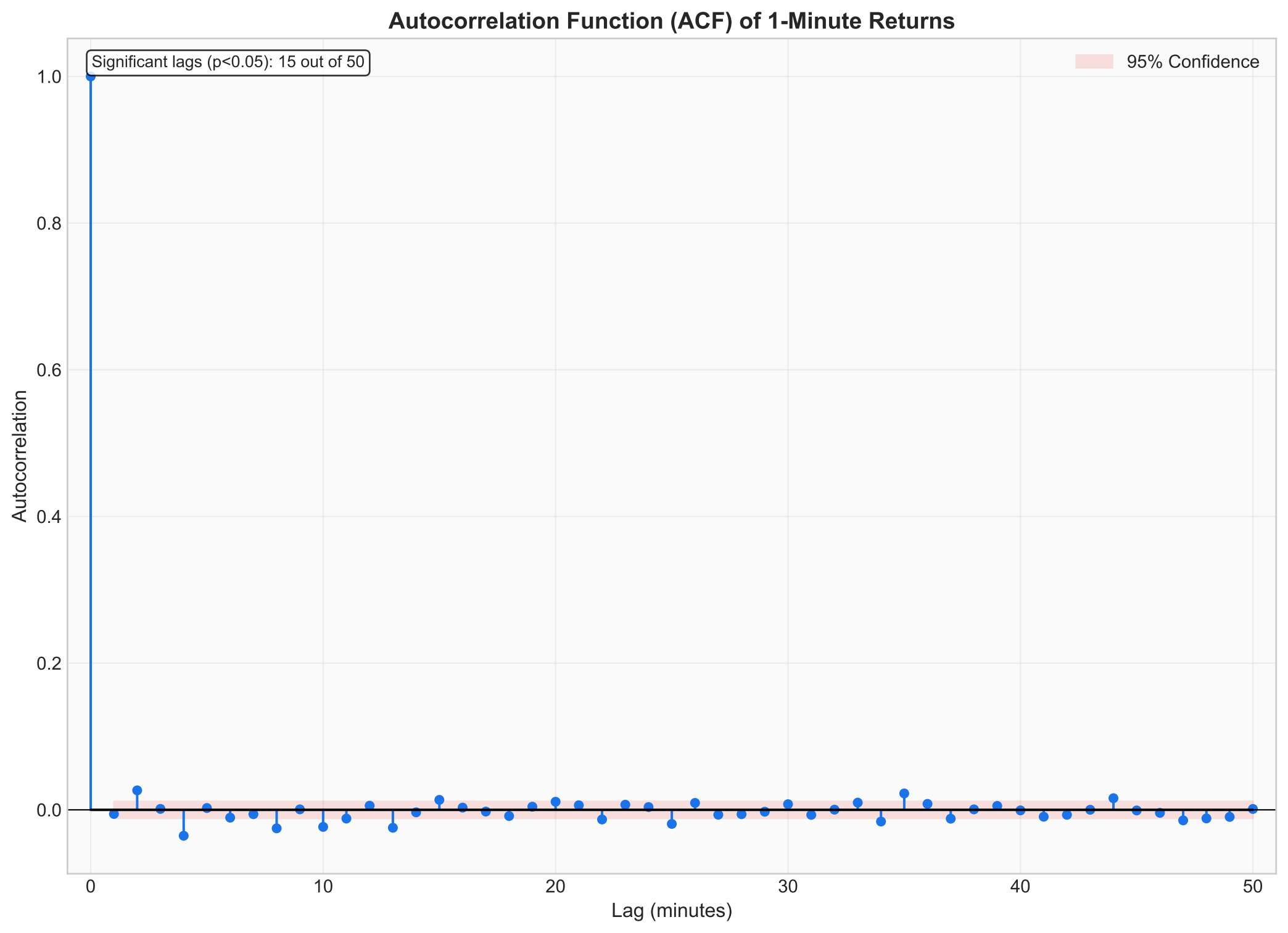
