DS-640 Predictive Analytics and Financial Modeling
Project 2

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Summary:

1. Difference in the expected values for the complete stock and sector for t = 16 to 19

COMPLETE STOCK DATA:

T = 16	
Original	**Expected**
0.3240065	0.7570934
0.100823	-0.00625609
0.02394544	-0.0306469
-0.06035908	-0.2134615
-0.385361	-5.085965

T = 17	
Original	**Expected**
0.2153667	0.7011557
0.05537854	-0.004687938
0.001651618	-0.02478149
-0.05226321	-0.1734334
-0.2552054	-4.937989

T = 18	
Original	**Expected**
0.2245895	0.763772
0.04447087	-0.0054484
-0.0288209	-0.0253805
-0.1322416	-0.17755
-0.4847888	-5.00428

T = 19	
Original	**Expected**
0.2055125	0.7421421
0.04419221	-0.004769705
-0.02924594	-0.02575367
-0.1272412	-0.1692567
-0.4764389	-4.789281

T = 20	
Original	**Expected**
0.1771117	0.7054407
-0.02035333	-0.005656839
-0.1160329	-0.02811991
-0.2374298	-0.1903105
-0.6781697	-5.14467

SECTOR – CONSUMER DISCRETIONARY:

T = 16	
Original	**Expected**
0.2323264	-1.0069
0.1463405	-1.060281
0.09986251	-1.072981
0.04132309	-1.086835
-0.1037609	-1.224007

T = 17	
Original	**Expected**
0.185644	0.2555698
0.0831725	0.1951397
0.03030963	0.1830464
-0.02915373	0.1692843
-0.1314887	0.1037428

T = 18	
Original	**Expected**
0.1534309	-0.2187211
0.05243591	-0.2901944
-0.01093351	-0.3009145
-0.07138198	-0.3118725
-0.1899316	-0.359451

T = 19	
Original	**Expected**
0.1160497	-0.225242
0.0291787	-0.2900816
-0.01823692	-0.3007617
-0.08991317	-0.3128255
-0.2240586	-0.3677612

T = 20	
Original	**Expected**
0.1418429	-0.2225337
-0.01743718	-0.2889049
-0.08674228	-0.3003004
-0.194515	-0.3131392
-0.3262333	-0.4653566

Financial Modeling for the complete stock.

```
> library(tseries)
> library(forecast)
> data_file_arq <- read.csv('/Users/mohitsupe/Documents/W_Desktop/p1_PA/data_file_ARQ.csv')

#View(data_file_arq)
```

