The Optimal Stock Portfolio Management

Project Objective

This application aims to support general investors with their portfolio management. It generates the optimal portfolio to users based on their stock of interest and risk preference, and provides financial statistics to them as reference.

Users

General investors with basic financial knowledge, but may not be very sure of how to calculate portfolio data and construct optimal portfolio.

Introduction

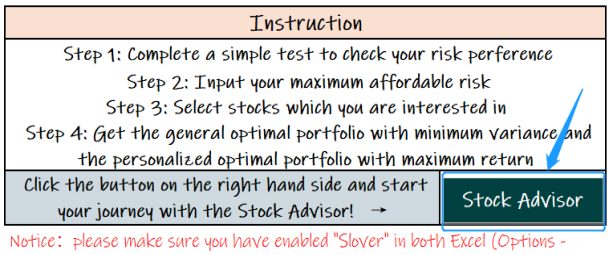
All investors pursue a portfolio which can generate high returns while carrying low risk. Therefore, how to allocate stocks into a portfolio becomes the most essential issue for investors. In order to get the optimal portfolio, one must take many financial statistics into account and do the tedious calculation. The optimal stock portfolio management system is developed to help investors to make decisions on its investment in an efficient way.

Functionality of the Application

1) Risk Attitude Test: a simple test that can help investors to understand the risk preference of their own.
2) Generates financial statistics of each stock of interest, including SMA-200, returns, volatility and its covariance with the other stock.
3) Provides two portfolio recommendations. One is the general optimal portfolio with minimum risk, the other is the personalized optimal portfolio with max return subject to user's maximum affordable risk.

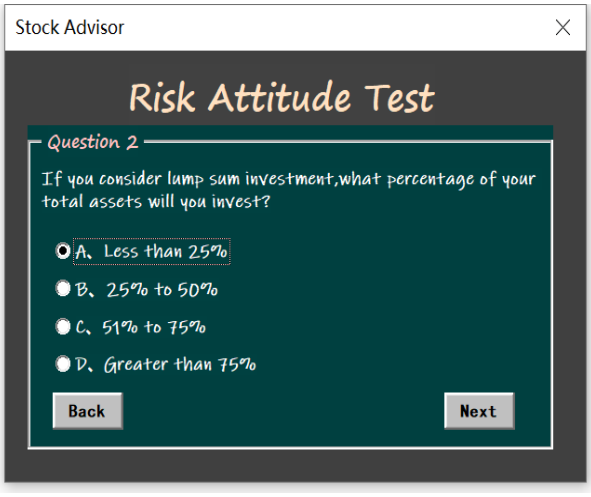
Demonstration of the Application

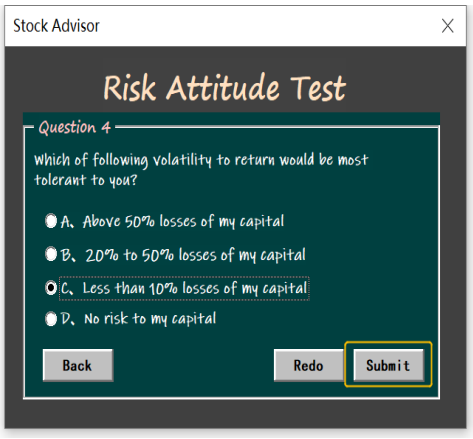
1) Enable Solver: Before start, user needs to enable "Solver add-in" in both Excel and VBA reference manually.
2) Hit the "Stock Advisor" button to start.



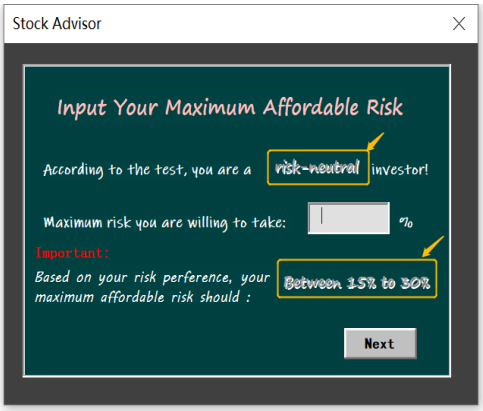
Notice: please make sure you have enabled "Slover" in both Excel (Options - Add-in) and VBA (Tools - References - "Solver")

3) Risk Attitude Test: A simple test with four questions. Each answer option for each question is assigned a score. Answer option with higher risk tendency is given a higher score (e.g., for question 1, option "A: Less than 1 year" score 4 while option "D: More than 5 years" only score 1). Users are able to move back and forth among questions, but only when all questions have been answered, the user is allowed to move to the next step.



