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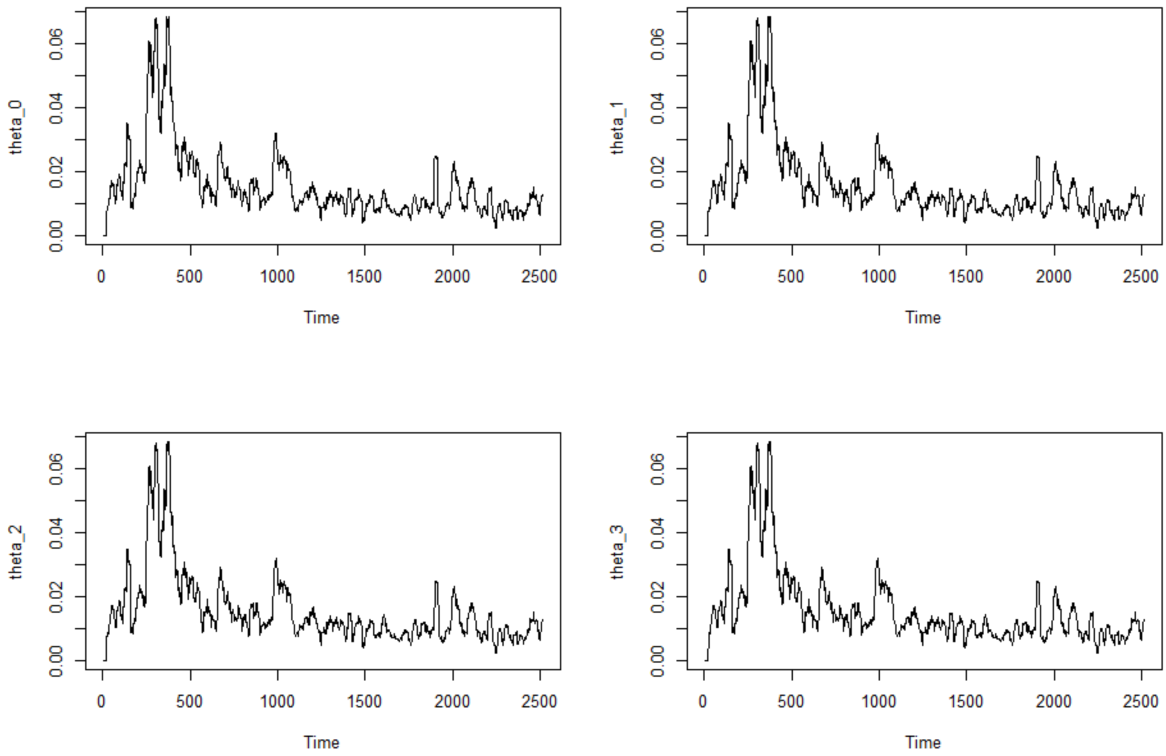
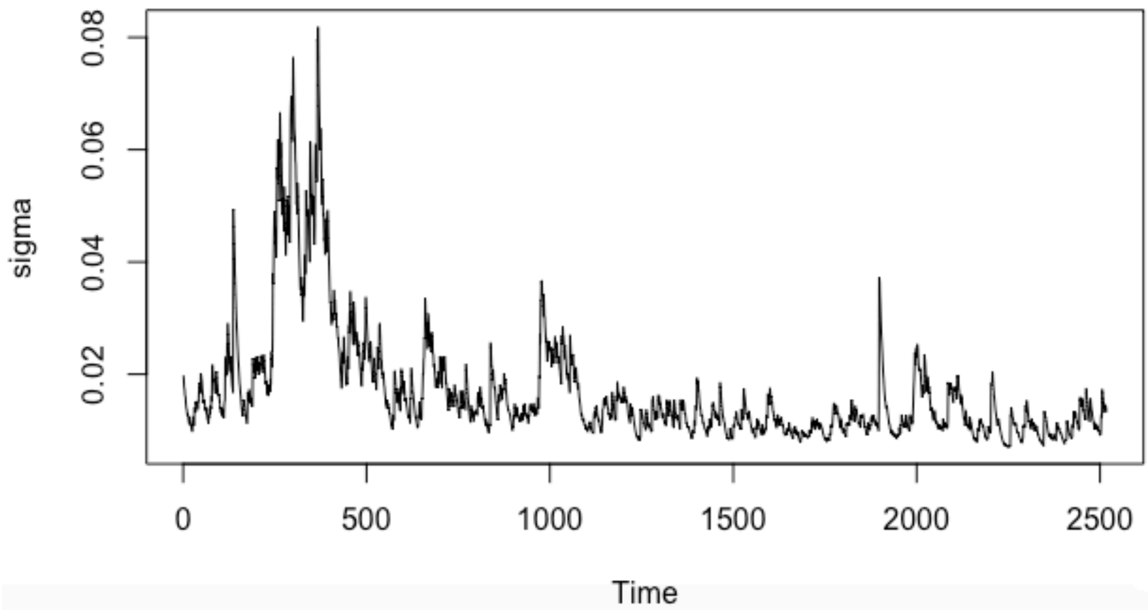
Q1:



Comment:
The distribution of these 4 are similar, which give us the conclusion that the 3 estimate method are not much different from each other.

Q2:

a) Model Grach(1,1)



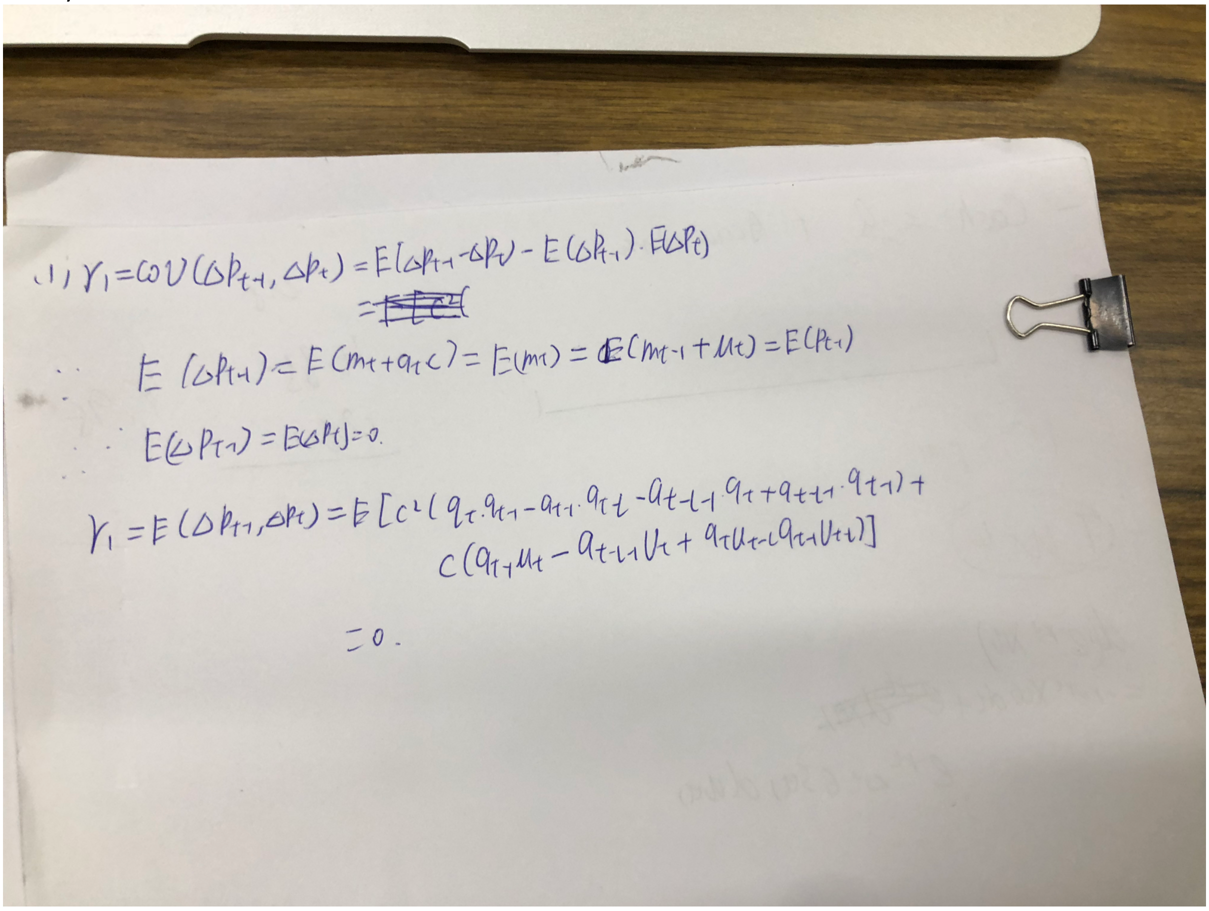
0.012574305
0.01[illegible] 0.012574
0.012966748
0.013010396
0.012965061

b)EMWA

0.01286618
0.01299428
0.01311964
0.01324235
0.01336250

GRACH

Q3:1)



