

Capstone Project

Case Study 3 Portfolio Analysis for Mr. George Soros

Group : 2D

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SCM315: Business Decision Model

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Executive Summary:

As we know Mr. George Soros wants to invest in a high-return, diverse and low risk portfolio of stocks for one year to gain enough capital to support his new business venture. On the basis of Mr. Soros' requirement, we performed an analysis and provided a report with suggestions for him to make a wise decision. In the report, we using given data implemented a two-part analysis to generate optimal solutions for Mr. Soros. The first part involved performing three optimization models. we did research to calculate one year return of each stock. And using analytic solver platform in Excel to get the optimal solutions. The goal of second part is to explain the unpredictability of the stock returns. It included using "Simulation" as an analysis tool to find out the output distribution of expected yearly return. By combining with two-part analysis, We believe that Portfolio 2 is the best option for Mr. Soros to collect enough capital to support his new business Venture.

Project Definition:

Mr. George Soros starts a new business venture of opening a chain of specialty Hungarian eateries in California. However, he does not have sufficient capital to start his plan. In order to collect sufficient capital, he plans to invest in a high return, diverse, and low risk portfolio of stocks for a year. Mr. Solos has approached our team to do an analysis to find out an optimal investment portfolio and meet the requirements at the same time. Mr. Soros lists down the list of 20 potential publicly traded companies to invest in. They are divided into five different industries.

The final optimal portfolio recommendation need to fulfill the following restrictions:

- Budget of \$1,000,000 cannot be exceeded
- Total investment must exceed \$1,000,000 minus the largest price
- A diverse portfolio of at least \$10,000 invested in each industry
- At most 40% of his total investment capital to be in each industry
- Average weighted profit margin must exceed 20%, Average weighted Beta must less than 1.2, Average weighted PEG ratio must less than 1.4
- At most %50,000 investment in Clorox, Equinix and Signature Bank

The goals of the portfolios are to find out:

- Maximize Expected Return Next Year
- Minimize Average Weighted Beta
- Minimize Average PEG Ratio

Besides that, Mr. Soros interested to know the result with the consideration of the unpredictability of stock returns. Data of historical records and bankruptcy risks of each stock option are provided to get the result. In order to give Mr. Soros a reliable recommendation, our team performed an analysis in two parts using accurate data analyzed through Excel tools. We are able to determine the best portfolio for him.

Part 1 Approach and Analysis - Optimization:

For part 1, we believe optimization model is the best model to satisfy all the goals:

- 1) The maximization of expected return next year
- 2) The minimization of average weighted beta and
- 3) The minimization of average weighted PEG ratio

Optimization models requires controllable values (values that we can made decision) and goals which we need to be achieved. The goals and values are restricted by a set of constraints. This framework is applied to achieve the solution for this part.

We used the “Company Statistics” sheet for all the three optimization models. In order to calculate the expected return next year. Our team do research to measure the on-year return of the public stock. We achieved three different portfolios of optimal stock investments. Before we start running excel, we need to determine the following requirements:

- the decision variables (how much money to invest in each stock)
- the objective function (what does Mr. Soros want to maximize or minimize)
- the constraints (the requirements previously given by Mr. Soros)

After that, we used the analytic solver platform in Excel to run the 3 analyses to obtain the optimal solutions. The details and results can be found in the appendix.

Through the analysis, we achieve the following results:

Portfolio 1: Maximizes expected return next year and would yield 42.1087. This means each dollar invested by Mr. Soros will return \$42.11 in a year.

Portfolio 2: Minimize of average weighted beta is 0.59368702. This means the volatility or risk is 0.59368702.

Portfolio 3: Minimize the PEG (price/earnings to growth) ratio is -7.768160216.

By comparison of the three portfolios, we recommend Mr. Soros refers to portfolio 2 to make investment. This portfolio minimizes beta (minimizes risk) to a low of 0.59368702, which is very safe. In addition, portfolio 2 has diverse investment among the industries and companies. In conclusion, portfolio 2 meets all the objective proposed by Mr. Soros.

