

#فراخوانی داده های سهام

```
data=read.table("D:\\payannname\\data\\stock\\txt",header=T)
```

```
library(tseries)
```

```
returns =ts(data)
```

```
fakhouz.ts.data= returns [,]
```

```
fakhouz=diff(log(fakhouz.ts.data))
```

```
famly.ts.data= returns [۲,]
```

```
famly=diff(log(famly.ts.data))
```

```
foulad.ts.data= returns [۳,]
```

```
foulad=diff(log(foulad.ts.data))
```

#برآورد گشتاورهای سهام فخوز، فملی و فولاد

```
library(moments)
```

```
mean.fakhouz=mean(fakhouz)
```

```
sd.fakhouz=sd(fakhouz)
```

```
sk.fakhouz=skewness(fakhouz)
```

```
ku.fakhouz=kurtosis(fakhouz)
```

```
mean.famly=mean(famly)
```

```
sd.famly=sd(famly)
```

```

sk.famly=skewness(famly)
ku.famly=kurtosis(famly)
mean.foulad=mean(foulad)
sd.foulad=sd(foulad)
sk.foulad=skewness(foulad)
ku.foulad=kurtosis(foulad)

table\=table\=matrix(data=c(mean.fakhouz,mean.famly,mean.foulad,sd.fakhouz,sd.famly,sd.foulad,sk.fakhouz,sk.famly,sk.foulad,ku.fakhouz,ku.famly,ku.foulad),nrow=۳,ncol=۴)

rownames(table\)=c("fakhouz","famly","foulad")

colnames(table\)=c("Mean","Std","Skewness","Kurtosis")

table\  #the moment estimation results

```

#بررسی سهم فخوز، برازش بهترین مدل و برآورد پارامترهای سهم

```

plot.ts(fakhouz)
acf(fakhouz)
pacf(fakhouz)
hist(fakhouz)

library(forecast)
fit.arma.fakhouz<-auto.arima(fakhouz,stepwise=F,ic="aic",trace=T)
summary(fit.arma.fakhouz)

res.fakhouz=resid(fit.arma.fakhouz)
library(EnvStats)
serialCorrelationTest(res.fakhouz,test="AR\mle")

```

```
qqnorm(res.fakhouz)
qqline(res.fakhouz)
hist(res.fakhouz)
shapiro.test(res.fakhouz)
```

```
t.fakhouz=bestNormalize(fakhouz)$x.t
hist(t.fakhouz)
shapiro.test(t.fakhouz)
```

```
t.fakhouz.arima=auto.arima(t.fakhouz,stepwise=F,ic="aic",trace=T)
```

```
res.t.fakhouz=resid(t.fakhouz.arima)
serialCorrelationTest(res.t.fakhouz,test="AR\ .mle")
hist(res.t.fakhouz)
qqnorm(res.t.fakhouz)
qqline(res.t.fakhouz)
shapiro.test(sample(res.t.fakhouz, $\Delta \cdot \cdot$ ))
```

```
summary(t.fakhouz.arima)
coef(t.fakhouz.arima)
```

#بررسی سهم فملی، برازش بهترین مدل و برآورد پارامترهای سهم

```
plot.ts(famly)
acf(famly)
pacf(famly)
hist(famly)
library(forecast)
fit.arma.famly<-auto.arma(famly,stepwise=F,ic="aic",trace=T)
summary(fit.arma.famly)
res.famly=resid(fit.arma.famly)
```

```
library(EnvStats)
serialCorrelationTest(res.famly,test="AR \.mle")
```

```
qqnorm(res.famly)
qqline(res.famly)
hist(res.famly)
shapiro.test(res.famly)
```

```
t.famly=bestNormalize(famly)$x.t
hist(t.famly)
shapiro.test(t.famly)
```

```
t.famly.arma=auto.arma(t.famly,stepwise=F,ic="aic",trace=T)
res.t.famly=resid(t.famly.arma)
```

```
serialCorrelationTest(res.t.famly,test="AR\mle")
```

```
hist(res.t.famly)
```

```
qqnorm(res.t.famly)
```

```
qqline(res.t.famly)
```

```
shapiro.test(sample(res.t.famly,500))
```

```
summary(t.famly.arima)
```

```
coef(t.famly.arima)
```

#بررسی سهم فولاد، برازش بهترین مدل و برآورد پارامترهای سهم

```
plot.ts(foulad)
```

```
acf(foulad)
```

```
pacf(foulad)
```

```
hist(foulad)
```

```
library(forecast)
```

```
fit.arma.foulad<-auto.arima(foulad,stepwise=F,ic="aic",trace=T)
```

```
summary(fit.arma.foulad)
```

```
res.foulad=resid(fit.arma.foulad)
```

```
library(EnvStats)
```

```
serialCorrelationTest(res.foulad,test="AR\mle")
```

```
qqnorm(res.foulad)
```

```
qqline(res.foulad)
hist(res.foulad)
shapiro.test(res.foulad)
```

```
t.foulad=bestNormalize(foulad)$x.t
hist(t.foulad)
shapiro.test(t.foulad)
```

```
t.foulad.arima=auto.arima(t.foulad,stepwise=F,ic="aic",trace=T)
```

```
res.t.foulad=resid(t.foulad.arima)
```

```
serialCorrelationTest(res.t.foulad,test="AR\ .mle")
```

```
hist(res.t.foulad)
```

```
qqnorm(res.t.foulad)
qqline(res.t.foulad)
```

```
shapiro.test(sample(res.t.foulad,500))
```

```
summary(t.foulad.arima)
coef(t.foulad.arima)
```

```
*****
```

#برازش توابع مفصل مختلف به باقی مانده مدل ARIMA پس از تبدیل نرمال

```
u.fakhouz=pnorm(res.t.fakhouz)
u.famly=pnorm(res.t.famly)
u.foulad=pnorm(res.t.foulad)
U=cbind(u.fakhouz,u.famly,u.foulad)
nrow(U)
head(U)
```

برازش تابع مفصل تی و برآورد پارامترهای تابع مفصل

```
t.cop=tCopula(c(.۲,.۴,.۷),dim = ۳, dispstr = "un",df.fixed=TRUE)
fit.t.cop=fitCopula(t.cop,U, method="ml")
fit.t.cop
param.t.cop=coef(fit.t.cop)
param.t.cop
```

برازش تابع مفصل نرمال و برآورد پارامترهای تابع مفصل

```
normal.cop= normalCopula(c(.۲,.۴,.۷),dim = ۳, dispstr = "un")
fit.normal.cop=fitCopula(normal.cop,U, method="ml")
fit.normal.cop
param.normal.cop=coef(fit.normal.cop)
param.normal.cop
```

برازش تابع مفصل گامبل و برآورد پارامترهای تابع مفصل

```
gambel.cop=gumbelCopula(dim = ۳)
fit.gambel.cop=fitCopula(gambel.cop,U, method="ml")
```

```
fit.gambel.cop  
param.gambel.cop=coef(fit.gambel.cop)  
param.gambel.cop
```

برازش تابع مفصل کلایتون و برآورد پارامترهای تابع مفصل

```
clayton.cop=claytonCopula(dim = ۳)  
fit.clayton.cop=fitCopula(clayton.cop,U, method="ml")  
fit.clayton.cop  
param.clayton.cop=coef(fit.clayton.cop)  
param.clayton.cop
```

برازش تابع مفصل فرانک و برآورد پارامترهای تابع مفصل

```
frank.cop=frankCopula(dim = ۳)  
fit.frank.cop=fitCopula(frank.cop,U, method="ml")  
fit.frank.cop  
param.frank.cop=coef(fit.frank.cop)  
param.frank.cop
```

برازش تابع مفصل کلایتون و برآورد پارامترهای تابع مفصل

```
joe.cop=joeCopula(dim = ۳)  
fit.joe.cop=fitCopula(joe.cop,U, method="ml")  
fit.joe.cop  
param.joe.cop=coef(fit.joe.cop)  
param.joe.cop
```

#برآورد ارزش در معرض خطر سبد سهام

```
coef.fakhouz=coef(t.fakhouz.arima)
```

```
ar\ .fakhouz=coef.fakhouz[\]
```

```
ar\ .fakhouz=coef.fakhouz[\]
```

```
ar\ .fakhouz=coef.fakhouz[\]
```

```
ma\ .fakhouz=coef.fakhouz[\]
```

```
ma\ .fakhouz=coef.fakhouz[\]
```

```
coef.famly=coef(t.famly.arima)
```

```
ar\ .famly=coef.famly[\]
```

```
ar\ .famly=coef.famly[\]
```

```
ar\ .famly=coef.famly[\]
```

```
ar\ .famly=coef.famly[\]
```

```
ar\ .famly=coef.famly[\]
```

```
coef.foulad=coef(t.foulad.arima)
```

```
ar\ .foulad=coef.foulad[\]
```

```
ma\ .foulad=coef.foulad[\]
```

```
ma\ .foulad=coef.foulad[\]
```

```
ma\ .foulad=coef.foulad[\]
```

```
ma\ .foulad=coef.foulad[\]
```

```
ret.t=c(t.fakhouz,t.famly,t.foulad)
```

```

head(ret.t)
no=nrow(ret.t)
res.t=c(res.t.fakhouz,res.t.family,res.t.foulad)

```

```

ret.t=cbind(t.fakhouz,t.family,t.foulad)
head(ret.t)
no=nrow(ret.t)
res.t=cbind(res.t.fakhouz,res.t.family,res.t.foulad)
head(res.t)
no=nrow(res.t)

