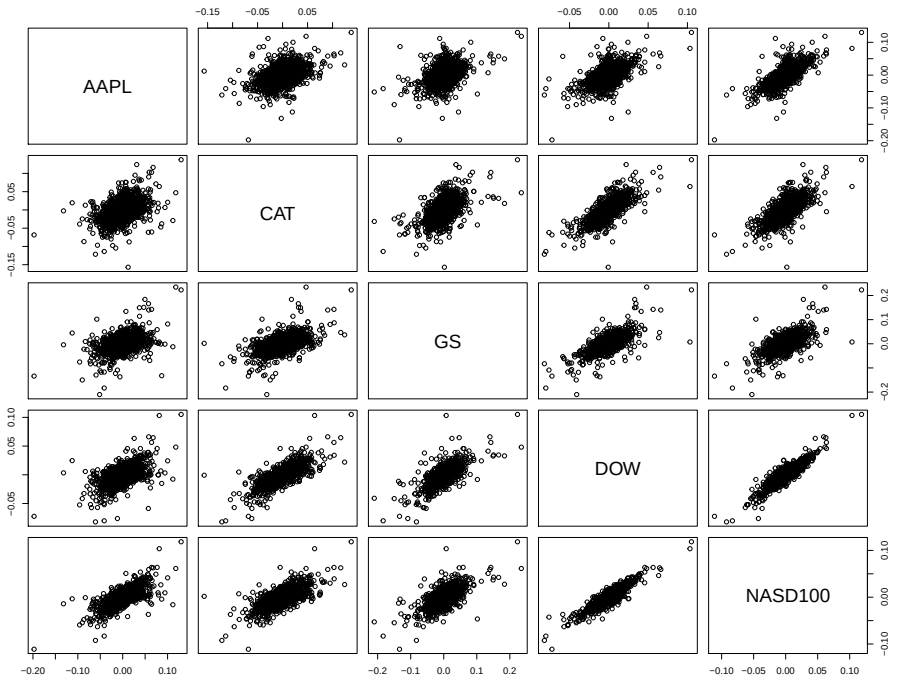
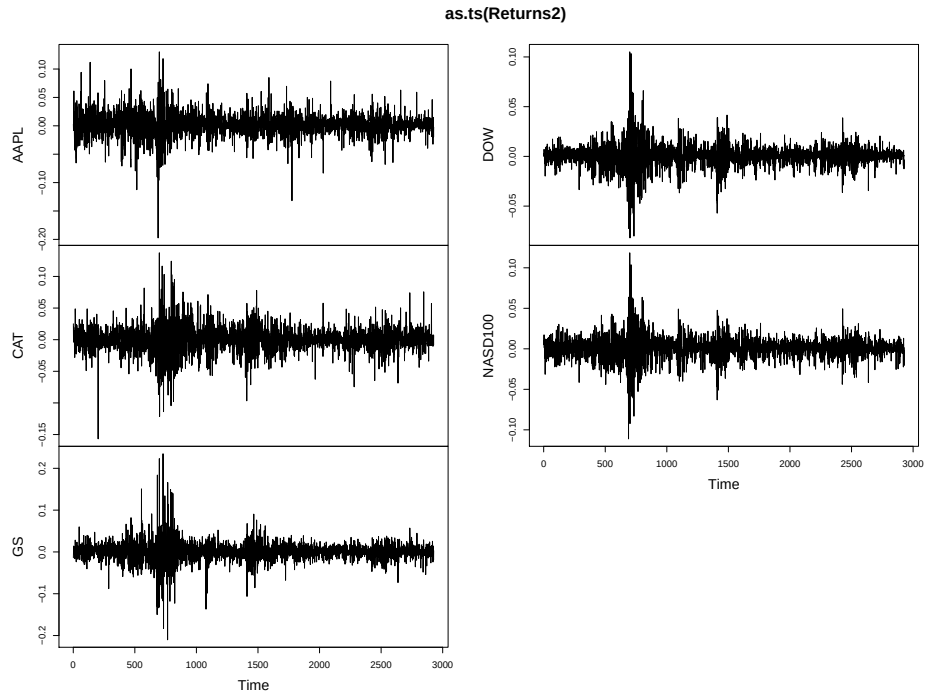
ORIE 4630: Spring Term 2019
Homework #1 Solutions

Question 1. [10 points]

