R Code for Lecture 12

```
library(WindR)
library(dplyr)
```

```
# Preparing Data
w.start()
w_wsd_data<-w.wsd("601398.SH,600519.SH,600050.SH,000001.SH","close",
                  "2007-12-01","2017-12-31","Period=M")
w_edb_data<-w.edb('M1004677','2008-01-01','2017-12-31','Fill=Previous',"Period=M")

risky <- w_wsd_data$Data %>%
  rename(GY = `601398.SH`, MT = `600519.SH`, LT = `600050.SH`, SH = `000001.SH`) %>%
  mutate(lGY = lag(GY, n = 1L), Rgy = (GY-lGY)/lGY,
         lMT = lag(MT, n = 1L), Rmt = (MT-lMT)/lMT,
         lLT = lag(LT, n = 1L), Rlt = (LT-lLT)/lLT,
         lSH = lag(SH, n = 1L), Rm = (SH-lSH)/lSH) %>%
  filter(is.na(Rm*Rgy*Rmt*Rlt) != 1) %>%
  select(Rgy, Rmt, Rlt, Rm)

riskless <- w_edb_data$Data %>%
  rename(Rf = `CLOSE`) %>%
  mutate(Rf = Rf/120) %>%
  filter(is.na(Rf) != 1) %>%
  select(Rf)

Data <- cbind(risky, riskless)
```

```
# Fitting the model
Ym = Data$Rm - Data$Rf
Ygy = Data$Rgy - Data$Rf
Ymt = Data$Rmt - Data$Rf
Ylt = Data$Rlt - Data$Rf

lm.gy <- lm(Ygy ~ Ym)
lm.mt <- lm(Ymt ~ Ym)
lm.lt <- lm(Ylt ~ Ym)

summary(lm.gy)
```

```
##
## Call:
## lm(formula = Ygy ~ Ym)
##
## Residuals:
##       Min        1Q    Median        3Q       Max
## -0.094883 -0.026391 -0.001216  0.024247  0.171900
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept) -0.006777   0.003741  -1.811   0.0726 .
## Ym           0.655004   0.045051  14.539   <2e-16 ***
## ---
```

```
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.03966 on 118 degrees of freedom
## Multiple R-squared:  0.6418, Adjusted R-squared:  0.6387
## F-statistic: 211.4 on 1 and 118 DF,  p-value: < 2.2e-16
```

```
summary(lm.mt)
```

```
##
## Call:
## lm(formula = Ymt ~ Ym)
##
## Residuals:
##       Min        1Q    Median        3Q       Max
## -0.235606 -0.057528  0.003198  0.050041  0.273894
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept) 0.006066   0.007836   0.774     0.44
## Ym          0.603681   0.094361   6.398 3.31e-09 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.08307 on 118 degrees of freedom
## Multiple R-squared:  0.2575, Adjusted R-squared:  0.2512
## F-statistic: 40.93 on 1 and 118 DF,  p-value: 3.311e-09
```

```
summary(lm.lt)
```

```
##
## Call:
## lm(formula = Ylt ~ Ym)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.16582 -0.04481 -0.01823  0.03231  0.55368
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept) 0.002006   0.008692   0.231    0.818
## Ym          0.997651   0.104667   9.532 2.58e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.09215 on 118 degrees of freedom
## Multiple R-squared:  0.435,  Adjusted R-squared:  0.4302
## F-statistic: 90.85 on 1 and 118 DF,  p-value: 2.581e-16
```

```
coef <- as.matrix(rbind(coef(lm.gy), coef(lm.mt), coef(lm.lt)))
alpha <- coef[, 1]; beta <- coef[, 2]

N <- length(alpha)
T <- nrow(Data)
residuals <- cbind(residuals(lm.gy), residuals(lm.mt), residuals(lm.lt))
Sigma <- t(residuals)%*%residuals/T
```

```
alpha
```

```
## [1] -0.006777031  0.006066175  0.002005794
```

```
beta
```

```
## [1] 0.6550042 0.6036810 0.9976509
```

```
Sigma
```

```
##               [,1]         [,2]          [,3]
## [1,]  0.0015468261 0.0006073608 -0.0003151515
## [2,]  0.0006073608 0.0067862164  0.0008884088
## [3,] -0.0003151515 0.0008884088  0.0083495022
```

```
# Wald Tests
AvgYm <- mean(Ym)
StdYm <- sd(Ym)

T0 <- T*(1 + AvgYm^2/StdYm^2)*t(alpha)%*%solve(Sigma)%*%alpha
T1 <- T0*(T - N - 1)/(N*T)
```

```
# Likelihood Ratio Tests
lm.gy.r <- lm(Ygy ~ Ym - 1)
lm.mt.r <- lm(Ymt ~ Ym - 1)
lm.lt.r <- lm(Ylt ~ Ym - 1)

summary(lm.gy.r)
```

```
##
## Call:
## lm(formula = Ygy ~ Ym - 1)
##
## Residuals:
##       Min        1Q    Median        3Q       Max
## -0.104607 -0.032391 -0.007308  0.017786  0.162724
##
## Coefficients:
##    Estimate Std. Error t value Pr(>|t|)
## Ym  0.67556    0.04401   15.35   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.04004 on 119 degrees of freedom
## Multiple R-squared:  0.6644, Adjusted R-squared:  0.6616
## F-statistic: 235.6 on 1 and 119 DF,  p-value: < 2.2e-16
```

```
beta.r <- as.matrix(rbind(coef(lm.gy.r), coef(lm.mt.r), coef(lm.lt.r)))

residuals.r <- cbind(residuals(lm.gy.r), residuals(lm.mt.r), residuals(lm.lt.r))
Sigma.r <- t(residuals.r)%*%residuals.r/T

beta.r
```

```
##             Ym
## [1,] 0.6755621
## [2,] 0.5852795
## [3,] 0.9915664
```

```
Sigma.r
```

```
##               [,1]         [,2]          [,3]
## [1,]  0.0015898396 0.0005688590 -0.0003278822
## [2,]  0.0005688590 0.0068206796  0.0008998042
## [3,] -0.0003278822 0.0008998042  0.0083532701
```

```
T2 <- T*(log(det(Sigma.r)) - log(det(Sigma)))
T3 <- T2*(T-N/2-2)/T

TS <- list(T0 = c(T0, 1 - pchisq(T0, df = N)),
           T1 = c(T1, 1 - pchisq(T1, df = N)),
           T2 = c(T2, 1 - pchisq(T2, df = N)),
           T3 = c(T3, 1 - pchisq(T3, df = N)))
TS
```

```
## $T0
## [1] 5.3003486 0.1510798
##
## $T1
## [1] 1.7078901 0.6351811
##
## $T2
## [1] 4.5635347 0.2066927
##
## $T3
## [1] 4.4304316 0.2185802
```