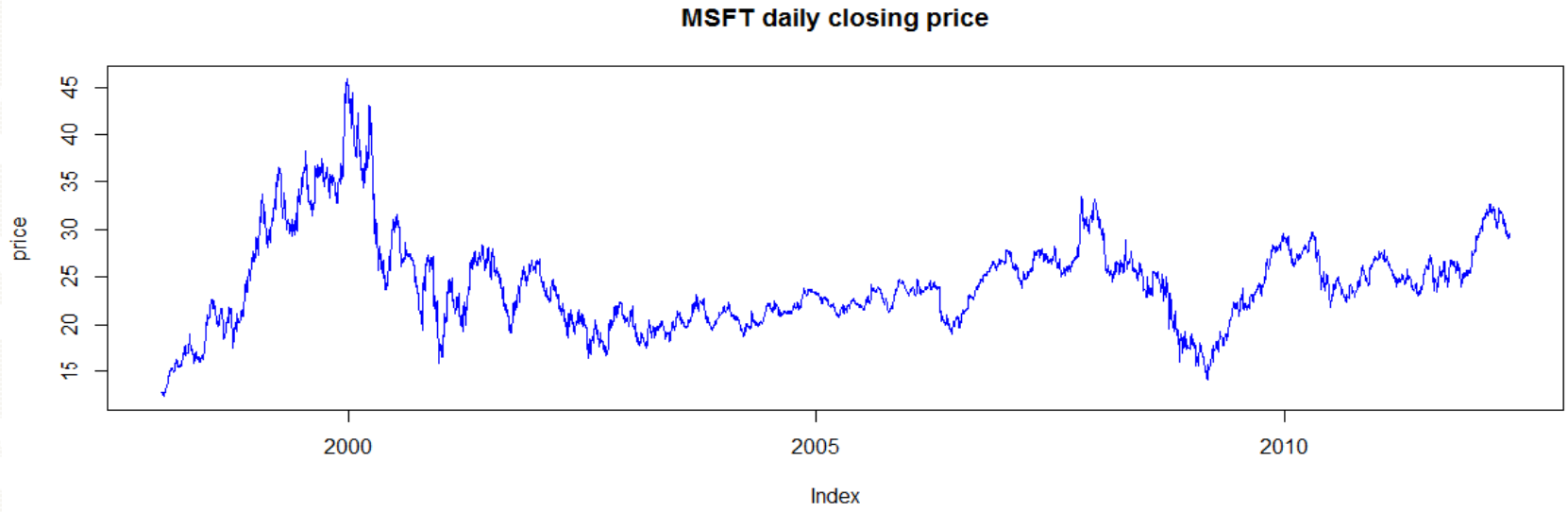
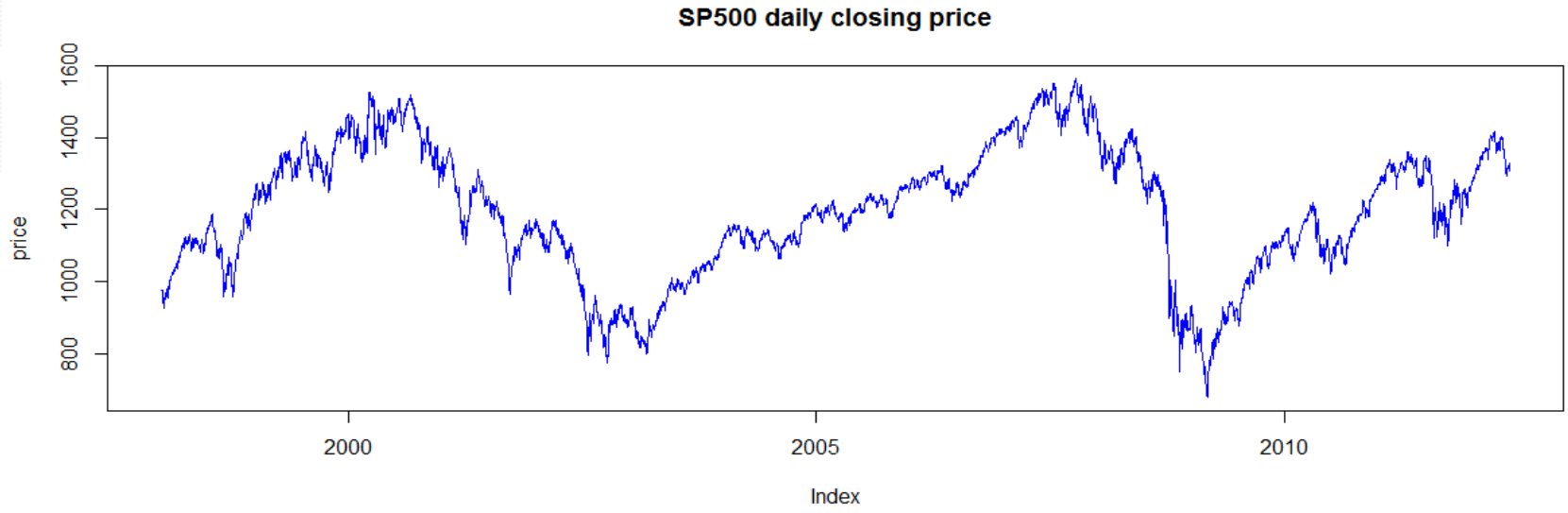
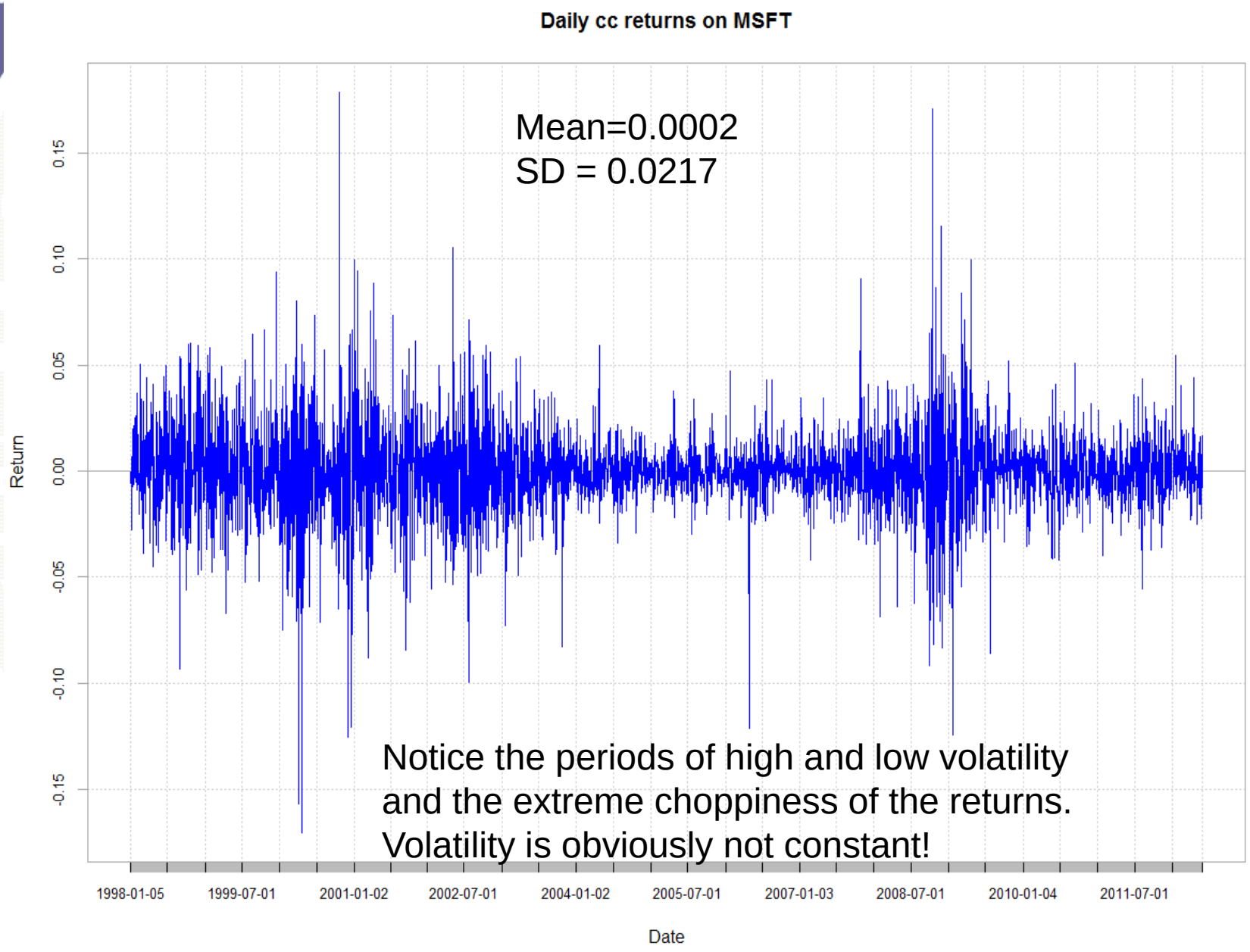
Descriptive Statistics for Daily Return Data

