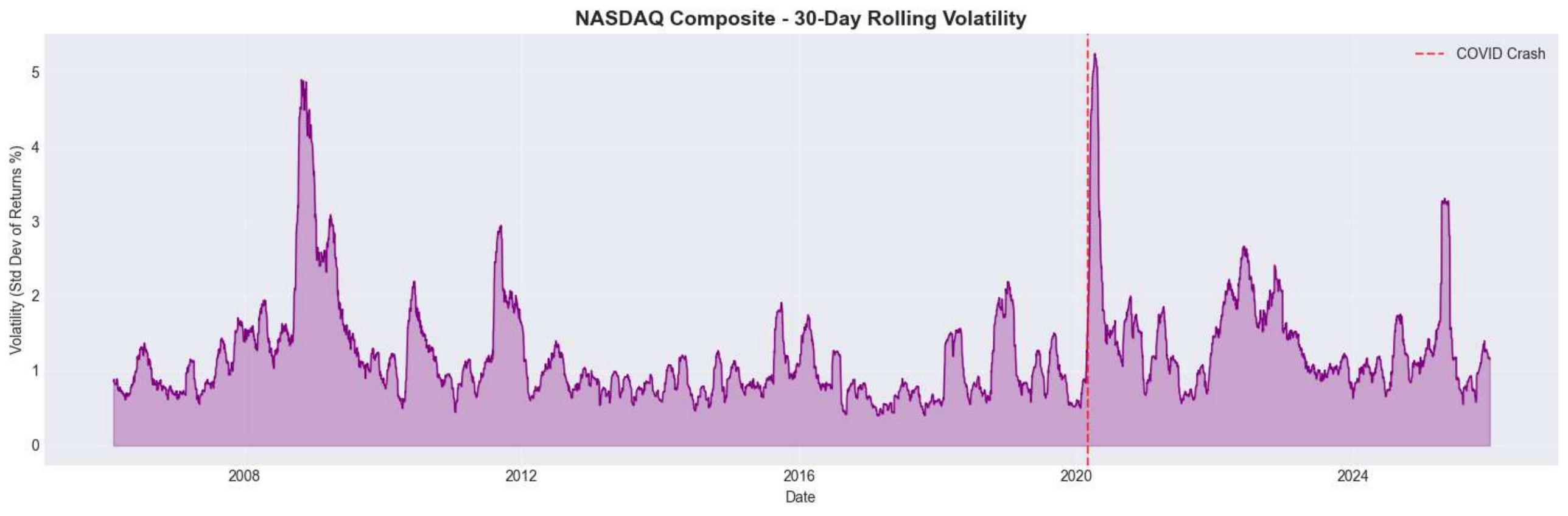

NASDAQ Composite - 20 Year Price History
COVID Crash
2022 Correction
AI Rally
25.0K
20.0K
15.0K
10.0K
5.0K
Closing Price ($)
2008
2012
2016
2020
2024
Date

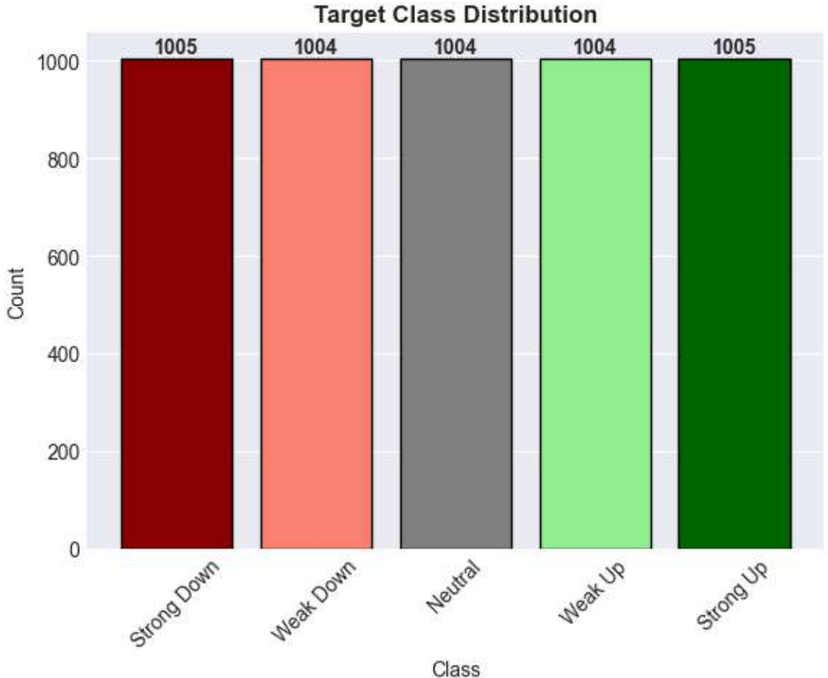

NASDAQ Composite - Trading Volume
80.0B
60.0B
40.0B
20.0B
0
Volume
2008
2012
2016
2020
2024
Date

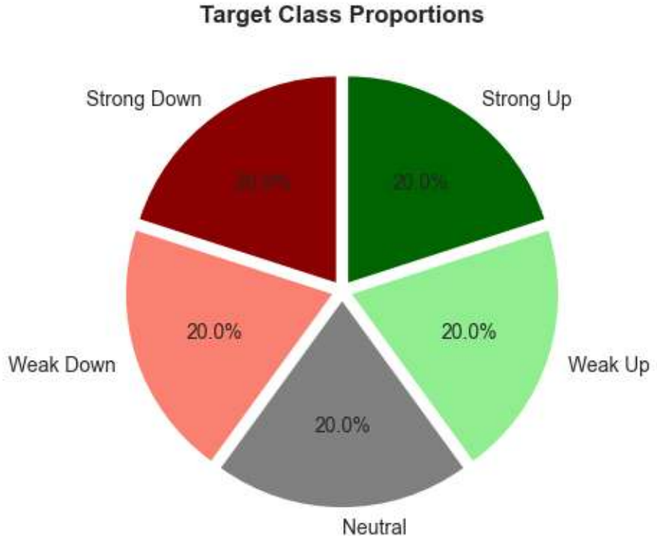

Daily Returns Distribution with Class Boundaries
Strong Down (<-5.0%)
Weak Down (<-2.0%)
Weak Up (>2.0%)
Strong Up (>5.0%)
Frequency
Daily Return (%)
600
500
400
300
200
100
0
−10.0
−7.5
−5.0
−2.5
0.0
2.5
5.0
7.5
10.0

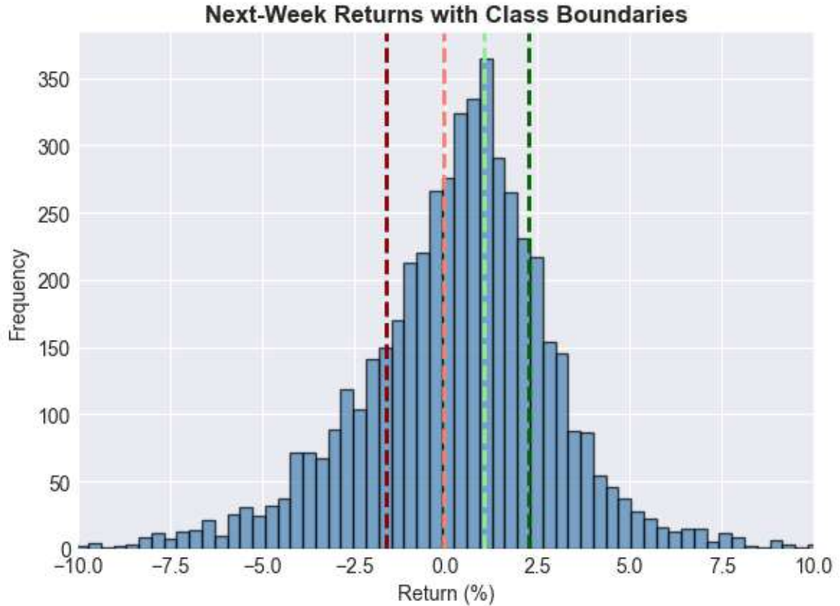

Daily Returns Box Plot
Daily Return (%)
10
5
0
−5
−10
1


Correlation Matrix - OHLCV Data
Open
High
Low
Close
Volume
Price
1.000
1.000
1.000
1.000
0.748
1.000
1.000
1.000
1.000
0.749
1.000
1.000
1.000
1.000
0.747
1.000
1.000
1.000
1.000
0.748
0.748
0.749
0.747
0.748
1.000
Open
High
Low
Close
Volume
Price
1.00
0.95
0.90
0.85
0.80
0.75


NASDAQ Composite - 30-Day Rolling Volatility
COVID Crash
Volatility (Std Dev of Returns %)
0
1
2
3
4
5
2008
2012
2016
2020
2024
Date


Target Class Distribution
1005
1004
1004
1004
1005
1000
800
600
400
200
0
Count
Strong Down
Weak Down
Neutral
Weak Up
Strong Up
Class


Target Class Proportions
Strong Down
Strong Up
20.0%
20.0%
20.0%
20.0%
20.0%
Weak Down
Weak Up
Neutral


Next-Week Returns with Class Boundaries
350
300
250
200
150
100
50
0
Frequency
−10.0
−7.5
−5.0
−2.5
0.0
2.5
5.0
7.5
10.0
Return (%)

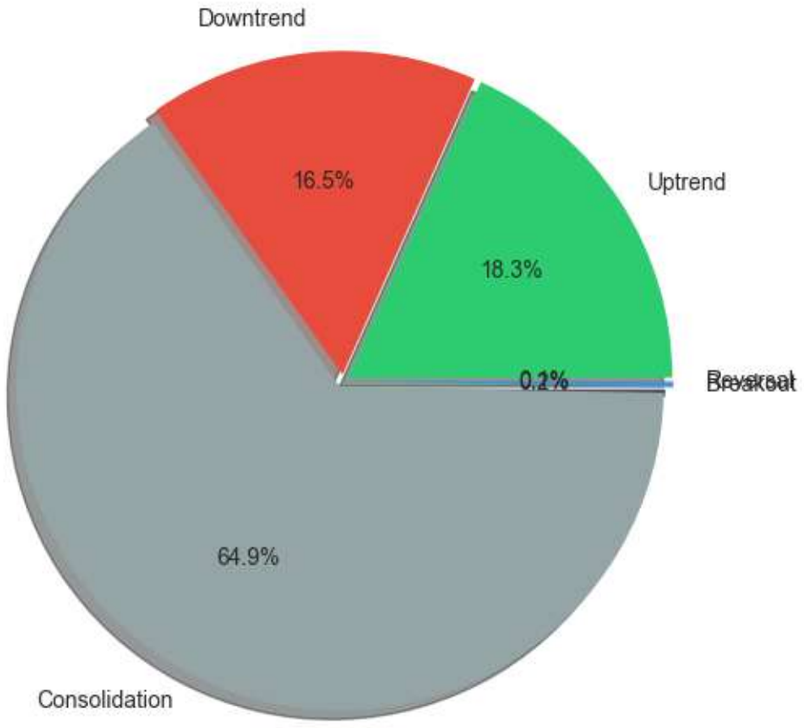
Feature Correlation Matrix (Including Trend Pattern Features)

Open
High
Low
Close
Volume
SMA_10
SMA_20
SMA_50
EMA_10
EMA_20
RSI
MACD
MACD_Signal
MACD_Diff
BB_High
BB_Low
BB_Mid
BB_Width
ATR
OBV
Volume_Surge
Price_Change
Price_Change_Pct
Daily_Return
Lag_1
Lag_2
Lag_3
Lag_4
Lag_5
ADX
Plus_DI
Minus_DI
Trend_Slope
Trend_Slope_Pct
Higher_Highs_Count
Lower_Lows_Count
BB_Width_Pctl