```

$N=\backslash \cdot$

$M=\backslash \cdot$

```
u=matrix(,ncol=۳,nrow=M)
```

```
z=matrix(,ncol=۳,nrow=M)
```

```
s=matrix(,ncol=N,nrow=M)
```

```
r=matrix(,ncol=۳,nrow=M)
```

```
v.VaR=c()
```

```
t.copula=tCopula(c(param.t.cop[۱],param.t.cop[۲],param.t.cop[۳]),dim=۳,dispstr = "un",df.fixed=TRUE)
```

```
set.seed(۲۳۲۴)
```

```
lambda=c(۰.۲۵,۰.۲۵,۰.۵)
```

```
for(n in ۱:N){
```

```
u=rCopula(M,t.copula)
```

```
z=qnorm(u)
```

```
for( m in ۱:M){
```

```

r[m, \]=ar\ .fakhouz*ret.t[no, \]+ar\ .fakhouz*ret.t[no-\, \]+ar\ .fakhouz*ret.t[no-
\, \]+ma\ .fakhouz*res.t[no, \]+ma\ .fakhouz*res.t[no-\, \]+z[m, \]

r[m, \]=ar\ .family*ret.t[no, \]+ar\ .family*ret.t[no-\, \]+ar\ .family*ret.t[no-\, \]+ar\ .family*ret.t[no-
\, \]+ar\ .family*ret.t[no-\, \]+z[m, \]

r[m, \]=ar\ .foulad*ret.t[no, \]+ma\ .foulad*res.t[no, \]+ma\ .foulad*res.t[no-\, \]+ma\ .foulad*res.t[no-
\, \]+ma\ .foulad*res.t[no-\, \]+z[m, \]

s[m,n]=lambda[\]*r[m, \]+lambda[\]*r[m, \]+lambda[\]*r[m, \]

}

v.VaR[n]=quantile(s[,n], . . \)

}

VaR\=mean(v.VaR)

VaR\

```

```

set.seed(1111)

for(n in 1:N){

u=rCopula(M,t.copula)

z=qnorm(u)

for( m in 1:M){

r[m, \]=ar\ .fakhouz*ret.t[no, \]+ar\ .fakhouz*ret.t[no-\, \]+ar\ .fakhouz*ret.t[no-
\, \]+ma\ .fakhouz*res.t[no, \]+ma\ .fakhouz*res.t[no-\, \]+z[m, \]

r[m, \]=ar\ .family*ret.t[no, \]+ar\ .family*ret.t[no-\, \]+ar\ .family*ret.t[no-\, \]+ar\ .family*ret.t[no-
\, \]+ar\ .family*ret.t[no-\, \]+z[m, \]

r[m, \]=ar\ .foulad*ret.t[no, \]+ma\ .foulad*res.t[no, \]+ma\ .foulad*res.t[no-\, \]+ma\ .foulad*res.t[no-
\, \]+ma\ .foulad*res.t[no-\, \]+z[m, \]

s[m,n]=lambda[\]*r[m, \]+lambda[\]*r[m, \]+lambda[\]*r[m, \]

}

v.VaR[n]=quantile(s[,n], . . \)

```

```

}
VaR $\gamma$ =mean(v.VaR)

VaR $\gamma$ 

set.seed(2224)

for(n in 1:N){

u=rCopula(M,t.copula)

z=qnorm(u)

for( m in 1:M){

r[m,1]=ar1.fakhouz*ret.t[no,1]+ar $\gamma$ .fakhouz*ret.t[no-1,1]+ar $\gamma$ .fakhouz*ret.t[no-
 $\gamma$ ,1]+ma1.fakhouz*res.t[no, $\gamma$ ]+ma $\gamma$ .fakhouz*res.t[no-1, $\gamma$ ]+z[m,1]

r[m, $\gamma$ ]=ar1.famly*ret.t[no, $\gamma$ ]+ar $\gamma$ .famly*ret.t[no-1, $\gamma$ ]+ar $\gamma$ .famly*ret.t[no- $\gamma$ , $\gamma$ ]+ar $\gamma$ .famly*ret.t[no-
 $\gamma$ , $\gamma$ ]+ar $\Delta$ .famly*ret.t[no- $\epsilon$ , $\gamma$ ]+z[m, $\gamma$ ]

r[m, $\gamma$ ]=ar1.foulad*ret.t[no, $\gamma$ ]+ma1.foulad*res.t[no, $\gamma$ ]+ma $\gamma$ .foulad*res.t[no-1, $\gamma$ ]+ma $\gamma$ .foulad*res.t[no-
 $\gamma$ , $\gamma$ ]+ma $\epsilon$ .foulad*res.t[no- $\gamma$ , $\gamma$ ]+z[m, $\gamma$ ]

s[m,n]=lambda[1]*r[m,1]+lambda[ $\gamma$ ]*r[m, $\gamma$ ]+lambda[ $\gamma$ ]*r[m, $\gamma$ ]

}

v.VaR[n]=quantile(s[,n],.1)

}

VaR $\gamma$ =mean(v.VaR)

VaR $\gamma$ 

```

```

set.seed(2224)

for(n in 1:N){

u=rCopula(M,t.copula)

z=qnorm(u)

```

```

for( m in 1:M){

r[m,1]=ar1.fakhouz*ret.t[no,1]+ar2.fakhouz*ret.t[no-1,1]+ar3.fakhouz*ret.t[no-
2,1]+ma1.fakhouz*res.t[no,2]+ma2.fakhouz*res.t[no-1,2]+z[m,1]

r[m,2]=ar1.famly*ret.t[no,2]+ar2.famly*ret.t[no-1,2]+ar3.famly*ret.t[no-2,2]+ar4.famly*ret.t[no-
3,2]+ar5.famly*ret.t[no-4,2]+z[m,2]

r[m,3]=ar1.foulad*ret.t[no,3]+ma1.foulad*res.t[no,3]+ma2.foulad*res.t[no-1,3]+ma3.foulad*res.t[no-
2,3]+ma4.foulad*res.t[no-3,3] +z[m,3]

s[m,n]=lambda[1]*r[m,1]+lambda[2]*r[m,2]+lambda[3]*r[m,3]

}

v.VaR[n]=quantile(s[n],.15)

}

VaR4=mean(v.VaR)

VaR4

```

```

lambda=c(.25,.5,.25)

set.seed(2222)

for(n in 1:N){

u=rCopula(M,t.copula)

z=qnorm(u)

for( m in 1:M){

r[m,1]=ar1.fakhouz*ret.t[no,1]+ar2.fakhouz*ret.t[no-1,1]+ar3.fakhouz*ret.t[no-
2,1]+ma1.fakhouz*res.t[no,2]+ma2.fakhouz*res.t[no-1,2]+z[m,1]

r[m,2]=ar1.famly*ret.t[no,2]+ar2.famly*ret.t[no-1,2]+ar3.famly*ret.t[no-2,2]+ar4.famly*ret.t[no-
3,2]+ar5.famly*ret.t[no-4,2]+z[m,2]

r[m,3]=ar1.foulad*ret.t[no,3]+ma1.foulad*res.t[no,3]+ma2.foulad*res.t[no-1,3]+ma3.foulad*res.t[no-
2,3]+ma4.foulad*res.t[no-3,3] +z[m,3]

```

```
s[m,n]=lambda[\]*r[m,\]+lambda[\]*r[m,\]+lambda[\]*r[m,\]
```

```
}
```

```
v.VaR[n]=quantile(s[,n],...)
```

```
}
```

```
VaRΔ=mean(v.VaR)
```

```
VaRΔ
```

```
set.seed(2222)
```

```
for(n in 1:N){
```

```
u=rCopula(M,t.copula)
```

```
z=qnorm(u)
```

```
for( m in 1:M){
```

```
r[m,\]=ar\ .fakhouz*ret.t[no,\]+ar\ .fakhouz*ret.t[no-\,\]+ar\ .fakhouz*ret.t[no-  

\,\]+ma\ .fakhouz*res.t[no,\]+ma\ .fakhouz*res.t[no-\,\]+z[m,\]
```

```
r[m,\]=ar\ .family*ret.t[no,\]+ar\ .family*ret.t[no-\,\]+ar\ .family*ret.t[no-\,\,\]+ar\ .family*ret.t[no-  

\,\,\]+ar\ .family*ret.t[no-\,\,\]+z[m,\]
```

```
r[m,\]=ar\ .foulad*ret.t[no,\]+ma\ .foulad*res.t[no,\]+ma\ .foulad*res.t[no-\,\,\]+ma\ .foulad*res.t[no-  

\,\,\]+ma\ .foulad*res.t[no-\,\,\]+z[m,\]
```

```
s[m,n]=lambda[\]*r[m,\]+lambda[\]*r[m,\]+lambda[\]*r[m,\]
```

```
}
```

```
v.VaR[n]=quantile(s[,n],...Δ)
```

```
}
```

```
VaRΔ=mean(v.VaR)
```

```
VaRΔ
```

```
set.seed(2222)
```

```

for(n in 1:N){
u=rCopula(M,t.copula)
z=qnorm(u)
for( m in 1:M){

r[m,1]=ar1.fakhouz*ret.t[no,1]+ar2.fakhouz*ret.t[no-1,1]+ar3.fakhouz*ret.t[no-
2,1]+ma1.fakhouz*res.t[no,2]+ma2.fakhouz*res.t[no-1,2]+z[m,1]

r[m,2]=ar1.famly*ret.t[no,2]+ar2.famly*ret.t[no-1,2]+ar3.famly*ret.t[no-2,2]+ar4.famly*ret.t[no-
3,2]+ar5.famly*ret.t[no-4,2]+z[m,2]

r[m,3]=ar1.foulad*ret.t[no,3]+ma1.foulad*res.t[no,3]+ma2.foulad*res.t[no-1,3]+ma3.foulad*res.t[no-
2,3]+ma4.foulad*res.t[no-3,3] +z[m,3]

s[m,n]=lambda[1]*r[m,1]+lambda[2]*r[m,2]+lambda[3]*r[m,3]

}
v.VaR[n]=quantile(s[n],.1)

}

VaR=mean(v.VaR)

VaR