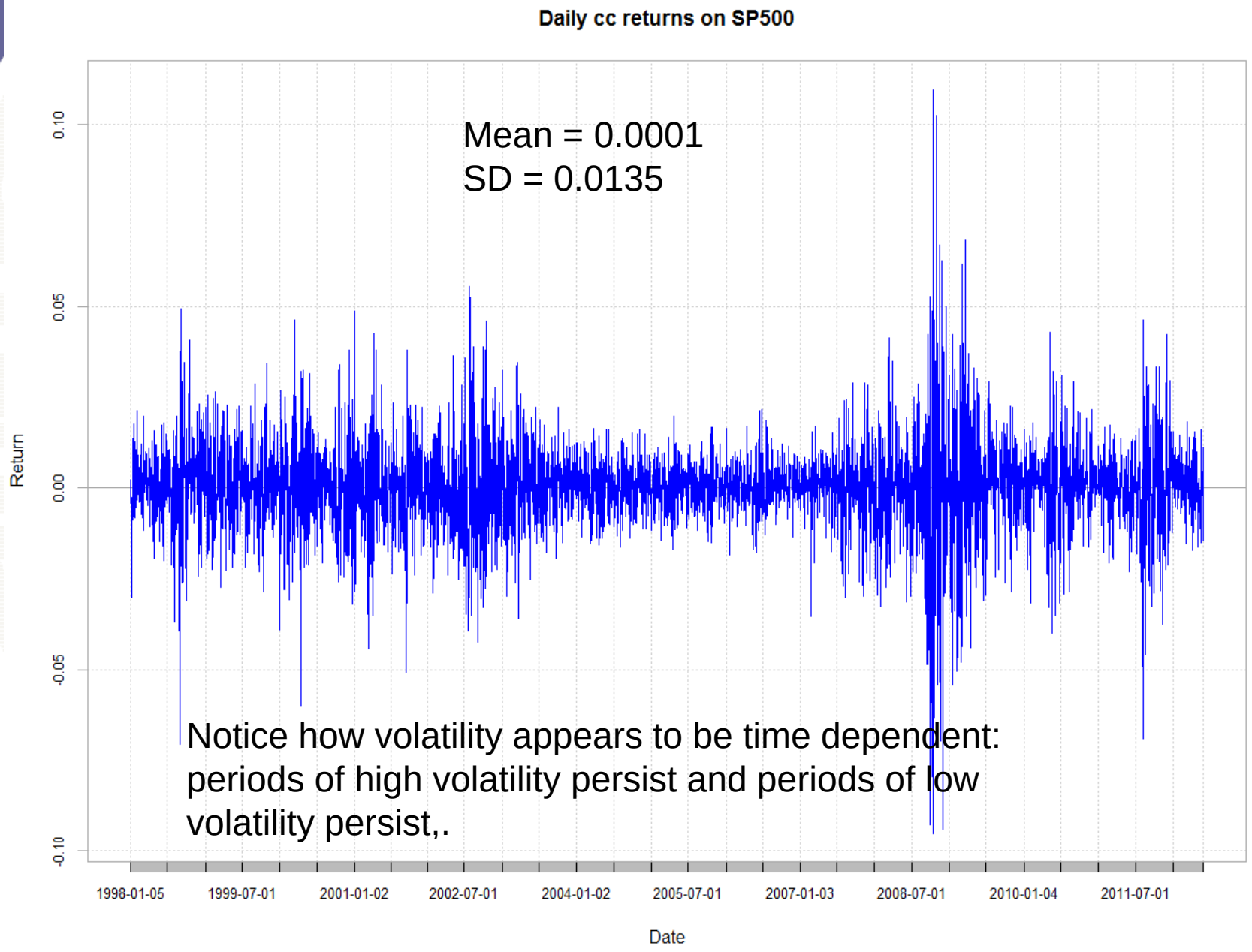
Econ 424
Fall 2014
Eric Zivot
Update: October 21, 2014

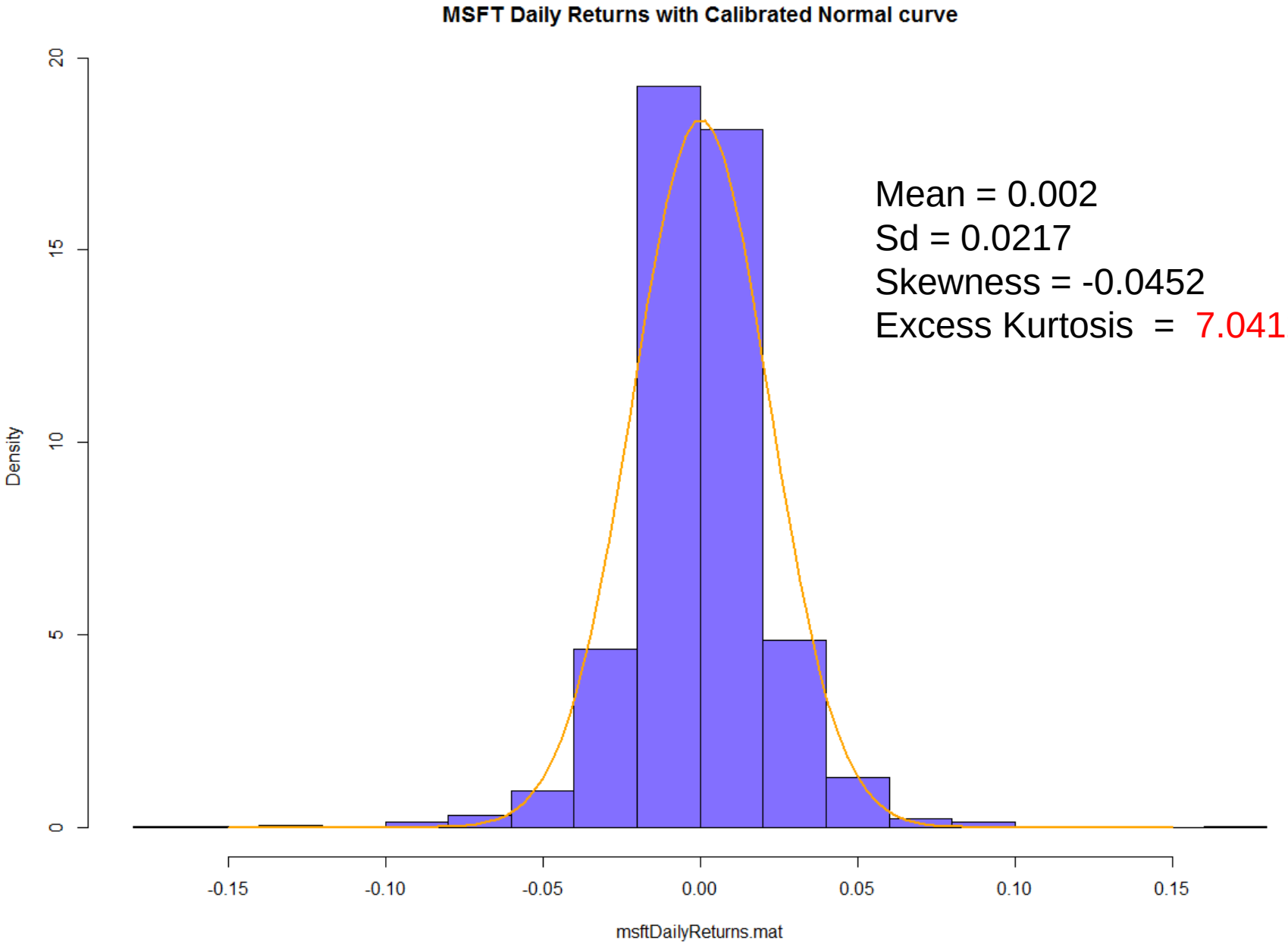
Daily Prices on Microsoft and the S&P 500 Index: January 1998 –May 2012, n = 3,627



