Asset Management: Homework 5

Yuyuan Cui
New York Campus
ID: yuyuanc

1. Performance Evaluation

1. a

Choose Hedge Fund Index 6, 16, 26, 36, 29

Index 6, Coefficient Estimate	Sub Period 1	Sub Period 2	Sub Period 3	Sub Period 4
Alpha	0.008156102	0.015509677	0.012639602	-0.003341452
SP500	0.0912344538	-0.0496246096	0.0911549446	0.0809225239
USD	-0.0734365908	-0.0598429720	0.0021981711	-0.0099754472
BOND	-0.0632854779	0.1545494983	0.1326470582	0.0094544284
CREDIT	0.0010659353	-0.0007724099	-0.0034581061	0.0019331870
DVIX	-0.0008046172	-0.0009890376	-0.0004431928	-0.0002025983

Index 6, Coefficient Standard Error	Sub Period 1	Sub Period 2	Sub Period 3	Sub Period 4
Alpha	0.007100650	0.015978132	0.003207657	0.002571015
SP500	0.0381100283	0.0497966257	0.0353983299	0.0179084175
USD	0.0479942763	0.0788949688	0.0339871847	0.0262262301
BOND	0.0801882398	0.1983351279	0.0655862765	0.0424157711
CREDIT	0.0039917265	0.0073115352	0.0012420040	0.0007671162
DVIX	0.0003602285	0.0005762366	0.0003414152	0.0001755582

Index 16, Coefficient Estimate	Sub Period 1	Sub Period 2	Sub Period 3	Sub Period 4
Alpha	0.09694452	-0.29763720	0.03694936	0.01037659
SP500	-1.2448031612	-0.490709243	-1.160599083	-0.7158058243
USD	-0.0445753813	0.627671357	-0.059791554	-0.0979337406
BOND	1.0206559710	-0.786204447	-0.002444692	0.1425772787
CREDIT	-0.0491207786	0.124057478	-0.012393252	-0.0048292979
DVIX	-0.0006418458	0.005833013	-0.001855986	-0.0006751673

Index 16, Coefficient Standard Error	Sub Period 1	Sub Period 2	Sub Period 3	Sub Period 4
Alpha	0.02734451	0.18468182	0.01177542	0.01018232
SP500	0.146761185	0.575569867	0.129948482	0.0709250086

USD	0.184825286	0.911900476	0.124768120	0.1038671114
BOND	0.308803788	2.292438926	0.240769469	0.1679846322
CREDIT	0.015372083	0.084509729	0.004559439	0.0030381091
DVIX	0.001387235	0.006660379	0.001253347	0.0006952856

Index 26, Coefficient Estimate	Sub Period 1	Sub Period 2	Sub Period 3	Sub Period 4
Alpha	-0.006503260	0.044005836	0.018167673	-0.001432691
SP500	0.2761135197	7.420525e-02	0.2712334903	0.3174959848
USD	-0.0809248064	-3.892333e-02	0.0107068167	0.0933811295
BOND	-0.2031452583	2.611789e-01	0.2295353567	0.0109638132
CREDIT	0.0105434309	-1.237328e-02	-0.0054217611	0.0014490559
DVIX	-0.0009527862	8.241515e-05	-0.0008384078	0.0003852566

Index 26, Coefficient Standard Error	Sub Period 1	Sub Period 2	Sub Period 3	Sub Period 4
Alpha	0.009932460	0.039958622	0.004612767	0.006693668
SP500	0.0533086821	0.124532986	0.0509045132	0.0466247851
USD	0.0671348654	0.197303048	0.0488752181	0.0682803124
BOND	0.1121680979	0.496002797	0.0943162429	0.1104299814
CREDIT	0.0055836663	0.018284920	0.0017860620	0.0019971966
DVIX	0.0005038911	0.001441071	0.0004909715	0.0004570679

Index 36, Coefficient Estimate	Sub Period 1	Sub Period 2	Sub Period 3	Sub Period 4
Alpha	-0.036548375	0.111476492	0.007631996	-0.010491546
SP500	0.3329068048	0.2701131139	0.3142052679	0.3249960567
USD	-0.1051704539	-0.0689979363	0.0178279958	0.0793788793
BOND	-0.2291250056	0.2951280601	0.2281035237	0.0903542362
CREDIT	0.0259600083	-0.0443437388	-0.0028420260	0.0034455539
DVIX	-0.0009254972	0.0001122939	-0.0004271142	0.0002931452

