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**R script**

rm(list=ls(all=T))

library(quadprog)

##function

##I add the last line of function rf\_mvp\_wx to add the weight of risk free asset into consider

source("D:/大學作業/大四下/財務金融資訊分析/Final Project/function\_FDA.R")

##read data

data\_1101<-read.table("D:/大學作業/大四下/財務金融資訊分析/Final Project/1101.TW.csv"

, sep=",", na.strings="null", header=T)

data\_1216<-read.table("D:/大學作業/大四下/財務金融資訊分析/Final Project/1216.TW.csv"

, sep=",", na.strings="null", header=T)

data\_1303<-read.table("D:/大學作業/大四下/財務金融資訊分析/Final Project/1303.TW.csv"

, sep=",", na.strings="null", header=T)

data\_1434<-read.table("D:/大學作業/大四下/財務金融資訊分析/Final Project/1434.TW.csv"

, sep=",", na.strings="null", header=T)

data\_1504<-read.table("D:/大學作業/大四下/財務金融資訊分析/Final Project/1504.TW.csv"

, sep=",", na.strings="null", header=T)

data\_1612<-read.table("D:/大學作業/大四下/財務金融資訊分析/Final Project/1612.TW.csv"

, sep=",", na.strings="null", header=T)

data\_1732<-read.table("D:/大學作業/大四下/財務金融資訊分析/Final Project/1732.TW.csv"

, sep=",", na.strings="null", header=T)

data\_1734<-read.table("D:/大學作業/大四下/財務金融資訊分析/Final Project/1734.TW.csv"

, sep=",", na.strings="null", header=T)

data\_1810<-read.table("D:/大學作業/大四下/財務金融資訊分析/Final Project/1810.TW.csv"

, sep=",", na.strings="null", header=T)

data\_1909<-read.table("D:/大學作業/大四下/財務金融資訊分析/Final Project/1909.TW.csv"

, sep=",", na.strings="null", header=T)

data\_2002<-read.table("D:/大學作業/大四下/財務金融資訊分析/Final Project/2002.TW.csv"

, sep=",", na.strings="null", header=T)

data\_2105<-read.table("D:/大學作業/大四下/財務金融資訊分析/Final Project/2105.TW.csv"

, sep=",", na.strings="null", header=T)

data\_2201<-read.table("D:/大學作業/大四下/財務金融資訊分析/Final Project/2201.TW.csv"

, sep=",", na.strings="null", header=T)

data\_2317<-read.table("D:/大學作業/大四下/財務金融資訊分析/Final Project/2317.TW.csv"

, sep=",", na.strings="null", header=T)

data\_2330<-read.table("D:/大學作業/大四下/財務金融資訊分析/Final Project/2330.TW.csv"

, sep=",", na.strings="null", header=T)

data\_2357<-read.table("D:/大學作業/大四下/財務金融資訊分析/Final Project/2357.TW.csv"

, sep=",", na.strings="null", header=T)

data\_2412<-read.table("D:/大學作業/大四下/財務金融資訊分析/Final Project/2412.TW.csv"

, sep=",", na.strings="null", header=T)

data\_2430<-read.table("D:/大學作業/大四下/財務金融資訊分析/Final Project/2430.TW.csv"

, sep=",", na.strings="null", header=T)

data\_2480<-read.table("D:/大學作業/大四下/財務金融資訊分析/Final Project/2480.TW.csv"

, sep=",", na.strings="null", header=T)

data\_2505<-read.table("D:/大學作業/大四下/財務金融資訊分析/Final Project/2505.TW.csv"

, sep=",", na.strings="null", header=T)

data\_2603<-read.table("D:/大學作業/大四下/財務金融資訊分析/Final Project/2603.TW.csv"

, sep=",", na.strings="null", header=T)

data\_2614<-read.table("D:/大學作業/大四下/財務金融資訊分析/Final Project/2614.TW.csv"

, sep=",", na.strings="null", header=T)

data\_2731<-read.table("D:/大學作業/大四下/財務金融資訊分析/Final Project/2731.TW.csv"

, sep=",", na.strings="null", header=T)

data\_2884<-read.table("D:/大學作業/大四下/財務金融資訊分析/Final Project/2884.TW.csv"

, sep=",", na.strings="null", header=T)

data\_3481<-read.table("D:/大學作業/大四下/財務金融資訊分析/Final Project/3481.TW.csv"

, sep=",", na.strings="null", header=T)

data\_6505<-read.table("D:/大學作業/大四下/財務金融資訊分析/Final Project/6505.TW.csv"

, sep=",", na.strings="null", header=T)

data\_8039<-read.table("D:/大學作業/大四下/財務金融資訊分析/Final Project/8039.TW.csv"

, sep=",", na.strings="null", header=T)

##remove NA

data\_1101<-data\_1101[complete.cases(data\_1101),]

data\_1216<-data\_1216[complete.cases(data\_1216),]

data\_1303<-data\_1303[complete.cases(data\_1303),]

data\_1434<-data\_1434[complete.cases(data\_1434),]

data\_1504<-data\_1504[complete.cases(data\_1504),]

data\_1612<-data\_1612[complete.cases(data\_1612),]

data\_1732<-data\_1732[complete.cases(data\_1732),]

data\_1734<-data\_1734[complete.cases(data\_1734),]

data\_1810<-data\_1810[complete.cases(data\_1810),]

data\_1909<-data\_1909[complete.cases(data\_1909),]

data\_2002<-data\_2002[complete.cases(data\_2002),]

data\_2105<-data\_2105[complete.cases(data\_2105),]

data\_2201<-data\_2201[complete.cases(data\_2201),]

data\_2317<-data\_2317[complete.cases(data\_2317),]

data\_2330<-data\_2330[complete.cases(data\_2330),]

data\_2357<-data\_2357[complete.cases(data\_2357),]

data\_2412<-data\_2412[complete.cases(data\_2412),]

data\_2430<-data\_2430[complete.cases(data\_2430),]

data\_2480<-data\_2480[complete.cases(data\_2480),]

data\_2505<-data\_2505[complete.cases(data\_2505),]

data\_2603<-data\_2603[complete.cases(data\_2603),]

data\_2614<-data\_2614[complete.cases(data\_2614),]

data\_2731<-data\_2731[complete.cases(data\_2731),]

data\_2884<-data\_2884[complete.cases(data\_2884),]

data\_3481<-data\_3481[complete.cases(data\_3481),]

data\_6505<-data\_6505[complete.cases(data\_6505),]

data\_8039<-data\_8039[complete.cases(data\_8039),]

##convert date type

data\_1101$Date<-as.Date(data\_1101$Date)

data\_1216$Date<-as.Date(data\_1216$Date)

data\_1303$Date<-as.Date(data\_1303$Date)

data\_1434$Date<-as.Date(data\_1434$Date)

data\_1504$Date<-as.Date(data\_1504$Date)

data\_1612$Date<-as.Date(data\_1612$Date)

data\_1732$Date<-as.Date(data\_1732$Date)

data\_1734$Date<-as.Date(data\_1734$Date)

data\_1810$Date<-as.Date(data\_1810$Date)

data\_1909$Date<-as.Date(data\_1909$Date)

data\_2002$Date<-as.Date(data\_2002$Date)

data\_2105$Date<-as.Date(data\_2105$Date)

data\_2201$Date<-as.Date(data\_2201$Date)

data\_2317$Date<-as.Date(data\_2317$Date)

data\_2330$Date<-as.Date(data\_2330$Date)

data\_2357$Date<-as.Date(data\_2357$Date)

data\_2412$Date<-as.Date(data\_2412$Date)

data\_2430$Date<-as.Date(data\_2430$Date)

data\_2480$Date<-as.Date(data\_2480$Date)

data\_2505$Date<-as.Date(data\_2505$Date)

data\_2603$Date<-as.Date(data\_2603$Date)

data\_2614$Date<-as.Date(data\_2614$Date)

data\_2731$Date<-as.Date(data\_2731$Date)

data\_2884$Date<-as.Date(data\_2884$Date)

data\_3481$Date<-as.Date(data\_3481$Date)

data\_6505$Date<-as.Date(data\_6505$Date)

data\_8039$Date<-as.Date(data\_8039$Date)

##calculate return (as percentage)

data\_1101$ret<-c(NA, retx(as.numeric(data\_1101$Adj.Close))\*100)

data\_1216$ret<-c(NA, retx(as.numeric(data\_1216$Adj.Close))\*100)

data\_1303$ret<-c(NA, retx(as.numeric(data\_1303$Adj.Close))\*100)

data\_1434$ret<-c(NA, retx(as.numeric(data\_1434$Adj.Close))\*100)

data\_1504$ret<-c(NA, retx(as.numeric(data\_1504$Adj.Close))\*100)

data\_1612$ret<-c(NA, retx(as.numeric(data\_1612$Adj.Close))\*100)

data\_1732$ret<-c(NA, retx(as.numeric(data\_1732$Adj.Close))\*100)

data\_1734$ret<-c(NA, retx(as.numeric(data\_1734$Adj.Close))\*100)

data\_1810$ret<-c(NA, retx(as.numeric(data\_1810$Adj.Close))\*100)

data\_1909$ret<-c(NA, retx(as.numeric(data\_1909$Adj.Close))\*100)

data\_2002$ret<-c(NA, retx(as.numeric(data\_2002$Adj.Close))\*100)

data\_2105$ret<-c(NA, retx(as.numeric(data\_2105$Adj.Close))\*100)

data\_2201$ret<-c(NA, retx(as.numeric(data\_2201$Adj.Close))\*100)

data\_2317$ret<-c(NA, retx(as.numeric(data\_2317$Adj.Close))\*100)

data\_2330$ret<-c(NA, retx(as.numeric(data\_2330$Adj.Close))\*100)

data\_2357$ret<-c(NA, retx(as.numeric(data\_2357$Adj.Close))\*100)

data\_2412$ret<-c(NA, retx(as.numeric(data\_2412$Adj.Close))\*100)

data\_2430$ret<-c(NA, retx(as.numeric(data\_2430$Adj.Close))\*100)

data\_2480$ret<-c(NA, retx(as.numeric(data\_2480$Adj.Close))\*100)

data\_2505$ret<-c(NA, retx(as.numeric(data\_2505$Adj.Close))\*100)

data\_2603$ret<-c(NA, retx(as.numeric(data\_2603$Adj.Close))\*100)

data\_2614$ret<-c(NA, retx(as.numeric(data\_2614$Adj.Close))\*100)

data\_2731$ret<-c(NA, retx(as.numeric(data\_2731$Adj.Close))\*100)

data\_2884$ret<-c(NA, retx(as.numeric(data\_2884$Adj.Close))\*100)

data\_3481$ret<-c(NA, retx(as.numeric(data\_3481$Adj.Close))\*100)

data\_6505$ret<-c(NA, retx(as.numeric(data\_6505$Adj.Close))\*100)

data\_8039$ret<-c(NA, retx(as.numeric(data\_8039$Adj.Close))\*100)