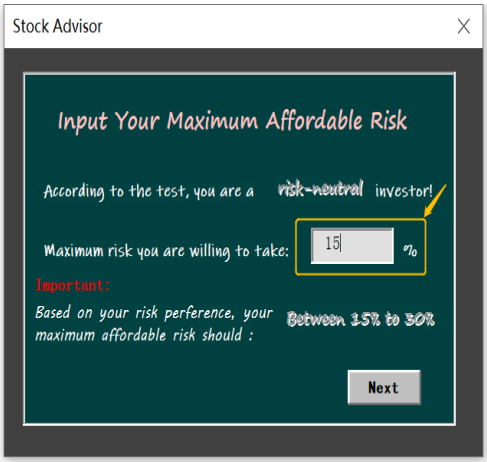


4) Exhibits test result: with all four questions answered, the total score is generated by summing up all scores from the chosen option in each question. Based on the total score, risk preference can be determined (risk-aversion: total score ≤6; risk-neutral: 6< total score≤11; risk-loving: 11< total score≤15). Once the risk preference is determined, the tool will then generate suggested range of risk for the user (risk-aversion: "less than 15%"; risk-neutral: "between 15% and 30%"; risk-loving: "larger than 30%").



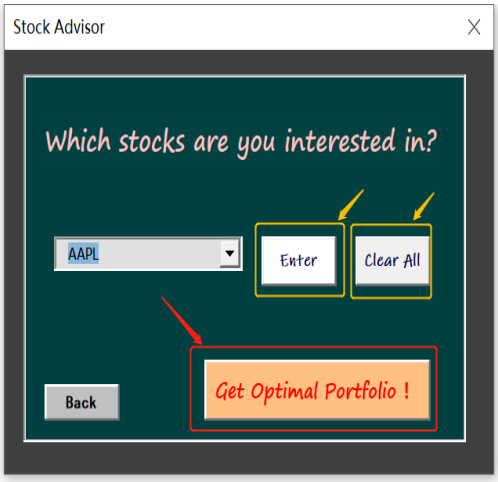
5) Input maximum affordable risk: users are asked to enter maximum affordable risk after having understanding on their risk preference and the suggested range of risk. Only when the input value is a valid number and is within the suggested range of risk, the value can be transferred to the "Home Page" and the user will be moved to the next step.

Personalized Optimized Portfolio	
Max affordable risk	0.15
Portfolio Return	
Portfolio Volatility	
Sum of Weights	

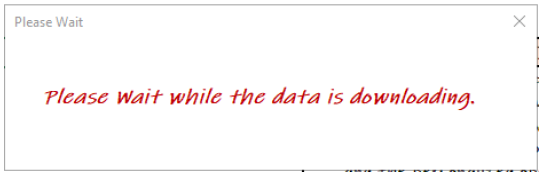


6) Select stock of interest: users can choose stock from listing. By pressing "Enter" button, ticker and company name of this chosen stock will be shown on the "Home Page". Once all stocks which the user wishes to put into his/her portfolio have been selected, the user can hit "Get Optimal Portfolio!" button to generate the optimal portfolio. The user can click "Clear All" button to clear all stocks that currently select. Each Stock cannot be selected twice.