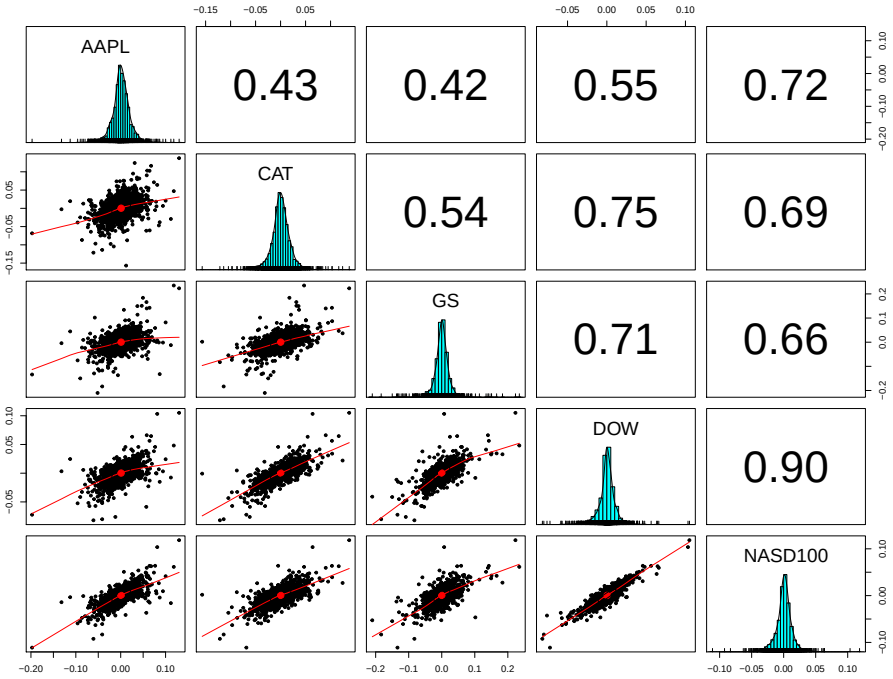
Output from line 14:



Output from line 15:



Output from line 18:

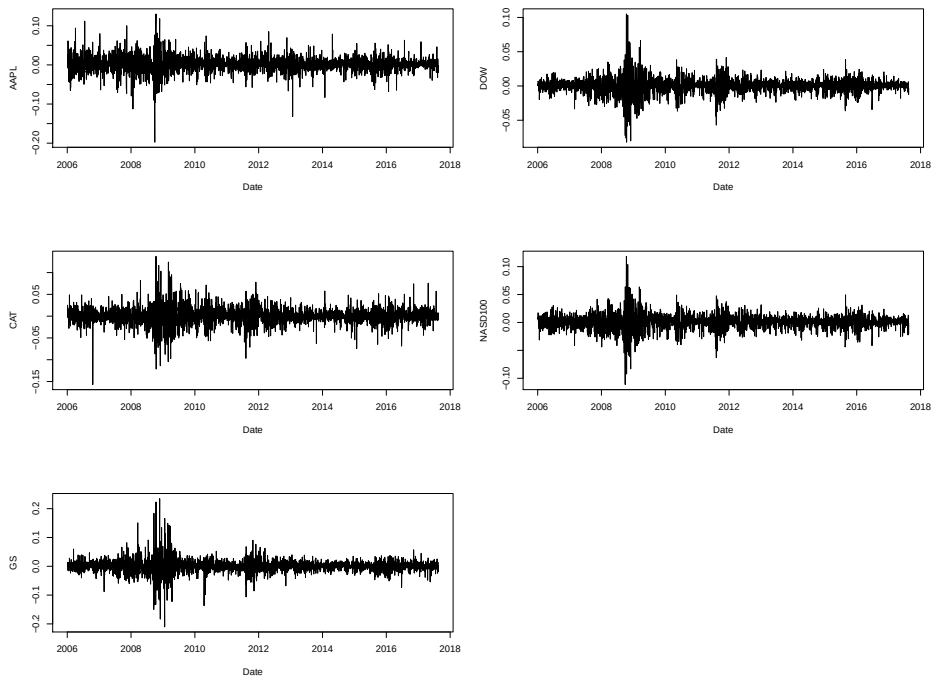


Question 2. [5 points]

The Apple (AAPL) returns are only moderately correlated with the returns from Caterpillar (CAT) and Goldman Sachs (GS); the correlation coefficients are 43% and 42%, respectively. These moderate correlations make sense because Apple is a technology company, while Caterpillar is an industrial company and Goldman Sachs is a financial company. The Apple (AAPL) returns have somewhat higher correlation with returns from the Dow Jones Industrial Average index (DOW); the correlation coefficient is 55%. This larger correlation makes sense because the Dow Jones Industrial Average index contains some technology stocks (CSCO, IBM, INTC, MSFT, and VZ) with which Apple might be closely correlated. The correlation is highest between returns from Apple (AAPL) and the NASDAQ 100 index (NASD100); the correlation coefficient is 72%. That this correlation is the largest among the four considered makes sense because the NASDAQ exchange consists largely of technology stocks and is perceived as being "tech heavy."

Question 3. [10 points]

Output from lines 21 to 25:



Question 4. [10 points]

The volatility (variance of the returns) is clearly elevated in late 2008 and 2009. This time period corresponds to the so-called "financial crisis," when key financial firms went bankrupt and the government loaned financial firms enormous sums to stabilize financial markets.