Below the amounts invested in each company for portfolio 2 are shown:

- \$0 - amount invested in Lam Research Corp.
- \$0 - amount invested in Micron Technology
- \$10,000 - amount invested in Equinix
- \$0 - amount invested in Apple inc
- \$0 - amount invested in Humana Inc
- \$209120.409906063- amount invested in Magellan Health Inc.
- \$0 - amount invested in UnitedHealth Group Inc.
- \$0 - amount invested in Cigna Corp.
- \$10,000 - amount invested in Enphase Energy

\$0 - amount invested in Hess Corporation
 \$0 - amount invested in Atwood Oceanics
 \$0 - amount invested in Schlumberger
 \$400,000 - amount invested in Intercontinental Exchange
 \$0 - amount invested in Signature Bank
 \$0 - amount invested in BNY Mellon
 \$0 - amount invested in KKR & Co L.P.
 \$0 - amount invested in Mondelez International
 \$0 - amount invested in PepsiCo
 \$320879.590093937 - amount invested in WD-40 Co.
 \$50,000 - amount invested in Clorox co

Part 2 Approach and Analysis - Simulation:

The returns in the prior analysis do not account for the unpredictability of stock returns. Hence, our team proposed to continue the analysis. Due to the availability of historical data of one-year returns and bankruptcy risk of a sample of 50 data points from each of the industry, and the goal of part 2 is to find out the output distribution of expected yearly return, “Simulation” would be the most appropriate analysis tool. We decided to continue using Analytic Solver Platform in Excel to get distribution of possible return for the investments.

First of all, we identified possible yearly return and the occurrence of bankruptcy as random binary input, the amount of each stock in each portfolio as fixed input, possible returns on investment as the output values. Secondly, we implemented the Fit function for known historical return data in order to find the statistical distribution of the possible yearly return which best describe the historical data. After finding the historical distribution, we used it to provide random input variable, which is possible yearly return of each stock, in precisely the same pattern as happened in real life.

Third, we tried to find out the equation of the output, which is the expected yearly return of each portfolio. And the formula can be written as follow:

$$\begin{aligned}
 E(R) &= W_1 \cdot R_1 + W_2 \cdot R_2 + \dots + W_n \cdot R_n \\
 &= (A_1 \cdot R_1 + A_2 \cdot R_2 + \dots + A_n \cdot R_n) / 1000000 \\
 (R &= \text{possible yearly return, } W = \text{the weight of each stock in portfolio, } A = \text{the amount of each stock})
 \end{aligned}$$

Nevertheless, we cannot ignore the influence of bankruptcy risk. If a company files bankruptcy, the yearly return of stock of the company will become zero. Therefore, we developed the “Bernoulli” distribution of bankruptcy risk of each industry with the possibility, which was calculated by the frequency of bankruptcy divided by 50, based on the given random sample of 50

data. If a company randomly inputted 0, it was assumed the company would not declare bankruptcy, and its possible yearly return should be additionally multiplied by 1. Accordingly, we let variable X to be the random binary variable for the occurrence of bankruptcy and made X equal to “If(A62=0, 1, 0)”. Hence, the output equation can be revised as follow:

$$\begin{aligned} E(R) &= W1*R1*X1 + W2*R2*X2 + ... + Wn*Rn*Xn \\ &= (A1*R1*X1 + A2*R2*X2 + ... + An*Rn*Xn)/1000000 \end{aligned}$$

After running the simulation of each portfolio, we do not consider portfolio 3 due to the lowest possible return and maximum return. Then, we find out that portfolio 1 has higher mean return, possible return, and maximum return. However, it has relatively higher range and standard deviation as well. Portfolio 2 has small standard, which indicates that the possible return tend to be close to the mean (also called the expected value) of the set. Portfolio 2 has less variety of stocks but more stable, which will provide the company with continuous return. Last but not least, portfolio 1 has a higher possibility to get a greater possible return. However, we still highly recommended portfolio 2 due to the stability and the lower risk.

Conclusions and Recommended Actions

As the analysis has demonstrated above, we highly suggested Mr. Soros should invest in Portfolio 2. It is clear that a high-return, diverse and low risk portfolio of stocks is what Mr. Soros looking for. Within three portfolios, our analysis data indicated that portfolio 2 best meet Mr. Soros’s requirements. In the first part of analysis, it showed that portfolio 2 has lowest beta which meaning is very safe. Plus, portfolio 2 has diverse investment among the industries and companies. More data has shown that portfolio 2 is the best option for Mr. Soros. In the last part of analysis, portfolio 3 has lowest possible return and maximum return. Portfolio 1 has higher standard deviation than Portfolio 2. By comparing with three portfolios, portfolio 2 win over portfolio 1 and 2 due to the stability and lower risk. As a result, we strongly recommended Mr. Soros to invest portfolio 2 in order to achieve financial support for his future business venture.