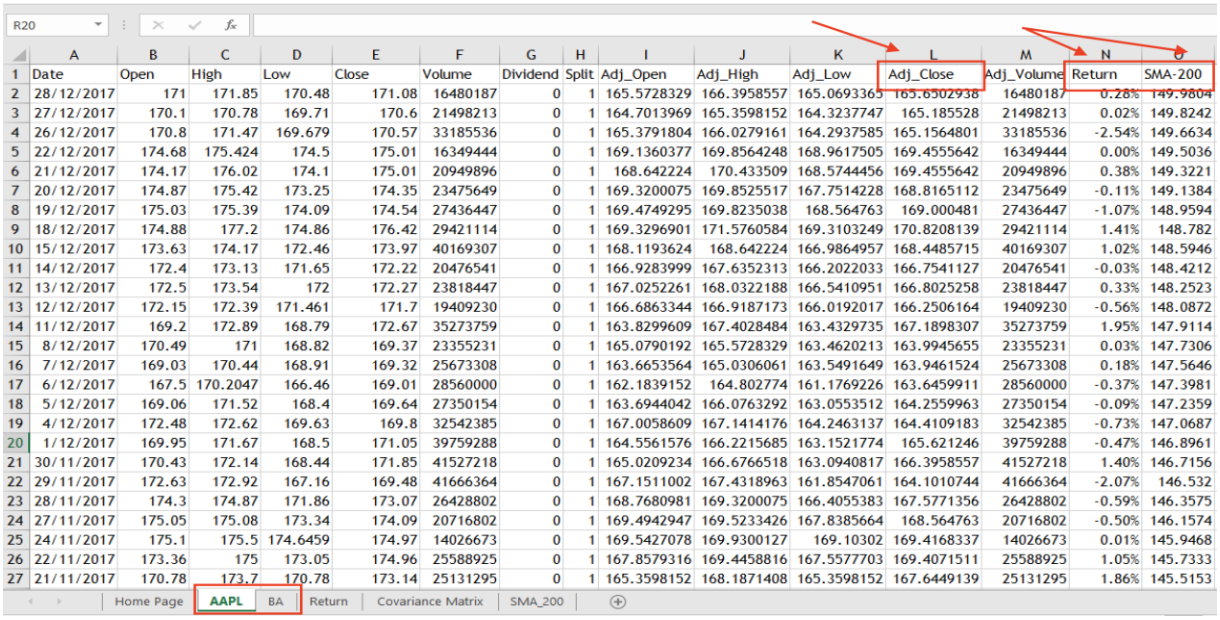
Ticker	Company Name
AAPL	Apple Inc.
BA	Boeing Company



7) Generate two stock portfolios: After click "Get Optimal Portfolio!" button, a user-form will pop up to remind user wait while data of selected stocks are downloading and processing in the background. The user-form will disappear automatically whenever the result is ready.



In the background, "Analysis ToolPak" will first be initialized. Then for each stock, a sheet with data, such as Date, Open, High, and most importantly Adjusted_Close, will be generated by connecting to the Quandl database.

