Stock Portfolio Management Report

#1 Monthly Return

	AXP	MMM	GS	MCD	NKE	
	American Express	3M	Goldman Sachs	McDonald's	Nike	S&P500
mean	0.0080	0.0100	0.0076	0.0102	0.0193	0.0032
std	0.0922	0.0573	0.0917	0.0563	0.0765	0.0419

Monthly return is calculated through $P_t/P_{t-1}-1$ using the stock price given in the table. From monthly return, mean is calculated by “=AVERAGE()” function with monthly return during 2000-01 to 2018-12 for each stock. Standard deviation is calculated by “=STDEV.S()”function with the same data.

#2 Monthly Excess Return

	AXP	MMM	GS	MCD	NKE	
	American Express	3M	Goldman Sachs	McDonald's	Nike	S&P500
mean	0.0066	0.0087	0.0062	0.0089	0.0179	0.0019
std	0.0924	0.0574	0.0917	0.0564	0.0765	0.0421

Monthly excess return is calculated by “monthly return of stock” – “monthly return of T-bills”. We get return of T-bill by dividing the given risk-free rate by 12. With monthly excess return data, mean is calculated by “=AVERAGE()” function with monthly return during 2000-01 to 2018-12 for each stock. Standard deviation is calculated by “=STDEV.S()”function with same data, just as in #1

#3

Market Risk Premium	0.0019
Average Risk-free Rate	0.0013

Market risk premium is a mean of excess return of market portfolio which is S&P 500. We calculated this with “=AVERAGE()” function with the excess return data of S&P 500. Average risk free rate is mean of the return of risk free asset, T-bill. We get the number by “=AVERAGE()” function with the data of monthly return of T-bill.

#4

			Alpha	*t*-stat	*p*-value	Beta	*t*-stat	*p*-value	R^2
1	AXP	American Express	0.0039	0.8392	0.4022	1.4303	12.9375	0.0000	0.4255
2	MMM	3M	0.0071	2.3074	0.0219	0.7962	10.8264	0.0000	0.3415
3	GS	Goldman Sachs	0.0035	0.7645	0.4454	1.4459	13.3552	0.0000	0.4411
4	MCD	McDonald's	0.0077	2.3441	0.0199	0.6558	8.4397	0.0000	0.2396

5	NKE	Nike	0.0164	3.6030	0.0004	0.8070	7.4587	0.0000	0.1975

This table is a result of regression analysis with the stock prices. We regress excess return of stock on excess return of market risk premium, which is excess return of S&P 500. For example, using regression analysis tool of the excel, we put excess return of American express on the Y variables, and put excess return of S&P 500 on the X variables.

Alpha is a value of the intercept in the regression result, t-stat is the value of t statistics for alpha(intercept), and p-value is the p-value of alpha(intercept) used for testing significance. Beta is the regression coefficient of S&P 500, t-stat is the value of test statistics for beta(S&P 500), and p-value is the p-value of S&P 500. R^2 is a value of coefficient of determination.

1	요약 출력								
2									
3	회귀분석 통계량								
4	다중 상관ㄱ	0.652297							
5	결정계수	0.425491							
6	조정된 결ㄱ	0.422949							
7	표준 오차	0.070167							
8	관측수	228							
9									
10	분산 분석								
11		자유도	제곱합	제곱 평균	F 비	유의한 F			
12	회귀	1	0.824066	0.824066	167.3794	5.1E-29			
13	잔차	226	1.112676	0.004923					
14	계	227	1.936742						
15									
16		계수	표준 오차	t 통계량	P-값	하위 95%	상위 95%	하위 95.0%	상위 95.0%
17	Y 절편	0.003904	0.004652	0.839229	0.402228	-0.00526	0.01307	-0.00526	0.01307
18	S&P500	1.430314	0.110556	12.93752	5.1E-29	1.212463	1.648166	1.212463	1.648166
19									

