FIN516Project2

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```
library(quantmod)
```

```
## Warning: package 'quantmod' was built under R version 3.6.2
```

```
## Loading required package: xts
```

```
## Warning: package 'xts' was built under R version 3.6.2
```

```
## Loading required package: zoo
```

```
##
## Attaching package: 'zoo'
```

```
## The following objects are masked from 'package:base':
##
##     as.Date, as.Date.numeric
```

```
## Loading required package: TTR
```

```
## Warning: package 'TTR' was built under R version 3.6.2
```

```
## Registered S3 method overwritten by 'quantmod':
##   method            from
```

```
##   as.zoo.data.frame zoo
```

```
## Version 0.4-0 included new data defaults. See ?getSymbols.
```

```
y <- read.csv("D:/FIN 516 Derivatives/Project 2/EqFutS20.csv")
# You may need to change formating depending on how your computer reads the date

y$Date <- as.Date(y$Date,'%Y-%m-%d')

# Convert to an xts object
y <- xts(y[,-1],order.by=y[,1])

# Seperate the futures from equity prices


z <- y[,1:4]
eq <- y[,5:ncol(y)]

View(z)
View(eq)
# Create the portfolio where each stock position was equally weighted 1/4/2018
z$port <- eq %*% as.vector( (1/ncol(eq)) / eq[1,])  #here %*% meansmatrix multiplication

View(z$port)

# Portfolio value on 2/10/2020
port <- 250e6 * as.numeric(z$port[nrow(z)])

# Compute log first-differences for futures prices and portfolio value
z <- na.omit(diff(log(z)))
port
```

```
## [1] 412989494
```

```
sd(z$port)
```

```
## [1] 0.01154735
```

```
sd(z$port)*port
```

```
## [1] 4768936
```

Daily standard deviation of returns for the portfolio: 0.01154735

Dollar amount of the daily standard deviation of returns for the portfolio: $4768936

```
es <- lm(z$port~z$ES)
coef(es)
```

```
##  (Intercept)         z$ES
## 0.0006234744 1.0505171975
```

```
es.beta <- coef(es)[2]
es.beta
```

```
##     z$ES
## 1.050517
```

```
es.r2 <- summary(es)$r.squared
es.r2
```

```
## [1] 0.795538
```

```r
#correlation coefficient
sqrt(es.r2)
```

```
## [1] 0.8919294
```

```r
summary(es)
```

```
##
## Call:
## lm(formula = z$port ~ z$ES)
##
## Residuals:
##        Min         1Q     Median         3Q        Max
## -0.0215064 -0.0028973  0.0002061  0.0026826  0.0294164
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept) 0.0006235  0.0002291   2.721  0.00672 **
## z$ES        1.0505172  0.0233774  44.937  < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.005226 on 519 degrees of freedom
## Multiple R-squared:  0.7955, Adjusted R-squared:  0.7951
## F-statistic:  2019 on 1 and 519 DF,  p-value: < 2.2e-16
```

```r
#Risk reduction factor
1-sqrt(1-es.r2)
```

```
## [1] 0.5478253
```

```
#daily standard deviation of hedged returns
sd(z$port)*sqrt(1-es.r2)
```

```
## [1] 0.005221421
```

```
#daily standard deviation of hedged returns by dollar value
sd(z$port)*port*sqrt(1-es.r2)
```

```
## [1] 2156392
```

```
#Varience minimizing number of contracts
N<-port/(50*3338)

#Adjusted for difference in beta
N*es.beta
```

```
##     z$ES
## 2599.476
```

Beta for ES = 1.0505

correlation coefficient for ES = 0.8919

Risk reduction factor for ES = 0.5478

Variance minimizing number of contracts for ES as hedging instrument: 2600

Daily standard deviation of hedged returns by ES contract: 0.0052

Dollar value of daily standard deviation of hedged returns by ES: $2156392

```
nq <- lm(z$port~z$NQ)
coef(nq)
```

```
##  (Intercept)         z$NQ
## 0.0004736819 0.8248021546
```

```
nq.beta <- coef(nq)[2]
nq.beta
```

```
##      z$NQ
## 0.8248022
```

```
nq.r2 <- summary(nq)$r.squared
nq.r2
```

```
## [1] 0.8149753
```

```
summary(nq)
```

```
##
## Call:
## lm(formula = z$port ~ z$NQ)
##
## Residuals:
##        Min         1Q     Median         3Q        Max
## -0.0212216 -0.0026854 -0.0000269  0.0026483  0.0241184
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept) 0.0004737  0.0002181   2.172   0.0303 *
## z$NQ        0.8248022  0.0172508  47.812   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.004972 on 519 degrees of freedom
```

```
## Multiple R-squared:  0.815,  Adjusted R-squared:  0.8146
## F-statistic:  2286 on 1 and 519 DF,  p-value: < 2.2e-16
```

