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> #Tosin Komolafe
> #Case Study 2 - Portfolio Combination
> #Statistics- 0617-B
> #Instructor: Professor Steven Stelk
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> #STEP 1:Download data for last 1 years for a set of the any five stock tickers belonging to the
 same industry segment.
> #Downloaded from Yahoo Finance focused on the five technology industries (AAPL,CSCO,FB,GOOG,MSF
T)
> #NASDAQ Composite Historical Data from October 1, 2016 - September 20, 2017
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>
> # 1 & 6 is the Date & Adj. Close Column respectively
>
> #AAPL - Apple Inc.
> aapl_data = read.csv("AAPL.csv",header=TRUE, sep=",")
> aapl = aapl_data[,c(1,6)]
> aapl
         Date Adj.Close
1  2016-10-01  111.5719
2  2016-11-01  108.6043
3  2016-12-01  114.3968
4  2017-01-01  119.8588
5  2017-02-01  135.3066
6  2017-03-01  142.5098
7  2017-04-01  142.4999
8  2017-05-01  151.5370
9  2017-06-01  143.4567
10 2017-07-01  148.1482
11 2017-08-01  163.3585
12 2017-09-01  156.0700
13 2017-09-20  156.0700
>
> #CSCO - Cisco Systems, Inc.
> csco_data = read.csv("CSCO.csv",header=TRUE, sep=",")
> csco = csco_data[,c(1,6)]
> csco
         Date Adj.Close
1  2016-10-01  29.63208
2  2016-11-01  29.03948
3  2016-12-01  29.42901
4  2017-01-01  29.91593
5  2017-02-01  33.57117
6  2017-03-01  33.19794
7  2017-04-01  33.46313
8  2017-05-01  31.23815
9  2017-06-01  31.01028
10 2017-07-01  31.15889
11 2017-08-01  32.21000
12 2017-09-01  32.60000
13 2017-09-20  32.60000
>
> #FB - Facebook, Inc.
> fb_data = read.csv("FB.csv",header=TRUE, sep=",")
> fb = fb_data[,c(1,6)]
> fb
         Date Adj.Close
1  2016-10-01    130.99
2  2016-11-01    118.42
3  2016-12-01    115.05
4  2017-01-01    130.32
5  2017-02-01    135.54
6  2017-03-01    142.05
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7  2017-04-01    150.25
8  2017-05-01    151.46
9  2017-06-01    150.98
10 2017-07-01    169.25
11 2017-08-01    171.97
12 2017-09-01    172.17
13 2017-09-20    172.17
>
> #GOOG - Alphabet Inc.
> goog_data = read.csv("GOOG.csv",header=TRUE, sep=",")
> goog = goog_data[,c(1,6)]
> goog
         Date Adj.Close
1  2016-10-01    784.54
2  2016-11-01    758.04
3  2016-12-01    771.82
4  2017-01-01    796.79
5  2017-02-01    823.21
6  2017-03-01    829.56
7  2017-04-01    905.96
8  2017-05-01    964.86
9  2017-06-01    908.73
10 2017-07-01    930.50
11 2017-08-01    939.33
12 2017-09-01    931.58
13 2017-09-20    931.58
>
> #MSFT - Microsoft Corporation
> msft_data = read.csv("MSFT.csv",header=TRUE, sep=",")
> msft = msft_data[,c(1,6)]
> msft
         Date Adj.Close
1  2016-10-01  58.51037
2  2016-11-01  58.84237
3  2016-12-01  61.08805
4  2017-01-01  63.55557
5  2017-02-01  62.89691
6  2017-03-01  65.13760
7  2017-04-01  67.70908
8  2017-05-01  69.07394
9  2017-06-01  68.56470
10 2017-07-01  72.31471
11 2017-08-01  74.37374
12 2017-09-01  74.94000
13 2017-09-20  74.94000
>
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> #STEP 2: Calculate Monthly returns of downloaded stock over the period under study
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>
> monthly_returns = function(stock_data){
+ year_stock_data = stock_data[c(which(stock_data$Date=='2016-10-01'): which(stock_data$Date=='20
17-09-01')),]
+ count = length(year_stock_data$Adj.Close)
+ for (i in 1:count-1){
+ year_stock_data$Returns[i] = (year_stock_data$Adj.Close[i+1]/year_stock_data$Adj.Close[i]-1)
+ }
+ return(year_stock_data)
+ }
>
> "AAPL Monthly Returns"
[1] "AAPL Monthly Returns"
> aapl_returns = monthly_returns(aapl)
> aapl_returns
         Date Adj.Close       Returns
1  2016-10-01  111.5719 -2.659810e-02
2  2016-11-01  108.6043  5.333583e-02
3  2016-12-01  114.3968  4.774609e-02
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4  2017-01-01  119.8588  1.288833e-01
5  2017-02-01  135.3066  5.323613e-02