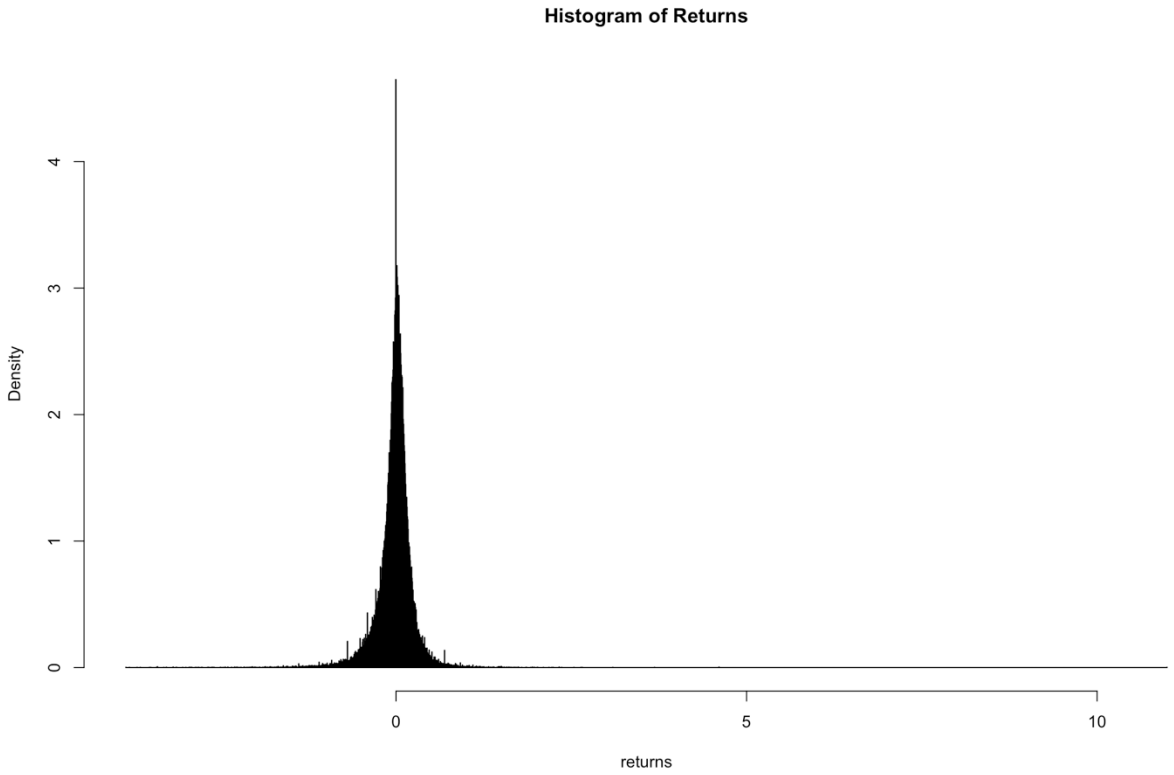
```
> # Selecting Factors
> data_file_arq_2 <- data_file_arq[c(1,2,3,72,7,77,79,61,30,87,59,21,58,13,56,35,49,14,19,33,36,69,46,89)]
> #View(data_file_arq_2)

> #Removing NAs
>
> data_file_arq_2 <- data_file_arq_2[!is.na(data_file_arq_2$price),]
> data_file_arq_2 <- data_file_arq_2[!is.na(data_file_arq_2$assets),]
> data_file_arq_2 <- data_file_arq_2[!is.na(data_file_arq_2$revenue),]
> data_file_arq_2 <- data_file_arq_2[!is.na(data_file_arq_2$rnd),]
> data_file_arq_2 <- data_file_arq_2[!is.na(data_file_arq_2$netinc),]
> data_file_arq_2 <- data_file_arq_2[!is.na(data_file_arq_2$eps),]
> data_file_arq_2 <- data_file_arq_2[!is.na(data_file_arq_2$shareswa),]
> data_file_arq_2 <- data_file_arq_2[!is.na(data_file_arq_2$ncfo),]
> data_file_arq_2 <- data_file_arq_2[!is.na(data_file_arq_2$depamor),]
> data_file_arq_2 <- data_file_arq_2[!is.na(data_file_arq_2$ncfi),]
> data_file_arq_2 <- data_file_arq_2[!is.na(data_file_arq_2$capex),]
> data_file_arq_2 <- data_file_arq_2[!is.na(data_file_arq_2$ncfdiv),]
> data_file_arq_2 <- data_file_arq_2[!is.na(data_file_arq_2$equityusd),]
> data_file_arq_2 <- data_file_arq_2[!is.na(data_file_arq_2$liabilities),]
> data_file_arq_2 <- data_file_arq_2[!is.na(data_file_arq_2$cashneq),]
> data_file_arq_2 <- data_file_arq_2[!is.na(data_file_arq_2$debt),]
> data_file_arq_2 <- data_file_arq_2[!is.na(data_file_arq_2$equity),]
> data_file_arq_2 <- data_file_arq_2[!is.na(data_file_arq_2$ev),]
> data_file_arq_2 <- data_file_arq_2[!is.na(data_file_arq_2$pe),]
> data_file_arq_2 <- data_file_arq_2[!is.na(data_file_arq_2$invcap),]
> data_file_arq_2 <- data_file_arq_2[!is.na(data_file_arq_2$sps),]
> rownames(data_file_arq_2) <- seq(length=nrow(data_file_arq_2))
> names(data_file_arq_2)
 [1] "ticker"      "dimension"   "calendardate" "price"       "assets"      "revenue"
 [7] "rnd"         "netinc"      "eps"          "shareswa"    "ncfo"        "depamor"
[13] "ncfi"        "capex"       "ncfdiv"       "equityusd"   "liabilities" "cashneq"
[19] "debt"        "equity"      "ev"           "pe"          "invcap"      "sps"
> #View(data_file_arq_2)
```

```
> # Sorting DataKey
>
> data_file_arq_2 <- data_file_arq_2[order(data_file_arq_2$ticker,as.Date(data_file_arq_2$calendardate,format="%m/%d/%y")),]
> #View(data_file_arq_2)
>
> # Normalizing the data
>
> n <- nrow(data_file_arq_2)
>
> n_func <- function(n)
+ {
+   return((n - min(n))/(max(n)-min(n)))
+ }
>
> data_file_arq_n <- as.data.frame(lapply(data_file_arq_2[,4:24], n_func))
> str(data_file_arq_n)
'data.frame':   84447 obs. of  21 variables:
 $ price      : num  0.00221 0.00229 0.00171 0.00161 0.00205 ...
 $ assets     : num  0.00242 0.00261 0.00264 0.00273 0.00274 ...
 $ revenue    : num  0.0775 0.0786 0.0787 0.079 0.0783 ...
 $ rnd        : num  0.0779 0.0795 0.0787 0.079 0.0787 ...
 $ netinc     : num  0.191 0.191 0.192 0.192 0.191 ...
 $ eps        : num  0.00692 0.00692 0.00692 0.00692 0.00692 ...
 $ shareswa   : num  0.0321 0.0321 0.0322 0.0321 0.0322 ...
 $ ncfo       : num  0.276 0.278 0.277 0.28 0.276 ...
 $ depamor    : num  0.0469 0.0469 0.0469 0.0469 0.0469 ...
 $ ncfi       : num  0.546 0.542 0.542 0.542 0.542 ...
 $ capex      : num  0.467 0.467 0.467 0.467 0.467 ...
 $ ncfdiv     : num  0.664 0.664 0.664 0.664 0.664 ...
 $ equityusd  : num  0.0629 0.0652 0.066 0.0665 0.0672 ...
 $ liabilities: num  0.00166 0.00165 0.00161 0.00167 0.00163 ...
 $ cashneq    : num  0.00679 0.00761 0.00793 0.00902 0.00937 ...
 $ debt       : num  0.000773 0.000775 0.000783 0.000789 0.000788 ...
 $ equity     : num  0.0629 0.0652 0.066 0.0665 0.0672 ...
 $ ev         : num  0.026 0.0261 0.025 0.0247 0.0254 ...
 $ pe         : num  0.64 0.64 0.64 0.64 0.64 ...
```

```
 $ invcap     : num  0.000917 0.000912 0.000928 0.000862 0.000866 ...
 $ sps        : num  0.0109 0.011 0.011 0.011 0.011 ...
> summary(data_file_arq_n)
    price              assets             revenue              rnd                netinc
 Min.   :0.0000000   Min.   :0.0000000   Min.   :0.00000   Min.   :0.00000   Min.   :0.0000
 1st Qu.:0.0004362   1st Qu.:0.0000458   1st Qu.:0.06687   1st Qu.:0.03488   1st Qu.:0.1878
 Median :0.0011195   Median :0.0002297   Median :0.06739   Median :0.03488   Median :0.1879
 Mean   :0.0019305   Mean   :0.0030379   Mean   :0.07286   Mean   :0.03908   Mean   :0.1887
 3rd Qu.:0.0023785   3rd Qu.:0.0009668   3rd Qu.:0.06975   3rd Qu.:0.03524   3rd Qu.:0.1882
 Max.   :1.0000000   Max.   :1.0000000   Max.   :1.00000   Max.   :1.00000   Max.   :1.0000
     eps              shareswa             ncfo             depamor             ncfi
 Min.   :0.000000   Min.   :0.000000   Min.   :0.0000   Min.   :0.00000   Min.   :0.0000
 1st Qu.:0.006915   1st Qu.:0.001391   1st Qu.:0.2744   1st Qu.:0.04537   1st Qu.:0.5419
 Median :0.006915   Median :0.003545   Median :0.2745   Median :0.04545   Median :0.5420
 Mean   :0.006927   Mean   :0.012128   Mean   :0.2757   Mean   :0.04643   Mean   :0.5418
 3rd Qu.:0.006916   3rd Qu.:0.008645   3rd Qu.:0.2749   3rd Qu.:0.04586   3rd Qu.:0.5420
 Max.   :1.000000   Max.   :1.000000   Max.   :1.0000   Max.   :1.00000   Max.   :1.0000
    capex             ncfdiv           equityusd          liabilities            cashneq
 Min.   :0.0000   Min.   :0.0000   Min.   :0.00000   Min.   :0.0000000   Min.   :0.0000000
 1st Qu.:0.4679   1st Qu.:0.6627   1st Qu.:0.05070   1st Qu.:0.0002337   1st Qu.:0.0000306
 Median :0.4686   Median :0.6638   Median :0.05141   Median :0.0003492   Median :0.0001331
 Mean   :0.4666   Mean   :0.6585   Mean   :0.05793   Mean   :0.0026637   Mean   :0.0018007
 3rd Qu.:0.4687   3rd Qu.:0.6638   3rd Qu.:0.05435   3rd Qu.:0.0008474   3rd Qu.:0.0005104
 Max.   :1.0000   Max.   :1.0000   Max.   :1.00000   Max.   :1.0000000   Max.   :1.0000000
     debt              equity             ev                pe              invcap
 Min.   :0.0000000   Min.   :0.00000   Min.   :0.00000   Min.   :0.0000   Min.   :0.0000000
 1st Qu.:0.0000127   1st Qu.:0.05070   1st Qu.:0.02226   1st Qu.:0.6399   1st Qu.:0.0002258
 Median :0.0000475   Median :0.05141   Median :0.02246   Median :0.6399   Median :0.0003070
 Mean   :0.0011823   Mean   :0.05793   Mean   :0.02484   Mean   :0.6399   Mean   :0.0020385
 3rd Qu.:0.0003054   3rd Qu.:0.05435   3rd Qu.:0.02339   3rd Qu.:0.6400   3rd Qu.:0.0006737
 Max.   :1.0000000   Max.   :1.00000   Max.   :1.00000   Max.   :1.0000   Max.   :1.0000000
     sps
 Min.   :0.00000
 1st Qu.:0.01068
 Median :0.01080
 Mean   :0.01124
```

```
 3rd Qu.:0.01111
 Max.   :1.00000
>
> data_file_arq_3 <- cbind(data_file_arq_2[,c(1,2,3)],data_file_arq_n)
> #View(data_file_arq_3)
>
> # Calculating the returns
>
> returns <- vector()
> for(i in 2: nrow(data_file_arq_3))
+ {
+   if(identical(data_file_arq_3[i,1], data_file_arq_3[i-1,1]))
+   {
+     returns[i] <- log(data_file_arq_3[i,4]/data_file_arq_3[i-1,4])
+   }
+   else
+   {
+     returns[i] <- NA
+   }
+ }
> warnings()
NULL
> #View(as.data.frame(returns))
> hist(returns, prob = T, breaks = 3000, main= 'Histogram of Returns')
```




```
> data_file_arq_final <- cbind(data_file_arq_3,returns)
> #View(data_file_arq_final)
>
> data_file_arq_final <- data_file_arq_final[!is.na(data_file_arq_final$returns),]
> data_file_arq_final <- subset(data_file_arq_final[data_file_arq_final$returns!=0,])
> data_file_arq_final <- subset(data_file_arq_final[data_file_arq_final$returns!=-Inf,])
> data_file_arq_final <- subset(data_file_arq_final[data_file_arq_final$returns!=Inf,])
> summary(data_file_arq_final)
    ticker      dimension    calendardate       price              assets             revenue
 ETAK   : 23   ARQ:78200   6/30/15: 4235   Min.   :0.0000001   Min.   :0.0000000   Min.   :0.00000
 GALE   : 23               3/31/15: 4232   1st Qu.:0.0004450   1st Qu.:0.0000489   1st Qu.:0.06687
 NNVC   : 23               9/30/15: 4217   Median :0.0011389   Median :0.0002398   Median :0.06742
 CUI    : 22               6/30/14: 4150   Mean   :0.0019584   Mean   :0.0030834   Mean   :0.07301
```

```
GTIM   :  22            9/30/14: 4150   3rd Qu.:0.0024268   3rd Qu.:0.0010039   3rd Qu.:0.06988
HPT    :  22           3/31/14: 4133   Max.   :1.0000000   Max.   :1.0000000   Max.   :1.00000
(Other):78065           (Other):53083
     rnd            netinc          eps            shareswa            ncfo
Min.   :0.00000   Min.   :0.0000   Min.   :0.000000   Min.   :0.0000002   Min.   :0.0000
1st Qu.:0.03488   1st Qu.:0.1878   1st Qu.:0.006915   1st Qu.:0.0014253   1st Qu.:0.2744
Median :0.03488   Median :0.1879   Median :0.006915   Median :0.0036011   Median :0.2745
Mean   :0.03920   Mean   :0.1887   Mean   :0.006915   Mean   :0.0122815   Mean   :0.2757
3rd Qu.:0.03524   3rd Qu.:0.1882   3rd Qu.:0.006916   3rd Qu.:0.0087625   3rd Qu.:0.2750
Max.   :1.00000   Max.   :1.0000   Max.   :0.024751   Max.   :1.0000000   Max.   :1.0000

   depamor            ncfi           capex          ncfdiv        equityusd
Min.   :0.00000   Min.   :0.04065   Min.   :0.0000   Min.   :0.0000   Min.   :0.00000
1st Qu.:0.04538   1st Qu.:0.54189   1st Qu.:0.4679   1st Qu.:0.6626   1st Qu.:0.05071
Median :0.04546   Median :0.54199   Median :0.4686   Median :0.6638   Median :0.05144
Mean   :0.04647   Mean   :0.54179   Mean   :0.4665   Mean   :0.6583   Mean   :0.05812
3rd Qu.:0.04588   3rd Qu.:0.54201   3rd Qu.:0.4687   3rd Qu.:0.6638   3rd Qu.:0.05447
Max.   :1.00000   Max.   :1.00000   Max.   :1.0000   Max.   :1.0000   Max.   :1.00000

 liabilities          cashneq             debt            equity             ev
Min.   :0.0000000   Min.   :0.0000000   Min.   :0.0000000   Min.   :0.00000   Min.   :0.00000
1st Qu.:0.0002349   1st Qu.:0.0000320   1st Qu.:0.0000129   1st Qu.:0.05071   1st Qu.:0.02226
Median :0.0003565   Median :0.0001367   Median :0.0000503   Median :0.05144   Median :0.02247
Mean   :0.0026936   Mean   :0.0018346   Mean   :0.0011765   Mean   :0.05812   Mean   :0.02488
3rd Qu.:0.0008723   3rd Qu.:0.0005242   3rd Qu.:0.0003196   3rd Qu.:0.05447   3rd Qu.:0.02344
Max.   :1.0000000   Max.   :1.0000000   Max.   :1.0000000   Max.   :1.00000   Max.   :1.00000

      pe             invcap             sps             returns
Min.   :0.0000   Min.   :0.0000000   Min.   :0.00000   Min.   :-3.852509
1st Qu.:0.6399   1st Qu.:0.0002269   1st Qu.:0.01069   1st Qu.:-0.105532
Median :0.6399   Median :0.0003112   Median :0.01080   Median : 0.005299
Mean   :0.6399   Mean   :0.0020514   Mean   :0.01124   Mean   :-0.017878
3rd Qu.:0.6400   3rd Qu.:0.0006891   3rd Qu.:0.01112   3rd Qu.: 0.098947
Max.   :1.0000   Max.   :1.0000000   Max.   :1.00000   Max.   :10.995411

> #View(data_file_arq_final)
```

```
>
> # Check unique dates
> unique_date <- as.data.frame(unique(data_file_arq_final$calendardate))
> colnames(unique_date)[1]<-"Unique_date"
> unique_date<-as.data.frame(unique_date[order(as.Date(unique_date$Unique_date, format="%m/%d/%Y")),])
> colnames(unique_date)[1]<-"Unique_date"
> #View(unique_date)
>
> #Calculating Actual returns for t=16 to 20
>
> #For t=16