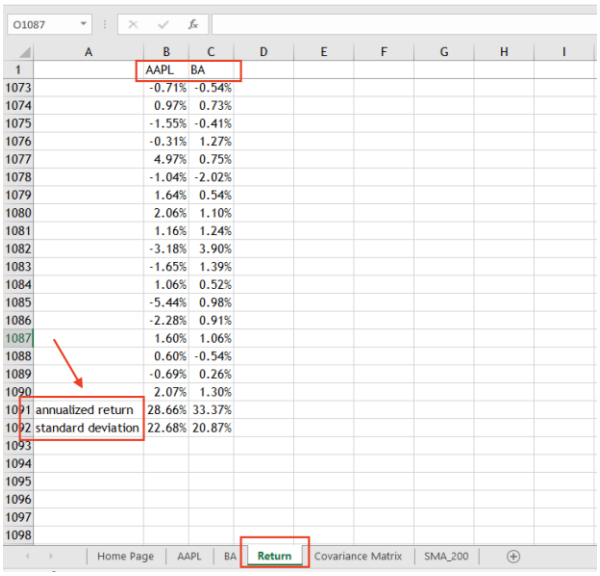


Date	Open	High	Low	Close	Volume	Dividend	Split	Adj_Open	Adj_High	Adj_Low	Adj_Close	Adj_Volume	Return	SMA-200
28/12/2017	171	171.85	170.48	171.08	16480187	0	1	165.5728329	166.3958557	165.0693365	165.6502938	16480187	0.28%	149.9804
27/12/2017	170.1	170.78	169.71	170.6	21498213	0	1	164.7013969	165.3598152	164.3237747	165.185528	21498213	0.02%	149.8242
26/12/2017	170.8	171.47	169.679	170.57	33185536	0	1	165.3791804	166.0279161	164.2937585	165.1564801	33185536	-2.54%	149.6634
22/12/2017	174.68	175.424	174.5	175.01	16349444	0	1	169.1360377	169.8564248	168.9617505	169.4555642	16349444	0.00%	149.5036
21/12/2017	174.17	176.02	174.1	175.01	20949896	0	1	168.642224	170.433509	168.5744456	169.4555642	20949896	0.38%	149.3221
20/12/2017	174.87	175.42	173.25	174.35	23475649	0	1	169.3200075	169.8525517	167.7514228	168.8165112	23475649	-0.11%	149.1384
19/12/2017	175.03	175.39	174.09	174.54	27436447	0	1	169.4749295	169.8235038	168.564763	169.000481	27436447	-1.07%	148.9594
18/12/2017	174.88	177.2	174.86	176.42	29421114	0	1	169.3296901	171.5760584	169.3103249	170.8208139	29421114	1.41%	148.782
15/12/2017	173.63	174.17	172.46	173.97	40169307	0	1	168.1193624	168.642224	166.9864957	168.4485715	40169307	1.02%	148.5946
14/12/2017	172.4	173.13	171.65	172.22	20476541	0	1	166.9283999	167.6352313	166.2022033	166.7541127	20476541	-0.03%	148.4212
13/12/2017	172.5	173.54	172	172.27	23818447	0	1	167.0252261	168.0322188	166.5410951	166.8025258	23818447	0.33%	148.2523
12/12/2017	172.15	172.39	171.461	171.7	19409230	0	1	166.6863344	166.9187173	166.0192017	166.2506164	19409230	-0.56%	148.0872
11/12/2017	169.2	172.89	168.79	172.67	35273759	0	1	163.8299609	167.4028484	163.4329735	167.1898307	35273759	1.95%	147.9114
8/12/2017	170.49	171	168.82	169.37	23355231	0	1	165.0790192	165.5728329	163.4620213	163.9945655	23355231	0.03%	147.7306
7/12/2017	169.03	170.44	168.91	169.32	25673308	0	1	163.6653564	165.0306061	163.5491649	163.9461524	25673308	0.18%	147.5646
6/12/2017	167.5	170.2047	166.46	169.01	28560000	0	1	162.1839152	164.802774	161.1769226	163.6459911	28560000	-0.37%	147.3981
5/12/2017	169.06	171.52	168.4	169.64	27350154	0	1	163.6944042	166.0763292	163.0553512	164.2559963	27350154	-0.09%	147.2359
4/12/2017	172.48	172.62	169.63	169.8	32542385	0	1	167.0058609	167.1414176	164.2463137	164.4109183	32542385	-0.73%	147.0687
1/12/2017	169.95	171.67	168.5	171.05	39759288	0	1	164.5561576	166.2215685	163.1521774	165.621246	39759288	-0.47%	146.8961
30/11/2017	170.43	172.14	168.44	171.85	41527218	0	1	165.0209234	166.6766518	163.0940817	166.3958557	41527218	1.40%	146.7156
29/11/2017	172.63	172.92	167.16	169.48	41666364	0	1	167.1511002	167.4318963	161.8547061	164.1010744	41666364	-2.07%	146.532
28/11/2017	174.3	174.87	171.86	173.07	26428802	0	1	168.7680981	169.3200075	166.4055383	167.5771356	26428802	-0.59%	146.3575
27/11/2017	175.05	175.08	173.34	174.09	20716802	0	1	169.4942947	169.5233426	167.8385664	168.564763	20716802	-0.50%	146.1574
24/11/2017	175.1	175.5	174.6459	174.97	14026673	0	1	169.5427078	169.9300127	169.10302	169.4168337	14026673	0.01%	145.9468
22/11/2017	173.36	175	173.05	174.96	25588925	0	1	167.8579316	169.4458816	167.5577703	169.4071511	25588925	1.05%	145.7333
21/11/2017	170.78	173.7	170.78	173.14	25131295	0	1	165.3598152	168.1871408	165.3598152	167.6449139	25131295	1.86%	145.5153

