PS4

Yu Shi

10/21/2016

1. BY2

(i) Pricing Kernel

(ii) Calibration

```
gamma=10
psi=1.5
theta=(1-gamma)/(1-1/psi)
kappa1=0.997
kappa.1m=0.96 #as in the slides
delta=0.998
mu=0.0015
mu.d=0.0015
pho=0.979
sigma=0.0078
Phi=3
phi.e=0.044
phi.d=4.5
nu1=0.987
sigma.w=0.23/(10^5)

A1=(1-1/psi)/(1-kappa1*pho)
A2=0.5*((theta-theta/psi)^2+(theta*A1*kappa1*phi.e)^2)/(theta*(1-kappa1*nu1))

B=kappa1*A1*phi.e

lambda.m.eta=-gamma
lambda.me=(1-theta)*B
lambda.mw=(1-theta)*A2*kappa1

A.1m=(Phi-1/psi)/(1-kappa.1m*pho)
beta.me=kappa.1m*A.1m*phi.e

Hm=lambda.m.eta^2+(-lambda.me+beta.me)^2+phi.d^2

A.2m=((1-theta)*A2*(1-kappa1*nu1)+0.5*Hm)/(1-kappa.1m*nu1)
beta.mw=kappa1*A.2m

w=rnorm(1000,0,1)

sigma.squared=rep(0,1000)
sigma.squared[1]=0.0078^2
for (i in 2:1000){
  sigma.squared[i]=sigma^2+nu1*(sigma.squared[i-1]-sigma^2)+sigma.w*w[i]
```

```
}

var.rm=rep(0,1000)
risk.premium=rep(0,1000)

for (i in 1:1000){
  var.rm[i]=(beta.me^2+phi.d^2)*sigma.squared[i]+beta.mw^2*sigma.w^2
  risk.premium[i]=beta.me*lambda.me*sigma.squared[i]+beta.mw*lambda.mw*sigma.w^2-
    0.5*var.rm[i]
}

var.ra=rep(0,1000)
risk.premium.ra=rep(0,1000)
for (i in 1:1000){
  var.ra[i]=(1+B^2)*sigma.squared[i]+(A2*kappa1)^2*sigma.w^2
  risk.premium.ra[i]=-lambda.m.eta*sigma.squared[i]+lambda.me*B*sigma.squared[i]+
    kappa1*A2*lambda.mw*sigma.w^2-0.5*var.ra[i]
}

eta=rnorm(1000,0,1)
e=rnorm(1000,0,1)

g=rep(0,1000)
x=rep(0,1000)
x[1]=0.0003
for (i in 2:1000){
  g[i]=mu+x[i-1]+sigma.squared[i-1]^0.5*eta[i]
  x[i]=pho*x[i-1]+phi.e*sigma.squared[i-1]^0.5*e[i]
}

rf=-log(delta)+1/psi*mean(g)+(1-theta)/theta*mean(risk.premium.ra)-
  1/(2*theta)*((lambda.m.eta^2+lambda.me^2)*mean(sigma.squared)+lambda.mw^2*sigma.w^2)

mean(risk.premium)
```

```
## [1] 0.001229515
```

```
rf
```

```
## [1] 0.002151136
```