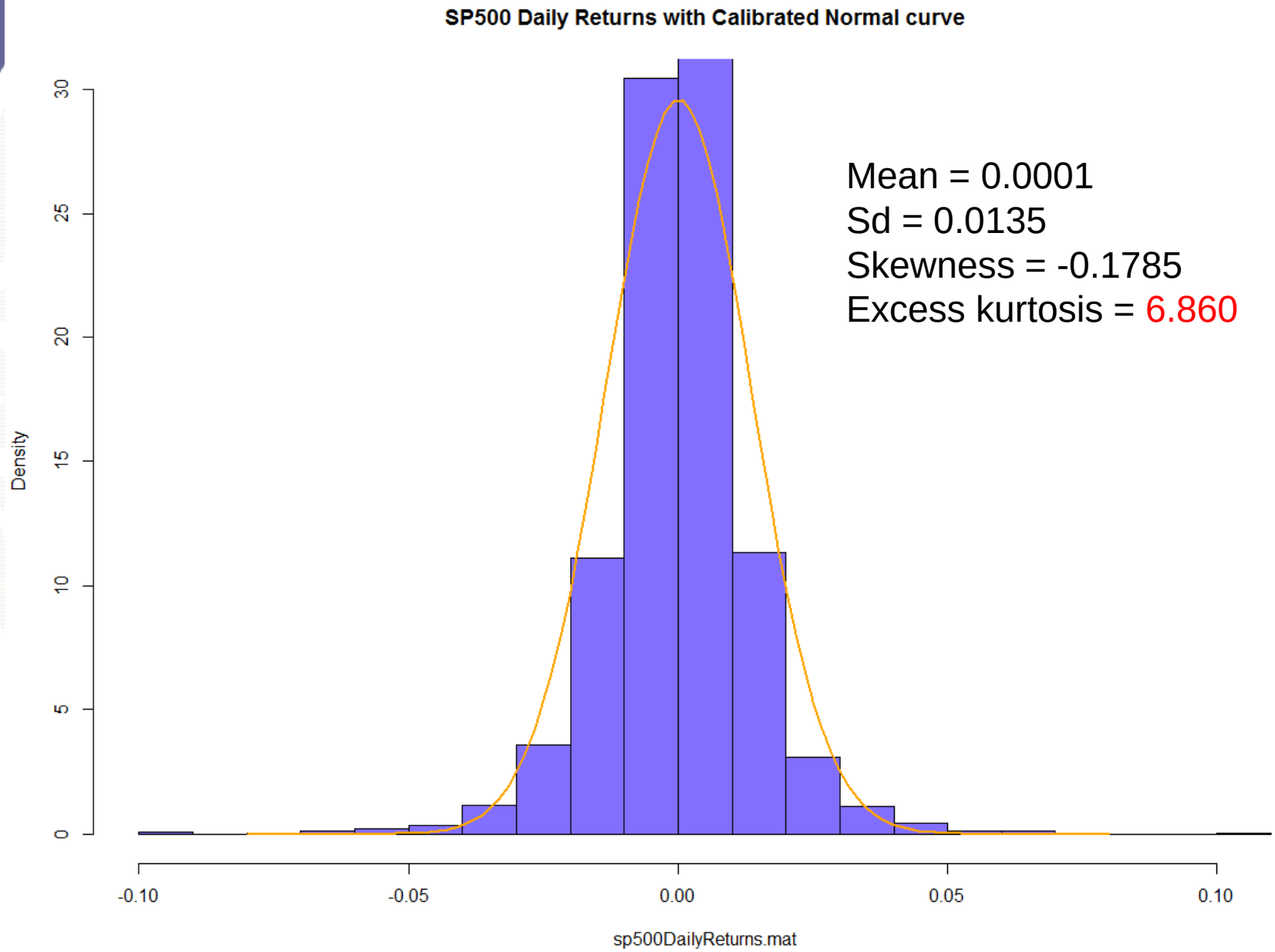


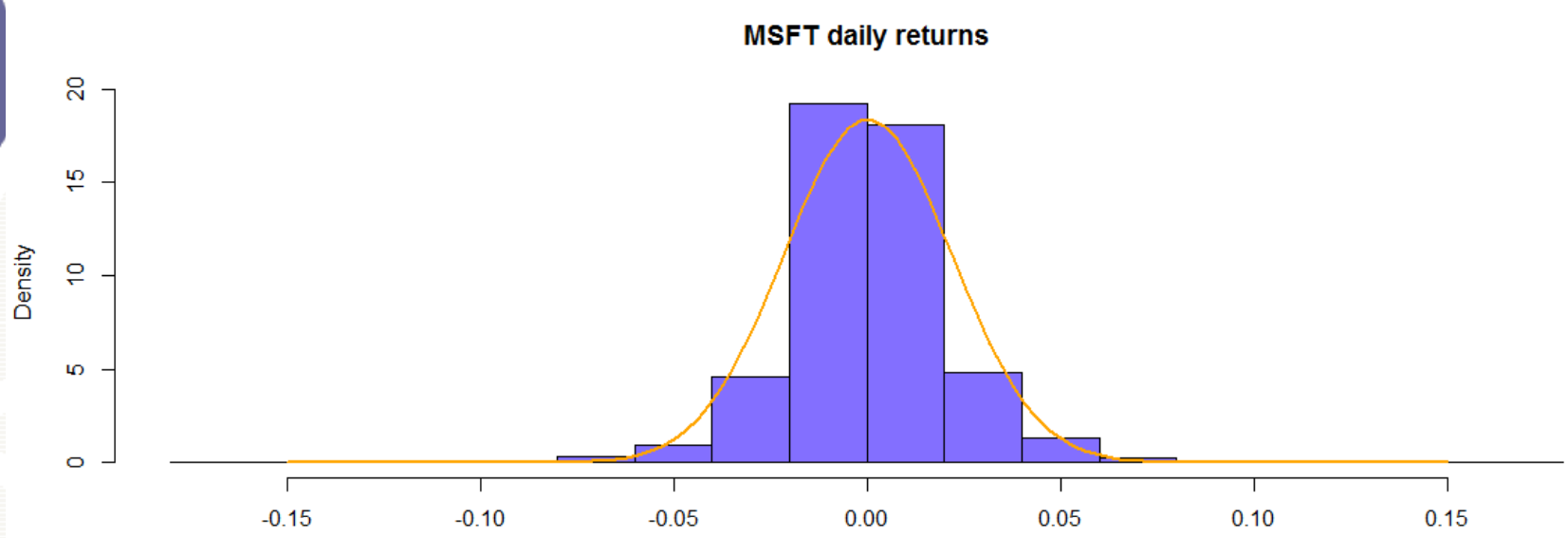


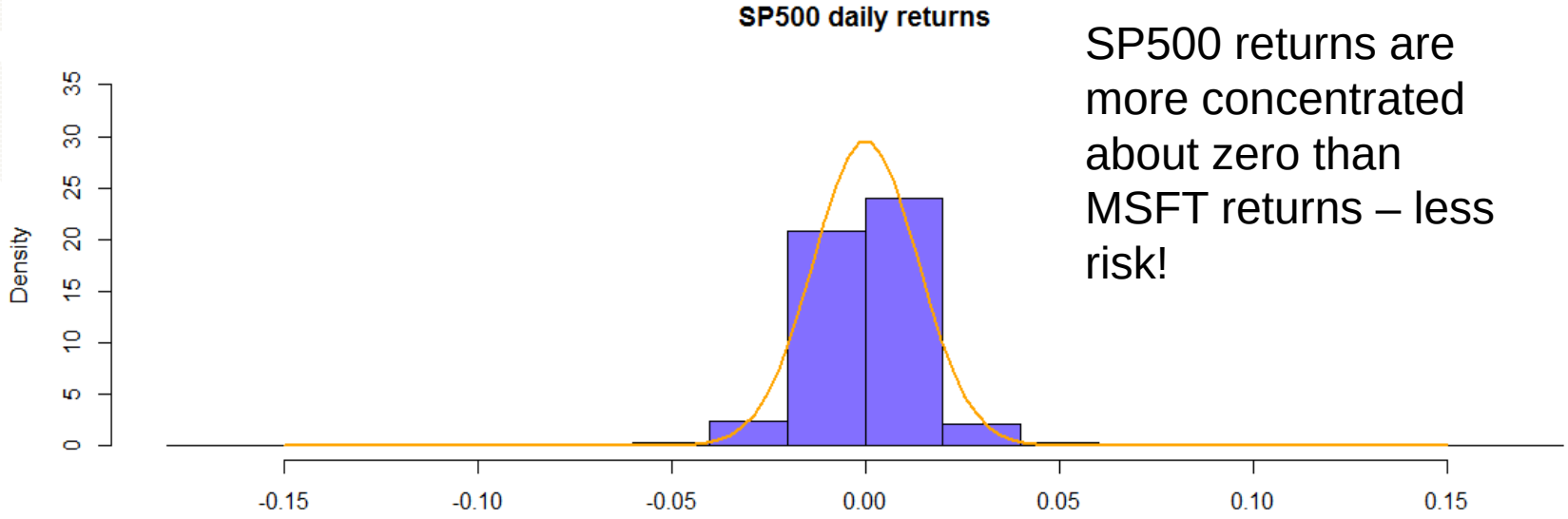

Daily cc returns on SP500
Mean = 0.0001
SD = 0.0135
Notice how volatility appears to be time dependent: periods of high volatility persist and periods of low volatility persist,.
Return
0.10
0.05
0.00
-0.05
-0.10
1998-01-05
1999-07-01
2001-01-02
2002-07-01
2004-01-02
2005-07-01
2007-01-03
2008-07-01
2010-01-04
2011-07-01
Date



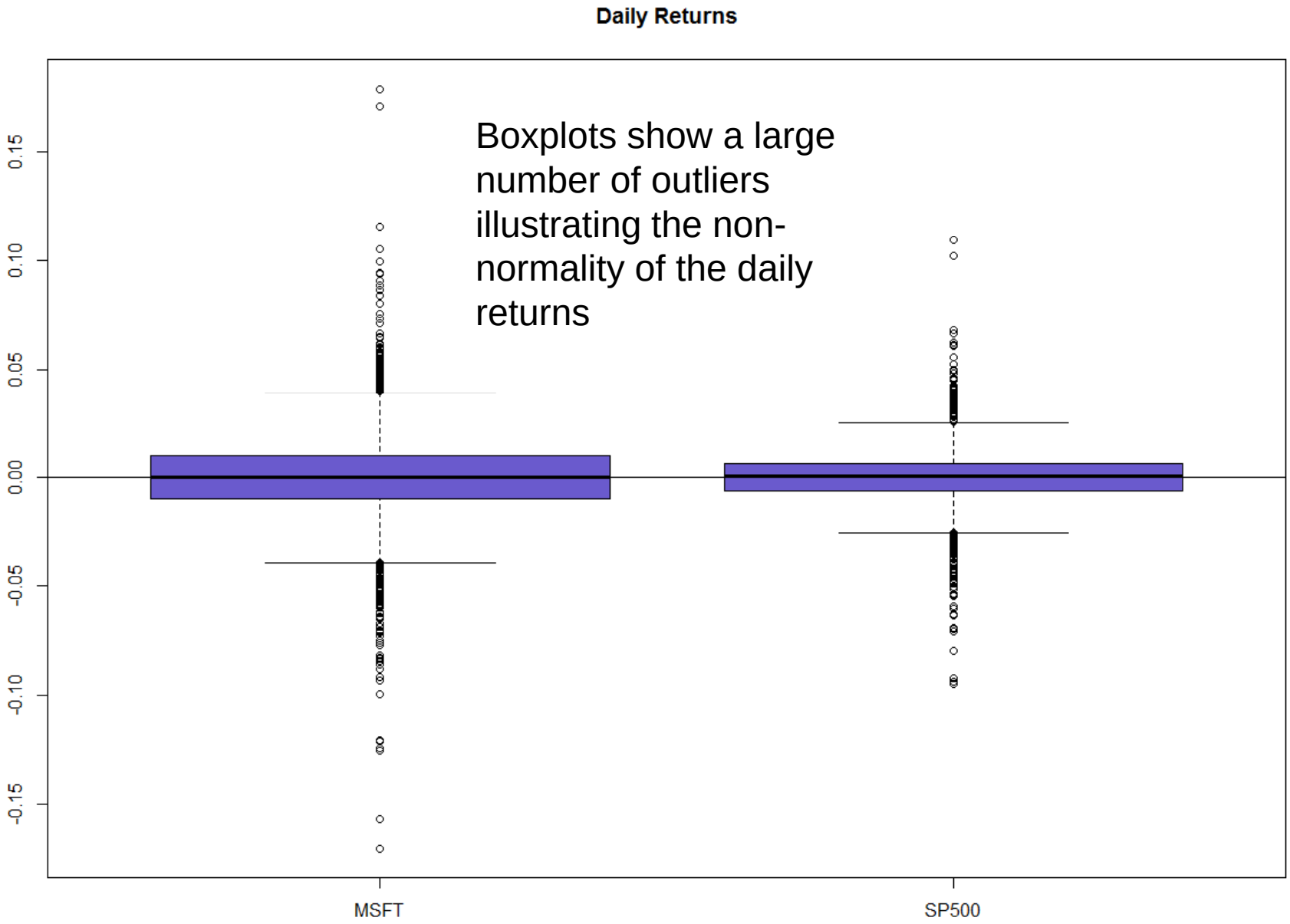
Mean = 0.002
Sd = 0.0217
Skewness = -0.0452
Excess Kurtosis = 7.0412







SP500 returns are more concentrated about zero than MSFT returns – less risk!