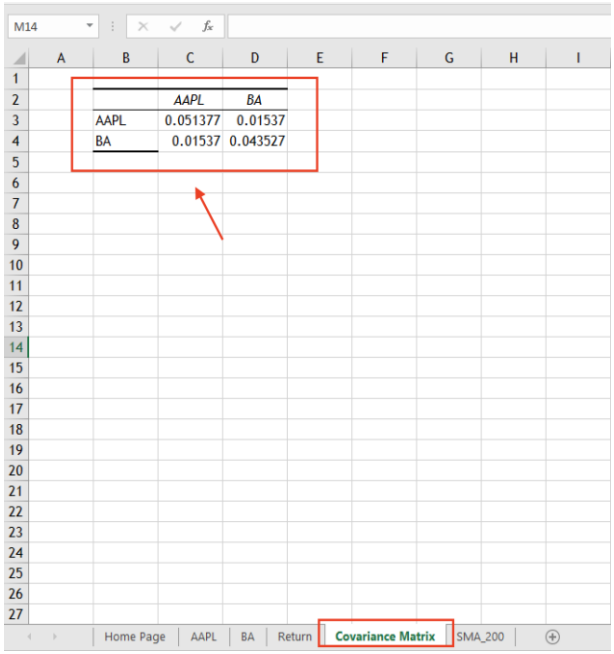
With adjusted close prices, return can be calculated and moved to a new "Return" sheet. There the application will then calculate the annualized return and standard deviation.

Besides, for user's information, it will compute SMA-200 price that will be later shown in the "Home Page". Above process will continue until the last selected stock is done.

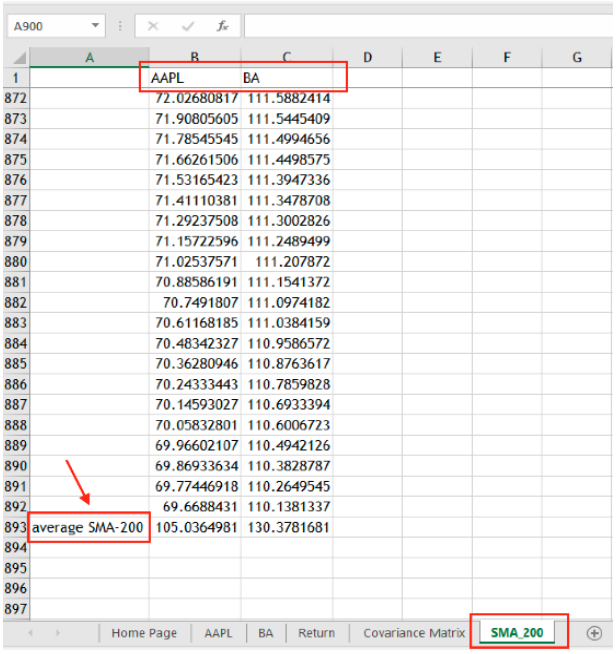
Moving on, a sheet called "Covariance Matrix" is created to capture the covariance matrix of all selected stocks using Analysis ToolPak - VBA.



	AAPL	BA
1073	-0.71%	-0.54%
1074	0.97%	0.73%
1075	-1.55%	-0.41%
1076	-0.31%	1.27%
1077	4.97%	0.75%
1078	-1.04%	-2.02%
1079	1.64%	0.54%
1080	2.06%	1.10%
1081	1.16%	1.24%
1082	-3.18%	3.90%
1083	-1.65%	1.39%
1084	1.06%	0.52%
1085	-5.44%	0.98%
1086	-2.28%	0.91%
1087	1.60%	1.06%
1088	0.60%	-0.54%
1089	-0.69%	0.26%
1090	2.07%	1.30%
1091 annualized return	28.66%	33.37%
1092 standard deviation	22.68%	20.87%