Appendix A: Part 1 Model

	A	B	C	D	E	F	G	H	I	J
1	Name	Ticker Symbol	Industry	Beta	PEG Ratio	Profit Margin	Current Stock Price	Purchase Price of Stock	Annual Return on Stock	Return on Stock
2	Lam Research Corp.	LRCX	Technology	1.55	1.2	14.39%	\$150.28	84.66	0.775100402	65.62
3	Micron Technology Inc.	MT	Technology	2.07	25.48	14.04%	\$31.20	12.51	1.494004796	18.69
4	Equinix	EQIX	Technology	0.48	1.78	6.89%	\$432.22	379.91	0.137690506	52.31
5	Apple Inc.	AAPL	Technology	1.35	0.89	22.87%	\$146.34	95.91	0.525805443	50.43
6	Humana Inc.	HUM	Health Care	0.92	1.35	2.35%	\$235.49	190.07	0.238964592	45.42
7	Magellan Health Inc.	MGLN	Health Care	0.22	-1.33	0.60%	\$72.40	65.96	0.09763493	6.44
8	UnitedHealth Group Inc.	UNH	Health Care	0.62	1.12	3.70%	\$183.02	138.19	0.324408423	44.83
9	Cigna Corp	CI	Health Care	0.42	1.44	5.53%	\$170.26	127.79	0.332342124	42.47
10	Enphase Energy	ENPH	Energy	0.76	-0.04	-1.49%	\$0.80	2.15	-0.627906977	-1.35
11	Hess Corporation	HES	Energy	1.43	0.36	-46.94%	\$42.96	58.7	-0.268143101	-15.74
12	Atwood Oceanics	ATW	Energy	2.07	-0.03	32.73%	\$9.02	12.64	-0.286392405	-3.62
13	Schlumberger	SLB	Energy	1.06	-20.48	5.84%	\$68.10	78.52	-0.132705043	-10.42
14	Intercontinental Exchange	ICE	Financial	0.76	1.12	38.17%	\$64.77	50.19	0.290496115	14.58
15	Signature Bank	SBNY	Financial	0.99	1.19	38.49%	\$142.12	127.94	0.110833203	14.18
16	BNY Mellon	BK	Financial	1.39	1	21.01%	\$50.28	40.44	0.243323442	9.84
17	KKR & Co L.P.	KKR	Financial	1.27	0.65	6.77%	\$18.84	13.08	0.440366972	5.76
18	Mondelez International	MDLZ	Consumer Goods	1.22	2.55	24.52%	\$45.48	44.48	0.022482014	1
19	PepsiCo	PEP	Consumer Goods	0.7	3.23	8.65%	\$117.29	104.08	0.126921599	13.21
20	WD-40 Co.	WDFC	Consumer Goods	0.66	2.49	12.31%	\$112.75	114.83	-0.018113733	-2.08
21	Clorox Co	CLX	Consumer Goods	0.39	3.67	12.05%	\$141.15	133.1	0.060480841	8.05

Optimization Model:

Decision variables

LRCX - amount invested in Lam Research Corp.

MT - amount invested in Micron Technology

EQIX- amount invested in Equinix

AAPL - amount invested in Apple inc

HUM - amount invested in Humana Inc.

MGLN- amount invested in Magellan Health Inc.

UNH - amount invested in UnitedHealth Group Inc.

CI - amount invested in Cigna Corp.

ENPH- amount invested in Enphase Energy

HES - amount invested in Hess Corporation

ATW - amount invested in Atwood Oceanics

SLB- amount invested in Schlumberger

ICE- amount invested in Intercontinental Exchange

SBNY- amount invested in Signature Bank

BK - amount invested in BNY Mellon

KKR - amount invested in KKR & Co L.P.

MDLZ - amount invested in Mondelez International

PEP- amount invested in PepsiCo

WDFC- amount invested in WD-40 Co.

CLX- amount invested in Clorox co

Objective Functions

(3 different functions for 3 separate models; technical excel functions in parenthesis for reference)

1) Maximize Expected Return Next Year = Sum of the product of the decision variables and the return on stock amounts, divided by total investment.

SUMPRODUCT(A27:A46,J2:J21)/H28

2) Minimize Average Weighted Beta = Sum of the product of the decision variables and the average weighted beta amounts, divided by total investment.