2. Yield Curve **

(i) Campbell and Shiller (1991)

```
library(DataAnalytics)
library(data.table)
```

```r
setwd("~/Dropbox (Personal)/239C/PS4")
yield <- read.table("yield.csv", header=TRUE,sep=",")

yield$year=substr(yield$X,1,4)
yield$year=as.numeric(yield$year)
substrRight <- function(x, n){
  substr(x, nchar(x)-n+1, nchar(x))
}
yield$X=as.character(yield$X)
yield$md=substrRight(yield$X,5)

CS=data.frame(yield$X,yield$year,yield$md,yield$SVENY01,yield$SVENY02,
              yield$SVENY03,yield$SVENY04,yield$SVENY05,yield$SVENY06,
              yield$SVENY07,yield$SVENY09,yield$SVENY10)
CS=data.table(CS)
CS=CS[order(CS$yield.md,-CS$yield.year),]

phi=function(n,mydata){

if(n-1<10){num=paste('0',n-1,sep='')}else{num=n-1}
if(n<10){num2=paste('0',n,sep='')}else{num2=n}

mydata[[paste('yield.SVENY',num,'.next',sep='')]]<-c(0,
                mydata[[paste('yield.SVENY',num,sep='')]][1:nrow(mydata)-1])
# drop data without a t+1 match
mydata$yield.year.next <- c(0,mydata$yield.year[1:nrow(mydata)-1])
mydata$diff=mydata$yield.year.next-mydata$yield.year
mydata=subset(mydata,mydata$diff==1)

mydata$y=mydata[[paste('yield.SVENY',num,'.next',sep='')]]-
  mydata[[paste('yield.SVENY',num2,sep='')]]
mydata$x=(mydata[[paste('yield.SVENY',num2,sep='')]]-mydata$yield.SVENY01)/(n-1)

ols=lm(y~x,data=mydata)

intercept=summary(ols)$coefficient[1]
slope=summary(ols)$coefficient[2]
se=summary(ols)$coefficient[4]
a=c(intercept,slope,se)
return(a)
}

#whole sample test of EH
phi(2,CS)
```

```
## [1] -0.16145288 -0.53486619  0.05139095
```

```r
phi(3,CS)
```

```
## [1] -0.0675234 -0.8460461  0.0553411
```

```r
phi(4,CS)
```

```
## [1]  0.001109388 -1.128445418  0.058330539
```

```r
phi(5,CS)
```

```
## [1]  0.05200359 -1.38062989  0.06095912
```

```r
phi(7,CS)
```

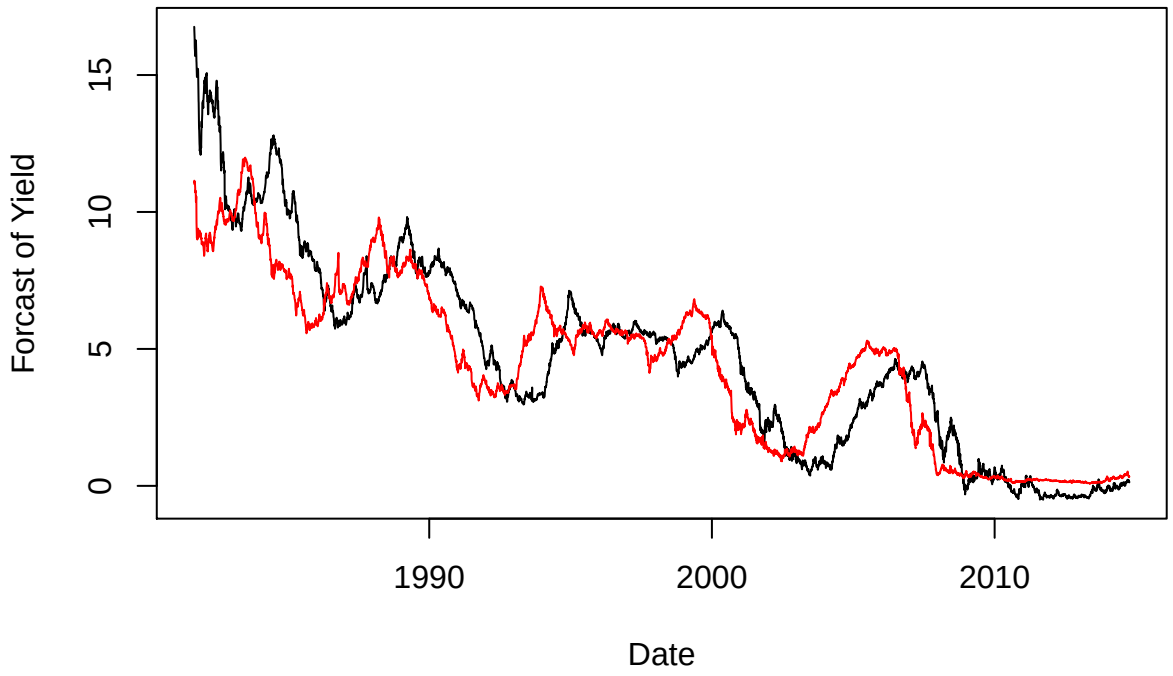
```
## [1]  0.12048416 -1.80600572  0.06623114
```

```r
phi(10,CS)
```