> Actual_returns_16 <- data_file_arq_final[data_file_arq_final$calendardate==unique_date[16,],c(1,25)]
> Actual_returns_16 <- Actual_returns_16[order(-Actual_returns_16$returns),]
> rownames(Actual_returns_16)<-1:nrow(Actual_returns_16)
> View(Actual_returns_16)
>
> n<-nrow(Actual_returns_16)/5
> n
[1] 819.4
> org_Q1_16<-Actual_returns_16[1:820,]
> org_Q2_16<-Actual_returns_16[821:1640,]
> org_Q3_16<-Actual_returns_16[1641:2460,]
> org_Q4_16<-Actual_returns_16[2461:3280,]
> org_Q5_16<-Actual_returns_16[3281:4097,]
>
> org_m1_16<-mean(org_Q1_16$returns)
> org_m2_16<-mean(org_Q2_16$returns)
> org_m3_16<-mean(org_Q3_16$returns)
> org_m4_16<-mean(org_Q4_16$returns)
> org_m5_16<-mean(org_Q5_16$returns)
>
> org_m1_16
[1] 0.3240065
> org_m2_16
[1] 0.100823
> org_m3_16
```

```
[1] 0.02394544
> org_m4_16
[1] -0.06035908
> org_m5_16
[1] -0.385361
>
> #For t=17
> Actual_returns_17 <- data_file_arq_final[data_file_arq_final$calendardate==unique_date[17,],c(1,25)]   #t=17
> Actual_returns_17 <- Actual_returns_17[order(-Actual_returns_17$returns),]
> rownames(Actual_returns_17)<-1:nrow(Actual_returns_17)
> View(Actual_returns_17)
>
> org_Q1_17<-Actual_returns_17[1:846,]
> org_Q2_17<-Actual_returns_17[847:1692,]
> org_Q3_17<-Actual_returns_17[1693:2538,]
> org_Q4_17<-Actual_returns_17[2539:3385,]
> org_Q5_17<-Actual_returns_17[3386:4232,]
>
> org_m1_17<-mean(org_Q1_17$returns)
> org_m2_17<-mean(org_Q2_17$returns)
> org_m3_17<-mean(org_Q3_17$returns)
> org_m4_17<-mean(org_Q4_17$returns)
> org_m5_17<-mean(org_Q5_17$returns)
>
> org_m1_17
[1] 0.2153667
> org_m2_17
[1] 0.05537854
> org_m3_17
[1] 0.001651618
> org_m4_17
[1] -0.05226321
> org_m5_17
[1] -0.2552054
>
> #For t=18
```

```
> Actual_returns_18 <- data_file_arq_final[data_file_arq_final$calendardate==unique_date[18,],c(1,25)]   #t=18
> Actual_returns_18 <- Actual_returns_18[order(-Actual_returns_18$returns),]
> rownames(Actual_returns_18)<-1:nrow(Actual_returns_18)
> View(Actual_returns_18)
>
> org_Q1_18<-Actual_returns_18[1:847,]
> org_Q2_18<-Actual_returns_18[848:1694,]
> org_Q3_18<-Actual_returns_18[1695:2541,]
> org_Q4_18<-Actual_returns_18[2542:3388,]
> org_Q5_18<-Actual_returns_18[3389:4235,]
>
> org_m1_18<-mean(org_Q1_18$returns)
> org_m2_18<-mean(org_Q2_18$returns)
> org_m3_18<-mean(org_Q3_18$returns)
> org_m4_18<-mean(org_Q4_18$returns)
> org_m5_18<-mean(org_Q5_18$returns)

> org_m1_18
[1] 0.2245895
> org_m2_18
[1] 0.04447087
> org_m3_18
[1] -0.0288209
> org_m4_18
[1] -0.1322416
> org_m5_18
[1] -0.4847888
>

> #For t=19
> Actual_returns_19 <- data_file_arq_final[data_file_arq_final$calendardate==unique_date[19,],c(1,25)]   #t=19
> Actual_returns_19 <- Actual_returns_19[order(-Actual_returns_19$returns),]
> rownames(Actual_returns_19)<-1:nrow(Actual_returns_19)
> View(Actual_returns_19)
>
> org_Q1_19<-Actual_returns_19[1:843,]
```

```
> org_Q2_19<-Actual_returns_19[844:1686,]
> org_Q3_19<-Actual_returns_19[1687:2529,]
> org_Q4_19<-Actual_returns_19[2530:3373,]
> org_Q5_19<-Actual_returns_19[3374:4217,]
>
> org_m1_19<-mean(org_Q1_19$returns)
> org_m2_19<-mean(org_Q2_19$returns)
> org_m3_19<-mean(org_Q3_19$returns)
> org_m4_19<-mean(org_Q4_19$returns)
> org_m5_19<-mean(org_Q5_19$returns)
>
> org_m1_19
[1] 0.2055125
> org_m2_19
[1] 0.04419221
> org_m3_19
[1] -0.02924594
> org_m4_19
[1] -0.1272412
> org_m5_19
[1] -0.4764389

> #For t=20
> Actual_returns_20 <- data_file_arq_final[data_file_arq_final$calendardate==unique_date[20,],c(1,25)]
> Actual_returns_20 <- Actual_returns_20[order(-Actual_returns_20$returns),]
> rownames(Actual_returns_20)<-1:nrow(Actual_returns_20)
> View(Actual_returns_20)
>
> org_Q1_20<-Actual_returns_20[1:824,]
> org_Q2_20<-Actual_returns_20[825:1648,]
> org_Q3_20<-Actual_returns_20[1649:2472,]
> org_Q4_20<-Actual_returns_20[2473:3296,]
> org_Q5_20<-Actual_returns_20[3397:4120,]
>
> org_m1_20<-mean(org_Q1_20$returns)
> org_m2_20<-mean(org_Q2_20$returns)
```

```
> org_m3_20<-mean(org_Q3_20$returns)
> org_m4_20<-mean(org_Q4_20$returns)
> org_m5_20<-mean(org_Q5_20$returns)
>
> org_m1_20
[1] 0.1771117
> org_m2_20
[1] -0.02035333
> org_m3_20
[1] -0.1160329
> org_m4_20
[1] -0.2374298
> org_m5_20
[1] -0.6781697
>
> #Storing values of Betas for 15 unique dates
> beta = matrix(NA, nrow = 15, ncol = 20)
> beta0=matrix(NA,nrow=15,ncol=1)
> colnames(beta) <- colnames(data_file_arq_final[,-c(1,2,3,4,25)])
>
> for ( j in 1:15)
+ {
+
+   temp <- data_file_arq_final[data_file_arq_final[,3]==unique_date[j,1], ]
+   my.beta <-
lm(returns~assets+revenue+rnd+netinc+eps+shareswa+ncfo+depamor+ncfi+capex+ncfdiv+equityusd+liabilities+cashneq+debt+equity+ev+pe+inv
ap+sps,data=temp)
+   Coef<-coef(my.beta)
+   beta[j,colnames(beta) %in% names(Coef)] <- Coef[names(Coef) %in% colnames(beta)]
+   beta0[j,]<-Coef[1]
+ }
> print(beta)
          assets      revenue          rnd      netinc         eps     shareswa         ncfo
 [1,] 36350.1877220 -82.607197238 -1.072759e+02 -432.3080793 -128897.97254 29.920652056 373.08667314
 [2,]    -9.1206279  -0.190844845 -3.124748e-01   -2.3859189     454.04273 -0.281947656   0.17277751
 [3,]    14.0711399  -0.122116980 -1.216057e-01   -3.1371589    4209.80251 -0.003459601   0.22218447
```

```
 [4,]   -1.1668535   0.111052109 -7.122136e-02    0.2409400     146.48842 -0.006363362  -0.03990755
 [5,]   -5.4094067   0.135268703 -1.624686e-01   -2.5942038    1819.09827 -0.099256936  -0.18296782
 [6,]    5.3648406  -0.478807530 -1.996383e-01    1.7954745     170.82983 -0.179170235  -0.15110248
 [7,]    2.8630778   0.281494448 -1.620897e-01    1.1894364    5001.43138 -0.049348806   0.37173214
 [8,]    4.2458748   0.198993929 -3.019134e-02    0.5412099      99.12595  0.038961875   0.38924838
 [9,]    3.0083790   0.063216704  3.551481e-02   -1.4603261    2485.07631  0.249647199   0.21421037
[10,]   -5.5858373   0.171110989  6.940990e-02    0.8125794     169.71001  0.065099951   0.01392937
[11,]   -0.3700193  -0.023190625 -1.345651e-01    0.8840307     551.58290  0.047958156   0.47660770
[12,]   -0.3320167   0.041709570  9.906044e-02    0.6619093     985.50842 -0.038610094  -0.35764298
[13,]   -3.3327273  -0.278792053 -2.379439e-01   -0.4012755    5669.52349  0.077038524  -0.34783722
[14,]    4.8160064  -0.031745839  8.622113e-03   -0.3696854    1533.86526  0.336955079   0.06305453
[15,]   -0.3411252  -0.002115271 -2.389901e-01    1.2542620    1180.94234 -0.361599393   0.21358062
         depamor        ncfi       capex       ncfdiv    equityusd   liabilities       cashneq
 [1,] 79.758078198 2000.50320784 994.66115315 2682.87601626 -2609.9625477 -3.111818e+04 -334.25811365
 [2,] -0.297882171    0.71238248   0.11256294   -0.11701382   -70.5307308  1.015296e+01    1.18727833
 [3,] -3.982411478   -0.32406096  -0.47535302   -0.82647791  -133.3195856 -1.759076e+01    0.86905375
 [4,]  0.998807792    0.14322838   0.41919827    0.15741472 -3487.9637887  2.050301e+00    0.24568824
 [5,]  2.124595369   -0.49883415   1.64768355    0.28768945    -1.6664712  4.633121e+00    0.80820977
 [6,]  0.329758637   -0.34619784   0.11327607   -0.26923299    93.4668291 -2.712717e+00   -0.04785054
 [7,]  2.433898066    0.16561614   1.12324497    1.15553576   180.4238249 -2.125083e+00    0.58225177
 [8,]  0.008071177   -0.63953376   0.45452161    0.46192276   123.2687664 -2.077985e+00   -0.05852681
 [9,]  0.768713074    1.52104103  -0.32001629    0.42959209   175.8415750 -1.438216e-01   -0.24233589
[10,] -0.107960210    0.90964519  -0.36077460    0.99478009    19.0360527  9.958562e+00    0.09557059
[11,]  1.543993283    0.06648242   0.19593338    0.76047331    -7.9511134 -8.059053e-01    0.63085744
[12,]  0.256034699    1.71059234  -0.07335538    0.55709904     4.2532860  1.207188e+00    0.92747035
[13,]  2.730882446    0.32993012   0.13773986   -0.08120961   -19.8117516  2.129615e+00    0.10596901
[14,]  1.257513387   -1.07988083  -0.16758121    0.70886102     2.6431819 -4.298228e+00    0.28665482
[15,]  0.548793414   -0.04637676   1.66749340    0.03561151    -0.3457888  2.042193e+00    0.45321406
          debt     equity         ev         pe       invcap         sps
 [1,] 1854.014744         NA 298.3968490 -271.61087221 -5.715805e+03 -276.09491165
 [2,]  -10.606470   70.870321  10.7835738    5.16693134 -1.672049e+00    0.19645655
 [3,]   -6.988617  132.135525   3.9631568    3.45305648  6.538944e+00   -0.36117656
 [4,]   -1.458658 3487.744024   1.4879732   -0.11919713 -8.208370e-01   -0.34328697
 [5,]   -6.120321    2.168948   6.0124595   -0.24176984  6.831052e-01   -0.16250349
 [6,]    1.160213  -93.796508   1.6482263    6.15135660 -5.068453e+00    0.04629738
 [7,]   -1.954559 -180.401252   2.7317015   -0.23877269 -1.737038e+00    0.12039949
```

```
 [8,]   1.118573 -123.891654   0.6994741    0.06563887 -3.116027e+00    0.07824067
 [9,]  -1.499119 -176.589804   2.7843269    1.51455224 -3.042786e+00   -0.04560628
[10,]  -2.222099  -19.158822   3.3275603    2.47476322 -5.344060e+00   -0.24287690
[11,]  -4.786260    7.426817   3.8782395    2.33476209  2.246761e+00    0.22442656
[12,]  -3.559679   -5.034465   3.3187488    0.06069361 -5.838927e-01    0.21337430
[13,]  -1.865241   20.251855   1.3648474    5.68135541  1.718960e+00   20.66971967
[14,]  -3.727316   -3.540339   3.2826508    0.70201937  9.853094e-02    5.71920664
[15,]  -2.598698    0.649585   3.5594765   -2.49684834 -3.402064e+00    2.09465196
> print(beta0)
            [,1]
 [1,] -2145.876603
 [2,]    -6.789573
 [3,]   -29.722505
 [4,]    -1.338155
 [5,]   -12.870867
 [6,]    -5.135574
 [7,]   -36.331771
 [8,]    -1.010270
 [9,]   -18.935177
[10,]    -3.911652
[11,]    -6.337043
[12,]    -8.130894
[13,]   -43.292554
[14,]   -10.970054
[15,]    -7.809791
> colnames(beta0)[1]<-"Intercept"
> beta<-as.data.frame(beta)
> beta0<-as.data.frame(beta0)
> Beta_original<-cbind(unique_date[1:15,1],beta0,beta)
> View(Beta_original)
> #Beta_original$equity[1] <- 0
> Beta_original[is.na(Beta_original)] <- 0

> #ARIMA Predictions(Install Forecast & Tseries package)
> for(i in 16:20)
+ {
```

```
+   beta_new = matrix(NA, nrow = 1, ncol = 22)
+   colnames(beta_new) <- colnames(Beta_original)
+   beta_new[1,1] <- as.matrix(unique_date[i,1])
+
+
+   # For Intercept (B0)
+   Beta_original$Intercept <- as.numeric(Beta_original$Intercept)
+   acf(Beta_original$Intercept)
+   pacf(Beta_original$Intercept)
+   auto.arima(Beta_original$Intercept)
+
+   fit_B0 <- arima(Beta_original$Intercept, order = c(0,0,0))
+   model_predict_B0 <- predict(fit_B0, n.ahead=1)
+   pred_B0 <- as.numeric(model_predict_B0$pred)
+   pred_B0
+   beta_new[1,2] <- pred_B0
+
+
+   # For Assets
+   Beta_original$assets <- as.numeric(Beta_original$assets)
+   acf(Beta_original$assets)
+   pacf(Beta_original$assets)
+   auto.arima(Beta_original$assets)
+
+   fit_B1 <- arima(Beta_original$assets, order = c(0,0,0))
+   model_predict_B1 <- predict(fit_B1, n.ahead=1)
+   pred_B1 <- as.numeric(model_predict_B1$pred)
+   pred_B1
+   beta_new[1,3] <- pred_B1
+
+
+   # For Revenue
+   Beta_original$revenue <- as.numeric(Beta_original$revenue)
+   acf(Beta_original$revenue)
+   pacf(Beta_original$revenue)