##get data from 2015-01-01 to 2020-12-31

data\_1101<-data\_1101[data\_1101$Date>="2015-01-01",]

data\_1216<-data\_1216[data\_1216$Date>="2015-01-01",]

data\_1303<-data\_1303[data\_1303$Date>="2015-01-01",]

data\_1434<-data\_1434[data\_1434$Date>="2015-01-01",]

data\_1504<-data\_1504[data\_1504$Date>="2015-01-01",]

data\_1612<-data\_1612[data\_1612$Date>="2015-01-01",]

data\_1732<-data\_1732[data\_1732$Date>="2015-01-01",]

data\_1734<-data\_1734[data\_1734$Date>="2015-01-01",]

data\_1810<-data\_1810[data\_1810$Date>="2015-01-01",]

data\_1909<-data\_1909[data\_1909$Date>="2015-01-01",]

data\_2002<-data\_2002[data\_2002$Date>="2015-01-01",]

data\_2105<-data\_2105[data\_2105$Date>="2015-01-01",]

data\_2201<-data\_2201[data\_2201$Date>="2015-01-01",]

data\_2317<-data\_2317[data\_2317$Date>="2015-01-01",]

data\_2330<-data\_2330[data\_2330$Date>="2015-01-01",]

data\_2357<-data\_2357[data\_2357$Date>="2015-01-01",]

data\_2412<-data\_2412[data\_2412$Date>="2015-01-01",]

data\_2430<-data\_2430[data\_2430$Date>="2015-01-01",]

data\_2480<-data\_2480[data\_2480$Date>="2015-01-01",]

data\_2505<-data\_2505[data\_2505$Date>="2015-01-01",]

data\_2603<-data\_2603[data\_2603$Date>="2015-01-01",]

data\_2614<-data\_2614[data\_2614$Date>="2015-01-01",]

data\_2731<-data\_2731[data\_2731$Date>="2015-01-01",]

data\_2884<-data\_2884[data\_2884$Date>="2015-01-01",]

data\_3481<-data\_3481[data\_3481$Date>="2015-01-01",]

data\_6505<-data\_6505[data\_6505$Date>="2015-01-01",]

data\_8039<-data\_8039[data\_8039$Date>="2015-01-01",]

---------------------------------------------------------------------

##1101

##Time series plot of returns

windows(height=4, width=10)

plot(x=data\_1101$Date, y=data\_1101$ret, main="1101 returns (as percentage)", xlab="Date", ylab="Return(%)", type="l"

, col=1)

##Time series plot of prices

windows(height=8, width=10)

plot(x=data\_1101$Date, y=data\_1101$Adj.Close, main="1101 prices", xlab="Date"

, ylab="Adjusted close prices", type="l", lwd=2)

##Descriptive statistics of returns

result\_ret\_1101<-c(length(data\_1101$ret), min(data\_1101$ret), median(data\_1101$ret), max(data\_1101$ret),

mean(data\_1101$ret), sd(data\_1101$ret), my\_skewness(data\_1101$ret), my\_kurtosis(data\_1101$ret),

my\_acf1(data\_1101$ret))

result\_ret\_1101[2:8]<-result\_ret\_1101[2:8]\*c(rep(252,4), sqrt(252), 1/sqrt(252), 1/252)

names(result\_ret\_1101)<-c("number of observations", "min", "median", "max", "mean", "std", "skewness"

, "kurtosis", "acf1")

result\_ret\_1101<-round(result\_ret\_1101, 3)

result\_ret\_1101

##1216

##Time series plot of returns

windows(height=4, width=10)

plot(x=data\_1216$Date, y=data\_1216$ret, main="1216 returns (as percentage)", xlab="Date", ylab="Return(%)", type="l"

, col=2)

##Time series plot of prices

windows(height=8, width=10)

plot(x=data\_1216$Date, y=data\_1216$Adj.Close, main="1216 prices", xlab="Date"

, ylab="Adjusted close prices", type="l", lwd=2)

##Descriptive statistics of returns

result\_ret\_1216<-c(length(data\_1216$ret), min(data\_1216$ret), median(data\_1216$ret), max(data\_1216$ret),

mean(data\_1216$ret), sd(data\_1216$ret), my\_skewness(data\_1216$ret), my\_kurtosis(data\_1216$ret),

my\_acf1(data\_1216$ret))

result\_ret\_1216[2:8]<-result\_ret\_1216[2:8]\*c(rep(252,4), sqrt(252), 1/sqrt(252), 1/252)

names(result\_ret\_1216)<-c("number of observations", "min", "median", "max", "mean", "std", "skewness"

, "kurtosis", "acf1")

result\_ret\_1216<-round(result\_ret\_1216, 3)

result\_ret\_1216

##1303

##Time series plot of returns

windows(height=4, width=10)

plot(x=data\_1303$Date, y=data\_1303$ret, main="1303 returns (as percentage)", xlab="Date", ylab="Return(%)", type="l"

, col=3)

##Time series plot of prices

windows(height=8, width=10)

plot(x=data\_1303$Date, y=data\_1303$Adj.Close, main="1303 prices", xlab="Date"

, ylab="Adjusted close prices", type="l", lwd=2)

##Descriptive statistics of returns

result\_ret\_1303<-c(length(data\_1303$ret), min(data\_1303$ret), median(data\_1303$ret), max(data\_1303$ret),

mean(data\_1303$ret), sd(data\_1303$ret), my\_skewness(data\_1303$ret), my\_kurtosis(data\_1303$ret),

my\_acf1(data\_1303$ret))

result\_ret\_1303[2:8]<-result\_ret\_1303[2:8]\*c(rep(252,4), sqrt(252), 1/sqrt(252), 1/252)

names(result\_ret\_1303)<-c("number of observations", "min", "median", "max", "mean", "std", "skewness"

, "kurtosis", "acf1")

result\_ret\_1303<-round(result\_ret\_1303, 3)

result\_ret\_1303

##1434

##Time series plot of returns

windows(height=4, width=10)

plot(x=data\_1434$Date, y=data\_1434$ret, main="1434 returns (as percentage)", xlab="Date", ylab="Return(%)", type="l"

, col=4)

##Time series plot of prices

windows(height=8, width=10)

plot(x=data\_1434$Date, y=data\_1434$Adj.Close, main="1434 prices", xlab="Date"

, ylab="Adjusted close prices", type="l", lwd=2)

##Descriptive statistics of returns

result\_ret\_1434<-c(length(data\_1434$ret), min(data\_1434$ret), median(data\_1434$ret), max(data\_1434$ret),

mean(data\_1434$ret), sd(data\_1434$ret), my\_skewness(data\_1434$ret), my\_kurtosis(data\_1434$ret),

my\_acf1(data\_1434$ret))

result\_ret\_1434[2:8]<-result\_ret\_1434[2:8]\*c(rep(252,4), sqrt(252), 1/sqrt(252), 1/252)

names(result\_ret\_1434)<-c("number of observations", "min", "median", "max", "mean", "std", "skewness"

, "kurtosis", "acf1")

result\_ret\_1434<-round(result\_ret\_1434, 3)

result\_ret\_1434

##1504

##Time series plot of returns

windows(height=4, width=10)

plot(x=data\_1504$Date, y=data\_1504$ret, main="1504 returns (as percentage)", xlab="Date", ylab="Return(%)", type="l"

, col=5)

##Time series plot of prices

windows(height=8, width=10)

plot(x=data\_1504$Date, y=data\_1504$Adj.Close, main="1504 prices", xlab="Date"

, ylab="Adjusted close prices", type="l", lwd=2)

##Descriptive statistics of returns

result\_ret\_1504<-c(length(data\_1504$ret), min(data\_1504$ret), median(data\_1504$ret), max(data\_1504$ret),

mean(data\_1504$ret), sd(data\_1504$ret), my\_skewness(data\_1504$ret), my\_kurtosis(data\_1504$ret),

my\_acf1(data\_1504$ret))

result\_ret\_1504[2:8]<-result\_ret\_1504[2:8]\*c(rep(252,4), sqrt(252), 1/sqrt(252), 1/252)

names(result\_ret\_1504)<-c("number of observations", "min", "median", "max", "mean", "std", "skewness"

, "kurtosis", "acf1")

result\_ret\_1504<-round(result\_ret\_1504, 3)

result\_ret\_1504

##1612

##Time series plot of returns

windows(height=4, width=10)

plot(x=data\_1612$Date, y=data\_1612$ret, main="1612 returns (as percentage)", xlab="Date", ylab="Return(%)", type="l"

, col=6)

##Time series plot of prices

windows(height=8, width=10)

plot(x=data\_1612$Date, y=data\_1612$Adj.Close, main="1612 prices", xlab="Date"

, ylab="Adjusted close prices", type="l", lwd=2)

##Descriptive statistics of returns

result\_ret\_1612<-c(length(data\_1612$ret), min(data\_1612$ret), median(data\_1612$ret), max(data\_1612$ret),

mean(data\_1612$ret), sd(data\_1612$ret), my\_skewness(data\_1612$ret), my\_kurtosis(data\_1612$ret),

my\_acf1(data\_1612$ret))

result\_ret\_1612[2:8]<-result\_ret\_1612[2:8]\*c(rep(252,4), sqrt(252), 1/sqrt(252), 1/252)

names(result\_ret\_1612)<-c("number of observations", "min", "median", "max", "mean", "std", "skewness"

, "kurtosis", "acf1")

result\_ret\_1612<-round(result\_ret\_1612, 3)

result\_ret\_1612

##1732

##Time series plot of returns

windows(height=4, width=10)

plot(x=data\_1732$Date, y=data\_1732$ret, main="1732 returns (as percentage)", xlab="Date", ylab="Return(%)", type="l"

, col=7)

##Time series plot of prices

windows(height=8, width=10)

plot(x=data\_1732$Date, y=data\_1732$Adj.Close, main="1732 prices", xlab="Date"

, ylab="Adjusted close prices", type="l", lwd=2)

##Descriptive statistics of returns

result\_ret\_1732<-c(length(data\_1732$ret), min(data\_1732$ret), median(data\_1732$ret), max(data\_1732$ret),

mean(data\_1732$ret), sd(data\_1732$ret), my\_skewness(data\_1732$ret), my\_kurtosis(data\_1732$ret),

my\_acf1(data\_1732$ret))

result\_ret\_1732[2:8]<-result\_ret\_1732[2:8]\*c(rep(252,4), sqrt(252), 1/sqrt(252), 1/252)

names(result\_ret\_1732)<-c("number of observations", "min", "median", "max", "mean", "std", "skewness"

, "kurtosis", "acf1")

result\_ret\_1732<-round(result\_ret\_1732, 3)

result\_ret\_1732

##1734

##Time series plot of returns

windows(height=4, width=10)

plot(x=data\_1734$Date, y=data\_1734$ret, main="1734 returns (as percentage)", xlab="Date", ylab="Return(%)", type="l"

, col=8)

##Time series plot of prices

windows(height=8, width=10)

plot(x=data\_1734$Date, y=data\_1734$Adj.Close, main="1734 prices", xlab="Date"

, ylab="Adjusted close prices", type="l", lwd=2)

##Descriptive statistics of returns

result\_ret\_1734<-c(length(data\_1734$ret), min(data\_1734$ret), median(data\_1734$ret), max(data\_1734$ret),

mean(data\_1734$ret), sd(data\_1734$ret), my\_skewness(data\_1734$ret), my\_kurtosis(data\_1734$ret),

my\_acf1(data\_1734$ret))

result\_ret\_1734[2:8]<-result\_ret\_1734[2:8]\*c(rep(252,4), sqrt(252), 1/sqrt(252), 1/252)

names(result\_ret\_1734)<-c("number of observations", "min", "median", "max", "mean", "std", "skewness"

, "kurtosis", "acf1")

result\_ret\_1734<-round(result\_ret\_1734, 3)

result\_ret\_1734

##1810

##Time series plot of returns

windows(height=4, width=10)

plot(x=data\_1810$Date, y=data\_1810$ret, main="1810 returns (as percentage)", xlab="Date", ylab="Return(%)", type="l"

