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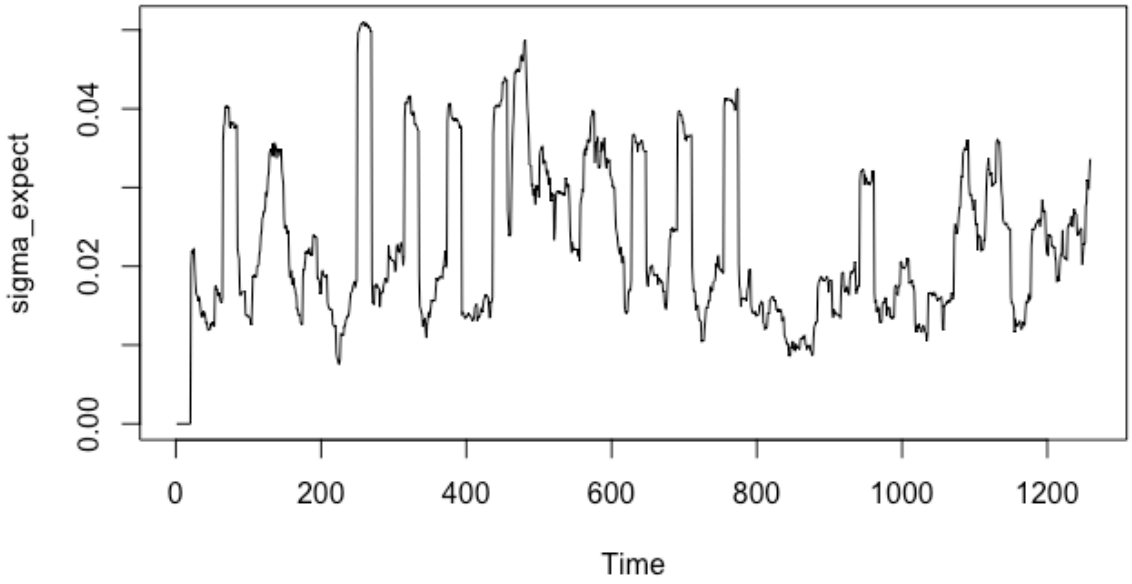
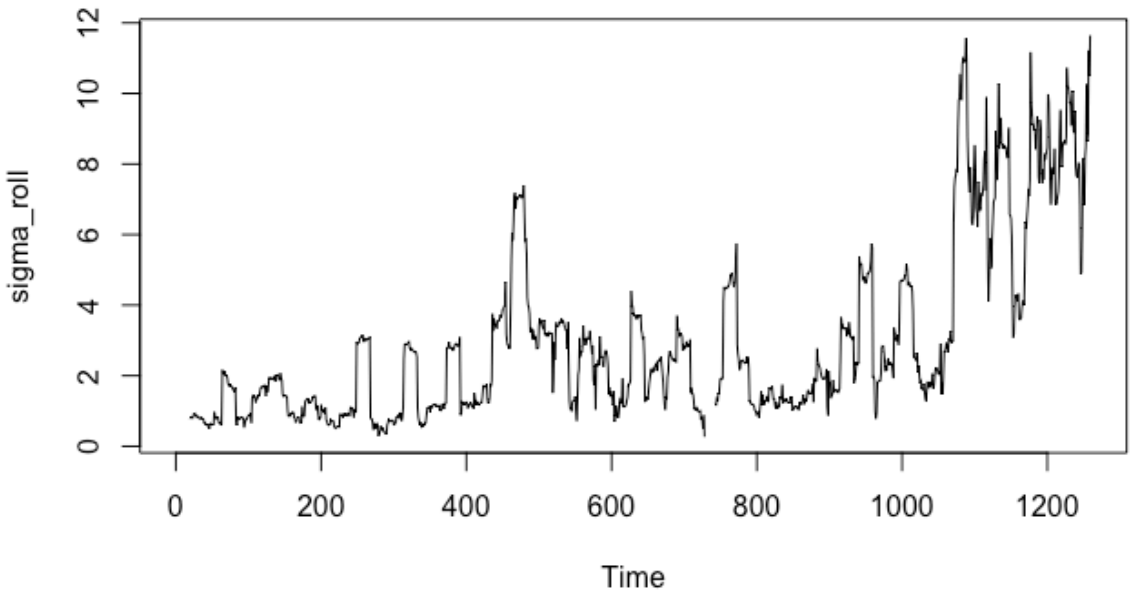
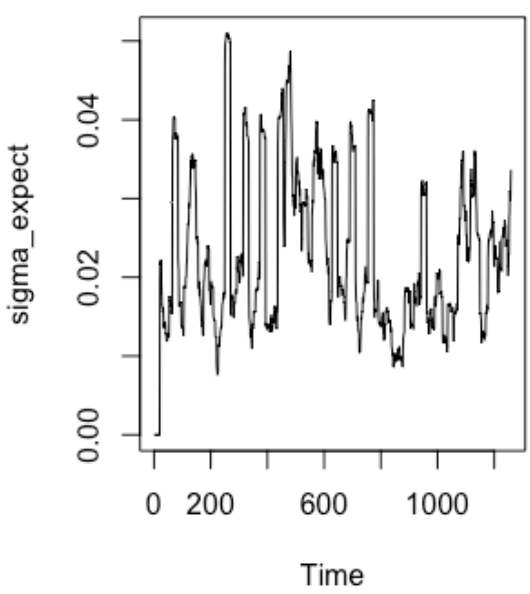
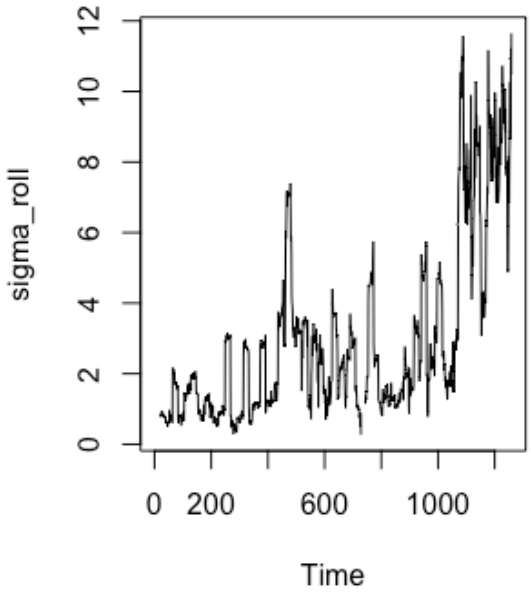
Q1:
the time series plot of the expected sigma using the method of EWMA