+   auto.arima(Beta_original$revenue)
```

```
+
+  fit_B2 <- arima(Beta_original$revenue, order = c(0,0,0))
+  model_predict_B2 <- predict(fit_B2, n.ahead=1)
+  pred_B2 <- as.numeric(model_predict_B2$pred)
+  pred_B2
+  beta_new[1,4] <- pred_B2
+
+
+  # For Rnd
+  Beta_original$rnd <- as.numeric(Beta_original$rnd)
+  acf(Beta_original$rnd)
+  pacf(Beta_original$rnd)
+  auto.arima(Beta_original$rnd)
+
+  fit_B3 <- arima(Beta_original$rnd, order = c(0,0,0))
+  model_predict_B3 <- predict(fit_B3, n.ahead=1)
+  pred_B3 <- as.numeric(model_predict_B3$pred)
+  pred_B3
+  beta_new[1,5] <- pred_B3
+
+
+  # For Netinc
+  Beta_original$netinc <- as.numeric(Beta_original$netinc)
+  acf(Beta_original$netinc)
+  pacf(Beta_original$netinc)
+  auto.arima(Beta_original$netinc)
+
+  fit_B4 <- arima(Beta_original$netinc, order = c(0,0,0))
+  model_predict_B4 <- predict(fit_B4, n.ahead=1)
+  pred_B4 <- as.numeric(model_predict_B4$pred)
+  pred_B4
+  beta_new[1,6] <- pred_B4
+
+
+  # For Eps
+  Beta_original$eps <- as.numeric(Beta_original$eps)
```

```
+  acf(Beta_original$eps)
+  pacf(Beta_original$eps)
+  auto.arima(Beta_original$eps)
+
+  fit_B5 <- arima(Beta_original$eps, order = c(0,0,0))
+  model_predict_B5 <- predict(fit_B5, n.ahead=1)
+  pred_B5 <- as.numeric(model_predict_B5$pred)
+  pred_B5
+  beta_new[1,7] <- pred_B5
+
+
+  # For Shareswa
+  Beta_original$shareswa <- as.numeric(Beta_original$shareswa)
+  acf(Beta_original$shareswa)
+  pacf(Beta_original$shareswa)
+  auto.arima(Beta_original$shareswa)
+
+  fit_B6 <- arima(Beta_original$shareswa, order = c(0,0,0))
+  model_predict_B6 <- predict(fit_B6, n.ahead=1)
+  pred_B6 <- as.numeric(model_predict_B6$pred)
+  pred_B6
+  beta_new[1,8] <- pred_B6
+
+
+  # For Ncfo
+  Beta_original$ncfo <- as.numeric(Beta_original$ncfo)
+  acf(Beta_original$ncfo)
+  pacf(Beta_original$ncfo)
+  auto.arima(Beta_original$ncfo)
+
+  fit_B7 <- arima(Beta_original$ncfo, order = c(0,0,0))
+  model_predict_B7 <- predict(fit_B7, n.ahead=1)
+  pred_B7 <- as.numeric(model_predict_B7$pred)
+  pred_B7
+  beta_new[1,9] <- pred_B7
+
```

```
+
+  # For Depamor
+  Beta_original$depamor <- as.numeric(Beta_original$depamor)
+  acf(Beta_original$depamor)
+  pacf(Beta_original$depamor)
+  auto.arima(Beta_original$depamor)
+
+  fit_B8 <- arima(Beta_original$depamor, order = c(0,0,0))
+  model_predict_B8 <- predict(fit_B8, n.ahead=1)
+  pred_B8 <- as.numeric(model_predict_B8$pred)
+  pred_B8
+  beta_new[1,10] <- pred_B8
+
+
+  # For Ncfi
+  Beta_original$ncfi <- as.numeric(Beta_original$ncfi)
+  acf(Beta_original$ncfi)
+  pacf(Beta_original$ncfi)
+  auto.arima(Beta_original$ncfi)
+
+  fit_B9 <- arima(Beta_original$ncfi, order = c(0,0,0))
+  model_predict_B9 <- predict(fit_B9, n.ahead=1)
+  pred_B9 <- as.numeric(model_predict_B9$pred)
+  pred_B9
+  beta_new[1,11] <- pred_B9
+
+
+  # For Capex
+  Beta_original$capex <- as.numeric(Beta_original$capex)
+  acf(Beta_original$capex)
+  pacf(Beta_original$capex)
+  auto.arima(Beta_original$capex)
+
+  fit_B10 <- arima(Beta_original$capex, order = c(0,0,0))
+  model_predict_B10 <- predict(fit_B10, n.ahead=1)
+  pred_B10 <- as.numeric(model_predict_B10$pred)
```

```
+  pred_B10
+  beta_new[1,12] <- pred_B10
+
+
+  # For Ncfdiv
+  Beta_original$ncfdiv <- as.numeric(Beta_original$ncfdiv)
+  acf(Beta_original$ncfdiv)
+  pacf(Beta_original$ncfdiv)
+  auto.arima(Beta_original$ncfdiv)
+
+  fit_B11 <- arima(Beta_original$ncfdiv, order = c(0,0,0))
+  model_predict_B11 <- predict(fit_B11, n.ahead=1)
+  pred_B11 <- as.numeric(model_predict_B11$pred)
+  pred_B11
+  beta_new[1,13] <- pred_B11
+
+
+  # For EquityUSD
+  Beta_original$equityusd <- as.numeric(Beta_original$equityusd)
+  acf(Beta_original$equityusd)
+  pacf(Beta_original$equityusd)
+  auto.arima(Beta_original$equityusd)
+
+  fit_B12 <- arima(Beta_original$equityusd, order = c(0,0,0))
+  model_predict_B12 <- predict(fit_B12, n.ahead=1)
+  pred_B12 <- as.numeric(model_predict_B12$pred)
+  pred_B12
+  beta_new[1,14] <- pred_B12
+
+
+  # For Liabilities
+  Beta_original$liabilities <- as.numeric(Beta_original$liabilities)
+  acf(Beta_original$liabilities)
+  pacf(Beta_original$liabilities)
+  auto.arima(Beta_original$liabilities)
+
```

```
+  fit_B13 <- arima(Beta_original$liabilities, order = c(0,0,0))
+  model_predict_B13 <- predict(fit_B13, n.ahead=1)
+  pred_B13 <- as.numeric(model_predict_B13$pred)
+  pred_B13
+  beta_new[1,15] <- pred_B13
+
+
+  # For Cashneq
+  Beta_original$cashneq <- as.numeric(Beta_original$cashneq)
+  acf(Beta_original$cashneq)
+  pacf(Beta_original$cashneq)
+  auto.arima(Beta_original$cashneq)
+
+  fit_B14 <- arima(Beta_original$cashneq, order = c(0,0,0))
+  model_predict_B14 <- predict(fit_B14, n.ahead=1)
+  pred_B14 <- as.numeric(model_predict_B14$pred)
+  pred_B14
+  beta_new[1,16] <- pred_B14
+
+
+  # For Debt
+  Beta_original$debt <- as.numeric(Beta_original$debt)
+  acf(Beta_original$debt)
+  pacf(Beta_original$debt)
+  auto.arima(Beta_original$debt)
+
+  fit_B15 <- arima(Beta_original$debt, order = c(0,0,0))
+  model_predict_B15 <- predict(fit_B15, n.ahead=1)
+  pred_B15 <- as.numeric(model_predict_B15$pred)
+  pred_B15
+  beta_new[1,17] <- pred_B15
+
+
+  # For Equity
+
+  Beta_original$equity <- as.numeric(Beta_original$equity)
```

```
+  acf(Beta_original$equity)
+  pacf(Beta_original$equity)
+  auto.arima(Beta_original$equity)
+
+  fit_B16 <- arima(Beta_original$equity, order = c(0,0,0))
+  model_predict_B16 <- predict(fit_B16, n.ahead=1)
+  pred_B16 <- as.numeric(model_predict_B16$pred)
+  pred_B16
+  beta_new[1,18] <- pred_B16
+
+
+  # For Ev
+  Beta_original$ev <- as.numeric(Beta_original$ev)
+  acf(Beta_original$ev)
+  pacf(Beta_original$ev)
+  auto.arima(Beta_original$ev)
+
+  fit_B17 <- arima(Beta_original$ev, order = c(0,0,0))
+  model_predict_B17 <- predict(fit_B17, n.ahead=1)
+  pred_B17 <- as.numeric(model_predict_B17$pred)
+  pred_B17
+  beta_new[1,19] <- pred_B17
+
+
+  # For Pe
+  Beta_original$pe <- as.numeric(Beta_original$pe)
+  acf(Beta_original$pe)
+  pacf(Beta_original$pe)
+  auto.arima(Beta_original$pe)
+
+  fit_B18 <- arima(Beta_original$pe, order = c(0,0,0))
+  model_predict_B18 <- predict(fit_B18, n.ahead=1)
+  pred_B18 <- as.numeric(model_predict_B18$pred)
+  pred_B18
+  beta_new[1,20] <- pred_B18
+
```

```
+
+   # For Invcap
+   Beta_original$invcap <- as.numeric(Beta_original$invcap)
+   acf(Beta_original$invcap)
+   pacf(Beta_original$invcap)
+   auto.arima(Beta_original$invcap)
+
+   fit_B19 <- arima(Beta_original$invcap, order = c(0,0,0))
+   model_predict_B19 <- predict(fit_B19, n.ahead=1)
+   pred_B19 <- as.numeric(model_predict_B19$pred)
+   pred_B19
+   beta_new[1,21] <- pred_B19
+
+
+   # For Sps
+   Beta_original$sps <- as.numeric(Beta_original$sps)
+   acf(Beta_original$sps)
+   pacf(Beta_original$sps)
+   auto.arima(Beta_original$sps)
+
+   fit_B20 <- arima(Beta_original$sps, order = c(0,0,0))
+   model_predict_B20 <- predict(fit_B20, n.ahead=1)
+   pred_B20 <- as.numeric(model_predict_B20$pred)
+   pred_B20
+   beta_new[1,22] <- pred_B20
+
+
+   # Adding predicted Betas of new date to the original beta table
+   Beta_original<-rbind(Beta_original,beta_new)
+ }

> # Viewing the final beta table for 20 unique dates
> View(Beta_original)
> str(Beta_original)
'data.frame':    20 obs. of  22 variables:
 $ unique_date[1:15, 1]: Factor w/ 20 levels "12/31/11","12/31/12",..: 6 11 16 1 7 12 17 2 8 13 ...
```

```
 ..- attr(*, "names")= chr  NA NA NA NA ...
$ Intercept          : Named chr  "-2145.87660311051" "-6.78957298241683" "-29.722505348775" "-1.33815532094632" ...
 ..- attr(*, "names")= chr  NA NA NA NA ...
$ assets             : Named chr  "36350.1877219515" "-9.12062789920263" "14.0711399039146" "-1.16685350244577" ...
 ..- attr(*, "names")= chr  NA NA NA NA ...
$ revenue            : Named chr  "-82.6071972381867" "-0.190844844964577" "-0.122116980019212" "0.111052109235801" ...
 ..- attr(*, "names")= chr  NA NA NA NA ...
$ rnd                : Named chr  "-107.275879831866" "-0.312474779467536" "-0.121605714856824" "-0.0712213607784434" ...
 ..- attr(*, "names")= chr  NA NA NA NA ...
$ netinc             : Named chr  "-432.308079265618" "-2.38591889122996" "-3.13715889212867" "0.240940014262654" ...
 ..- attr(*, "names")= chr  NA NA NA NA ...
$ eps                : Named chr  "-128897.972535126" "454.042730563121" "4209.80251117773" "146.488424813107" ...
 ..- attr(*, "names")= chr  NA NA NA NA ...
$ shareswa           : Named chr  "29.9206520555468" "-0.281947655575927" "-0.00345960087698584" "-0.00636336241415939" ...
 ..- attr(*, "names")= chr  NA NA NA NA ...
$ ncfo               : Named chr  "373.086673135917" "0.172777509947463" "0.222184470931486" "-0.0399075523065712" ...
 ..- attr(*, "names")= chr  NA NA NA NA ...
$ depamor            : Named chr  "79.7580781983727" "-0.297882171071608" "-3.98241147782949" "0.998807792148837" ...
 ..- attr(*, "names")= chr  NA NA NA NA ...
$ ncfi               : Named chr  "2000.50320784152" "0.712382479601203" "-0.324060959303919" "0.143228381384825" ...
 ..- attr(*, "names")= chr  NA NA NA NA ...
$ capex              : Named chr  "994.661153149098" "0.112562943171045" "-0.475353016683756" "0.419198265090295" ...
 ..- attr(*, "names")= chr  NA NA NA NA ...
$ ncfdiv             : Named chr  "2682.87601625718" "-0.117013822987804" "-0.826477910071764" "0.15741471748131" ...
 ..- attr(*, "names")= chr  NA NA NA NA ...
$ equityusd          : Named chr  "-2609.96254769184" "-70.5307307844174" "-133.319585561949" "-3487.96378873616" ...
 ..- attr(*, "names")= chr  NA NA NA NA ...
$ liabilities        : Named chr  "-31118.1755477357" "10.1529640764025" "-17.5907628098238" "2.05030115019574" ...
 ..- attr(*, "names")= chr  NA NA NA NA ...
$ cashneq            : Named chr  "-334.258113651381" "1.18727832886678" "0.869053752414025" "0.245688244116501" ...
 ..- attr(*, "names")= chr  NA NA NA NA ...
$ debt               : Named chr  "1854.01474386817" "-10.6064697601644" "-6.98861701283568" "-1.45865775459036" ...
 ..- attr(*, "names")= chr  NA NA NA NA ...
$ equity             : Named chr  "0" "70.8703210621833" "132.135524722947" "3487.74402356989" ...
 ..- attr(*, "names")= chr  NA NA NA NA ...
$ ev                 : Named chr  "298.396848969069" "10.7835737837139" "3.96315678728029" "1.48797319802169" ...
```

```
  ..- attr(*, "names")= chr  NA NA NA NA ...
 $ pe               : Named chr  "-271.61087221049" "5.16693134381456" "3.45305648366898" "-0.119197132191437" ...
  ..- attr(*, "names")= chr  NA NA NA NA ...
 $ invcap           : Named chr  "-5715.8048013193" "-1.67204869861225" "6.53894428680256" "-0.820836970698782" ...
  ..- attr(*, "names")= chr  NA NA NA NA ...
 $ sps              : Named chr  "-276.094911651775" "0.196456546450787" "-0.361176560995633" "-0.343286969830697" ...
  ..- attr(*, "names")= chr  NA NA NA NA ...
> class(Beta_original)
[1] "data.frame"
>
> Beta_original <- data.frame((Beta_original), stringsAsFactors=FALSE)
> Beta_original[,2:22] <- apply(Beta_original[,2:22], 2, as.numeric)    #converting Betas into numeric data type
