### ---problem 1--- ###

# # A. Preliminary Work

setwd("C:/Users/47494/GitHub/MF793/data")

daily\_rets <- read.csv("stk-day.csv",header=T)

monthly\_rets <- read.csv("stk-mon.csv",header=T)

# # (a)

log\_monthly\_rets <- cbind(monthly\_rets[,1],log(1 + monthly\_rets[,2:13]))

log\_daily\_rets <- cbind(daily\_rets[,1],log(1 + daily\_rets[,2:13]))

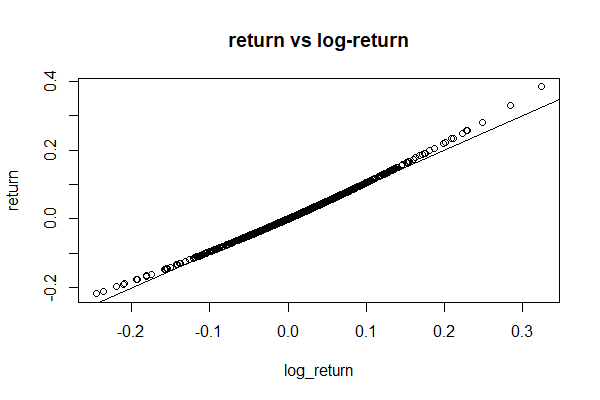
x <- unlist(log\_monthly\_rets[,2:12])

y <- unlist(monthly\_rets[,2:12])

plot(x,y,xlab="log\_return",ylab="return",

main="return vs log-return")

abline(a=0, b=1)



***Figure1***

# # (b)

# daily statistics

library("moments")

T <- round(dim(daily\_rets)[1] / 8, 2)

daily\_mean <- colMeans(log\_daily\_rets[,2:12])

daily\_ann\_mean <- T \* daily\_mean

daily\_sd <- vector(mode="numeric",length=length(daily\_mean))

daily\_ann\_sd <- vector(mode="numeric",length=length(daily\_ann\_mean))

names(daily\_sd) <- names(daily\_mean)

names(daily\_ann\_sd) <- names(daily\_ann\_mean)

for (i in 2:12) {

daily\_sd[i-1] <- sd(log\_daily\_rets[,i])

daily\_ann\_sd[i-1] <- sqrt(T) \* daily\_sd[i-1]

}

# table 1

round(daily\_mean,4)

round(daily\_ann\_mean,4)

round(daily\_sd,4)

round(daily\_ann\_sd,3)

daily\_acf <- vector(mode="numeric",length=length(daily\_mean))

daily\_skewness <- vector(mode="numeric",length=length(daily\_mean))

daily\_kurtosis <- vector(mode="numeric",length=length(daily\_mean))

daily\_jbtest <- vector(mode="numeric",length=length(daily\_mean))

names(daily\_acf) <- names(daily\_mean)

names(daily\_skewness) <- names(daily\_mean)

names(daily\_kurtosis) <- names(daily\_mean)

names(daily\_jbtest) <- names(daily\_mean)

for (i in 2:12) {

daily\_acf[i-1] <- acf(log\_daily\_rets[,i])[["acf"]][2]

daily\_skewness[i-1] <- skewness(log\_daily\_rets[,i])

daily\_kurtosis[i-1] <- kurtosis(log\_daily\_rets[,i])

daily\_jbtest[i-1] <- jarque.test(log\_daily\_rets[,i])[["statistic"]]

}

round(daily\_acf,4)

round(daily\_skewness,2)

round(daily\_kurtosis,2)

round(daily\_jbtest,2)

round(mean(daily\_mean),4)

round(mean(daily\_ann\_mean),4)

round(mean(daily\_sd),4)

round(mean(daily\_ann\_sd),3)

round(mean(daily\_acf),4)

round(mean(daily\_skewness),2)

round(mean(daily\_kurtosis),2)

round(mean(daily\_jbtest),2)

ew\_daily\_ret <- rowMeans(log\_daily\_rets[,2:12])

ew\_daily\_mean <- mean(ew\_daily\_ret)

ew\_daily\_ann\_mean <- T \* ew\_daily\_mean

ew\_daily\_sd <- sd(ew\_daily\_ret)