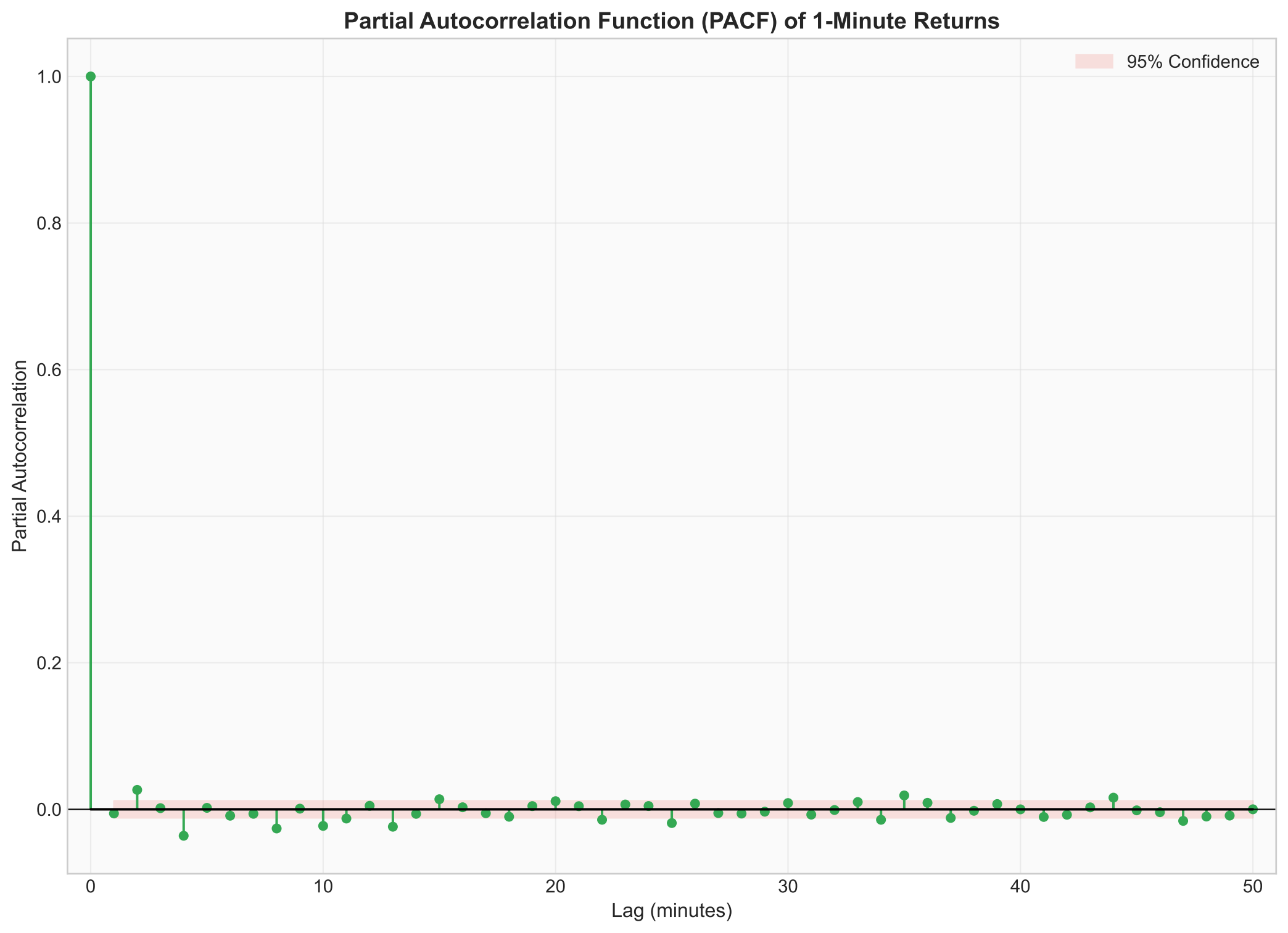
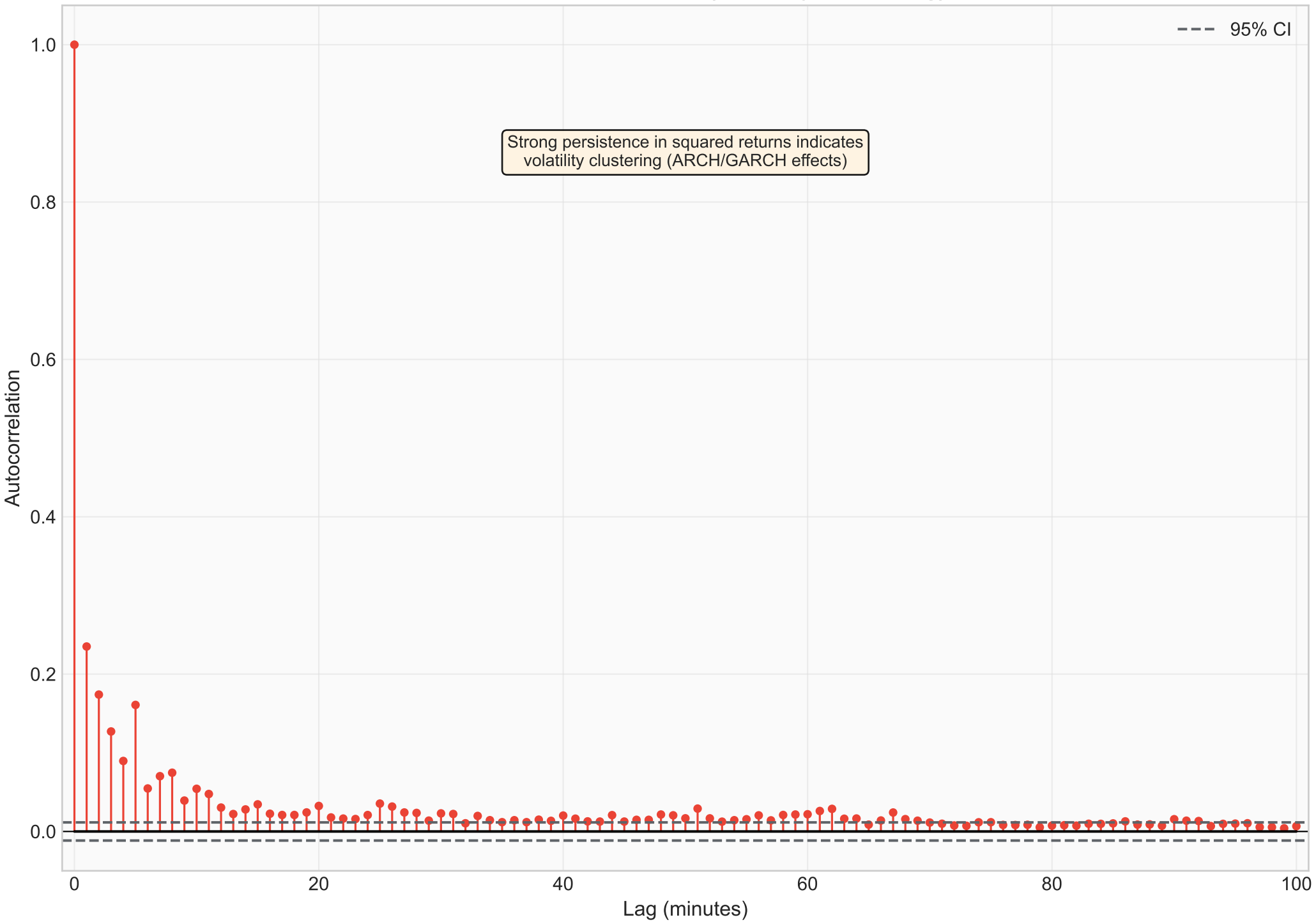
