Portfolio Builder 1.1 Help File

I. Specification

Portfolio Builder 1.1 is based on the ***Modern Portfolio Theory MPT,*** introduced by Noble prize winner Harry Markowitz, The Model in this version forms a portfolio of two "assets" stocks or share prices from up to ten stocks, with a possibility of adding a Risk-Free asset to the model, the Expected Returns and Risks of the portfolio are calculated among a range of weights of the two assets, also providing the Risk-Return Trade-off measure, graphing the portfolio possibilities frontier, and calculating the weights for the Minimum-Variance portfolio.

II System Requirements

Portfolio Builder 1.1 runs as MS Excel spreadsheet, but would not run if the security level is high since all macros would be disabled, beyond that no other requirements are needed, to change the security status go to **Tools** > **Macros** > **Security**. Never set security at the low level.

III. Getting Started

Portfolio Builder 1.1 is ready to use, just click on "Enable Macros" when starting MS Excel, if any other alerts appear just press on 'yes' it is also of vital importance ***not to alter, delete or move any cell or sheets in the file***, if you missed up, Don't panic just close the file without saving then reopen

Open the Excel file and just click on START button on the main page, directly linked to the Data Sheet ready for typing in your data or to be Copied-N-Pasted from other MS Excel sheet, click on RESET button on the right if you wish to clear the form, data could be daily, weekly, … etc.

IV. Menus & Commands

A Command button runs a specific task using an MS Excel macro or function command buttons are active only when they are feasible to be used.

Home

START

Clicking on this button moves you to the Data Entry form where it is possible to paste or type data, the Excel sheet have the capacity of 65483 entries.

Data

DESCRIPTIVE STATISTICS

Moves you to a new sheet to the right named 'STATS' that show the mean, variance, minimum, maximum and other descriptive statistics for a general view of the data, this provides an insight into which two assets should be included in the portfolio.

CLEAR

Delete all the Data entered by default.

STATS

Calculate

Show the results for the listed descriptive statistics.

Clear and Back to Data

This would delete the results obtained so far, and moves you back to the Data Entry form.

Form Portfolio

Once the descriptive statistics inform your choice, clicking on this button moves you to the next step, the portfolio menu.

Portfolio

Assign Portfolio

Ticking the Check Box selects the specified Stock as labelled in the Data form, first row is for Asset ***A*** and the second row is for Asset ***B***, DO NOT tick more than one box in each array, if done the system would consider the last box ticked or un-ticked as the assigned stock, to avoid any inconvenience the assigned stocks are always listed in the Portfolio Information Box that also show whether the portfolio include a Risk-Free investment.

DESCRIPTIVE STATISTICS

Moves you back to STATS showing the descriptive statistics.

ADD RISK-FREE INVESTMENT

Is an optional item for whether there is a Risk-Free asset in the portfolio or not.

RUN PORTFOLIO

Next step is to choose your portfolio, this button creates a new sheet in the Excel file that allows you to pick the stocks in the portfolio, show the results and alter your choices.
After filling in the which stocks to pick, its optional to estimate the expected return or to type-in your own expected return, pressing on the RUN would show the results of the model, in terms of portfolio Expected Return, portfolio Risk and the T/O Slope.

CHART

Plot the charts of Expected Return against Risk, and the portfolio possibilities frontier and the reward-to-variability ratio plot.

RESET

Clears all the results, to be ready for another data another portfolio analysis.

V. Methods and Formulas of the Modern Portfolio Model

Expected Return of a stock, portfolio:
The Expected Return is measured in the sample mean of the Data for the share price; the Expected return is then given by:

$E(\overline{R}) = \sum_{i=1}^{N} \rho_i R_i$, ρ : is the probability of occurrence.

the Expected Return of a share price is given by the mean calculated as

$\overline{X} = \sum_{i=1}^{N} \frac{X_i}{N}$, for share *X*.

The Expected Return of the portfolio consisting of share prices of stocks *A* and *B* is provided by a simple ***Weighted Average*** of the expected returns of stocks *A* and *B* using several weights.

$$E(R_P) = \omega_A E(R_A) + \omega_B E(R_B)$$

Risk of stock, portfolio

Risk is defined by the ***Standard Deviation*** (the square root of the ***Variance***) for each stock, denoted σ with the general formula of

$$\sigma_X = \sqrt{\sum_{i=1}^{N} \rho_i \left[(X_i - E(X))^2 \right]} = \sqrt{(X - \overline{X})^2 / N} \text{ for a variable } X$$

Risk of each asset (share price) is two folded, ***Diversifiable Risk*** arising from unique circumstances related to the stock itself, second is a ***non-Diversifiable Risk*** this is market risk affecting all assets, the first is diversified away through finding the right size of investment for the asset, however the second is not diversified away regardless of the size of the portfolio.