ew\_daily\_ann\_sd <- sqrt(T) \* ew\_daily\_sd

ew\_daily\_acf <- acf(ew\_daily\_ret)[["acf"]][2]

ew\_daily\_skewness <- skewness(ew\_daily\_ret)

ew\_daily\_kurtosis <- kurtosis(ew\_daily\_ret)

ew\_daily\_jbtest <- jarque.test(ew\_daily\_ret)[["statistic"]]

round(ew\_daily\_mean,4)

round(ew\_daily\_ann\_mean,4)

round(ew\_daily\_sd,4)

round(ew\_daily\_ann\_sd,3)

round(ew\_daily\_acf,4)

round(ew\_daily\_skewness,2)

round(ew\_daily\_kurtosis,2)

round(ew\_daily\_jbtest,2)

vw\_daily\_ret <- log\_daily\_rets[,13]

vw\_daily\_mean <- mean(vw\_daily\_ret)

vw\_daily\_ann\_mean <- T \* vw\_daily\_mean

vw\_daily\_sd <- sd(vw\_daily\_ret)

vw\_daily\_ann\_sd <- sqrt(T) \* vw\_daily\_sd

vw\_daily\_acf <- acf(vw\_daily\_ret)[["acf"]][2]

vw\_daily\_skewness <- skewness(vw\_daily\_ret)

vw\_daily\_kurtosis <- kurtosis(vw\_daily\_ret)

vw\_daily\_jbtest <- jarque.test(vw\_daily\_ret)[["statistic"]]

round(vw\_daily\_mean,4)

round(vw\_daily\_ann\_mean,4)

round(vw\_daily\_sd,4)

round(vw\_daily\_ann\_sd,3)

round(vw\_daily\_acf,4)

round(vw\_daily\_skewness,2)

round(vw\_daily\_kurtosis,2)

round(vw\_daily\_jbtest,2)

# # B. Mean and Variance

# monthly statistics

N = 12

monthly\_mean <- colMeans(log\_monthly\_rets[,2:12])

monthly\_ann\_mean <- N \* monthly\_mean

monthly\_sd <- vector(mode="numeric",length=length(monthly\_mean))

monthly\_ann\_sd <- vector(mode="numeric",length=length(monthly\_ann\_mean))

names(monthly\_sd) <- names(monthly\_mean)

names(monthly\_ann\_sd) <- names(monthly\_ann\_mean)

for (i in 2:12) {

monthly\_sd[i-1] <- sd(log\_monthly\_rets[,i])

monthly\_ann\_sd[i-1] <- sqrt(N) \* monthly\_sd[i-1]

}

# table 2

round(monthly\_mean,4)

round(monthly\_ann\_mean,4)

round(monthly\_sd,4)

round(monthly\_ann\_sd,3)

monthly\_acf <- vector(mode="numeric",length=length(monthly\_mean))

monthly\_skewness <- vector(mode="numeric",length=length(monthly\_mean))

monthly\_kurtosis <- vector(mode="numeric",length=length(monthly\_mean))

monthly\_jbtest <- vector(mode="numeric",length=length(monthly\_mean))

names(monthly\_acf) <- names(monthly\_mean)

names(monthly\_skewness) <- names(monthly\_mean)

names(monthly\_kurtosis) <- names(monthly\_mean)

names(monthly\_jbtest) <- names(monthly\_mean)

for (i in 2:12) {

monthly\_acf[i-1] <- acf(log\_monthly\_rets[,i])[["acf"]][2]

monthly\_skewness[i-1] <- skewness(log\_monthly\_rets[,i])

monthly\_kurtosis[i-1] <- kurtosis(log\_monthly\_rets[,i])

monthly\_jbtest[i-1] <- jarque.test(log\_monthly\_rets[,i])[["statistic"]]