Index 36, Coefficient Standard Error	Sub Period 1	Sub Period 2	Sub Period 3	Sub Period 4
Alpha	0.009501166	0.050826163	0.004346878	0.005677168
SP500	0.0509938810	0.158402206	0.047970276	0.0395443430
USD	0.0642196955	0.250963533	0.046057953	0.0579112609
BOND	0.1072974684	0.630900616	0.088879667	0.0936600791
CREDIT	0.0053412090	0.023257867	0.001683110	0.0016939022
DVIX	0.0004820108	0.001832999	0.000462671	0.0003876575

Index 29, Coefficient Estimate	Sub Period 1	Sub Period 2	Sub Period 3	Sub Period 4
Alpha	0.010908249	0.096386846	0.004583126	-0.011150740
SP500	0.1034558253	0.082670260	0.0250600908	0.1388967008
USD	-0.0945582598	-0.007961582	0.0151573476	0.0372859077
BOND	0.0933894665	0.019874087	0.3009111652	0.2718866728

CREDIT	-0.0033036424	-0.039543767	0.0001424425	0.0025133564
DVIX	-0.0003121618	0.001295438	0.0004017127	0.0007081987

Index 29, Coefficient Standard Error	Sub Period 1	Sub Period 2	Sub Period 3	Sub Period 4
Alpha	0.012241257	0.033915213	0.005494348	0.008410289
SP500	0.0657002695	0.105698409	0.0606332704	0.0585819147
USD	0.0827403450	0.167462605	0.0582161408	0.0857910965
BOND	0.1382415390	0.420986505	0.1123417531	0.1387502320
CREDIT	0.0068815878	0.015519478	0.0021274101	0.0025093864
DVIX	0.0006210204	0.001223121	0.0005848049	0.0005742849

1. b

Index	6	16	26	36	29
P value	0.005	0.005	0.1056923	0.008727969	0.6113375

1. c

Adjusted R-Squared	Sub Period 1	Sub Period 2	Sub Period 3	Sub Period 4
Index 6	0.2178784	-0.1027683	0.3945996	0.5661841
Index 16	0.5450114	-0.05289442	0.6400663	0.7716111
Index 26	0.4271793	-0.2538587	0.6515381	0.6007075
Index 36	0.5742186	0.1129777	0.6626373	0.7082288
Index 29	0.05837314	0.2454771	0.03351223	0.1043588

1. d

Index alphas vary across periods. On average, Index 29 has highest alpha and Index 16 has lowest alpha. Risk exposures vary across funds and periods (can change signs across periods for the same fund). Index 29 has smallest adjusted-R-squared and small factor loadings (commensurate with general results).

R Code:

```
# setwd("/Users/")
# install.packages("strucchange")
library(strucchange)
FFactors = read.csv("factordata.csv",header=TRUE)
HFIndex = read.csv("HFIndex.csv",header=TRUE)

# factor earliest start time: Feb 1990
# length(FFactors[,"SP500"])
FFactors = FFactors[12:286,]


NumMonths = 275
# Hedge Fund Index earliest start time: Jan 1991
HFIndex = HFIndex[1:275,]
eps = c(93,111,215)
```

```
#chosen indexes: 10(index 6), 20(index 16), 30(index 26), 40(index36), 33(index 29)
ChosenIdx = as.numeric(HFIndex[,10])
# ChosenIdx = as.numeric(HFIndex[,20])
# ChosenIdx = as.numeric(HFIndex[,30])
# ChosenIdx = as.numeric(HFIndex[,40])
# ChosenIdx = as.numeric(HFIndex[,33])

#1
#dummy variables

D1 = matrix(0,NumMonths,1)

D2 = matrix(0,NumMonths,1)
D3 = matrix(0,NumMonths,1)
D4 = matrix(0,NumMonths,1)
D1[1:eps[1],] = 1

D2[(eps[1]+1):eps[2],] = 1
D3[(eps[2]+1):eps[3],] = 1
D4[(eps[3]+1):NumMonths,] = 1
FFactors$D1 = D1
FFactors$D2 = D2

FFactors$D3 = D3
FFactors$D4 = D4
X = FFactors[,2:6]

D1Xt = X
D2Xt = X
D3Xt = X
D4Xt = X

D1Xt[(eps[1]+1):NumMonths,] = 0
D2Xt[c(1:eps[1],(eps[2]+1):NumMonths),] = 0
D3Xt[c(1:eps[2],(eps[3]+1):NumMonths),] = 0
D4Xt[1:eps[3],] = 0


Alphas = matrix(0,4,1)

AlphaSE = matrix(0,4,1)

Betas= matrix(0,5,4)

BetaSE = matrix(0,5,4)
```

```
AdjRsq = matrix(0,1,4)


for (i in 1:4){
    if(i==1){
        submodel = lm(ChosenIdx[1:eps[1]]~(as.matrix(FFactors[1:eps[1],2:6])))
    }
    if(i==2){
        submodel = lm(ChosenIdx[(eps[1]+1):eps[2]]~(as.matrix(FFactors[(eps[1]+1):eps[2],2:6])))
    }
    if(i==3){
        submodel = lm(ChosenIdx[(eps[2]+1):eps[3]]~(as.matrix(FFactors[(eps[2]+1):eps[3],2:6])))
    }
    if(i==4){
        submodel = lm(ChosenIdx[(eps[3]+1):NumMonths]~(as.matrix(FFactors[(eps[3]+1):NumMonths,2:6])))
    }
    Alphas[i] = coef(summary(submodel))[,  1][1]

    AlphaSE[i] = coef(summary(submodel))[,  2][1]
    Betas[1:5,i] = coef(summary(submodel))[,  1][2:6]

    BetaSE[1:5,i] = coef(summary(submodel))[,  2][2:6]
    AdjRsq[i] = summary(submodel)$adj.r.squared
    # summary(submodel)

}
Alphas
Betas
AlphaSE
BetaSE
AdjRsq
tTest = sctest(ChosenIdx ~as.matrix(FFactors[,2:6]), type= "Nyblom-Hansen", point=3)

tTest$p.value
```