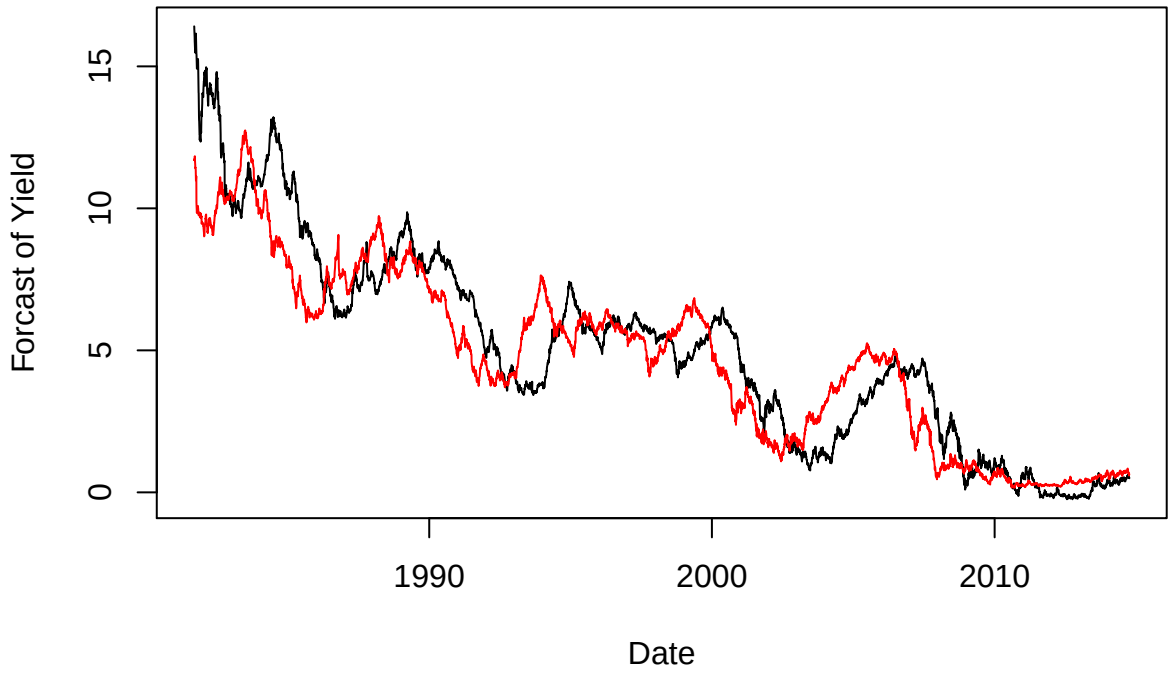
```
## [1]  0.12390250 -2.18701665  0.08542965
```

```r
prediction=function(n){
if(n-1<10){num=paste('0',n-1,sep='')}else{num=n-1}
if(n<10){num2=paste('0',n,sep='')}else{num2=n}

#prediction
predict=rep(0,215*63-63*4*20)
#assume each quarter have 63 trading dates, use 20 years of data to "train" regression
for (i in 1:135){
CS=CS[order(CS$yield.year,CS$yield.md),]
data=CS[(63*(i-1)+1):(63*4*20+63*(i-1)),]
data=data[order(data$yield.md,-data$yield.year),]
coef=phi(n,data)
CS=CS[order(CS$yield.year,CS$yield.md),]
pred=CS[(63*4*20+63*(i-1)+1):(63*4*20+63*(i-1)+63),]
predict[(63*(i-1)+1):(63*i)]=coef[1]+
  coef[2]*(1/(n-1))*(pred[[paste('yield.SVENY',num2,sep='')]]-pred$yield.SVENY01)+
  pred[[paste('yield.SVENY',num2,sep='')]]
}

CS=CS[order(CS$yield.year,CS$yield.md),]
pred.series=cbind(CS[(63*4*20+1):(63*4*20+63*135),],predict)
pred.series$yield.X=as.character(pred.series$yield.X)
pred.series$yield.X <- as.Date(pred.series$yield.X, "%Y-%m-%d")

pred.series=pred.series[order(pred.series$yield.md,-pred.series$yield.year),]
pred.series$actual<- c(0,
              pred.series[[paste('yield.SVENY',num,sep='')]][1:nrow(pred.series)-1])
pred.series$year.next<- c(0,pred.series$yield.year[1:nrow(pred.series)-1])
pred.series$diff=pred.series$year.next-pred.series$yield.year
pred.series=subset(pred.series,pred.series$diff==1)
pred.series=pred.series[order(pred.series$yield.year,pred.series$yield.md),]

plot(pred.series$predict~pred.series$yield.X,type="l",lwd=1,
     ylab="Forcast of Yield",xlab="Date")
```

