hw1

September 7, 2016

1 HW1 (S.Mottahedi)

2 Chapter 1

3 Problem 1

3.1 (a)

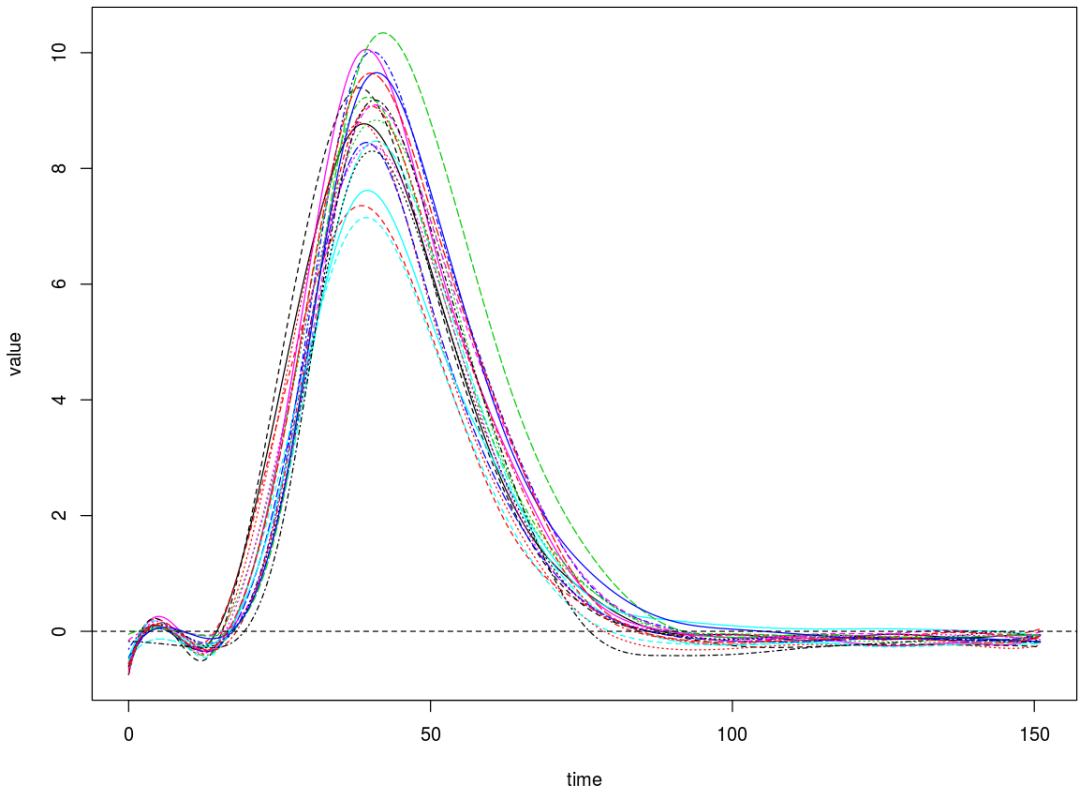
In [2]:
```
library(fda)
library(ggplot2)
library(tidyr)
library(dplyr)
library(fds)

options(repr.plot.width=10, repr.plot.height=8)
```

In [23]:
```
df <- data.frame(pinch)
names(df) <- 1:20
```

In [42]:
```
bs.basis <- create.bspline.basis(rangeval=c(0, 151),
                                 nbasis=15, norder=4)
pinch.fd = smooth.basis(y=pinch, fdParobj=bs.basis)
# pinch.fd <- Data2fd(argvals=1:151, y=pinch, basisobj=bs.basis)
plot(pinch.fd)
```