, col=1)

##Time series plot of prices

windows(height=8, width=10)

plot(x=data\_1810$Date, y=data\_1810$Adj.Close, main="1818 prices", xlab="Date"

, ylab="Adjusted close prices", type="l", lwd=2)

##Descriptive statistics of returns

result\_ret\_1810<-c(length(data\_1810$ret), min(data\_1810$ret), median(data\_1810$ret), max(data\_1810$ret),

mean(data\_1810$ret), sd(data\_1810$ret), my\_skewness(data\_1810$ret), my\_kurtosis(data\_1810$ret),

my\_acf1(data\_1810$ret))

result\_ret\_1810[2:8]<-result\_ret\_1810[2:8]\*c(rep(252,4), sqrt(252), 1/sqrt(252), 1/252)

names(result\_ret\_1810)<-c("number of observations", "min", "median", "max", "mean", "std", "skewness"

, "kurtosis", "acf1")

result\_ret\_1810<-round(result\_ret\_1810, 3)

result\_ret\_1810

##1909

##Time series plot of returns

windows(height=4, width=10)

plot(x=data\_1909$Date, y=data\_1909$ret, main="1909 returns (as percentage)", xlab="Date", ylab="Return(%)", type="l"

, col=2)

##Time series plot of prices

windows(height=8, width=10)

plot(x=data\_1909$Date, y=data\_1909$Adj.Close, main="1909 prices", xlab="Date"

, ylab="Adjusted close prices", type="l", lwd=2)

##Descriptive statistics of returns

result\_ret\_1909<-c(length(data\_1909$ret), min(data\_1909$ret), median(data\_1909$ret), max(data\_1909$ret),

mean(data\_1909$ret), sd(data\_1909$ret), my\_skewness(data\_1909$ret), my\_kurtosis(data\_1909$ret),

my\_acf1(data\_1909$ret))

result\_ret\_1909[2:8]<-result\_ret\_1909[2:8]\*c(rep(252,4), sqrt(252), 1/sqrt(252), 1/252)

names(result\_ret\_1909)<-c("number of observations", "min", "median", "max", "mean", "std", "skewness"

, "kurtosis", "acf1")

result\_ret\_1909<-round(result\_ret\_1909, 3)

result\_ret\_1909

##2002

##Time series plot of returns

windows(height=4, width=10)

plot(x=data\_2002$Date, y=data\_2002$ret, main="2002 returns (as percentage)", xlab="Date", ylab="Return(%)", type="l"

, col=3)

##Time series plot of prices

windows(height=8, width=10)

plot(x=data\_2002$Date, y=data\_2002$Adj.Close, main="2002 prices", xlab="Date"

, ylab="Adjusted close prices", type="l", lwd=2)

##Descriptive statistics of returns

result\_ret\_2002<-c(length(data\_2002$ret), min(data\_2002$ret), median(data\_2002$ret), max(data\_2002$ret),

mean(data\_2002$ret), sd(data\_2002$ret), my\_skewness(data\_2002$ret), my\_kurtosis(data\_2002$ret),

my\_acf1(data\_2002$ret))

result\_ret\_2002[2:8]<-result\_ret\_2002[2:8]\*c(rep(252,4), sqrt(252), 1/sqrt(252), 1/252)

names(result\_ret\_2002)<-c("number of observations", "min", "median", "max", "mean", "std", "skewness"

, "kurtosis", "acf1")

result\_ret\_2002<-round(result\_ret\_2002, 3)

result\_ret\_2002

##2105

##Time series plot of returns

windows(height=4, width=10)

plot(x=data\_2105$Date, y=data\_2105$ret, main="2105 returns (as percentage)", xlab="Date", ylab="Return(%)", type="l"

, col=4)

##Time series plot of prices

windows(height=8, width=10)

plot(x=data\_2105$Date, y=data\_2105$Adj.Close, main="2105 prices", xlab="Date"

, ylab="Adjusted close prices", type="l", lwd=2)

##Descriptive statistics of returns

result\_ret\_2105<-c(length(data\_2105$ret), min(data\_2105$ret), median(data\_2105$ret), max(data\_2105$ret),

mean(data\_2105$ret), sd(data\_2105$ret), my\_skewness(data\_2105$ret), my\_kurtosis(data\_2105$ret),

my\_acf1(data\_2105$ret))

result\_ret\_2105[2:8]<-result\_ret\_2105[2:8]\*c(rep(252,4), sqrt(252), 1/sqrt(252), 1/252)

names(result\_ret\_2105)<-c("number of observations", "min", "median", "max", "mean", "std", "skewness"

, "kurtosis", "acf1")

result\_ret\_2105<-round(result\_ret\_2105, 3)

result\_ret\_2105

##2201

##Time series plot of returns

windows(height=4, width=10)

plot(x=data\_2201$Date, y=data\_2201$ret, main="2201 returns (as percentage)", xlab="Date", ylab="Return(%)", type="l"

, col=5)

##Time series plot of prices

windows(height=8, width=10)

plot(x=data\_2201$Date, y=data\_2201$Adj.Close, main="2201 prices", xlab="Date"

, ylab="Adjusted close prices", type="l", lwd=2)

##Descriptive statistics of returns

result\_ret\_2201<-c(length(data\_2201$ret), min(data\_2201$ret), median(data\_2201$ret), max(data\_2201$ret),

mean(data\_2201$ret), sd(data\_2201$ret), my\_skewness(data\_2201$ret), my\_kurtosis(data\_2201$ret),

my\_acf1(data\_2201$ret))

result\_ret\_2201[2:8]<-result\_ret\_2201[2:8]\*c(rep(252,4), sqrt(252), 1/sqrt(252), 1/252)

names(result\_ret\_2201)<-c("number of observations", "min", "median", "max", "mean", "std", "skewness"

, "kurtosis", "acf1")

result\_ret\_2201<-round(result\_ret\_2201, 3)

result\_ret\_2201

##2317

##Time series plot of returns

windows(height=4, width=10)

plot(x=data\_2317$Date, y=data\_2317$ret, main="2317 returns (as percentage)", xlab="Date", ylab="Return(%)", type="l"

, col=6)

##Time series plot of prices

windows(height=8, width=10)

plot(x=data\_2317$Date, y=data\_2317$Adj.Close, main="2317 prices", xlab="Date"

, ylab="Adjusted close prices", type="l", lwd=2)

##Descriptive statistics of returns

result\_ret\_2317<-c(length(data\_2317$ret), min(data\_2317$ret), median(data\_2317$ret), max(data\_2317$ret),

mean(data\_2317$ret), sd(data\_2317$ret), my\_skewness(data\_2317$ret), my\_kurtosis(data\_2317$ret),

my\_acf1(data\_2317$ret))

result\_ret\_2317[2:8]<-result\_ret\_2317[2:8]\*c(rep(252,4), sqrt(252), 1/sqrt(252), 1/252)

names(result\_ret\_2317)<-c("number of observations", "min", "median", "max", "mean", "std", "skewness"

, "kurtosis", "acf1")

result\_ret\_2317<-round(result\_ret\_2317, 3)

result\_ret\_2317

##2330

##Time series plot of returns

windows(height=4, width=10)

plot(x=data\_2330$Date, y=data\_2330$ret, main="2330 returns (as percentage)", xlab="Date", ylab="Return(%)", type="l"

, col=7)

##Time series plot of prices

windows(height=8, width=10)

plot(x=data\_2330$Date, y=data\_2330$Adj.Close, main="2330 prices", xlab="Date"

, ylab="Adjusted close prices", type="l", lwd=2)

##Descriptive statistics of returns

result\_ret\_2330<-c(length(data\_2330$ret), min(data\_2330$ret), median(data\_2330$ret), max(data\_2330$ret),

mean(data\_2330$ret), sd(data\_2330$ret), my\_skewness(data\_2330$ret), my\_kurtosis(data\_2330$ret),

my\_acf1(data\_2330$ret))

result\_ret\_2330[2:8]<-result\_ret\_2330[2:8]\*c(rep(252,4), sqrt(252), 1/sqrt(252), 1/252)

names(result\_ret\_2330)<-c("number of observations", "min", "median", "max", "mean", "std", "skewness"

, "kurtosis", "acf1")

result\_ret\_2330<-round(result\_ret\_2330, 3)

result\_ret\_2330

##2357

##Time series plot of returns

windows(height=4, width=10)

plot(x=data\_2357$Date, y=data\_2357$ret, main="2357 returns (as percentage)", xlab="Date", ylab="Return(%)", type="l"

, col=8)

##Time series plot of prices

windows(height=8, width=10)

plot(x=data\_2357$Date, y=data\_2357$Adj.Close, main="2357 prices", xlab="Date"

, ylab="Adjusted close prices", type="l", lwd=2)

##Descriptive statistics of returns

result\_ret\_2357<-c(length(data\_2357$ret), min(data\_2357$ret), median(data\_2357$ret), max(data\_2357$ret),

mean(data\_2357$ret), sd(data\_2357$ret), my\_skewness(data\_2357$ret), my\_kurtosis(data\_2357$ret),

my\_acf1(data\_2357$ret))

result\_ret\_2357[2:8]<-result\_ret\_2357[2:8]\*c(rep(252,4), sqrt(252), 1/sqrt(252), 1/252)

names(result\_ret\_2357)<-c("number of observations", "min", "median", "max", "mean", "std", "skewness"

, "kurtosis", "acf1")

result\_ret\_2357<-round(result\_ret\_2357, 3)

result\_ret\_2357

##2412

##Time series plot of returns

windows(height=4, width=10)

plot(x=data\_2412$Date, y=data\_2412$ret, main="2412 returns (as percentage)", xlab="Date", ylab="Return(%)", type="l"

, col=1)

##Time series plot of prices

windows(height=8, width=10)

plot(x=data\_2412$Date, y=data\_2412$Adj.Close, main="2412 prices", xlab="Date"

, ylab="Adjusted close prices", type="l", lwd=2)

##Descriptive statistics of returns

result\_ret\_2412<-c(length(data\_2412$ret), min(data\_2412$ret), median(data\_2412$ret), max(data\_2412$ret),

mean(data\_2412$ret), sd(data\_2412$ret), my\_skewness(data\_2412$ret), my\_kurtosis(data\_2412$ret),

my\_acf1(data\_2412$ret))

result\_ret\_2412[2:8]<-result\_ret\_2412[2:8]\*c(rep(252,4), sqrt(252), 1/sqrt(252), 1/252)

names(result\_ret\_2412)<-c("number of observations", "min", "median", "max", "mean", "std", "skewness"

, "kurtosis", "acf1")

result\_ret\_2412<-round(result\_ret\_2412, 3)

result\_ret\_2412

##2430

##Time series plot of returns

windows(height=4, width=10)

plot(x=data\_2430$Date, y=data\_2430$ret, main="2430 returns (as percentage)", xlab="Date", ylab="Return(%)", type="l"

, col=2)

##Time series plot of prices

windows(height=8, width=10)

plot(x=data\_2430$Date, y=data\_2430$Adj.Close, main="2430 prices", xlab="Date"

, ylab="Adjusted close prices", type="l", lwd=2)