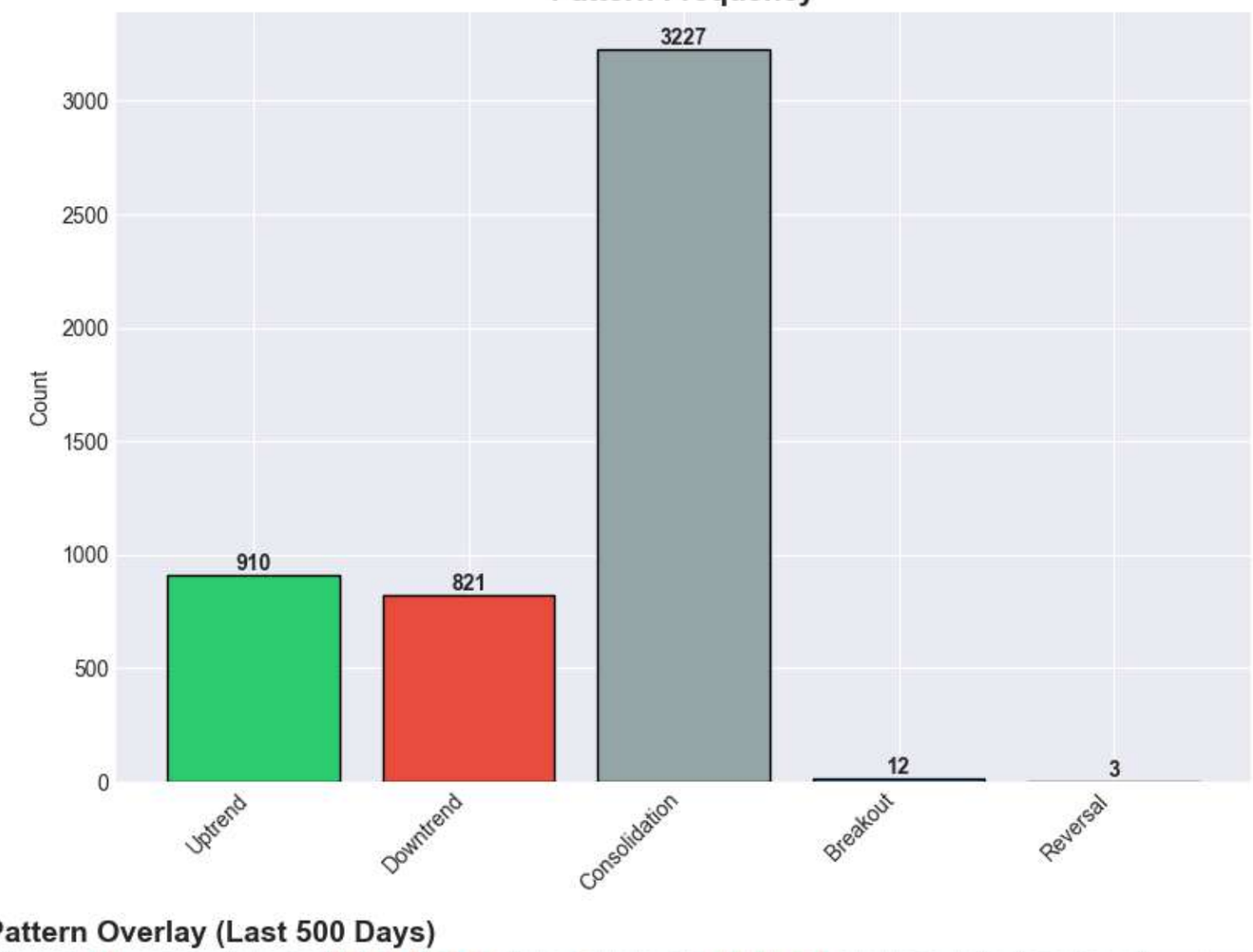
Price

1.00
0.75
0.50
0.25
0.00
−0.25
−0.50
−0.75

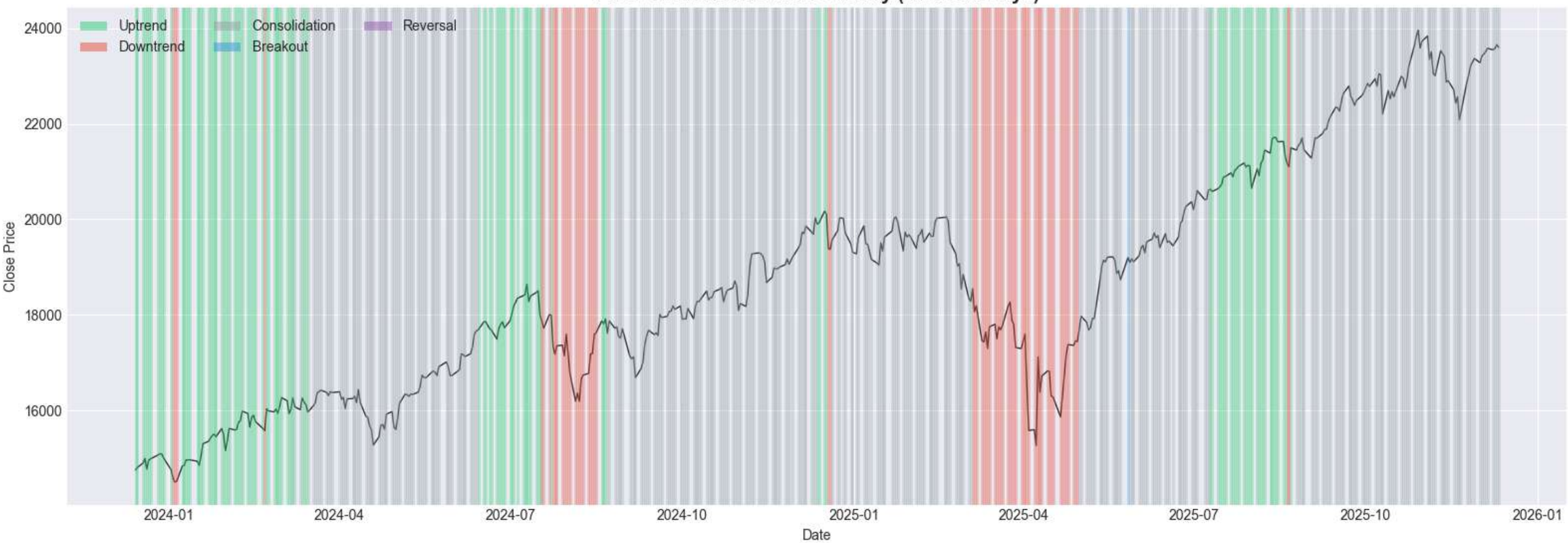
Pattern Distribution

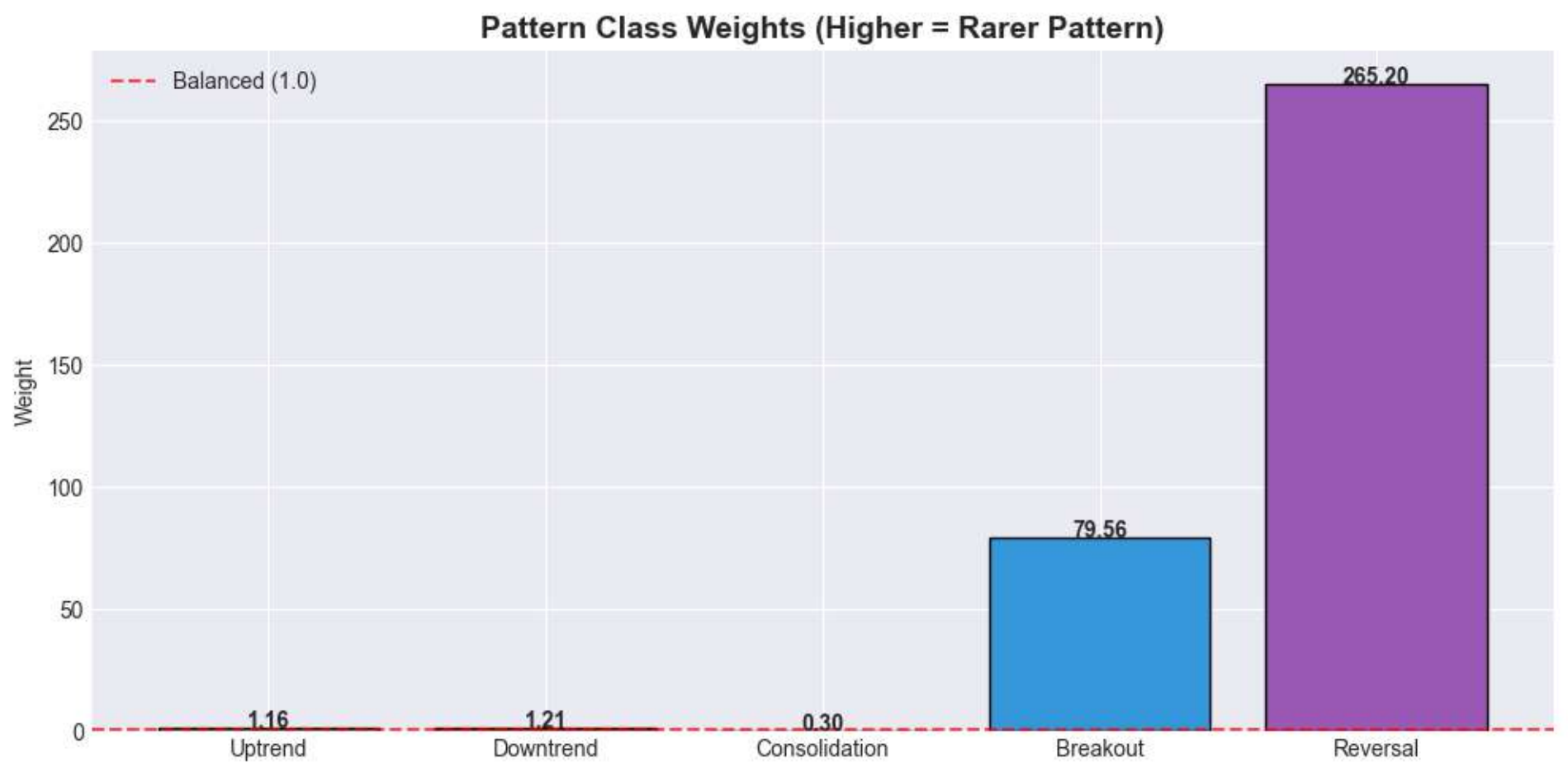


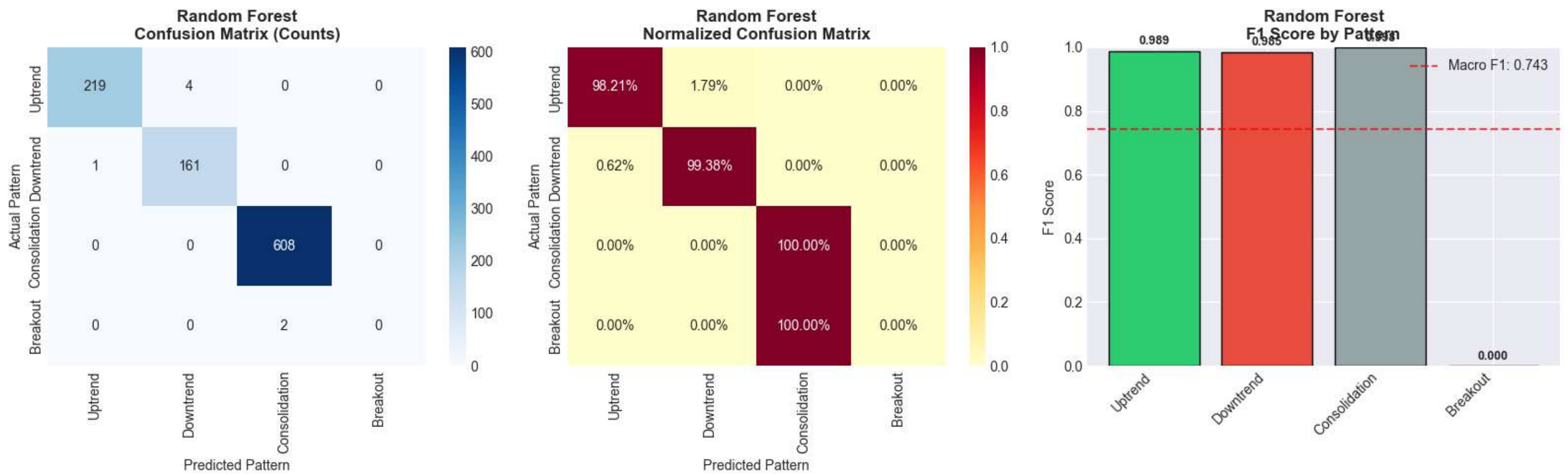
Pattern Frequency

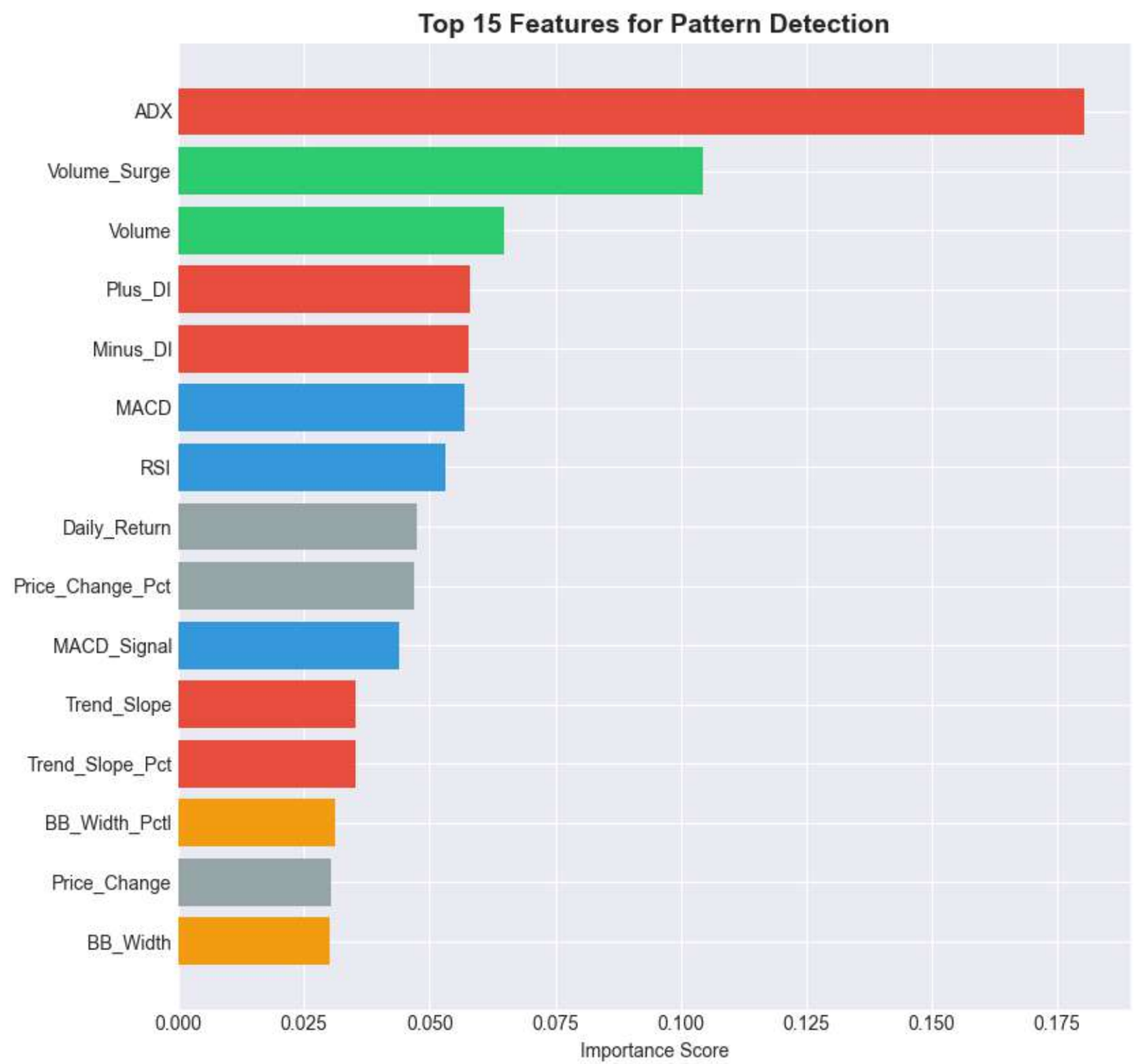


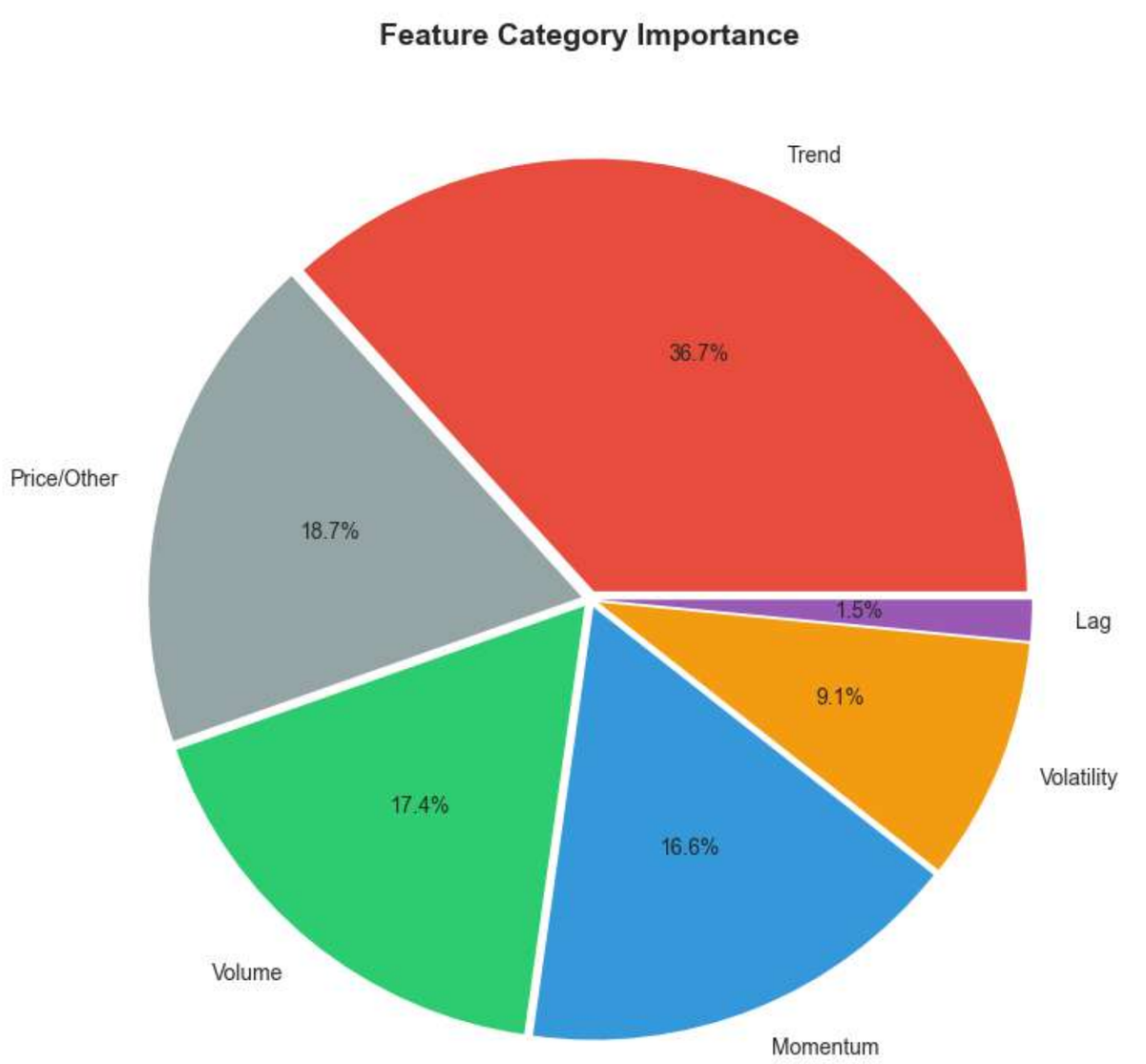
Price Chart with Pattern Overlay (Last 500 Days)

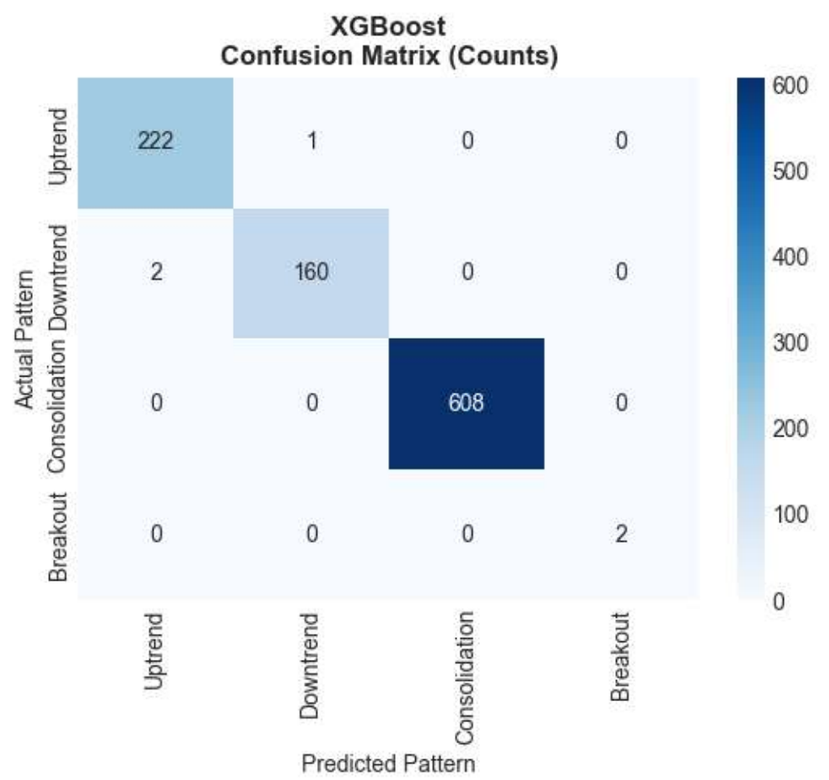


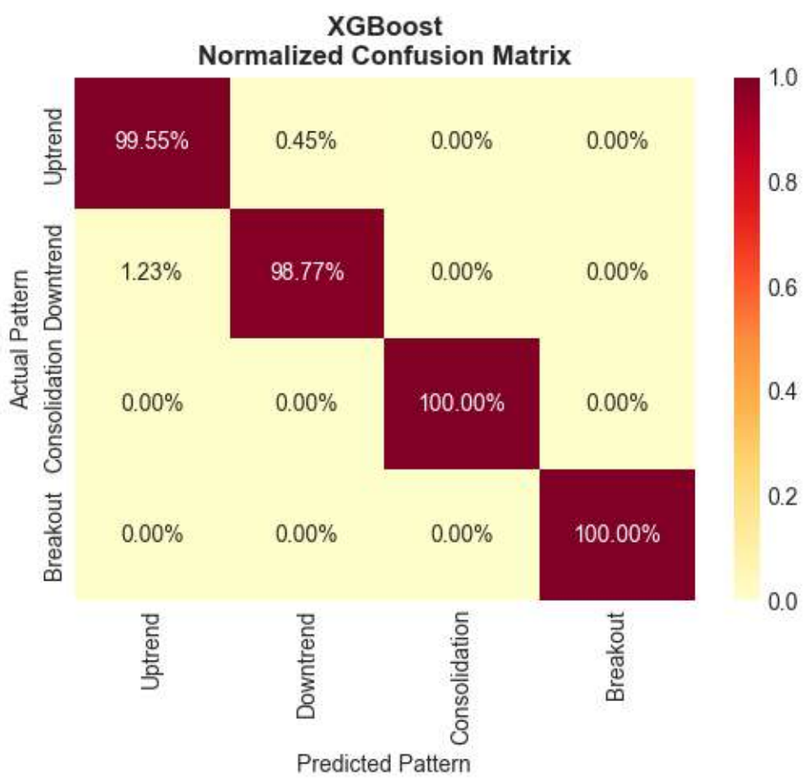

Pattern Class Weights (Higher = Rarer Pattern)
Balanced (1.0)
Weight
0
50
100
150
200
250
1.16
1.21
0.30
79.56
265.20
Uptrend
Downtrend
Consolidation
Breakout
Reversal

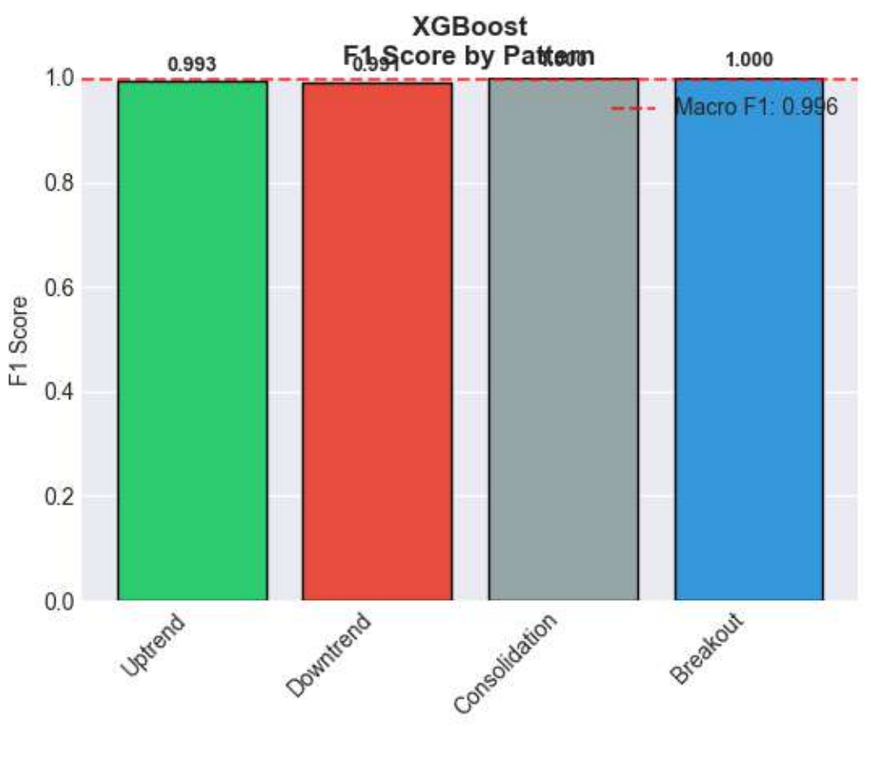

Random Forest
Confusion Matrix (Counts)
Actual Pattern
Uptrend
Downtrend
Consolidation
Breakout
219
4
0
0
1
161
0
0
0
0
608
0
0
0
2