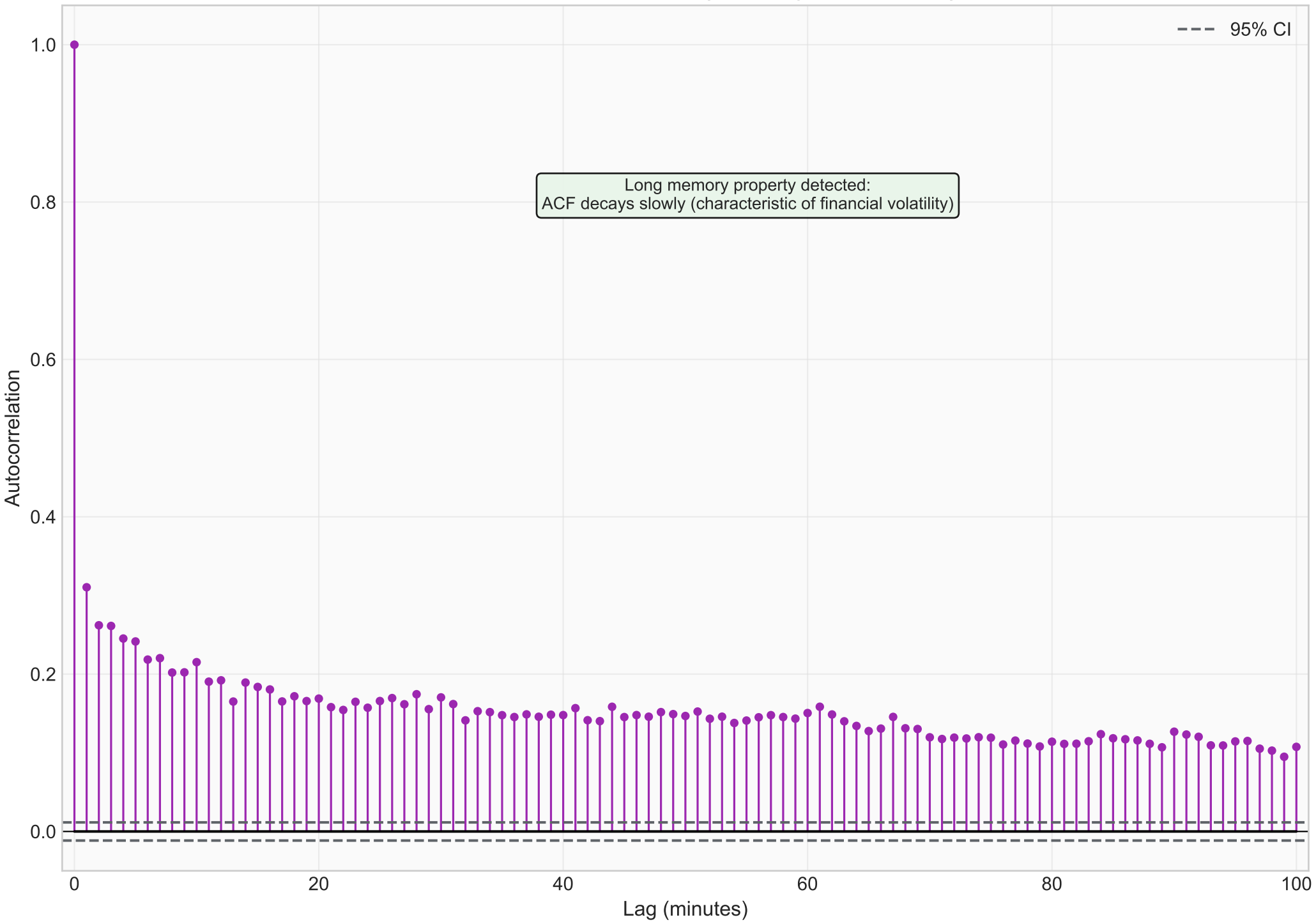