Captured picture is an example of the regression output

#5

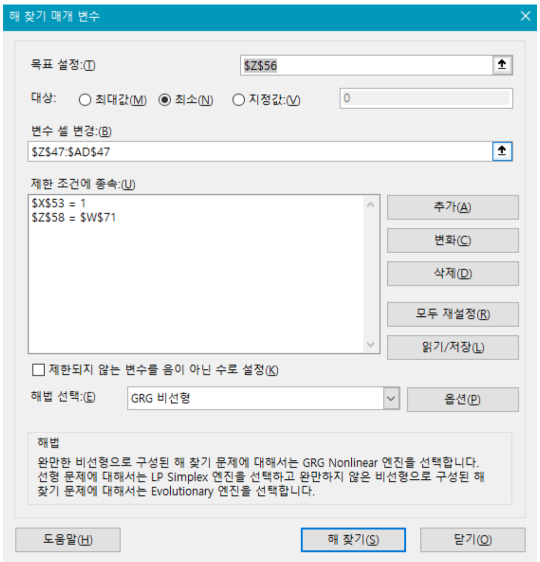
			w1	w2	w3	w4	w5
			0	0	0	0	0
		Covariance	**AXP**	**MMM**	**GS**	**MCD**	**NKE**
w1	0	**AXP**	0.008505	0.002675	0.003447	0.001587	0.002768
w2	0	**MMM**	0.002675	0.003285	0.001778	0.000853	0.001554
w3	0	**GS**	0.003447	0.001778	0.008413	0.001283	0.002088
w4	0	**MCD**	0.001587	0.000853	0.001283	0.003174	0.001606
w5	0	**NKE**	0.002768	0.001554	0.002088	0.001606	0.00585

We can covariance with "=COVARIANCE.S()" function. Using the monthly return or excess return of each stocks, (since covariance is independent to addition or subtraction), we can calculate the covariance of the returns on each two sets of stocks. For example, covariance of the returns on AXP and MMM can be calculated by =COVARIANCE.S(I5:I232, J5:J232).

#6

MV Frontier	w1	w2	w3	w4	w5	min var	min std	mean
0.029	-0.53635	0.14861	-0.33733	-0.12071	1.84578	0.01643	0.12818	0.029
0.025	-0.42876	0.21271	-0.24753	0.00520	1.45838	0.01074	0.10362	0.025
0.021	-0.32117	0.27681	-0.15773	0.13110	1.07098	0.00646	0.08037	0.021
0.017	-0.21358	0.34091	-0.06792	0.25700	0.68359	0.00360	0.05997	0.017
0.013	-0.10599	0.40501	0.02188	0.38290	0.29619	0.00215	0.04637	0.013
0.009	0.00160	0.46912	0.11168	0.50881	-0.09120	0.00212	0.04604	0.009
0.005	0.10919	0.53322	0.20149	0.63471	-0.47860	0.00351	0.05921	0.005
0.001	0.21678	0.59732	0.29129	0.76061	-0.86600	0.00631	0.07942	0.001

We can use the solver for the minimum variance frontier. Our target is to minimize variance, so choose target=pf Var, minimize. The variable cells are the weight on stocks variable (w1, w2, w3, w4, w5), since we are choosing stock weights through which we can get minimum variance at a given mean. Finally, we have two constraints: (1) the sum of stock weights should equal 1 and (2) the portfolio mean should be the given value of mean. The solver setting is attached below.



Setting the solver settings as above, we can get the weights as well as the portfolio variance, given the target mean.

MV Fronti	w1	w2	w3	w4	w5	min var	min std	mean
0.0290	-0.5363	0.1486	-0.3373	-0.1207	1.8458	0.0164	0.1282	0.0290

For example, the results for the mean=0.0290 is as above. It can be interpreted that for the given mean 0.0290, the portfolio with smallest variance can be formed with the weights from the result, and the corresponding variance will be 0.0164. Graphically, if we draw a horizontal line for E(r)=0.0290 it would meet the MVF curve at std(sigma)=0.1282.

