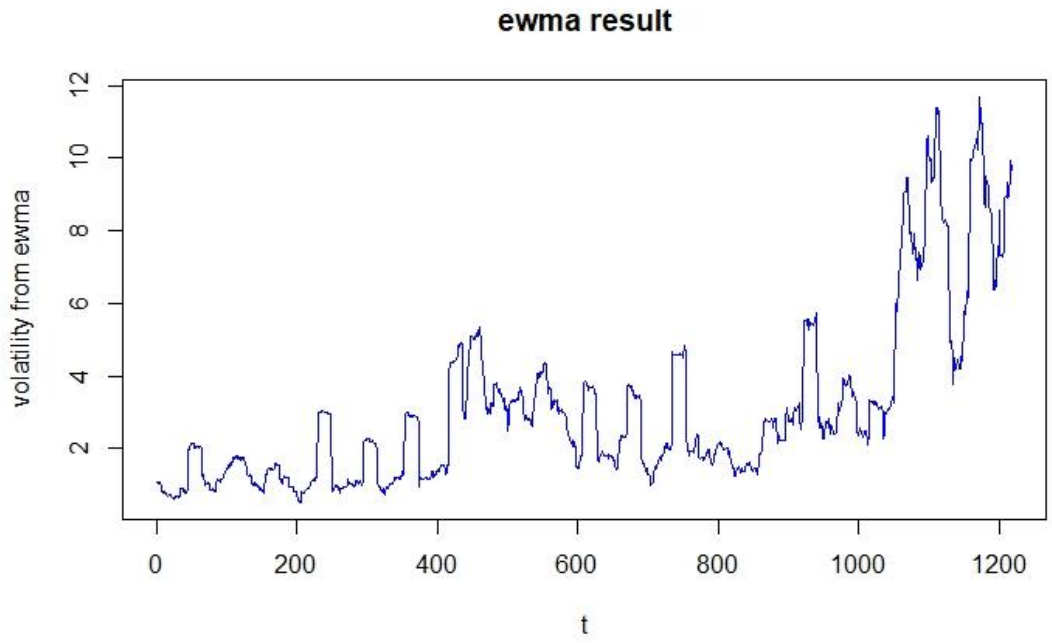
Part II:

We first calculate the absolute return and the standard deviation in a 20 day moving window.

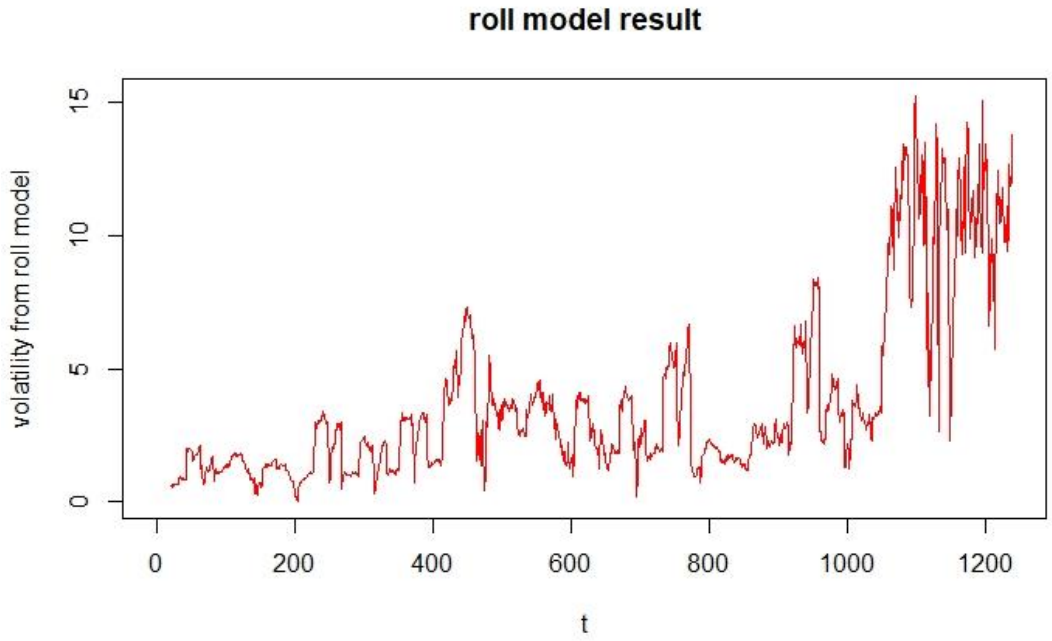
(a)

Then we use EWMA model to calculate the “expected” volatility using the formula given.