```
#correlation coefficient
sqrt(nq.r2)
```

```
## [1] 0.9027598
```

```
#Risk reduction factor
1-sqrt(1-nq.r2)
```

```
## [1] 0.569855
```

```
#daily standard deviation of hedged returns
sd(z$port)*sqrt(1-nq.r2)
```

```
## [1] 0.004967036
```

```
#daily standard deviation of hedged returns by dollar value
sd(z$port)*port*sqrt(1-nq.r2)
```

```
## [1] 2051334
```

```
#Varience minimizing number of contracts

N<-port/(20*9460)

#Adjusted for difference in beta

N*nq.beta
```

```
##     z$NQ
## 1800.394
```

Beta for NQ = 0.8248

Correlation coefficient for NQ = 0.9027

Risk reduction factor for NQ = 0.5698

Variance minimizing number of contracts for NQ as hedging instrument: 1801

Daily standard deviation of hedged returns by NQ contract: 0.0049

Dollar value of daily standard deviation of hedged returns by NQ: $2051334

```
rty <- lm(z$port~z$RTY)
coef(rty)
```

```
##  (Intercept)        z$RTY
## 0.0009023889 0.8743644060
```

```
rty.beta <- coef(rty)[2]
rty.beta
```

```
##     z$RTY
## 0.8743644
```

```
rty.r2 <- summary(rty)$r.squared
rty.r2
```

```
## [1] 0.7219297
```

```
summary(rty)
```

```
##
## Call:
## lm(formula = z$port ~ z$RTY)
##
## Residuals:
##        Min         1Q     Median         3Q        Max
## -0.0220313 -0.0034629  0.0001445  0.0036416  0.0201502
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept) 0.0009024  0.0002670   3.379 0.000781 ***
## z$RTY       0.8743644  0.0238198  36.707  < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.006095 on 519 degrees of freedom
## Multiple R-squared:  0.7219, Adjusted R-squared:  0.7214
## F-statistic:  1347 on 1 and 519 DF,  p-value: < 2.2e-16
```

```
#correlation coefficient
sqrt(rty.r2)
```

```
## [1] 0.8496645
```

```
#Risk reduction factor
1-sqrt(1-rty.r2)
```

```
## [1] 0.4726763
```

```
#daily standard deviation of hedged returns
sd(z$port)*sqrt(1-rty.r2)
```

```
## [1] 0.006089193
```

```
#daily standard deviation of hedged returns by dollar value
sd(z$port)*port*sqrt(1-rty.r2)
```

```
## [1] 2514773
```

```
#Varience minimizing number of contracts

N<-port/(50*1660)

#Adjusted for difference in beta
N*rty.beta
```

```
##    z$RTY
## 4350.642
```

Beta for RTY = 0.8743

Correlation coefficient for RTY = 0.8496

Risk reduction factor for RTY= 0.4726

Variance minimizing number of contracts for RTY as hedging instrument: 4351

Daily standard deviation of hedged returns by RTY: 0.0060

Dollar value of daily standard deviation of hedged returns by RTY: $2514773

```
ixt <- lm(z$port~z$IXT)
coef(ixt)
```

```
##  (Intercept)        z$IXT
## 0.0003907649 0.7995475953
```

```
ixt.beta <- coef(ixt)[2]
ixt.beta
```

```
##     z$IXT
## 0.7995476
```

```
ixt.r2 <- summary(ixt)$r.squared
ixt.r2
```

```
## [1] 0.8248587
```

```
summary(ixt)
```

```
##
## Call:
## lm(formula = z$port ~ z$IXT)
##
## Residuals:
##        Min         1Q     Median         3Q        Max
## -0.0278667 -0.0029194 -0.0000451  0.0026607  0.0233686
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept) 0.0003908  0.0002122   1.841   0.0662 .
## z$IXT       0.7995476  0.0161721  49.440   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.004837 on 519 degrees of freedom
## Multiple R-squared:  0.8249, Adjusted R-squared:  0.8245
## F-statistic:  2444 on 1 and 519 DF,  p-value: < 2.2e-16
```

```
#correlation coefficient
sqrt(ixt.r2)
```

```
## [1] 0.9082173
```

```
#Risk reduction factor
1-sqrt(1-ixt.r2)
```

```
## [1] 0.5815011
```

```
#daily standard deviation of hedged returns
sd(z$port)*sqrt(1-ixt.r2)
```

```
## [1] 0.004832554
```

```
#daily standard deviation of hedged returns by dollar value
sd(z$port)*port*sqrt(1-ixt.r2)
```

```
## [1] 1995794
```

```
#Varience minimizing number of contracts
N<-port/(100*1008)

#Adjusted for difference in beta
N*ixt.beta
```

```
##    z$IXT
## 3275.841
```

Beta for IXT = 0.7995

Correlation coefficient for IXT = 0.9082

Risk reduction factor for IXT = 0.5815

Variance minimizing number of contracts for IXT as hedging instrument: 3276

Daily standard deviation of hedged returns by IXT contract: 0.0048

Dollar value of daily standard deviation of hedged returns by IXT: $1995794

f. IXT(E-mini Technology Select Sector) contract should be used for variance-minimizing cross hedge as it offers least risk among all the four contracts with a daily standard deviation of 0.00483