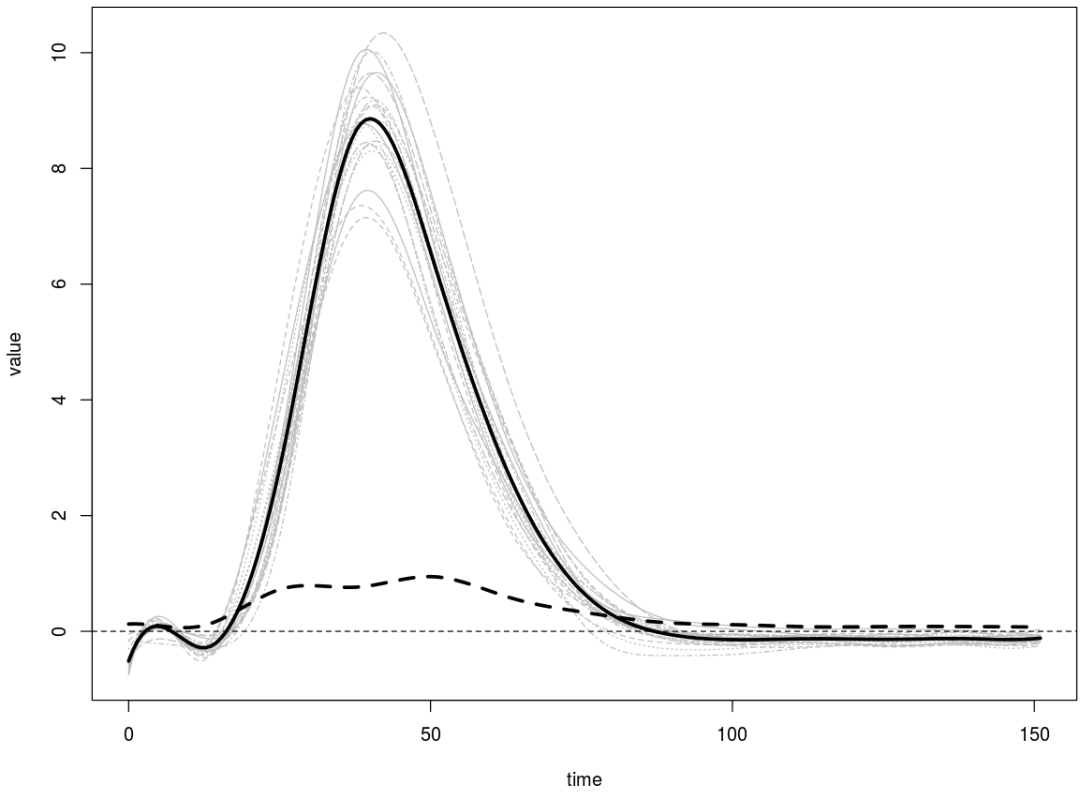
'done'



3.2 (b)

```
In [44]: pinch.mean = mean(pinch.fd$fd)
         pinch.sd = std.fd(pinch.fd$fd)
         plot(pinch.fd, col='gray')
         lines(pinch.mean, lwd=3)
         lines(pinch.sd, lty=2, lwd=3)
```

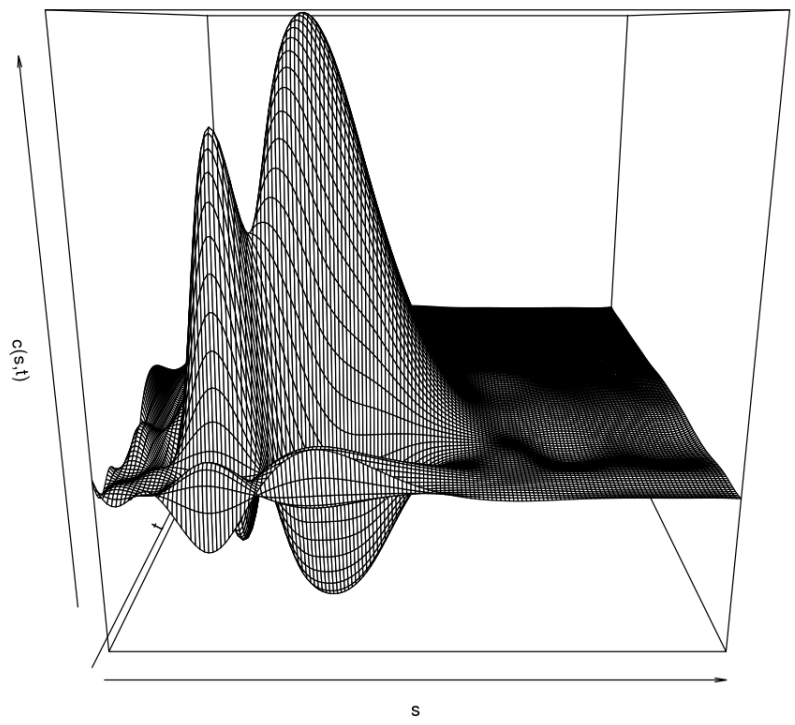
'done'