}

round(monthly\_acf,4)

round(monthly\_skewness,2)

round(monthly\_kurtosis,2)

round(monthly\_jbtest,2)

round(mean(monthly\_mean),4)

round(mean(monthly\_ann\_mean),4)

round(mean(monthly\_sd),4)

round(mean(monthly\_ann\_sd),3)

round(mean(monthly\_acf),4)

round(mean(monthly\_skewness),2)

round(mean(monthly\_kurtosis),2)

round(mean(monthly\_jbtest),2)

ew\_monthly\_ret <- rowMeans(log\_monthly\_rets[,2:12])

ew\_monthly\_mean <- mean(ew\_monthly\_ret)

ew\_monthly\_ann\_mean <- N \* ew\_monthly\_mean

ew\_monthly\_sd <- sd(ew\_monthly\_ret)

ew\_monthly\_ann\_sd <- sqrt(N) \* ew\_monthly\_sd

ew\_monthly\_acf <- acf(ew\_monthly\_ret)[["acf"]][2]

ew\_monthly\_skewness <- skewness(ew\_monthly\_ret)

ew\_monthly\_kurtosis <- kurtosis(ew\_monthly\_ret)

ew\_monthly\_jbtest <- jarque.test(ew\_monthly\_ret)[["statistic"]]

round(ew\_monthly\_mean,4)

round(ew\_monthly\_ann\_mean,4)

round(ew\_monthly\_sd,4)

round(ew\_monthly\_ann\_sd,3)

round(ew\_monthly\_acf,4)

round(ew\_monthly\_skewness,2)

round(ew\_monthly\_kurtosis,2)

round(ew\_monthly\_jbtest,2)

vw\_monthly\_ret <- log\_monthly\_rets[,13]

vw\_monthly\_mean <- mean(vw\_monthly\_ret)

vw\_monthly\_ann\_mean <- N \* vw\_monthly\_mean

vw\_monthly\_sd <- sd(vw\_monthly\_ret)

vw\_monthly\_ann\_sd <- sqrt(N) \* vw\_monthly\_sd

vw\_monthly\_acf <- acf(vw\_monthly\_ret)[["acf"]][2]

vw\_monthly\_skewness <- skewness(vw\_monthly\_ret)

vw\_monthly\_kurtosis <- kurtosis(vw\_monthly\_ret)

vw\_monthly\_jbtest <- jarque.test(vw\_monthly\_ret)[["statistic"]]

round(vw\_monthly\_mean,4)

round(vw\_monthly\_ann\_mean,4)

round(vw\_monthly\_sd,4)

round(vw\_monthly\_ann\_sd,3)

round(vw\_monthly\_acf,4)

round(vw\_monthly\_skewness,2)

round(vw\_monthly\_kurtosis,2)

round(vw\_monthly\_jbtest,2)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Table 1:** Monthly returns summary statistics | | | | | | | |  |
|  | Mean | Ann. Mean | Stdev | Ann. Stdev | Skewness | Kurtosis | JB test | ρ(1) |
| Apple | 0.0191 | 0.2291 | 0.0701 | 0.243 | -0.25 | 2.78 | 1.19 | 0.0296 |
| Amazon | 0.0225 | 0.2703 | 0.0770 | 0.267 | 0.15 | 2.83 | 0.50 | -0.0208 |
| Biogen | 0.0194 | 0.2332 | 0.0839 | 0.291 | 0.09 | 3.89 | 3.27 | -0.0598 |
| Citygroup | 0.0087 | 0.1050 | 0.0835 | 0.289 | -0.48 | 3.36 | 4.28 | 0.0185 |
| GE | 0.0042 | 0.0503 | 0.0633 | 0.219 | -0.04 | 3.16 | 0.13 | -0.0141 |
| Nike | 0.0150 | 0.1796 | 0.0599 | 0.208 | -0.59 | 4.37 | 12.95 | -0.0588 |
| Pepsi | 0.0095 | 0.1139 | 0.0333 | 0.115 | -0.18 | 2.80 | 0.70 | -0.0568 |
| State Street | 0.0098 | 0.1173 | 0.0713 | 0.247 | -0.02 | 3.91 | 3.32 | -0.0601 |
| Toyota | 0.0060 | 0.0716 | 0.0542 | 0.188 | -0.19 | 3.60 | 2.03 | 0.0952 |
| Valero | 0.0207 | 0.2482 | 0.0932 | 0.323 | 0.08 | 3.54 | 1.28 | -0.0464 |
| Verizon | 0.0096 | 0.1153 | 0.0483 | 0.167 | 0.10 | 2.66 | 0.61 | -0.1569 |
| Average | 0.0131 | 0.1576 | 0.0671 | 0.232 | -0.12 | 3.35 | 2.75 | -0.0300 |
|  |  |  |  |  |  |  |  |  |
| EW Portfolio | 0.0131 | 0.1576 | 0.0395 | 0.137 | -0.09 | 3.05 | 0.15 | -0.0618 |
| VW US | 0.0099 | 0.1193 | 0.0352 | 0.122 | -0.31 | 3.65 | 3.29 | -0.0937 |

\* 96 months, 8 years, 1/2010 – 12/2017

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Table 2:** Daily returns summary statistics | | | | | | | |  |
|  | Mean | Ann. Mean | Stdev | Ann. Stdev | Skewness | Kurtosis | JB test | ρ(1) |
| Apple | 0.0009 | 0.2295 | 0.0159 | 0.253 | -0.26 | 7.97 | 2094.55 | 0.0243 |
| Amazon | 0.0011 | 0.2703 | 0.0195 | 0.310 | 0.23 | 11.31 | 5810.98 | -0.0063 |
| Biogen | 0.0009 | 0.2332 | 0.0200 | 0.317 | -0.54 | 19.82 | 23812.82 | -0.0215 |
| Citygroup | 0.0004 | 0.1051 | 0.0205 | 0.325 | -0.45 | 9.11 | 3199.23 | -0.0244 |
| GE | 0.0002 | 0.0502 | 0.0136 | 0.216 | -0.01 | 7.78 | 1916.32 | 0.0358 |
| Nike | 0.0007 | 0.1796 | 0.0146 | 0.232 | 0.43 | 12.18 | 7129.44 | -0.0412 |
| Pepsi | 0.0005 | 0.1140 | 0.0086 | 0.136 | -0.17 | 5.53 | 547.74 | -0.0463 |
| State Street | 0.0005 | 0.1173 | 0.0169 | 0.268 | -0.12 | 7.45 | 1662.86 | -0.0566 |
| Toyota | 0.0003 | 0.0715 | 0.0135 | 0.214 | -0.09 | 5.24 | 424.08 | -0.0290 |
| Valero | 0.0010 | 0.2484 | 0.0214 | 0.339 | -0.14 | 6.43 | 991.13 | -0.0093 |
| Verizon | 0.0005 | 0.1154 | 0.0103 | 0.163 | 0.05 | 5.53 | 536.66 | 0.0086 |
| Average | 0.0006 | 0.1577 | 0.0159 | 0.252 | -0.10 | 8.94 | 4375.07 | -0.0151 |
|  |  |  |  |  |  |  |  |  |
| EW Portfolio | 0.0006 | 0.1577 | 0.0103 | 0.164 | -0.50 | 7.18 | 1550.66 | -0.0315 |
| VW US | 0.0005 | 0.1195 | 0.0094 | 0.149 | -0.50 | 7.92 | 2112.78 | -0.0343 |

\* 251.62 days per year, T = 2013 days, 2010 – 2017

# # D.Normality

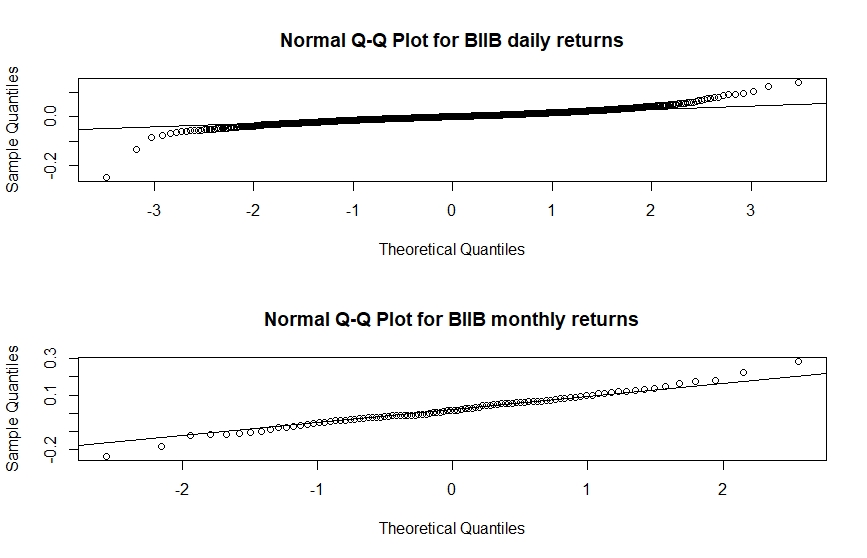
par(mfrow=c(2,1))

qqnorm(log\_daily\_rets[,4],main="Normal Q-Q Plot for BIIB daily returns")

qqline(log\_daily\_rets[,4])

qqnorm(log\_monthly\_rets[,4],main="Normal Q-Q Plot for BIIB monthly returns")

qqline(log\_monthly\_rets[,4])