```

```

set.seed(2222)

for(n in 1:N){
u=rCopula(M,t.copula)
z=qnorm(u)
for( m in 1:M){

r[m,1]=ar1.fakhouz*ret.t[no,1]+ar2.fakhouz*ret.t[no-1,1]+ar3.fakhouz*ret.t[no-
2,1]+ma1.fakhouz*res.t[no,2]+ma2.fakhouz*res.t[no-1,2]+z[m,1]

r[m,2]=ar1.famly*ret.t[no,2]+ar2.famly*ret.t[no-1,2]+ar3.famly*ret.t[no-2,2]+ar4.famly*ret.t[no-
3,2]+ar5.famly*ret.t[no-4,2]+z[m,2]

r[m,3]=ar1.foulad*ret.t[no,3]+ma1.foulad*res.t[no,3]+ma2.foulad*res.t[no-1,3]+ma3.foulad*res.t[no-

```

```

 $\gamma, \gamma] + \text{ma}\epsilon . \text{foulad} * \text{res.t}[\text{no} - \gamma, \gamma] + z[m, \gamma]$ 

```

```

 $s[m, n] = \text{lambda}[\gamma] * r[m, \gamma] + \text{lambda}[\gamma] * r[m, \gamma] + \text{lambda}[\gamma] * r[m, \gamma]$ 

```

```

}
```

```

 $v.VaR[n] = \text{quantile}(s[n], \cdot . \gamma \Delta)$ 

```

```

}
```

```

 $VaR\lambda = \text{mean}(v.VaR)$ 

```

```

 $VaR\lambda$ 

```

```

 $\text{lambda} = c(\cdot . \Delta, \cdot . \gamma \Delta, \cdot . \gamma \Delta)$ 

```

```

 $\text{set.seed}(2224)$ 

```

```

for(n in 1:N){

```

```

  u=rCopula(M,t.copula)

```

```

  z=qnorm(u)

```

```

  for( m in 1:M){

```

```

     $r[m, \gamma] = \text{ar}\gamma . \text{fakhouz} * \text{ret.t}[\text{no}, \gamma] + \text{ar}\gamma . \text{fakhouz} * \text{ret.t}[\text{no} - \gamma, \gamma] + \text{ar}\gamma . \text{fakhouz} * \text{ret.t}[\text{no} -$ 

```

```

     $\gamma, \gamma] + \text{ma}\gamma . \text{fakhouz} * \text{res.t}[\text{no}, \gamma] + \text{ma}\gamma . \text{fakhouz} * \text{res.t}[\text{no} - \gamma, \gamma] + z[m, \gamma]$ 

```

```

     $r[m, \gamma] = \text{ar}\gamma . \text{family} * \text{ret.t}[\text{no}, \gamma] + \text{ar}\gamma . \text{family} * \text{ret.t}[\text{no} - \gamma, \gamma] + \text{ar}\gamma . \text{family} * \text{ret.t}[\text{no} - \gamma, \gamma] + \text{ar}\epsilon . \text{family} * \text{ret.t}[\text{no} -$ 

```

```

     $\gamma, \gamma] + \text{ar}\Delta . \text{family} * \text{ret.t}[\text{no} - \epsilon, \gamma] + z[m, \gamma]$ 

```

```

     $r[m, \gamma] = \text{ar}\gamma . \text{foulad} * \text{ret.t}[\text{no}, \gamma] + \text{ma}\gamma . \text{foulad} * \text{res.t}[\text{no}, \gamma] + \text{ma}\gamma . \text{foulad} * \text{res.t}[\text{no} - \gamma, \gamma] + \text{ma}\gamma . \text{foulad} * \text{res.t}[\text{no} -$ 

```

```

     $\gamma, \gamma] + \text{ma}\epsilon . \text{foulad} * \text{res.t}[\text{no} - \gamma, \gamma] + z[m, \gamma]$ 

```

```

     $s[m, n] = \text{lambda}[\gamma] * r[m, \gamma] + \text{lambda}[\gamma] * r[m, \gamma] + \text{lambda}[\gamma] * r[m, \gamma]$ 

```

```

  }
```

```

   $v.VaR[n] = \text{quantile}(s[n], \cdot . \cdot \gamma)$ 

```

```

}
```

```

 $VaR\gamma = \text{mean}(v.VaR)$ 

```

```

 $VaR\gamma$ 

```



```

set.seed(۳۳۳۴)

for(n in ۱:N){

u=rCopula(M,t.copula)
z=qnorm(u)

for( m in ۱:M){

r[m,۱]=ar۱.fakhouz*ret.t[no,۱]+ar۲.fakhouz*ret.t[no-۱,۱]+ar۳.fakhouz*ret.t[no-
۲,۱]+ma۱.fakhouz*res.t[no,۲]+ma۲.fakhouz*res.t[no-۱,۲]+z[m,۱]

r[m,۲]=ar۱.family*ret.t[no,۲]+ar۲.family*ret.t[no-۱,۲]+ar۳.family*ret.t[no-۲,۲]+ar۴.family*ret.t[no-
۳,۲]+ar۵.family*ret.t[no-۴,۲]+z[m,۲]

r[m,۳]=ar۱.foulad*ret.t[no,۳]+ma۱.foulad*res.t[no,۳]+ma۲.foulad*res.t[no-۱,۳]+ma۳.foulad*res.t[no-
۲,۳]+ma۴.foulad*res.t[no-۳,۳] +z[m,۳]

s[m,n]=lambda[۱]*r[m,۱]+lambda[۲]*r[m,۲]+lambda[۳]*r[m,۳]

}

v.VaR[n]=quantile(s[,n],. . . Δ)

}

VaR۱ . =mean(v.VaR)

VaR۱ .

set.seed(۳۳۳۴)

for(n in ۱:N){

u=rCopula(M,t.copula)
z=qnorm(u)

for( m in ۱:M){

r[m,۱]=ar۱.fakhouz*ret.t[no,۱]+ar۲.fakhouz*ret.t[no-۱,۱]+ar۳.fakhouz*ret.t[no-
۲,۱]+ma۱.fakhouz*res.t[no,۲]+ma۲.fakhouz*res.t[no-۱,۲]+z[m,۱]

r[m,۲]=ar۱.family*ret.t[no,۲]+ar۲.family*ret.t[no-۱,۲]+ar۳.family*ret.t[no-۲,۲]+ar۴.family*ret.t[no-
۳,۲]+ar۵.family*ret.t[no-۴,۲]+z[m,۲]

```

```
r[m,ϑ]=ar\ .foulad*ret.t[no,ϑ]+ma\ .foulad*res.t[no,ϑ]+maϑ.foulad*res.t[no-\,ϑ]+maϑ.foulad*res.t[no-ϑ,ϑ]+maϕ.foulad*res.t[no-ϑ,ϑ] +z[m,ϑ]
```

```
s[m,n]=lambda[\]*r[m,\]+lambda[ϑ]*r[m,ϑ]+lambda[ϑ]*r[m,ϑ]
```

```
}
```

```
v.VaR[n]=quantile(s[,n],. . \)
```

```
}
```

```
VaR\ \=mean(v.VaR)
```

```
VaR\ \
```

```
set.seed(ϑϑϑϑ)
```

```
for(n in 1:N){
```

```
u=rCopula(M,t.copula)
```

```
z=qnorm(u)
```

```
for( m in 1:M){
```

```
r[m,\]=ar\ .fakhouz*ret.t[no,\]+arϑ.fakhouz*ret.t[no-\,\]+arϑ.fakhouz*ret.t[no-ϑ,\]+ma\ .fakhouz*res.t[no,ϑ]+maϑ.fakhouz*res.t[no-\,ϑ]+z[m,\]
```

```
r[m,ϑ]=ar\ .family*ret.t[no,ϑ]+arϑ.family*ret.t[no-\,ϑ]+arϑ.family*ret.t[no-ϑ,ϑ]+arϕ.family*ret.t[no-ϑ,ϑ]+arΔ.family*ret.t[no-ϕ,ϑ]+z[m,ϑ]
```

```
r[m,ϑ]=ar\ .foulad*ret.t[no,ϑ]+ma\ .foulad*res.t[no,ϑ]+maϑ.foulad*res.t[no-\,ϑ]+maϑ.foulad*res.t[no-ϑ,ϑ]+maϕ.foulad*res.t[no-ϑ,ϑ] +z[m,ϑ]
```

```
s[m,n]=lambda[\]*r[m,\]+lambda[ϑ]*r[m,ϑ]+lambda[ϑ]*r[m,ϑ]
```

```
}
```

```
v.VaR[n]=quantile(s[,n],. . \Δ)
```

```
}
```

```
VaR\ ϑ=mean(v.VaR)
```

```
VaR\ ϑ
```

```
lambda=c(\, ., .)
```

```

set.seed(۲۳۲۴)

for(n in ۱:N){

u=rCopula(M,t.copula)
z=qnorm(u)

for( m in ۱:M){

r[m,۱]=ar۱.fakhouz*ret.t[no,۱]+ar۲.fakhouz*ret.t[no-۱,۱]+ar۳.fakhouz*ret.t[no-
۲,۱]+ma۱.fakhouz*res.t[no,۲]+ma۲.fakhouz*res.t[no-۱,۲]+z[m,۱]

r[m,۲]=ar۱.family*ret.t[no,۲]+ar۲.family*ret.t[no-۱,۲]+ar۳.family*ret.t[no-۲,۲]+ar۴.family*ret.t[no-
۳,۲]+ar۵.family*ret.t[no-۴,۲]+z[m,۲]

r[m,۳]=ar۱.foulad*ret.t[no,۳]+ma۱.foulad*res.t[no,۳]+ma۲.foulad*res.t[no-۱,۳]+ma۳.foulad*res.t[no-
۲,۳]+ma۴.foulad*res.t[no-۳,۳] +z[m,۳]

s[m,n]=lambda[۱]*r[m,۱]+lambda[۲]*r[m,۲]+lambda[۳]*r[m,۳]

}

v.VaR[n]=quantile(s[n],. . . ۱)

}

VaR۱۳=mean(v.VaR)

VaR۱۳