SUMPRODUCT(A27:A46,D2:D21)/H28

3) Minimize Average Weighted PEG Ratio = Sum of the product of the decision variables and the average weighted PEG ratio amounts, divided by total investment.

SUMPRODUCT(A27:A46,E2:E21)/H28

Constraints

Budget of \$1,000,000 cannot be exceeded

SUM(A27:A46) <= 1000000

Total investment must exceed \$1,000,000 minus the largest price

SUM(A27:A46) >= H28-MAX(A27:A46)

At least \$10,000 invest in Technology industries

SUM(A27:A30) >= 10000

At least \$10,000 invest in Health Care industries

SUM(A31:A34) >= 10000

At least \$10,000 invest in Energy industries

SUM(A35:A38) >= 10000

At least \$10,000 invest in Financial industries

SUM(A39:A42) >= 10000

At least \$10,000 invest in Consumer Goods

SUM(A43:A46) >= 10000

At most 40% of total investment in Technology industries

SUM(A27:A30) <= \$F\$28*0.4

At most 40% of total investment in Health Care industries

$$\text{SUM}(\text{A31:A34}) \leq \$\text{F\$28} * 0.4$$

At most 40% of total investment in Energy industries

$$\text{SUM}(\text{A35:A38}) \leq \$\text{F\$28} * 0.4$$

At most 40% of total investment in Financial industries

$$\text{SUM}(\text{A39:A42}) \leq \$\text{F\$28} * 0.4$$

At most 40% of total investment in Consumer Goods industries

$$\text{SUM}(\text{A43:A46}) \leq \$\text{F\$28} * 0.4$$

Average weighted profit margin must exceed 20%

$$\text{SUMPRODUCT}(\text{A27:A46}, \text{F2:F21}) / \text{H28} \geq 0.2$$

Average weighted Beta is less than 1.2

$$\text{SUMPRODUCT}(\text{A27:A46}, \text{D2:D21}) / \text{H28} \leq 1.2$$

Average weighted PEG ratio is less than 1.4

$$\text{SUMPRODUCT}(\text{A27:A46}, \text{E2:E21}) / \text{H28} \leq 1.4$$

At most \$50,000 investment in Clorox Co.