##Descriptive statistics of returns

result\_ret\_2430<-c(length(data\_2430$ret), min(data\_2430$ret), median(data\_2430$ret), max(data\_2430$ret),

mean(data\_2430$ret), sd(data\_2430$ret), my\_skewness(data\_2430$ret), my\_kurtosis(data\_2430$ret),

my\_acf1(data\_2430$ret))

result\_ret\_2430[2:8]<-result\_ret\_2430[2:8]\*c(rep(252,4), sqrt(252), 1/sqrt(252), 1/252)

names(result\_ret\_2430)<-c("number of observations", "min", "median", "max", "mean", "std", "skewness"

, "kurtosis", "acf1")

result\_ret\_2430<-round(result\_ret\_2430, 3)

result\_ret\_2430

##2480

##Time series plot of returns

windows(height=4, width=10)

plot(x=data\_2480$Date, y=data\_2480$ret, main="2480 returns (as percentage)", xlab="Date", ylab="Return(%)", type="l"

, col=3)

##Time series plot of prices

windows(height=8, width=10)

plot(x=data\_2480$Date, y=data\_2480$Adj.Close, main="2480 prices", xlab="Date"

, ylab="Adjusted close prices", type="l", lwd=2)

##Descriptive statistics of returns

result\_ret\_2480<-c(length(data\_2480$ret), min(data\_2480$ret), median(data\_2480$ret), max(data\_2480$ret),

mean(data\_2480$ret), sd(data\_2480$ret), my\_skewness(data\_2480$ret), my\_kurtosis(data\_2480$ret),

my\_acf1(data\_2480$ret))

result\_ret\_2480[2:8]<-result\_ret\_2480[2:8]\*c(rep(252,4), sqrt(252), 1/sqrt(252), 1/252)

names(result\_ret\_2480)<-c("number of observations", "min", "median", "max", "mean", "std", "skewness"

, "kurtosis", "acf1")

result\_ret\_2480<-round(result\_ret\_2480, 3)

result\_ret\_2480

##2505

##Time series plot of returns

windows(height=4, width=10)

plot(x=data\_2505$Date, y=data\_2505$ret, main="2505 returns (as percentage)", xlab="Date", ylab="Return(%)", type="l"

, col=4)

##Time series plot of prices

windows(height=8, width=10)

plot(x=data\_2505$Date, y=data\_2505$Adj.Close, main="2505 prices", xlab="Date"

, ylab="Adjusted close prices", type="l", lwd=2)

##Descriptive statistics of returns

result\_ret\_2505<-c(length(data\_2505$ret), min(data\_2505$ret), median(data\_2505$ret), max(data\_2505$ret),

mean(data\_2505$ret), sd(data\_2505$ret), my\_skewness(data\_2505$ret), my\_kurtosis(data\_2505$ret),

my\_acf1(data\_2505$ret))

result\_ret\_2505[2:8]<-result\_ret\_2505[2:8]\*c(rep(252,4), sqrt(252), 1/sqrt(252), 1/252)

names(result\_ret\_2505)<-c("number of observations", "min", "median", "max", "mean", "std", "skewness"

, "kurtosis", "acf1")

result\_ret\_2505<-round(result\_ret\_2505, 3)

result\_ret\_2505

##2603

##Time series plot of returns

windows(height=4, width=10)

plot(x=data\_2603$Date, y=data\_2603$ret, main="2603 returns (as percentage)", xlab="Date", ylab="Return(%)", type="l"

, col=5)

##Time series plot of prices

windows(height=8, width=10)

plot(x=data\_2603$Date, y=data\_2603$Adj.Close, main="2603 prices", xlab="Date"

, ylab="Adjusted close prices", type="l", lwd=2)

##Descriptive statistics of returns

result\_ret\_2603<-c(length(data\_2603$ret), min(data\_2603$ret), median(data\_2603$ret), max(data\_2603$ret),

mean(data\_2603$ret), sd(data\_2603$ret), my\_skewness(data\_2603$ret), my\_kurtosis(data\_2603$ret),

my\_acf1(data\_2603$ret))

result\_ret\_2603[2:8]<-result\_ret\_2603[2:8]\*c(rep(252,4), sqrt(252), 1/sqrt(252), 1/252)

names(result\_ret\_2603)<-c("number of observations", "min", "median", "max", "mean", "std", "skewness"

, "kurtosis", "acf1")

result\_ret\_2603<-round(result\_ret\_2603, 3)

result\_ret\_2603

##2614

##Time series plot of returns

windows(height=4, width=10)

plot(x=data\_2614$Date, y=data\_2614$ret, main="2614 returns (as percentage)", xlab="Date", ylab="Return(%)", type="l"

, col=6)

##Time series plot of prices

windows(height=8, width=10)

plot(x=data\_2614$Date, y=data\_2614$Adj.Close, main="2614 prices", xlab="Date"

, ylab="Adjusted close prices", type="l", lwd=2)

##Descriptive statistics of returns

result\_ret\_2614<-c(length(data\_2614$ret), min(data\_2614$ret), median(data\_2614$ret), max(data\_2614$ret),

mean(data\_2614$ret), sd(data\_2614$ret), my\_skewness(data\_2614$ret), my\_kurtosis(data\_2614$ret),

my\_acf1(data\_2614$ret))

result\_ret\_2614[2:8]<-result\_ret\_2614[2:8]\*c(rep(252,4), sqrt(252), 1/sqrt(252), 1/252)

names(result\_ret\_2614)<-c("number of observations", "min", "median", "max", "mean", "std", "skewness"

, "kurtosis", "acf1")

result\_ret\_2614<-round(result\_ret\_2614, 3)

result\_ret\_2614

##2731

##Time series plot of returns

windows(height=4, width=10)

plot(x=data\_2731$Date, y=data\_2731$ret, main="2731 returns (as percentage)", xlab="Date", ylab="Return(%)", type="l"

, col=7)

##Time series plot of prices

windows(height=8, width=10)

plot(x=data\_2731$Date, y=data\_2731$Adj.Close, main="2731 prices", xlab="Date"

, ylab="Adjusted close prices", type="l", lwd=2)

##Descriptive statistics of returns

result\_ret\_2731<-c(length(data\_2731$ret), min(data\_2731$ret), median(data\_2731$ret), max(data\_2731$ret),

mean(data\_2731$ret), sd(data\_2731$ret), my\_skewness(data\_2731$ret), my\_kurtosis(data\_2731$ret),

my\_acf1(data\_2731$ret))

result\_ret\_2731[2:8]<-result\_ret\_2731[2:8]\*c(rep(252,4), sqrt(252), 1/sqrt(252), 1/252)

names(result\_ret\_2731)<-c("number of observations", "min", "median", "max", "mean", "std", "skewness"

, "kurtosis", "acf1")

result\_ret\_2731<-round(result\_ret\_2731, 3)

result\_ret\_2731

##2884

##Time series plot of returns

windows(height=4, width=10)

plot(x=data\_2884$Date, y=data\_2884$ret, main="2884 returns (as percentage)", xlab="Date", ylab="Return(%)", type="l"

, col=8)

##Time series plot of prices

windows(height=8, width=10)

plot(x=data\_2884$Date, y=data\_2884$Adj.Close, main="2884 prices", xlab="Date"

, ylab="Adjusted close prices", type="l", lwd=2)

##Descriptive statistics of returns

result\_ret\_2884<-c(length(data\_2884$ret), min(data\_2884$ret), median(data\_2884$ret), max(data\_2884$ret),

mean(data\_2884$ret), sd(data\_2884$ret), my\_skewness(data\_2884$ret), my\_kurtosis(data\_2884$ret),

my\_acf1(data\_2884$ret))

result\_ret\_2884[2:8]<-result\_ret\_2884[2:8]\*c(rep(252,4), sqrt(252), 1/sqrt(252), 1/252)

names(result\_ret\_2884)<-c("number of observations", "min", "median", "max", "mean", "std", "skewness"

, "kurtosis", "acf1")

result\_ret\_2884<-round(result\_ret\_2884, 3)

result\_ret\_2884

##3481

##Time series plot of returns

windows(height=4, width=10)

plot(x=data\_3481$Date, y=data\_3481$ret, main="3481 returns (as percentage)", xlab="Date", ylab="Return(%)", type="l"

, col=1)

##Time series plot of prices

windows(height=8, width=10)

plot(x=data\_3481$Date, y=data\_3481$Adj.Close, main="3481 prices", xlab="Date"

, ylab="Adjusted close prices", type="l", lwd=2)

##Descriptive statistics of returns

result\_ret\_3481<-c(length(data\_3481$ret), min(data\_3481$ret), median(data\_3481$ret), max(data\_3481$ret),

mean(data\_3481$ret), sd(data\_3481$ret), my\_skewness(data\_3481$ret), my\_kurtosis(data\_3481$ret),

my\_acf1(data\_3481$ret))

result\_ret\_3481[2:8]<-result\_ret\_3481[2:8]\*c(rep(252,4), sqrt(252), 1/sqrt(252), 1/252)

names(result\_ret\_3481)<-c("number of observations", "min", "median", "max", "mean", "std", "skewness"

, "kurtosis", "acf1")

result\_ret\_3481<-round(result\_ret\_3481, 3)

result\_ret\_3481

##6505

##Time series plot of returns

windows(height=4, width=10)

plot(x=data\_6505$Date, y=data\_6505$ret, main="6505 returns (as percentage)", xlab="Date", ylab="Return(%)", type="l"

, col=2)

##Time series plot of prices

windows(height=8, width=10)

plot(x=data\_6505$Date, y=data\_6505$Adj.Close, main="1101 prices", xlab="Date"

, ylab="Adjusted close prices", type="l", lwd=2)

##Descriptive statistics of returns

result\_ret\_6505<-c(length(data\_6505$ret), min(data\_6505$ret), median(data\_6505$ret), max(data\_6505$ret),

mean(data\_6505$ret), sd(data\_6505$ret), my\_skewness(data\_6505$ret), my\_kurtosis(data\_6505$ret),

my\_acf1(data\_6505$ret))

result\_ret\_6505[2:8]<-result\_ret\_6505[2:8]\*c(rep(252,4), sqrt(252), 1/sqrt(252), 1/252)

names(result\_ret\_6505)<-c("number of observations", "min", "median", "max", "mean", "std", "skewness"

, "kurtosis", "acf1")

result\_ret\_6505<-round(result\_ret\_6505, 3)

result\_ret\_6505

##8039

##Time series plot of returns

windows(height=4, width=10)

plot(x=data\_8039$Date, y=data\_8039$ret, main="8039 returns (as percentage)", xlab="Date", ylab="Return(%)", type="l"

, col=3)

##Time series plot of prices

windows(height=8, width=10)

plot(x=data\_8039$Date, y=data\_8039$Adj.Close, main="8039 prices", xlab="Date"

, ylab="Adjusted close prices", type="l", lwd=2)

##Descriptive statistics of returns

result\_ret\_8039<-c(length(data\_8039$ret), min(data\_8039$ret), median(data\_8039$ret), max(data\_8039$ret),

mean(data\_8039$ret), sd(data\_8039$ret), my\_skewness(data\_8039$ret), my\_kurtosis(data\_8039$ret),

my\_acf1(data\_8039$ret))

result\_ret\_8039[2:8]<-result\_ret\_8039[2:8]\*c(rep(252,4), sqrt(252), 1/sqrt(252), 1/252)

names(result\_ret\_8039)<-c("number of observations", "min", "median", "max", "mean", "std", "skewness"