>
> #Calculating Expected Returns for t=16
> data_file_arq_final<-na.omit(data_file_arq_final)
> temp_pred<- data_file_arq_final[data_file_arq_final[,3]==unique_date[16,1], ]  #Subsetting data file with t=16
> temp_pred_16<-temp_pred[,-c(1,2,3,4,25)]
> rownames(temp_pred_16)<-1:nrow(temp_pred_16)
> exp_return = matrix(NA, nrow = nrow(temp_pred_16), ncol =1)
> beta_pred<-Beta_original[16,-c(1,2)]     #Expected 20 Beta values for t=16
> beta0<-Beta_original[16,2]              #Expected Beta0 for t=16
>
> for(k in 1:nrow(temp_pred_16))
+ {
+   exp_return[k,]<-
beta0+beta_pred[,1]*temp_pred_16[k,1]+beta_pred[,2]*temp_pred_16[k,2]+beta_pred[,3]*temp_pred_16[k,3]+beta_pred[,4]*temp_pred_16[k
]+beta_pred[,5]*temp_pred_16[k,5]+beta_pred[,6]*temp_pred_16[k,6]+beta_pred[,7]*temp_pred_16[k,7]+beta_pred[,8]*temp_pred_16[k,8]+b
ta_pred[,9]*temp_pred_16[k,9]+beta_pred[,10]*temp_pred_16[k,10]+beta_pred[,11]*temp_pred_16[k,11]+beta_pred[,12]*temp_pred_16[k,12
beta_pred[,13]*temp_pred_16[k,13]+beta_pred[,14]*temp_pred_16[k,14]+beta_pred[,15]*temp_pred_16[k,15]+beta_pred[,16]*temp_pred_16
,16]+beta_pred[,17]*temp_pred_16[k,17]+beta_pred[,18]*temp_pred_16[k,18]+beta_pred[,19]*temp_pred_16[k,19]+beta_pred[,20]*temp_pre
_16[k,20]
+ }
>
>
> exp_return_16<-as.data.frame(exp_return)
> exp_return_16<-cbind(temp_pred[,1],exp_return_16)
```

```
> colnames(exp_return_16)[1]<-"Tickers"
> colnames(exp_return_16)[2]<-"Exp_returns"
> #View(exp_return_16)
>
> #Sorting Expected returns in descending order
> exp_return_16_sort <- exp_return_16[order(-exp_return_16$Exp_returns),]
> rownames(exp_return_16_sort)<-1:nrow(exp_return_16_sort)   #Resquence the row numbers
> #View(exp_return_16_sort)
>
> #Subsetting Sorted Expected returns into 5 Quantiles
> K<-nrow(exp_return_16_sort)/5   #846 stock Expected Returns
>
> Q1_16<-exp_return_16_sort[1:820,]
> Q2_16<-exp_return_16_sort[821:1640,]
> Q3_16<-exp_return_16_sort[1641:2460,]
> Q4_16<-exp_return_16_sort[2461:3280,]
> Q5_16<-exp_return_16_sort[3281:4097,]
>
> m1_16<-mean(Q1_16$Exp_returns)
> m2_16<-mean(Q2_16$Exp_returns)
> m3_16<-mean(Q3_16$Exp_returns)
> m4_16<-mean(Q4_16$Exp_returns)
> m5_16<-mean(Q5_16$Exp_returns)
>
> m1_16
[1] 0.7570934
> m2_16
[1] -0.00625609
> m3_16
[1] -0.0306469
> m4_16
[1] -0.2134615
> m5_16
[1] -5.085965
>
> #Calculating Expected Returns for t=17
```

```
> temp_17<- data_file_arq_final[data_file_arq_final[,3]==unique_date[17,1], ]  #Subsetting data file with t=16
> temp_pred_17<-temp_17[,-c(1,2,3,4,25)]
> rownames(temp_pred_17)<-1:nrow(temp_pred_17)
> exp_return = matrix(NA, nrow = nrow(temp_pred_17), ncol =1)
> beta_pred<-Beta_original[17,-c(1,2)]     #Expected 20 Beta values for t=16
> beta0<-Beta_original[17,2]               #Expected Beta0 for t=16
>
> for(k in 1:nrow(temp_pred_17))
+ {
+   exp_return[k,]<-
beta0+beta_pred[,1]*temp_pred_17[k,1]+beta_pred[,2]*temp_pred_17[k,2]+beta_pred[,3]*temp_pred_17[k,3]+beta_pred[,4]*temp_pred_17[k
]+beta_pred[,5]*temp_pred_17[k,5]+beta_pred[,6]*temp_pred_17[k,6]+beta_pred[,7]*temp_pred_17[k,7]+beta_pred[,8]*temp_pred_17[k,8]+b
ta_pred[,9]*temp_pred_17[k,9]+beta_pred[,10]*temp_pred_17[k,10]+beta_pred[,11]*temp_pred_17[k,11]+beta_pred[,12]*temp_pred_17[k,12
beta_pred[,13]*temp_pred_17[k,13]+beta_pred[,14]*temp_pred_17[k,14]+beta_pred[,15]*temp_pred_17[k,15]+beta_pred[,16]*temp_pred_17
,16]+beta_pred[,17]*temp_pred_17[k,17]+beta_pred[,18]*temp_pred_17[k,18]+beta_pred[,19]*temp_pred_17[k,19]+beta_pred[,20]*temp_pre
_17[k,20]
+ }
>
>
> exp_return_17<-as.data.frame(exp_return)
> exp_return_17<-cbind(temp_17[,1],exp_return_17)
> colnames(exp_return_17)[1]<-"Tickers"
> colnames(exp_return_17)[2]<-"Exp_returns"
> #View(exp_return_17)
>
> #Sorting Expected returns in descending order
> exp_return_17_sort <- exp_return_17[order(-exp_return_17$Exp_returns),]
> rownames(exp_return_17_sort)<-1:nrow(exp_return_17_sort)   #Resquence the row numbers
> #View(exp_return_17_sort)
>
> #Subsetting Sorted Expected returns into 5 Quantiles
>
> Q1_17<-exp_return_17_sort[1:846,]
> Q2_17<-exp_return_17_sort[847:1692,]
> Q3_17<-exp_return_17_sort[1693:2538,]
> Q4_17<-exp_return_17_sort[2539:3385,]
```

```
> Q5_17<-exp_return_17_sort[3386:4232,]
>
> m1_17<-mean(Q1_17$Exp_returns)
> m2_17<-mean(Q2_17$Exp_returns)
> m3_17<-mean(Q3_17$Exp_returns)
> m4_17<-mean(Q4_17$Exp_returns)
> m5_17<-mean(Q5_17$Exp_returns)
>
> m1_17
[1] 0.7011557
> m2_17
[1] -0.004687938
> m3_17
[1] -0.02478149
> m4_17
[1] -0.1734334
> m5_17
[1] -4.937989

> #Calculating Expected Returns for t=18
> temp_18<- data_file_arq_final[data_file_arq_final[,3]==unique_date[18,1], ]  #Subsetting data file with t=16
> temp_pred_18<-temp_18[,-c(1,2,3,4,25)]
> rownames(temp_pred_18)<-1:nrow(temp_pred_18)
> exp_return = matrix(NA, nrow = nrow(temp_pred_18), ncol =1)
> beta_pred<-Beta_original[18,-c(1,2)]     #Expected 20 Beta values for t=16
> beta0<-Beta_original[18,2]              #Expected Beta0 for t=16
>
> for(k in 1:nrow(temp_pred_18))
+ {
+   exp_return[k,]<-
beta0+beta_pred[,1]*temp_pred_18[k,1]+beta_pred[,2]*temp_pred_18[k,2]+beta_pred[,3]*temp_pred_18[k,3]+beta_pred[,4]*temp_pred_18[k
]+beta_pred[,5]*temp_pred_18[k,5]+beta_pred[,6]*temp_pred_18[k,6]+beta_pred[,7]*temp_pred_18[k,7]+beta_pred[,8]*temp_pred_18[k,8]+b
ta_pred[,9]*temp_pred_18[k,9]+beta_pred[,10]*temp_pred_18[k,10]+beta_pred[,11]*temp_pred_18[k,11]+beta_pred[,12]*temp_pred_18[k,12
beta_pred[,13]*temp_pred_18[k,13]+beta_pred[,14]*temp_pred_18[k,14]+beta_pred[,15]*temp_pred_18[k,15]+beta_pred[,16]*temp_pred_18
,16]+beta_pred[,17]*temp_pred_18[k,17]+beta_pred[,18]*temp_pred_18[k,18]+beta_pred[,19]*temp_pred_18[k,19]+beta_pred[,20]*temp_pre
_18[k,20]
```

```
+ }
>
>
> exp_return_18<-as.data.frame(exp_return)
> exp_return_18<-cbind(temp_18[,1],exp_return_18)
> colnames(exp_return_18)[1]<-"Tickers"
> colnames(exp_return_18)[2]<-"Exp_returns"
> #View(exp_return_18)
>
> #Sorting Expected returns in descending order
> exp_return_18_sort <- exp_return_18[order(-exp_return_18$Exp_returns),]
> rownames(exp_return_18_sort)<-1:nrow(exp_return_18_sort)   #Resquence the row numbers
> #View(exp_return_18_sort)
>
> #Subsetting Sorted Expected returns into 5 Quantiles
> Q1_18<-exp_return_18_sort[1:847,]
> Q2_18<-exp_return_18_sort[848:1694,]
> Q3_18<-exp_return_18_sort[1695:2541,]
> Q4_18<-exp_return_18_sort[2542:3388,]
> Q5_18<-exp_return_18_sort[3389:4235,]
>
>
> m1_18<-mean(Q1_18$Exp_returns)
> m2_18<-mean(Q2_18$Exp_returns)
> m3_18<-mean(Q3_18$Exp_returns)
> m4_18<-mean(Q4_18$Exp_returns)
> m5_18<-mean(Q5_18$Exp_returns)
>
> m1_18
[1] 0.763772
> m2_18
[1] -0.00544848
> m3_18
[1] -0.02538056
> m4_18
[1] -0.177557
```

```
> m5_18
[1] -5.004281
>
> #Calculating Expected Returns for t=19
> temp_19<- data_file_arq_final[data_file_arq_final[,3]==unique_date[19,1], ]  #Subsetting data file with t=19
> temp_pred_19<-temp_19[,-c(1,2,3,4,25)]
> rownames(temp_pred_19)<-1:nrow(temp_pred_19)
> exp_return = matrix(NA, nrow = nrow(temp_pred_19), ncol =1)
> beta_pred<-Beta_original[19,-c(1,2)]     #Expected 20 Beta values for t=19
> beta0<-Beta_original[19,2]               #Expected Beta0 for t=19
>
> for(k in 1:nrow(temp_pred_19))
+ {
+   exp_return[k,]<-
beta0+beta_pred[,1]*temp_pred_19[k,1]+beta_pred[,2]*temp_pred_19[k,2]+beta_pred[,3]*temp_pred_19[k,3]+beta_pred[,4]*temp_pred_19[k
]+beta_pred[,5]*temp_pred_19[k,5]+beta_pred[,6]*temp_pred_19[k,6]+beta_pred[,7]*temp_pred_19[k,7]+beta_pred[,8]*temp_pred_19[k,8]+b
ta_pred[,9]*temp_pred_19[k,9]+beta_pred[,10]*temp_pred_19[k,10]+beta_pred[,11]*temp_pred_19[k,11]+beta_pred[,12]*temp_pred_19[k,12
beta_pred[,13]*temp_pred_19[k,13]+beta_pred[,14]*temp_pred_19[k,14]+beta_pred[,15]*temp_pred_19[k,15]+beta_pred[,16]*temp_pred_19
,16]+beta_pred[,17]*temp_pred_19[k,17]+beta_pred[,18]*temp_pred_19[k,18]+beta_pred[,19]*temp_pred_19[k,19]+beta_pred[,20]*temp_pre
_19[k,20]
+ }
>
>
> exp_return_19<-as.data.frame(exp_return)
> exp_return_19<-cbind(temp_19[,1],exp_return_19)
> colnames(exp_return_19)[1]<-"Tickers"
> colnames(exp_return_19)[2]<-"Exp_returns"
> #View(exp_return_19)
>
> #Sorting Expected returns in descending order
> exp_return_19_sort <- exp_return_19[order(-exp_return_19$Exp_returns),]
> rownames(exp_return_19_sort)<-1:nrow(exp_return_19_sort)   #Resquence the row numbers
> #View(exp_return_19_sort)
>
> #Subsetting Sorted Expected returns into 5 Quantiles
> Q1_19<-exp_return_19_sort[1:843,]
```

```
> Q2_19<-exp_return_19_sort[844:1686,]
> Q3_19<-exp_return_19_sort[1687:2529,]
> Q4_19<-exp_return_19_sort[2530:3373,]
> Q5_19<-exp_return_19_sort[3374:4217,]
>
> m1_19<-mean(Q1_19$Exp_returns)
> m2_19<-mean(Q2_19$Exp_returns)
> m3_19<-mean(Q3_19$Exp_returns)
> m4_19<-mean(Q4_19$Exp_returns)
> m5_19<-mean(Q5_19$Exp_returns)
>
> m1_19
[1] 0.7421421
> m2_19
[1] -0.004769705
> m3_19
[1] -0.02575367
> m4_19
[1] -0.1692567
> m5_19
[1] -4.789281
>
> #Calculating Expected Returns for t=20
> temp_20<- data_file_arq_final[data_file_arq_final[,3]==unique_date[20,1], ]  #Subsetting data file with t=20
> temp_pred_20<-temp_20[,-c(1,2,3,4,25)]
> rownames(temp_pred_20)<-1:nrow(temp_pred_20)
> exp_return = matrix(NA, nrow = nrow(temp_pred_20), ncol =1)
> beta_pred<-Beta_original[20,-c(1,2)]     #Expected 20 Beta values for t=20
> beta0<-Beta_original[20,2]               #Expected Beta0 for t=20
>
> for(k in 1:nrow(temp_pred_20))
+ {
+   exp_return[k,]<-
beta0+beta_pred[,1]*temp_pred_20[k,1]+beta_pred[,2]*temp_pred_20[k,2]+beta_pred[,3]*temp_pred_20[k,3]+beta_pred[,4]*temp_pred_20[k
]+beta_pred[,5]*temp_pred_20[k,5]+beta_pred[,6]*temp_pred_20[k,6]+beta_pred[,7]*temp_pred_20[k,7]+beta_pred[,8]*temp_pred_20[k,8]+b
ta_pred[,9]*temp_pred_20[k,9]+beta_pred[,10]*temp_pred_20[k,10]+beta_pred[,11]*temp_pred_20[k,11]+beta_pred[,12]*temp_pred_20[k,12
```

```
beta_pred[,13]*temp_pred_20[k,13]+beta_pred[,14]*temp_pred_20[k,14]+beta_pred[,15]*temp_pred_20[k,15]+beta_pred[,16]*temp_pred_20
,16]+beta_pred[,17]*temp_pred_20[k,17]+beta_pred[,18]*temp_pred_20[k,18]+beta_pred[,19]*temp_pred_20[k,19]+beta_pred[,20]*temp_pre
_20[k,20]
+ }
>
>
> exp_return_20<-as.data.frame(exp_return)
> exp_return_20<-cbind(temp_20[,1],exp_return_20)
> colnames(exp_return_20)[1]<-"Tickers"
> colnames(exp_return_20)[2]<-"Exp_returns"
> #View(exp_return_20)
>
> #Sorting Expected returns in descending order
> exp_return_20_sort <- exp_return_20[order(-exp_return_20$Exp_returns),]
> rownames(exp_return_20_sort)<-1:nrow(exp_return_20_sort)   #Resquence the row numbers
> #View(exp_return_20_sort)
>
> #Subsetting Sorted Expected returns into 5 Quantiles
> Q1_20<-exp_return_20_sort[1:824,]
> Q2_20<-exp_return_20_sort[825:1648,]
> Q3_20<-exp_return_20_sort[1649:2472,]
> Q4_20<-exp_return_20_sort[2473:3296,]
> Q5_20<-exp_return_20_sort[3297:4120,]
>
> m1_20<-mean(Q1_20$Exp_returns)
> m2_20<-mean(Q2_20$Exp_returns)
> m3_20<-mean(Q3_20$Exp_returns)
> m4_20<-mean(Q4_20$Exp_returns)
> m5_20<-mean(Q5_20$Exp_returns)
>
> m1_20
[1] 0.7054407
> m2_20
[1] -0.005656839
> m3_20
[1] -0.02811991
```

```
> m4_20
[1] -0.1903105
> m5_20
[1] -5.14467
```