2. Linear Clones of Hedge Funds

2. a

Rows are beta estimates for the coefficients SP500, USD, BOND, CREDIT, and DVIX, respectively. Columns are the 4 consecutive sub periods.

Choose Hedge Fund Index 6, 16, 26, 36, 29, as in question #1.

Index 6:

```
                [,1]          [,2]          [,3]          [,4]
[1,]  0.1090160381 -0.088700161 0.3239048613  0.1386810394
[2,]  0.2509238718  0.145113176 0.0599392361  0.2167112879
[3,]  0.6382407573  0.937778124 0.6138418461  0.6443025745
[4,]  0.0020067379  0.006398973 0.0007195931 -0.0003290252
[5,] -0.0001874051 -0.000590112 0.0015944634  0.0006341233
```

Index 16

	[,1]	[,2]	[,3]	[,4]
[1,]	-1.1830039946	-0.319567611	-0.489740647	-0.577112001
[2,]	0.4113984052	0.718255756	0.105545535	0.342535174
[3,]	1.7704398719	0.608135477	1.380337299	1.237359216
[4,]	0.0007418361	-0.010855137	-0.000152347	-0.004019219
[5,]	0.0004238814	0.004031515	0.004010161	0.001236830

Index 26:

	[,1]	[,2]	[,3]	[,4]
[1,]	0.2866041171	0.0215213875	0.4448671805	0.3551021664
[2,]	0.2211718132	0.1380524313	0.0353825967	0.2367817380
[3,]	0.4892215807	0.8320986511	0.5181275878	0.4069618056
[4,]	0.0034130998	0.0077018019	0.0010593297	0.0002281738
[5,]	-0.0004106108	0.0006257283	0.0005633053	0.0009261161

Index 36:

	[,1]	[,2]	[,3]	[,4]
[1,]	0.3294511343	0.173492780	0.4478827380	0.3391057214
[2,]	0.1739569222	0.123185922	0.0502064795	0.1893711359
[3,]	0.4950576350	0.695866886	0.5014717975	0.4713638772
[4,]	0.0020296203	0.006338427	-0.0002991593	-0.0003893884
[5,]	-0.0004953117	0.001115985	0.0007381442	0.0005486540

Index 29:

	[,1]	[,2]	[,3]	[,4]
[1,]	0.1205498574	-0.014550566	0.206584820	0.1549934954
[2,]	0.1872405079	0.253315462	0.071296717	0.1581492442
[3,]	0.6922924362	0.754591456	0.718686269	0.6874459367
[4,]	-0.0003157202	0.004342012	0.001369818	-0.0015840453
[5,]	0.0002329187	0.002301636	0.002062375	0.0009953689