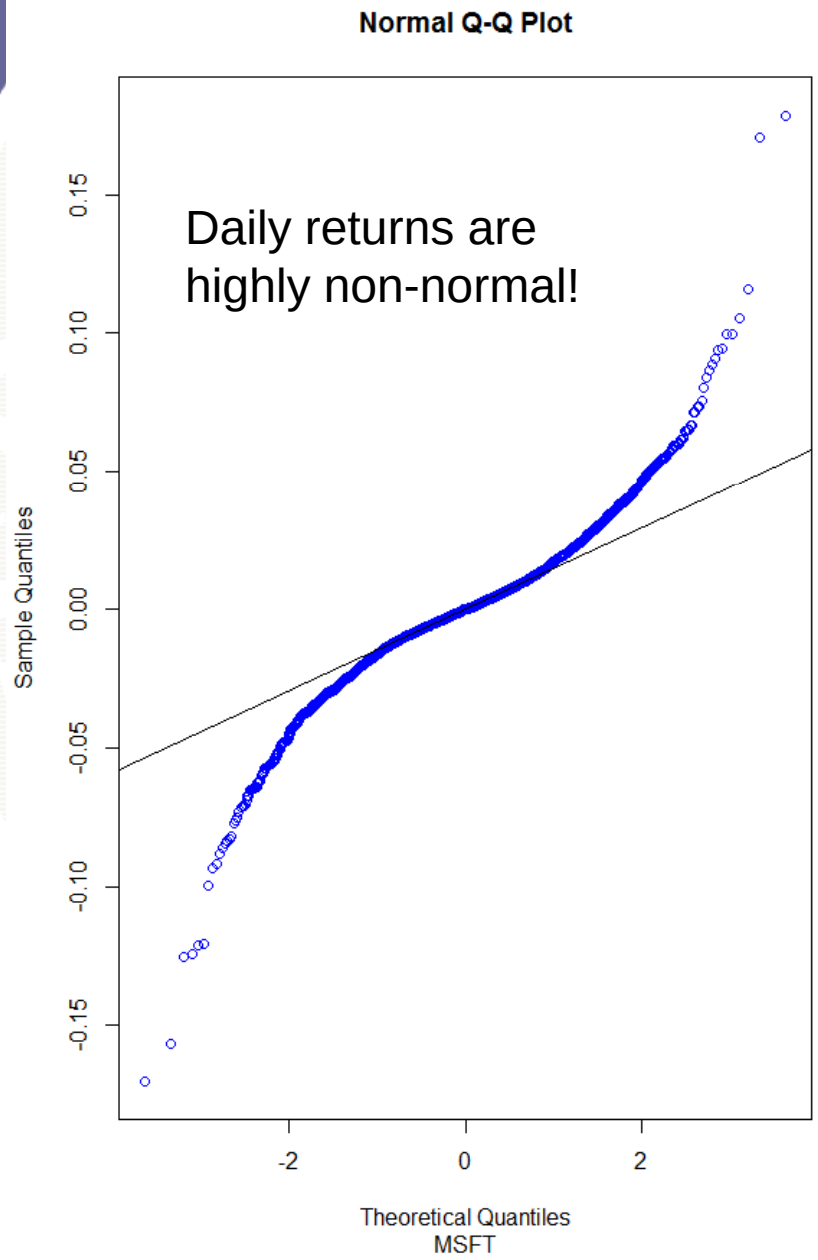


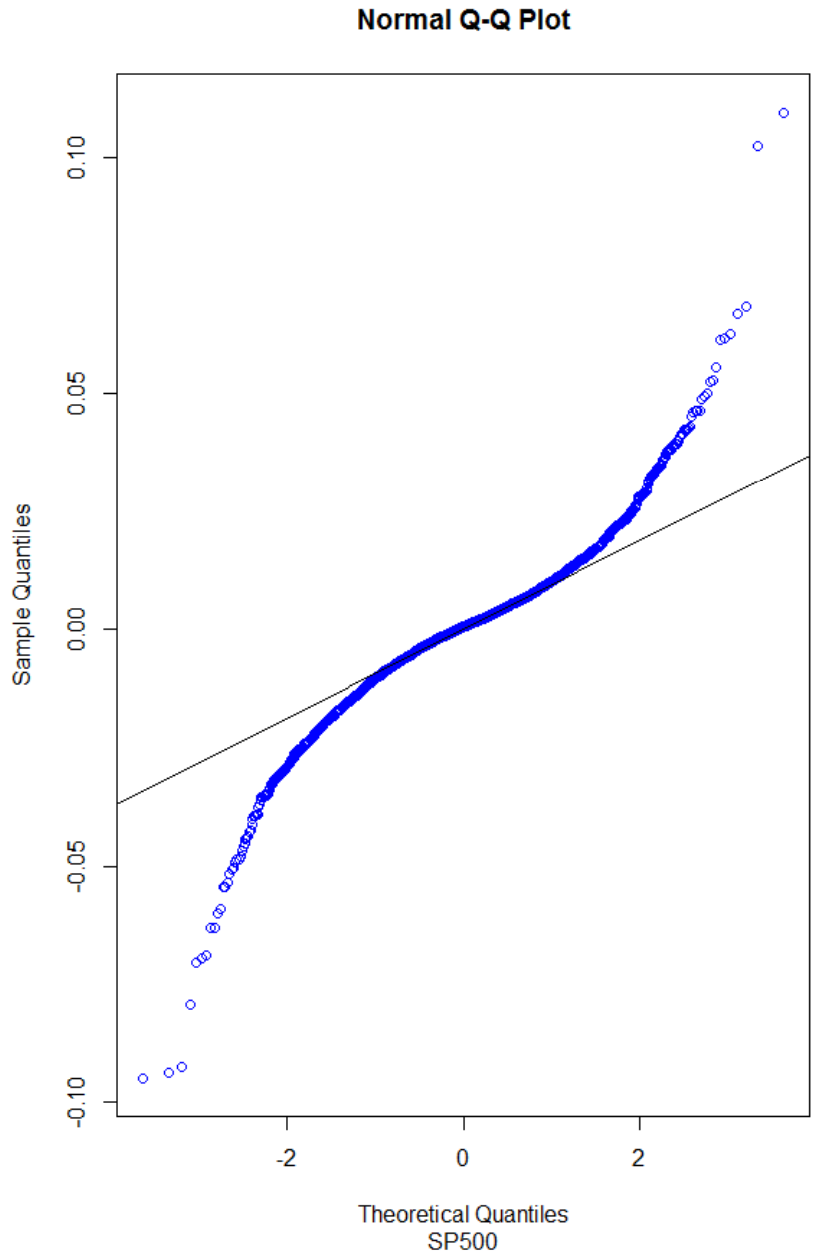
Daily Historical VaR on $100K invested in MSFT

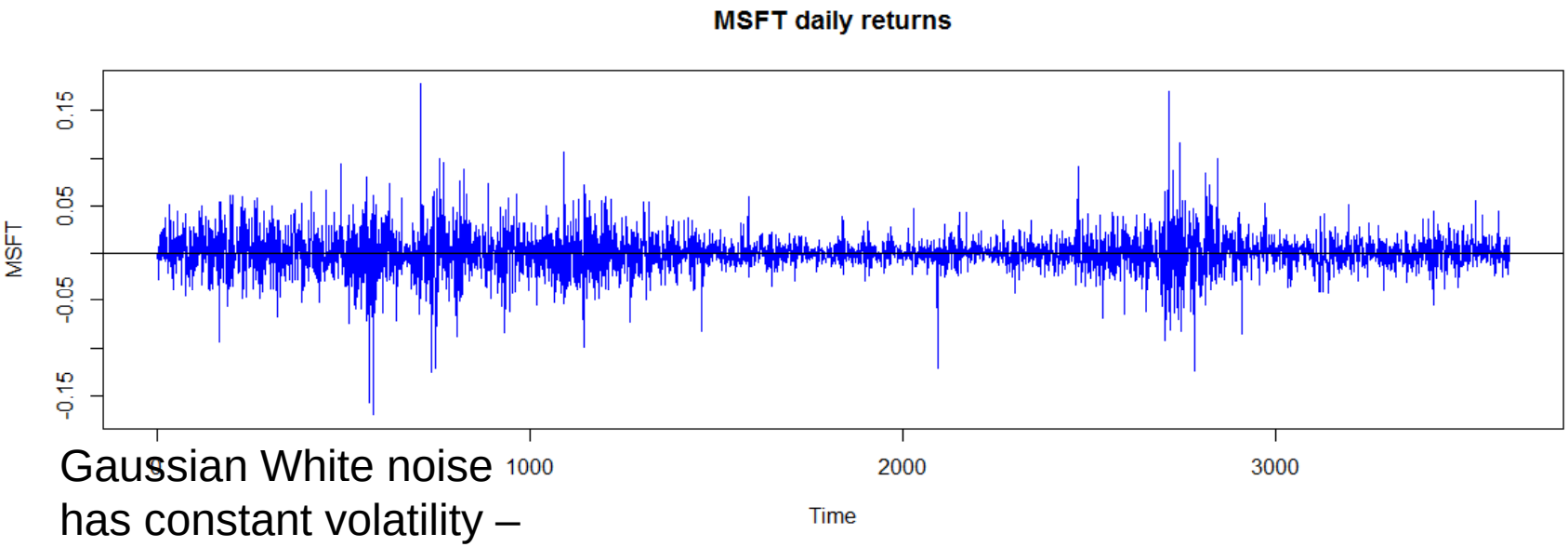
```
# Compute daily VaR using empirical quantiles
> q.01 = quantile(msftDailyReturns.mat, probs=0.01)
> q.05 = quantile(msftDailyReturns.mat, probs=0.05)
> q.01
      1%
-0.05854
> q.05
      5%
-0.03243
> VaR.01 = 100000*(exp(q.01) - 1)
> VaR.05 = 100000*(exp(q.05) - 1)
> VaR.01
   1%
-5686
> VaR.05
   5%
-3191
```

Daily Historical VaR on $100K invested in SP500

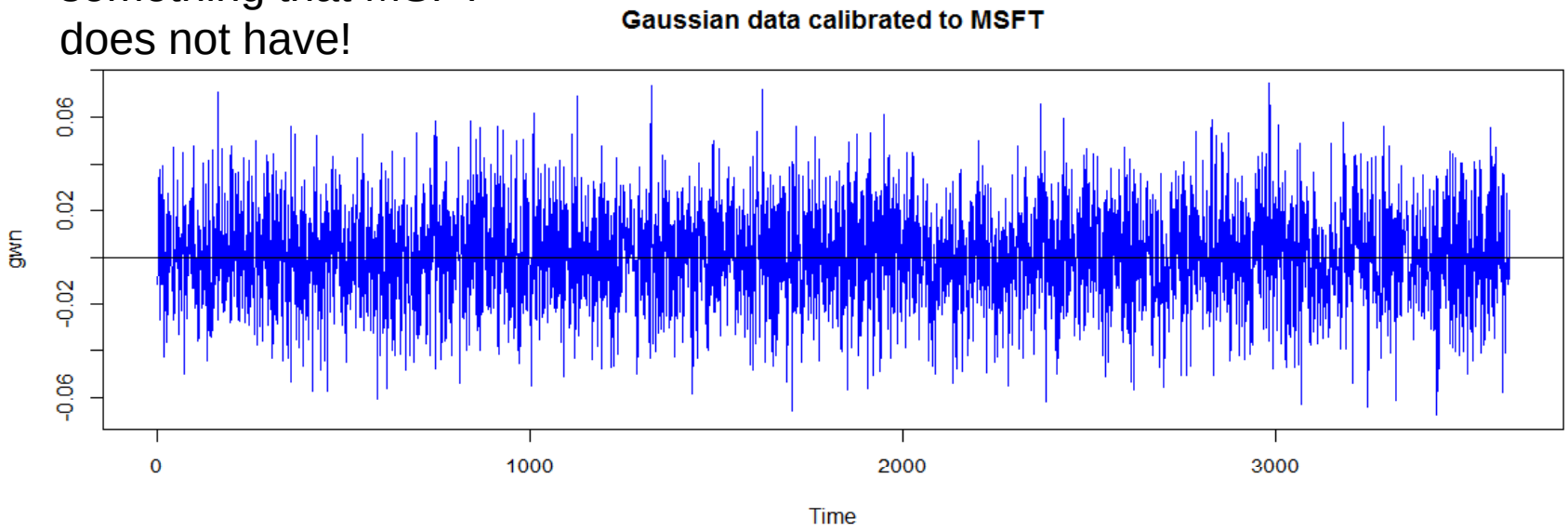
```
# Compute daily VaR using empirical quantiles
> q.01 = quantile(sp500DailyReturns.mat, probs=0.01)
> q.05 = quantile(sp500DailyReturns.mat, probs=0.05)
> q.01
      1%
-0.03727
> q.05
      5%
-0.02114
> VaR.01 = 100000*(exp(q.01) - 1)
> VaR.05 = 100000*(exp(q.05) - 1)
> VaR.01
   1%
-3658
> VaR.05
   5%
-2092
```