```

```

set.seed(۲۳۲۴)

for(n in ۱:N){

u=rCopula(M,t.copula)
z=qnorm(u)

for( m in ۱:M){

r[m,۱]=ar۱.fakhouz*ret.t[no,۱]+ar۲.fakhouz*ret.t[no-۱,۱]+ar۳.fakhouz*ret.t[no-
۲,۱]+ma۱.fakhouz*res.t[no,۲]+ma۲.fakhouz*res.t[no-۱,۲]+z[m,۱]

r[m,۲]=ar۱.family*ret.t[no,۲]+ar۲.family*ret.t[no-۱,۲]+ar۳.family*ret.t[no-۲,۲]+ar۴.family*ret.t[no-

```

```

 $\mathfrak{r}, \mathfrak{r}] + \text{ar}\Delta.\text{family} * \text{ret.t}[\text{no}-\mathfrak{f}, \mathfrak{r}] + \text{z}[\text{m}, \mathfrak{r}]$ 

 $\text{r}[\text{m}, \mathfrak{r}] = \text{ar}\backslash.\text{foulad} * \text{ret.t}[\text{no}, \mathfrak{r}] + \text{ma}\backslash.\text{foulad} * \text{res.t}[\text{no}, \mathfrak{r}] + \text{ma}\mathfrak{r}.\text{foulad} * \text{res.t}[\text{no}-\backslash, \mathfrak{r}] + \text{ma}\mathfrak{r}.\text{foulad} * \text{res.t}[\text{no}-$ 
 $\mathfrak{r}, \mathfrak{r}] + \text{ma}\mathfrak{f}.\text{foulad} * \text{res.t}[\text{no}-\mathfrak{r}, \mathfrak{r}] + \text{z}[\text{m}, \mathfrak{r}]$ 

 $\text{s}[\text{m}, \text{n}] = \text{lambda}[\backslash] * \text{r}[\text{m}, \backslash] + \text{lambda}[\mathfrak{r}] * \text{r}[\text{m}, \mathfrak{r}] + \text{lambda}[\mathfrak{r}] * \text{r}[\text{m}, \mathfrak{r}]$ 
}
v.VaR[n]=quantile(s[,n], $\cdot \cdot \Delta$ )
}
VaR\mathfrak{f}=mean(v.VaR)

VaR\backslash\mathfrak{f}

set.seed(2222)

for(n in 1:N){

u=rCopula(M,t.copula)

z=qnorm(u)

for( m in 1:M){

 $\text{r}[\text{m}, \backslash] = \text{ar}\backslash.\text{fakhouz} * \text{ret.t}[\text{no}, \backslash] + \text{ar}\mathfrak{r}.\text{fakhouz} * \text{ret.t}[\text{no}-\backslash, \backslash] + \text{ar}\mathfrak{r}.\text{fakhouz} * \text{ret.t}[\text{no}-$ 
 $\mathfrak{r}, \backslash] + \text{ma}\backslash.\text{fakhouz} * \text{res.t}[\text{no}, \mathfrak{r}] + \text{ma}\mathfrak{r}.\text{fakhouz} * \text{res.t}[\text{no}-\backslash, \mathfrak{r}] + \text{z}[\text{m}, \backslash]$ 

 $\text{r}[\text{m}, \mathfrak{r}] = \text{ar}\backslash.\text{family} * \text{ret.t}[\text{no}, \mathfrak{r}] + \text{ar}\mathfrak{r}.\text{family} * \text{ret.t}[\text{no}-\backslash, \mathfrak{r}] + \text{ar}\mathfrak{r}.\text{family} * \text{ret.t}[\text{no}-\mathfrak{r}, \mathfrak{r}] + \text{ar}\mathfrak{f}.\text{family} * \text{ret.t}[\text{no}-$ 
 $\mathfrak{r}, \mathfrak{r}] + \text{ar}\Delta.\text{family} * \text{ret.t}[\text{no}-\mathfrak{f}, \mathfrak{r}] + \text{z}[\text{m}, \mathfrak{r}]$ 

 $\text{r}[\text{m}, \mathfrak{r}] = \text{ar}\backslash.\text{foulad} * \text{ret.t}[\text{no}, \mathfrak{r}] + \text{ma}\backslash.\text{foulad} * \text{res.t}[\text{no}, \mathfrak{r}] + \text{ma}\mathfrak{r}.\text{foulad} * \text{res.t}[\text{no}-\backslash, \mathfrak{r}] + \text{ma}\mathfrak{r}.\text{foulad} * \text{res.t}[\text{no}-$ 
 $\mathfrak{r}, \mathfrak{r}] + \text{ma}\mathfrak{f}.\text{foulad} * \text{res.t}[\text{no}-\mathfrak{r}, \mathfrak{r}] + \text{z}[\text{m}, \mathfrak{r}]$ 

 $\text{s}[\text{m}, \text{n}] = \text{lambda}[\backslash] * \text{r}[\text{m}, \backslash] + \text{lambda}[\mathfrak{r}] * \text{r}[\text{m}, \mathfrak{r}] + \text{lambda}[\mathfrak{r}] * \text{r}[\text{m}, \mathfrak{r}]$ 
}
v.VaR[n]=quantile(s[,n], $\cdot \cdot \backslash$ )
}
VaR\Delta=mean(v.VaR)

VaR\backslash\Delta

set.seed(2222)

```

```

for(n in 1:N){
u=rCopula(M,t.copula)
z=qnorm(u)
for( m in 1:M){

r[m,1]=ar1.fakhouz*ret.t[no,1]+ar2.fakhouz*ret.t[no-1,1]+ar3.fakhouz*ret.t[no-
2,1]+ma1.fakhouz*res.t[no,2]+ma2.fakhouz*res.t[no-1,2]+z[m,1]

r[m,2]=ar1.famly*ret.t[no,2]+ar2.famly*ret.t[no-1,2]+ar3.famly*ret.t[no-2,2]+ar4.famly*ret.t[no-
3,2]+ar5.famly*ret.t[no-4,2]+z[m,2]

r[m,3]=ar1.foulad*ret.t[no,3]+ma1.foulad*res.t[no,3]+ma2.foulad*res.t[no-1,3]+ma3.foulad*res.t[no-
2,3]+ma4.foulad*res.t[no-3,3] +z[m,3]

s[m,n]=lambda[1]*r[m,1]+lambda[2]*r[m,2]+lambda[3]*r[m,3]
}
v.VaR[n]=quantile(s[n],.1*delta)
}
VaR16=mean(v.VaR)

VaR16

lambda=c(.1,.1,.1)

set.seed(2222)

for(n in 1:N){
u=rCopula(M,t.copula)
z=qnorm(u)
for( m in 1:M){

r[m,1]=ar1.fakhouz*ret.t[no,1]+ar2.fakhouz*ret.t[no-1,1]+ar3.fakhouz*ret.t[no-
2,1]+ma1.fakhouz*res.t[no,2]+ma2.fakhouz*res.t[no-1,2]+z[m,1]

r[m,2]=ar1.famly*ret.t[no,2]+ar2.famly*ret.t[no-1,2]+ar3.famly*ret.t[no-2,2]+ar4.famly*ret.t[no-
3,2]+ar5.famly*ret.t[no-4,2]+z[m,2]

r[m,3]=ar1.foulad*ret.t[no,3]+ma1.foulad*res.t[no,3]+ma2.foulad*res.t[no-1,3]+ma3.foulad*res.t[no-

```

```

 $\gamma, \gamma] + ma\epsilon.foulad*res.t[no-\gamma, \gamma] + z[m, \gamma]$ 

s[m,n]=lambda[ $\lambda$ ]*r[m,  $\lambda$ ]+lambda[ $\gamma$ ]*r[m,  $\gamma$ ]+lambda[ $\gamma$ ]*r[m,  $\gamma$ ]

}

v.VaR[n]=quantile(s[,n],  $\cdot \cdot \cdot \lambda$ )

}

VaR  $\lambda \gamma$  = mean(v.VaR)

VaR  $\lambda \gamma$ 

```

```

set.seed(2222)

for(n in 1:N){

u=rCopula(M,t.copula)

z=qnorm(u)

for( m in 1:M){

r[m,  $\lambda$ ] = ar $\lambda$ .fakhouz*ret.t[no,  $\lambda$ ] + ar $\gamma$ .fakhouz*ret.t[no- $\lambda$ ,  $\lambda$ ] + ar $\gamma$ .fakhouz*ret.t[no- $\gamma$ ,  $\lambda$ ] + ma $\lambda$ .fakhouz*res.t[no,  $\gamma$ ] + ma $\gamma$ .fakhouz*res.t[no- $\lambda$ ,  $\gamma$ ] + z[m,  $\lambda$ ]

r[m,  $\gamma$ ] = ar $\lambda$ .family*ret.t[no,  $\gamma$ ] + ar $\gamma$ .family*ret.t[no- $\lambda$ ,  $\gamma$ ] + ar $\gamma$ .family*ret.t[no- $\gamma$ ,  $\gamma$ ] + ar $\epsilon$ .family*ret.t[no- $\gamma$ ,  $\gamma$ ] + ar $\Delta$ .family*ret.t[no- $\epsilon$ ,  $\gamma$ ] + z[m,  $\gamma$ ]

r[m,  $\gamma$ ] = ar $\lambda$ .foulad*ret.t[no,  $\gamma$ ] + ma $\lambda$ .foulad*res.t[no,  $\gamma$ ] + ma $\gamma$ .foulad*res.t[no- $\lambda$ ,  $\gamma$ ] + ma $\gamma$ .foulad*res.t[no- $\gamma$ ,  $\gamma$ ] + ma $\epsilon$ .foulad*res.t[no- $\gamma$ ,  $\gamma$ ] + z[m,  $\gamma$ ]

s[m,n]=lambda[ $\lambda$ ]*r[m,  $\lambda$ ]+lambda[ $\gamma$ ]*r[m,  $\gamma$ ]+lambda[ $\gamma$ ]*r[m,  $\gamma$ ]

}

v.VaR[n]=quantile(s[,n],  $\cdot \cdot \cdot \Delta$ )

}

VaR  $\lambda \Delta$  = mean(v.VaR)

VaR  $\lambda \Delta$ 

set.seed(2222)