0
Uptrend
Downtrend
Consolidation
Breakout
Predicted Pattern
600
500
400
300
200
100
0
Random Forest
Normalized Confusion Matrix
Actual Pattern
Uptrend
Downtrend
Consolidation
Breakout
98.21%
1.79%
0.00%
0.00%
0.62%
99.38%
0.00%
0.00%
0.00%
0.00%
100.00%
0.00%
0.00%
0.00%
100.00%
0.00%
Uptrend
Downtrend
Consolidation
Breakout
Predicted Pattern
1.0
0.8
0.6
0.4
0.2
0.0
Random Forest
F1 Score by Pattern
F1 Score
1.0
0.8
0.6
0.4
0.2
0.0
0.989
0.985
0.993
0.000
Macro F1: 0.743
Uptrend
Downtrend
Consolidation
Breakout

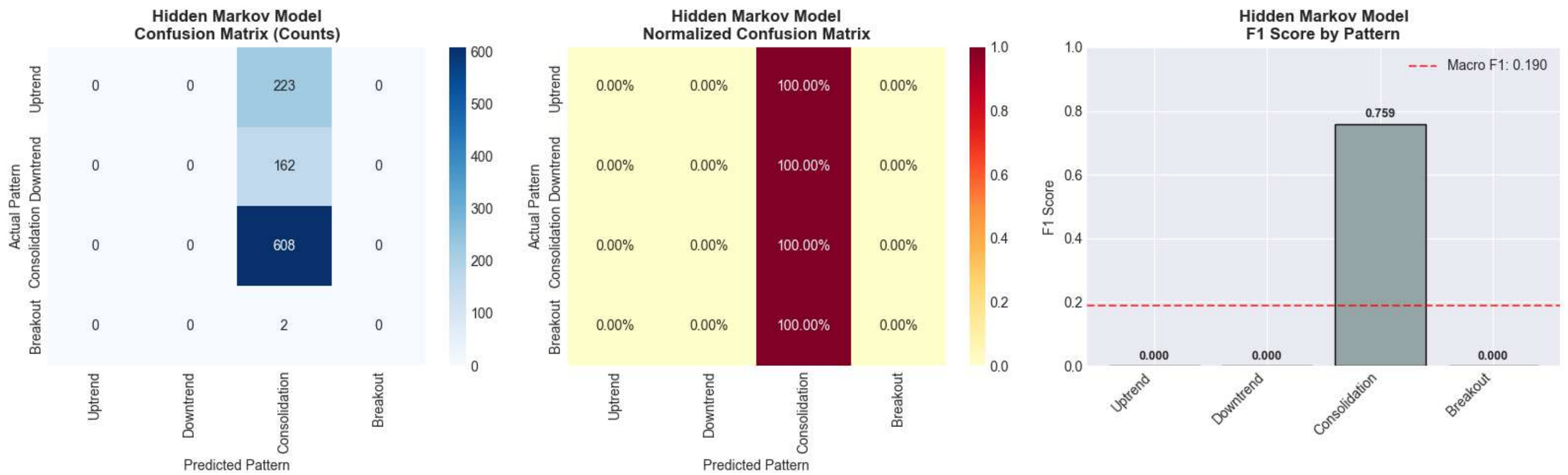

Top 15 Features for Pattern Detection
ADX
Volume_Surge
Volume
Plus_DI
Minus_DI
MACD
RSI
Daily_Return
Price_Change_Pct
MACD_Signal
Trend_Slope
Trend_Slope_Pct
BB_Width_Pctl
Price_Change
BB_Width
0.000
0.025
0.050
0.075
0.100
0.125
0.150
0.175
Importance Score