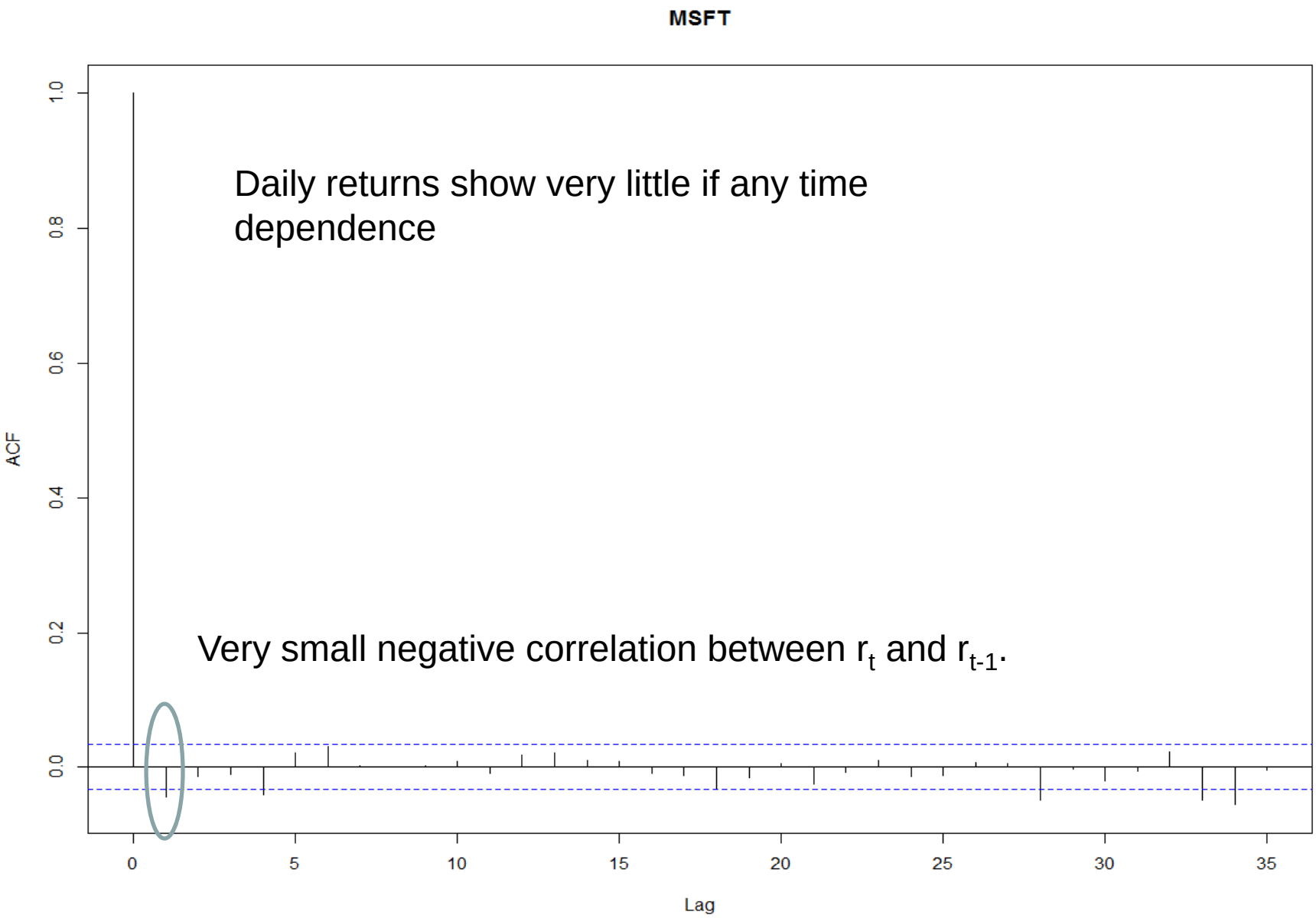


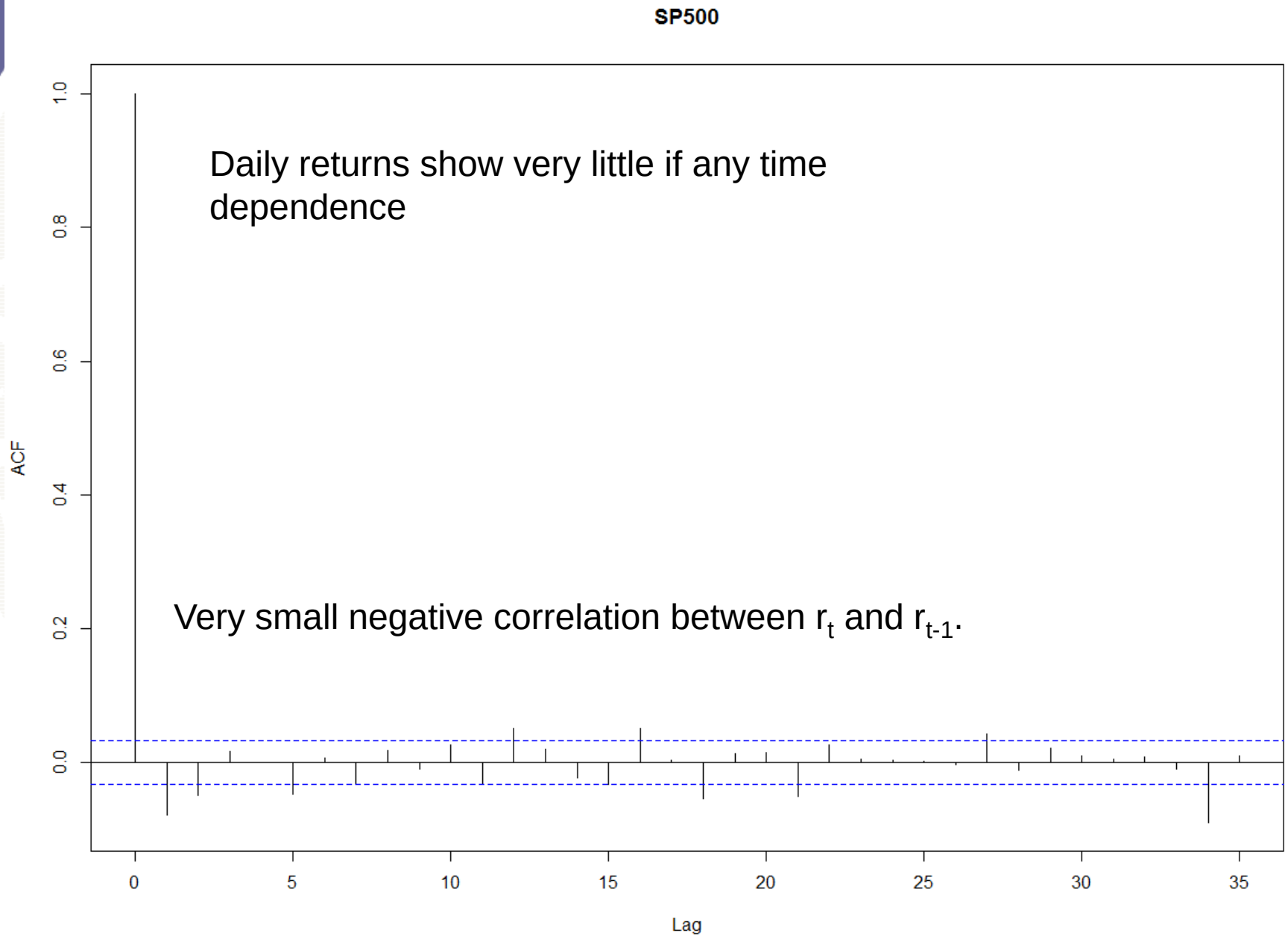


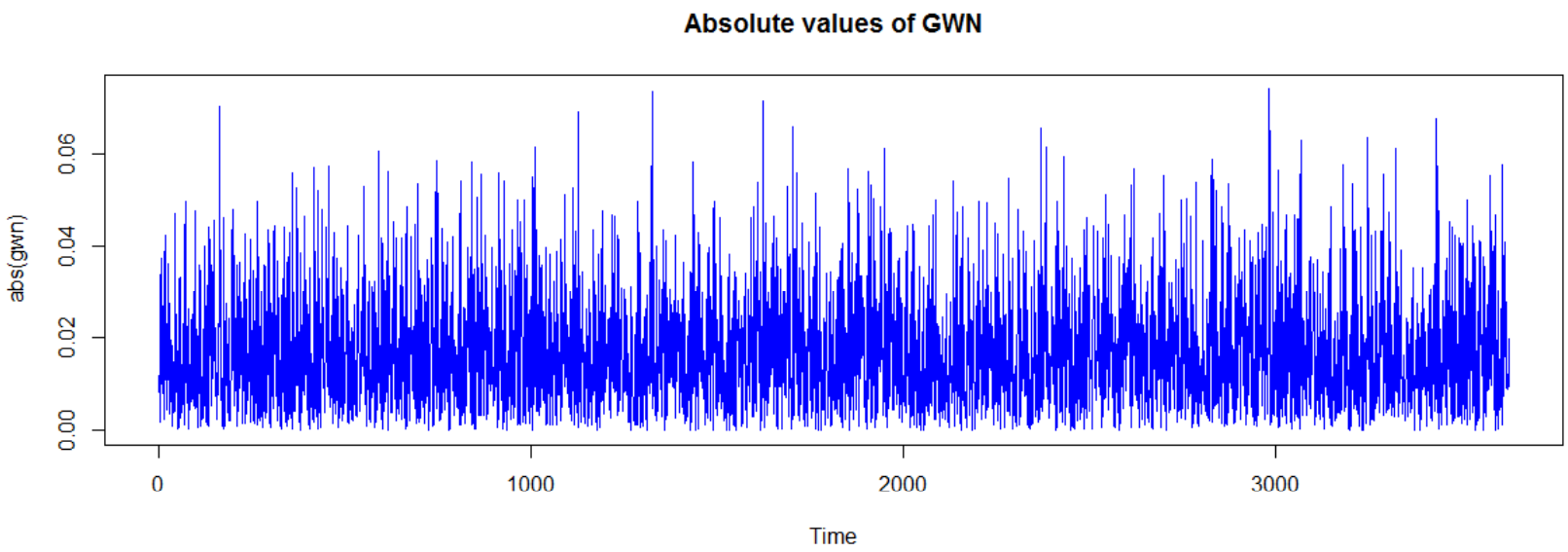


Gaussian White noise has constant volatility – something that MSFT does not have!