```

```

for(n in 1:N){
u=rCopula(M,t.copula)
z=qnorm(u)
for( m in 1:M){

r[m,1]=ar1.fakhouz*ret.t[no,1]+ar2.fakhouz*ret.t[no-1,1]+ar3.fakhouz*ret.t[no-
2,1]+ma1.fakhouz*res.t[no,2]+ma2.fakhouz*res.t[no-1,2]+z[m,1]

r[m,2]=ar1.famly*ret.t[no,2]+ar2.famly*ret.t[no-1,2]+ar3.famly*ret.t[no-2,2]+ar4.famly*ret.t[no-
3,2]+ar5.famly*ret.t[no-4,2]+z[m,2]

r[m,3]=ar1.foulad*ret.t[no,3]+ma1.foulad*res.t[no,3]+ma2.foulad*res.t[no-1,3]+ma3.foulad*res.t[no-
2,3]+ma4.foulad*res.t[no-3,3] +z[m,3]

s[m,n]=lambda[1]*r[m,1]+lambda[2]*r[m,2]+lambda[3]*r[m,3]
}
v.VaR[n]=quantile(s[,n],.1)
}
VaR19=mean(v.VaR)

VaR19

set.seed(2224)

for(n in 1:N){
u=rCopula(M,t.copula)
z=qnorm(u)
for( m in 1:M){

r[m,1]=ar1.fakhouz*ret.t[no,1]+ar2.fakhouz*ret.t[no-1,1]+ar3.fakhouz*ret.t[no-
2,1]+ma1.fakhouz*res.t[no,2]+ma2.fakhouz*res.t[no-1,2]+z[m,1]

r[m,2]=ar1.famly*ret.t[no,2]+ar2.famly*ret.t[no-1,2]+ar3.famly*ret.t[no-2,2]+ar4.famly*ret.t[no-
3,2]+ar5.famly*ret.t[no-4,2]+z[m,2]

r[m,3]=ar1.foulad*ret.t[no,3]+ma1.foulad*res.t[no,3]+ma2.foulad*res.t[no-1,3]+ma3.foulad*res.t[no-
2,3]+ma4.foulad*res.t[no-3,3] +z[m,3]

```

```

s[m,n]=lambda[\]*r[m,\]+lambda[\]*r[m,\]+lambda[\]*r[m,\]
}
v.VaR[n]=quantile(s[,n],\Delta)
}
VaR\=mean(v.VaR)

VaR\

lambda=c(\,\)

set.seed(1234)

for(n in 1:N){

u=rCopula(M,t.copula)

z=qnorm(u)

for( m in 1:M){

r[m,\]=ar\ .fakhouz*ret.t[no,\]+ar\ .fakhouz*ret.t[no-\,\]+ar\ .fakhouz*ret.t[no-
\,\]+ma\ .fakhouz*res.t[no,\]+ma\ .fakhouz*res.t[no-\,\]+z[m,\]

r[m,\]=ar\ .family*ret.t[no,\]+ar\ .family*ret.t[no-\,\]+ar\ .family*ret.t[no-\,\]+ar\ .family*ret.t[no-
\,\]+ar\ .family*ret.t[no-\,\]+z[m,\]

r[m,\]=ar\ .foulad*ret.t[no,\]+ma\ .foulad*res.t[no,\]+ma\ .foulad*res.t[no-\,\]+ma\ .foulad*res.t[no-
\,\]+ma\ .foulad*res.t[no-\,\]+z[m,\]

s[m,n]=lambda[\]*r[m,\]+lambda[\]*r[m,\]+lambda[\]*r[m,\]
}

v.VaR[n]=quantile(s[,n],\Delta)
}

VaR\=mean(v.VaR)

VaR\

set.seed(1234)

```



```

for(n in 1:N){
u=rCopula(M,t.copula)
z=qnorm(u)
for( m in 1:M){

r[m,1]=ar1.fakhouz*ret.t[no,1]+ar2.fakhouz*ret.t[no-1,1]+ar3.fakhouz*ret.t[no-
2,1]+ma1.fakhouz*res.t[no,2]+ma2.fakhouz*res.t[no-1,2]+z[m,1]

r[m,2]=ar1.famly*ret.t[no,2]+ar2.famly*ret.t[no-1,2]+ar3.famly*ret.t[no-2,2]+ar4.famly*ret.t[no-
3,2]+ar5.famly*ret.t[no-4,2]+z[m,2]

r[m,3]=ar1.foulad*ret.t[no,3]+ma1.foulad*res.t[no,3]+ma2.foulad*res.t[no-1,3]+ma3.foulad*res.t[no-
2,3]+ma4.foulad*res.t[no-3,3] +z[m,3]

s[m,n]=lambda[1]*r[m,1]+lambda[2]*r[m,2]+lambda[3]*r[m,3]
}
v.VaR[n]=quantile(s[,n],. . . delta)
}
VaR22=mean(v.VaR)

VaR22

set.seed(2222)

for(n in 1:N){
u=rCopula(M,t.copula)
z=qnorm(u)
for( m in 1:M){

r[m,1]=ar1.fakhouz*ret.t[no,1]+ar2.fakhouz*ret.t[no-1,1]+ar3.fakhouz*ret.t[no-
2,1]+ma1.fakhouz*res.t[no,2]+ma2.fakhouz*res.t[no-1,2]+z[m,1]

r[m,2]=ar1.famly*ret.t[no,2]+ar2.famly*ret.t[no-1,2]+ar3.famly*ret.t[no-2,2]+ar4.famly*ret.t[no-
3,2]+ar5.famly*ret.t[no-4,2]+z[m,2]

r[m,3]=ar1.foulad*ret.t[no,3]+ma1.foulad*res.t[no,3]+ma2.foulad*res.t[no-1,3]+ma3.foulad*res.t[no-
2,3]+ma4.foulad*res.t[no-3,3] +z[m,3]

```

```

s[m,n]=lambda[\]*r[m,\]+lambda[\]*r[m,\]+lambda[\]*r[m,\]
}
v.VaR[n]=quantile(s[,n],\.\)
}
VaR\=mean(v.VaR)

VaR\
set.seed(2222)

for(n in 1:N){
u=rCopula(M,t.copula)
z=qnorm(u)
for( m in 1:M){

r[m,\]=ar\ .fakhouz*ret.t[no,\]+ar\ .fakhouz*ret.t[no-\,\]+ar\ .fakhouz*ret.t[no-
\,\]+ma\ .fakhouz*res.t[no,\]+ma\ .fakhouz*res.t[no-\,\]+z[m,\]

r[m,\]=ar\ .family*ret.t[no,\]+ar\ .family*ret.t[no-\,\]+ar\ .family*ret.t[no-\,\]+ar\ .family*ret.t[no-
\,\]+ar\ .family*ret.t[no-\,\]+z[m,\]

r[m,\]=ar\ .foulad*ret.t[no,\]+ma\ .foulad*res.t[no,\]+ma\ .foulad*res.t[no-\,\]+ma\ .foulad*res.t[no-
\,\]+ma\ .foulad*res.t[no-\,\]+z[m,\]

s[m,n]=lambda[\]*r[m,\]+lambda[\]*r[m,\]+lambda[\]*r[m,\]
}
v.VaR[n]=quantile(s[,n],\.\)
}
VaR\=mean(v.VaR)

VaR\
lambda=c(\.\,\.\)
set.seed(2222)

for(n in 1:N){
u=rCopula(M,t.copula)

```

```

z=qnorm(u)
for( m in 1:M){

r[m,1]=ar1.fakhouz*ret.t[no,1]+ar2.fakhouz*ret.t[no-1,1]+ar3.fakhouz*ret.t[no-
2,1]+ma1.fakhouz*res.t[no,2]+ma2.fakhouz*res.t[no-1,2]+z[m,1]

r[m,2]=ar1.famly*ret.t[no,2]+ar2.famly*ret.t[no-1,2]+ar3.famly*ret.t[no-2,2]+ar4.famly*ret.t[no-
3,2]+ar5.famly*ret.t[no-4,2]+z[m,2]

r[m,3]=ar1.foulad*ret.t[no,3]+ma1.foulad*res.t[no,3]+ma2.foulad*res.t[no-1,3]+ma3.foulad*res.t[no-
2,3]+ma4.foulad*res.t[no-3,3] +z[m,3]

s[m,n]=lambda[1]*r[m,1]+lambda[2]*r[m,2]+lambda[3]*r[m,3]

}

v.VaR[n]=quantile(s[n],...1)

}

VaR2=mean(v.VaR)

VaR2

```

```

set.seed(2222)

for(n in 1:N){

u=rCopula(M,t.copula)

z=qnorm(u)

for( m in 1:M){

r[m,1]=ar1.fakhouz*ret.t[no,1]+ar2.fakhouz*ret.t[no-1,1]+ar3.fakhouz*ret.t[no-
2,1]+ma1.fakhouz*res.t[no,2]+ma2.fakhouz*res.t[no-1,2]+z[m,1]

r[m,2]=ar1.famly*ret.t[no,2]+ar2.famly*ret.t[no-1,2]+ar3.famly*ret.t[no-2,2]+ar4.famly*ret.t[no-
3,2]+ar5.famly*ret.t[no-4,2]+z[m,2]

r[m,3]=ar1.foulad*ret.t[no,3]+ma1.foulad*res.t[no,3]+ma2.foulad*res.t[no-1,3]+ma3.foulad*res.t[no-
2,3]+ma4.foulad*res.t[no-3,3] +z[m,3]

s[m,n]=lambda[1]*r[m,1]+lambda[2]*r[m,2]+lambda[3]*r[m,3]