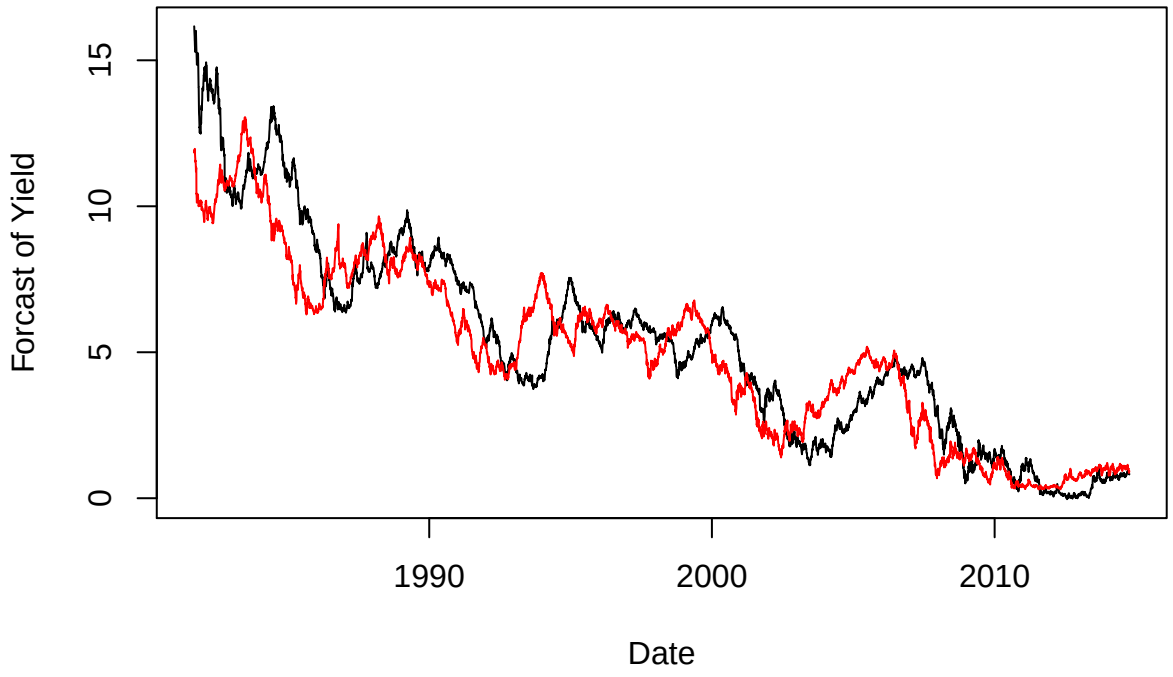
```
lines(pred.series$actual~pred.series$yield.X,type="l",lwd=1,col="red",
      ylab="Forcast of Yield",xlab="Date")
}

prediction(2)
```