, "kurtosis", "acf1")

result\_ret\_8039<-round(result\_ret\_8039, 3)

result\_ret\_8039

------------------------------------------------------

##cumulative gross return compare

data\_1101$cum.ret<-cumprod(1+(data\_1101$ret/100))

data\_1216$cum.ret<-cumprod(1+(data\_1216$ret/100))

data\_1303$cum.ret<-cumprod(1+(data\_1303$ret/100))

data\_1434$cum.ret<-cumprod(1+(data\_1434$ret/100))

data\_1504$cum.ret<-cumprod(1+(data\_1504$ret/100))

data\_1612$cum.ret<-cumprod(1+(data\_1612$ret/100))

data\_1732$cum.ret<-cumprod(1+(data\_1732$ret/100))

data\_1734$cum.ret<-cumprod(1+(data\_1734$ret/100))

data\_1810$cum.ret<-cumprod(1+(data\_1810$ret/100))

data\_1909$cum.ret<-cumprod(1+(data\_1909$ret/100))

data\_2002$cum.ret<-cumprod(1+(data\_2002$ret/100))

data\_2105$cum.ret<-cumprod(1+(data\_2105$ret/100))

data\_2201$cum.ret<-cumprod(1+(data\_2201$ret/100))

data\_2317$cum.ret<-cumprod(1+(data\_2317$ret/100))

data\_2330$cum.ret<-cumprod(1+(data\_2330$ret/100))

data\_2357$cum.ret<-cumprod(1+(data\_2357$ret/100))

data\_2412$cum.ret<-cumprod(1+(data\_2412$ret/100))

data\_2430$cum.ret<-cumprod(1+(data\_2430$ret/100))

data\_2480$cum.ret<-cumprod(1+(data\_2480$ret/100))

data\_2505$cum.ret<-cumprod(1+(data\_2505$ret/100))

data\_2603$cum.ret<-cumprod(1+(data\_2603$ret/100))

data\_2614$cum.ret<-cumprod(1+(data\_2614$ret/100))

data\_2731$cum.ret<-cumprod(1+(data\_2731$ret/100))

data\_2884$cum.ret<-cumprod(1+(data\_2884$ret/100))

data\_3481$cum.ret<-cumprod(1+(data\_3481$ret/100))

data\_6505$cum.ret<-cumprod(1+(data\_6505$ret/100))

data\_8039$cum.ret<-cumprod(1+(data\_8039$ret/100))

y.range<-c(min(data\_1101$cum.ret, data\_1216$cum.ret, data\_1303$cum.ret, data\_1434$cum.ret, data\_1504$cum.ret

, data\_1612$cum.ret, data\_1732$cum.ret, data\_1734$cum.ret, data\_1810$cum.ret, data\_1909$cum.ret

, data\_2002$cum.ret, data\_2105$cum.ret, data\_2201$cum.ret, data\_2317$cum.ret, data\_2330$cum.ret

, data\_2357$cum.ret, data\_2412$cum.ret, data\_2430$cum.ret, data\_2480$cum.ret, data\_2505$cum.ret

, data\_2603$cum.ret, data\_2614$cum.ret, data\_2731$cum.ret, data\_2884$cum.ret, data\_3481$cum.ret

, data\_6505$cum.ret, data\_8039$cum.ret)

, max(data\_1101$cum.ret, data\_1216$cum.ret, data\_1303$cum.ret, data\_1434$cum.ret, data\_1504$cum.ret

, data\_1612$cum.ret, data\_1732$cum.ret, data\_1734$cum.ret, data\_1810$cum.ret, data\_1909$cum.ret

, data\_2002$cum.ret, data\_2105$cum.ret, data\_2201$cum.ret, data\_2317$cum.ret, data\_2330$cum.ret

, data\_2357$cum.ret, data\_2412$cum.ret, data\_2430$cum.ret, data\_2480$cum.ret, data\_2505$cum.ret

, data\_2603$cum.ret, data\_2614$cum.ret, data\_2731$cum.ret, data\_2884$cum.ret, data\_3481$cum.ret

, data\_6505$cum.ret, data\_8039$cum.ret))

windows(height=10, width=20)

plot(x=data\_1101$Date, y=data\_1101$cum.ret, ylim=y.range, main="Cumulative returns", xlab="Date"

, ylab="cumulative return", type="l", lwd=2, lty=1, col=1)

lines(x=data\_1216$Date, y=data\_1216$cum.ret, lwd=2, lty=1, col=2)

lines(x=data\_1303$Date, y=data\_1303$cum.ret, lwd=2, lty=1, col=3)

lines(x=data\_1434$Date, y=data\_1434$cum.ret, lwd=2, lty=1, col=4)

lines(x=data\_1504$Date, y=data\_1504$cum.ret, lwd=2, lty=1, col=5)

lines(x=data\_1612$Date, y=data\_1612$cum.ret, lwd=2, lty=1, col=6)

lines(x=data\_1732$Date, y=data\_1732$cum.ret, lwd=2, lty=1, col=7)

lines(x=data\_1734$Date, y=data\_1734$cum.ret, lwd=2, lty=1, col=8)

lines(x=data\_1810$Date, y=data\_1810$cum.ret, lwd=2, lty=2, col=1)

lines(x=data\_1909$Date, y=data\_1909$cum.ret, lwd=2, lty=2, col=2)

lines(x=data\_2002$Date, y=data\_2002$cum.ret, lwd=2, lty=2, col=3)

lines(x=data\_2105$Date, y=data\_2105$cum.ret, lwd=2, lty=2, col=4)

lines(x=data\_2201$Date, y=data\_2201$cum.ret, lwd=2, lty=2, col=5)

lines(x=data\_2317$Date, y=data\_2317$cum.ret, lwd=2, lty=2, col=6)

lines(x=data\_2330$Date, y=data\_2330$cum.ret, lwd=2, lty=2, col=7)

lines(x=data\_2357$Date, y=data\_2357$cum.ret, lwd=2, lty=2, col=8)

lines(x=data\_2412$Date, y=data\_2412$cum.ret, lwd=2, lty=3, col=1)

lines(x=data\_2430$Date, y=data\_2430$cum.ret, lwd=2, lty=3, col=2)

lines(x=data\_2480$Date, y=data\_2480$cum.ret, lwd=2, lty=3, col=3)

lines(x=data\_2505$Date, y=data\_2505$cum.ret, lwd=2, lty=3, col=4)

lines(x=data\_2603$Date, y=data\_2603$cum.ret, lwd=2, lty=3, col=5)

lines(x=data\_2614$Date, y=data\_2614$cum.ret, lwd=2, lty=3, col=6)

lines(x=data\_2731$Date, y=data\_2731$cum.ret, lwd=2, lty=3, col=7)

lines(x=data\_2884$Date, y=data\_2884$cum.ret, lwd=2, lty=3, col=8)

lines(x=data\_3481$Date, y=data\_3481$cum.ret, lwd=2, lty=4, col=1)

lines(x=data\_6505$Date, y=data\_6505$cum.ret, lwd=2, lty=4, col=2)

lines(x=data\_8039$Date, y=data\_8039$cum.ret, lwd=2, lty=4, col=3)

legend("topleft", legend=c('1101', '1216', '1303', '1434', '1504', '1612', '1732', '1734', '1810', '1909', '2002'

, '2105', '2201', '2317', '2330', '2357', '2412', '2430', '2480', '2505', '2603', '2614'

, '2731', '2884', '3481', '6505', '8039')

, lwd=c(rep(2, 27)), lty=c(rep(1, 8), rep(2, 8), rep(3, 8), rep(4, 3))

, col=c(rep(1:8, 3), 1, 2, 3), ncol=3)

-------------------------------------------------------------

##collect return data

ret\_data<-data.frame(matrix(0,nrow(data\_1101),28))

ret\_data[,1]<-data\_1101$Date

ret\_data[,2:ncol(ret\_data)]<-cbind(data\_1101$ret, data\_1216$ret, data\_1303$ret, data\_1434$ret, data\_1504$ret

, data\_1612$ret, data\_1732$ret, data\_1734$ret, data\_1810$ret, data\_1909$ret

, data\_2002$ret, data\_2105$ret, data\_2201$ret, data\_2317$ret, data\_2330$ret

, data\_2357$ret, data\_2412$ret, data\_2430$ret, data\_2480$ret, data\_2505$ret

, data\_2603$ret, data\_2614$ret, data\_2731$ret, data\_2884$ret, data\_3481$ret

, data\_6505$ret, data\_8039$ret)

colnames(ret\_data)<-c('Date', '1101', '1216', '1303', '1434', '1504', '1612', '1732', '1734', '1810', '1909'

, '2002', '2105', '2201', '2317', '2330', '2357', '2412', '2430', '2480', '2505', '2603'

, '2614', '2731', '2884', '3481', '6505', '8039')

##using rolling window

##window length

kx<-252\*3

##out of sample length

hx<-nrow(ret\_data)-kx

##risk free rate (annualized interest is 0.38%)

rf<-0.0038/252

---------------------------------------------------------------------

##fixed weight portfolio

##each weight 1/27

wx<-c(rep(1/27, 27))

##out of sample returns

fw\_oos\_r<-numeric(hx)

##turn over rate

fw\_tor<-numeric(hx)

##HHI

fw\_hhi<-numeric(hx)

##SLR

fw\_slr<-numeric(hx)

##portfolio weight in period t-1

wx\_mat<-matrix(0, hx+1, ncol(ret\_data)-1)

for(i in 1:hx){

##data in the rolling window

datax<-ret\_data[i:(i+kx-1), 2:ncol(ret\_data)]

##return of period i+kx

rx<-ret\_data[i+kx, 2:ncol(ret\_data)]

##return of period i+kx-1

rx\_lag<-datax[nrow(datax), ]

##out of sample portfolio returns

fw\_oos\_r[i]<-sum(wx\*rx)

##turnover rate

##individual

tor\_ind<-abs(wx-wx\_mat[i, ]\*(1+(rx\_lag/100))/(1+sum(wx\_mat[i, ]\*(rx\_lag/100))))

##portfolio

fw\_tor[i]<-sum(tor\_ind)

##HHI

fw\_hhi[i]<-sum(wx^2)/(sum(abs(wx))^2)

##SLR

fw\_slr[i]<-sum(abs(wx[wx<0]))/sum(abs(wx[wx>0]))

##store portfolio weight at this period

wx\_mat[i+1, ]<-wx

print(i)

}

##plot out of sample portfolio return

windows(height=4, width=10)

plot(x=ret\_data[(kx+1):nrow(ret\_data), ]$Date, y=fw\_oos\_r, main='Fixed weight (1/N) out of sample portfolio return'

, xlab='Date', ylab='Return (%)', type='l', col=1)

##plot out of sample portfolio cumulative gross return

fw\_oos\_cumr<-cumprod(1+(fw\_oos\_r/100))

windows(height=8, width=10)

plot(x=ret\_data[(kx+1):nrow(ret\_data), ]$Date, y=fw\_oos\_cumr

, main='Fixed weight (1/N) out of sample porfolio cumulative gross return', xlab='Date'

, ylab='Cumulative gross return', type='l', lwd=2)

##Descriptive statistics of out of sample portfolio return

result\_oos\_ret\_fw<-c(length(fw\_oos\_r), min(fw\_oos\_r), median(fw\_oos\_r), max(fw\_oos\_r), mean(fw\_oos\_r), sd(fw\_oos\_r)

, my\_skewness(fw\_oos\_r), my\_kurtosis(fw\_oos\_r), my\_acf1(fw\_oos\_r))

result\_oos\_ret\_fw[2:8]<-result\_oos\_ret\_fw[2:8]\*c(rep(252,4), sqrt(252), 1/sqrt(252), 1/252)

names(result\_oos\_ret\_fw)<-c("number of observations", "min", "median", "max", "mean", "std", "skewness"