```

```

}
v.VaR[n]=quantile(s[,n],. . . Δ)
}
VaR٢٩=mean(v.VaR)

VaR٢٩

set.seed(٢٣٢٢٤)

for(n in ١:N){

u=rCopula(M,t.copula)
z=qnorm(u)

for( m in ١:M){

r[m,١]=ar١.fakhouz*ret.t[no,١]+ar٢.fakhouz*ret.t[no-١,١]+ar٣.fakhouz*ret.t[no-
٢,١]+ma١.fakhouz*res.t[no,٢]+ma٢.fakhouz*res.t[no-١,٢]+z[m,١]

r[m,٢]=ar١.family*ret.t[no,٢]+ar٢.family*ret.t[no-١,٢]+ar٣.family*ret.t[no-٢,٢]+ar٤.family*ret.t[no-
٣,٢]+arΔ.family*ret.t[no-٤,٢]+z[m,٢]

r[m,٣]=ar١.foulad*ret.t[no,٣]+ma١.foulad*res.t[no,٣]+ma٢.foulad*res.t[no-١,٣]+ma٣.foulad*res.t[no-
٢,٣]+ma٤.foulad*res.t[no-٣,٣] +z[m,٣]

s[m,n]=lambda[١]*r[m,١]+lambda[٢]*r[m,٢]+lambda[٣]*r[m,٣]

}

v.VaR[n]=quantile(s[,n],. . ١)
}

VaR٢٧=mean(v.VaR)

VaR٢٧

set.seed(٢٣٢٢٤)

for(n in ١:N){

u=rCopula(M,t.copula)
z=qnorm(u)

for( m in ١:M){

```

```

r[m, \]=ar\ .fakhouz*ret.t[no, \]+ar\ .fakhouz*ret.t[no-\, \]+ar\ .fakhouz*ret.t[no-
\, \]+ma\ .fakhouz*res.t[no, \]+ma\ .fakhouz*res.t[no-\, \]+z[m, \]

r[m, \]=ar\ .family*ret.t[no, \]+ar\ .family*ret.t[no-\, \]+ar\ .family*ret.t[no-\, \]+ar\ .family*ret.t[no-
\, \]+ar\ .family*ret.t[no-\, \]+z[m, \]

r[m, \]=ar\ .foulad*ret.t[no, \]+ma\ .foulad*res.t[no, \]+ma\ .foulad*res.t[no-\, \]+ma\ .foulad*res.t[no-
\, \]+ma\ .foulad*res.t[no-\, \]+z[m, \]

s[m,n]=lambda[\]*r[m, \]+lambda[\]*r[m, \]+lambda[\]*r[m, \]

}

v.VaR[n]=quantile(s[,n], . . \Delta)

}

VaR\Delta=mean(v.VaR)

VaR\Delta

lambda=c(. \Delta, . . \Delta)

set.seed(1234)

for(n in 1:N){

u=rCopula(M,t.copula)

z=qnorm(u)

for( m in 1:M){

r[m, \]=ar\ .fakhouz*ret.t[no, \]+ar\ .fakhouz*ret.t[no-\, \]+ar\ .fakhouz*ret.t[no-
\, \]+ma\ .fakhouz*res.t[no, \]+ma\ .fakhouz*res.t[no-\, \]+z[m, \]

r[m, \]=ar\ .family*ret.t[no, \]+ar\ .family*ret.t[no-\, \]+ar\ .family*ret.t[no-\, \]+ar\ .family*ret.t[no-
\, \]+ar\ .family*ret.t[no-\, \]+z[m, \]

r[m, \]=ar\ .foulad*ret.t[no, \]+ma\ .foulad*res.t[no, \]+ma\ .foulad*res.t[no-\, \]+ma\ .foulad*res.t[no-
\, \]+ma\ .foulad*res.t[no-\, \]+z[m, \]

s[m,n]=lambda[\]*r[m, \]+lambda[\]*r[m, \]+lambda[\]*r[m, \]

}

v.VaR[n]=quantile(s[,n], . . \Delta)

```

```

}
VaR $\gamma$ =mean(v.VaR)

VaR $\gamma$ 

set.seed(2224)

for(n in 1:N){

u=rCopula(M,t.copula)
z=qnorm(u)

for( m in 1:M){

r[m,1]=ar1.fakhouz*ret.t[no,1]+ar $\gamma$ .fakhouz*ret.t[no-1,1]+ar $\gamma$ .fakhouz*ret.t[no-
 $\gamma$ ,1]+ma1.fakhouz*res.t[no, $\gamma$ ]+ma $\gamma$ .fakhouz*res.t[no-1, $\gamma$ ]+z[m,1]

r[m, $\gamma$ ]=ar1.family*ret.t[no, $\gamma$ ]+ar $\gamma$ .family*ret.t[no-1, $\gamma$ ]+ar $\gamma$ .family*ret.t[no- $\gamma$ , $\gamma$ ]+ar $\gamma$ .family*ret.t[no-
 $\gamma$ , $\gamma$ ]+ar $\Delta$ .family*ret.t[no- $\gamma$ , $\gamma$ ]+z[m, $\gamma$ ]

r[m, $\gamma$ ]=ar1.foulad*ret.t[no, $\gamma$ ]+ma1.foulad*res.t[no, $\gamma$ ]+ma $\gamma$ .foulad*res.t[no-1, $\gamma$ ]+ma $\gamma$ .foulad*res.t[no-
 $\gamma$ , $\gamma$ ]+ma $\gamma$ .foulad*res.t[no- $\gamma$ , $\gamma$ ]+z[m, $\gamma$ ]

s[m,n]=lambda[1]*r[m,1]+lambda[ $\gamma$ ]*r[m, $\gamma$ ]+lambda[ $\gamma$ ]*r[m, $\gamma$ ]

}

v.VaR[n]=quantile(s[,n],... $\Delta$ )

}

VaR $\gamma$ =mean(v.VaR)

VaR $\gamma$ 

set.seed(2224)

for(n in 1:N){

u=rCopula(M,t.copula)
z=qnorm(u)

for( m in 1:M){

r[m,1]=ar1.fakhouz*ret.t[no,1]+ar $\gamma$ .fakhouz*ret.t[no-1,1]+ar $\gamma$ .fakhouz*ret.t[no-

```

```

 $\gamma, \lambda] + ma \backslash .fakhouz * res.t[no, \gamma] + ma \gamma .fakhouz * res.t[no - \lambda, \gamma] + z[m, \lambda]$ 

 $r[m, \gamma] = ar \backslash .family * ret.t[no, \gamma] + ar \gamma .family * ret.t[no - \lambda, \gamma] + ar \gamma .family * ret.t[no - \gamma, \gamma] + ar \epsilon .family * ret.t[no - \gamma, \gamma] + ar \Delta .family * ret.t[no - \epsilon, \gamma] + z[m, \gamma]$ 

 $r[m, \gamma] = ar \backslash .foulad * ret.t[no, \gamma] + ma \backslash .foulad * res.t[no, \gamma] + ma \gamma .foulad * res.t[no - \lambda, \gamma] + ma \gamma .foulad * res.t[no - \gamma, \gamma] + ma \epsilon .foulad * res.t[no - \gamma, \gamma] + z[m, \gamma]$ 

 $s[m, n] = \lambda[m, \lambda] * r[m, \lambda] + \lambda[m, \gamma] * r[m, \gamma] + \lambda[m, \gamma] * r[m, \gamma]$ 
}
v.VaR[n]=quantile(s[,n], . .  $\lambda$ )
}
VaR $\gamma \backslash$  = mean(v.VaR)

VaR $\gamma \backslash$ 

set.seed(2222)

for(n in 1:N){

u=rCopula(M,t.copula)

z=qnorm(u)

for( m in 1:M){

 $r[m, \lambda] = ar \backslash .fakhouz * ret.t[no, \lambda] + ar \gamma .fakhouz * ret.t[no - \lambda, \lambda] + ar \gamma .fakhouz * ret.t[no - \gamma, \lambda] + ma \backslash .fakhouz * res.t[no, \gamma] + ma \gamma .fakhouz * res.t[no - \lambda, \gamma] + z[m, \lambda]$ 

 $r[m, \gamma] = ar \backslash .family * ret.t[no, \gamma] + ar \gamma .family * ret.t[no - \lambda, \gamma] + ar \gamma .family * ret.t[no - \gamma, \gamma] + ar \epsilon .family * ret.t[no - \gamma, \gamma] + ar \Delta .family * ret.t[no - \epsilon, \gamma] + z[m, \gamma]$ 

 $r[m, \gamma] = ar \backslash .foulad * ret.t[no, \gamma] + ma \backslash .foulad * res.t[no, \gamma] + ma \gamma .foulad * res.t[no - \lambda, \gamma] + ma \gamma .foulad * res.t[no - \gamma, \gamma] + ma \epsilon .foulad * res.t[no - \gamma, \gamma] + z[m, \gamma]$ 

 $s[m, n] = \lambda[m, \lambda] * r[m, \lambda] + \lambda[m, \gamma] * r[m, \gamma] + \lambda[m, \gamma] * r[m, \gamma]$ 
}
v.VaR[n]=quantile(s[,n], . .  $\lambda \Delta$ )
}
VaR $\gamma \gamma$  = mean(v.VaR)

```

VaR $\gamma\gamma$

lambda=c(\cdot , \cdot . $\gamma\Delta$, \cdot . $\gamma\Delta$)

set.seed($\gamma\gamma\gamma\epsilon$)

for(n in 1:N){

u=rCopula(M,t.copula)

z=qnorm(u)

for(m in 1:M){

r[m,1]=ar1.fakhouz*ret.t[no,1]+ar γ .fakhouz*ret.t[no-1,1]+ar γ .fakhouz*ret.t[no-
 γ ,1]+ma1.fakhouz*res.t[no, γ]+ma γ .fakhouz*res.t[no-1, γ]+z[m,1]

r[m, γ]=ar1.family*ret.t[no, γ]+ar γ .family*ret.t[no-1, γ]+ar γ .family*ret.t[no- γ , γ]+ar ϵ .family*ret.t[no-
 γ , γ]+ar Δ .family*ret.t[no- ϵ , γ]+z[m, γ]

r[m, γ]=ar1.foulad*ret.t[no, γ]+ma1.foulad*res.t[no, γ]+ma γ .foulad*res.t[no-1, γ]+ma γ .foulad*res.t[no-
 γ , γ]+ma ϵ .foulad*res.t[no- γ , γ]+z[m, γ]

s[m,n]=lambda[1]*r[m,1]+lambda[γ]*r[m, γ]+lambda[γ]*r[m, γ]