6  2017-03-01  142.5098 -6.946891e-05
7  2017-04-01  142.4999  6.341829e-02
8  2017-05-01  151.5370 -5.332229e-02
9  2017-06-01  143.4567  3.270325e-02
10 2017-07-01  148.1482  1.026695e-01
11 2017-08-01  163.3585 -4.461659e-02
12 2017-09-01  156.0700 -2.659810e-02
>
> "CSCO Monthly Returns"
[1] "CSCO Monthly Returns"
> csco_returns = monthly_returns(csco)
> csco_returns
         Date Adj.Close      Returns
1  2016-10-01  29.63208 -0.019998529
2  2016-11-01  29.03948  0.013413807
3  2016-12-01  29.42901  0.016545374
4  2017-01-01  29.91593  0.122183916
5  2017-02-01  33.57117 -0.011117694
6  2017-03-01  33.19794  0.007988267
7  2017-04-01  33.46313 -0.066490521
8  2017-05-01  31.23815 -0.007294702
9  2017-06-01  31.01028  0.004792379
10 2017-07-01  31.15889  0.033733840
11 2017-08-01  32.21000  0.012108010
12 2017-09-01  32.60000 -0.019998529
>
> "FB Monthly Returns"
[1] "FB Monthly Returns"
> fb_returns = monthly_returns(fb)
> fb_returns
         Date Adj.Close      Returns
1  2016-10-01    130.99 -0.095961574
2  2016-11-01    118.42 -0.028457989
3  2016-12-01    115.05  0.132724934
4  2017-01-01    130.32  0.040055139
5  2017-02-01    135.54  0.048030178
6  2017-03-01    142.05  0.057726130
7  2017-04-01    150.25  0.008053291
8  2017-05-01    151.46 -0.003169226
9  2017-06-01    150.98  0.121009435
10 2017-07-01    169.25  0.016070907
11 2017-08-01    171.97  0.001162976
12 2017-09-01    172.17 -0.095961574
>
> "GOOG Monthly Returns"
[1] "GOOG Monthly Returns"
> goog_returns = monthly_returns(goog)
> goog_returns
         Date Adj.Close      Returns
1  2016-10-01    784.54 -0.033777756
2  2016-11-01    758.04  0.018178499
3  2016-12-01    771.82  0.032352065
4  2017-01-01    796.79  0.033158103
5  2017-02-01    823.21  0.007713677
6  2017-03-01    829.56  0.092097044
7  2017-04-01    905.96  0.065013865
8  2017-05-01    964.86 -0.058174249
9  2017-06-01    908.73  0.023956533
10 2017-07-01    930.50  0.009489540
11 2017-08-01    939.33 -0.008250561
12 2017-09-01    931.58 -0.033777756
>
> "MSFT Monthly Returns"
[1] "MSFT Monthly Returns"
> msft_returns = monthly_returns(msft)
> msft_returns
         Date Adj.Close      Returns
1  2016-10-01  58.51037  0.005674345
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2  2016-11-01  58.84237  0.038164368
3  2016-12-01  61.08805  0.040392741
4  2017-01-01  63.55557 -0.010363482
5  2017-02-01  62.89691  0.035624833
6  2017-03-01  65.13760  0.039477534
7  2017-04-01  67.70908  0.020157711
8  2017-05-01  69.07394 -0.007372376
9  2017-06-01  68.56470  0.054693102
10 2017-07-01  72.31471  0.028473155
11 2017-08-01  74.37374  0.007613722
12 2017-09-01  74.94000  0.005674345
>
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> #STEP 3:Using a combination function, calculate the monthly returns of an equally
> #       weighted portfolio consisting of any 3 of the five stocks(AAPL,CSCO,FB,GOOG,MSFT) in qu
estion
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> number_of_cases = 3
> cases = combn(c(1,2,3,4,5),number_of_cases)
> length = length(cases)/number_of_cases
> variance_sum = 0
> cummulative_average_returns = NULL
> cummulative_variance = 0
> num_points = length(aapl_returns$Returns)
> color = c('chartreuse4','coral4','blue4','darkgoldenrod','darkmagenta',
+ 'dimgray','lightcoral','greenyellow','orangered4','black')
> plot(0, 0, xlim=c(1,13), ylim=c(-0.05,0.35),xlab="Month", ylab="Cumulative Monthly Return", mai
n="Equally Weighted Portfolio of Cummulative Returns from October 2016 - September 2017", type =
"n")
>
> for (i in 1:length){
+ average_returns = numeric(num_points)
+ for (j in 1:num_points){
+ average_returns[j]=0
+ for (k in 1:number_of_cases){
+ return = 0
+ stock_quote = cases[k, i]
+ if (stock_quote==1){
+ return=aapl_returns$Returns[j]
+ }else if (stock_quote==2){
+ return=csco_returns$Returns[j]
+ }else if (stock_quote==3){