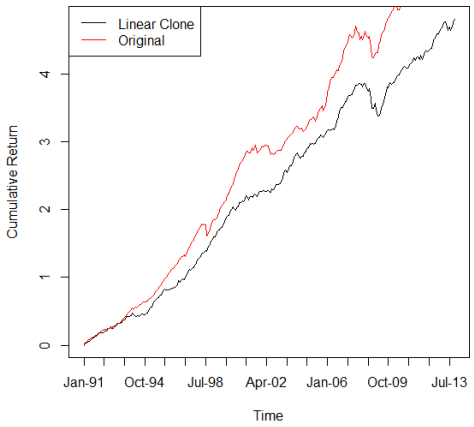
R Code:

```
betaclone = matrix(0,5,4)
FittedRet = matrix(0,NumMonths,1)
for (i in 1:4){
    if(i==1){
        submodel = lm((ChosenIdx[1:eps[1]]-FFactors[1:eps[1],6])~0+(as.matrix(FFactors[1:eps[1],2:5]-
FFactors[1:eps[1],6])))
        FittedRet[1:eps[1]] = submodel$fitted.values+  FFactors[1:eps[1],6]
    }
    if(i==2){
        submodel = lm((ChosenIdx[(eps[1]+1):eps[2]]-
FFactors[(eps[1]+1):eps[2],6])~0+(as.matrix(FFactors[(eps[1]+1):eps[2],2:5]-  FFactors

[(eps[1]+1):eps[2],6])))
        FittedRet[(eps[1]+1):eps[2]]  = submodel$fitted.values+  FFactors[(eps[1]+1):eps[2],6]
    }
    if(i==3){
        submodel = lm((ChosenIdx[(eps[2]+1):eps[3]]-
```

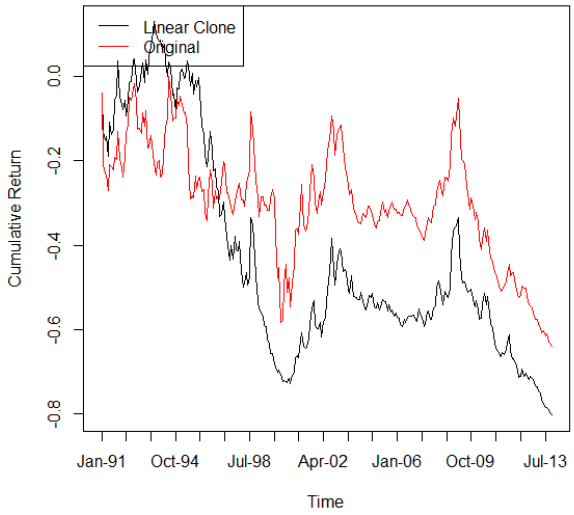
```
FFactors[(eps[2]+1):eps[3],6])~0+(as.matrix(FFactors[(eps[2]+1):eps[3],2:5]-FFactors

[(eps[2]+1):eps[3],6])))
            FittedRet[(eps[2]+1):eps[3]]=submodel$fitted.values+FFactors[(eps[2]+1):eps[3],6]
        }
        if(i==4){
            submodel                                                                    =
lm((ChosenIdx[(eps[3]+1):NumMonths]-FFactors[(eps[3]+1):NumMonths,6])~0+(as.matrix(FFactors[(eps[3]+1):NumMonth
s,2:5]-

FFactors[(eps[3]+1):NumMonths,6])))
            FittedRet[(eps[3]+1):NumMonths]=submodel$fitted.values+FFactors[(eps[3]+1):NumMonths,6]
        }
        betaclone[1:4,i]=coef(summary(submodel))[,  1][1:4]
        betaclone[5,i]=1-sum(coef(summary(submodel))[,  1][1:4])
}

betaclone
```

2. b~c

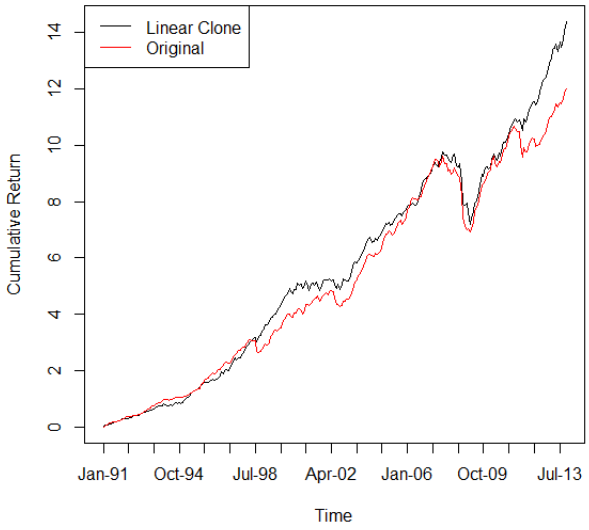
Annualized Amount	Index 6	Linear Clone of Index 6
Mean	0.08398058	0.07759704
Volatility	0.03557928	0.03577784
Sharpe Ratio	2.360379	2.168858



