APS 502 Project Assignment Fall 2017

Due Dec. 7 by 5PM. Slide your assignment under my office door MC 320. Note: You must use MATLAB for the project and must include the code, data, and output in MATLAB in an appendix. You must write up the formulation for each part and show results of solving the model using tables or graphs with reasonable formatting (please do not just give me the dump of the computational output from MATLAB, this dump as mentioned should go in an appendix).

Part 1

Suppose that you have $20,000 to invest. Stock ABC sells at $20 per share today. A European call option to buy stock ABC for $15 in 6 months is available and this option is for 100 shares of stock ABC and costs $1000. You can either buy OR sell this option. In addition, a six-month riskless zero-coupon bond with face value of $100 sells now at $90 per unit. You have decided to limit the number of call options that you buy or sell to at most 50.

There are three scenarios (possibilities) for the price of stock ABC six months from now. Scenario 1 is that the price of stock ABC will be the same as today. Scenario 2 is that the price will go up to $40. Scenario 3 is that price will go down to $12. Assume that each of these scenarios are equally likely.

(a) Formulate a linear program to determine the portfolio of stock ABC, Bond, and Call Option that maximizes the expected profit. Solve for the optimal portfolio using MATLAB and describe the optimal portfolio and its expected profit.
(b) Does your portfolio in (a) result in a profit under all scenarios? If not, under which scenarios do you lose money?
(c) Suppose that you want to have a profit of at least $2000 no matter which scenario occurs. Formulate an LP to find the portfolio that maximizes expected return subject to earning at least $2000. Solve using MATLAB and show the optimal portfolio and its expected profit again.
(d) A riskless profit is defined as the maximum possible profit that a portfolio is guaranteed to earn no matter which scenario occurs. Formulate an LP to find the maximum riskless profit under the three scenarios and solve using MATLAB (show optimal portfolio and riskless profit)

For each model you must define all variables and explain all constraints.

Please highlight the optimal decisions and objective function clearly in your report.

Part 2

In this portion of the project, you will use the following three ETFs (exchange-traded funds) to form a portfolio of these three assets. An ETF operates just like a stock, but these assets represent market indices or broad set of securities (stocks or bonds). For example, the purchase of one share of SPY (see below for description) represents an investment into the 500 stocks in the S&P 500.

(1) **SPDR S&P 500 ETF (SPY),** this is a fund that mimics the performance of the S&P 500 which is a well known market index consisting of 500 large capitalization stocks from the U.S.
(2) **iShares Core US Treasury Bond (GOVT),** this is a fund that mimics the performance of a wide set of U.S Treasury bonds.

(3) **iShares MSCI Emerging Markets Mini Vol (EEMV**), this is fund that mimics the performance of emerging market stocks but with lower volatility compared to other emerging market funds.

Tasks

(a) Use yahoo (e.g. yahoo.com or yahoo.ca) finance to get the monthly adjusted closing prices of SPY, GOVT, and EEMV from Jan 2015 to Dec 2016 and compute the expected returns of the three assets, the standard deviations of the three assets as well as the co-variances between all assets over this 2-year time period. Show these parameters in your report but you don't have to show the monthly prices or the computations that you did to get the parameters.

(b) Use the mean-variance optimization model to generate an efficient frontier of the three assets. Create a table where for each expected return goal R show the optimal weights of the assets as well as the portfolio variance value. Also, plot the efficient frontier.

(c) Pick a portfolio from the efficient frontier i.e. get the weights associated with some portfolio on the efficient frontier from part (b) and use *the realized* returns for SPY, GOVT, and EEMV for the month of January of 2017 and compute the realized return of the portfolio that you chose from part (b) for the month of January 2017 i.e. use the realized returns for the three assets and your weights from part (b) to compute the return of the portfolio (this is the realized return of the portfolio for Jan. 2017). Compare the performance of this portfolio with respect to realized return against the realized individual returns of SPY, GOVT, and EEMV over this single month. Try to explain the performance (realized return) of your portfolio versus the realized return of the individual assets.

Note: A formula sheet will be posted on the blackboard that you can use to get the parameters for part (a) from the monthly adjusted closing prices.