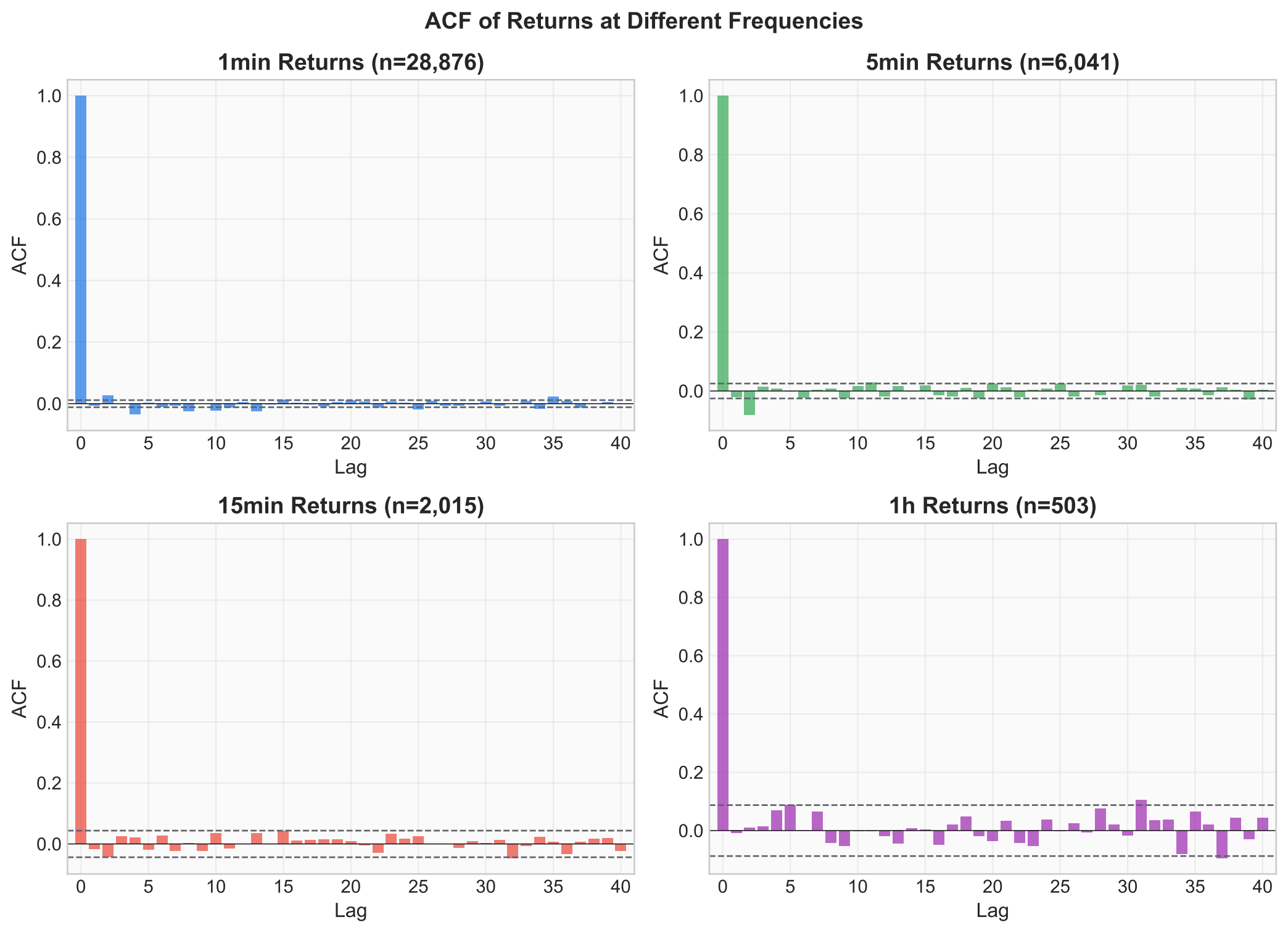

Autocorrelation Function (ACF) of 1-Minute Returns
Significant lags (p<0.05): 15 out of 50
95% Confidence
Autocorrelation
1.0
0.8
0.6
0.4
0.2
0.0
0
10
20
30
40
50
Lag (minutes)

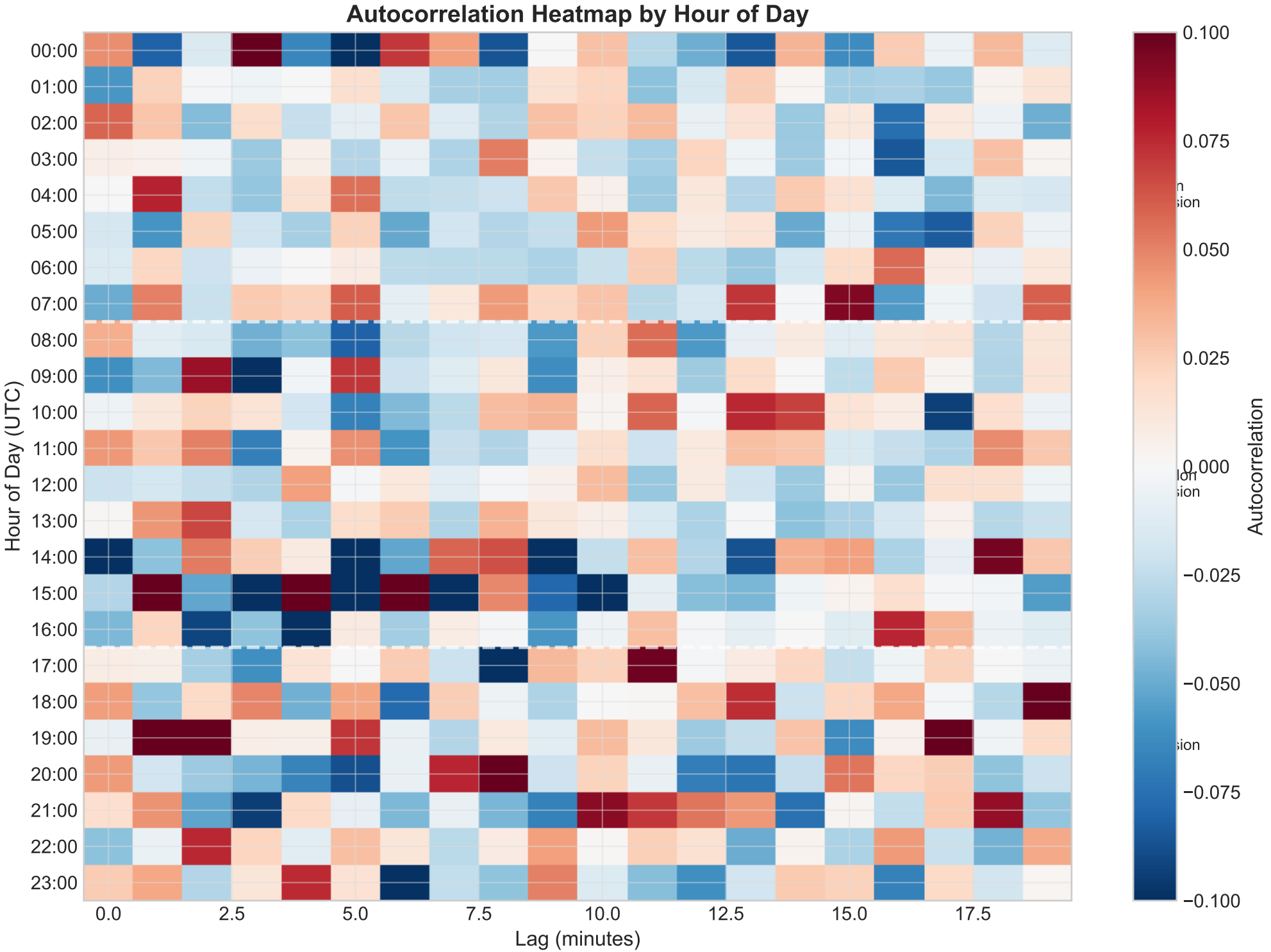

Partial Autocorrelation Function (PACF) of 1-Minute Returns
95% Confidence
Partial Autocorrelation
1.0
0.8
0.6
0.4
0.2
0.0
0
10
20
30
40
50
Lag (minutes)


ACF of Squared Returns (Volatility Clustering)
95% CI
Strong persistence in squared returns indicates volatility clustering (ARCH/GARCH effects)
Autocorrelation
1.0
0.8
0.6
0.4
0.2
0.0
0
20
40
60
80
100
Lag (minutes)

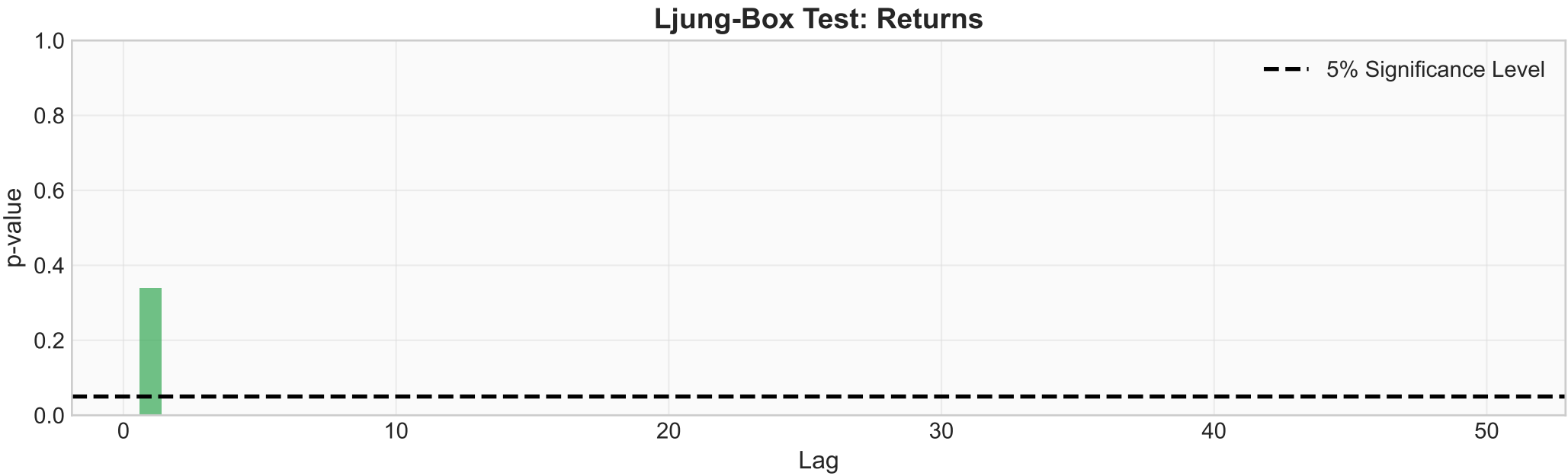

ACF of Absolute Returns (Volatility Persistence)
95% CI
Long memory property detected:
ACF decays slowly (characteristic of financial volatility)
Autocorrelation
1.0
0.8
0.6
0.4
0.2
0.0
0
20
40
60
80
100
Lag (minutes)

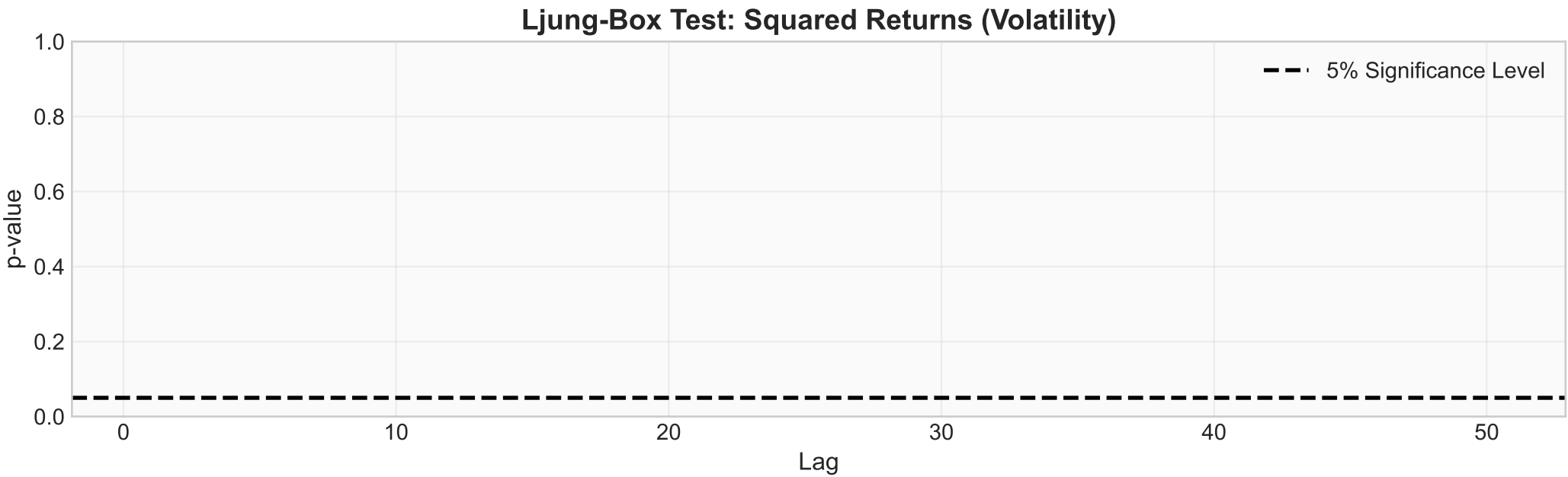

Autocorrelation Comparison: Returns vs Volatility Proxies
Returns: Little Autocorrelation (Efficient Market)
ACF
0.15
0.10
0.05
0.00
−0.05
−0.10
−0.15
Squared Returns: Strong Volatility Clustering
ACF
1.0
0.8
0.6
0.4
0.2
0.0
Absolute Returns: Persistent Volatility
ACF
1.0
0.8
0.6
0.4
0.2
0.0
0
10
20
30
40
50
60
Lag (minutes)


ACF of Returns at Different Frequencies
1min Returns (n=28,876)
5min Returns (n=6,041)
15min Returns (n=2,015)
1h Returns (n=503)
ACF
Lag
0.0
0.2
0.4
0.6
0.8
1.0
0
5
10
15
20
25
30
35
40