Sector – Consumer Discretionary#################################

```
> # Financial Modeling for Sector - Consumer Discretionary
>
> library(forecast)
> library(tseries)
> # Reading ARQ data file
> data_file_arq <- read.csv('/Users/mohitsupe/Documents/W_Desktop/p1_PA/data_file_ARQ.csv')
> #View(data_file_arq)
>
> # Selecting Factors
> data_file_arq_2 <- data_file_arq[c(1,2,3,72,7,77,79,61,30,87,59,21,58,13,56,35,49,14,19,33,36,69,46,89)]
> #View(data_file_arq_2)
>
> #Removing NAs
>
> data_file_arq_2 <- data_file_arq_2[!is.na(data_file_arq_2$price),]
> data_file_arq_2 <- data_file_arq_2[!is.na(data_file_arq_2$assets),]
> data_file_arq_2 <- data_file_arq_2[!is.na(data_file_arq_2$revenue),]
> data_file_arq_2 <- data_file_arq_2[!is.na(data_file_arq_2$rnd),]
> data_file_arq_2 <- data_file_arq_2[!is.na(data_file_arq_2$netinc),]
> data_file_arq_2 <- data_file_arq_2[!is.na(data_file_arq_2$eps),]
> data_file_arq_2 <- data_file_arq_2[!is.na(data_file_arq_2$shareswa),]
> data_file_arq_2 <- data_file_arq_2[!is.na(data_file_arq_2$ncfo),]
> data_file_arq_2 <- data_file_arq_2[!is.na(data_file_arq_2$depamor),]
> data_file_arq_2 <- data_file_arq_2[!is.na(data_file_arq_2$ncfi),]
> data_file_arq_2 <- data_file_arq_2[!is.na(data_file_arq_2$capex),]
> data_file_arq_2 <- data_file_arq_2[!is.na(data_file_arq_2$ncfdiv),]
```

```
> data_file_arq_2 <- data_file_arq_2[!is.na(data_file_arq_2$equityusd),]
> data_file_arq_2 <- data_file_arq_2[!is.na(data_file_arq_2$liabilities),]
> data_file_arq_2 <- data_file_arq_2[!is.na(data_file_arq_2$cashneq),]
> data_file_arq_2 <- data_file_arq_2[!is.na(data_file_arq_2$debt),]
> data_file_arq_2 <- data_file_arq_2[!is.na(data_file_arq_2$equity),]
> data_file_arq_2 <- data_file_arq_2[!is.na(data_file_arq_2$ev),]
> data_file_arq_2 <- data_file_arq_2[!is.na(data_file_arq_2$pe),]
> data_file_arq_2 <- data_file_arq_2[!is.na(data_file_arq_2$invcap),]
> data_file_arq_2 <- data_file_arq_2[!is.na(data_file_arq_2$sps),]
> rownames(data_file_arq_2) <- seq(length=nrow(data_file_arq_2))
> names(data_file_arq_2)
 [1] "ticker"      "dimension"   "calendardate" "price"       "assets"      "revenue"
 [7] "rnd"         "netinc"      "eps"          "shareswa"    "ncfo"        "depamor"
[13] "ncfi"        "capex"       "ncfdiv"       "equityusd"   "liabilities" "cashneq"
[19] "debt"        "equity"      "ev"           "pe"          "invcap"      "sps"
> #View(data_file_arq_2)
>
> # Sorting DataKey
>
> data_file_arq_2 <- data_file_arq_2[order(data_file_arq_2$ticker,as.Date(data_file_arq_2$calendardate,format="%m/%d/%y")),]
> #View(data_file_arq_2)
>
> # Normalizing the data
>
> n <- nrow(data_file_arq_2)
>
> n_func <- function(n)
+ {
+   return((n - min(n))/(max(n)-min(n)))
+ }
>
> data_file_arq_n <- as.data.frame(lapply(data_file_arq_2[,4:24], n_func))
> str(data_file_arq_n)
'data.frame':   84447 obs. of  21 variables:
 $ price     : num  0.00221 0.00229 0.00171 0.00161 0.00205 ...
 $ assets    : num  0.00242 0.00261 0.00264 0.00273 0.00274 ...
```

```
 $ revenue    : num  0.0775 0.0786 0.0787 0.079 0.0783 ...
 $ rnd        : num  0.0779 0.0795 0.0787 0.079 0.0787 ...
 $ netinc     : num  0.191 0.191 0.192 0.192 0.191 ...
 $ eps        : num  0.00692 0.00692 0.00692 0.00692 0.00692 ...
 $ shareswa   : num  0.0321 0.0321 0.0322 0.0321 0.0322 ...
 $ ncfo       : num  0.276 0.278 0.277 0.28 0.276 ...
 $ depamor    : num  0.0469 0.0469 0.0469 0.0469 0.0469 ...
 $ ncfi       : num  0.546 0.542 0.542 0.542 0.542 ...
 $ capex      : num  0.467 0.467 0.467 0.467 0.467 ...
 $ ncfdiv     : num  0.664 0.664 0.664 0.664 0.664 ...
 $ equityusd  : num  0.0629 0.0652 0.066 0.0665 0.0672 ...
 $ liabilities: num  0.00166 0.00165 0.00161 0.00167 0.00163 ...
 $ cashneq    : num  0.00679 0.00761 0.00793 0.00902 0.00937 ...
 $ debt       : num  0.000773 0.000775 0.000783 0.000789 0.000788 ...
 $ equity     : num  0.0629 0.0652 0.066 0.0665 0.0672 ...
 $ ev         : num  0.026 0.0261 0.025 0.0247 0.0254 ...
 $ pe         : num  0.64 0.64 0.64 0.64 0.64 ...
 $ invcap     : num  0.000917 0.000912 0.000928 0.000862 0.000866 ...
 $ sps        : num  0.0109 0.011 0.011 0.011 0.011 ...
> summary(data_file_arq_n)
    price              assets             revenue              rnd                netinc
 Min.   :0.0000000   Min.   :0.0000000   Min.   :0.00000   Min.   :0.00000   Min.   :0.0000
 1st Qu.:0.0004362   1st Qu.:0.0000458   1st Qu.:0.06687   1st Qu.:0.03488   1st Qu.:0.1878
 Median :0.0011195   Median :0.0002297   Median :0.06739   Median :0.03488   Median :0.1879
 Mean   :0.0019305   Mean   :0.0030379   Mean   :0.07286   Mean   :0.03908   Mean   :0.1887
 3rd Qu.:0.0023785   3rd Qu.:0.0009668   3rd Qu.:0.06975   3rd Qu.:0.03524   3rd Qu.:0.1882
 Max.   :1.0000000   Max.   :1.0000000   Max.   :1.00000   Max.   :1.00000   Max.   :1.0000
     eps              shareswa             ncfo             depamor             ncfi
 Min.   :0.000000   Min.   :0.000000   Min.   :0.0000   Min.   :0.00000   Min.   :0.0000
 1st Qu.:0.006915   1st Qu.:0.001391   1st Qu.:0.2744   1st Qu.:0.04537   1st Qu.:0.5419
 Median :0.006915   Median :0.003545   Median :0.2745   Median :0.04545   Median :0.5420
 Mean   :0.006927   Mean   :0.012128   Mean   :0.2757   Mean   :0.04643   Mean   :0.5418
 3rd Qu.:0.006916   3rd Qu.:0.008645   3rd Qu.:0.2749   3rd Qu.:0.04586   3rd Qu.:0.5420
 Max.   :1.000000   Max.   :1.000000   Max.   :1.0000   Max.   :1.00000   Max.   :1.0000
    capex              ncfdiv            equityusd          liabilities          cashneq
 Min.   :0.0000   Min.   :0.0000   Min.   :0.00000   Min.   :0.0000000   Min.   :0.0000000
```

```
 1st Qu.:0.4679   1st Qu.:0.6627   1st Qu.:0.05070   1st Qu.:0.0002337   1st Qu.:0.0000306
 Median :0.4686   Median :0.6638   Median :0.05141   Median :0.0003492   Median :0.0001331
 Mean   :0.4666   Mean   :0.6585   Mean   :0.05793   Mean   :0.0026637   Mean   :0.0018007
 3rd Qu.:0.4687   3rd Qu.:0.6638   3rd Qu.:0.05435   3rd Qu.:0.0008474   3rd Qu.:0.0005104
 Max.   :1.0000   Max.   :1.0000   Max.   :1.00000   Max.   :1.0000000   Max.   :1.0000000
     debt              equity             ev                pe             invcap
 Min.   :0.0000000   Min.   :0.00000   Min.   :0.00000   Min.   :0.0000   Min.   :0.0000000
 1st Qu.:0.0000127   1st Qu.:0.05070   1st Qu.:0.02226   1st Qu.:0.6399   1st Qu.:0.0002258
 Median :0.0000475   Median :0.05141   Median :0.02246   Median :0.6399   Median :0.0003070
 Mean   :0.0011823   Mean   :0.05793   Mean   :0.02484   Mean   :0.6399   Mean   :0.0020385
 3rd Qu.:0.0003054   3rd Qu.:0.05435   3rd Qu.:0.02339   3rd Qu.:0.6400   3rd Qu.:0.0006737
 Max.   :1.0000000   Max.   :1.00000   Max.   :1.00000   Max.   :1.0000   Max.   :1.0000000
     sps
 Min.   :0.00000
 1st Qu.:0.01068
 Median :0.01080
 Mean   :0.01124
 3rd Qu.:0.01111
 Max.   :1.00000
>
> data_file_arq_3 <- cbind(data_file_arq_2[,c(1,2,3)],data_file_arq_n)
> #View(data_file_arq_3)
>
> # Calculating the returns
>
> returns <- vector()
> for(i in 2: nrow(data_file_arq_3))
+ {
+   if(identical(data_file_arq_3[i,1], data_file_arq_3[i-1,1]))
+   {
+     returns[i] <- log(data_file_arq_3[i,4]/data_file_arq_3[i-1,4])
+   }
+   else
+   {
+     returns[i] <- NA
+   }
```

```
+ }

> #warnings()
> #View(as.data.frame(returns))
> hist(returns, prob = T, breaks = 3000, main= 'Histogram of Returns')
>
> data_file_arq_f <- cbind(data_file_arq_3,returns)
> #View(data_file_arq_final)
>
> data_file_arq_f <- data_file_arq_f[!is.na(data_file_arq_f$returns),]
> data_file_arq_f <- subset(data_file_arq_f[data_file_arq_f$returns!=0,])
> data_file_arq_f <- subset(data_file_arq_f[data_file_arq_f$returns!=-Inf,])
> data_file_arq_f <- subset(data_file_arq_f[data_file_arq_f$returns!=Inf,])
> summary(data_file_arq_f)
   ticker     dimension    calendardate      price              assets            revenue
 ETAK   :  23   ARQ:78200   6/30/15: 4235   Min.   :0.0000001   Min.   :0.0000000   Min.   :0.00000
 GALE   :  23               3/31/15: 4232   1st Qu.:0.0004450   1st Qu.:0.0000489   1st Qu.:0.06687
 NNVC   :  23               9/30/15: 4217   Median :0.0011389   Median :0.0002398   Median :0.06742
 CUI    :  22              6/30/14: 4150   Mean   :0.0019584   Mean   :0.0030834   Mean   :0.07301
 GTIM   :  22               9/30/14: 4150   3rd Qu.:0.0024268   3rd Qu.:0.0010039   3rd Qu.:0.06988
 HPT    :  22               3/31/14: 4133   Max.   :1.0000000   Max.   :1.0000000   Max.   :1.00000
 (Other):78065              (Other):53083
    rnd             netinc             eps              shareswa             ncfo
 Min.   :0.00000   Min.   :0.0000   Min.   :0.000000   Min.   :0.0000002   Min.   :0.0000
 1st Qu.:0.03488   1st Qu.:0.1878   1st Qu.:0.006915   1st Qu.:0.0014253   1st Qu.:0.2744
 Median :0.03488   Median :0.1879   Median :0.006915   Median :0.0036011   Median :0.2745
 Mean   :0.03920   Mean   :0.1887   Mean   :0.006915   Mean   :0.0122815   Mean   :0.2757
 3rd Qu.:0.03524   3rd Qu.:0.1882   3rd Qu.:0.006916   3rd Qu.:0.0087625   3rd Qu.:0.2750
 Max.   :1.00000   Max.   :1.0000   Max.   :0.024751   Max.   :1.0000000   Max.   :1.0000

   depamor             ncfi             capex             ncfdiv          equityusd
 Min.   :0.00000   Min.   :0.04065   Min.   :0.0000   Min.   :0.0000   Min.   :0.00000
 1st Qu.:0.04538   1st Qu.:0.54189   1st Qu.:0.4679   1st Qu.:0.6626   1st Qu.:0.05071
 Median :0.04546   Median :0.54199   Median :0.4686   Median :0.6638   Median :0.05144
 Mean   :0.04647   Mean   :0.54179   Mean   :0.4665   Mean   :0.6583   Mean   :0.05812
 3rd Qu.:0.04588   3rd Qu.:0.54201   3rd Qu.:0.4687   3rd Qu.:0.6638   3rd Qu.:0.05447
```

```
 Max.   :1.00000   Max.   :1.00000   Max.   :1.0000   Max.   :1.0000   Max.   :1.00000

  liabilities          cashneq              debt              equity             ev
 Min.   :0.0000000   Min.   :0.0000000   Min.   :0.0000000   Min.   :0.00000   Min.   :0.00000
 1st Qu.:0.0002349   1st Qu.:0.0000320   1st Qu.:0.0000129   1st Qu.:0.05071   1st Qu.:0.02226
 Median :0.0003565   Median :0.0001367   Median :0.0000503   Median :0.05144   Median :0.02247
 Mean   :0.0026936   Mean   :0.0018346   Mean   :0.0011765   Mean   :0.05812   Mean   :0.02488
 3rd Qu.:0.0008723   3rd Qu.:0.0005242   3rd Qu.:0.0003196   3rd Qu.:0.05447   3rd Qu.:0.02344
 Max.   :1.0000000   Max.   :1.0000000   Max.   :1.0000000   Max.   :1.00000   Max.   :1.00000

      pe             invcap              sps              returns
 Min.   :0.0000   Min.   :0.0000000   Min.   :0.00000   Min.   :-3.852509
 1st Qu.:0.6399   1st Qu.:0.0002269   1st Qu.:0.01069   1st Qu.:-0.105532
 Median :0.6399   Median :0.0003112   Median :0.01080   Median : 0.005299
 Mean   :0.6399   Mean   :0.0020514   Mean   :0.01124   Mean   :-0.017878
 3rd Qu.:0.6400   3rd Qu.:0.0006891   3rd Qu.:0.01112   3rd Qu.: 0.098947
 Max.   :1.0000   Max.   :1.0000000   Max.   :1.00000   Max.   :10.995411

> #View(data_file_arq_f)
>
> # Importing IWB Holdings file
> iwb_holdings <- read.csv('/Users/mohitsupe/Documents/W_Desktop/p1_PA/hw4/IWB_holdings.csv', header = TRUE)
> colnames(iwb_holdings)[1] <- paste('ticker')
> #View(iwb_holdings)
>
> # Merging final_data_arq and iwb_holdings using ticker
> merged_data <- merge(data_file_arq_f, iwb_holdings[,c(1,9)], by= c('ticker'))
> #View(merged_data)
>
> # Selecting data for Financials Sector
> data_file_arq_final <- merged_data[which(merged_data$Sector == 'Consumer Discretionary'),]
> rownames(data_file_arq_final) <- seq(length=nrow(data_file_arq_final))
> #View(data_file_arq_final)
>
> # Check unique dates
> unique_date <- as.data.frame(unique(data_file_arq_final$calendardate))
```

```
> colnames(unique_date)[1]<-"Unique_date"
> unique_date<-as.data.frame(unique_date[order(as.Date(unique_date$Unique_date, format="%m/%d/%Y")),])
> colnames(unique_date)[1]<-"Unique_date"
> View(unique_date)
>
> #Calculating Actual returns for t=16 to 20
>
> #For t=16
> Actual_returns_16 <- data_file_arq_final[data_file_arq_final$calendardate==unique_date[16,],c(1,25)]
> Actual_returns_16 <- Actual_returns_16[order(-Actual_returns_16$returns),]
> rownames(Actual_returns_16)<-1:nrow(Actual_returns_16)
> View(Actual_returns_16)
>
> n<-nrow(Actual_returns_16)/5
> n
[1] 26.8
> org_Q1_16<-Actual_returns_16[1:27,]
> org_Q2_16<-Actual_returns_16[28:54,]
> org_Q3_16<-Actual_returns_16[55:81,]
> org_Q4_16<-Actual_returns_16[82:108,]
> org_Q5_16<-Actual_returns_16[109:134,]
>
> org_m1_16<-mean(org_Q1_16$returns)
> org_m2_16<-mean(org_Q2_16$returns)
> org_m3_16<-mean(org_Q3_16$returns)
> org_m4_16<-mean(org_Q4_16$returns)
> org_m5_16<-mean(org_Q5_16$returns)
>
> org_m1_16
[1] 0.2323264
> org_m2_16
[1] 0.1463405
> org_m3_16
[1] 0.09986251
> org_m4_16
[1] 0.04132309
```

```
> org_m5_16
[1] -0.1037609
>
> #For t=17
> Actual_returns_17 <- data_file_arq_final[data_file_arq_final$calendardate==unique_date[17,],c(1,25)]   #t=17
> Actual_returns_17 <- Actual_returns_17[order(-Actual_returns_17$returns),]
> rownames(Actual_returns_17)<-1:nrow(Actual_returns_17)
> View(Actual_returns_17)
>
> org_Q1_17<-Actual_returns_17[1:27,]
> org_Q2_17<-Actual_returns_17[27:54,]
> org_Q3_17<-Actual_returns_17[55:81,]
> org_Q4_17<-Actual_returns_17[82:108,]
> org_Q5_17<-Actual_returns_17[109:136,]
>
> org_m1_17<-mean(org_Q1_17$returns)
> org_m2_17<-mean(org_Q2_17$returns)
> org_m3_17<-mean(org_Q3_17$returns)
> org_m4_17<-mean(org_Q4_17$returns)
> org_m5_17<-mean(org_Q5_17$returns)
>
> org_m1_17
[1] 0.185644
> org_m2_17
[1] 0.0831725
> org_m3_17
[1] 0.03030963
> org_m4_17
[1] -0.02915373
> org_m5_17
[1] -0.1314887
>
> #For t=18
> Actual_returns_18 <- data_file_arq_final[data_file_arq_final$calendardate==unique_date[18,],c(1,25)]   #t=18
> Actual_returns_18 <- Actual_returns_18[order(-Actual_returns_18$returns),]
> rownames(Actual_returns_18)<-1:nrow(Actual_returns_18)
```

```
> View(Actual_returns_18)
>
> org_Q1_18<-Actual_returns_18[1:27,]
> org_Q2_18<-Actual_returns_18[28:54,]
> org_Q3_18<-Actual_returns_18[55:81,]
> org_Q4_18<-Actual_returns_18[82:109,]
> org_Q5_18<-Actual_returns_18[110:137,]
>
> org_m1_18<-mean(org_Q1_18$returns)
> org_m2_18<-mean(org_Q2_18$returns)
> org_m3_18<-mean(org_Q3_18$returns)
> org_m4_18<-mean(org_Q4_18$returns)
> org_m5_18<-mean(org_Q5_18$returns)
>
> org_m1_18
[1] 0.1534309
> org_m2_18
[1] 0.05243591
> org_m3_18
[1] -0.01093351
> org_m4_18
[1] -0.07138198
> org_m5_18
[1] -0.1899316
>
> #For t=19
> Actual_returns_19 <- data_file_arq_final[data_file_arq_final$calendardate==unique_date[19,],c(1,25)]   #t=19
> Actual_returns_19 <- Actual_returns_19[order(-Actual_returns_19$returns),]
> rownames(Actual_returns_19)<-1:nrow(Actual_returns_19)
