---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)
```

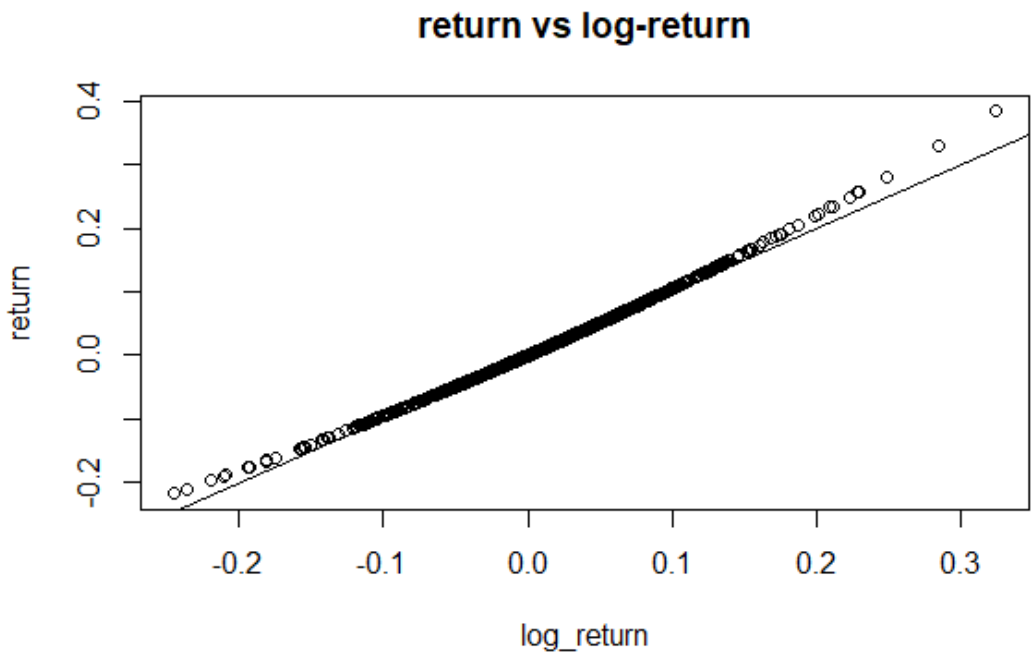

Figure1

(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])
```

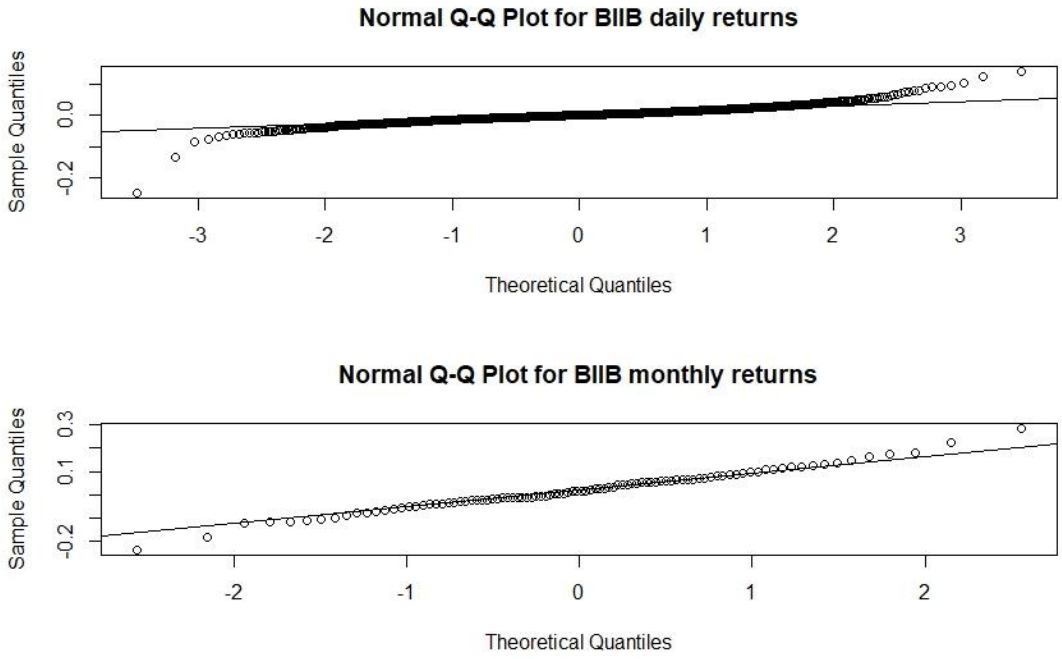

Figure2

```
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])
```

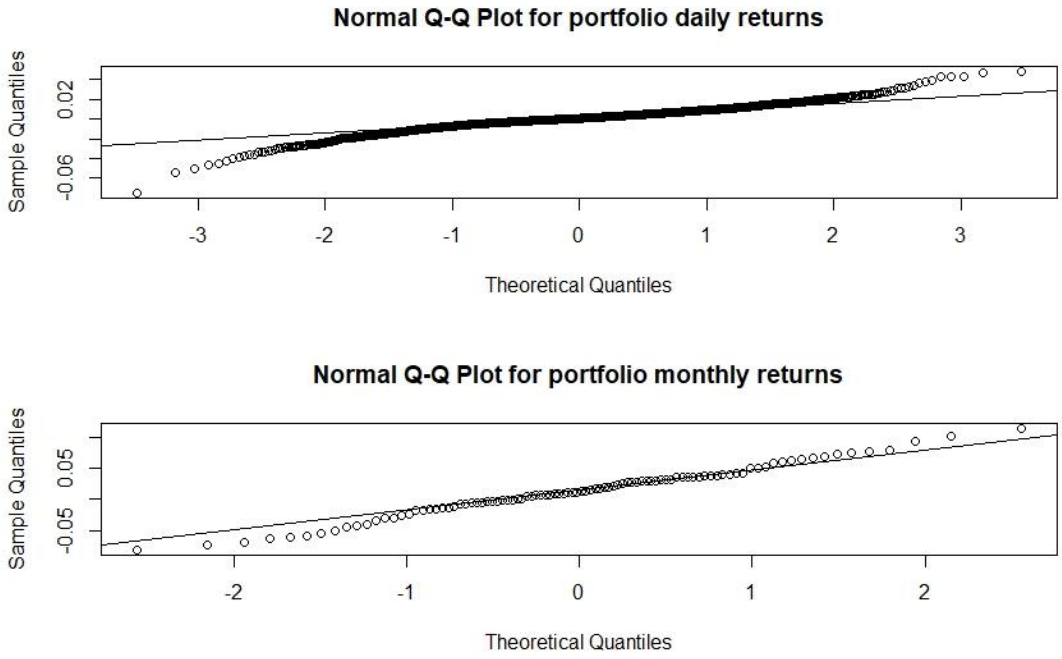

Figure3

---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