Risk of the portfolio is not a weighted average of the risks of each asset, unlike the expected return, it is actually less than the weighted average of the two risks because of ***Diversification*** of risks that is achieved because of the presence of ***Correlation*** among the two share prices, then one asset variability of generating returns is offset by the variability of the other asset (or share price), risk of the portfolio is given by the standard deviation of portfolio according to the MPT:

$$\sigma_P = \sqrt{\omega_A^2 \sigma_A^2 + \omega_B^2 \sigma_B^2 + 2 \times \omega_A \sigma_A \omega_B \sigma_B \times r_{AB}}$$

where ω represents the weights of the two stocks in the portfolio, the correlation between *A* and *B* is given by r_{AB} which has the following property:

$$r_{AB} = \frac{Cov(A,B)}{\sigma_A \sigma_B}$$

The correlation coefficient is also equal to the ***Covariance*** divided by the multiplication of the Standard Deviations of the two stocks, using this property the portfolio risk could be alternatively given by:

$$\sigma_P = \sqrt{\omega_A^2 \sigma_A^2 + \omega_A^2 \sigma_B^2 + 2\ \omega_A \omega_B Cov(A,B)}$$

Deriving the Weights of the Minimum Variance Portfolio

By minimising the portfolio variance and setting it to zero, the optimal weight of an asset or stock could then be solved, the variance of a portfolio is given by σ_P^2

$$\sigma_P^2 = \omega_A \sigma_A^2 + \omega_B \sigma_B^2 + 2 \times \omega_A \sigma_A \omega_B \sigma_B \times r_{AB}$$

Now denote ω_A by α then its obvious that ω_B is equal to $(1-\alpha)$, then the above is written as:

$$\sigma_P^2 = \alpha^2 \sigma_A^2 + (1-\alpha)^2 \sigma_B^2 + 2 \times \alpha \sigma_A (1-\alpha)^2 \sigma_B \times r_{AB}$$

$$\sigma_P^2 = \alpha^2 \sigma_A^2 + (1 - 2\alpha - \alpha^2) \sigma_B^2 + 2 \times \alpha \sigma_A (1-\alpha) \sigma_B \times r_{AB}$$

Taking the First Order Condition F.O.C:

$$\frac{\partial \sigma_P^2}{\partial \alpha} = 2\alpha\sigma_A^2 - 2\sigma_B^2 + 2\alpha\sigma_B^2 + 2\ \sigma_A \sigma_B r_{AB} - 4\ \alpha \sigma_A \sigma_B r_{AB}$$

$$= 2\alpha(\sigma_A^2 + \sigma_B^2 - 2\alpha \sigma_A \sigma_B\ r_{AB}) + 2\ \sigma_A \sigma_B r_{AB} - 2\sigma_B^2$$

Setting the FOC to equal zero

$$2\alpha(\sigma_A^2 + \sigma_B^2 - 2\alpha\sigma_A\sigma_B\ r_{AB}) + 2\ \sigma_A\sigma_B r_{AB} - 2\sigma_B^2 = 0$$

$$\alpha(\sigma_A^2 + \sigma_B^2 - \alpha\sigma_A\sigma_B\ r_{AB}) + \sigma_A\sigma_B r_{AB} - \sigma_B^2 = 0$$

$$\therefore \quad \alpha = \frac{\sigma_B^2 - \sigma_A\sigma_B\, r_{AB}}{(\sigma_A^2 + \sigma_B^2 - \alpha\sigma_A\sigma_B\ r_{AB})}$$

This is the optimum value of the weight of asset *A;* $\alpha = \omega_A$ and clearly the weight of Asset *B* is equal to $\omega_B = 1 - \alpha$.

VI. Graphing & Interpretation

Clicking on **CHART** plots three plots on three sheets; the first is a plot of Expected Return against the Risk of the Portfolio, where the Data points represents the different weights of assets A and B and the graph helps in identifying the best combination of the two assets as some points on the graph exhibit very low return with a high risk that should be clearly avoided whereas other points would show higher return with a lower risk comparing with the other combinations which favours that combination of the portfolio to be selected for investment.

The Second graph aims for finding the ***Efficient Frontier*** by plotting the expected returns against the standard deviation, according to the MPT there exist a combination of various weighted portfolios that yield the maximum expected return at every level of portfolio risk measured in Standard deviation, note that the red line shown in the graph does not show all the Efficient Frontier.

The third graph, shows the T/O slope known as the reward-to-variability ratio, this is also affected by whether the portfolio contains a Risk-Free asset or not, this ratio always improve with diversification so the combination of weights with the highest T/O ratio is the preferred combination to be applied to the portfolio, this measure is provided in the Portfolio results table, for the mathematically minded, this ratio is given by:

$$T/O = E\,R_P / \sigma_P$$

& in the presence of a Risk-Free investment R_F, it becomes

$$T/O = \left(E\,R_P - R_f\right)/\sigma_P$$

Further Readings

[1] Arnold, (1998), " Corporate Financial Management", Financial Times, 2nd Edition.

[2] Brealey and Myers, (2000), " Principles Of Corporate Finance", McGraw Hill, 7th Edition.

[3] Markowitz, H. (1952), " Portfolio Selection", *Journal of Finance*, Vol. XII (1), pp. 77-91.

[4] Sharpe, W. (1964), "Capital Asset Prices: A Theory Of Market Equilibrium Under Conditions Of Risk", *Journal of Finance*, Vol. 19 (3), pp. 425-442.

Portfolio Builder 2.0??

The users of Portfolio Builder 1.1 would inform the design of the next version, users can supply their views by sending an email to jnja1@le.ac.uk or doctoreconometrics@yahoo.com, criticism is valued -whether constructive or destructive- and suggestions of extending the model technically and theoretically are very appreciated, further developments in the future are also considered.