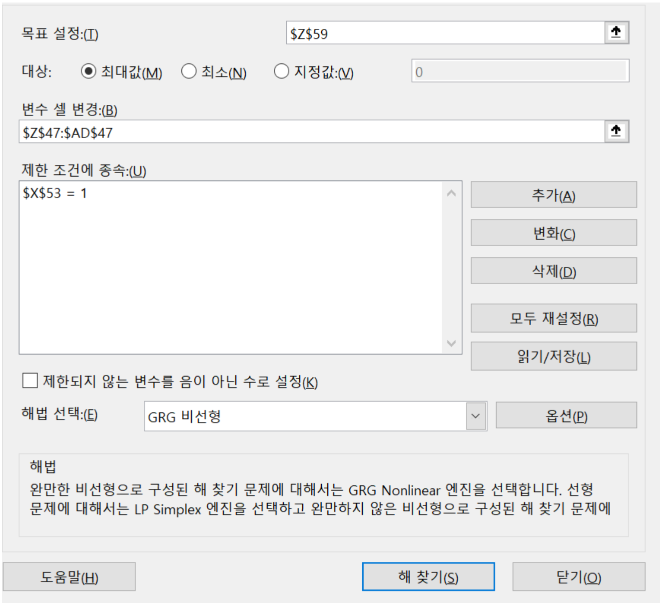
Repeating the procedure for each of the mean values, we can earn the MVF table.

#7

Max Sharpe Ratio	0.2635
Mean	0.0155
Variance	0.0029
Std	0.0539

w1	w2	w3	w4	w5	var	std	mean
-0.174203	0.364374	-0.035045	0.303095	0.541779	0.002903	0.05388	0.015536

To get the the optimal risky portfolio of the five stocks, we again use the MS Excel Solver function to get the ORP with the maximum sharpe ratio. Our target is to maximise pf Sharpe ratio, so choose target=pf S-ratio, maximise. The variable cells are the weight on stocks variable (w1, w2, w3, w4, w5), since we are choosing stock weights of a portfolio through which we can get the maximum Sharpe ratio when combined with the risk-free asset. Finally, we have one constraint: the sum of stock weights should equal 1. The solver setting is attached below.



Now we get the maximised pf S-ratio and each weight. Since weights are newly filled, the adjusted pf Var and pf Mean are also automatically renewed. We copy and paste these values to fill in the yellow shaded tables.

#8

Treynor-Black Sharpe Ratio	0.0646

weight on passive portfolio	0.1984
weight on active portfolio	0.8016
weight on MCD	0.5780
weight on NKE	0.2236

Here, we first construct a new table of an active portfolio A that consists of MCD and NIKE where each (monthly) alphas of the two stocks are 0.0020 and 0.0015, respectively. See the table below. From the result of the regression analysis of MCD and NIKE done in previous problems, we get the estimate for beta and var(e) by the regression coefficient of S&P500 and MSE(or Mean Squared Residual), respectively. Then we get the optimal weight for each stock in this active portfolio stock by calculating =(alpha/var(e)[stock i])/sum. With this weights, we calculate each alpha and beta of the active pf by calculating weighted average of each individual components. For var(e), we have sum of w_i^2*var(e_i). Then with the formula of Treynor-Black model, we calculate w(0), w*(A), and w*(M), using the S&P 500 index fund as a passive, market portfolio. All the explained results are given below by the table.

	MCD	NKE			
alpha	0.0020	0.0015			
beta	0.6558	0.8070			
var(e)	0.0024	0.0047			
alpha/var(e) MCD		0.822279		weight on MCD	0.721041
alpha/var(e) NKE		0.318126		weight on NKE	0.278959
sum		1.140405			
alpha (portfolio A)		0.001861			
beta (portfolio A)		0.697984			
var(e) (portfolio A)		0.001631			
w(0)		1.057638			
w*(A)		0.801591			
w*(M)		0.198409			
market sharpe ratio		0.045222			

Since we have calculated the weight on passive portfolio and the weight on active portfolio by the formula, we fill in the yellow blanks. For the weight on MCD and NKE, we multiply the weight on active pf and the weight on each individual stock inside the active pf. For example, for MCD, we get =AA92*AI96=0.721041*0.801591=0.5780

Finally, we calculate the Treynor-Black Sharpe Ratio by

=SQRT((market sharpe ratio)^2+(alpha of portfolio A)^2/(var(e) of portfolio A))

=SQRT(AE108^2+AE100^2/AE102)

=0.0646