}

v.VaR[n]=quantile(s[n], \cdot .. γ)

}

VaR $\gamma\gamma$ =mean(v.VaR)

VaR $\gamma\gamma$

set.seed($\gamma\gamma\gamma\epsilon$)

for(n in 1:N){

u=rCopula(M,t.copula)

z=qnorm(u)

for(m in 1:M){

r[m,1]=ar1.fakhouz*ret.t[no,1]+ar γ .fakhouz*ret.t[no-1,1]+ar γ .fakhouz*ret.t[no-
 γ ,1]+ma1.fakhouz*res.t[no, γ]+ma γ .fakhouz*res.t[no-1, γ]+z[m,1]


```

r[m,ʎ]=ar\ .family*ret.t[no,ʎ]+arʎ.famly*ret.t[no-\,ʎ]+arʎ.famly*ret.t[no-ʎ,ʎ]+arʆ.famly*ret.t[no-
ʎ,ʎ]+arΔ.famly*ret.t[no-ʆ,ʎ]+z[m,ʎ]

r[m,ʎ]=ar\ .foulad*ret.t[no,ʎ]+ma\ .foulad*res.t[no,ʎ]+maʎ.foulad*res.t[no-\,ʎ]+maʎ.foulad*res.t[no-
ʎ,ʎ]+maʆ.foulad*res.t[no-ʎ,ʎ] +z[m,ʎ]

s[m,n]=lambda[\]*r[m,\]+lambda[ʎ]*r[m,ʎ]+lambda[ʎ]*r[m,ʎ]
}
v.VaR[n]=quantile(s[,n],. . Δ)
}
VaRʎʆ=mean(v.VaR)

VaRʎʆ

set.seed(ʎʎʎʆ)

for(n in 1:N){

u=rCopula(M,t.copula)

z=qnorm(u)

for( m in 1:M){

r[m,\]=ar\ .fakhouz*ret.t[no,\]+arʎ.fakhouz*ret.t[no-\,\]+arʎ.fakhouz*ret.t[no-
ʎ,\]+ma\ .fakhouz*res.t[no,ʎ]+maʎ.fakhouz*res.t[no-\,ʎ]+z[m,\]

r[m,ʎ]=ar\ .family*ret.t[no,ʎ]+arʎ.famly*ret.t[no-\,ʎ]+arʎ.famly*ret.t[no-ʎ,ʎ]+arʆ.famly*ret.t[no-
ʎ,ʎ]+arΔ.famly*ret.t[no-ʆ,ʎ]+z[m,ʎ]

r[m,ʎ]=ar\ .foulad*ret.t[no,ʎ]+ma\ .foulad*res.t[no,ʎ]+maʎ.foulad*res.t[no-\,ʎ]+maʎ.foulad*res.t[no-
ʎ,ʎ]+maʆ.foulad*res.t[no-ʎ,ʎ] +z[m,ʎ]

s[m,n]=lambda[\]*r[m,\]+lambda[ʎ]*r[m,ʎ]+lambda[ʎ]*r[m,ʎ]
}
v.VaR[n]=quantile(s[,n],. . \)
}
VaRʎΔ=mean(v.VaR)

VaRʎΔ

```

```

set.seed(۲۳۲۴)

for(n in ۱:N){

u=rCopula(M,t.copula)
z=qnorm(u)

for( m in ۱:M){

r[m,۱]=ar۱.fakhouz*ret.t[no,۱]+ar۲.fakhouz*ret.t[no-۱,۱]+ar۳.fakhouz*ret.t[no-
۲,۱]+ma۱.fakhouz*res.t[no,۲]+ma۲.fakhouz*res.t[no-۱,۲]+z[m,۱]

r[m,۲]=ar۱.family*ret.t[no,۲]+ar۲.family*ret.t[no-۱,۲]+ar۳.family*ret.t[no-۲,۲]+ar۴.family*ret.t[no-
۳,۲]+ar۵.family*ret.t[no-۴,۲]+z[m,۲]

r[m,۳]=ar۱.foulad*ret.t[no,۳]+ma۱.foulad*res.t[no,۳]+ma۲.foulad*res.t[no-۱,۳]+ma۳.foulad*res.t[no-
۲,۳]+ma۴.foulad*res.t[no-۳,۳] +z[m,۳]

s[m,n]=lambda[۱]*r[m,۱]+lambda[۲]*r[m,۲]+lambda[۳]*r[m,۳]

}

v.VaR[n]=quantile(s[n],. .۱۵)

}

VaR۳۶=mean(v.VaR)

VaR۳۶

lambda=c(.۵,.۵,.۵)

set.seed(۲۳۲۴)

for(n in ۱:N){

u=rCopula(M,t.copula)
z=qnorm(u)

for( m in ۱:M){

r[m,۱]=ar۱.fakhouz*ret.t[no,۱]+ar۲.fakhouz*ret.t[no-۱,۱]+ar۳.fakhouz*ret.t[no-
۲,۱]+ma۱.fakhouz*res.t[no,۲]+ma۲.fakhouz*res.t[no-۱,۲]+z[m,۱]

r[m,۲]=ar۱.family*ret.t[no,۲]+ar۲.family*ret.t[no-۱,۲]+ar۳.family*ret.t[no-۲,۲]+ar۴.family*ret.t[no-
۳,۲]+ar۵.family*ret.t[no-۴,۲]+z[m,۲]

```

```
r[m,ϑ]=ar\ .foulad*ret.t[no,ϑ]+ma\ .foulad*res.t[no,ϑ]+maϑ.foulad*res.t[no-\,ϑ]+maϑ.foulad*res.t[no-ϑ,ϑ]+maϕ.foulad*res.t[no-ϑ,ϑ] +z[m,ϑ]
```

```
s[m,n]=lambda[\]*r[m,\]+lambda[ϑ]*r[m,ϑ]+lambda[ϑ]*r[m,ϑ]
```

```
}
```

```
v.VaR[n]=quantile(s[,n],. . \)
```

```
}
```

```
VaRϑϑ=mean(v.VaR)
```

```
VaRϑϑ
```

```
set.seed(ϑϑϑϑ)
```

```
for(n in \:N){
```

```
u=rCopula(M,t.copula)
```

```
z=qnorm(u)
```

```
for( m in \:M){
```

```
r[m,\]=ar\ .fakhouz*ret.t[no,\]+arϑ.fakhouz*ret.t[no-\,\]+arϑ.fakhouz*ret.t[no-ϑ,\]+ma\ .fakhouz*res.t[no,ϑ]+maϑ.fakhouz*res.t[no-\,ϑ]+z[m,\]
```

```
r[m,ϑ]=ar\ .family*ret.t[no,ϑ]+arϑ.family*ret.t[no-\,ϑ]+arϑ.family*ret.t[no-ϑ,ϑ]+arϕ.family*ret.t[no-ϑ,ϑ]+arΔ.family*ret.t[no-ϕ,ϑ]+z[m,ϑ]
```

```
r[m,ϑ]=ar\ .foulad*ret.t[no,ϑ]+ma\ .foulad*res.t[no,ϑ]+maϑ.foulad*res.t[no-\,ϑ]+maϑ.foulad*res.t[no-ϑ,ϑ]+maϕ.foulad*res.t[no-ϑ,ϑ] +z[m,ϑ]
```

```
s[m,n]=lambda[\]*r[m,\]+lambda[ϑ]*r[m,ϑ]+lambda[ϑ]*r[m,ϑ]
```

```
}
```

```
v.VaR[n]=quantile(s[,n],. . Δ)
```

```
}
```

```
VaRϑΔ=mean(v.VaR)
```

```
VaRϑΔ
```

```
set.seed(ϑϑϑϑ)
```

```

for(n in 1:N){
u=rCopula(M,t.copula)
z=qnorm(u)
for( m in 1:M){

r[m,1]=ar1.fakhouz*ret.t[no,1]+ar2.fakhouz*ret.t[no-1,1]+ar3.fakhouz*ret.t[no-
2,1]+ma1.fakhouz*res.t[no,2]+ma2.fakhouz*res.t[no-1,2]+z[m,1]

r[m,2]=ar1.famly*ret.t[no,2]+ar2.famly*ret.t[no-1,2]+ar3.famly*ret.t[no-2,2]+ar4.famly*ret.t[no-
3,2]+ar5.famly*ret.t[no-4,2]+z[m,2]

r[m,3]=ar1.foulad*ret.t[no,3]+ma1.foulad*res.t[no,3]+ma2.foulad*res.t[no-1,3]+ma3.foulad*res.t[no-
2,3]+ma4.foulad*res.t[no-3,3] +z[m,3]

s[m,n]=lambda[1]*r[m,1]+lambda[2]*r[m,2]+lambda[3]*r[m,3]
}
v.VaR[n]=quantile(s[,n],.1)
}
VaR39=mean(v.VaR)

VaR39

set.seed(2224)

for(n in 1:N){
u=rCopula(M,t.copula)
z=qnorm(u)
for( m in 1:M){

r[m,1]=ar1.fakhouz*ret.t[no,1]+ar2.fakhouz*ret.t[no-1,1]+ar3.fakhouz*ret.t[no-
2,1]+ma1.fakhouz*res.t[no,2]+ma2.fakhouz*res.t[no-1,2]+z[m,1]

r[m,2]=ar1.famly*ret.t[no,2]+ar2.famly*ret.t[no-1,2]+ar3.famly*ret.t[no-2,2]+ar4.famly*ret.t[no-
3,2]+ar5.famly*ret.t[no-4,2]+z[m,2]

r[m,3]=ar1.foulad*ret.t[no,3]+ma1.foulad*res.t[no,3]+ma2.foulad*res.t[no-1,3]+ma3.foulad*res.t[no-
2,3]+ma4.foulad*res.t[no-3,3] +z[m,3]