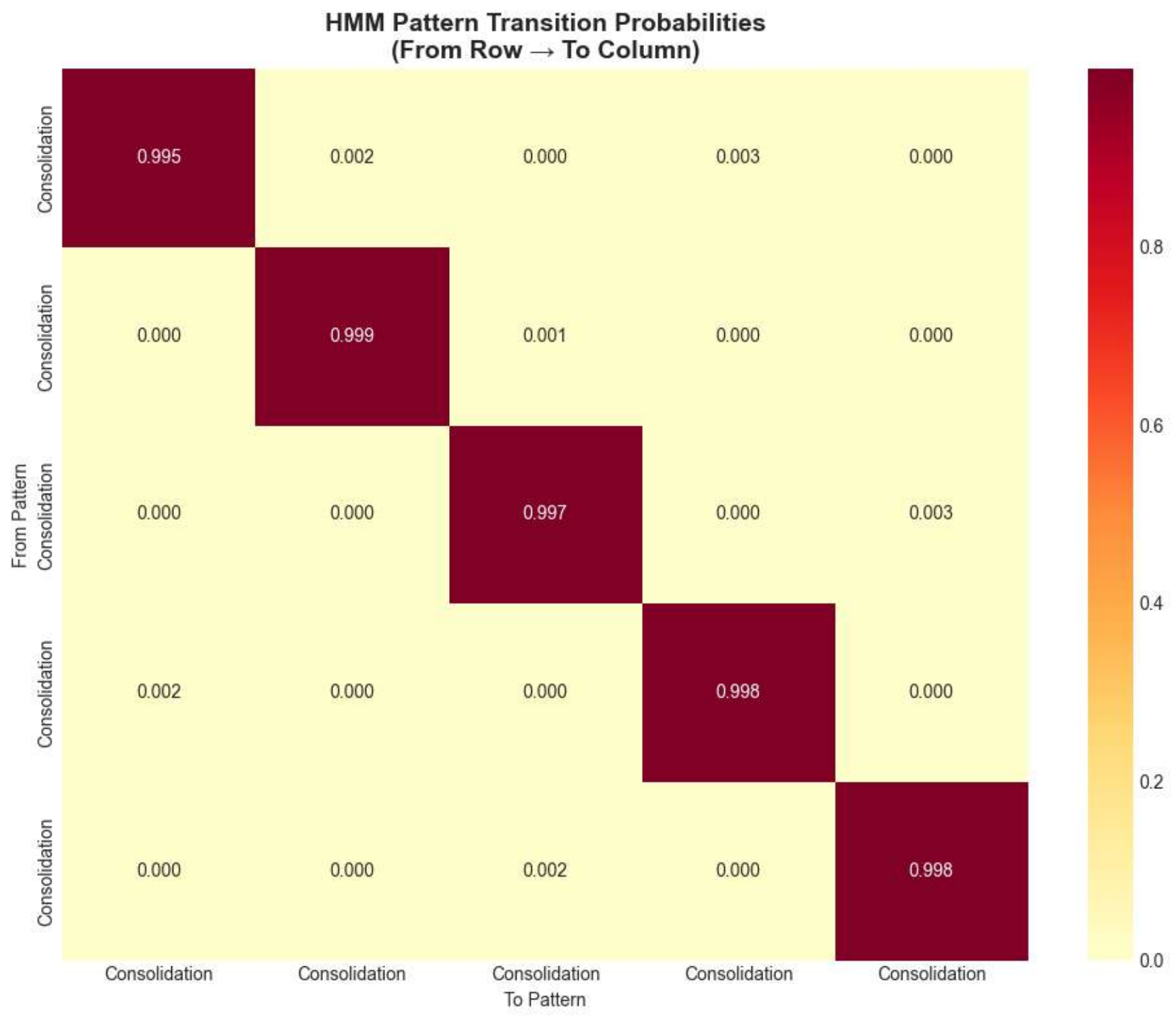

Feature Category Importance
Trend
36.7%
Price/Other
18.7%
Lag
1.5%
Volatility
9.1%
Volume
17.4%
Momentum
16.6%

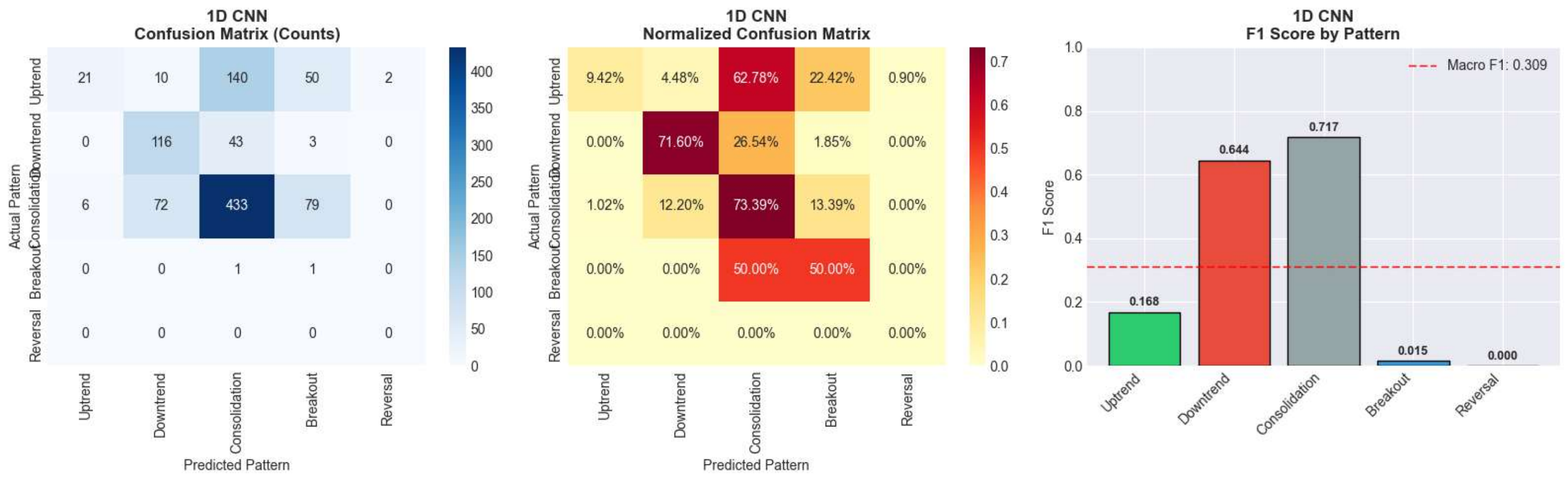

XGBoost
Confusion Matrix (Counts)
Actual Pattern
Uptrend
Downtrend
Consolidation
Breakout
222
1
0
0
2
160
0
0
0
0
608
0
0
0
0
2
Uptrend
Downtrend
Consolidation
Breakout
Predicted Pattern
600
500
400
300
200
100
0

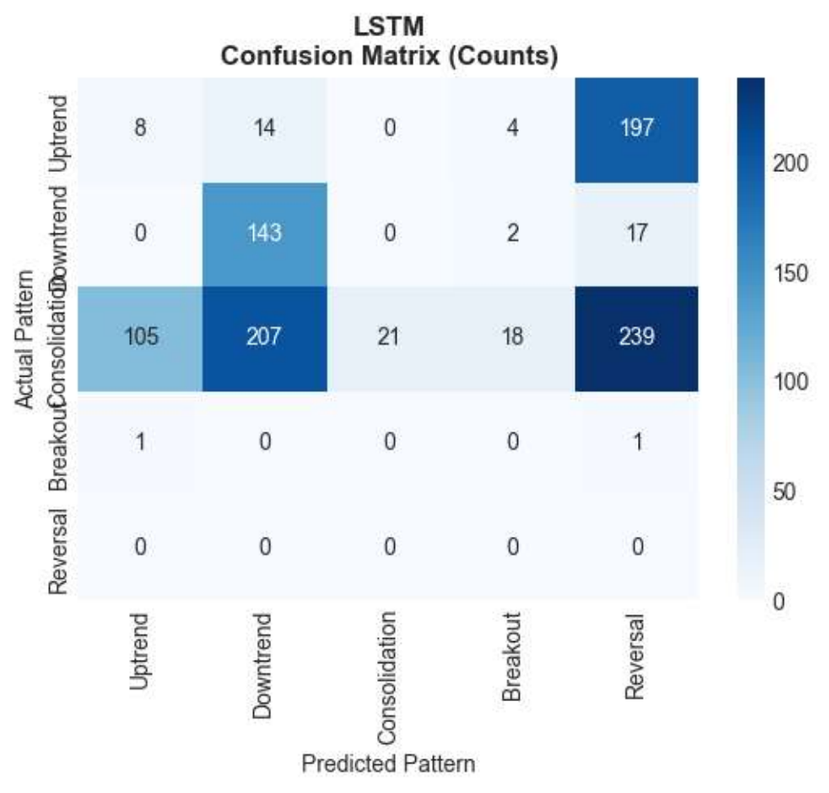

XGBoost
Normalized Confusion Matrix
Actual Pattern
Uptrend
Downtrend
Consolidation
Breakout
99.55%
0.45%
0.00%
0.00%
1.23%
98.77%
0.00%
0.00%
0.00%
0.00%
100.00%
0.00%
0.00%
0.00%
0.00%
100.00%
Uptrend
Downtrend
Consolidation
Breakout
Predicted Pattern
1.0
0.8
0.6
0.4
0.2
0.0

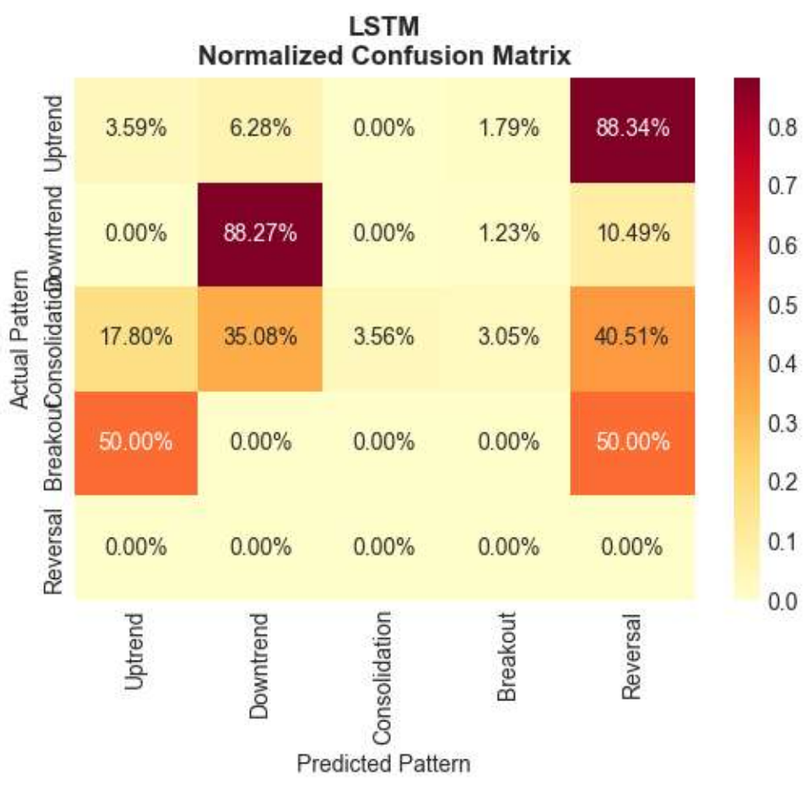

XGBoost
F1 Score by Pattern
F1 Score
0.993
0.991
1.000
1.000
Macro F1: 0.996
1.0
0.8
0.6
0.4
0.2
0.0
Uptrend
Downtrend
Consolidation
Breakout

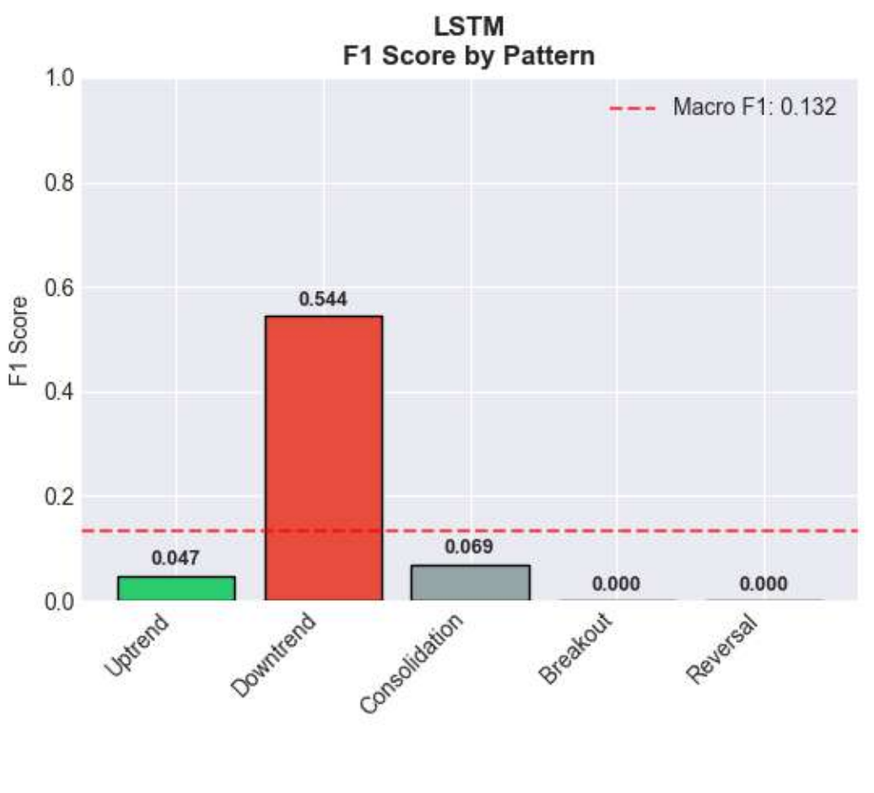

Hidden Markov Model
Confusion Matrix (Counts)
Actual Pattern
Uptrend
Downtrend
Consolidation
Breakout
0
0
223
0
0
0
162
0
0
0
608
0
0
0
2
0
Uptrend
Downtrend
Consolidation
Breakout
Predicted Pattern
600
500
400
300
200
100
0
Hidden Markov Model
Normalized Confusion Matrix
Actual Pattern
Uptrend
Downtrend
Consolidation
Breakout
0.00%
0.00%
100.00%
0.00%
0.00%
0.00%
100.00%
0.00%
0.00%
0.00%
100.00%
0.00%
0.00%
0.00%
100.00%
0.00%
Uptrend
Downtrend
Consolidation
Breakout
Predicted Pattern
1.0
0.8
0.6
0.4
0.2
0.0
Hidden Markov Model
F1 Score by Pattern
F1 Score
Macro F1: 0.190
0.759
0.000
0.000
0.000
Uptrend
Downtrend
Consolidation
Breakout