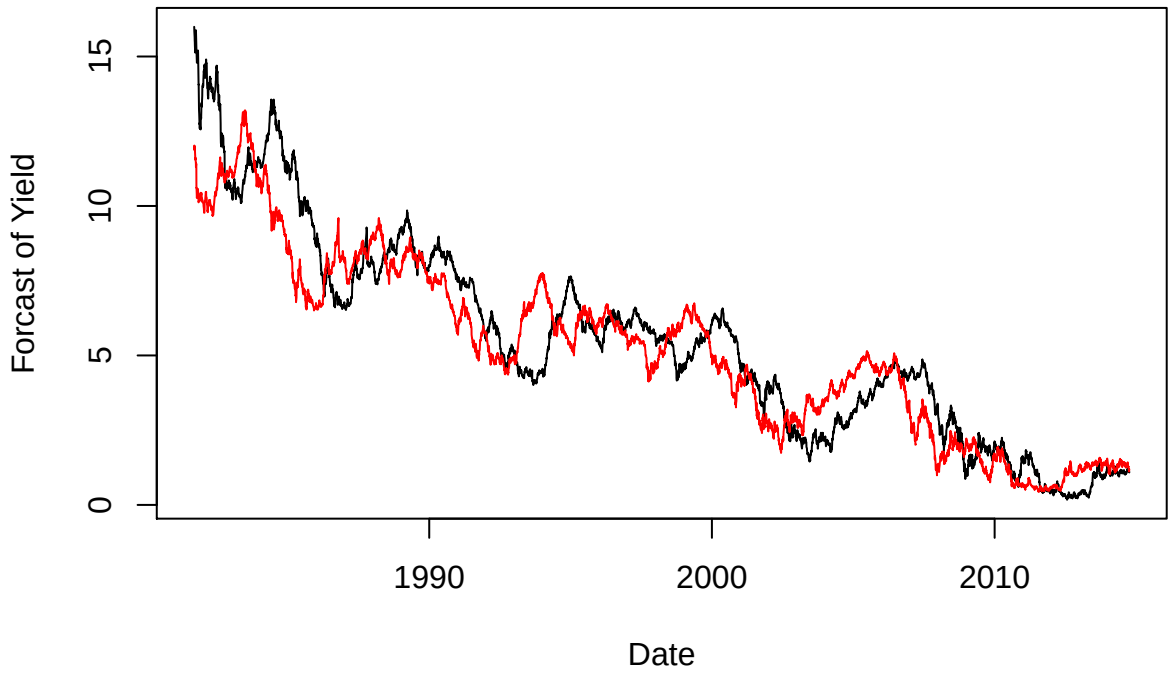

```
prediction(3)
```



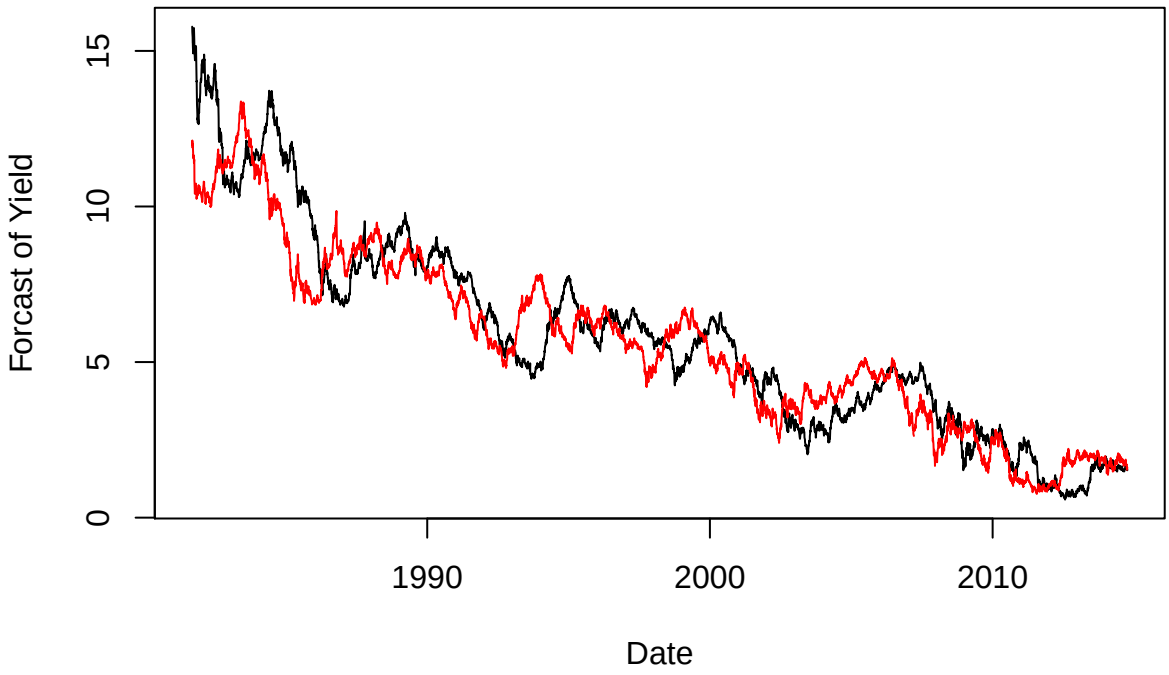
```
prediction(4)
```




```
prediction(5)
```




```
prediction(7)
```




```
prediction(10)
```