$$\text{A46} \leq 50000$$

At most \$50,000 investment in Equinix

$$\text{A29} \leq 5000$$

At most \$50,000 investment in Signature Bank

$$\text{A40} \leq 50000$$

Non Negative Constraints

$$\text{A27:A46} \geq 0$$

	A	B	C	D	E	F	G	H	I	J	K	L	N
1	Name	Ticker Symbol	Industry	Beta	PEG Ratio	Profit Margin	Current Stock Price	Purchase Price of Stock	Annual Return on Stock	Return on Stock			
2	Lam Research Corp.	LRCX	Technology	1.55	1.2	14.39%	\$150.28	84.66	0.775100402	65.62			
3	Micron Technology Inc.	MU	Technology	2.07	25.48	14.04%	\$31.20	12.51	1.494004796	18.69			
4	Equinix	EQIX	Technology	0.48	1.78	6.89%	\$432.22	379.91	0.137690506	52.31			
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11	Hess Corporation	HES	Energy	1.43	0.36	-46.94%	\$42.96	58.7	-0.268143101	-15.74			
12	Atwood Oceanics	ATW	Energy	2.07	-0.03	32.73%	\$9.02	12.64	-0.286392405	-3.62			
13	Schlumberger	SLB	Energy	1.06	-20.48	5.84%	\$68.10	78.52	-0.132705043	-10.42			
14	Intercontinental Exchange	ICE	Financial	0.76	1.12	38.17%	\$64.77	50.19	0.290496115	14.58			
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16	BNY Mellon	BK	Financial	1.39	1	21.01%	\$50.28	40.44	0.243323442	9.84			
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20	WD-40 Co.	WDFC	Consumer Goods	0.66	2.49	12.31%	\$112.75	114.83	-0.018113733	-2.08			
21	Clorox Co	CLX	Consumer Goods	0.39	3.67	12.05%	\$141.15	133.1	0.060480841	8.05			
22													
23													
24													
25													
26	Decision Variable		Objective Function			Constraints							
27		0 LRCX	0.59368702			LHS	Inequality	RHS		Explanation			
28		0 MU				1000000	<=		1000000	Budget of \$1,000,000 cannot be exceeded			
29		10000 EQIX				1000000	>=		600000	Total investment must exceed \$1,000,000 minus the largest price			
30		0 AAPL				10000	>=		10,000	At least \$10,000 invest in Technology industries			
31		0 HUM				209120.4099	>=		10,000	At least \$10,000 invest in Health Care industries			
32		209120.4099 MGLN				10000	>=		10,000	At least \$10,000 invest in Energy industries			
33		0 UNH				400000	>=		10,000	At least \$10,000 invest in Financial industries			
34		0 CI				370879.5901	>=		10,000	At least \$10,000 invest in Consumer Goods			
35		10000 ENPH				10000	<=		400000	At most 40% of total investement in Technology industries			
36		0 HES				209120.4099	<=		400000	At most 40% of total investement in Health Care industries			
37		0 ATW				10000	<=		400000	At most 40% of total investement in Energy industries			
38		0 SLB				400000	<=		400000	At most 40% of total investement in Financial industries			
39		400000 ICE				370879.5901	<=		400000	At most 40% of total investement in Consumer Goods industries			
40		0 SBNY				0.2	>=		0.2	Average weighted profit margin must exceed 20%			
41		0 BK				0.59368702	<=		1.2	Average weighted Beta is less than 1.2			
42		0 KKR				1.169760034	<=		1.4	Average weighted PEG ratio is less than 1.4			
43		0 MDLZ				50000	<=		50,000	At most \$50,000 investment in Clorox Co.			
44		0 PEP				10000	<=		50,000	At most \$50,000 investment in Equinix			
45		320879.5901 WDFC				0	<=		50,000	At most \$50,000 investment in Signature Bank			
46		50000 CLX				0	>=		0				
47						0	>=		0				
48						10000	>=		0				
49						0	>=		0				
50						0	>=		0				
51						209120.4099	>=		0				
52						0	>=		0				
53						0	>=		0				
54						10000	>=		0				
55						0	>=		0				
56						0	>=		0				
57						0	>=		0				
58						400000	>=		0				
59						0	>=		0				
60						0	>=		0				
61						0	>=		0				
62						0	>=		0				
63						0	>=		0				
64						320879.5901	>=		0				
65						50000	>=		0				

Appendix B: Part 2 Model

Simulation Model:

The worksheet of part 2:

	A	B	C	D	E	F	G	H	I	J
1	Name	Lam Research Corp.	Micron Technology Inc.	Equinix	Apple Inc.	Humana Inc.	Magellan Health Inc.	UnitedHealth Group Inc.	Cigna Corp	Enphase Energy
2	Ticker Symbol	LRCX	MU	EQIX	AAPL	HUM	MGLN	UNH	CI	ENPH
3	Industry	Technology	Technology	Technology	Technology	Health Care	Health Care	Health Care	Health Care	Energy
56	random return	0.945463763	0.47988577	1.401657342	1.564543586	1.667123618	1.039733482	1.573461015	1.253335186	0.28142
57	Return per dollars (A56-1)	-0.054536237	-0.52011423	0.401657342	0.564543586	0.667123618	0.039733482	0.573461015	0.253335186	-0.71857
58	AMOUNT(P1)	400000	0	0	0	0	0	245636.7856	0	0
59	AMOUNT(P2)	0	0	10000	0	0	209120.4099	0	0	1
60	AMOUNT(P3)	0	0	0	91459.36237	0	98540.63763	0	0	0
61	risk of bankruptcy	0.16	0.16	0.16	0.16	0.08	0.08	0.08	0.08	0.08
62	random bankruptcy	0	0	0	0	0	0	0	0	0
63	If(A62=0,1,0)	1	1	1	1	1	1	1	1	1
64	OUTPUT_P1 (R%*W*0/1)	0.153503734	1.153503734	OUTPUT_P2 (R%*W*0/1)	0.117572916	1.117572916	OUTPUT_P3 (R%*W*0/1)	0.055899296	1.055899296	
65	max return	0.57495832	1.57495832	max return	0.520236545	1.520236545	max return	0.199333766	1.199333766	
66	min return	-0.054304184	0.945695816	min return	-0.020984648	0.979015352	min return	-0.181130352	0.818869648	
67	mean	0.162079937	1.162079937	mean	0.154269181	1.154269181	mean	0.022411333	1.022411333	
68	stdDeV	0.094372658	1.094372658	stdDeV	0.054978006	1.054978006	stdDeV	0.054522537	1.054522537	
69	range	0.629262505	1.629262505	range	0.541221193	1.541221193	range	0.380464117	1.380464117	