(1) $\gamma_1 = cov(\Delta P_{t+1}, \Delta P_t) = E[\Delta P_{t+1} \cdot \Delta P_t] - E(\Delta P_{t+1}) \cdot E(\Delta P_t)$

$= \cancel{E[c^2(}$

$\because$ $E(\Delta P_{t+1}) = E(m_t + q_t c) = E(m_t) = E(m_{t-1} + u_t) = E(P_{t-1})$

$\therefore$ $E(\Delta P_{t+1}) = E(\Delta P_t) = 0.$

$\gamma_1 = E(\Delta P_{t+1}, \Delta P_t) = E[c^2(q_t \cdot q_{t+1} - q_{t+1} \cdot q_{t-1} - q_{t-1} \cdot q_t + q_{t-1} \cdot q_{t+1}) + c(q_{t+1} u_t - q_{t-1} u_t + q_t u_{t-1} q_{t+1} u_{t+1})]$

$= 0.$

2)

Gama0

	-3.93669900696703e-06

Gama1

	-3.93669900696703e-06

C

theta_u	0.0279208118141753

Thetau

theta_u	0.0279208118141753

###Source code

```
getwd()
setwd("/Users/yifuhe/Desktop")
data<-read.csv("GE_2007-2017.csv")

n<-22
beta<-2/(n+1)

pt<-unlist(data[6])
rt<-c(NA)
rt[1]<-0
for(i in 2:nrow(data))
  rt[i]<-log(pt[i])-log(pt[i-1])

t<-n
theta_0<-matrix(0,nrow=nrow(data))
while(t<=nrow(data)){
  r_mean0<-mean(rt[(t-n+1):t]);
  theta_0[t,1]=sqrt(1/n*sum((rt[(t-n+1):t]-r_mean0)^2));
  t=t+1;
}

t<-n
theta_1<-matrix(0,nrow=nrow(data))
r_mean<-matrix(0,nrow=nrow(data))
while(t<=nrow(data)){
  r_mean[t,1]<-mean(rt[(t-1-n+1):(t-1)]);
  theta_1[t,1]=sqrt(1/n*sum((rt[(t-1-n+1):(t-1)]-r_mean[t,1])^2));
  t=t+1;
}

t<-n
theta_2<-matrix(0,nrow=nrow(data))
theta_2[n-1,1]=sqrt(1/n*sum((rt[0:(n-1)]-mean(rt[0:(n-1)]))^2));
while(t<=nrow(data)){
  theta_2[t,1]=(1-beta)*theta_1[t,1]+beta*theta_2[t-1,1];
  t=t+1;
}

```

```

t<-n+1
theta_3<-matrix(0,nrow=nrow(data))
betas<-matrix(0,nrow=22)
for(j in 1:n) betas[j,1]=beta^j
betasum<-matrix(0,nrow=n)
while(t<=nrow(data)){
  for(i in 1:n){
    betasum[i,1]=betas[i,1]*theta_0[t-i,1];
  }
  theta_3[t,1]=sum(betasum[,1])/sum(betas[,1]);
  t=t+1;
}

theta<-cbind(theta_0,theta_1,theta_2,theta_3)
par(mfrow = c(2,2))
ts.plot(theta_0)
ts.plot(theta_1)
ts.plot(theta_2)
ts.plot(theta_3)
par(mfrow = c(1,1))

```

Q2:

```r
###Q2

library(fGarch)
r1<-garchFit(~garch(1,1),data=rt,trace=FALSE)

resi<-residuals(r1)
residual<-as.matrix(resi,ncol=1)

new5<-predict(r1,5)

ht<-as.matrix(r1@h.t)
sigma<-as.matrix(r1@sigma.t)

```

Q3:

```r
###Q3

gama1<-var(rt)

rt1<-as.vector(NA)
rt1[1]<-0
for(j in 2:nrow(data))
  rt1[j]<-rt[j-1]

gama0<-cov(rt,rt1)

co_var<-as.vector(NA)
for(k in 1:nrow(data))
  co_var[k]=(rt[k]-mean(rt))*(rt1[k]-mean(rt1))
gama_0<-1/(nrow(data)-1)*sum(co_var)

c<- -sqrt(gama1)
theta_u<-sqrt(gama0+2*gama1)

```