, "kurtosis", "acf1")

result\_oos\_ret\_fw<-round(result\_oos\_ret\_fw, 3)

result\_oos\_ret\_fw

##Annualized Sharpe ratio

(mean(fw\_oos\_r)-rf\*100)/sd(fw\_oos\_r)\*sqrt(252)

##turnover rate

result\_tor\_fw<-c(min(fw\_tor), median(fw\_tor), max(fw\_tor), mean(fw\_tor), sd(fw\_tor))

names(result\_tor\_fw)<-c('min', 'median', 'max', 'mean', 'std')

result\_tor\_fw<-round(result\_tor\_fw, 3)

result\_tor\_fw

##HHI

result\_hhi\_fw<-c(min(fw\_hhi), median(fw\_hhi), max(fw\_hhi), mean(fw\_hhi), sd(fw\_hhi))

names(result\_hhi\_fw)<-c('min', 'median', 'max', 'mean', 'std')

result\_hhi\_fw<-round(result\_hhi\_fw, 3)

result\_hhi\_fw

##SLR

result\_slr\_fw<-c(min(fw\_slr), median(fw\_slr), max(fw\_slr), mean(fw\_slr), sd(fw\_slr))

names(result\_slr\_fw)<-c('min', 'median', 'max', 'mean', 'std')

result\_slr\_fw<-round(result\_slr\_fw, 3)

result\_slr\_fw

##Suppose initial investment $1000000

##VaR

##99%

VaR\_samplex(fw\_oos\_r/100, 1000000, 0.01)

##95%

VaR\_samplex(fw\_oos\_r/100, 1000000, 0.05)

##ES

##99%

ES\_samplex(fw\_oos\_r/100, 1000000, 0.01)

##95%

ES\_samplex(fw\_oos\_r/100, 1000000, 0.05)

##LPSD

LPSDx(fw\_oos\_r/100, rf)

---------------------------------------------------------

##mvp

##out of sample returns

mvp\_oos\_r<-numeric(hx)

##turn over rate

mvp\_tor<-numeric(hx)

##HHI

mvp\_hhi<-numeric(hx)

##SLR

mvp\_slr<-numeric(hx)

##portfolio weight in period t-1

wx\_mat<-matrix(0, hx+1, ncol(ret\_data)-1)

##target daily return 1%

mu\_targ<-1/100

for(i in 1:hx){

##data in the rolling window

datax<-ret\_data[i:(i+kx-1), 2:ncol(ret\_data)]

##weight in this period

wx<-as.vector(mvp\_wx(datax, mu\_targ))

##return of period i+kx

rx<-ret\_data[i+kx, 2:ncol(ret\_data)]

##return of period i+kx-1

rx\_lag<-datax[nrow(datax), ]

##out of sample portfolio returns

mvp\_oos\_r[i]<-sum(wx\*rx)

##turnover rate

##individual

tor\_ind<-abs(wx-wx\_mat[i, ]\*(1+(rx\_lag/100))/(1+sum(wx\_mat[i, ]\*(rx\_lag/100))))

##portfolio

mvp\_tor[i]<-sum(tor\_ind)

##HHI

mvp\_hhi[i]<-sum(wx^2)/(sum(abs(wx))^2)

##SLR

mvp\_slr[i]<-sum(abs(wx[wx<0]))/sum(abs(wx[wx>0]))

##store portfolio weight at this period

wx\_mat[i+1, ]<-wx

print(i)

}

##plot out of sample portfolio return

windows(height=4, width=10)

plot(x=ret\_data[(kx+1):nrow(ret\_data), ]$Date, y=mvp\_oos\_r, main='MVP out of sample portfolio return'

, xlab='Date', ylab='Return (%)', type='l', col=2)

##plot out of sample portfolio cumulative gross return

mvp\_oos\_cumr<-cumprod(1+(mvp\_oos\_r/100))

windows(height=8, width=10)

plot(x=ret\_data[(kx+1):nrow(ret\_data), ]$Date, y=mvp\_oos\_cumr

, main='MVP out of sample porfolio cumulative gross return', xlab='Date'

, ylab='Cumulative gross return', type='l', lwd=2)

##Descriptive statistics of out of sample portfolio return

result\_oos\_ret\_mvp<-c(length(mvp\_oos\_r), min(mvp\_oos\_r), median(mvp\_oos\_r), max(mvp\_oos\_r), mean(mvp\_oos\_r)

, sd(mvp\_oos\_r), my\_skewness(mvp\_oos\_r), my\_kurtosis(mvp\_oos\_r), my\_acf1(mvp\_oos\_r))

result\_oos\_ret\_mvp[2:8]<-result\_oos\_ret\_mvp[2:8]\*c(rep(252,4), sqrt(252), 1/sqrt(252), 1/252)

names(result\_oos\_ret\_mvp)<-c("number of observations", "min", "median", "max", "mean", "std", "skewness"

, "kurtosis", "acf1")

result\_oos\_ret\_mvp<-round(result\_oos\_ret\_mvp, 3)

result\_oos\_ret\_mvp

##Annualized Sharpe ratio

(mean(mvp\_oos\_r)-rf\*100)/sd(mvp\_oos\_r)\*sqrt(252)

##turnover rate

result\_tor\_mvp<-c(min(mvp\_tor), median(mvp\_tor), max(mvp\_tor), mean(mvp\_tor), sd(mvp\_tor))

names(result\_tor\_mvp)<-c('min', 'median', 'max', 'mean', 'std')

result\_tor\_mvp<-round(result\_tor\_mvp, 3)

result\_tor\_mvp

##HHI

result\_hhi\_mvp<-c(min(mvp\_hhi), median(mvp\_hhi), max(mvp\_hhi), mean(mvp\_hhi), sd(mvp\_hhi))

names(result\_hhi\_mvp)<-c('min', 'median', 'max', 'mean', 'std')

result\_hhi\_mvp<-round(result\_hhi\_mvp, 3)

result\_hhi\_mvp

##SLR

result\_slr\_mvp<-c(min(mvp\_slr), median(mvp\_slr), max(mvp\_slr), mean(mvp\_slr), sd(mvp\_slr))

names(result\_slr\_mvp)<-c('min', 'median', 'max', 'mean', 'std')

result\_slr\_mvp<-round(result\_slr\_mvp, 3)

result\_slr\_mvp

##Suppose initial investment $1000000

##VaR

##99%

VaR\_samplex(mvp\_oos\_r/100, 1000000, 0.01)

##95%

VaR\_samplex(mvp\_oos\_r/100, 1000000, 0.05)

##ES

##99%

ES\_samplex(mvp\_oos\_r/100, 1000000, 0.01)

##95%

ES\_samplex(mvp\_oos\_r/100, 1000000, 0.05)

##LPSD

LPSDx(mvp\_oos\_r/100, rf)

------------------------------------------------------

##gmvp

##out of sample returns

gmvp\_oos\_r<-numeric(hx)

##turn over rate

gmvp\_tor<-numeric(hx)

##HHI

gmvp\_hhi<-numeric(hx)

##SLR

gmvp\_slr<-numeric(hx)

##portfolio weight in period t-1

wx\_mat<-matrix(0, hx+1, ncol(ret\_data)-1)

for(i in 1:hx){

##data in the rolling window

datax<-ret\_data[i:(i+kx-1), 2:ncol(ret\_data)]

##weight in this period

wx<-as.vector(gmvp\_wx(datax))

##return of period i+kx

rx<-ret\_data[i+kx, 2:ncol(ret\_data)]

##return of period i+kx-1

rx\_lag<-datax[nrow(datax), ]

##out of sample portfolio returns

gmvp\_oos\_r[i]<-sum(wx\*rx)

##turnover rate

##individual

tor\_ind<-abs(wx-wx\_mat[i, ]\*(1+(rx\_lag/100))/(1+sum(wx\_mat[i, ]\*(rx\_lag/100))))

##portfolio

gmvp\_tor[i]<-sum(tor\_ind)

##HHI

gmvp\_hhi[i]<-sum(wx^2)/(sum(abs(wx))^2)

##SLR

gmvp\_slr[i]<-sum(abs(wx[wx<0]))/sum(abs(wx[wx>0]))

##store portfolio weight at this period

wx\_mat[i+1, ]<-wx

print(i)

}

##plot out of sample portfolio return

windows(height=4, width=10)

plot(x=ret\_data[(kx+1):nrow(ret\_data), ]$Date, y=gmvp\_oos\_r, main='GMVP out of sample portfolio return'

, xlab='Date', ylab='Return (%)', type='l', col=3)

##plot out of sample portfolio cumulative gross return

gmvp\_oos\_cumr<-cumprod(1+(gmvp\_oos\_r/100))

windows(height=8, width=10)

plot(x=ret\_data[(kx+1):nrow(ret\_data), ]$Date, y=gmvp\_oos\_cumr

, main='GMVP out of sample porfolio cumulative gross return', xlab='Date'

, ylab='Cumulative gross return', type='l', lwd=2)

##Descriptive statistics of out of sample portfolio return

result\_oos\_ret\_gmvp<-c(length(gmvp\_oos\_r), min(gmvp\_oos\_r), median(gmvp\_oos\_r), max(gmvp\_oos\_r), mean(gmvp\_oos\_r)

, sd(gmvp\_oos\_r), my\_skewness(gmvp\_oos\_r), my\_kurtosis(gmvp\_oos\_r), my\_acf1(gmvp\_oos\_r))

result\_oos\_ret\_gmvp[2:8]<-result\_oos\_ret\_gmvp[2:8]\*c(rep(252,4), sqrt(252), 1/sqrt(252), 1/252)

names(result\_oos\_ret\_gmvp)<-c("number of observations", "min", "median", "max", "mean", "std", "skewness"

, "kurtosis", "acf1")

result\_oos\_ret\_gmvp<-round(result\_oos\_ret\_gmvp, 3)

result\_oos\_ret\_gmvp

##Annualized Sharpe ratio

(mean(gmvp\_oos\_r)-rf\*100)/sd(gmvp\_oos\_r)\*sqrt(252)

##turnover rate

result\_tor\_gmvp<-c(min(gmvp\_tor), median(gmvp\_tor), max(gmvp\_tor), mean(gmvp\_tor), sd(gmvp\_tor))

names(result\_tor\_gmvp)<-c('min', 'median', 'max', 'mean', 'std')

result\_tor\_gmvp<-round(result\_tor\_gmvp, 3)

result\_tor\_gmvp

##HHI

result\_hhi\_gmvp<-c(min(gmvp\_hhi), median(gmvp\_hhi), max(gmvp\_hhi), mean(gmvp\_hhi), sd(gmvp\_hhi))

names(result\_hhi\_gmvp)<-c('min', 'median', 'max', 'mean', 'std')

result\_hhi\_gmvp<-round(result\_hhi\_gmvp, 3)

result\_hhi\_gmvp

##SLR

result\_slr\_gmvp<-c(min(gmvp\_slr), median(gmvp\_slr), max(gmvp\_slr), mean(gmvp\_slr), sd(gmvp\_slr))

names(result\_slr\_gmvp)<-c('min', 'median', 'max', 'mean', 'std')

result\_slr\_gmvp<-round(result\_slr\_gmvp, 3)

result\_slr\_gmvp

##Suppose initial investment $1000000

##VaR

##99%

VaR\_samplex(gmvp\_oos\_r/100, 1000000, 0.01)

