Homework Assignment #6 Financial Econometrics II

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- Computer Problems

Computer Problems

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. (See codes in the R example file.)

```
library("quantmod")
library(YieldCurve)
library(tidyverse)
getSymbols(c("GS1M","GS3M","GS6M","GS1","GS2","GS3","GS5","GS7","GS10","GS20","GS30"), s
rc = "FRED")
```

```
##  [1] "GS1M" "GS3M" "GS6M" "GS1"  "GS2"  "GS3"  "GS5"  "GS7"  "GS10" "GS20"
## [11] "GS30"
```

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?

```
date = "2007-03-01"
GS3M[index(GS3M) == date]
```

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

```
GS20[index(GS20) == date]
```

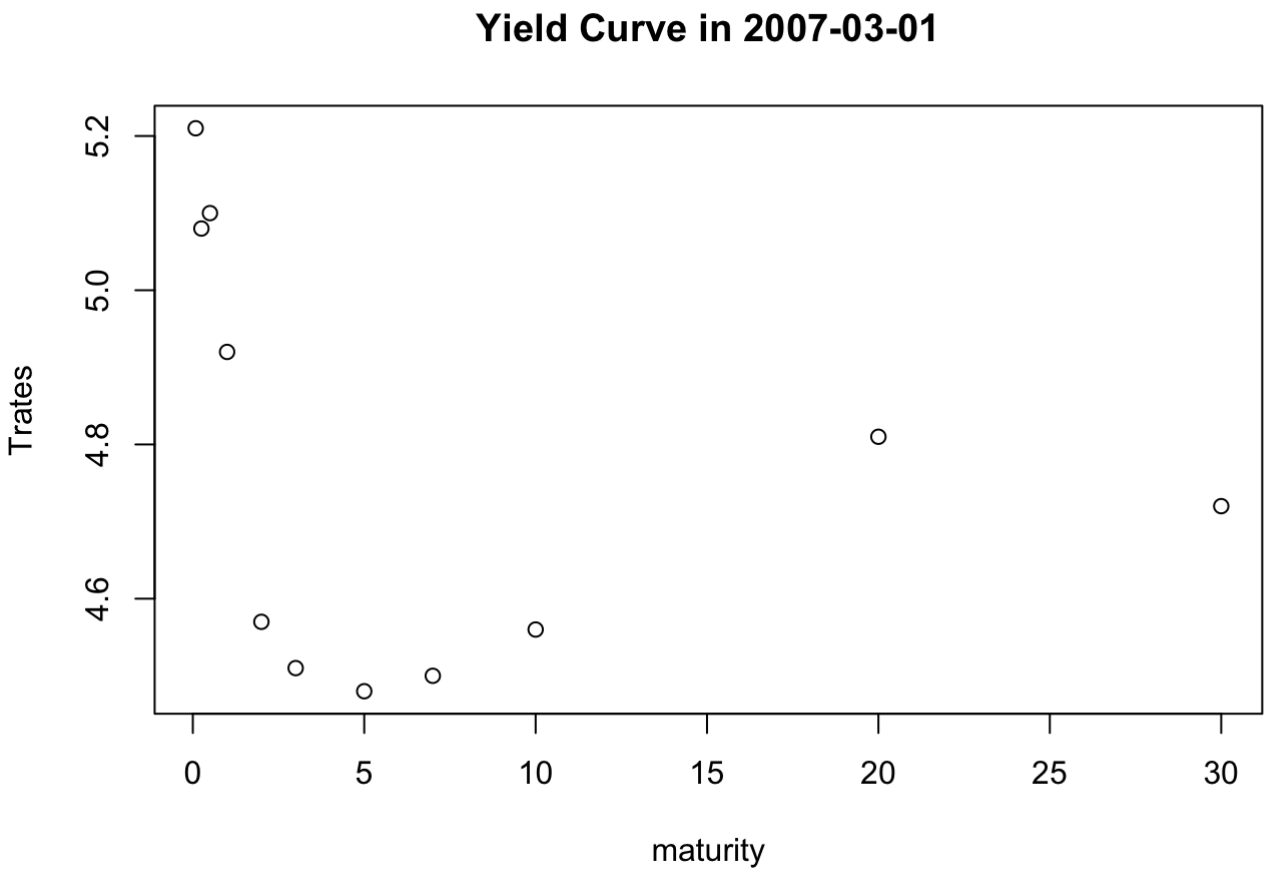
```
##            GS20
## 2007-03-01 4.81
```

The 3-month T-bill in March 2007 had a 5.08% annual yield. The 20-year T-bill in March 2007 had a 4.81% annual yield.

Since the 20 year T-bill has a lower annual yield than the 3-month we see a lack of a “liquidity premium” and investor could be bracing for a recession.

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).

```
Trates <- 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,Trates, main=paste("Yield Curve in ", date, sep=""))
```



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?

```
NSresults <- Nelson.Siegel(rate = Trates, maturity = maturity)
NSresults
```

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

The long term interest rate is 4.919922. The long-to-short-term spread is 0.3399517. The sign of β_2 is negative indicating the curve produces a trough/inverted yield curve.

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?

```
yield <- NSrates(NSresults,2.5)
yield
```

```
##                X2.5
## 2007-03-01 4.573102
```

The Nelson-Siegel model predicts the annual yield of U.S. treasury bonds in the secondary market in March 2007 that has 2.5 years left to maturity is 4.57%.

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. You could use either one of the following compounding formulae (for a zero-coupon bound). (Note gain that the unit of the yield data stored in R is percentage point.)

```
cp <- function(value, yield, years) {
  value / exp(yield*.01*years)
}
cp(1000, yield = yield, years = 2.5)
```

```
##                X2.5
## 2007-03-01 891.9658
```

The predicted price of this zero-coupon bond using our predicted yield in the last question would be 891.97$