	AAPL	BA
AAPL	0.051377	0.01537
BA	0.01537	0.043527

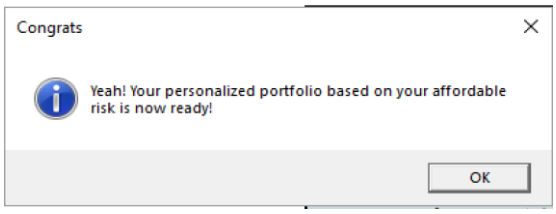


	AAPL	BA
872	72.02680817	111.5882414
873	71.90805605	111.5445409
874	71.78545545	111.4994656
875	71.66261506	111.4498575
876	71.53165423	111.3947336
877	71.41110381	111.3478708
878	71.29237508	111.3002826
879	71.15722596	111.2489499
880	71.02537571	111.207872
881	70.88586191	111.1541372
882	70.7491807	111.0974182
883	70.61168185	111.0384159
884	70.48342327	110.9586572
885	70.36280946	110.8763617
886	70.24333443	110.7859828
887	70.14593027	110.6933394
888	70.05832801	110.6006723
889	69.96602107	110.4942126
890	69.86933634	110.3828787
891	69.77446918	110.2649545
892	69.6688431	110.1381337
893	average SMA-200	105.0364981	130.3781681

After these steps, information including SMA-200, annualized return and volatility will be pasted to the "Home Page". Meanwhile, formula for portfolio return and volatility are updated.

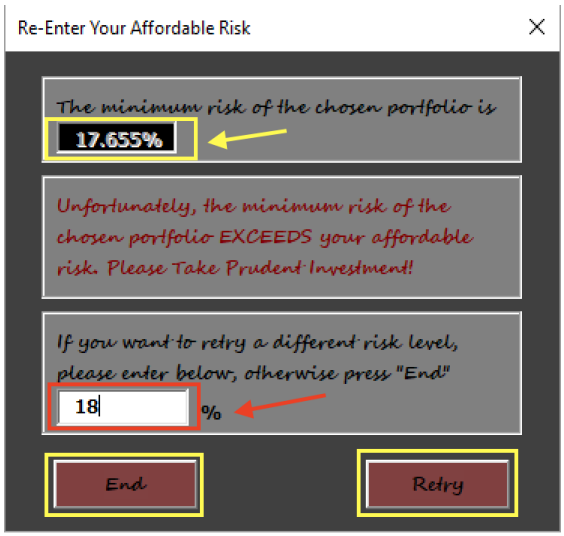
With all the preparation, the application will run the first Solver that minimizes the portfolio risk with only one constraint that the total weight should be equal to zero. Later, the second Solver will be triggered to maximize the portfolio return by adding one more constraint that portfolio volatility should be less than the maximum affordable risk inputted by user. This is what we called personalized optimized portfolio.

8) Ready to check the result: If both Solvers find solutions, user can then check the result on the Home Page.