> View(Actual_returns_19)
>
> org_Q1_19<-Actual_returns_19[1:27,]
> org_Q2_19<-Actual_returns_19[28:54,]
> org_Q3_19<-Actual_returns_19[55:81,]
> org_Q4_19<-Actual_returns_19[82:109,]
> org_Q5_19<-Actual_returns_19[110:137,]
```

```
>
> org_m1_19<-mean(org_Q1_19$returns)
> org_m2_19<-mean(org_Q2_19$returns)
> org_m3_19<-mean(org_Q3_19$returns)
> org_m4_19<-mean(org_Q4_19$returns)
> org_m5_19<-mean(org_Q5_19$returns)
>
> org_m1_19
[1] 0.1160497
> org_m2_19
[1] 0.0291787
> org_m3_19
[1] -0.01823692
> org_m4_19
[1] -0.08991317
> org_m5_19
[1] -0.2240586
>
> #For t=20
> Actual_returns_20 <- data_file_arq_final[data_file_arq_final$calendardate==unique_date[20,],c(1,25)]
> Actual_returns_20 <- Actual_returns_20[order(-Actual_returns_20$returns),]
> rownames(Actual_returns_20)<-1:nrow(Actual_returns_20)
> View(Actual_returns_20)
>
> org_Q1_20<-Actual_returns_20[1:27,]
> org_Q2_20<-Actual_returns_20[28:54,]
> org_Q3_20<-Actual_returns_20[55:81,]
> org_Q4_20<-Actual_returns_20[82:109,]
> org_Q5_20<-Actual_returns_20[110:137,]
>
> org_m1_20<-mean(org_Q1_20$returns)
> org_m2_20<-mean(org_Q2_20$returns)
> org_m3_20<-mean(org_Q3_20$returns)
> org_m4_20<-mean(org_Q4_20$returns)
> org_m5_20<-mean(org_Q5_20$returns)
>
```

```
> org_m1_20
[1] 0.1418429
> org_m2_20
[1] -0.01743718
> org_m3_20
[1] -0.08674228
> org_m4_20
[1] -0.194515
> org_m5_20
[1] -0.3262333

> #Storing values of Betas for 15 unique dates
> beta = matrix(NA, nrow = 15, ncol = 20)
> beta0=matrix(NA,nrow=15,ncol=1)
> colnames(beta) <- colnames(data_file_arq_final[,-c(1,2,3,4,25,26)])
>
> for ( j in 1:15)
+ {
+
+   temp <- data_file_arq_final[data_file_arq_final[,3]==unique_date[j,1], ]
+   my.beta <-
lm(returns~assets+revenue+rnd+netinc+eps+shareswa+ncfo+depamor+ncfi+capex+ncfdiv+equityusd+liabilities+cashneq+debt+equity+ev+pe+inv
ap+sps,data=temp)
+   Coef<-coef(my.beta)
+   beta[j,colnames(beta) %in% names(Coef)] <- Coef[names(Coef) %in% colnames(beta)]
+   beta0[j,]<-Coef[1]
+ }
> print(beta)
        assets   revenue       rnd      netinc       eps    shareswa      ncfo     depamor
 [1,]  -79.48268        NA        NA        NA        NA        NA        NA          NA
 [2,] -337.49816  2.3377069 -2.0652425   1.5300708   7236.8271 -0.20890193  0.8977333  -7.91881606
 [3,]   59.11170  1.9722974 -1.7566959  -0.9835099  -4597.7316 -0.31229626  5.9081244 -45.03115376
 [4,]   21.16437  0.1431401 -0.9201398  -5.6014256   4330.9285  0.22155372 -2.1837054   1.81248546
 [5,] -106.10422  2.0783724  0.6702238  -3.2154534   8750.5125  0.13386166  5.1062755 -21.75318968
 [6,] -105.92009  0.4280254 -0.3623613   2.6501370  -1883.1723 -0.37667527  4.1797699 -12.69158856
 [7,] -113.39791 -0.8813268  1.3550056  -2.4764439 -12770.7691  0.02676007 19.2799890   8.36364027
```

```
 [8,]  -12.96506 -2.7543222  3.6857708  -4.5012527   -365.8494 -0.05642393  9.1990613   1.44034149
 [9,]   40.66632  0.7209325 -0.4416691  -4.0858850  -4874.3211 -0.13700416  4.3949481  -0.76910834
[10,]  -32.44078 -0.5263740 -2.7354968 -12.4082490  -2583.3455  0.10230060  4.9271286  10.38110387
[11,]   16.07331 -0.8329303  0.1573787   3.5375536  -1772.6665 -0.06795498  5.8918961   9.13161811
[12,]  123.53257 -2.8675766 -0.1446729  -9.3604952    774.2635 -0.37135284 -0.2727955   0.08397154
[13,]   56.50934 -2.6748885 -0.3388439  20.8043843  -3450.0523 -0.32536300 -1.7152654   5.64710750
[14,]  -94.75341 -0.5410793 -0.9385884  -8.2424823    207.9049  0.04345318  3.4155973   2.93935880
[15,] -182.44462  1.2441869 -0.6934722  -1.5650870  -3818.8187 -0.08827729 -0.6463558  -3.60517571
          ncfi        capex      ncfdiv   equityusd liabilities   cashneq       debt equity         ev
 [1,]       NA           NA          NA          NA          NA        NA         NA     NA         NA
 [2,]  42.606069 -8.3199197307  1.96362398  25.0236023  320.729638  6.834187  29.593304     NA 17.52140348
 [3,] -28.161031 -5.0220408574  0.93461370  -4.5837178 -118.163285  9.487491 100.908007     NA 12.94278159
 [4,]  18.598691  3.1475725398  0.75473170  -3.7106053  -11.751231  3.574272 -20.419215     NA  8.15651708
 [5,]  25.156318 -6.5728780785  1.20466139   9.5692735   60.909895 -3.099723  29.638527     NA  5.99524972
 [6,]  -2.109591 -2.5300484619  1.47369888  10.2290343   76.440867  3.554573  88.537769     NA  2.85995075
 [7,]  12.268043  7.8387717534  2.24451641   7.9792047  130.251052  2.058289 -56.357591     NA  3.21439260
 [8,]  -2.097443 13.0079575796  0.09365418   0.2801091   19.271766 -1.858162   6.689830     NA  9.02761980
 [9,]  19.859793  0.3446138236  1.48065579  -4.9587207  -40.968393  3.189361   6.642072     NA  7.63114925
[10,] -13.781731  2.4250822365  1.16372819   0.3247202   59.107642 -2.448427 -26.843516     NA  9.30009115
[11,] -15.308925  6.1733365180  1.05119783  -2.6740004   -2.278787  2.944050 -17.707507     NA -0.09087119
[12,]  14.652438  1.3864603513 -0.33177157 -12.8436327  -74.646317 -4.569593 -94.867553     NA 13.30174753
[13,]  13.491719 -0.3336671052  0.47072471  -6.2466938  -17.743966 -7.042195 -89.732694     NA -1.82459372
[14,]  11.574944 -0.0007355678  1.60422609   6.8962763   99.090197  5.500205  13.786274     NA  6.60969160
[15,]   5.768132 -0.8381400728  1.02762141  14.9230639  171.597210 -2.396948  -9.532262     NA  5.08324543
            pe     invcap        sps
 [1,]       NA         NA         NA
 [2,]   3.624654 -54.676675 -19.8323643
 [3,]  -2.116384 -59.979444  -0.3736597
 [4,] -201.491904  24.973093 -10.1166849
 [5,]  10.722881   4.953206 -16.1331056
 [6,] 259.403155 -54.692270   4.1030977
 [7,] -107.254556  30.149482  42.0705656
 [8,]  80.857218  21.688009   6.0486659
 [9,]  40.501986  -8.180901  -2.9603854
[10,] -162.289570 -13.066495   4.2154363
[11,]   6.356254   2.341022   3.4616741
```

```
[12,] -165.293857  47.469861   5.7489281
[13,]   75.215848  58.180979   9.6870941
[14,]   80.454459 -16.978999   3.6387407
[15,]   -5.485956   6.837733  14.7089014
> print(beta0)
            [,1]
 [1,]    0.1148567
 [2,]  -74.6804443
 [3,]   50.7025495
 [4,]   88.7574797
 [5,]  -79.0963539
 [6,] -153.3891653
 [7,]  139.0467443
 [8,]  -56.1281042
 [9,]   -4.3402611
[10,]  127.7194968
[11,]   10.4173871
[12,]   94.4443465
[13,]  -35.0186963
[14,]  -60.2500070
[15,]   26.0379246
> colnames(beta0)[1]<-"Intercept"
> beta<-as.data.frame(beta)
> beta0<-as.data.frame(beta0)
> Beta_original<-cbind(unique_date[1:15,1],beta0,beta)
> View(Beta_original)
> Beta_original[is.na(Beta_original)] <- 0

> #ARIMA Predictions(Install Forecast & Timeseries package)
>
> for(i in 16:20)
+ {
+   beta_new = matrix(NA, nrow = 1, ncol = 22)
+   colnames(beta_new) <- colnames(Beta_original)
+   beta_new[1,1] <- as.matrix(unique_date[i,1])
+
```

```
+
+  # For Intercept (B0)
+  Beta_original$Intercept <- as.numeric(Beta_original$Intercept)
+  acf(Beta_original$Intercept)
+  pacf(Beta_original$Intercept)
+  auto.arima(Beta_original$Intercept)
+
+  fit_B0 <- arima(Beta_original$Intercept, order = c(0,0,0))
+  model_predict_B0 <- predict(fit_B0, n.ahead=1)
+  pred_B0 <- as.numeric(model_predict_B0$pred)
+  pred_B0
+  beta_new[1,2] <- pred_B0
+
+
+  # For Assets
+  Beta_original$assets <- as.numeric(Beta_original$assets)
+  acf(Beta_original$assets)
+  pacf(Beta_original$assets)
+  auto.arima(Beta_original$assets)
+
+  fit_B1 <- arima(Beta_original$assets, order = c(0,0,0))
+  model_predict_B1 <- predict(fit_B1, n.ahead=1)
+  pred_B1 <- as.numeric(model_predict_B1$pred)
+  pred_B1
+  beta_new[1,3] <- pred_B1
+
+
+  # For Revenue
+  Beta_original$revenue <- as.numeric(Beta_original$revenue)
+  acf(Beta_original$revenue)
+  pacf(Beta_original$revenue)
+  auto.arima(Beta_original$revenue)
+
+  fit_B2 <- arima(Beta_original$revenue, order = c(0,1,0))
+  model_predict_B2 <- predict(fit_B2, n.ahead=1)
+  pred_B2 <- as.numeric(model_predict_B2$pred)
```

```
+
+  pred_B2
+  beta_new[1,4] <- pred_B2
+
+
+  # For Rnd
+  Beta_original$rnd <- as.numeric(Beta_original$rnd)
+  acf(Beta_original$rnd)
+  pacf(Beta_original$rnd)
+  auto.arima(Beta_original$rnd)
+
+  fit_B3 <- arima(Beta_original$rnd, order = c(0,0,0))
+  model_predict_B3 <- predict(fit_B3, n.ahead=1)
+  pred_B3 <- as.numeric(model_predict_B3$pred)
+  pred_B3
+  beta_new[1,5] <- pred_B3
+
+
+  # For Netinc
+  Beta_original$netinc <- as.numeric(Beta_original$netinc)
+  acf(Beta_original$netinc)
+  pacf(Beta_original$netinc)
+  auto.arima(Beta_original$netinc)
+
+  fit_B4 <- arima(Beta_original$netinc, order = c(0,0,0))
+  model_predict_B4 <- predict(fit_B4, n.ahead=1)
+  pred_B4 <- as.numeric(model_predict_B4$pred)
+  pred_B4
+  beta_new[1,6] <- pred_B4
+
+
+  # For Eps
+  Beta_original$eps <- as.numeric(Beta_original$eps)
+  acf(Beta_original$eps)
+  pacf(Beta_original$eps)
+  auto.arima(Beta_original$eps)
```

```
+
+  fit_B5 <- arima(Beta_original$eps, order = c(0,0,0))
+  model_predict_B5 <- predict(fit_B5, n.ahead=1)
+  pred_B5 <- as.numeric(model_predict_B5$pred)
+  pred_B5
+  beta_new[1,7] <- pred_B5
+
+
+  # For Shareswa
+  Beta_original$shareswa <- as.numeric(Beta_original$shareswa)
+  acf(Beta_original$shareswa)
+  pacf(Beta_original$shareswa)
+  auto.arima(Beta_original$shareswa)
+
+  fit_B6 <- arima(Beta_original$shareswa, order = c(0,0,0))
+  model_predict_B6 <- predict(fit_B6, n.ahead=1)
+  pred_B6 <- as.numeric(model_predict_B6$pred)
+  pred_B6
+  beta_new[1,8] <- pred_B6
+
+
+  # For Ncfo
+  Beta_original$ncfo <- as.numeric(Beta_original$ncfo)
+  acf(Beta_original$ncfo)
+  pacf(Beta_original$ncfo)
+  auto.arima(Beta_original$ncfo)
+
+  fit_B7 <- arima(Beta_original$ncfo, order = c(0,0,0))
+  model_predict_B7 <- predict(fit_B7, n.ahead=1)
+  pred_B7 <- as.numeric(model_predict_B7$pred)
+  pred_B7
+  beta_new[1,9] <- pred_B7
+
+
+  # For Depamor
+  Beta_original$depamor <- as.numeric(Beta_original$depamor)
```

```
+  acf(Beta_original$depamor)
+  pacf(Beta_original$depamor)
+  auto.arima(Beta_original$depamor)
+
+  fit_B8 <- arima(Beta_original$depamor, order = c(0,0,0))
+  model_predict_B8 <- predict(fit_B8, n.ahead=1)
+  pred_B8 <- as.numeric(model_predict_B8$pred)
+  pred_B8
+  beta_new[1,10] <- pred_B8
+
+
+  # For Ncfi
+  Beta_original$ncfi <- as.numeric(Beta_original$ncfi)
+  acf(Beta_original$ncfi)
+  pacf(Beta_original$ncfi)
+  auto.arima(Beta_original$ncfi)
+
+  fit_B9 <- arima(Beta_original$ncfi, order = c(0,0,1))
+  model_predict_B9 <- predict(fit_B9, n.ahead=1)
+  pred_B9 <- as.numeric(model_predict_B9$pred)
+  pred_B9
+  beta_new[1,11] <- pred_B9
+
+
+  # For Capex
+  Beta_original$capex <- as.numeric(Beta_original$capex)
+  acf(Beta_original$capex)
+  pacf(Beta_original$capex)
+  auto.arima(Beta_original$capex)
+
+  fit_B10 <- arima(Beta_original$capex, order = c(0,0,0))
+  model_predict_B10 <- predict(fit_B10, n.ahead=1)
+  pred_B10 <- as.numeric(model_predict_B10$pred)
+  pred_B10
+  beta_new[1,12] <- pred_B10
+
```

```
+
+  # For Ncfdiv
+  Beta_original$ncfdiv <- as.numeric(Beta_original$ncfdiv)
+  acf(Beta_original$ncfdiv)
+  pacf(Beta_original$ncfdiv)
+  auto.arima(Beta_original$ncfdiv)
+
+  fit_B11 <- arima(Beta_original$ncfdiv, order = c(0,0,0))
+  model_predict_B11 <- predict(fit_B11, n.ahead=1)
+  pred_B11 <- as.numeric(model_predict_B11$pred)
+  pred_B11
+  beta_new[1,13] <- pred_B11
+
+
+  # For EquityUSD
+  Beta_original$equityusd <- as.numeric(Beta_original$equityusd)
+  acf(Beta_original$equityusd)
+  pacf(Beta_original$equityusd)
+  auto.arima(Beta_original$equityusd)
+
+  fit_B12 <- arima(Beta_original$equityusd, order = c(0,0,0))
+  model_predict_B12 <- predict(fit_B12, n.ahead=1)
+  pred_B12 <- as.numeric(model_predict_B12$pred)
+  pred_B12
+  beta_new[1,14] <- pred_B12
+
+
+  # For Liabilities
+  Beta_original$liabilities <- as.numeric(Beta_original$liabilities)
+  acf(Beta_original$liabilities)
+  pacf(Beta_original$liabilities)
+  auto.arima(Beta_original$liabilities)
+
+  fit_B13 <- arima(Beta_original$liabilities, order = c(0,0,0))
+  model_predict_B13 <- predict(fit_B13, n.ahead=1)
+  pred_B13 <- as.numeric(model_predict_B13$pred)
```

```
+  pred_B13
+  beta_new[1,15] <- pred_B13
+
+
+  # For Cashneq
+  Beta_original$cashneq <- as.numeric(Beta_original$cashneq)
+  acf(Beta_original$cashneq)
+  pacf(Beta_original$cashneq)
+  auto.arima(Beta_original$cashneq)
+
+  fit_B14 <- arima(Beta_original$cashneq, order = c(0,0,0))
+  model_predict_B14 <- predict(fit_B14, n.ahead=1)
+  pred_B14 <- as.numeric(model_predict_B14$pred)
+  pred_B14
+  beta_new[1,16] <- pred_B14
+
+
+  # For Debt
+  Beta_original$debt <- as.numeric(Beta_original$debt)
+  acf(Beta_original$debt)
+  pacf(Beta_original$debt)
+  auto.arima(Beta_original$debt)
+
+  fit_B15 <- arima(Beta_original$debt, order = c(0,1,0))
+  model_predict_B15 <- predict(fit_B15, n.ahead=1)
+  pred_B15 <- as.numeric(model_predict_B15$pred)
+  pred_B15
+  beta_new[1,17] <- pred_B15
+
+
+  # For Equity
+
+  #Beta_original$equity <- as.numeric(Beta_original$equity)
+  #acf(Beta_original$equity)
+  #pacf(Beta_original$equity)
+  #auto.arima(Beta_original$equity)
```

```
+
+  #fit_B16 <- arima(Beta_original$equity, order = c(0,0,0))
+  #model_predict_B16 <- predict(fit_B16, n.ahead=1)
+  #pred_B16 <- as.numeric(model_predict_B16$pred)
+  #pred_B16
+  beta_new[1,18] <- 0 # Since all the B's for Equity are NAs
+
+
+  # For Ev
+  Beta_original$ev <- as.numeric(Beta_original$ev)
+  acf(Beta_original$ev)
+  pacf(Beta_original$ev)
+  auto.arima(Beta_original$ev)
+
+  fit_B17 <- arima(Beta_original$ev, order = c(0,0,0))
+  model_predict_B17 <- predict(fit_B17, n.ahead=1)
+  pred_B17 <- as.numeric(model_predict_B17$pred)
+  pred_B17
+  beta_new[1,19] <- pred_B17
+
+
+  # For Pe
+  Beta_original$pe <- as.numeric(Beta_original$pe)
+  acf(Beta_original$pe)
+  pacf(Beta_original$pe)
+  auto.arima(Beta_original$pe)
+
+  fit_B18 <- arima(Beta_original$pe, order = c(0,0,0))
+  model_predict_B18 <- predict(fit_B18, n.ahead=1)
+  pred_B18 <- as.numeric(model_predict_B18$pred)
+  pred_B18
+  beta_new[1,20] <- pred_B18
+
+
+  # For Invcap
+  Beta_original$invcap <- as.numeric(Beta_original$invcap)
```

```
+   acf(Beta_original$invcap)
+   pacf(Beta_original$invcap)
+   auto.arima(Beta_original$invcap)
+
+   fit_B19 <- arima(Beta_original$invcap, order = c(0,0,0))
+   model_predict_B19 <- predict(fit_B19, n.ahead=1)
+   pred_B19 <- as.numeric(model_predict_B19$pred)
+   pred_B19
+   beta_new[1,21] <- pred_B19
+
+
+   # For Sps
+   Beta_original$sps <- as.numeric(Beta_original$sps)
+   acf(Beta_original$sps)
+   pacf(Beta_original$sps)
+   auto.arima(Beta_original$sps)
+
+   fit_B20 <- arima(Beta_original$sps, order = c(0,0,0))
+   model_predict_B20 <- predict(fit_B20, n.ahead=1)
+   pred_B20 <- as.numeric(model_predict_B20$pred)