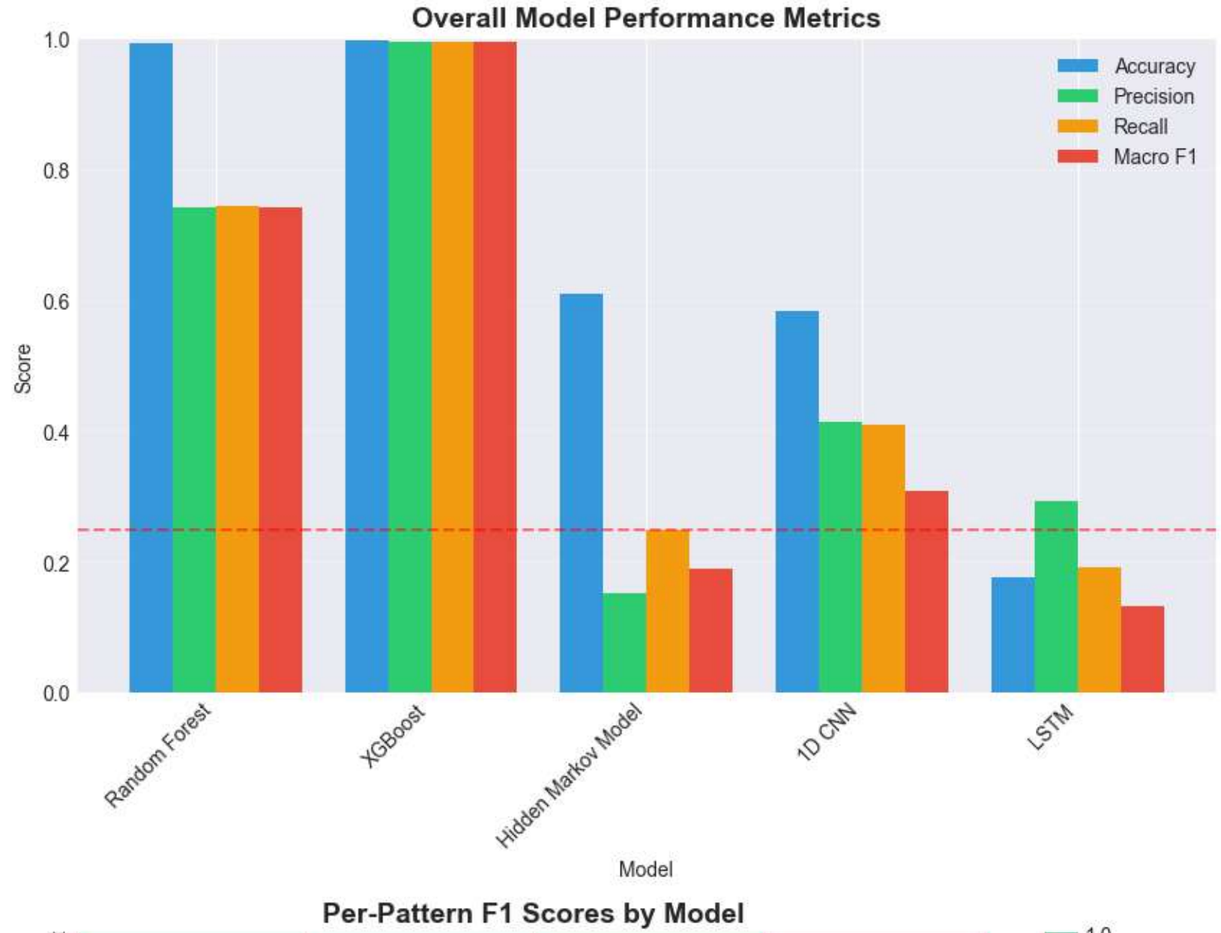

HMM Pattern Transition Probabilities
(From Row → To Column)
From Pattern
Consolidation
Consolidation
Consolidation
Consolidation
Consolidation
0.995
0.002
0.000
0.003
0.000
0.000
0.999
0.001
0.000
0.000
0.000
0.000
0.997
0.000
0.003
0.002
0.000
0.000
0.998
0.000
0.000
0.000
0.002
0.000
0.998
Consolidation
Consolidation
Consolidation
Consolidation
Consolidation
To Pattern
0.8
0.6
0.4
0.2
0.0

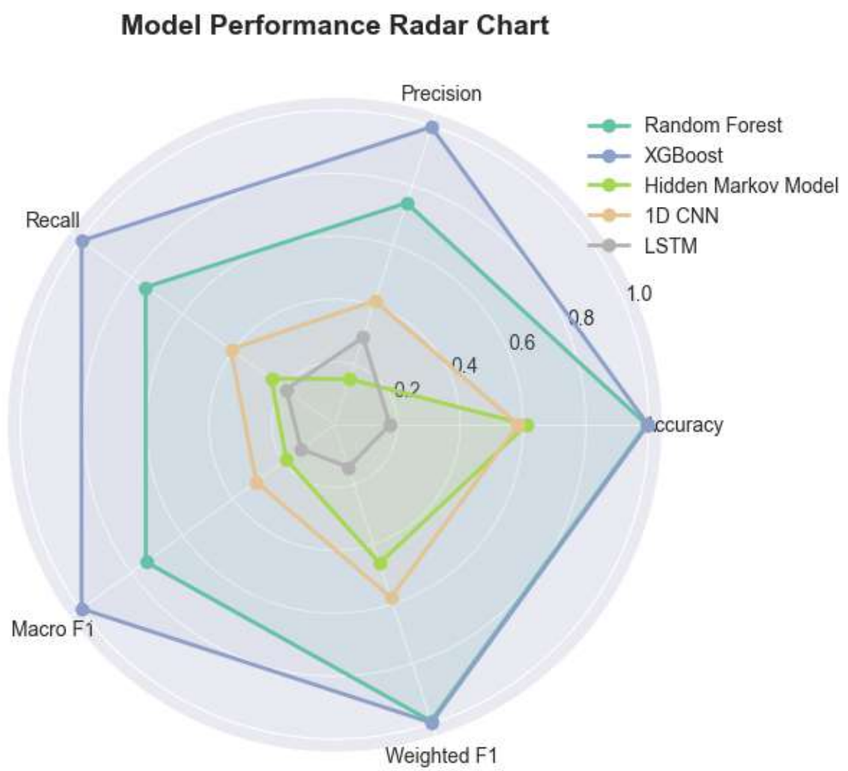

1D CNN
Confusion Matrix (Counts)
Actual Pattern
Uptrend
Downtrend
Consolidation
Breakout
Reversal
21 10 140 50 2
0 116 43 3 0
6 72 433 79 0
0 0 1 1 0
0 0 0 0 0
Uptrend
Downtrend
Consolidation
Breakout
Reversal
Predicted Pattern
400
350
300
250
200
150
100
50
0
1D CNN
Normalized Confusion Matrix
Actual Pattern
Uptrend
Downtrend
Consolidation
Breakout
Reversal
9.42% 4.48% 62.78% 22.42% 0.90%
0.00% 71.60% 26.54% 1.85% 0.00%
1.02% 12.20% 73.39% 13.39% 0.00%
0.00% 0.00% 50.00% 50.00% 0.00%
0.00% 0.00% 0.00% 0.00% 0.00%
Uptrend
Downtrend
Consolidation
Breakout
Reversal
Predicted Pattern
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1D CNN
F1 Score by Pattern
F1 Score
Macro F1: 0.309
0.168
0.644
0.717
0.015
0.000
1.0
0.8
0.6
0.4
0.2
0.0
Uptrend
Downtrend
Consolidation
Breakout
Reversal

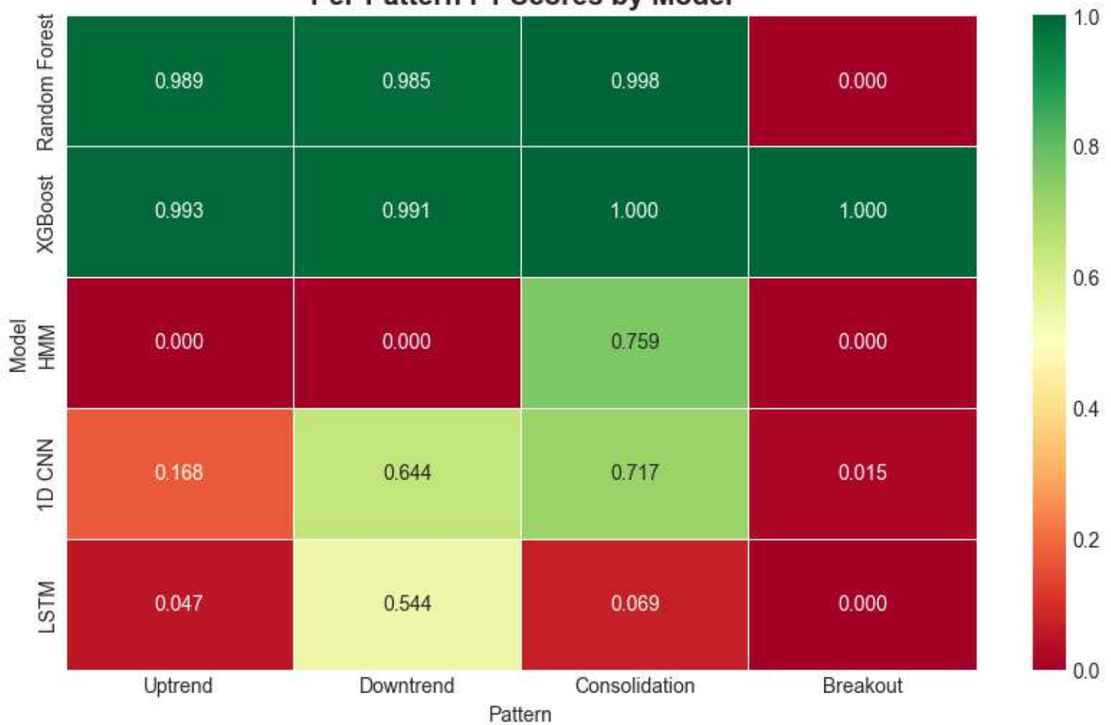

LSTM
Confusion Matrix (Counts)
Actual Pattern
Uptrend
Downtrend
Consolidation
Breakout
Reversal
8 14 0 4 197
0 143 0 2 17
105 207 21 18 239
1 0 0 0 1
0 0 0 0 0
Uptrend
Downtrend
Consolidation
Breakout
Reversal
Predicted Pattern
200
150
100
50
0

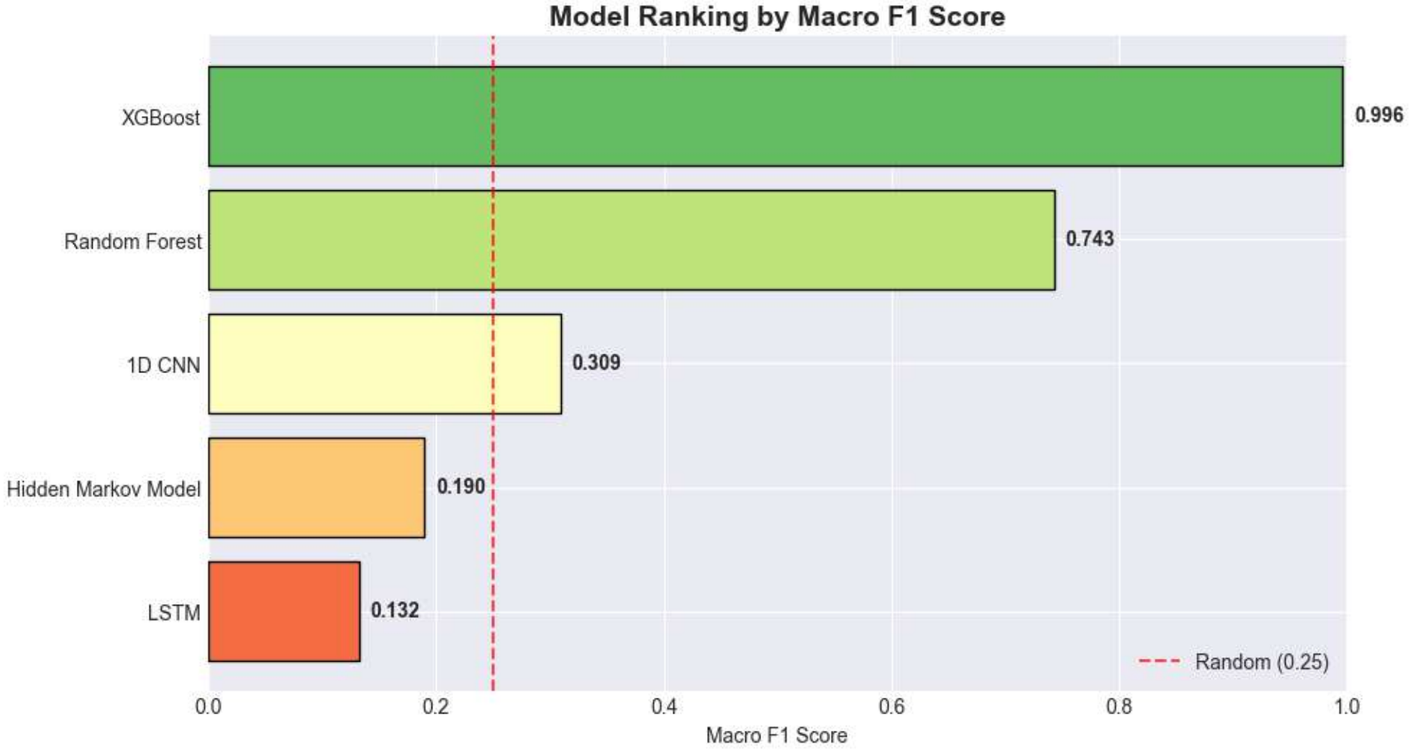

LSTM
Normalized Confusion Matrix
Actual Pattern
Uptrend
Downtrend
Consolidation
Breakout
Reversal
3.59% 6.28% 0.00% 1.79% 88.34%
0.00% 88.27% 0.00% 1.23% 10.49%
17.80% 35.08% 3.56% 3.05% 40.51%
50.00% 0.00% 0.00% 0.00% 50.00%
0.00% 0.00% 0.00% 0.00% 0.00%
Uptrend
Downtrend
Consolidation
Breakout
Reversal
Predicted Pattern
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0