+ return=fb_returns$Returns[j]
+ }else if (stock_quote==4){
+ return=goog_returns$Returns[j]
+ }else if (stock_quote==5){
+ return=msft_returns$Returns[j]
+ }
+ average_returns[j] = average_returns[j]+return
+ }
+ average_returns[j] = average_returns[j]/number_of_cases
+ cummulative_average_returns = append(cummulative_average_returns, average_returns[j])
+ }
+ mark = ''
+ for (n in 1:number_of_cases){
+ stock_quote = cases[n,i]
+ if (stock_quote==1){
+ mark = paste(mark,'AAPL',seq=' ')
+ }else if (stock_quote==2){
+ mark = paste(mark,'CSCO',seq=' ')
+ }else if (stock_quote==3){
+ mark = paste(mark,'FB',seq=' ')
+ }else if (stock_quote==4){
+ mark = paste(mark,'GOOG',seq=' ')
+ }else if (stock_quote==5){
+ mark = paste(mark,'MSFT',seq=' ')
+ }
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+
+ }
+ print(mark)
+   print(average_returns)
+
+ ##############################################################################################
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+ #STEP 4:Graphically represent the cumulative monthly returns of each of the possible portfolios
 through line plots in question
+ ##############################################################################################
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+   cummulative_monthly_returns = numeric(num_points)
+   cummulative_monthly_returns[1] = average_returns[1]
+   for (m in 2:num_points) {
+     cummulative_monthly_returns[m] = cummulative_monthly_returns[m-1]+average_returns[m]
+   }
+ lines(cummulative_monthly_returns, col=color[i])
+
+ ##############################################################################################
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+ #STEP 5:Calculate mean, median and standard deviation of monthly values for each of the portfol
ios in question
+ #  and plot them on the same graph mentioned in step 4.
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+   mean = mean(average_returns)
+   median = median(average_returns)
+   std = sd(average_returns)
+   text(10, cummulative_monthly_returns[num_points-2],paste(mark, 'Portfolio Monthly Returns:','
Mean = ', format(round(mean,8),nsmall=8),
+ 'Median = ', format(round(median,8), nsmall=8),'SD = ', format(round(std,8), nsmall=8)),cex=0.4
)
+ cummulative_variance = cummulative_variance + (std^2)
+ }
[1] " AAPL   CSCO   FB  "
 [1] -0.047519399  0.012763881  0.065672133  0.097040792  0.030049539
 [6]  0.021881643  0.001660354 -0.021262073  0.052835021  0.050824745
[11] -0.010448536 -0.047519399
[1] " AAPL   CSCO   GOOG  "
 [1] -0.02679146  0.02830938  0.03221451  0.09474178  0.01661070  0.03333861
 [7]  0.02064721 -0.03959708  0.02048405  0.04863096 -0.01358638 -0.02679146
[1] " AAPL   CSCO   MSFT  "
 [1] -0.013640760  0.034971334  0.034894735  0.080234585  0.025914424
 [6]  0.015798778  0.005695160 -0.022663123  0.030729576  0.054958828
[11] -0.008298287 -0.013640760
[1] " AAPL   FB   GOOG  "
 [1] -0.05211247  0.01435211  0.07094103  0.06736552  0.03632666  0.04991790
 [7]  0.04549515 -0.03822192  0.05922307  0.04274331 -0.01723473 -0.05211247
[1] " AAPL   FB   MSFT  "
 [1] -0.03896177  0.02101407  0.07362126  0.05285833  0.04563038  0.03237807
 [7]  0.03054310 -0.02128796  0.06946860  0.04907118 -0.01194663 -0.03896177
[1] " AAPL   GOOG   MSFT  "
 [1] -0.01823384  0.03655956  0.04016363  0.05055931  0.03219155  0.04383504
 [7]  0.04952996 -0.03962297  0.03711763  0.04687739 -0.01508448 -0.01823384
[1] " CSCO   FB   GOOG  "
 [1] -0.049912619  0.001044772  0.060540791  0.065132386  0.014875387
 [6]  0.052603814  0.002192212 -0.022879392  0.049919449  0.019764762
[11]  0.001673475 -0.049912619
[1] " CSCO   FB   MSFT  "
 [1] -0.036761919  0.007706729  0.063221016  0.050625191  0.024179106
 [6]  0.035063977 -0.012759839 -0.005945435  0.060164972  0.026092634
[11]  0.006961570 -0.036761919