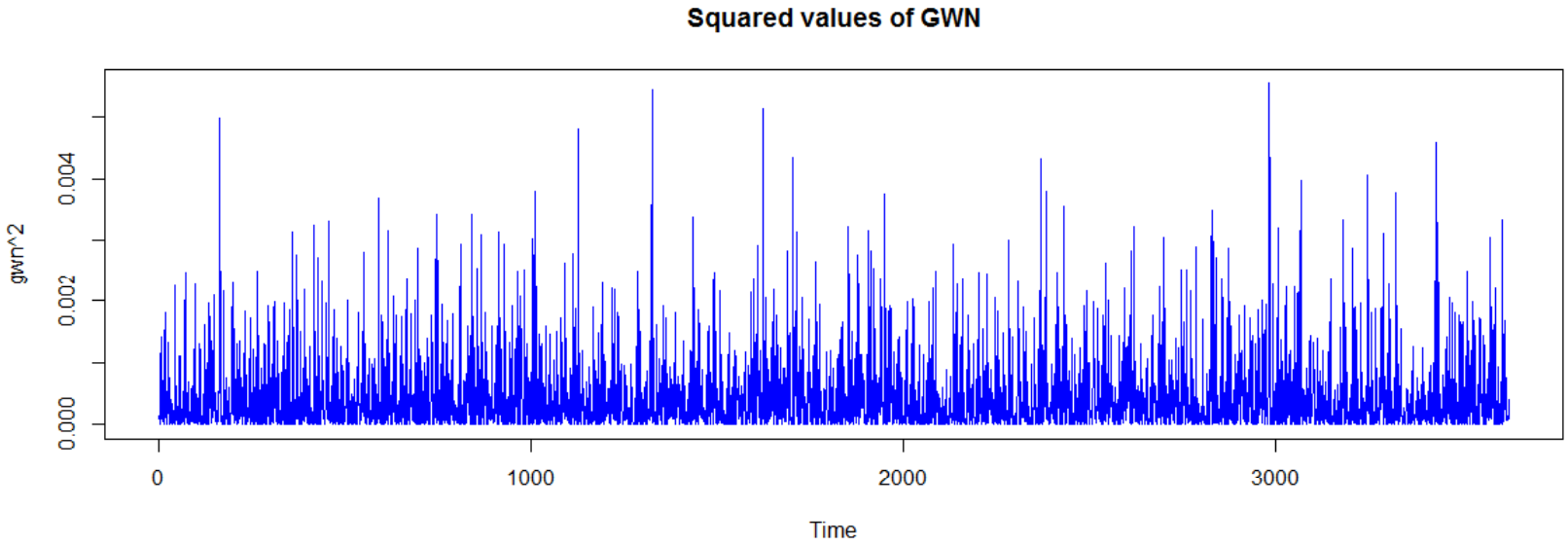


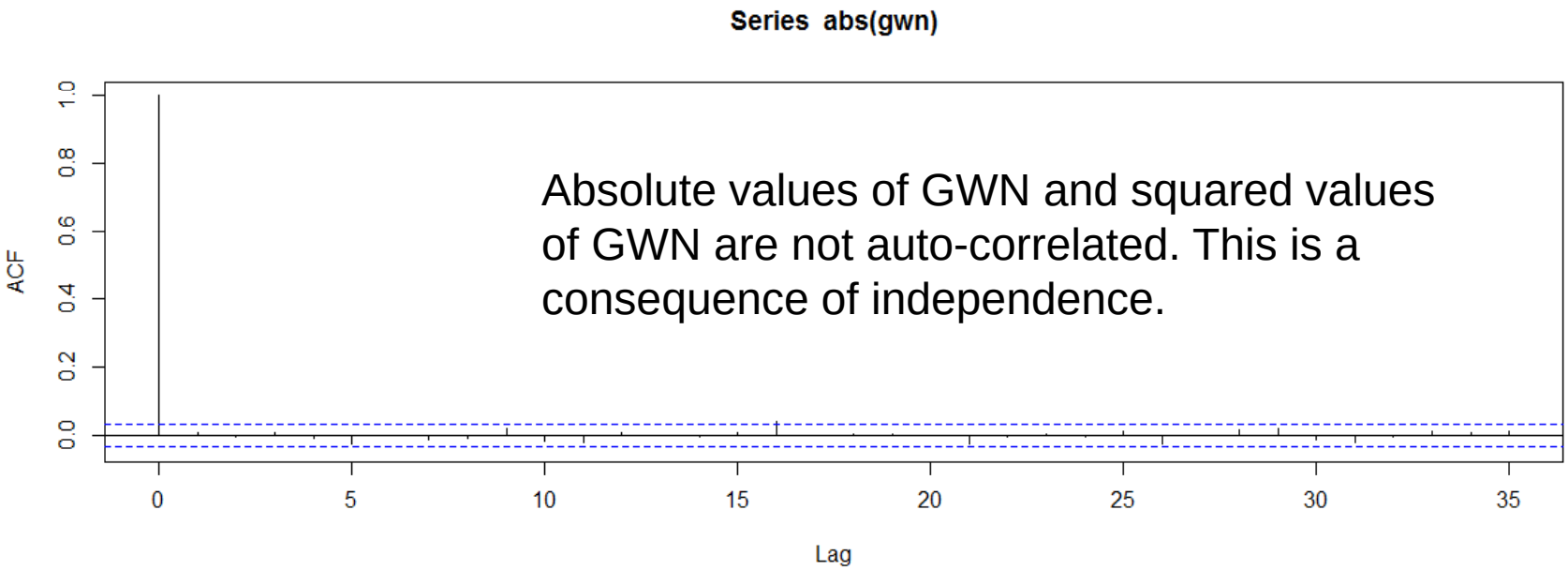



SP500
Daily returns show very little if any time dependence
Very small negative correlation between r_t and r_{t-1}.
ACF
1.0
0.8
0.6
0.4
0.2
0.0
0
5
10
15
20
25
30
35
Lag

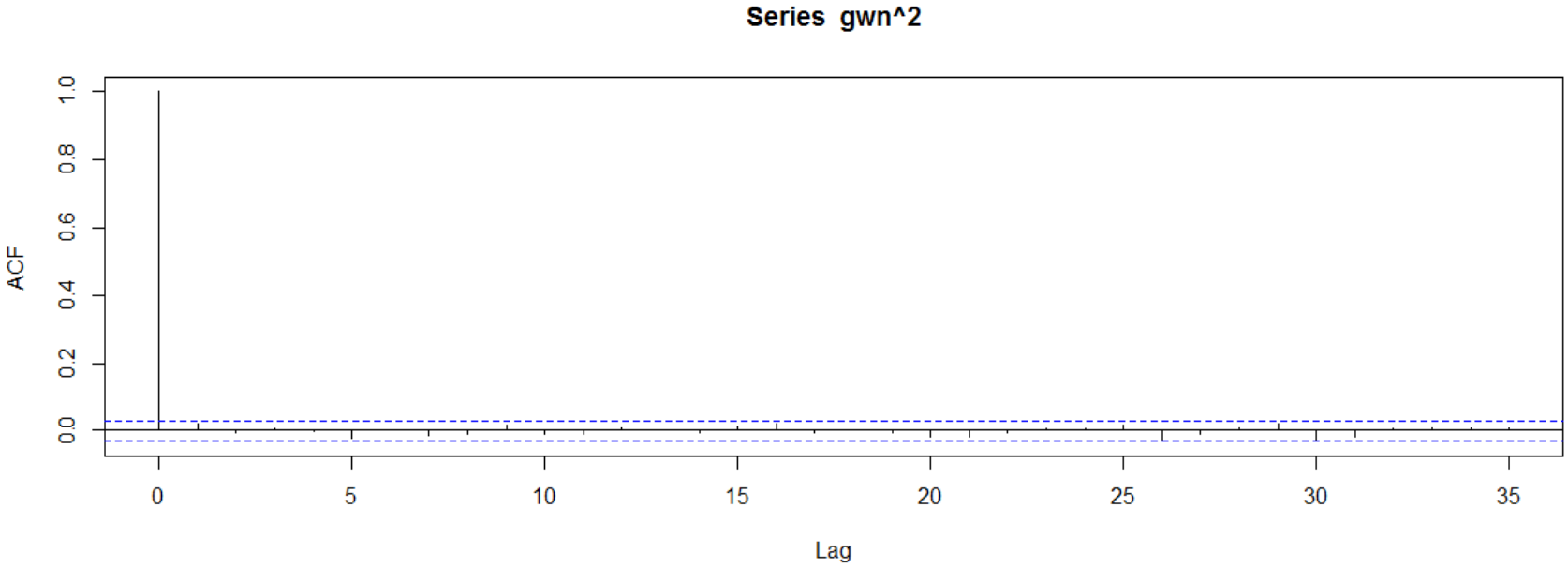


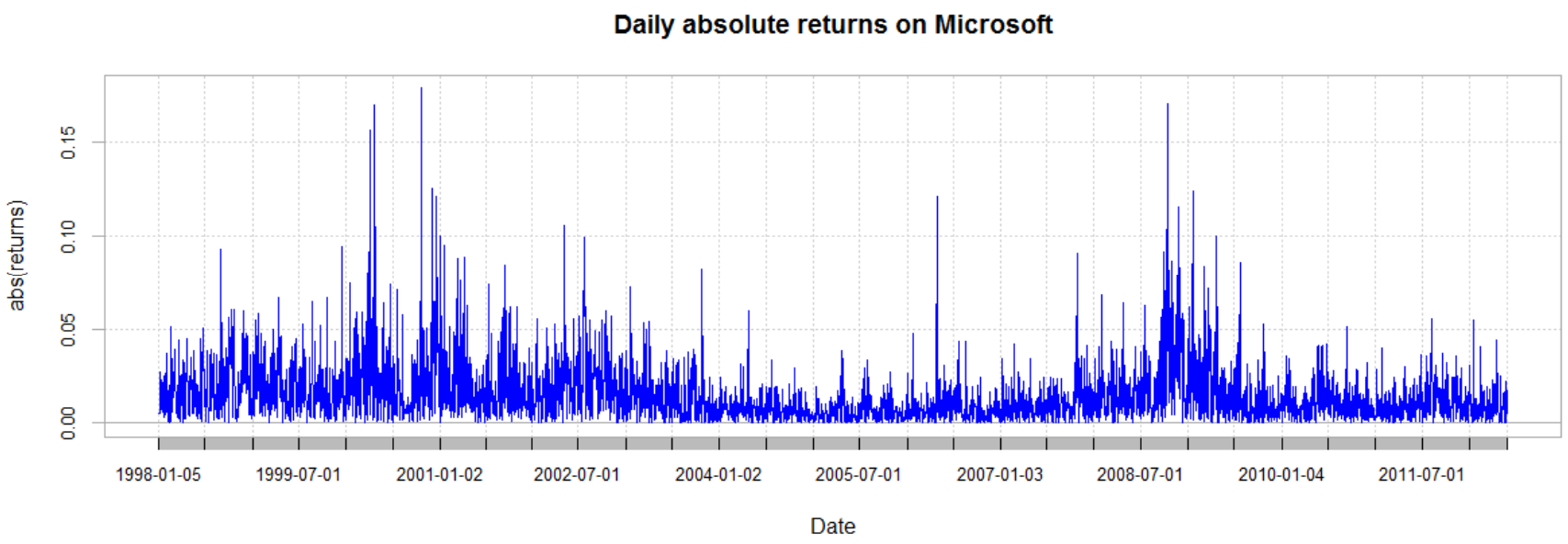
Absolute values proxy volatility; squares proxy variance

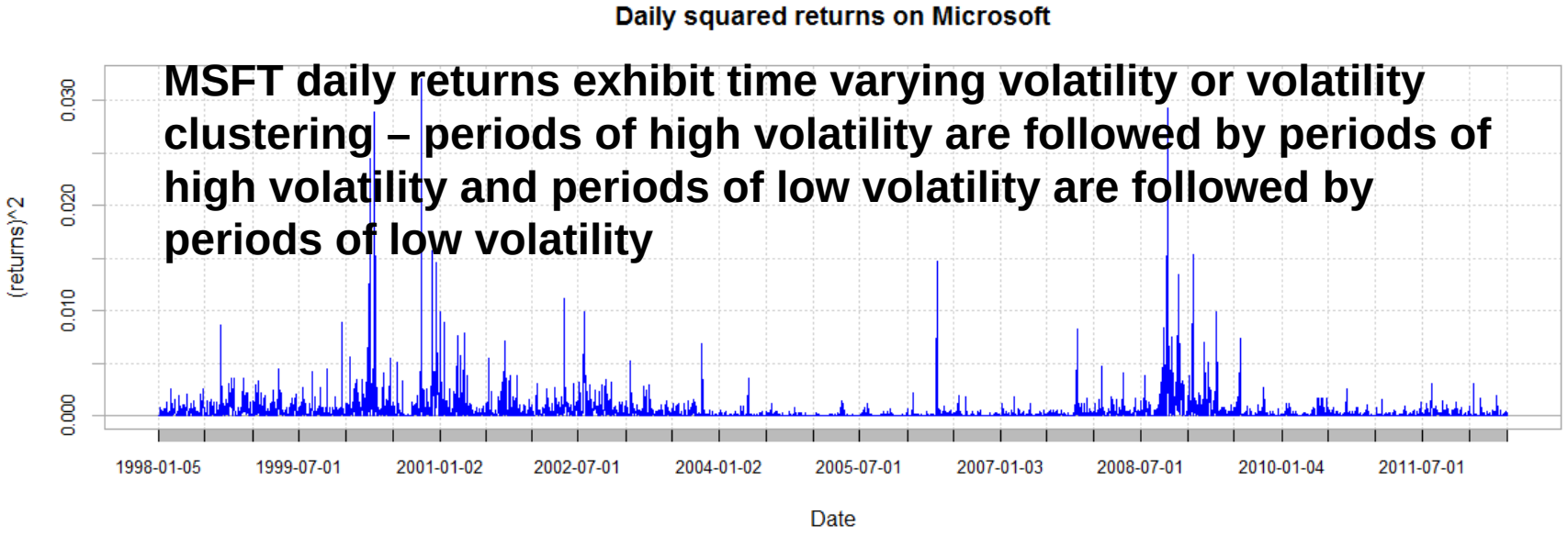




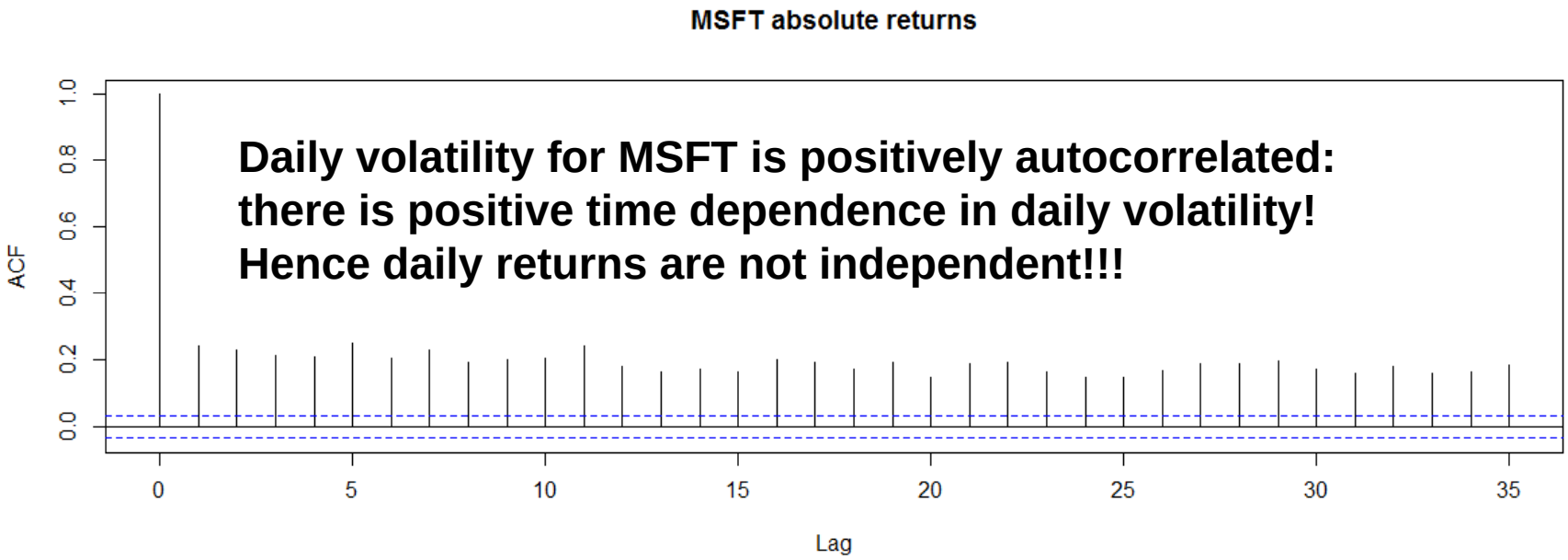
Absolute values of GWN and squared values of GWN are not auto-correlated. This is a consequence of independence.