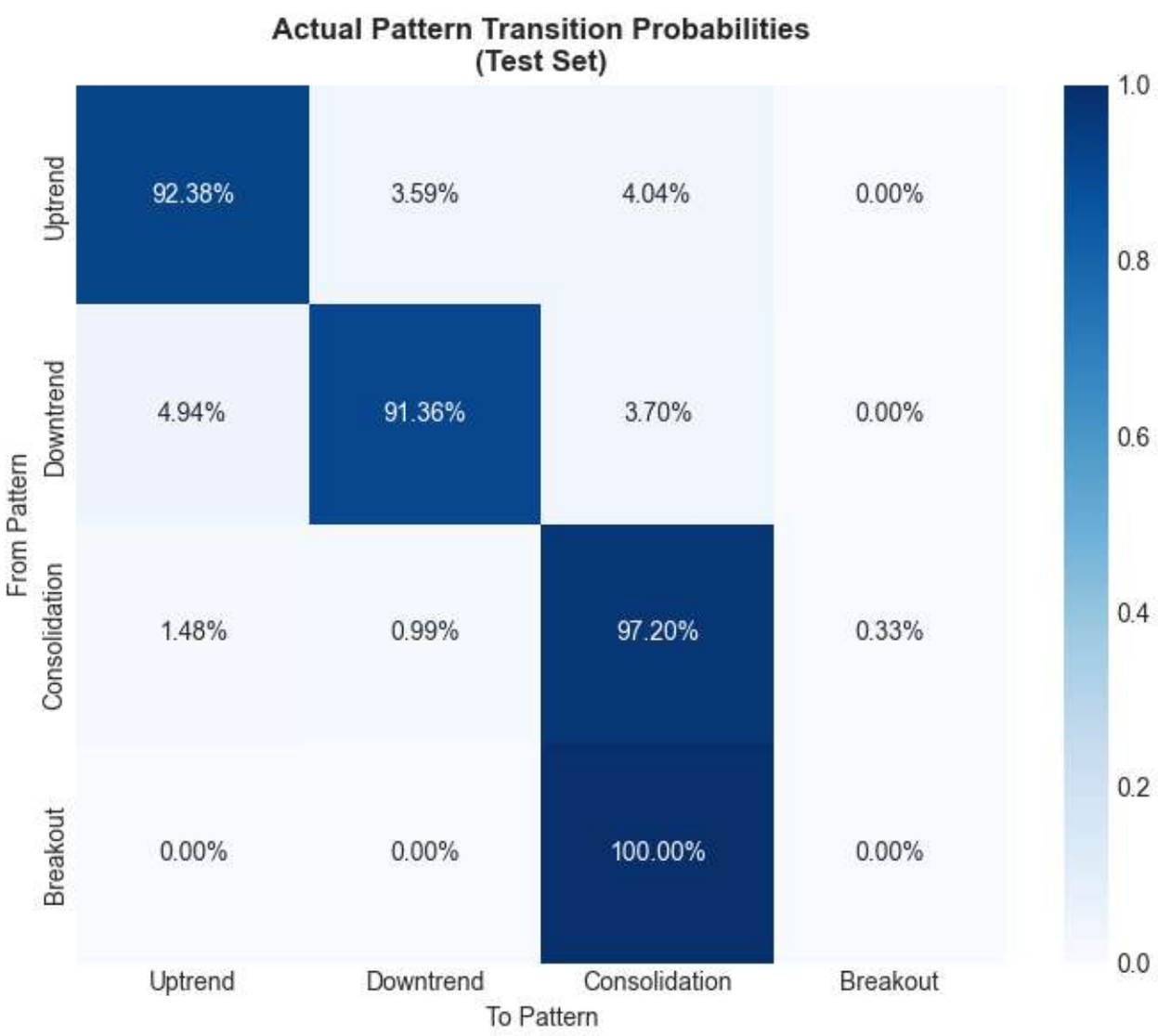

LSTM
F1 Score by Pattern
Macro F1: 0.132
F1 Score
1.0
0.8
0.6
0.4
0.2
0.0
0.047
0.544
0.069
0.000
0.000
Uptrend
Downtrend
Consolidation
Breakout
Reversal

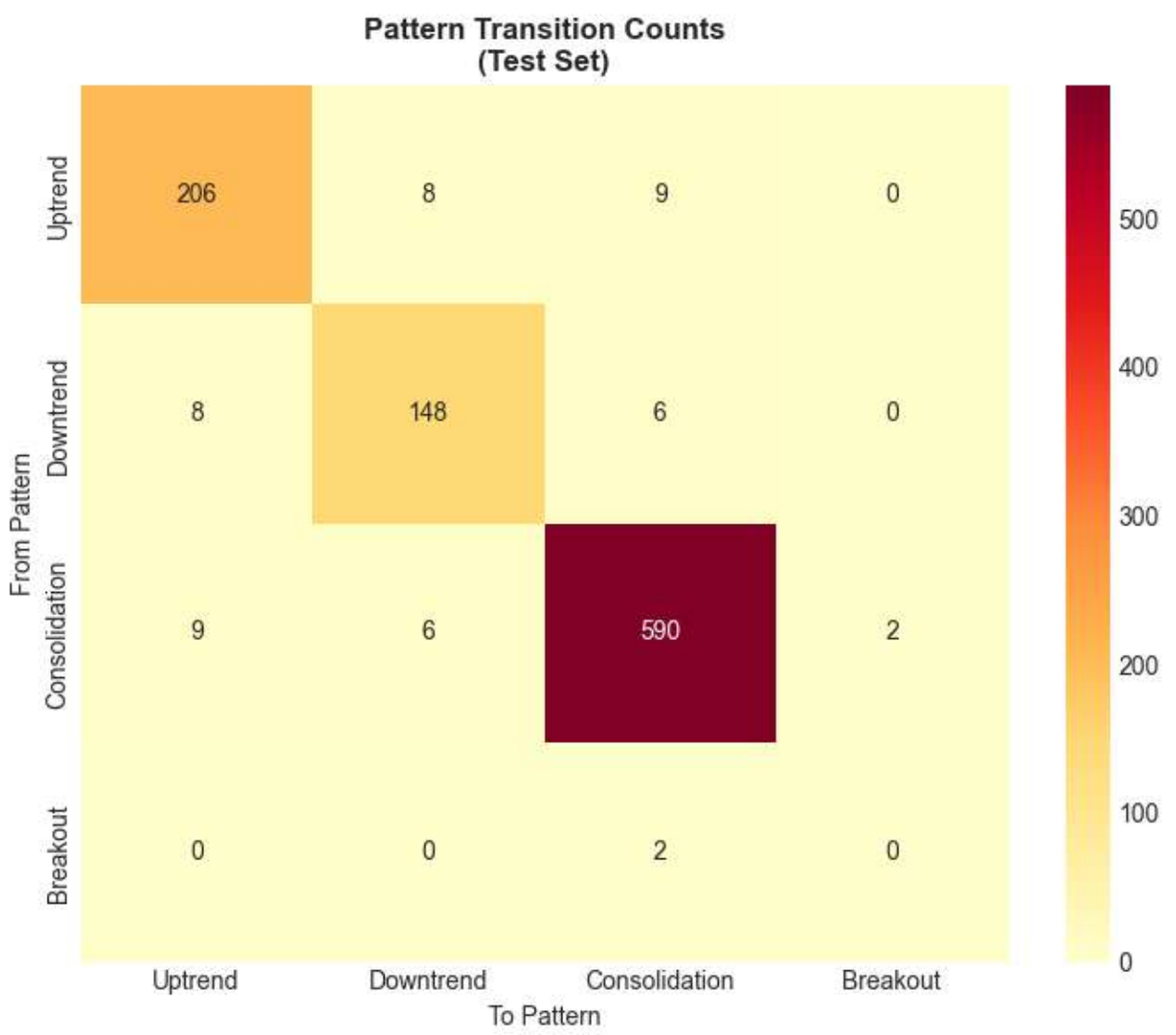

Overall Model Performance Metrics
Accuracy
Precision
Recall
Macro F1
Score
1.0
0.8
0.6
0.4
0.2
0.0
Random Forest
XGBoost
Hidden Markov Model
1D CNN
LSTM
Model

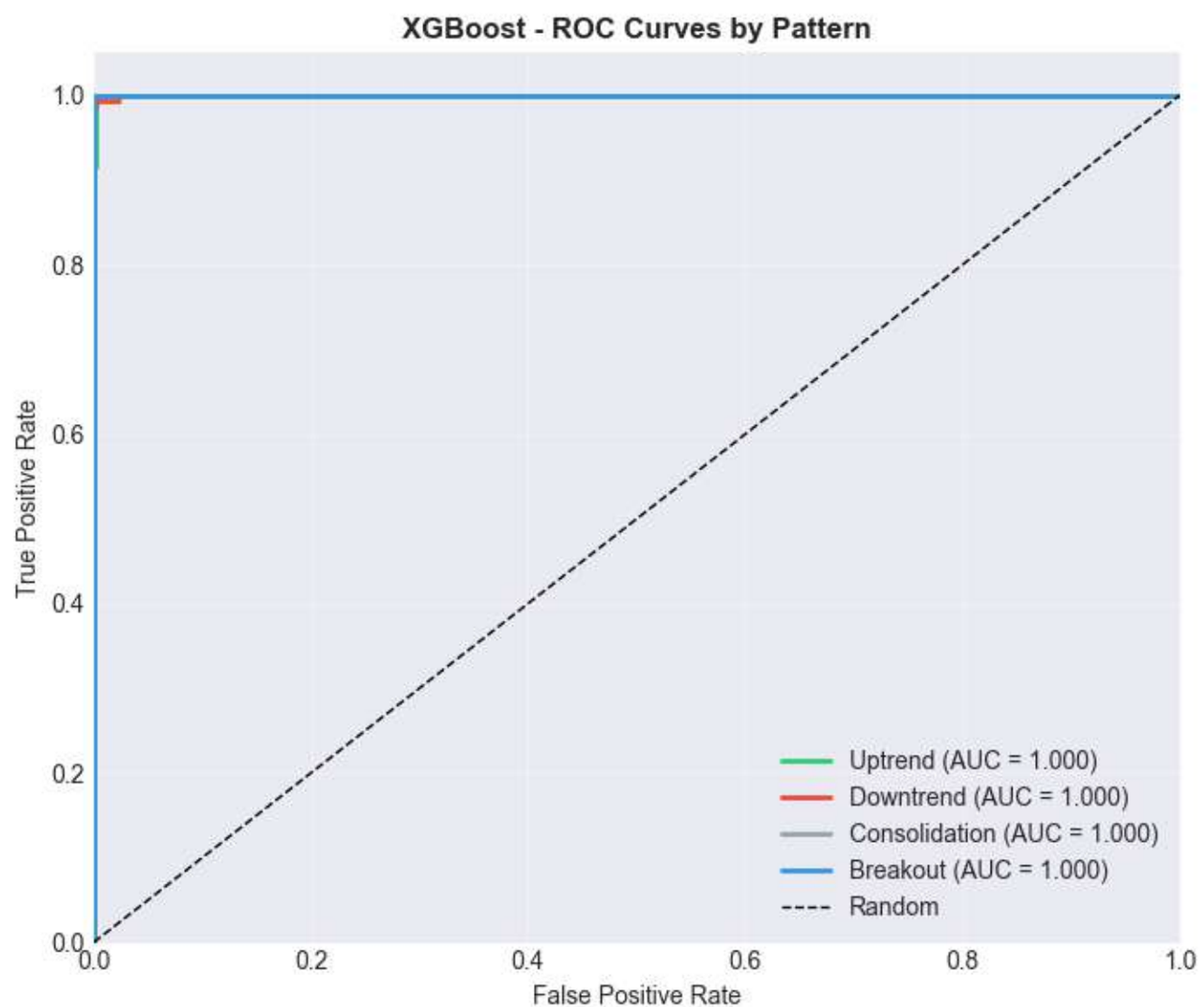

Model Performance Radar Chart
Precision
Recall
Macro F1
Weighted F1
Random Forest
XGBoost
Hidden Markov Model
1D CNN
LSTM
0.2
0.4
0.6
0.8
1.0