Table 1: Fitted distribution for random variables in simulation model

Name	Industry	Fitted Distribution
Lam Research Corp.	Technology	Weibull
Micron Technology Inc.	Technology	LogLogistic
Equinix	Technology	Rayleigh
Apple Inc.	Technology	Rayleigh
Humana Inc.	Health Care	Erf
Magellan Health Inc.	Health Care	Logistic
UnitedHealth Group Inc.	Health Care	Erf
Cigna Corp	Health Care	Normal
Enphase Energy	Energy	Pearson5
Hess Corporation	Energy	Gamma
Atwood Oceanics	Energy	Normal
Schlumberger	Energy	Laplace
Intercontinental Exchange	Financial	MinExtreme
Signature Bank	Financial	Uniform
BNY Mellon	Financial	Rayleigh
KKR & Co L.P.	Financial	Weibull
Mondelez International	Consumer Goods	Pearson5
PepsiCo	Consumer Goods	InvNormal
WD:40 Co.	Consumer Goods	Erf
Clorox Co	Consumer Goods	Erlang

Table 2 : The distributions for random variables of bankrupt event

Name	Industry	Distribution	Parameter
Lam Research Corp.	Technology	Bernoulli	Probability : 0.16
Micron Technology Inc.	Technology	Bernoulli	Probability : 0.16
Equinix	Technology	Bernoulli	Probability : 0.16
Apple Inc.	Technology	Bernoulli	Probability : 0.16
Humana Inc.	Health Care	Bernoulli	Probability : 0.08
Magellan Health Inc.	Health Care	Bernoulli	Probability : 0.08
UnitedHealth Group Inc.	Health Care	Bernoulli	Probability : 0.08
Cigna Corp	Health Care	Bernoulli	Probability : 0.08
Enphase Energy	Energy	Bernoulli	Probability : 0.04
Hess Corporation	Energy	Bernoulli	Probability : 0.04
Atwood Oceanics	Energy	Bernoulli	Probability : 0.04
Schlumberger	Energy	Bernoulli	Probability : 0.04
Intercontinental Exchange	Financial	Bernoulli	Probability : 0.08
Signature Bank	Financial	Bernoulli	Probability : 0.08
BNY Mellon	Financial	Bernoulli	Probability : 0.08
KKR & Co L.P.	Financial	Bernoulli	Probability : 0.08
Mondelez International	Consumer Goods	Bernoulli	Probability : 0.12
PepsiCo	Consumer Goods	Bernoulli	Probability : 0.12
WD:40 Co.	Consumer Goods	Bernoulli	Probability : 0.12
Clorox Co	Consumer Goods	Bernoulli	Probability : 0.12

Simulation Model Random Variables:

R_{LRCX} : Possible yearly return on the stock of Lam Research Corp.

R_{MU} : Possible yearly return on the stock of Micron Technology

R_{EQIX} : Possible yearly return on the stock of in Equinix

R_{AAPL} : Possible yearly return on the stock of Apple Inc.

R_{HUM} : Possible yearly return on the stock of Humana Inc.

R_{MGLN} : Possible yearly return on the stock of Magellan Health Inc.

R_{UNH} : Possible yearly return on the stock of UnitedHealth Group Inc.

R_{CI} : Possible yearly return on the stock of Cigna Corp.

R_{ENPH} : Possible yearly return on the stock of Enphase Energy

R_{HES} : Possible yearly return on the stock of Hess Corporation

R_{ATW} : Possible yearly return on the stock of Atwood Oceanics

R_{SLB} : Possible yearly return on the stock of Schlumberger

R_{ICE} : Possible yearly return on the stock of Intercontinental Exchange

R_{SBNY} : Possible yearly return on the stock of Signature Bank

R_{BK} : Possible yearly return on the stock of BNY Mellon

R_{KKR} : Possible yearly return on the stock of KKR & Co L.P.