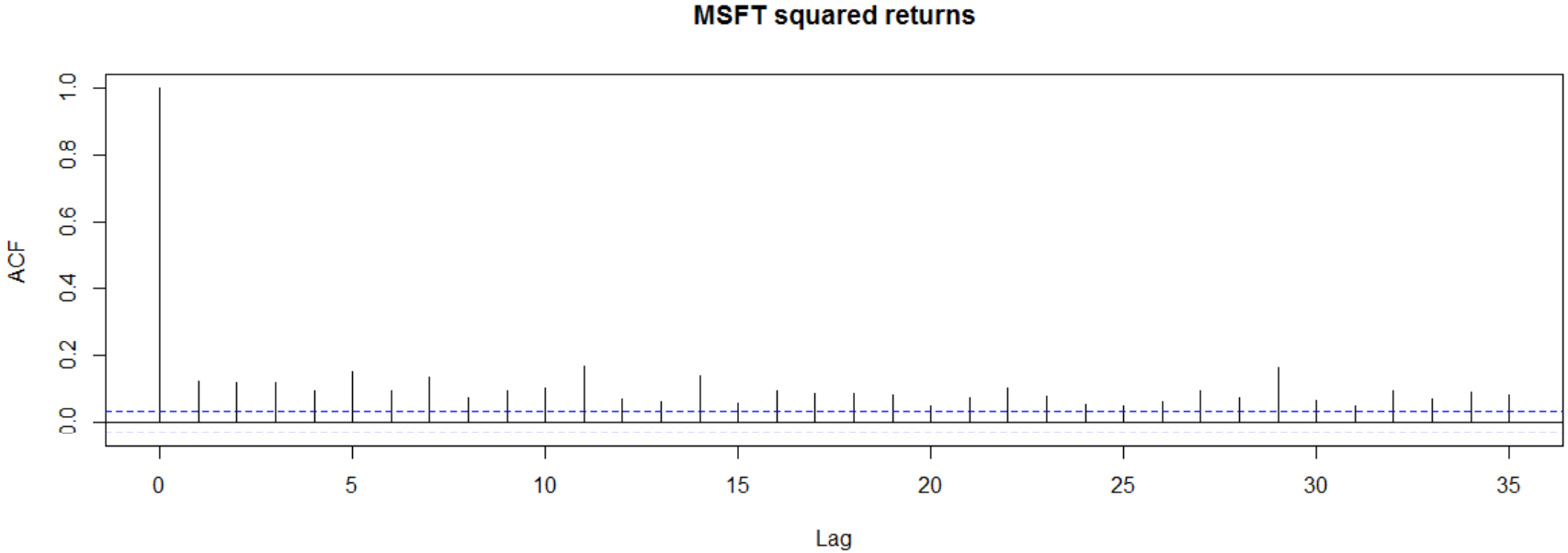




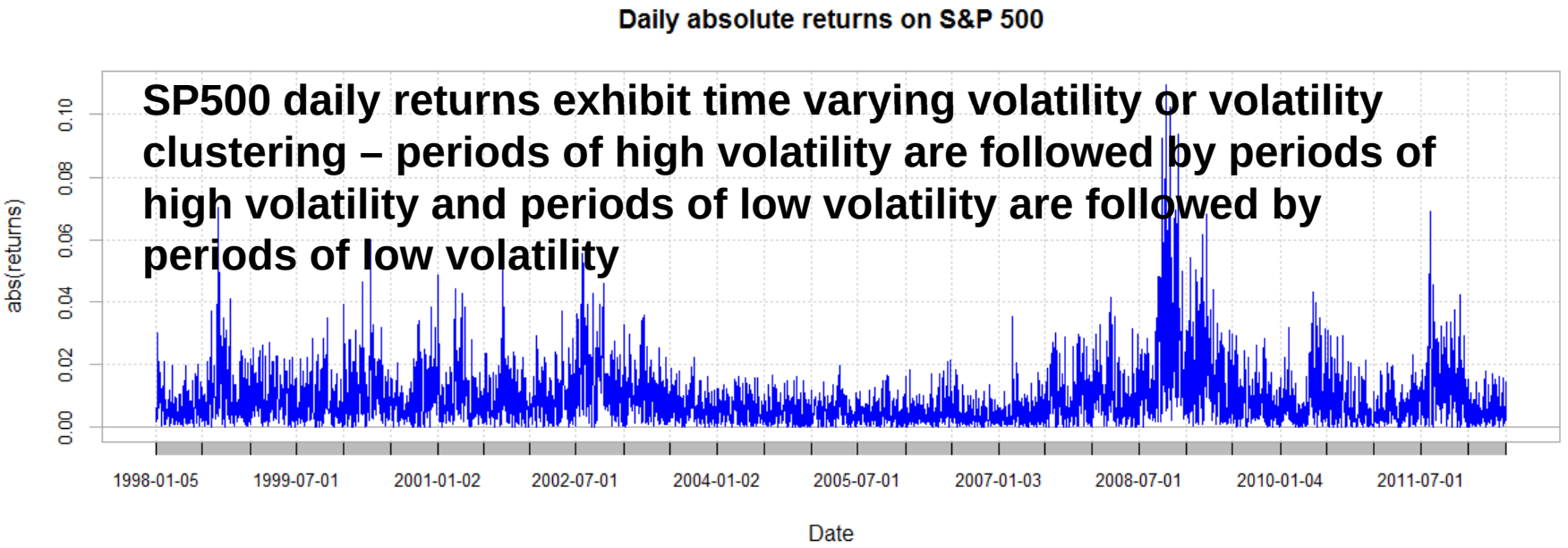
MSFT daily returns exhibit time varying volatility or volatility clustering – periods of high volatility are followed by periods of high volatility and periods of low volatility are followed by periods of low volatility

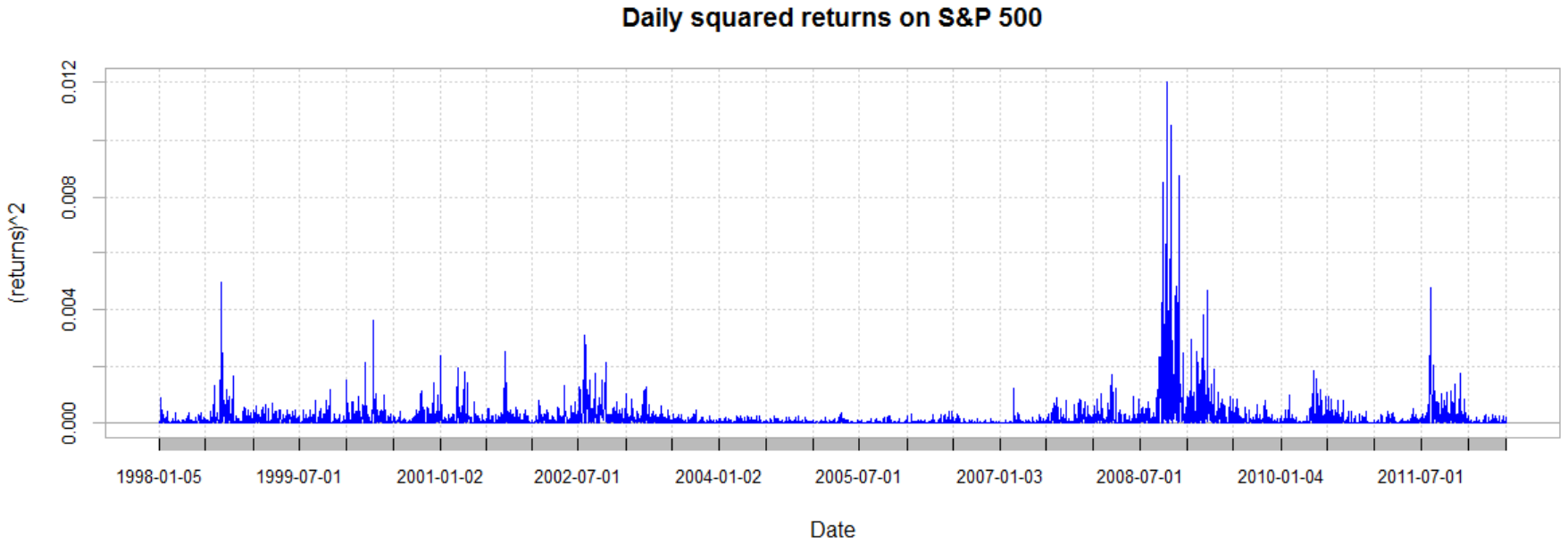


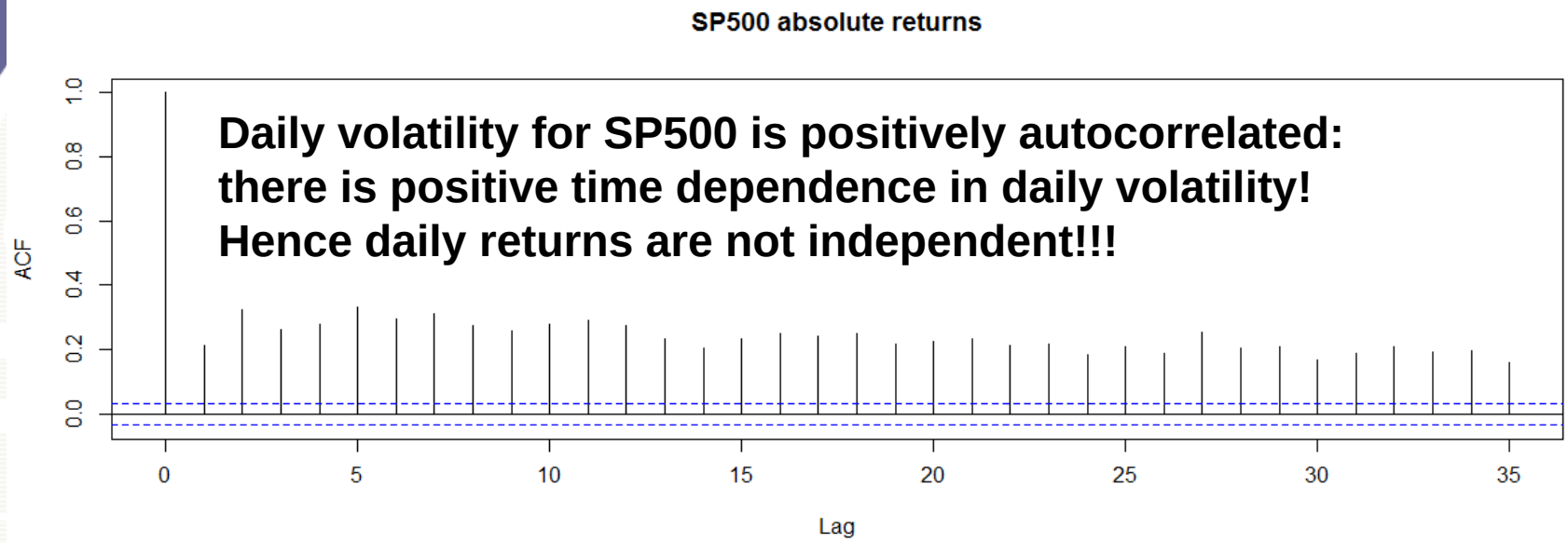
Daily volatility for MSFT is positively autocorrelated: there is positive time dependence in daily volatility! Hence daily returns are not independent!!!

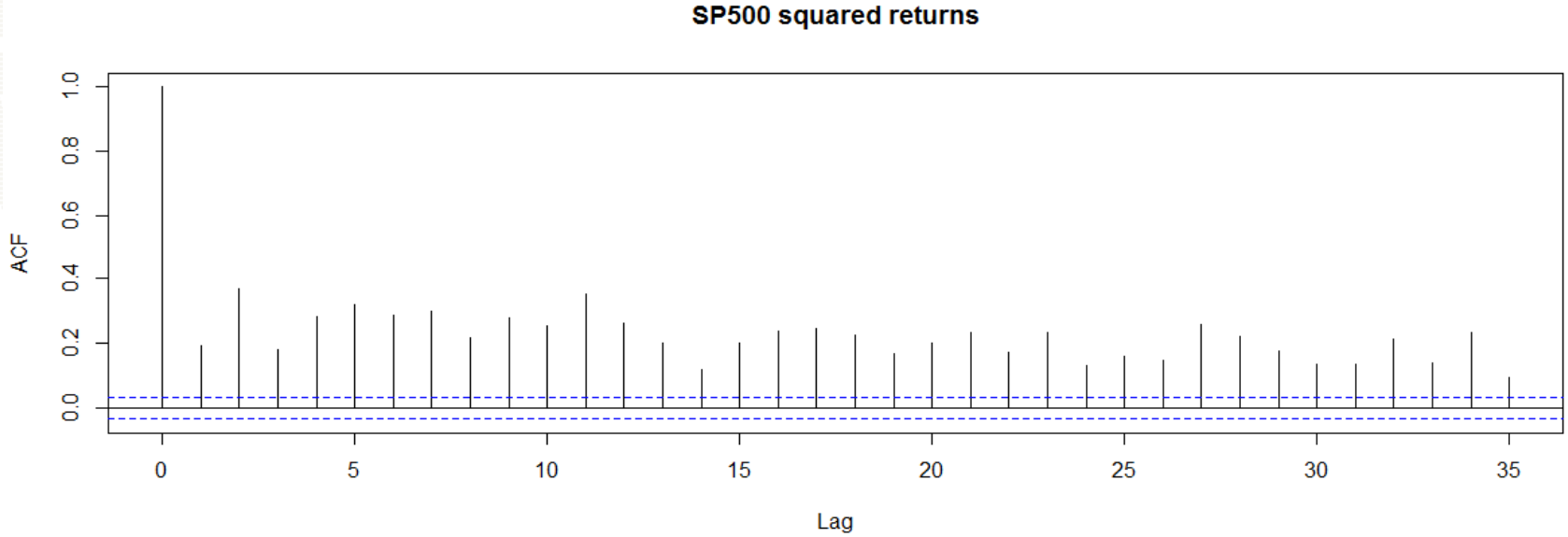


SP500 daily returns exhibit time varying volatility or volatility clustering – periods of high volatility are followed by periods of high volatility and periods of low volatility are followed by periods of low volatility









Stylized Facts for Daily Returns

- Returns are not normally distributed. Empirical distributions have fatter tails than normal distribution (more outliers)
- Returns are approximately uncorrelated over time (no serial correlation)
- Returns are not independent over time
  - Squared and absolute returns are positively autocorrelated
  - Volatility appears to be serially correlated
  - See Engle's GARCH model