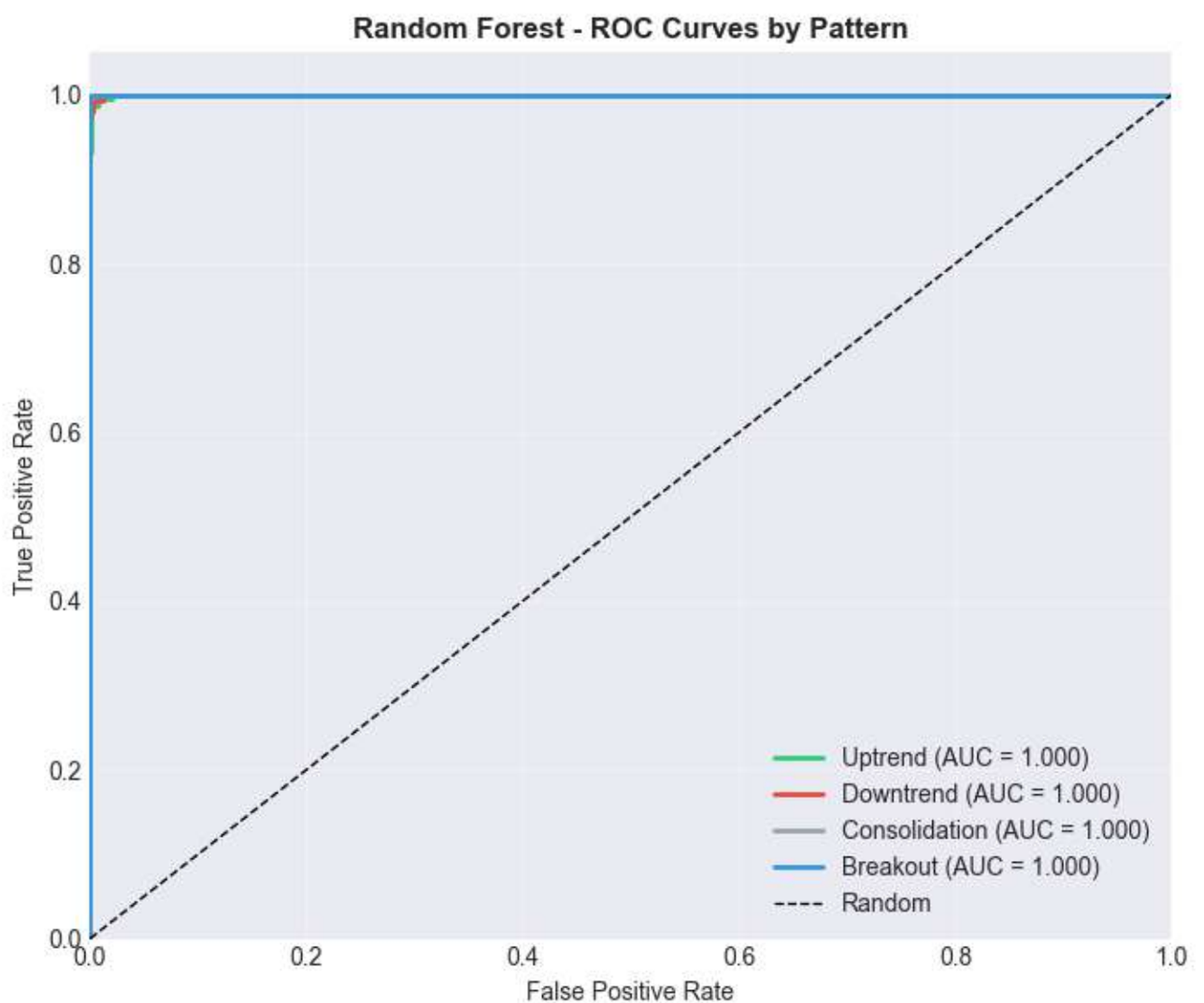

Per-Pattern F1 Scores by Model
Random Forest
XGBoost
HMM
1D CNN
LSTM
Model
0.989
0.985
0.998
0.000
0.993
0.991
1.000
1.000
0.000
0.000
0.759
0.000
0.168
0.644
0.717
0.015
0.047
0.544
0.069
0.000
Untrend
Downtrend
Consolidation
Breakout
Pattern
1.0
0.8
0.6
0.4
0.2
0.0

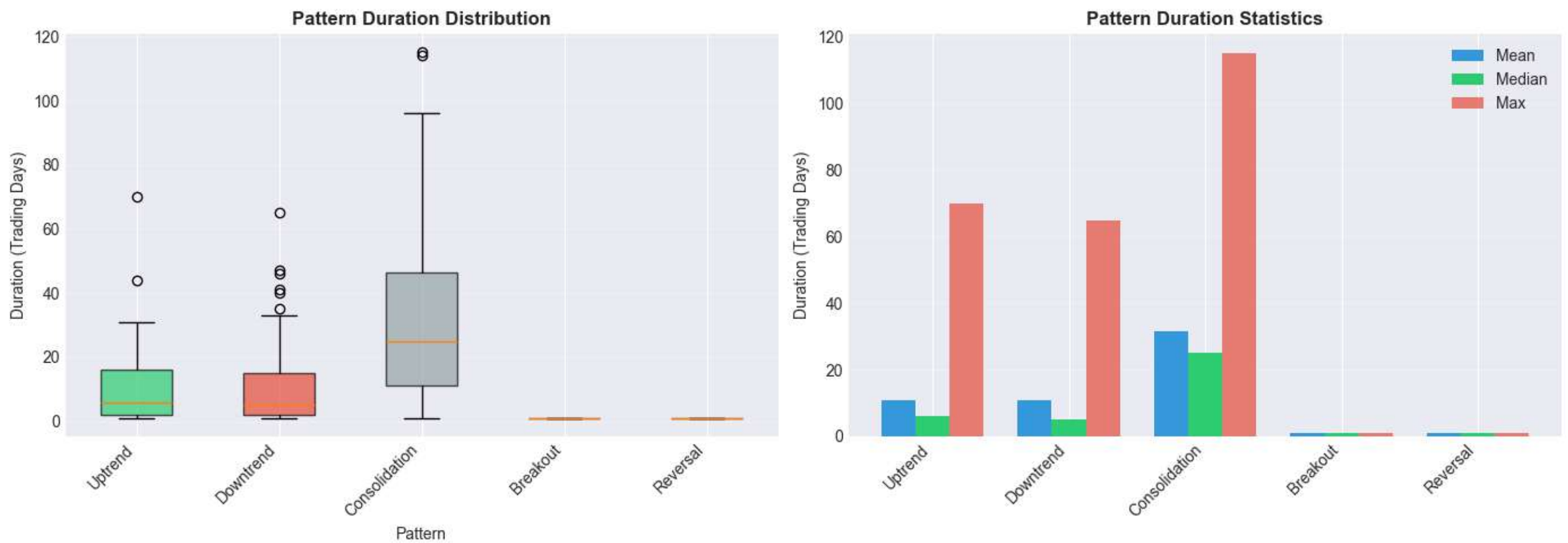

Model Ranking by Macro F1 Score
XGBoost
Random Forest
1D CNN
Hidden Markov Model
LSTM
0.996
0.743
0.309
0.190
0.132
Random (0.25)
0.0
0.2
0.4
0.6
0.8
1.0
Macro F1 Score

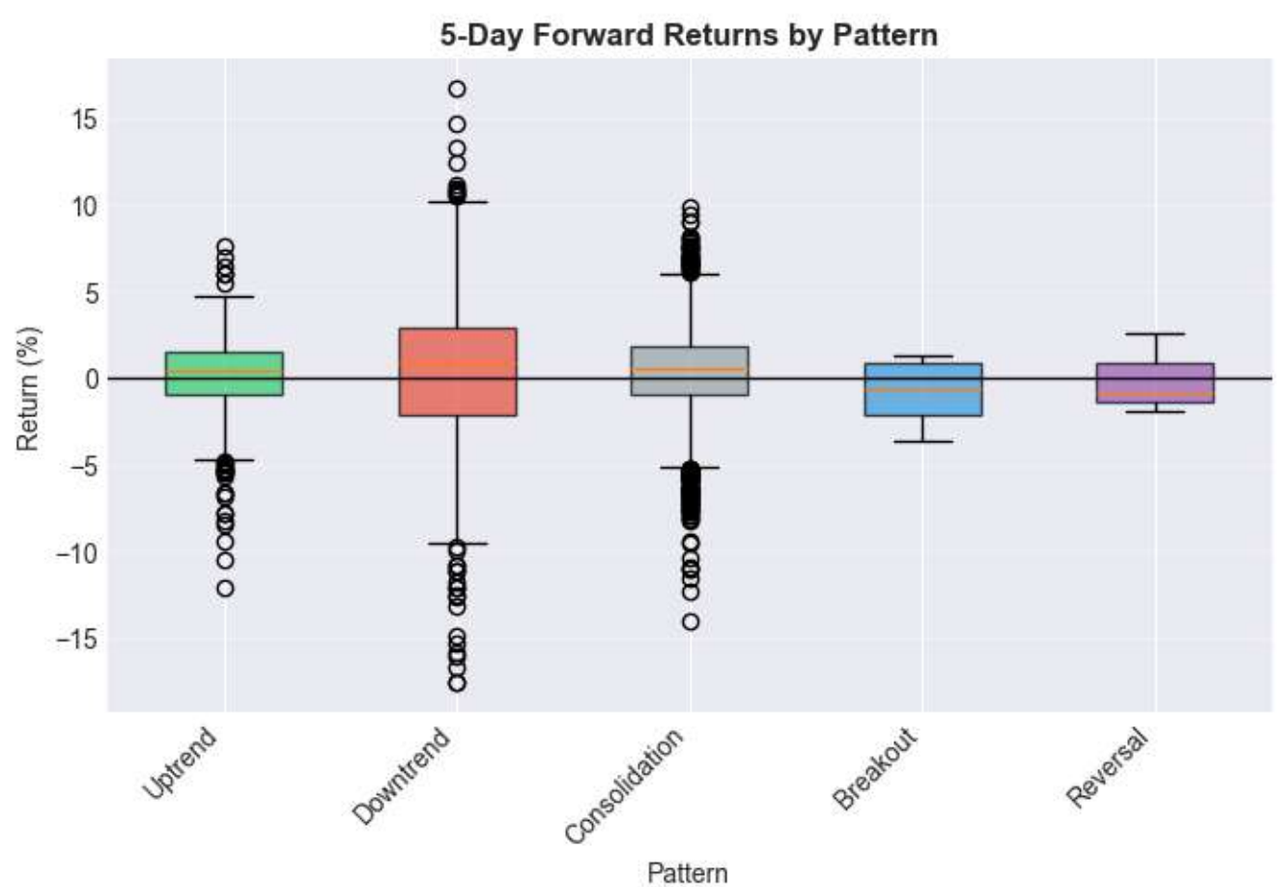

Actual Pattern Transition Probabilities
(Test Set)
From Pattern
Uptrend
Downtrend
Consolidation
Breakout
92.38%
3.59%
4.04%
0.00%
4.94%
91.36%
3.70%
0.00%
1.48%
0.99%
97.20%
0.33%
0.00%
0.00%
100.00%
0.00%
Uptrend
Downtrend
Consolidation
Breakout
To Pattern
1.0
0.8
0.6
0.4
0.2
0.0

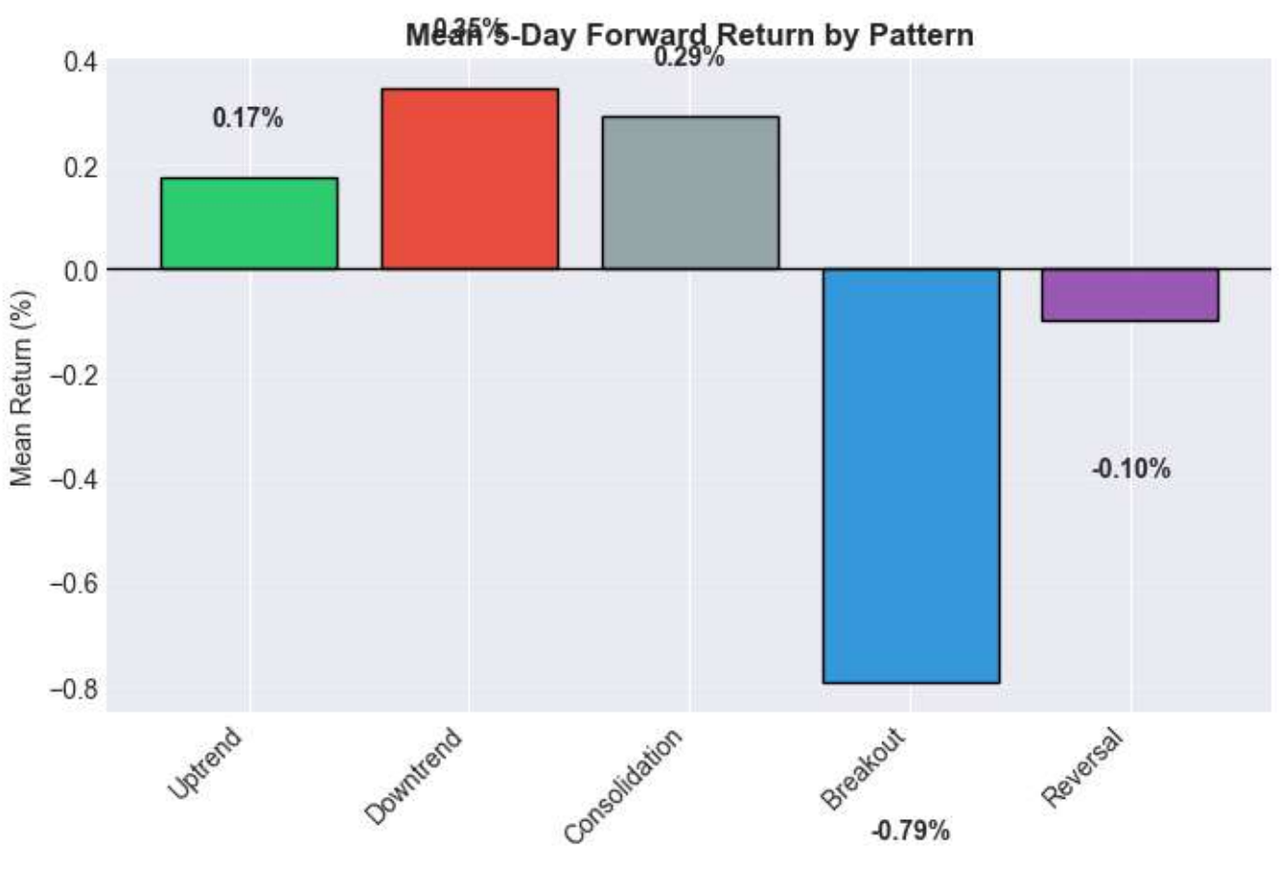

Pattern Transition Counts
(Test Set)
From Pattern
Uptrend
Downtrend
Consolidation
Breakout
206
8
9
0
8
148
6
0
9
6
590
2
0
0
2
0
Uptrend
Downtrend
Consolidation
Breakout
To Pattern
500
400
300
200
100
0


XGBoost - ROC Curves by Pattern
True Positive Rate
False Positive Rate
0.0
0.2
0.4
0.6
0.8
1.0
Uptrend (AUC = 1.000)
Downtrend (AUC = 1.000)
Consolidation (AUC = 1.000)
Breakout (AUC = 1.000)
Random