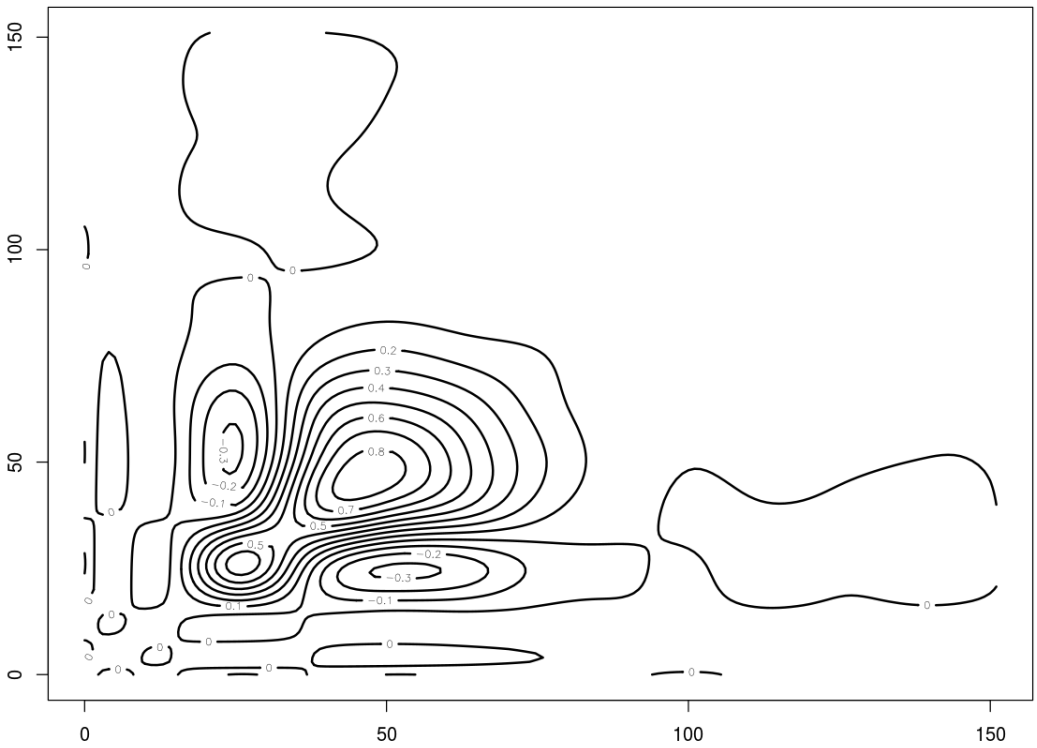
3.3 (c)

```
In [49]: pinch.cov <- var.fd(pinch.fd$fd)
         grid <- 0:151
         cov.mat <- eval.bifd(grid, grid, pinch.cov)

In [52]: persp(grid, grid, cov.mat,
               xlab='s', ylab='t', zlab='c(s,t)')
```



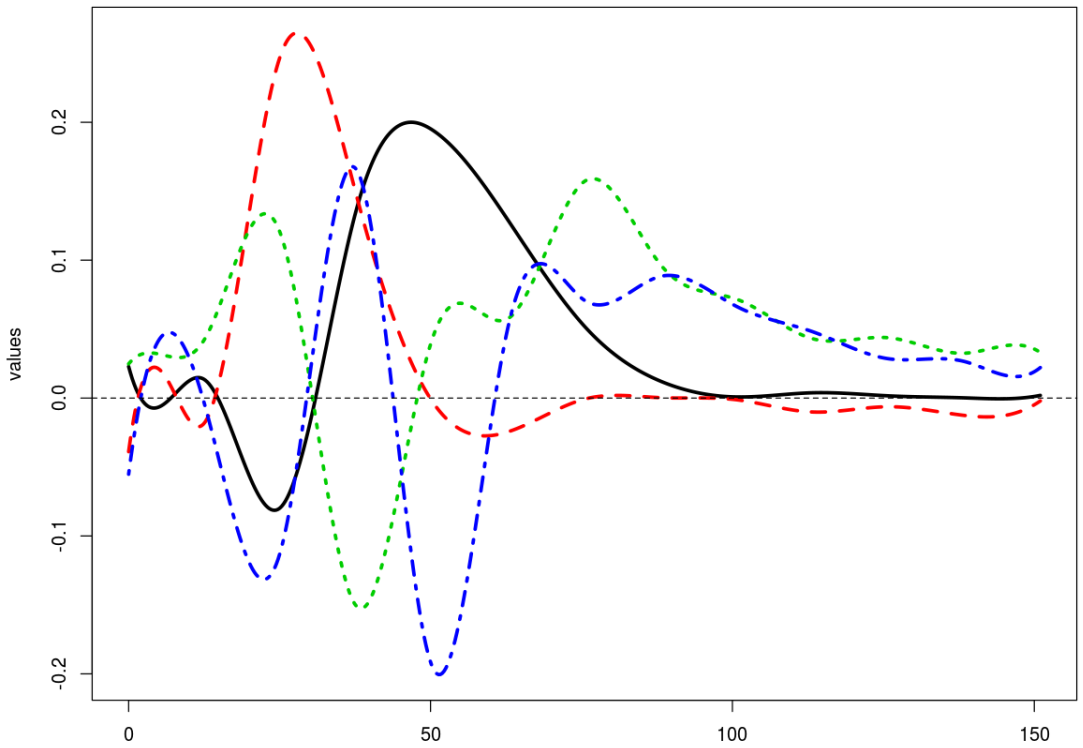
In [54]: contour(grid, grid, cov.mat, lwd=2)



3.4 (d)

```
In [57]: pinch.pca = pca.fd(pinch.fd$fd, nharm=4)
         plot(pinch.pca$harmonics, lwd=3)
```

'done'



the first two EFPC can explain 92% of variability.

```
In [61]: sum(pinch.pca$varprop[1:2])
```

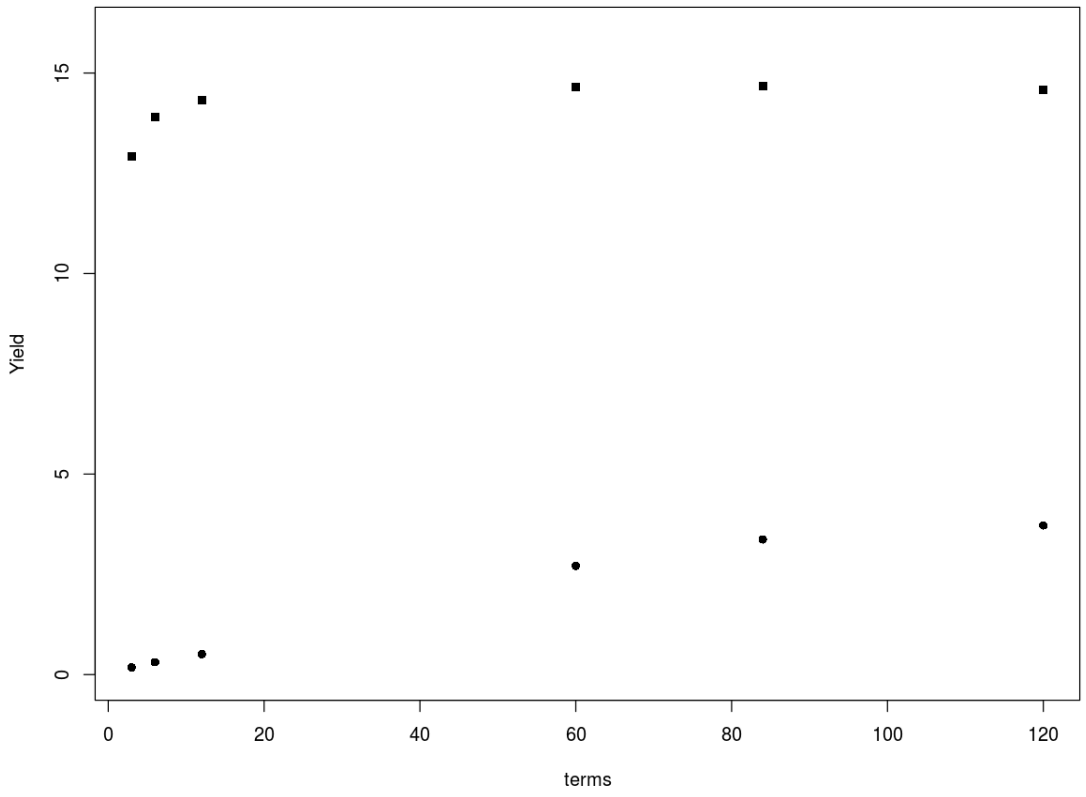
0.919562437559035

4 Problem 2

4.1 (a)

In general Tereseries yield is higher in 1982 compared to 2009. The 2009 curve is a $NormalYieldCurve$ which has higher return for long term investments and lower return for short term investments. This kind of yield curve is a sign of expansionary economic policies. The 1982 yield curve is $HumpedYieldCurve$, the highest rate of return is for 60 month investment rather than longer term maturities which is a sign of slowing economic growth.

```
In [10]: yield = FedYieldcurve; terms = yield$x
         plot(terms, yield$y[,1], pch=15, ylab="Yield", ylim=c(0,16))
         points(terms, yield$y[,330], pch=16)
```



4.2 (b)

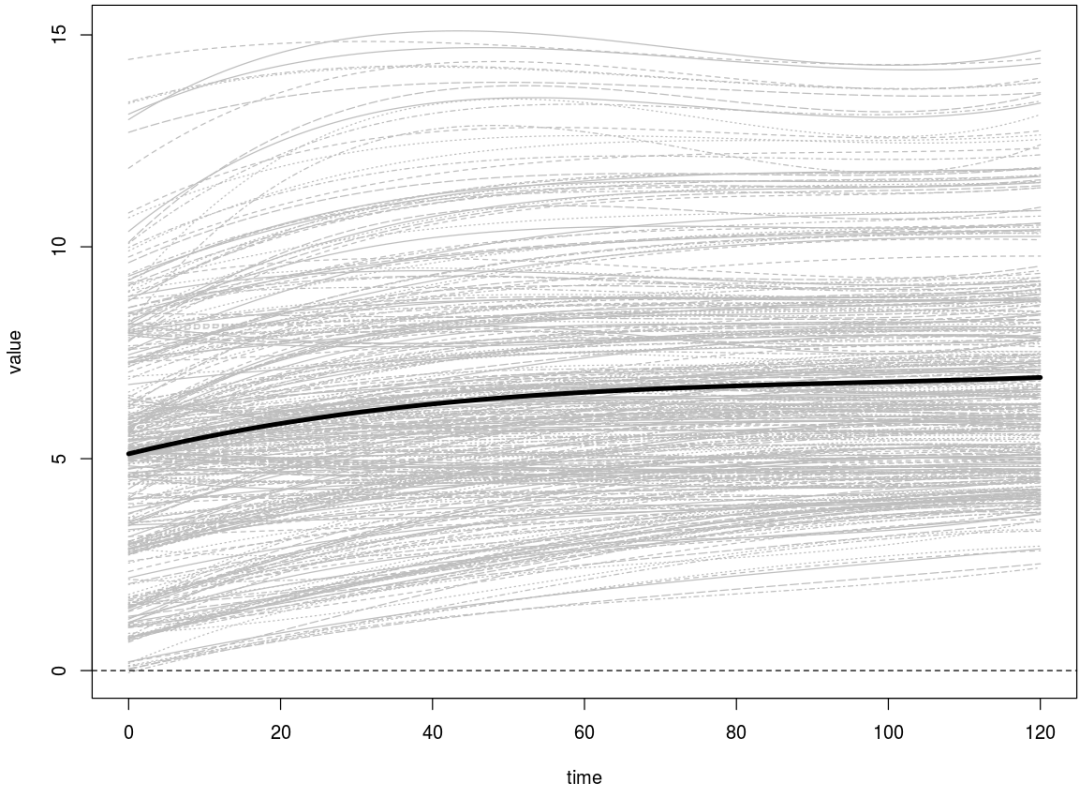
the average yield has a positive slope with lowest return for short and highest return for long term investments.

```
In [25]: bs.basis <- create.bspline.basis(rangeval=c(0, 120), nbasis=4)
         yield.fd = smooth.basis(y=yield$y, argvals=yield$x, fdParobj=bs.basis)

         yield.mean = mean(yield.fd$fd)

         plot(yield.fd, col='gray')
         lines(yield.mean, lwd = 4)
```

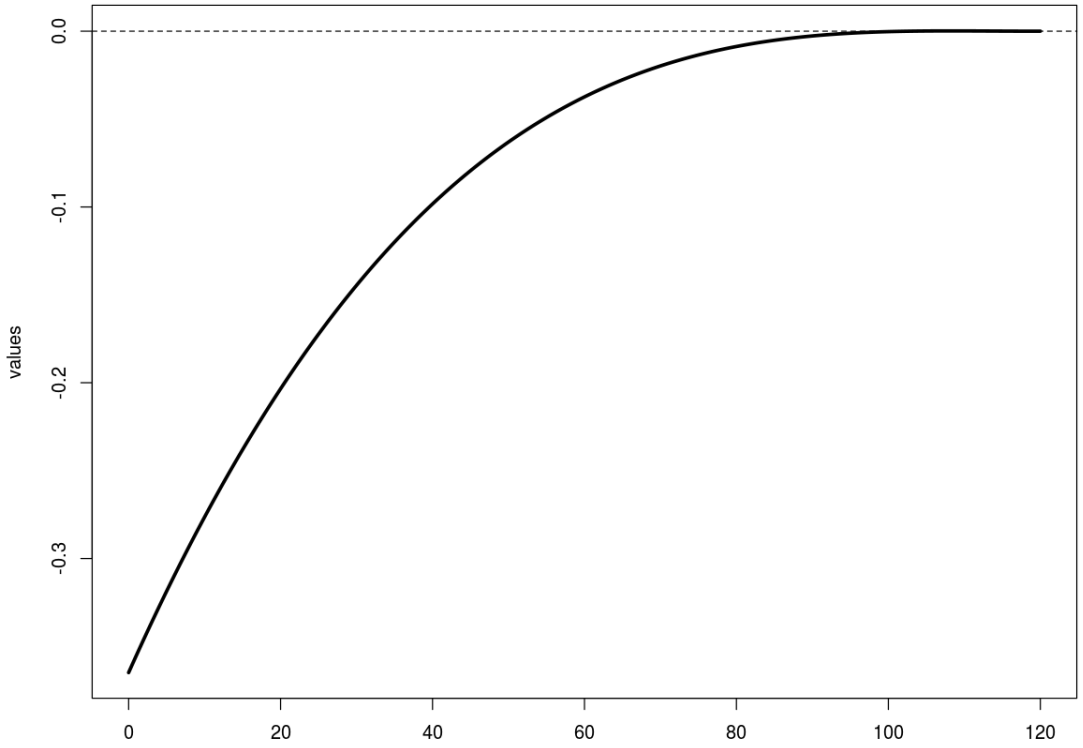
'done'



4.3 (c)

```
In [30]: yield.pca = pca.fd(yield.fd$fd, nharm=1, centerfns=T)
         plot(yield.pca$harmonics, lwd=3)
```

'done'



the first principle component explains 99.99% variability in the data. The first pricinple components shows that the yield increases with investment target maturity.

```
In [31]: yield.pca$varprop
```

0.999978266493213

5 Problem 6