```

```

s[m,n]=lambda[\]*r[m,\]+lambda[\]*r[m,\]+lambda[\]*r[m,\]
}
v.VaR[n]=quantile(s[,n],\.\Delta)
}
VaR\.=mean(v.VaR)

VaR\.

lambda=c(\.\Delta,\.\Delta)

set.seed(2222)

for(n in 1:N){

u=rCopula(M,t.copula)

z=qnorm(u)

for( m in 1:M){

r[m,\]=ar\ .fakhouz*ret.t[no,\]+ar\ .fakhouz*ret.t[no-\,\]+ar\ .fakhouz*ret.t[no-
\,\]+ma\ .fakhouz*res.t[no,\]+ma\ .fakhouz*res.t[no-\,\]+z[m,\]

r[m,\]=ar\ .family*ret.t[no,\]+ar\ .family*ret.t[no-\,\]+ar\ .family*ret.t[no-\,\]+ar\ .family*ret.t[no-
\,\]+ar\ .family*ret.t[no-\,\]+z[m,\]

r[m,\]=ar\ .foulad*ret.t[no,\]+ma\ .foulad*res.t[no,\]+ma\ .foulad*res.t[no-\,\]+ma\ .foulad*res.t[no-
\,\]+ma\ .foulad*res.t[no-\,\]+z[m,\]

s[m,n]=lambda[\]*r[m,\]+lambda[\]*r[m,\]+lambda[\]*r[m,\]
}
v.VaR[n]=quantile(s[,n],\.\.\)
}
VaR\.=mean(v.VaR)

VaR\

set.seed(2222)

```

```

for(n in 1:N){
u=rCopula(M,t.copula)
z=qnorm(u)
for( m in 1:M){

r[m,1]=ar1.fakhouz*ret.t[no,1]+ar2.fakhouz*ret.t[no-1,1]+ar3.fakhouz*ret.t[no-
2,1]+ma1.fakhouz*res.t[no,2]+ma2.fakhouz*res.t[no-1,2]+z[m,1]

r[m,2]=ar1.famly*ret.t[no,2]+ar2.famly*ret.t[no-1,2]+ar3.famly*ret.t[no-2,2]+ar4.famly*ret.t[no-
3,2]+ar5.famly*ret.t[no-4,2]+z[m,2]

r[m,3]=ar1.foulad*ret.t[no,3]+ma1.foulad*res.t[no,3]+ma2.foulad*res.t[no-1,3]+ma3.foulad*res.t[no-
2,3]+ma4.foulad*res.t[no-3,3] +z[m,3]

s[m,n]=lambda[1]*r[m,1]+lambda[2]*r[m,2]+lambda[3]*r[m,3]

}
v.VaR[n]=quantile(s[,n],. . . delta)

}

VaR42=mean(v.VaR)

VaR42

set.seed(2222)

for(n in 1:N){
u=rCopula(M,t.copula)
z=qnorm(u)
for( m in 1:M){

r[m,1]=ar1.fakhouz*ret.t[no,1]+ar2.fakhouz*ret.t[no-1,1]+ar3.fakhouz*ret.t[no-
2,1]+ma1.fakhouz*res.t[no,2]+ma2.fakhouz*res.t[no-1,2]+z[m,1]

r[m,2]=ar1.famly*ret.t[no,2]+ar2.famly*ret.t[no-1,2]+ar3.famly*ret.t[no-2,2]+ar4.famly*ret.t[no-
3,2]+ar5.famly*ret.t[no-4,2]+z[m,2]

r[m,3]=ar1.foulad*ret.t[no,3]+ma1.foulad*res.t[no,3]+ma2.foulad*res.t[no-1,3]+ma3.foulad*res.t[no-
2,3]+ma4.foulad*res.t[no-3,3] +z[m,3]

```

```

s[m,n]=lambda[\]*r[m,\]+lambda[\]*r[m,\]+lambda[\]*r[m,\]
}
v.VaR[n]=quantile(s[,n],\.\)
}
VaR\=mean(v.VaR)

VaR\

set.seed(2222)

for(n in 1:N){
u=rCopula(M,t.copula)
z=qnorm(u)
for( m in 1:M){

r[m,\]=ar\ .fakhouz*ret.t[no,\]+ar\ .fakhouz*ret.t[no-\,\]+ar\ .fakhouz*ret.t[no-
\,\]+ma\ .fakhouz*res.t[no,\]+ma\ .fakhouz*res.t[no-\,\]+z[m,\]

r[m,\]=ar\ .family*ret.t[no,\]+ar\ .family*ret.t[no-\,\]+ar\ .family*ret.t[no-\,\]+ar\ .family*ret.t[no-
\,\]+ar\ .family*ret.t[no-\,\]+z[m,\]

r[m,\]=ar\ .foulad*ret.t[no,\]+ma\ .foulad*res.t[no,\]+ma\ .foulad*res.t[no-\,\]+ma\ .foulad*res.t[no-
\,\]+ma\ .foulad*res.t[no-\,\]+z[m,\]

s[m,n]=lambda[\]*r[m,\]+lambda[\]*r[m,\]+lambda[\]*r[m,\]
}
v.VaR[n]=quantile(s[,n],\.\)
}
VaR\=mean(v.VaR)

VaR\

lambda=c(\,\.\,\.\)

set.seed(2222)

for(n in 1:N){
u=rCopula(M,t.copula)

```

```

z=qnorm(u)
for( m in 1:M){

r[m,1]=ar1.fakhouz*ret.t[no,1]+ar2.fakhouz*ret.t[no-1,1]+ar3.fakhouz*ret.t[no-
2,1]+ma1.fakhouz*res.t[no,2]+ma2.fakhouz*res.t[no-1,2]+z[m,1]

r[m,2]=ar1.famly*ret.t[no,2]+ar2.famly*ret.t[no-1,2]+ar3.famly*ret.t[no-2,2]+ar4.famly*ret.t[no-
3,2]+ar5.famly*ret.t[no-4,2]+z[m,2]

r[m,3]=ar1.foulad*ret.t[no,3]+ma1.foulad*res.t[no,3]+ma2.foulad*res.t[no-1,3]+ma3.foulad*res.t[no-
2,3]+ma4.foulad*res.t[no-3,3] +z[m,3]

s[m,n]=lambda[1]*r[m,1]+lambda[2]*r[m,2]+lambda[3]*r[m,3]

}

v.VaR[n]=quantile(s[n],...1)

}

VaR45=mean(v.VaR)

VaR45

```

```

set.seed(2222)

for(n in 1:N){

u=rCopula(M,t.copula)

z=qnorm(u)

for( m in 1:M){

r[m,1]=ar1.fakhouz*ret.t[no,1]+ar2.fakhouz*ret.t[no-1,1]+ar3.fakhouz*ret.t[no-
2,1]+ma1.fakhouz*res.t[no,2]+ma2.fakhouz*res.t[no-1,2]+z[m,1]

r[m,2]=ar1.famly*ret.t[no,2]+ar2.famly*ret.t[no-1,2]+ar3.famly*ret.t[no-2,2]+ar4.famly*ret.t[no-
3,2]+ar5.famly*ret.t[no-4,2]+z[m,2]

r[m,3]=ar1.foulad*ret.t[no,3]+ma1.foulad*res.t[no,3]+ma2.foulad*res.t[no-1,3]+ma3.foulad*res.t[no-
2,3]+ma4.foulad*res.t[no-3,3] +z[m,3]

s[m,n]=lambda[1]*r[m,1]+lambda[2]*r[m,2]+lambda[3]*r[m,3]

```



```

}
v.VaR[n]=quantile(s[,n],. . . Δ)
}
VaRϕ̂=mean(v.VaR)

VaRϕ̂

set.seed(٢٣٢٢٤)

for(n in ١:N){

u=rCopula(M,t.copula)
z=qnorm(u)

for( m in ١:M){

r[m,١]=ar١.fakhouz*ret.t[no,١]+ar٢.fakhouz*ret.t[no-١,١]+ar٣.fakhouz*ret.t[no-
٢,١]+ma١.fakhouz*res.t[no,٢]+ma٢.fakhouz*res.t[no-١,٢]+z[m,١]

r[m,٢]=ar١.family*ret.t[no,٢]+ar٢.family*ret.t[no-١,٢]+ar٣.family*ret.t[no-٢,٢]+ar٤.family*ret.t[no-
٣,٢]+arΔ.family*ret.t[no-٤,٢]+z[m,٢]

r[m,٣]=ar١.foulad*ret.t[no,٣]+ma١.foulad*res.t[no,٣]+ma٢.foulad*res.t[no-١,٣]+ma٣.foulad*res.t[no-
٢,٣]+ma٤.foulad*res.t[no-٣,٣] +z[m,٣]

s[m,n]=lambda[١]*r[m,١]+lambda[٢]*r[m,٢]+lambda[٣]*r[m,٣]

}

v.VaR[n]=quantile(s[,n],. . ١)
}

VaRϕ̂̂=mean(v.VaR)

VaRϕ̂̂

set.seed(٢٣٢٢٤)

for(n in ١:N){

u=rCopula(M,t.copula)
z=qnorm(u)

for( m in ١:M){

```

```

r[m, \]=ar\ .fakhouz*ret.t[no, \]+ar\ .fakhouz*ret.t[no-\, \]+ar\ .fakhouz*ret.t[no-
\, \]+ma\ .fakhouz*res.t[no, \]+ma\ .fakhouz*res.t[no-\, \]+z[m, \]

r[m, \]=ar\ .family*ret.t[no, \]+ar\ .family*ret.t[no-\, \]+ar\ .family*ret.t[no-\, \]+ar\ .family*ret.t[no-
\, \]+ar\ .family*ret.t[no-\, \]+z[m, \]

r[m, \]=ar\ .foulad*ret.t[no, \]+ma\ .foulad*res.t[no, \]+ma\ .foulad*res.t[no-\, \]+ma\ .foulad*res.t[no-
\, \]+ma\ .foulad*res.t[no-\, \]+z[m, \]

s[m,n]=lambda[\]*r[m, \]+lambda[\]*r[m, \]+lambda[\]*r[m, \]

}

v.VaR[n]=quantile(s[,n], . \)

}

VaR^=mean(v.VaR)

VaR^

```