Question 5. [10 points]

Output from line 28:

```
            AAPL      CAT       GS      DOW  NASD100
AAPL    0.000427 0.000180 0.000210 0.000130 0.000200
CAT     0.000180 0.000414 0.000265 0.000175 0.000188
GS      0.000210 0.000265 0.000580 0.000196 0.000213
DOW     0.000130 0.000175 0.000196 0.000130 0.000137
NASD100 0.000200 0.000188 0.000213 0.000137 0.000180
```

Output from line 29:

```
         AAPL   CAT    GS   DOW NASD100
AAPL    1.000 0.428 0.423 0.552   0.721
CAT     0.428 1.000 0.541 0.752   0.687
GS      0.423 0.541 1.000 0.714   0.658
DOW     0.552 0.752 0.714 1.000   0.896
NASD100 0.721 0.687 0.658 0.896   1.000
```

Output from line 30:

```
    AAPL      CAT       GS      DOW  NASD100
0.000956 0.000342 0.000232 0.000236 0.000423
```

Question 6. [5 points]

0.000342

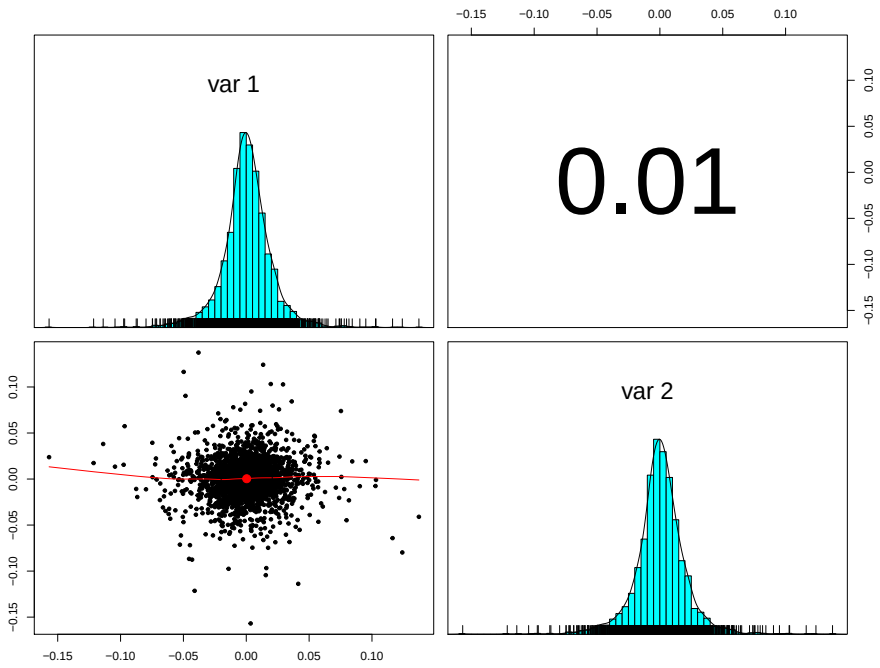
Question 7. [5 points]

0.000580

Question 8. [5 points]

0.896

Question 9. [10 points]



Question 10. [5 points]

The correlation between r_t and r_{t-1} for the returns from Caterpillar (CAT) is 0.01. This value is very small (extremely close to 0), so there is no evidence of serial correlation suggested by this value.

Question 11. [10 points]
$r_{16}(16)$ has mean $16 \times 0.004 = 0.064$ and standard deviation $\sqrt{16} \times 0.012 = 0.048$. Thus, $P(P_{16} \leq \$108,000)$ is given by `pnorm(log(108000/100000), 0.064, 0.048)`, which yields the output:

```
> pnorm(log(108000/100000), 0.064, 0.048)
[1] 0.6064282
```

Consequently, the desired answer is $P(P_{16} \geq \$108,000) = 1 - 0.60643 = 0.39357$.

Question 12. [15 points]
The code is:

```
t1=proc.time()
set.seed(8765)
niter=250000
ind=matrix(nrow=niter, ncol=1)
for (i in 1:niter)
  {
    logR=rnorm(30, mean=0.004, sd=0.012)
    cumR=cumsum(logR)
    logP=log(100000)+cumR
    ind[i]=(max(logP)>log(108000))
  }
estProb=mean(ind)
se=sqrt(estProb*(1-estProb)/niter)
UpperCL=estProb+qnorm(0.995)*se
LowerCL=estProb+qnorm(0.005)*se

estProb
se
UpperCL
LowerCL
t2=proc.time()
t2-t1
```

which produces the output

```
> estProb
[1] 0.812808
> se
[1] 0.0007801312
> UpperCL
[1] 0.8148175
> LowerCL
[1] 0.8107985
> t2=proc.time()
```

```
> t2-t1
   user  system elapsed
   1.14    0.01    1.18
```

The estimate of the probability is 81.281%.

The 99% confidence interval for the probability is $(81.080\%, 81.482\%)$.