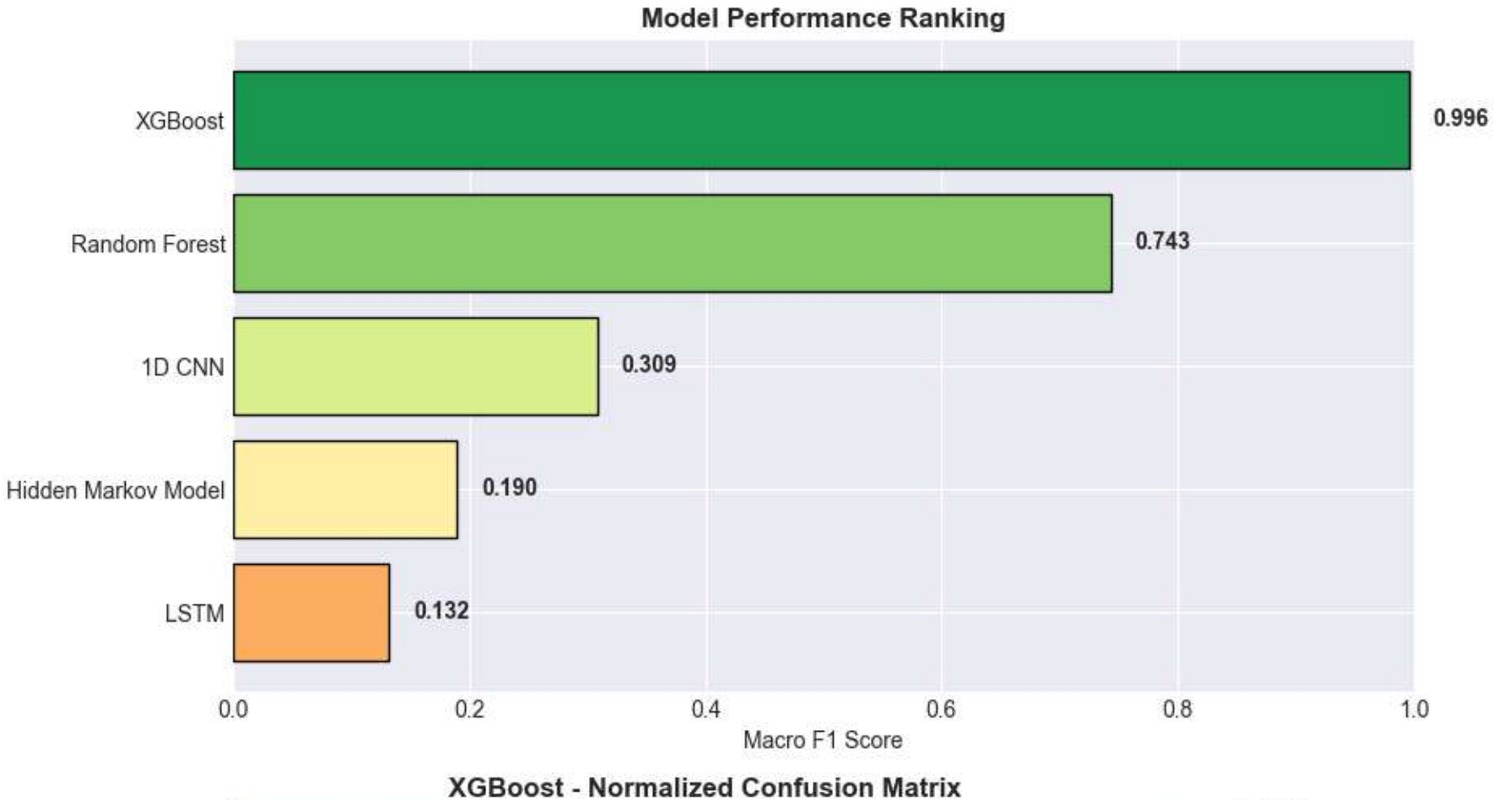

Random Forest - ROC Curves by Pattern
True Positive Rate
False Positive Rate
0.0
0.2
0.4
0.6
0.8
1.0
Uptrend (AUC = 1.000)
Downtrend (AUC = 1.000)
Consolidation (AUC = 1.000)
Breakout (AUC = 1.000)
Random

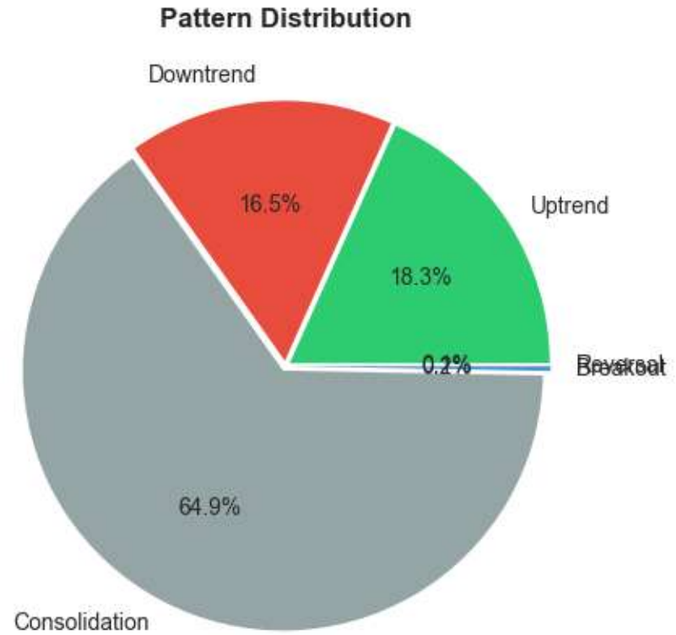

Pattern Duration Distribution
Duration (Trading Days)
120
100
80
60
40
20
0
Uptrend
Downtrend
Consolidation
Breakout
Reversal
Pattern
Pattern Duration Statistics
Duration (Trading Days)
Mean
Median
Max

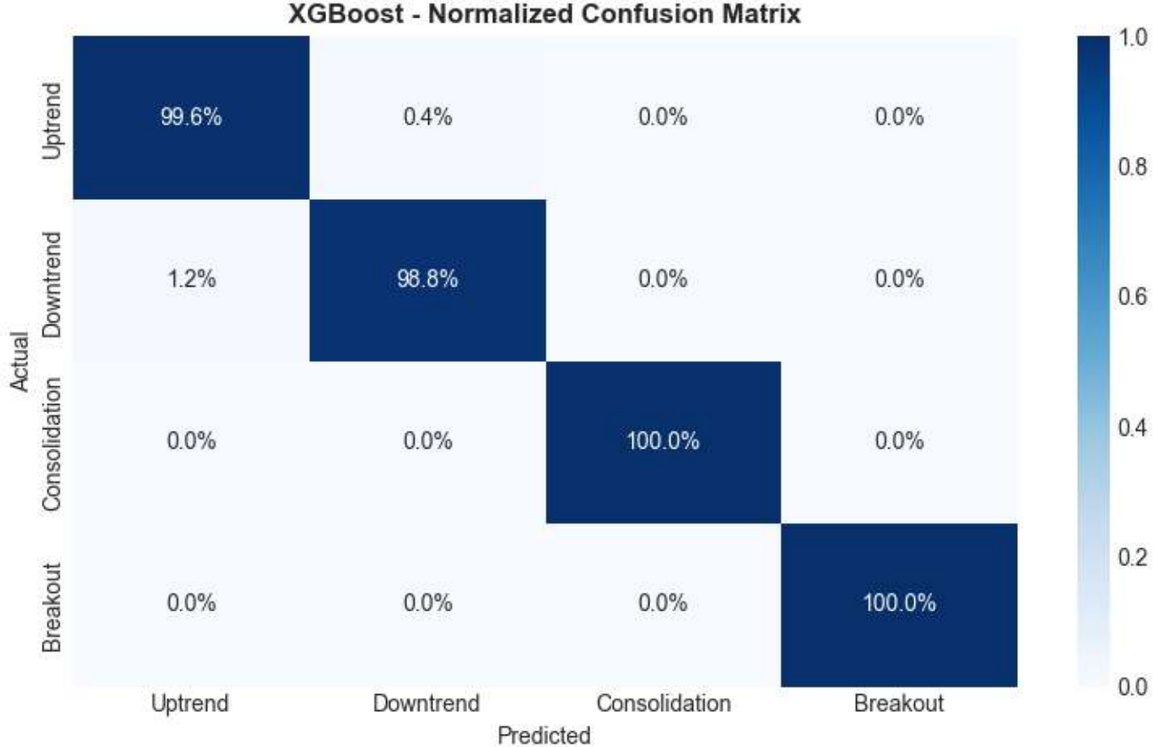

5-Day Forward Returns by Pattern
Return (%)
15
10
5
0
−5
−10
−15
Uptrend
Downtrend
Consolidation
Breakout
Reversal
Pattern


Mean 5-Day Forward Return by Pattern
Mean Return (%)
0.4
0.2
0.0
−0.2
−0.4
−0.6
−0.8
0.17%
0.35%
0.29%
-0.79%
-0.10%
Uptrend
Downtrend
Consolidation
Breakout
Reversal

Pattern Recognition - Executive Summary





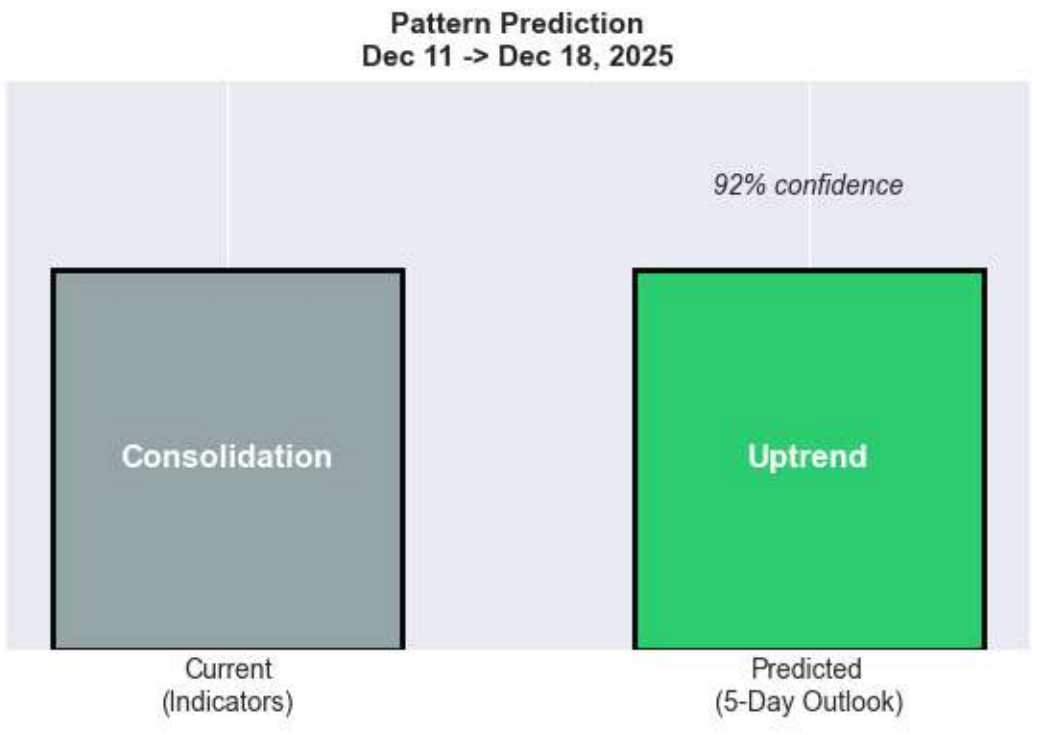


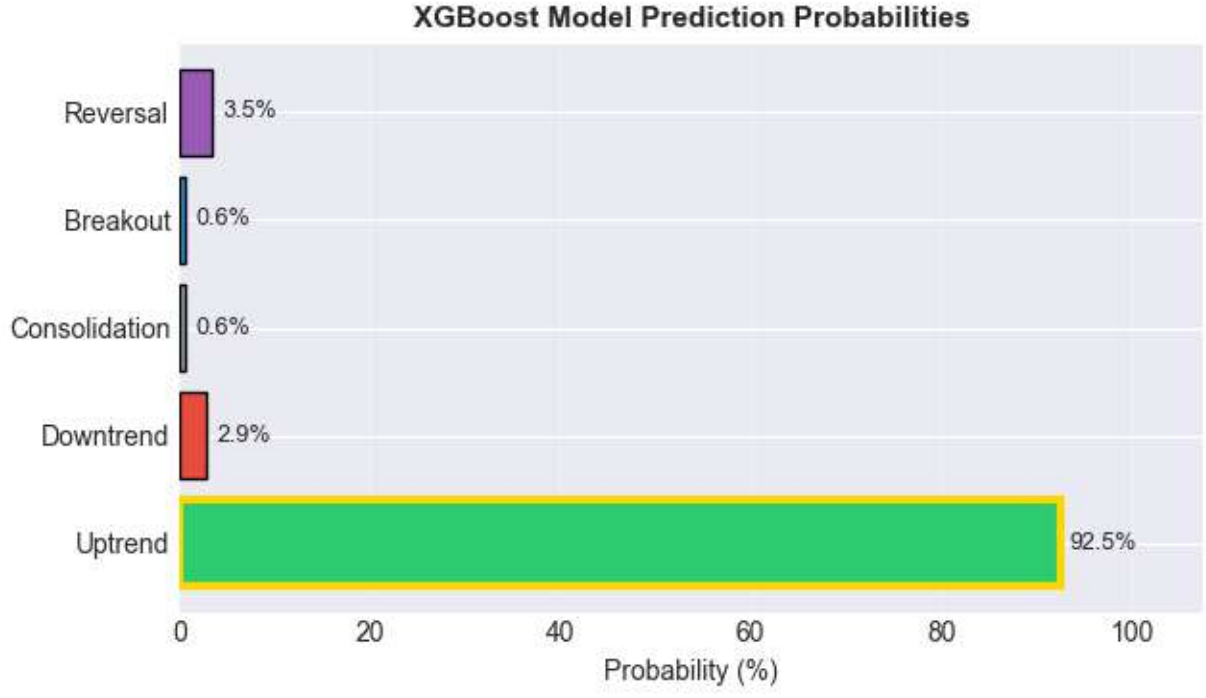

```
PATTERN RECOGNITION SUMMARY
====================================

Best Model: XGBoost
Macro F1 Score: 0.9960
Accuracy: 0.9970

Key Findings:
• 5 models successfully trained
• All models beat random baseline (25.0%)
• Pattern transitions captured via HMM
• Feature importance identifies key indicators

Trading Implications:
• Use patterns for market regime detection
• Combine with traditional analysis
• Monitor pattern transitions for signals
```


Pattern Prediction
Dec 11 -> Dec 18, 2025
92% confidence
Consolidation
Uptrend
Current
(Indicators)
Predicted
(5-Day Outlook)


XGBoost Model Prediction Probabilities
Reversal
3.5%
Breakout
0.6%
Consolidation
0.6%
Downtrend
2.9%
Uptrend
92.5%
0
20
40
60
80
100
Probability (%)