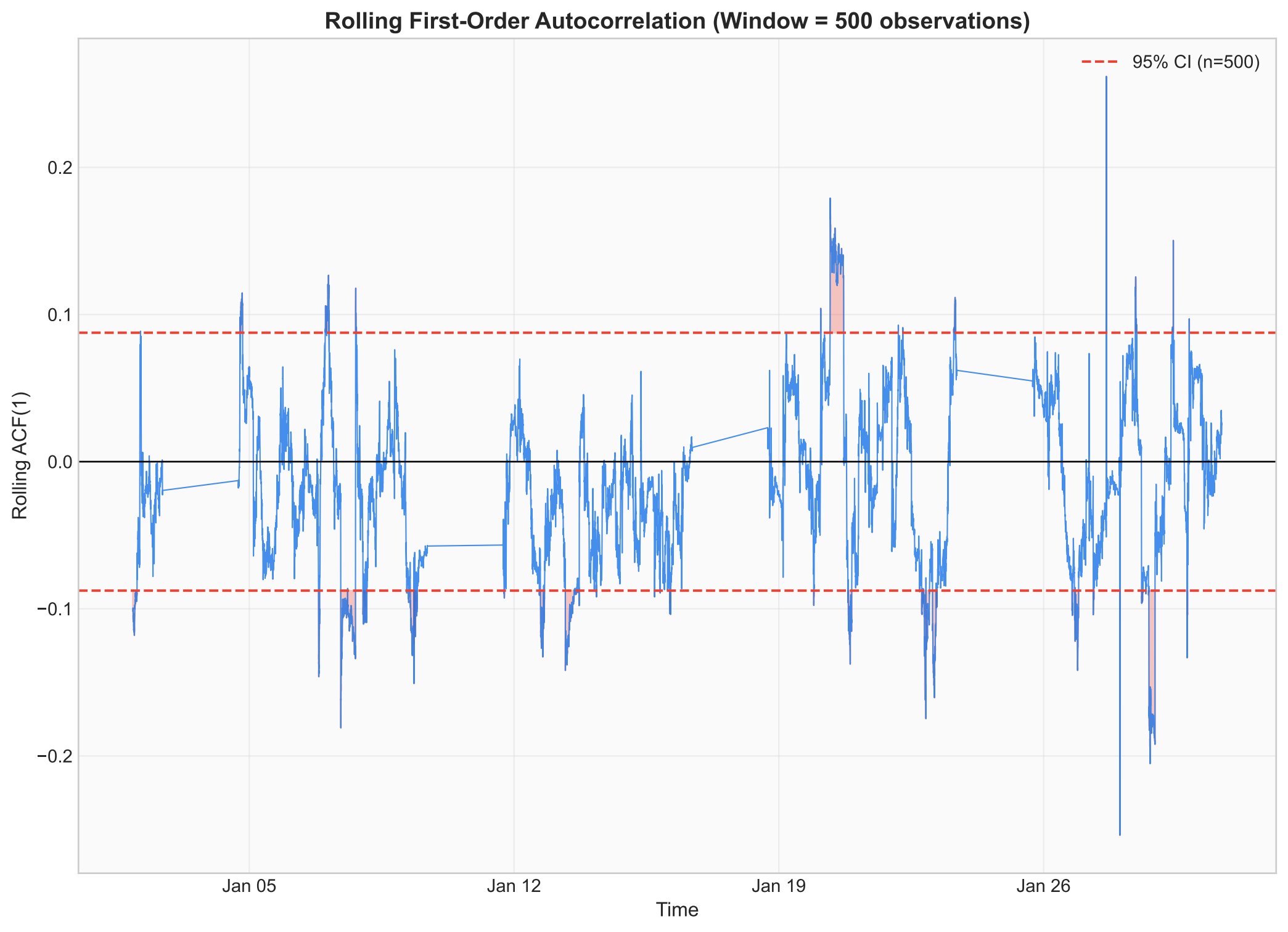

Autocorrelation Heatmap by Hour of Day
Hour of Day (UTC)
00:00
01:00
02:00
03:00
04:00
05:00
06:00
07:00
08:00
09:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5
Lag (minutes)
Autocorrelation
0.100
0.075
0.050
0.025
0.000
−0.025
−0.050
−0.075
−0.100

Ljung-Box Tests for Autocorrelation (H0: No Autocorrelation)





Returns: 49/50 lags significant | Squared Returns: 50/50 lags significant


Rolling First-Order Autocorrelation (Window = 500 observations)
95% CI (n=500)
0.2
0.1
0.0
−0.1
−0.2
Rolling ACF(1)
Jan 05
Jan 12
Jan 19
Jan 26
Time

Summary of Autocorrelation Analysis

AUTOCORRELATION ANALYSIS SUMMARY
EUR/USD Tick Data - January 2026

1. RETURNS AUTOCORRELATION
   - Significant lags at 5% level: 7/20
   - Ljung-Box p-value (lag 10): 0.0000
   - Interpretation: Evidence of serial correlation (consistent with efficient market hypothesis)

2. VOLATILITY CLUSTERING
   - Significant lags in squared returns: 20/20
   - Ljung-Box p-value (lag 10): 0.0000
   - Interpretation: Strong volatility clustering (ARCH effects)

3. KEY FINDINGS
   - Returns show minimal autocorrelation (market efficiency)
   - Squared/absolute returns show strong persistence (GARCH effects)
   - Autocorrelation patterns vary by trading session
   - Long memory property observed in volatility

4. IMPLICATIONS
   - Standard ARMA models unlikely to improve return prediction
   - GARCH-family models appropriate for volatility modeling
   - Consider regime-switching models for intraday patterns