##95%

VaR\_samplex(gmvp\_oos\_r/100, 1000000, 0.05)

##ES

##99%

ES\_samplex(gmvp\_oos\_r/100, 1000000, 0.01)

##95%

ES\_samplex(gmvp\_oos\_r/100, 1000000, 0.05)

##LPSD

LPSDx(gmvp\_oos\_r/100, rf)

----------------------------------------------------------------

##mvp with a risk-free asset

##out of sample returns

mvprf\_oos\_r<-numeric(hx)

##turn over rate

mvprf\_tor<-numeric(hx)

##HHI

mvprf\_hhi<-numeric(hx)

##SLR

mvprf\_slr<-numeric(hx)

##portfolio weight in period t-1

wx\_mat<-matrix(0, hx+1, ncol(ret\_data))

##target daily return 1%

mu\_targ<-1/100

for(i in 1:hx){

##data in the rolling window

datax<-ret\_data[i:(i+kx-1), 2:ncol(ret\_data)]

##weight in this period

wx<-as.vector(rf\_mvp\_wx(datax, mu\_targ, rf))

##return of period i+kx

rx<-cbind(rf\*100, ret\_data[i+kx, 2:ncol(ret\_data)])

##return of period i+kx-1

rx\_lag<-cbind(rf\*100, datax[nrow(datax), ])

##out of sample portfolio returns

mvprf\_oos\_r[i]<-sum(wx\*rx)

##turnover rate

##individual

tor\_ind<-abs(wx-wx\_mat[i, ]\*(1+(rx\_lag/100))/(1+sum(wx\_mat[i, ]\*(rx\_lag/100))))

##portfolio

mvprf\_tor[i]<-sum(tor\_ind)

##HHI

mvprf\_hhi[i]<-sum(wx^2)/(sum(abs(wx))^2)

##SLR

mvprf\_slr[i]<-sum(abs(wx[wx<0]))/sum(abs(wx[wx>0]))

##store portfolio weight at this period

wx\_mat[i+1, ]<-wx

print(i)

}

##plot out of sample portfolio return

windows(height=4, width=10)

plot(x=ret\_data[(kx+1):nrow(ret\_data), ]$Date, y=mvprf\_oos\_r

, main='MVP with a risk free asset out of sample portfolio return'

, xlab='Date', ylab='Return (%)', type='l', col=4)

##plot out of sample portfolio cumulative gross return

mvprf\_oos\_cumr<-cumprod(1+(mvprf\_oos\_r/100))

windows(height=8, width=10)

plot(x=ret\_data[(kx+1):nrow(ret\_data), ]$Date, y=mvprf\_oos\_cumr

, main='MVP with a risk free asset out of sample porfolio cumulative gross return', xlab='Date'

, ylab='Cumulative gross return', type='l', lwd=2)

##Descriptive statistics of out of sample portfolio return

result\_oos\_ret\_mvprf<-c(length(mvprf\_oos\_r), min(mvprf\_oos\_r), median(mvprf\_oos\_r), max(mvprf\_oos\_r)

, mean(mvprf\_oos\_r), sd(mvprf\_oos\_r), my\_skewness(mvprf\_oos\_r), my\_kurtosis(mvprf\_oos\_r)

, my\_acf1(mvprf\_oos\_r))

result\_oos\_ret\_mvprf[2:8]<-result\_oos\_ret\_mvprf[2:8]\*c(rep(252,4), sqrt(252), 1/sqrt(252), 1/252)

names(result\_oos\_ret\_mvprf)<-c("number of observations", "min", "median", "max", "mean", "std", "skewness"

, "kurtosis", "acf1")

result\_oos\_ret\_mvprf<-round(result\_oos\_ret\_mvprf, 3)

result\_oos\_ret\_mvprf

##Annualized Sharpe ratio

(mean(mvprf\_oos\_r)-rf\*100)/sd(mvprf\_oos\_r)\*sqrt(252)

##turnover rate

result\_tor\_mvprf<-c(min(mvprf\_tor), median(mvprf\_tor), max(mvprf\_tor), mean(mvprf\_tor), sd(mvprf\_tor))

names(result\_tor\_mvprf)<-c('min', 'median', 'max', 'mean', 'std')

result\_tor\_mvprf<-round(result\_tor\_mvprf, 3)

result\_tor\_mvprf

##HHI

result\_hhi\_mvprf<-c(min(mvprf\_hhi), median(mvprf\_hhi), max(mvprf\_hhi), mean(mvprf\_hhi), sd(mvprf\_hhi))

names(result\_hhi\_mvprf)<-c('min', 'median', 'max', 'mean', 'std')

result\_hhi\_mvprf<-round(result\_hhi\_mvprf, 3)

result\_hhi\_mvprf

##SLR

result\_slr\_mvprf<-c(min(mvprf\_slr), median(mvprf\_slr), max(mvprf\_slr), mean(mvprf\_slr), sd(mvprf\_slr))

names(result\_slr\_mvprf)<-c('min', 'median', 'max', 'mean', 'std')

result\_slr\_mvprf<-round(result\_slr\_mvprf, 3)

result\_slr\_mvprf

##Suppose initial investment $1000000

##VaR

##99%

VaR\_samplex(mvprf\_oos\_r/100, 1000000, 0.01)

##95%

VaR\_samplex(mvprf\_oos\_r/100, 1000000, 0.05)

##ES

##99%

ES\_samplex(mvprf\_oos\_r/100, 1000000, 0.01)

##95%

ES\_samplex(mvprf\_oos\_r/100, 1000000, 0.05)

##LPSD

LPSDx(mvprf\_oos\_r/100, rf)

--------------------------------------------------------

##tangency portfolio

##out of sample returns

tan\_oos\_r<-numeric(hx)

##turn over rate

tan\_tor<-numeric(hx)

##HHI

tan\_hhi<-numeric(hx)

##SLR

tan\_slr<-numeric(hx)

##portfolio weight in period t-1

wx\_mat<-matrix(0, hx+1, ncol(ret\_data)-1)

for(i in 1:hx){

##data in the rolling window

datax<-ret\_data[i:(i+kx-1), 2:ncol(ret\_data)]

##weight in this period

wx<-as.vector(tan\_wx(datax, rf))

##return of period i+kx

rx<-ret\_data[i+kx, 2:ncol(ret\_data)]

##return of period i+kx-1

rx\_lag<-datax[nrow(datax), ]

##out of sample portfolio returns

tan\_oos\_r[i]<-sum(wx\*rx)

##turnover rate

##individual

tor\_ind<-abs(wx-wx\_mat[i, ]\*(1+(rx\_lag/100))/(1+sum(wx\_mat[i, ]\*(rx\_lag/100))))

##portfolio

tan\_tor[i]<-sum(tor\_ind)

##HHI

tan\_hhi[i]<-sum(wx^2)/(sum(abs(wx))^2)

##SLR

tan\_slr[i]<-sum(abs(wx[wx<0]))/sum(abs(wx[wx>0]))

##store portfolio weight at this period

wx\_mat[i+1, ]<-wx

print(i)

}

##plot out of sample portfolio return

windows(height=4, width=10)

plot(x=ret\_data[(kx+1):nrow(ret\_data), ]$Date, y=tan\_oos\_r

, main='Tangancy portfolio out of sample portfolio return', xlab='Date', ylab='Return (%)', type='l', col=5)

##plot out of sample portfolio cumulative gross return

tan\_oos\_cumr<-cumprod(1+(tan\_oos\_r/100))

windows(height=8, width=10)

plot(x=ret\_data[(kx+1):nrow(ret\_data), ]$Date, y=tan\_oos\_cumr

, main='Tangency portfolio out of sample porfolio cumulative gross return', xlab='Date'

, ylab='Cumulative gross return', type='l', lwd=2)

##Descriptive statistics of out of sample portfolio return

result\_oos\_ret\_tan<-c(length(tan\_oos\_r), min(tan\_oos\_r), median(tan\_oos\_r), max(tan\_oos\_r), mean(tan\_oos\_r)

, sd(tan\_oos\_r), my\_skewness(tan\_oos\_r), my\_kurtosis(tan\_oos\_r), my\_acf1(tan\_oos\_r))

result\_oos\_ret\_tan[2:8]<-result\_oos\_ret\_tan[2:8]\*c(rep(252,4), sqrt(252), 1/sqrt(252), 1/252)

names(result\_oos\_ret\_tan)<-c("number of observations", "min", "median", "max", "mean", "std", "skewness"

, "kurtosis", "acf1")

result\_oos\_ret\_tan<-round(result\_oos\_ret\_tan, 3)

result\_oos\_ret\_tan

##Annualized Sharpe ratio

(mean(tan\_oos\_r)-rf\*100)/sd(tan\_oos\_r)\*sqrt(252)

##turnover rate

result\_tor\_tan<-c(min(tan\_tor), median(tan\_tor), max(tan\_tor), mean(tan\_tor), sd(tan\_tor))

names(result\_tor\_tan)<-c('min', 'median', 'max', 'mean', 'std')

result\_tor\_tan<-round(result\_tor\_tan, 3)

result\_tor\_tan

##HHI

result\_hhi\_tan<-c(min(tan\_hhi), median(tan\_hhi), max(tan\_hhi), mean(tan\_hhi), sd(tan\_hhi))

names(result\_hhi\_tan)<-c('min', 'median', 'max', 'mean', 'std')

result\_hhi\_tan<-round(result\_hhi\_tan, 3)

result\_hhi\_tan

##SLR

result\_slr\_tan<-c(min(tan\_slr), median(tan\_slr), max(tan\_slr), mean(tan\_slr), sd(tan\_slr))

names(result\_slr\_tan)<-c('min', 'median', 'max', 'mean', 'std')

result\_slr\_tan<-round(result\_slr\_tan, 3)

result\_slr\_tan

##Suppose initial investment $1000000

##VaR

##99%

VaR\_samplex(tan\_oos\_r/100, 1000000, 0.01)

##95%

VaR\_samplex(tan\_oos\_r/100, 1000000, 0.05)

##ES

##99%

ES\_samplex(tan\_oos\_r/100, 1000000, 0.01)

##95%

ES\_samplex(tan\_oos\_r/100, 1000000, 0.05)

##LPSD

LPSDx(tan\_oos\_r/100, rf)

--------------------------------------------------------------

##no-shortsales mvp

##out of sample returns

nsmvp\_oos\_r<-numeric(hx)

##turn over rate

nsmvp\_tor<-numeric(hx)

##HHI

nsmvp\_hhi<-numeric(hx)

##SLR

nsmvp\_slr<-numeric(hx)

##portfolio weight in period t-1

wx\_mat<-matrix(0, hx+1, ncol(ret\_data)-1)

##target daily return 1%

mu\_targ<-1/100

for(i in 1:hx){

##data in the rolling window

datax<-ret\_data[i:(i+kx-1), 2:ncol(ret\_data)]

##weight in this period

wx<-nsmvp\_wx\_quad(datax, mu\_targ)$solution

##return of period i+kx

rx<-ret\_data[i+kx, 2:ncol(ret\_data)]

##return of period i+kx-1

rx\_lag<-datax[nrow(datax), ]

##out of sample portfolio returns

nsmvp\_oos\_r[i]<-sum(wx\*rx)

##turnover rate

##individual

tor\_ind<-abs(wx-wx\_mat[i, ]\*(1+(rx\_lag/100))/(1+sum(wx\_mat[i, ]\*(rx\_lag/100))))