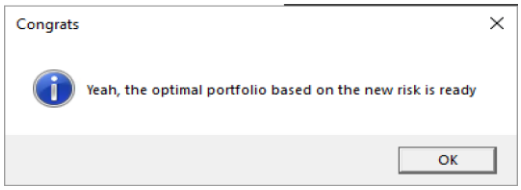


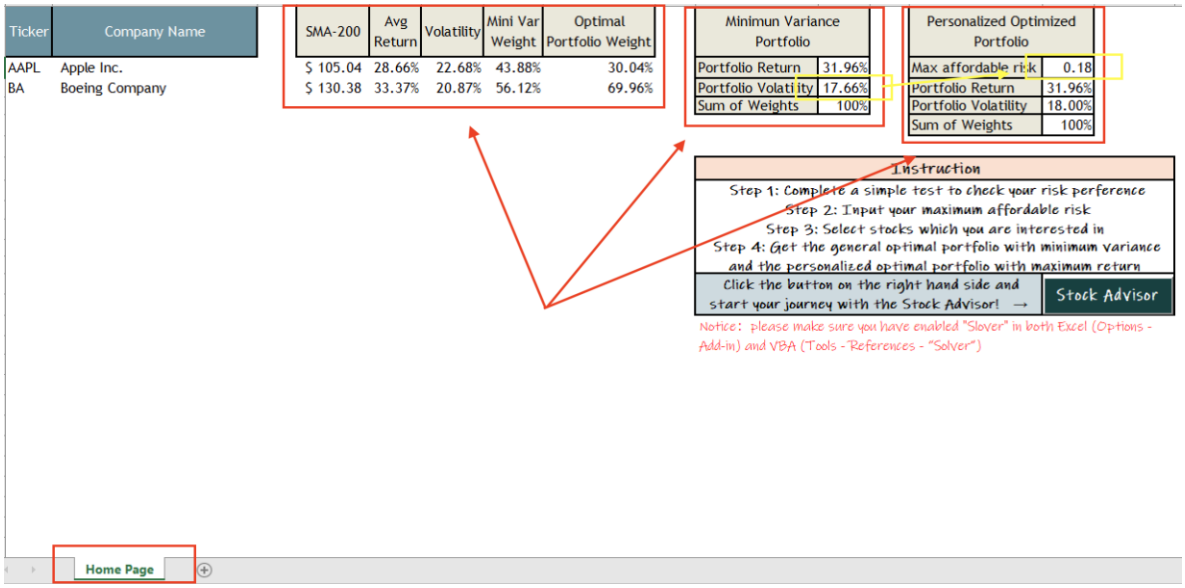
9) Renter affordable risk: However, if the second Solver can't work, in other words, user's maximum affordable risk is even lower than the minimum variance, a new user-form will pop up by asking user to input a new risk, which must be a number and larger than the minimum risk. The minimum risk will be referred in the first paragraph. Of course, if user has no intention to retry, he can always press "End" button.

Minimun Variance Portfolio	
Portfolio Return	31.96%
Portfolio Volatility	17.66%
Sum of Weights	100%

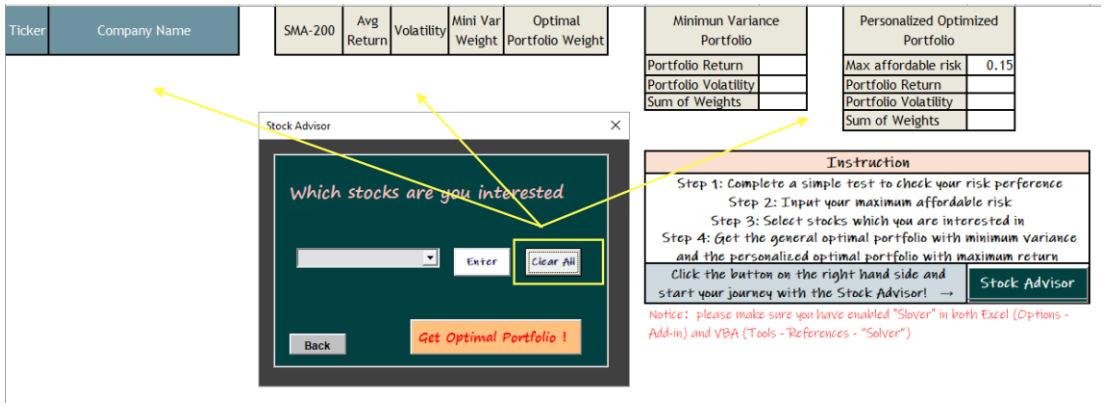


But by clicking "Retry", the third Solver will run and generate the result for user's personalized portfolio. To make it more user-friendly, only the Home Page will be presented at the end.





9) Redo the application: If user wants to reselect stocks and do another round of portfolio management, repeat step 2 to 8. At step 6, the “Clear All” button will clear all data and sheets related to the last round.



Summary

There are some limitations related to our application, which we should consider improve in the future. Firstly, the risk test we designed is not professional enough to capture user's risk attitude 100% correct. Secondly, regarding the waiting time, it usually takes about 10 seconds to reach the end, but if a large number of stocks are chosen, the application may slow down. Thirdly, without subscription, the URL we used to download stock data can't access the whole stock market, so the number of stocks available to choose in the application is limited. Put these limitations aside, our application can do pretty good job on help those general investors perform the tedious work to find their personalized portfolio in general. Such function can play significant role in the financial field, especially as Portfolio Management is getting more and more important in diversifying investment risks nowadays.