***Figure2***

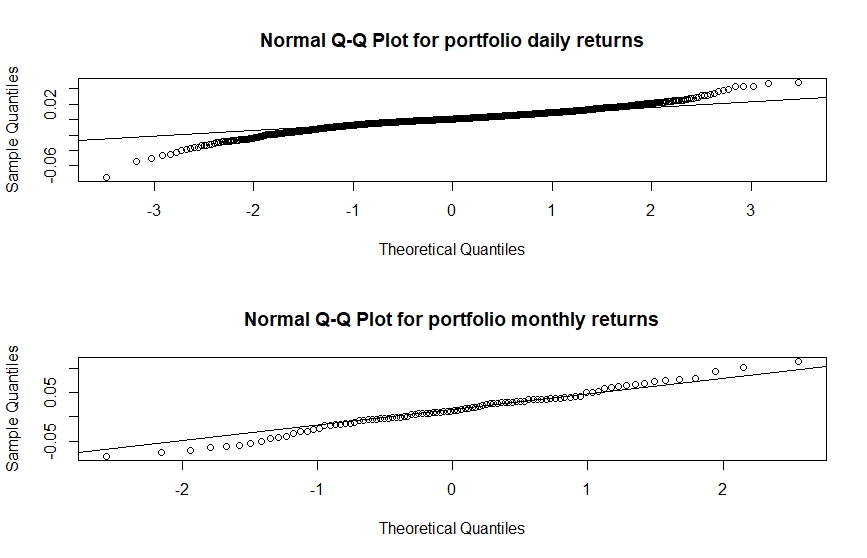
par(mfrow=c(2,1))

qqnorm(log\_daily\_rets[,14],main="Normal Q-Q Plot for portfolio daily returns")

qqline(log\_daily\_rets[,14])

qqnorm(log\_monthly\_rets[,14],main="Normal Q-Q Plot for portfolio monthly returns")

qqline(log\_monthly\_rets[,14])



***Figure3***

### ---problem 2--- ###

# # pepsi

mean(monthly\_rets[,8]) \* 12

sd(monthly\_rets[,8]) \* sqrt(12)

quantile(monthly\_rets[,8], probs=c(0.05,0.95))

quantile(log\_monthly\_rets[,8], probs=c(0.05,0.95))

# # valero

mean(monthly\_rets[,11]) \* 12

sd(monthly\_rets[,11]) \* sqrt(12)

quantile(monthly\_rets[,11], probs=c(0.05,0.95))

quantile(log\_monthly\_rets[,11], probs=c(0.05,0.95))

### ---problem 4--- ###

# # (1)

daily\_matrix <- cor(log\_daily\_rets[,2:12])

daily\_cor <- unlist(daily\_matrix[daily\_matrix<1])

quantile(daily\_cor, prob=c(0,0.25,0.5,0.75,1))

monthly\_matrix <- cor(log\_monthly\_rets[,2:12])

monthly\_cor <- unlist(monthly\_matrix[monthly\_matrix<1])

quantile(monthly\_cor,prob=c(0,0.25,0.5,0.75,1))

# # (2)

quantile(ew\_monthly\_ret,0.05)

qnorm(0.05, mean(ew\_monthly\_ret),sd(ew\_monthly\_ret))

quantile(ew\_daily\_ret,0.05)

qnorm(0.05, mean(ew\_daily\_ret),sd(ew\_daily\_ret))

**Table: Cross-correlations of stock returns**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Ann. Mean | Ann. Stdv | 5% | 95% |
| Pepsi |  |  |  |  |
| R | 0.1210 | 0.116 | -0.0377 | 0.0644 |
| log(1+R) | 0.1139 | 0.115 | -0.0384 | 0.0624 |
| Valero |  |  |  |  |
| R | 0.3037 | 0.334 | -0.1080 | 0.1520 |
| log(1+R) | 0.2482 | 0.323 | -0.1143 | 0.1414 |