**Nithin Das, CWID: 10422784, Date: 11/7/19 Assignment W&A 4th Edition, Ch 7, Q 36**

I pledge on my honor that I have not given or received any unauthorized assistance on this

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Signature: NITHIN DAS

Date: 11/7/2019

**Management Overview**

* **Problem Statement**
* To use Non-Linear Programming to find the portfolio of the three stocks that minimizes the risk, measured by portfolio variance, subject to achieving an expected return of at least 0.12.
* **Data Sources**

**Input**: Estimates of means, standard deviations, and correlations for stock returns, minimum r required expected portfolio return

**Decision variables**: Fractions invested in the various stocks

**Constraints**: Total fraction invested = 1

Expected portfolio return >=Minimum required expected portfolio return

* **Model Approach**
* Enter all the inputs in the spreadsheet
* Identify the changing cells and constraints for the model
* Enter random values for ‘Investment Weights’ field, this is the changing cell
* Calculate ‘Portfolio Variance’ as matrix multiplication weights and covariance matrix
* Calculate Portfolio Standard deviation’ as square root of ‘Portfolio Variance’
* Use Solver to maximize the Portfolio Variance
* Use one-way SolverTable to perform Sensitivity analysis
* **Solution**

Results:

The portfolio variance is 0.0059

Yes, the stock 4 is on optimal portfolios on the efficient frontier.

Sensitivity Analysis:

1. The sensitivity analysis shows that even if we increase required mean return, the investment fraction in stock 2 should still be 0.

2. As we increase the required return beyond 0.125, investment fraction on stock 4 will decrease.

3. As the required return increases above 0.125, the standard deviation or risk of the portfolio increases. Though risk shows increasing trend with the mean portfolio return, this increase is very gradual.

**Recommendation:**

The company should not increase the required return beyond 0.125, as the mean portfolio return has only gradual increase whereas risk increases linearly beyond that point.