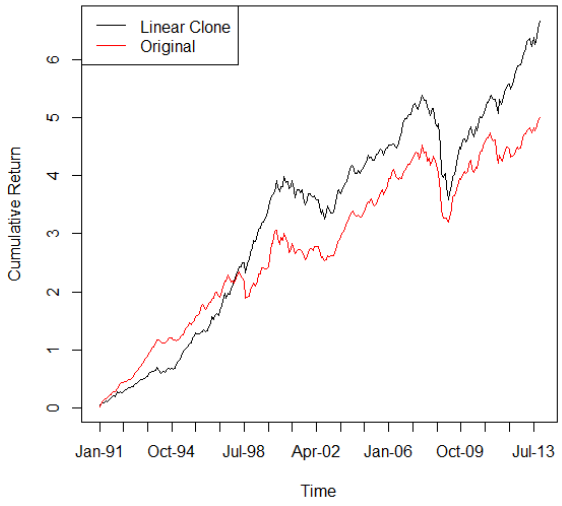
Annualized Amount	Index 16	Linear Clone of Index 16
Mean	-0.0276223	-0.05437296
Volatility	0.1823409	0.1822462
Sharpe Ratio	-0.1514871	-0.298349



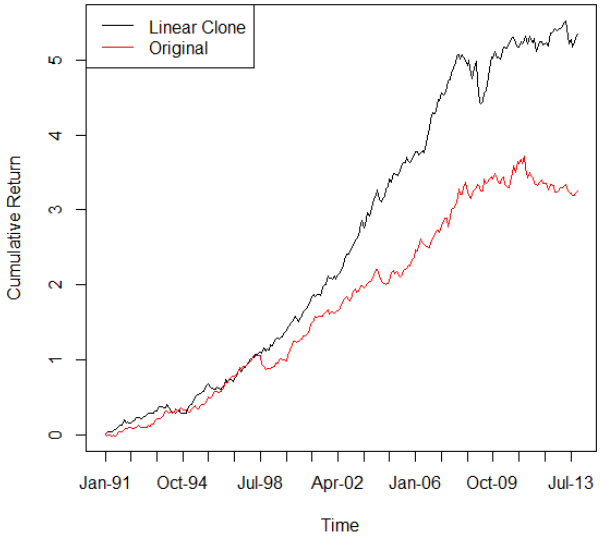
Annualized Amount	Index 26	Linear Clone of Index 26
Mean	0.1145821	0.1219376
Volatility	0.06563792	0.06552957
Sharpe Ratio	1.74567	1.860803



Annualized Amount	Index 36	Linear Clone of Index 36
Mean	0.08088232	0.09151589
Volatility	0.06923958	0.06912386
Sharpe Ratio	1.168152	1.323941



Annualized Amount	Index 29	Linear Clone of Index 29
Mean	0.06481522	0.08229301
Volatility	0.05437826	0.05386179
Sharpe Ratio	1.191933	1.527855



R Code:

```
gamma = sqrt((ChosenIdx-mean(ChosenIdx))^2/(FittedRet-mean(FittedRet))^2)

Rhat = matrix(0,NumMonths,1)

for (i in 1:NumMonths){
      Rhat[i] = gamma[i]*FittedRet[i]
}
gamma = sqrt(sum((ChosenIdx-mean(ChosenIdx))^2)/sum((FittedRet-mean(FittedRet))^2))
Rhat = gamma*FittedRet
delta = 1-gamma
TBill = read.csv("TBill.csv",header=FALSE)
R_hat = Rhat + delta*TBill[,3]
```

```
# Annualized Amount
mean(ChosenIdx)*12

sd(ChosenIdx)*sqrt(12)
mean(ChosenIdx)/sd(ChosenIdx)*sqrt(12)
mean(R_hat)*12

sd(R_hat)*sqrt(12)
mean(R_hat)/sd(R_hat)*sqrt(12)
cumretOrig = matrix(0,NumMonths,1)
curetClon = matrix(0,NumMonths,1)
cumretOrig[1] = ChosenIdx[1]
curetClon[1] =R_hat[1]
for (i in 2:NumMonths) {
      cumretOrig[i] = (1+cumretOrig[i-1])*(1+ChosenIdx[i])-1
      curetClon[i] = (1+curetClon[i-1])*(1+R_hat[i])-1
}
plot(cumretOrig,ylim = c(-1,20),xlab = "Time", ylab = "Cumulative Return", xaxt = "n",col=1,type='l')
plot(curetClon,xlab = "Time", ylab = "Cumulative Return", xaxt = "n",col=1,type='l')
axis(1, at=seq(1,NumMonths,15),  labels=FFactors[seq(1,NumMonths,15),1])
lines(cumretOrig,col = 2)
legend("topleft", legend=c("Linear Clone","Original"), col=1:2,lty=1,cex=1)
```