Q2:
Use the Roll's model to estimate the fundamental volatility
The total fundamental volatility of 5 years is Sigma_mu = 4.313382.
The 20 days fundamental volatility time series of the stock in 5 years is this:







They both reflected the fluctuation of the asset prices

Source code:

```
getwd()
setwd("/Users/yifuhe/Desktop")
mydata <- read.csv("NFLX-2013_2018.csv")

###Q1
n <- 20
beta <- 2/(n+1)
price <- unlist(mydata[6])
log_r <-c(NA)
log_r[1] <- 0
for (i in 2:length(price)){log_r[i] <- log(price[i])-log(price[i-1])}

## create sigma_ori
sigma_ori <- c(NA)
for (i in seq(n)){
  sigma_ori[i] <- 0
}
for (i in n:length(price)){
  r_mean <- mean(log_r[(i-n+1):i])
  sum <-0
  for (j in 1:n){
```

```
   sum=sum + (log_r[i-n+j] - r_mean)^2
  }
  sigma_ori[i]<-sqrt(sum/n)
}



## create sigma
sigma_expect <- c(NA)
for (i in seq(n)){
  sigma_expect[i] <- 0
}

down_sub <- 0
for (i in 1:n){
  down_sub <-  down_sub + beta^i
}

for (i in (n+1):length(sigma_ori)){
  total <- 0
  for (j in seq(n)){
    total <- total+ (beta^j)*sigma_ori[i-j]/down_sub
  }
  sigma_expect[i] <- total
}


## create the plot of sigma_expect
ts.plot(sigma_expect)

##Question3
gamma<-acf(diff(price),type="covariance",lag.max=1,plot=FALSE)
gamma0<-gamma$acf[1]
gamma1<-gamma$acf[2]
sigma_u<-sqrt(gamma0+2*gamma1)
sigma_u


##question3
sigma_roll <- c(NA)


for (i in n:(length(price))){
gamma<-acf(diff(price[(i-n+1):(i)]),type="covariance",lag.max=1,plot=FALSE)
gamma0<-gamma$acf[1]
gamma1<-gamma$acf[2]
sigma_u<-sqrt(gamma0+2*gamma1)
```

```
sigma_roll[i] <-sigma_u
}
par
ts.plot(sigma_roll)
```