[1] " CSCO   GOOG   MSFT  "
 [1] -0.016033980  0.023252225  0.029763393  0.048326179  0.010740272
 [6]  0.046520949  0.006227019 -0.024280442  0.027814005  0.023898845
[11]  0.003823724 -0.016033980
[1] " FB   GOOG   MSFT  "
 [1] -0.0413549949  0.0092949595  0.0684899132  0.0209499199  0.0304562293
 [6]  0.0631002364  0.0310749560 -0.0229052835  0.0665530236  0.0180112005
[11]  0.0001753789 -0.0413549949
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> #STEP 6:Calculate the overall variance of all portfolio returns.
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> overall_variance = cummulative_variance/length
> overall_variance
[1] 0.001410445
>
>
> ##############################################################################################################################
> #Based on your project analysis, answer the following questions:
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> # Question 1: How are the monthly returns of possible portfolios distributed?
> #
> # Answer: Seeing this clearly shows I have to plot an histogram to properly analysis this. We can do this with the R command
> #         for plotting histogram and after analysis, the monthly returns of (AAPL, CSCO, FB, GOOG & MSFT) portfolio follows
> #    an approximately symmertic normal distribution with a bell-curve shape.
> #    The skewness is around -0.3627 which is closer to 0, mean is around 1.7069% and standard deviation is around 3.6224%.
>
> min=min(cummulative_average_returns)
> max=max(cummulative_average_returns)
> mean=mean(cummulative_average_returns)
> sd=sd(cummulative_average_returns)
> median=median(cummulative_average_returns)
> skewness=(3*(mean-median))/sd
> par(oma=c(0,0,0,2))
> hist(cummulative_average_returns, right=FALSE, breaks=seq(min,max,length=15),xlab="Monthly Returns", ylab="Frequency",
+ main="Monthly Returns Distribution for (AAPL, CSCO, FB, GOOG & MSFT) during October 2016 - September, 2017",col=c("blue"))
> points(seq(min, max, length.out=500),dnorm(seq(min,max,length.out=500),mean, sd), type="l", col="red")
> text(0.07, 15, paste("Mean=", format(round(mean,8))),cex=0.8)
> text(0.07, 14, paste("Median=", format(round(median,8),nsmall=8)),cex=0.8)
> text(0.07, 13, paste("Standard Deviation=", format(round(sd,8),nsmall=8)),cex=0.8)
> text(0.07, 12, paste("Skewness=", format(round(skewness,8),nsmall=8)),cex=0.8)
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> # Question 2: Do you see a wide variance in the possible portfolio returns and its cumulative outcome?
> #
> # Answer:  No. I do not see a wide variance in the possible portfolio returns and its cumulative
> #          outcome. All the portfolio combinations, sees to be moving in similar directions.
> #     Hence, the normal distribution as I already answered in Question 1.
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> # Question 3: Given that you chose similar stocks from the same industry, what accounts for the variance of returns
> #        among different portfolios (if any)?
> #
> # Answer 3: When we evaluate each company's performance we see that their individual performances are different.
> #           Apple's stock (AAPL) has been on the increase through out the year and has performed very well. The second best
> #           performing is Facebook (FB) and the top 3 porfolio combination which are AAPL, FB & MSFT are all gradually growing in
> #           terms of their individual company performance. However, Cisco's stock hasn't grown so much is the last one year.
> #           It's performance has been relatively low and stable. But because all the other companies including GOOG have been
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> #           performing well in his last year under study, it has reduced the variances of the s
tock portfolio.
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