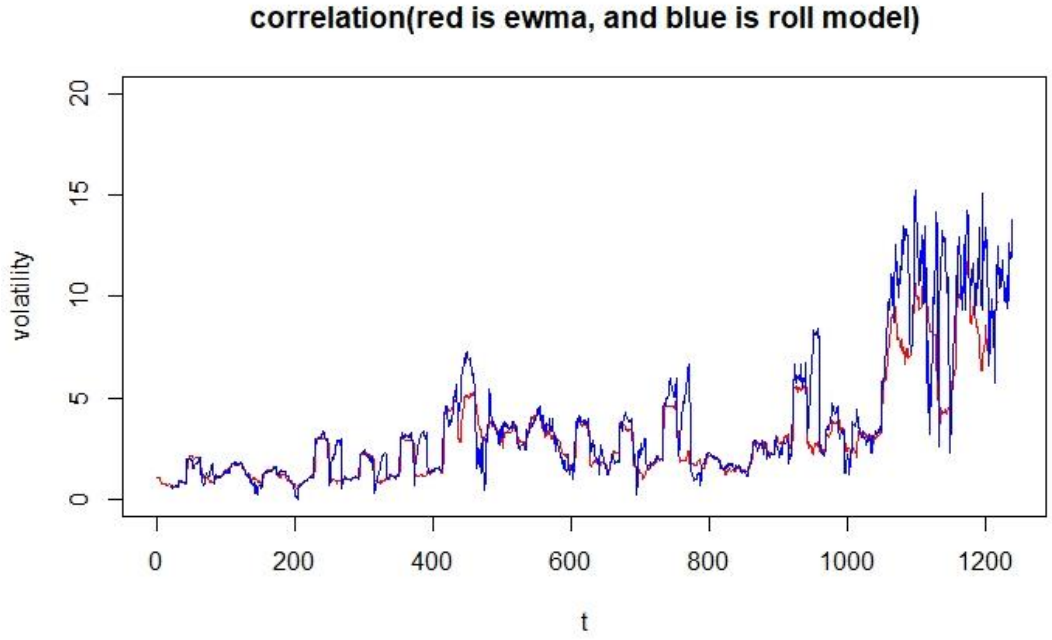
(b)

We calculate the gamma zero and gamma one in 20 days, and we get a time series of fundamental volatility from roll model.



(c)

Lastly, we plot two models together to see the connections.



Comments:

From the plot, we know that this two "volatility" are not absolutely the same, but they are similar

to each other, they have the same tendency in a lot of times. So I think there is some correlation between this two volatility measures.

R code attached:

```
Netflix<-read.csv(file.choose())
n<-20
library(zoo)
beta<-2/(n+1)
price<-Netflix$Adj.Close
return<-diff(price)
sigma<-c(rollapply(return,width=n,FUN=sd))
#EWMA
n1<-length(sigma)
ewma<-c(rep(0,n1))
weight<-c(rep(0,n))
total<-sum(beta^c(1:20))
for(i in 1:20)
{
   weight[i]<-(beta)^i/total
}
for(j in (n+1):n1)
{
   ewma[j]<-sum(sigma[(j-1):j-n]*weight)
}
ewma

#Roll model
var<-c(rollapply(return,width=n,FUN=var))
```

```
delta<-return

delta1<-c(0,var[1:(length(delta)-1)])

COV<-c()

for (i in 20:length(var))

{

   COV[i]=cov(delta[(i-19):i],delta1[(i-19):i])

}

vol<-c(sqrt(abs(var+2*COV)))

vol

plot(ewma,type="l",col="blue",xlab="t",ylab="volatility from ewma",main="ewma result")

plot(vol,type="l",col="red",xlab="t",ylab="volatility from roll model",main="roll model result")

plot(ewma,type="l",col="red",ylim=c(0,20),xlab="t",ylab="volatility",main="correlation(red is ewma, and blue is roll model)")

lines(vol,type="l",col="blue")

#from the plot, we know that this two "volatility" are not absolutely the same, but they have the same tendency.

#So there is some correlation between this two volatility measures.
```