How to use the Markowitz Portfolio Optimization Spreadsheet.

Just like the Algebra with Gaussians Spreadsheet, the Markowitz Portfolio Optimization spreadsheet calculates the mean [Cell F12] and standard deviation [Cell E12] of the weighted sum of two Gaussian probability distributions.

In finance, it is common to represent the potential return from an investment asset over a fixed future time interval with a Gaussian probability distribution. The Gaussian's mean is equal to the asset's mean or "expected" financial return, and the standard deviation is equal to the estimated standard deviation of the asset's financial returns, also called its "volatility."

A weighted combination of financial assets held for investment is called a "portfolio." The portfolio is also represented as a Gaussian, with combined mean equal to the portfolio's expected return, and standard deviation equal to the portfolio's estimated volatility.

The Markowitz Portfolio Optimization Spreadsheet includes an additional financial input: the "risk free rate" which is the return earned by a zero-volatility ("risk free") asset such as a U.S. government short-term bond [Cell G8].

And it outputs an important financial performance metric: the "Sharpe Ratio." [Cell G11]. The Sharpe Ratio is defined as the difference between the portfolio expected return, and the risk-free rate of return, divided by the portfolio volatility (standard deviation). Maximizing the Sharpe Ratio is a combined profitability and risk metric that ensures the highest return over the risk-free rate for each unit of volatility (risk) over the zero-volatility risk free asset.

Examples.

Question 1. What is the portfolio weighting the maximizes the Sharpe Ratio? What is the portfolio return, volatility, and Sharpe Ratio at this maximum?

Answer 1. Use MS Solver to set [Cell G11] to a maximum by changing the asset weighting [Cell C9] subject to the constraints that $0 < C9 < 1$. At a portfolio weighting of .53, .47, the portfolio return is 10.9%, the portfolio standard deviation is 5.1%, and the Sharpe Ratio is 1.97.

Question 2. Change the risk-free rate to 2% and the expected return of Asset A to 9%. What is the new portfolio weighting the maximizes the Sharpe Ratio? What is the new portfolio return, volatility, and Sharpe Ratio at this maximum?

Answer 2. At a portfolio weighting of .51, .49 the expected return is 10.5%, the volatility is 5.1% and the Sharpe Ratio is 1.67.