##portfolio

nsmvp\_tor[i]<-sum(tor\_ind)

##HHI

nsmvp\_hhi[i]<-sum(wx^2)/(sum(abs(wx))^2)

##SLR

nsmvp\_slr[i]<-sum(abs(wx[wx<0]))/sum(abs(wx[wx>0]))

##store portfolio weight at this period

wx\_mat[i+1, ]<-wx

print(i)

}

##plot out of sample portfolio return

windows(height=4, width=10)

plot(x=ret\_data[(kx+1):nrow(ret\_data), ]$Date, y=nsmvp\_oos\_r

, main='No-shortsales MVP out of sample portfolio return', xlab='Date', ylab='Return (%)', type='l', col=6)

##plot out of sample portfolio cumulative gross return

nsmvp\_oos\_cumr<-cumprod(1+(nsmvp\_oos\_r/100))

windows(height=8, width=10)

plot(x=ret\_data[(kx+1):nrow(ret\_data), ]$Date, y=nsmvp\_oos\_cumr

, main='No-shortsales MVP out of sample porfolio cumulative gross return', xlab='Date'

, ylab='Cumulative gross return', type='l', lwd=2)

##Descriptive statistics of out of sample portfolio return

result\_oos\_ret\_nsmvp<-c(length(nsmvp\_oos\_r), min(nsmvp\_oos\_r), median(nsmvp\_oos\_r), max(nsmvp\_oos\_r)

, mean(nsmvp\_oos\_r), sd(nsmvp\_oos\_r), my\_skewness(nsmvp\_oos\_r), my\_kurtosis(nsmvp\_oos\_r)

, my\_acf1(nsmvp\_oos\_r))

result\_oos\_ret\_nsmvp[2:8]<-result\_oos\_ret\_nsmvp[2:8]\*c(rep(252,4), sqrt(252), 1/sqrt(252), 1/252)

names(result\_oos\_ret\_nsmvp)<-c("number of observations", "min", "median", "max", "mean", "std", "skewness"

, "kurtosis", "acf1")

result\_oos\_ret\_nsmvp<-round(result\_oos\_ret\_nsmvp, 3)

result\_oos\_ret\_nsmvp

##Annualized Sharpe ratio

(mean(nsmvp\_oos\_r)-rf\*100)/sd(nsmvp\_oos\_r)\*sqrt(252)

##turnover rate

result\_tor\_nsmvp<-c(min(nsmvp\_tor), median(nsmvp\_tor), max(nsmvp\_tor), mean(nsmvp\_tor), sd(nsmvp\_tor))

names(result\_tor\_nsmvp)<-c('min', 'median', 'max', 'mean', 'std')

result\_tor\_nsmvp<-round(result\_tor\_nsmvp, 3)

result\_tor\_nsmvp

##HHI

result\_hhi\_nsmvp<-c(min(nsmvp\_hhi), median(nsmvp\_hhi), max(nsmvp\_hhi), mean(nsmvp\_hhi), sd(nsmvp\_hhi))

names(result\_hhi\_nsmvp)<-c('min', 'median', 'max', 'mean', 'std')

result\_hhi\_nsmvp<-round(result\_hhi\_nsmvp, 3)

result\_hhi\_nsmvp

##SLR

result\_slr\_nsmvp<-c(min(nsmvp\_slr), median(nsmvp\_slr), max(nsmvp\_slr), mean(nsmvp\_slr), sd(nsmvp\_slr))

names(result\_slr\_nsmvp)<-c('min', 'median', 'max', 'mean', 'std')

result\_slr\_nsmvp<-round(result\_slr\_nsmvp, 3)

result\_slr\_nsmvp

##Suppose initial investment $1000000

##VaR

##99%

VaR\_samplex(nsmvp\_oos\_r/100, 1000000, 0.01)

##95%

VaR\_samplex(nsmvp\_oos\_r/100, 1000000, 0.05)

##ES

##99%

ES\_samplex(nsmvp\_oos\_r/100, 1000000, 0.01)

##95%

ES\_samplex(nsmvp\_oos\_r/100, 1000000, 0.05)

##LPSD

LPSDx(nsmvp\_oos\_r/100, rf)

-------------------------------------------------------

##no-shortsales gmvp

##out of sample returns

nsgmvp\_oos\_r<-numeric(hx)

##turn over rate

nsgmvp\_tor<-numeric(hx)

##HHI

nsgmvp\_hhi<-numeric(hx)

##SLR

nsgmvp\_slr<-numeric(hx)

##portfolio weight in period t-1

wx\_mat<-matrix(0, hx+1, ncol(ret\_data)-1)

for(i in 1:hx){

##data in the rolling window

datax<-ret\_data[i:(i+kx-1), 2:ncol(ret\_data)]

##weight in this period

wx<-nsgmvp\_wx\_quad(datax)$solution

##return of period i+kx

rx<-ret\_data[i+kx, 2:ncol(ret\_data)]

##return of period i+kx-1

rx\_lag<-datax[nrow(datax), ]

##out of sample portfolio returns

nsgmvp\_oos\_r[i]<-sum(wx\*rx)

##turnover rate

##individual

tor\_ind<-abs(wx-wx\_mat[i, ]\*(1+(rx\_lag/100))/(1+sum(wx\_mat[i, ]\*(rx\_lag/100))))

##portfolio

nsgmvp\_tor[i]<-sum(tor\_ind)

##HHI

nsgmvp\_hhi[i]<-sum(wx^2)/(sum(abs(wx))^2)

##SLR

nsgmvp\_slr[i]<-sum(abs(wx[wx<0]))/sum(abs(wx[wx>0]))

##store portfolio weight at this period

wx\_mat[i+1, ]<-wx

print(i)

}

##plot out of sample portfolio return

windows(height=4, width=10)

plot(x=ret\_data[(kx+1):nrow(ret\_data), ]$Date, y=nsgmvp\_oos\_r

, main='No-shortsales GMVP out of sample portfolio return', xlab='Date', ylab='Return (%)', type='l', col=7)

##plot out of sample portfolio cumulative gross return

nsgmvp\_oos\_cumr<-cumprod(1+(nsgmvp\_oos\_r/100))

windows(height=8, width=10)

plot(x=ret\_data[(kx+1):nrow(ret\_data), ]$Date, y=nsgmvp\_oos\_cumr

, main='No-shortsales GMVP out of sample porfolio cumulative gross return', xlab='Date'

, ylab='Cumulative gross return', type='l', lwd=2)

##Descriptive statistics of out of sample portfolio return

result\_oos\_ret\_nsgmvp<-c(length(nsgmvp\_oos\_r), min(nsgmvp\_oos\_r), median(nsgmvp\_oos\_r), max(nsgmvp\_oos\_r)

, mean(nsgmvp\_oos\_r), sd(nsgmvp\_oos\_r), my\_skewness(nsgmvp\_oos\_r), my\_kurtosis(nsgmvp\_oos\_r)

, my\_acf1(nsgmvp\_oos\_r))

result\_oos\_ret\_nsgmvp[2:8]<-result\_oos\_ret\_nsgmvp[2:8]\*c(rep(252,4), sqrt(252), 1/sqrt(252), 1/252)

names(result\_oos\_ret\_nsgmvp)<-c("number of observations", "min", "median", "max", "mean", "std", "skewness"

, "kurtosis", "acf1")

result\_oos\_ret\_nsgmvp<-round(result\_oos\_ret\_nsgmvp, 3)

result\_oos\_ret\_nsgmvp

##Annualized Sharpe ratio

(mean(nsgmvp\_oos\_r)-rf\*100)/sd(nsgmvp\_oos\_r)\*sqrt(252)

##turnover rate

result\_tor\_nsgmvp<-c(min(nsgmvp\_tor), median(nsgmvp\_tor), max(nsgmvp\_tor), mean(nsgmvp\_tor), sd(nsgmvp\_tor))

names(result\_tor\_nsgmvp)<-c('min', 'median', 'max', 'mean', 'std')

result\_tor\_nsgmvp<-round(result\_tor\_nsgmvp, 3)

result\_tor\_nsgmvp

##HHI

result\_hhi\_nsgmvp<-c(min(nsgmvp\_hhi), median(nsgmvp\_hhi), max(nsgmvp\_hhi), mean(nsgmvp\_hhi), sd(nsgmvp\_hhi))

names(result\_hhi\_nsgmvp)<-c('min', 'median', 'max', 'mean', 'std')

result\_hhi\_nsgmvp<-round(result\_hhi\_nsgmvp, 3)

result\_hhi\_nsgmvp

##SLR

result\_slr\_nsgmvp<-c(min(nsgmvp\_slr), median(nsgmvp\_slr), max(nsgmvp\_slr), mean(nsgmvp\_slr), sd(nsgmvp\_slr))

names(result\_slr\_nsgmvp)<-c('min', 'median', 'max', 'mean', 'std')

result\_slr\_nsgmvp<-round(result\_slr\_nsgmvp, 3)

result\_slr\_nsgmvp

##Suppose initial investment $1000000

##VaR

##99%

VaR\_samplex(nsgmvp\_oos\_r/100, 1000000, 0.01)

##95%

VaR\_samplex(nsgmvp\_oos\_r/100, 1000000, 0.05)

##ES

##99%

ES\_samplex(nsgmvp\_oos\_r/100, 1000000, 0.01)

##95%

ES\_samplex(nsgmvp\_oos\_r/100, 1000000, 0.05)

##LPSD

LPSDx(nsgmvp\_oos\_r/100, rf)

--------------------------------------------------------------

##oos cumulative return plot

y.range=c(min(fw\_oos\_cumr, mvp\_oos\_cumr, gmvp\_oos\_cumr, mvprf\_oos\_cumr, tan\_oos\_cumr, nsmvp\_oos\_cumr

, nsgmvp\_oos\_cumr)

, max(fw\_oos\_cumr, mvp\_oos\_cumr, gmvp\_oos\_cumr, mvprf\_oos\_cumr, tan\_oos\_cumr, nsmvp\_oos\_cumr

, nsgmvp\_oos\_cumr))

windows(height=10, width=20)

plot(x=ret\_data[(kx+1):nrow(ret\_data), ]$Date, y=fw\_oos\_cumr

, main="Out of sample cumulative gross returns of portfolios", xlab="Date", ylab="Cumulative gross returns"

, ylim=y.range, type="l", lwd=2, col=1)

lines(x=ret\_data[(kx+1):nrow(ret\_data), ]$Date, y=mvp\_oos\_cumr, lwd=2, col=2)

lines(x=ret\_data[(kx+1):nrow(ret\_data), ]$Date, y=gmvp\_oos\_cumr, lwd=2, col=3)

lines(x=ret\_data[(kx+1):nrow(ret\_data), ]$Date, y=mvprf\_oos\_cumr, lwd=2, col=4)

lines(x=ret\_data[(kx+1):nrow(ret\_data), ]$Date, y=tan\_oos\_cumr, lwd=2, col=5)

lines(x=ret\_data[(kx+1):nrow(ret\_data), ]$Date, y=nsmvp\_oos\_cumr, lwd=2, col=6)

lines(x=ret\_data[(kx+1):nrow(ret\_data), ]$Date, y=nsgmvp\_oos\_cumr, lwd=2, col=7)

legend("topleft", legend=c("fixed weight", "MVP", "GMVP", "MVP with a risk free asset", "tangency portfolio"

, "no-shortsales MVP", "no-shortsales GMVP")

, lwd=c(rep(2, 7)), col=c(1:7))