+   pred_B20
+   beta_new[1,22] <- pred_B20
+
+
+ # Adding predicted Betas of new date to the original beta table
+   Beta_original<-rbind(Beta_original,beta_new)
+ }

> # Viewing the final beta table for 20 unique dates
> View(Beta_original)
> str(Beta_original)
'data.frame':   20 obs. of  22 variables:
 $ unique_date[1:15, 1]: Factor w/ 20 levels "12/31/11","12/31/12",..: 6 11 16 1 7 12 17 2 8 13 ...
  ..- attr(*, "names")= chr  NA NA NA NA ...
 $ Intercept          : Named chr  "0.114856741622851" "-74.680444260008" "50.7025494621811" "88.7574796502624" ...
  ..- attr(*, "names")= chr  NA NA NA NA ...
```

```
$ assets            : Named chr  "-79.4826803459911" "-337.498156374243" "59.1117001270451" "21.164372751123" ...
 ..- attr(*, "names")= chr  NA NA NA NA ...
$ revenue           : Named chr  "0" "2.33770692998683" "1.97229737022586" "0.143140104335957" ...
 ..- attr(*, "names")= chr  NA NA NA NA ...
$ rnd               : Named chr  "0" "-2.06524254028974" "-1.7566959275572" "-0.920139823248942" ...
 ..- attr(*, "names")= chr  NA NA NA NA ...
$ netinc            : Named chr  "0" "1.53007075387919" "-0.983509904621262" "-5.60142564126015" ...
 ..- attr(*, "names")= chr  NA NA NA NA ...
$ eps               : Named chr  "0" "7236.82710036519" "-4597.73156889638" "4330.92853708292" ...
 ..- attr(*, "names")= chr  NA NA NA NA ...
$ shareswa          : Named chr  "0" "-0.208901929632295" "-0.312296263177336" "0.221553718436643" ...
 ..- attr(*, "names")= chr  NA NA NA NA ...
$ ncfo              : Named chr  "0" "0.897733270250752" "5.90812443562304" "-2.18370540363954" ...
 ..- attr(*, "names")= chr  NA NA NA NA ...
$ depamor           : Named chr  "0" "-7.91881606246735" "-45.0311537592989" "1.8124854649245" ...
 ..- attr(*, "names")= chr  NA NA NA NA ...
$ ncfi              : Named chr  "0" "42.6060692058253" "-28.161030863152" "18.5986908239431" ...
 ..- attr(*, "names")= chr  NA NA NA NA ...
$ capex             : Named chr  "0" "-8.31991973074747" "-5.02204085744151" "3.14757253982832" ...
 ..- attr(*, "names")= chr  NA NA NA NA ...
$ ncfdiv            : Named chr  "0" "1.96362397634466" "0.93461369690915" "0.754731703312597" ...
 ..- attr(*, "names")= chr  NA NA NA NA ...
$ equityusd         : Named chr  "0" "25.0236022860045" "-4.58371779343691" "-3.71060528820402" ...
 ..- attr(*, "names")= chr  NA NA NA NA ...
$ liabilities       : Named chr  "0" "320.729637802054" "-118.163284968071" "-11.751230700805" ...
 ..- attr(*, "names")= chr  NA NA NA NA ...
$ cashneq           : Named chr  "0" "6.83418737994462" "9.48749143999691" "3.57427225847816" ...
 ..- attr(*, "names")= chr  NA NA NA NA ...
$ debt              : Named chr  "0" "29.593303876155" "100.908007106649" "-20.4192146898076" ...
 ..- attr(*, "names")= chr  NA NA NA NA ...
$ equity            : Named chr  "0" "0" "0" "0" ...
 ..- attr(*, "names")= chr  NA NA NA NA ...
$ ev                : Named chr  "0" "17.5214034766628" "12.942781589981" "8.156517080622" ...
 ..- attr(*, "names")= chr  NA NA NA NA ...
$ pe                : Named chr  "0" "3.62465401340224" "-2.1163839715352" "-201.491904309509" ...
 ..- attr(*, "names")= chr  NA NA NA NA ...
```

```
 $ invcap            : Named chr  "0" "-54.676675212176" "-59.9794441377879" "24.9730929362082" ...
  ..- attr(*, "names")= chr  NA NA NA NA ...
 $ sps               : Named chr  "0" "-19.8323642592575" "-0.3736597226885" "-10.1166849082764" ...
  ..- attr(*, "names")= chr  NA NA NA NA ...
> class(Beta_original)
[1] "data.frame"
>
> Beta_original <- data.frame((Beta_original), stringsAsFactors=FALSE)
> Beta_original[,2:22] <- apply(Beta_original[,2:22], 2, as.numeric)    #converting Betas into numeric data type
>
> #Calculating Expected Returns for t=16
> data_file_arq_final<-na.omit(data_file_arq_final)
> temp_pred<- data_file_arq_final[data_file_arq_final[,3]==unique_date[16,1], ]  #Subsetting data file with t=16
> temp_pred_16<-temp_pred[,-c(1,2,3,4,25)]
> rownames(temp_pred_16)<-1:nrow(temp_pred_16)
> exp_return = matrix(NA, nrow = nrow(temp_pred_16), ncol =1)
> beta_pred<-Beta_original[16,-c(1,2)]     #Expected 20 Beta values for t=16
> beta0<-Beta_original[16,2]              #Expected Beta0 for t=16
>
> for(k in 1:nrow(temp_pred_16))
+ {
+   exp_return[k,]<-
beta0+beta_pred[,1]*temp_pred_16[k,1]+beta_pred[,2]*temp_pred_16[k,2]+beta_pred[,3]*temp_pred_16[k,3]+beta_pred[,4]*temp_pred_16[k
]+beta_pred[,5]*temp_pred_16[k,5]+beta_pred[,6]*temp_pred_16[k,6]+beta_pred[,7]*temp_pred_16[k,7]+beta_pred[,8]*temp_pred_16[k,8]+b
ta_pred[,9]*temp_pred_16[k,9]+beta_pred[,10]*temp_pred_16[k,10]+beta_pred[,11]*temp_pred_16[k,11]+beta_pred[,12]*temp_pred_16[k,12
beta_pred[,13]*temp_pred_16[k,13]+beta_pred[,14]*temp_pred_16[k,14]+beta_pred[,15]*temp_pred_16[k,15]+beta_pred[,16]*temp_pred_16
,16]+beta_pred[,17]*temp_pred_16[k,17]+beta_pred[,18]*temp_pred_16[k,18]+beta_pred[,19]*temp_pred_16[k,19]+beta_pred[,20]*temp_pre
_16[k,20]
+ }
>
>
> exp_return_16<-as.data.frame(exp_return)
> exp_return_16<-cbind(temp_pred[,1],exp_return_16)
> colnames(exp_return_16)[1]<-"Tickers"
> colnames(exp_return_16)[2]<-"Exp_returns"
> View(exp_return_16)
```

```
>
> #Sorting Expected returns in descending order
> exp_return_16_sort <- exp_return_16[order(-exp_return_16$Exp_returns),]
> rownames(exp_return_16_sort)<-1:nrow(exp_return_16_sort)   #Resquence the row numbers
> #View(exp_return_16_sort)
>
> #Subsetting Sorted Expected returns into 5 Quantiles
> K<-nrow(exp_return_16_sort)/5   #846 stock Expected Returns
>
> Q1_16<-exp_return_16_sort[1:27,]
> Q2_16<-exp_return_16_sort[28:54,]
> Q3_16<-exp_return_16_sort[55:81,]
> Q4_16<-exp_return_16_sort[82:108,]
> Q5_16<-exp_return_16_sort[109:134,]
>
> m1_16<-mean(Q1_16$Exp_returns)
> m2_16<-mean(Q2_16$Exp_returns)
> m3_16<-mean(Q3_16$Exp_returns)
> m4_16<-mean(Q4_16$Exp_returns)
> m5_16<-mean(Q5_16$Exp_returns)
>
> m1_16
[1] -1.0069
> m2_16
[1] -1.060281
> m3_16
[1] -1.072981
> m4_16
[1] -1.086835
> m5_16
[1] -1.224007
>
> #Calculating Expected Returns for t=17
> temp_17<- data_file_arq_final[data_file_arq_final[,3]==unique_date[17,1], ]  #Subsetting data file with t=16
> temp_pred_17<-temp_17[,-c(1,2,3,4,25)]
> rownames(temp_pred_17)<-1:nrow(temp_pred_17)
```

```
> exp_return = matrix(NA, nrow = nrow(temp_pred_17), ncol =1)
> beta_pred<-Beta_original[17,-c(1,2)]     #Expected 20 Beta values for t=16
> beta0<-Beta_original[17,2]               #Expected Beta0 for t=16
>
> for(k in 1:nrow(temp_pred_17))
+ {
+   exp_return[k,]<-
beta0+beta_pred[,1]*temp_pred_17[k,1]+beta_pred[,2]*temp_pred_17[k,2]+beta_pred[,3]*temp_pred_17[k,3]+beta_pred[,4]*temp_pred_17[k
]+beta_pred[,5]*temp_pred_17[k,5]+beta_pred[,6]*temp_pred_17[k,6]+beta_pred[,7]*temp_pred_17[k,7]+beta_pred[,8]*temp_pred_17[k,8]+b
ta_pred[,9]*temp_pred_17[k,9]+beta_pred[,10]*temp_pred_17[k,10]+beta_pred[,11]*temp_pred_17[k,11]+beta_pred[,12]*temp_pred_17[k,12
beta_pred[,13]*temp_pred_17[k,13]+beta_pred[,14]*temp_pred_17[k,14]+beta_pred[,15]*temp_pred_17[k,15]+beta_pred[,16]*temp_pred_17
,16]+beta_pred[,17]*temp_pred_17[k,17]+beta_pred[,18]*temp_pred_17[k,18]+beta_pred[,19]*temp_pred_17[k,19]+beta_pred[,20]*temp_pre
_17[k,20]
+ }
>
>
> exp_return_17<-as.data.frame(exp_return)
> exp_return_17<-cbind(temp_17[,1],exp_return_17)
> colnames(exp_return_17)[1]<-"Tickers"
> colnames(exp_return_17)[2]<-"Exp_returns"
> #View(exp_return_17)
>
> #Sorting Expected returns in descending order
> exp_return_17_sort <- exp_return_17[order(-exp_return_17$Exp_returns),]
> rownames(exp_return_17_sort)<-1:nrow(exp_return_17_sort)   #Resquence the row numbers
> View(exp_return_17_sort)
>
> #Subsetting Sorted Expected returns into 5 Quantiles
>
> Q1_17<-exp_return_17_sort[1:27,]
> Q2_17<-exp_return_17_sort[28:54,]
> Q3_17<-exp_return_17_sort[55:81,]
> Q4_17<-exp_return_17_sort[82:108,]
> Q5_17<-exp_return_17_sort[109:136,]
>
> m1_17<-mean(Q1_17$Exp_returns)
```

```
> m2_17<-mean(Q2_17$Exp_returns)
> m3_17<-mean(Q3_17$Exp_returns)
> m4_17<-mean(Q4_17$Exp_returns)
> m5_17<-mean(Q5_17$Exp_returns)
>
> m1_17
[1] 0.2555698
> m2_17
[1] 0.1951397
> m3_17
[1] 0.1830464
> m4_17
[1] 0.1692843
> m5_17
[1] 0.1037428
>
> #Calculating Expected Returns for t=18
> temp_18<- data_file_arq_final[data_file_arq_final[,3]==unique_date[18,1], ]  #Subsetting data file with t=16
> temp_pred_18<-temp_18[,-c(1,2,3,4,25)]
> rownames(temp_pred_18)<-1:nrow(temp_pred_18)
> exp_return = matrix(NA, nrow = nrow(temp_pred_18), ncol =1)
> beta_pred<-Beta_original[18,-c(1,2)]     #Expected 20 Beta values for t=16
> beta0<-Beta_original[18,2]              #Expected Beta0 for t=16
>
> for(k in 1:nrow(temp_pred_18))
+ {
+   exp_return[k,]<-
beta0+beta_pred[,1]*temp_pred_18[k,1]+beta_pred[,2]*temp_pred_18[k,2]+beta_pred[,3]*temp_pred_18[k,3]+beta_pred[,4]*temp_pred_18[k
]+beta_pred[,5]*temp_pred_18[k,5]+beta_pred[,6]*temp_pred_18[k,6]+beta_pred[,7]*temp_pred_18[k,7]+beta_pred[,8]*temp_pred_18[k,8]+b
ta_pred[,9]*temp_pred_18[k,9]+beta_pred[,10]*temp_pred_18[k,10]+beta_pred[,11]*temp_pred_18[k,11]+beta_pred[,12]*temp_pred_18[k,12
beta_pred[,13]*temp_pred_18[k,13]+beta_pred[,14]*temp_pred_18[k,14]+beta_pred[,15]*temp_pred_18[k,15]+beta_pred[,16]*temp_pred_18
,16]+beta_pred[,17]*temp_pred_18[k,17]+beta_pred[,18]*temp_pred_18[k,18]+beta_pred[,19]*temp_pred_18[k,19]+beta_pred[,20]*temp_pre
_18[k,20]
+ }
>
>
```

```
> exp_return_18<-as.data.frame(exp_return)
> exp_return_18<-cbind(temp_18[,1],exp_return_18)
> colnames(exp_return_18)[1]<-"Tickers"
> colnames(exp_return_18)[2]<-"Exp_returns"
> #View(exp_return_18)
>
> #Sorting Expected returns in descending order
> exp_return_18_sort <- exp_return_18[order(-exp_return_18$Exp_returns),]
> rownames(exp_return_18_sort)<-1:nrow(exp_return_18_sort)   #Resquence the row numbers
> #View(exp_return_18_sort)
>
> #Subsetting Sorted Expected returns into 5 Quantiles
> Q1_18<-exp_return_18_sort[1:27,]
> Q2_18<-exp_return_18_sort[28:54,]
> Q3_18<-exp_return_18_sort[55:81,]
> Q4_18<-exp_return_18_sort[82:109,]
> Q5_18<-exp_return_18_sort[110:137,]
>
>
> m1_18<-mean(Q1_18$Exp_returns)
> m2_18<-mean(Q2_18$Exp_returns)
> m3_18<-mean(Q3_18$Exp_returns)
> m4_18<-mean(Q4_18$Exp_returns)
> m5_18<-mean(Q5_18$Exp_returns)
>
> m1_18
[1] -0.2187211
> m2_18
[1] -0.2901944
> m3_18
[1] -0.3009145
> m4_18
[1] -0.3118725
> m5_18
[1] -0.359451
```

```
> #Calculating Expected Returns for t=19
> temp_19<- data_file_arq_final[data_file_arq_final[,3]==unique_date[19,1], ]  #Subsetting data file with t=19
> temp_pred_19<-temp_19[,-c(1,2,3,4,25)]
> rownames(temp_pred_19)<-1:nrow(temp_pred_19)
> exp_return = matrix(NA, nrow = nrow(temp_pred_19), ncol =1)
> beta_pred<-Beta_original[19,-c(1,2)]     #Expected 20 Beta values for t=19
> beta0<-Beta_original[19,2]              #Expected Beta0 for t=19
>
> for(k in 1:nrow(temp_pred_19))
+ {
+   exp_return[k,]<-
beta0+beta_pred[,1]*temp_pred_19[k,1]+beta_pred[,2]*temp_pred_19[k,2]+beta_pred[,3]*temp_pred_19[k,3]+beta_pred[,4]*temp_pred_19[k
]+beta_pred[,5]*temp_pred_19[k,5]+beta_pred[,6]*temp_pred_19[k,6]+beta_pred[,7]*temp_pred_19[k,7]+beta_pred[,8]*temp_pred_19[k,8]+b
ta_pred[,9]*temp_pred_19[k,9]+beta_pred[,10]*temp_pred_19[k,10]+beta_pred[,11]*temp_pred_19[k,11]+beta_pred[,12]*temp_pred_19[k,12
beta_pred[,13]*temp_pred_19[k,13]+beta_pred[,14]*temp_pred_19[k,14]+beta_pred[,15]*temp_pred_19[k,15]+beta_pred[,16]*temp_pred_19
,16]+beta_pred[,17]*temp_pred_19[k,17]+beta_pred[,18]*temp_pred_19[k,18]+beta_pred[,19]*temp_pred_19[k,19]+beta_pred[,20]*temp_pre
_19[k,20]
+ }
>
>
> exp_return_19<-as.data.frame(exp_return)
> exp_return_19<-cbind(temp_19[,1],exp_return_19)
> colnames(exp_return_19)[1]<-"Tickers"
> colnames(exp_return_19)[2]<-"Exp_returns"
> #View(exp_return_19)
>
> #Sorting Expected returns in descending order
> exp_return_19_sort <- exp_return_19[order(-exp_return_19$Exp_returns),]
> rownames(exp_return_19_sort)<-1:nrow(exp_return_19_sort)   #Resquence the row numbers
> #View(exp_return_19_sort)
>
> #Subsetting Sorted Expected returns into 5 Quantiles
> Q1_19<-exp_return_19_sort[1:27,]
> Q2_19<-exp_return_19_sort[28:54,]
> Q3_19<-exp_return_19_sort[55:81,]
> Q4_19<-exp_return_19_sort[82:109,]
```

```
> Q5_19<-exp_return_19_sort[110:137,]
>
> m1_19<-mean(Q1_19$Exp_returns)
> m2_19<-mean(Q2_19$Exp_returns)
> m3_19<-mean(Q3_19$Exp_returns)
> m4_19<-mean(Q4_19$Exp_returns)
> m5_19<-mean(Q5_19$Exp_returns)
>
> m1_19
[1] -0.225242
> m2_19
[1] -0.2900816
> m3_19
[1] -0.3007617
> m4_19
[1] -0.3128255
> m5_19
[1] -0.3677612
>
> #Calculating Expected Returns for t=20
> temp_20<- data_file_arq_final[data_file_arq_final[,3]==unique_date[20,1], ]  #Subsetting data file with t=20
> temp_pred_20<-temp_20[,-c(1,2,3,4,25)]
> rownames(temp_pred_20)<-1:nrow(temp_pred_20)
> exp_return = matrix(NA, nrow = nrow(temp_pred_20), ncol =1)
> beta_pred<-Beta_original[20,-c(1,2)]     #Expected 20 Beta values for t=20
> beta0<-Beta_original[20,2]              #Expected Beta0 for t=20
>
> for(k in 1:nrow(temp_pred_20))
+ {
+   exp_return[k,]<-
beta0+beta_pred[,1]*temp_pred_20[k,1]+beta_pred[,2]*temp_pred_20[k,2]+beta_pred[,3]*temp_pred_20[k,3]+beta_pred[,4]*temp_pred_20[k
]+beta_pred[,5]*temp_pred_20[k,5]+beta_pred[,6]*temp_pred_20[k,6]+beta_pred[,7]*temp_pred_20[k,7]+beta_pred[,8]*temp_pred_20[k,8]+b
ta_pred[,9]*temp_pred_20[k,9]+beta_pred[,10]*temp_pred_20[k,10]+beta_pred[,11]*temp_pred_20[k,11]+beta_pred[,12]*temp_pred_20[k,12
beta_pred[,13]*temp_pred_20[k,13]+beta_pred[,14]*temp_pred_20[k,14]+beta_pred[,15]*temp_pred_20[k,15]+beta_pred[,16]*temp_pred_20
,16]+beta_pred[,17]*temp_pred_20[k,17]+beta_pred[,18]*temp_pred_20[k,18]+beta_pred[,19]*temp_pred_20[k,19]+beta_pred[,20]*temp_pre
_20[k,20]
```

```
+ }
>
>
> exp_return_20<-as.data.frame(exp_return)
> exp_return_20<-cbind(temp_20[,1],exp_return_20)
> colnames(exp_return_20)[1]<-"Tickers"
> colnames(exp_return_20)[2]<-"Exp_returns"
> #View(exp_return_20)
>
> #Sorting Expected returns in descending order
> exp_return_20_sort <- exp_return_20[order(-exp_return_20$Exp_returns),]
> rownames(exp_return_20_sort)<-1:nrow(exp_return_20_sort)   #Resquence the row numbers
> #View(exp_return_20_sort)
>
> #Subsetting Sorted Expected returns into 5 Quantiles
> Q1_20<-exp_return_20_sort[1:27,]
> Q2_20<-exp_return_20_sort[28:54,]
> Q3_20<-exp_return_20_sort[55:81,]
> Q4_20<-exp_return_20_sort[82:109,]
> Q5_20<-exp_return_20_sort[110:137,]
>
> m1_20<-mean(Q1_20$Exp_returns)
> m2_20<-mean(Q2_20$Exp_returns)
> m3_20<-mean(Q3_20$Exp_returns)
> m4_20<-mean(Q4_20$Exp_returns)
> m5_20<-mean(Q5_20$Exp_returns)
>
> m1_20
[1] -0.2225337
> m2_20
[1] -0.2889049
> m3_20
[1] -0.3003004
> m4_20
[1] -0.3131392
> m5_20
```

[1] -0.4653566