R_{MDLZ} : Possible yearly return on the stock of Mondelez international

R_{PEP} : Possible yearly return on the stock of PepsiCo

R_{WDFC} : Possible yearly return on the stock of WD:40 Co

R_{CLX} : Possible yearly return on the stock of Clorox co

X_{LRCX} : Binary variable indicating the occurrence of Lam Research Corp. declaring bankruptcy

X_{MU} : Binary variable indicating the occurrence of Micron Technology declaring bankruptcy

X_{EQIX} : Binary variable indicating the occurrence of Equinix declaring bankruptcy

X_{AAPL} : Binary variable indicating the occurrence of Apple Inc. declaring bankruptcy

X_{HUM} : Binary variable indicating the occurrence of Humana Inc. declaring bankruptcy

X_{MGLN} : Binary variable indicating the occurrence of Magellan Health Inc. declaring bankruptcy

X_{UNH} : Binary variable indicating the occurrence of UnitedHealth Group Inc. declaring bankruptcy

X_{CI} : Binary variable indicating the occurrence of Cigna Corp. declaring bankruptcy

X_{ENPH} : Binary variable indicating the occurrence of Intercontinental Exchange declaring bankruptcy

X_{HES} : Binary variable indicating the occurrence of Hess Corporation declaring bankruptcy

X_{ATW} : Binary variable indicating the occurrence of Atwood Oceanics declaring bankruptcy

X_{SLB} : Binary variable indicating the occurrence of Schlumberger declaring bankruptcy

X_{ICE} : Binary variable indicating the occurrence of Intercontinental Exchange declaring bankruptcy

X_{SBNY} : Binary variable indicating the occurrence of Signature Bank declaring bankruptcy

X_{BK} : Binary variable indicating the occurrence of BNY Mellon declaring bankruptcy

X_{KKR} : Binary variable indicating the occurrence of KKR & Co L.P. declaring bankruptcy

X_{MDLZ} : Binary variable indicating the occurrence of Mondelez international declaring bankruptcy

X_{PEP} : Binary variable indicating the occurrence of PepsiCo declaring bankruptcy

X_{WDFC} : Binary variable indicating the occurrence of WD:40 Co declaring bankruptcy

X_{CLX} : Binary variable indicating the occurrence of Clorox co declaring bankruptcy

($X_i = 1$, if the event of bankruptcy did not occur, $X_i = 0$, if the event of bankruptcy did occur.)

Simulation Model Fixed Variables:

W_{LRCX} : the weight of stock of Lam Research Corp.

W_{MU} : the weight of stock of Micron Technology

W_{EQIX} : the weight of stock of Equinix

W_{AAPL} : the weight of stock of Apple Inc.

W_{HUM} : the weight of stock of Humana Inc.

W_{MGLN} : the weight of stock of Magellan Health Inc.

W_{UNH} : the weight of stock of United Health Group Inc.

W_{CI} : the weight of stock of Cigna Corp.

W_{ENPH} : the weight of stock of Enphase Energy

W_{HES} : The weight of the stock of Hess Corporation

W_{ATW} : the weight of stock of Atwood Oceanics

W_{SLB} : the weight of stock of Schlumberger

W_{ICE} : the weight of stock of Intercontinental Exchange

W_{SBNY} : the weight of stock of Signature Bank

W_{BK} : the weight of stock of BNY Mellon

W_{KKW} : the weight of stock of KKR & Co L.P.

W_{MDLZ} : the weight of stock of Mondelez international

W_{PEP} : the weight of stock of PepsiCo

W_{WDFC} : the weight of stock of WD:40 Co

W_{CLX} : the weight of stock of Clorox co

(W_i = the amount of each stock/1000000 = $A_i/1000000$)

Simulation Model Outputs:

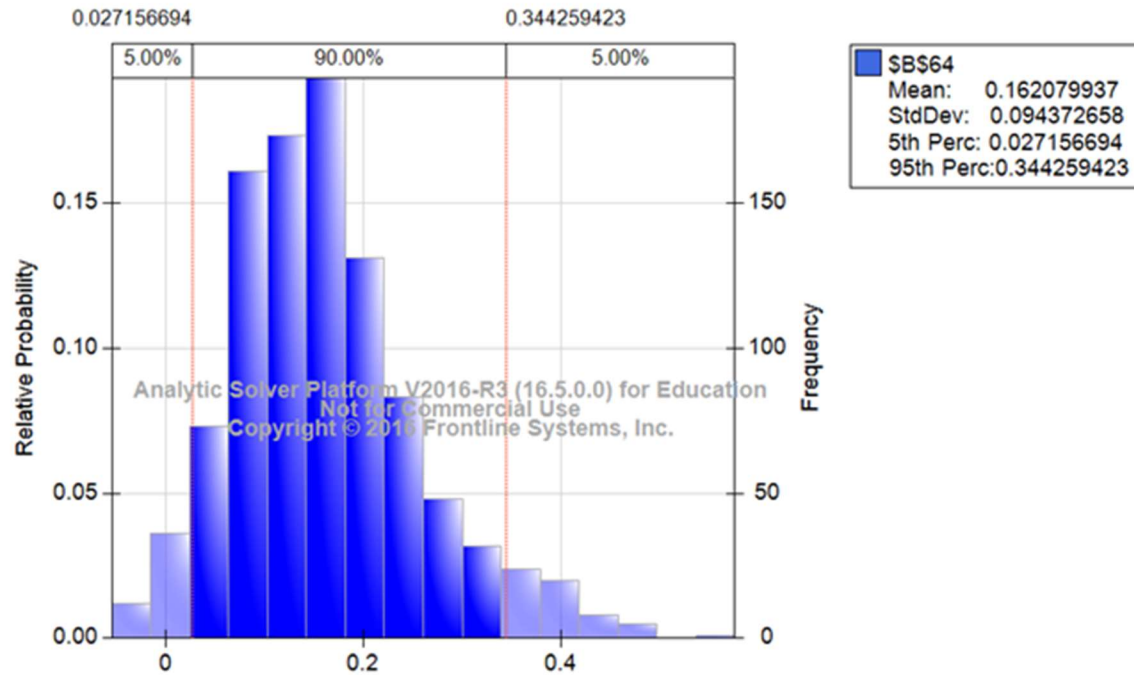
O = Expected Yearly Return of Portfolio

Simulation Equations:

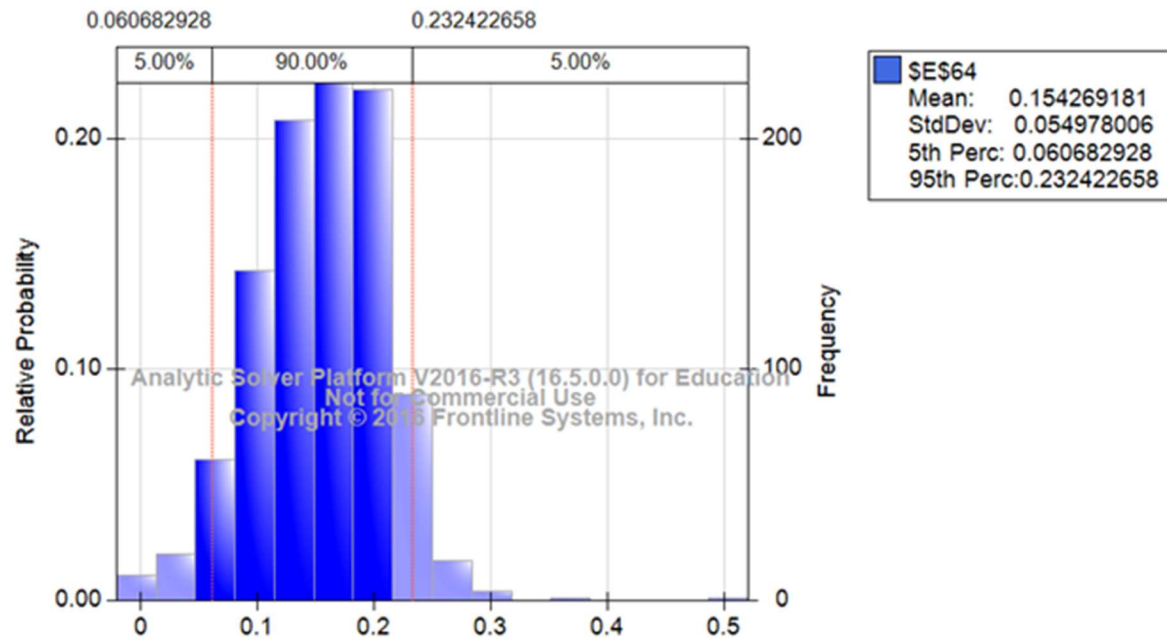
$$O = \sum_{i=eac \ stock}^{20} W_i * R_i * X_i$$

$$= \frac{\sum_{i=eac \ stock}^{20} (A_i * R_i * X_i)}{1,000,000}$$

The distribution of expected yearly return of Portfolio 1 :



The distribution of expected yearly return of Portfolio 2 :



The distribution of expected yearly return of Portfolio 3:

