Homework 6

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1. Obtain the monthly data of interest rate (aka. annual yield) of different U.S. treasury bonds with maturities 1-month, 3-month, 6-month, 1-year, 2-year, 3-year, 5-year, 7-year, 10-year, 20-year, and 30-years.

```
##            GS1M
## 2001-07-01 3.67
## 2001-08-01 3.53
## 2001-09-01 2.68
## 2001-10-01 2.27
## 2001-11-01 1.99
## 2001-12-01 1.72
```

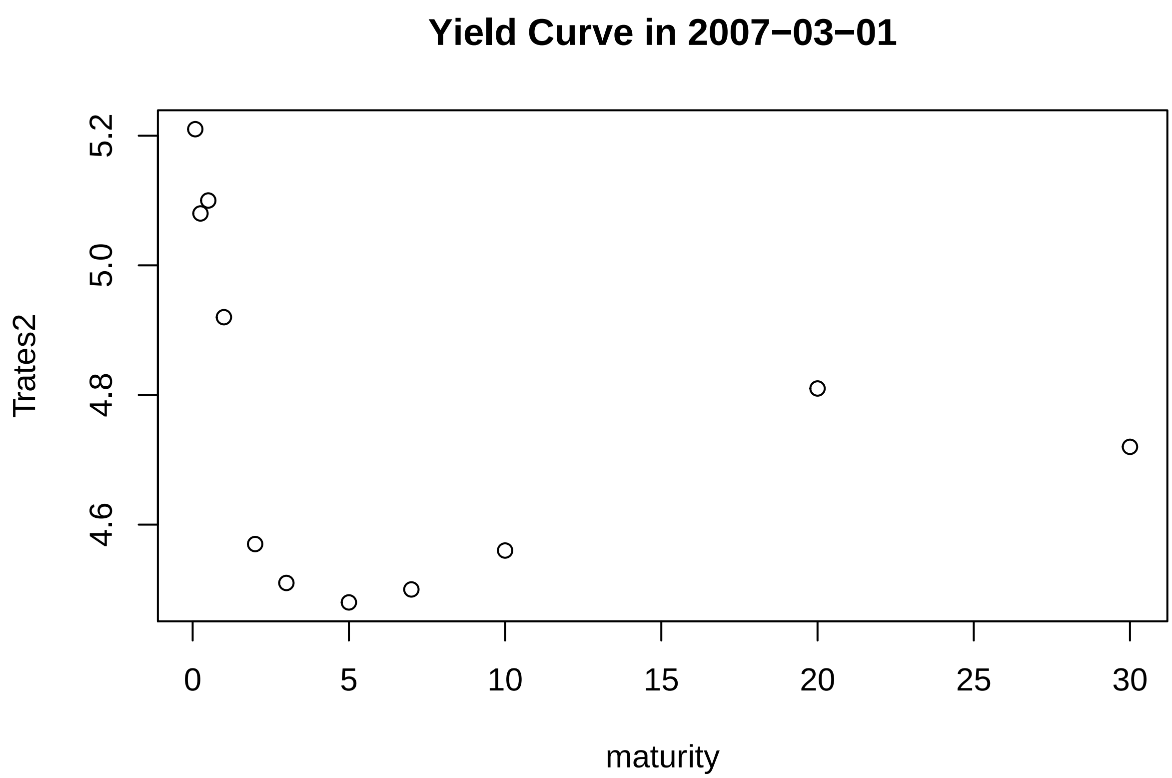
```
##             GS3M
## 1982-01-01 12.92
## 1982-02-01 14.28
## 1982-03-01 13.31
## 1982-04-01 13.34
## 1982-05-01 12.71
## 1982-06-01 13.08
```

2. Find the (annual) yield of a 3-month T-bill in March 2007. Then find the (annual) yield of 20-year T-bond in the same month. (Find those numbers from the time series you loaded into R in the last question. Note that the unit of the yield data stored in R is percentage point. That is if you get a 4 from your data it means a 4% or 0.04 annual yield.) What would you comment on those numbers?

```
##            GS3M GS20
## 2007-03-01 5.08 4.81
```

There is a slightly higher yield for a 3 month T-bill in March 2007 (5.08% annual yield) than a 20 year T-bond (4.81%). This means the return on the 3 month T-bill is higher than the reteun on the 20 year T-bond.

3. Now, draw a scatter plot of the yield data of all bonds in March 2007 against their maturity dates (you will have 11 data points in the scatter plot).



4. Fit a yield curve using the Nelson-Siegel model for March 2007. Interpret your β_0 and β_1 estimates. Also, find the sign of your β_2 estimate. What does the sign tell you?

```
##              beta_0    beta_1    beta_2    lambda
## 2007-03-01 4.919922 0.3399517 -2.023063 0.4391611
```

β_0 is the long-term interest rate. β_1 is the long-to-short-term spread, which means the difference between the long term interest rate and the short term interest rate. β_2 is the curvature parameter and since β_2 is less than 0, the curve produces a trough, which means it is inverted.

5. What does your Nelson-Siegel model predict about the annual yield of U.S. treasury bonds in the secondary market in March 2007 that has 2.5 years left to maturity?

```
##              X2.5
## 2007-03-01 4.5731
```

Our Nelson-Siegel model predicts 4.5731% as the annual yield of a US treasury bond in the secondary market in March 2007 with 2.5 years left to maturity.

6. Suppose there is a zero-coupon bond with face value $1000 that in March 2007 has 2.5 years left to maturity. Calculate the predicted price of this zero-coupon bond using your predicted yield in the last question.

```
## [1] 894.2316
```

Appendix

```
library("quantmod")
library("YieldCurve")
library(tidyverse)

rm(list=ls())
library("quantmod")
getSymbols(c("GS1M","GS3M","GS6M","GS1","GS2","GS3","GS5","GS7","GS10","GS20","GS30"), src = "FRED")

head(GS1M);head(GS3M)

cat("\\newpage")
date = "2007-03-01"
Trates<- cbind(GS3M[index(GS3M)==date],GS20[index(GS20)==date])
Trates
Trates2 <-cbind(GS1M[index(GS1M)==date],GS3M[index(GS3M)==date],GS6M[index(GS6M)==date],
              GS1[index(GS1)==date],GS2[index(GS2)==date],GS3[index(GS3)==date],
              GS5[index(GS5)==date], GS7[index(GS7)==date],GS10[index(GS10)==date],
              GS20[index(GS20)==date],GS30[index(GS30)==date])
maturity<-c(1/12,3/12,6/12,1,2,3,5,7,10,20,30)
plot(maturity,Trates2, main=paste("Yield Curve in ", date, sep=""))
cat("\\newpage")
NSresults <- Nelson.Siegel(rate = Trates2, maturity = maturity)
NSresults
beta0 <- NSresults[,1]
beta1 <- NSresults[,2]
beta2 <- NSresults[,3]
predict <- NSrates(NSresults, 2.5)
predict = predict %>% round(4)
predict
fv = 1000
price <- fv/((1+0.04573102)^2.5)
price
cat("\\newpage")
```