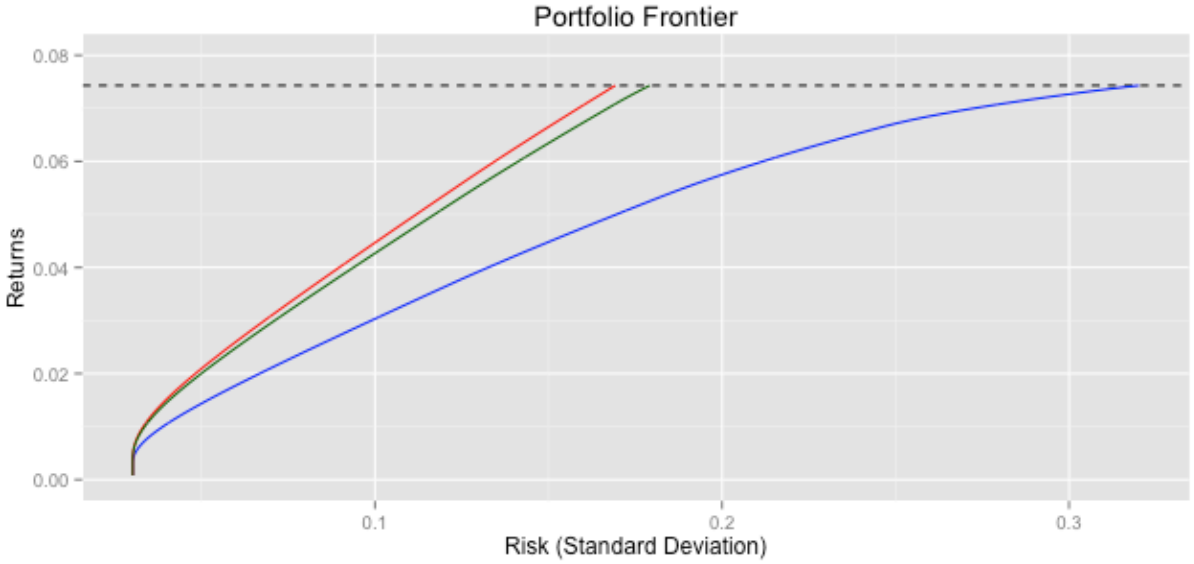
STA 372-6 Project 3: Portfolio Optimization with Non-Linear Programming

Evan Johnston, Jordan Tavarez, Arjo Mozumder, Orukeme Ukiri

A. Portfolio Frontiers



This plot shows the generated portfolio frontiers for each portfolio. Blue shows the frontier using purely historical data, red shows the frontier for the data considering beliefs though the Black-Litterman model with τ=1, and green is the same B-L model with τ= 0.25. Also note the dotted black line showing the maximum return of 0.0743. We chose this as the max return based on the given historical means of which this was the highest.

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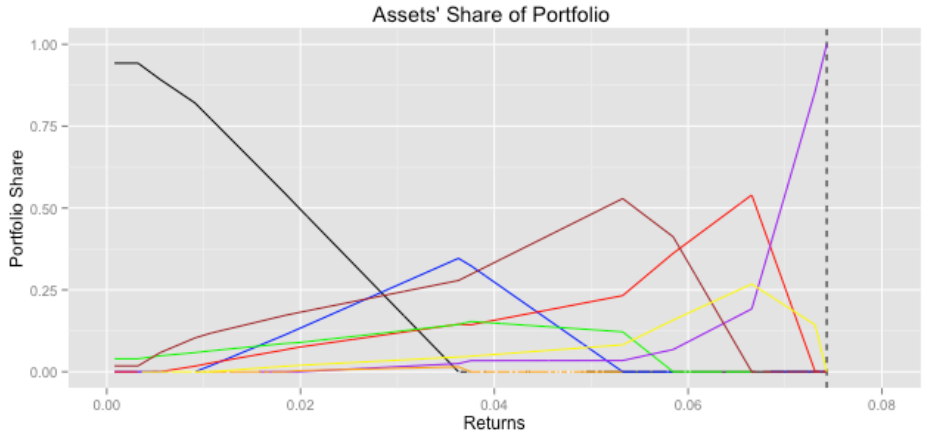
B. Change of Asset Weights

Figure B.1



Black: US Bonds
Blue: Int'l Bonds
Red: US Large Growth
Green: US Large Value
Purple: US Small Growth
Orange: US Small Value
Brown: Int'l Dev. Equity
Yellow: Int'l Emerg. Equity

Figure B.2

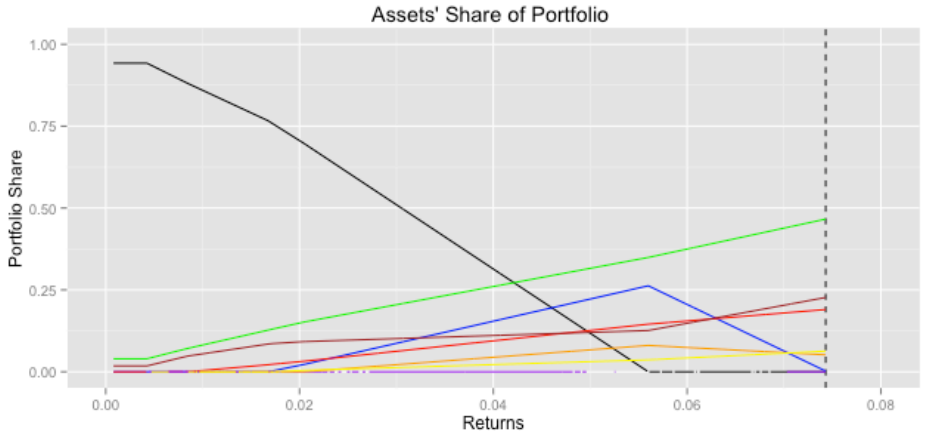


Figure B.1 shows the portfolio share of each asset as returns range from 0 to 0.0743 for the initial portfolio frontier (blue line in Figure A). Note that our return values range from 0.0008 to 0.0743 as indicated by the min and max of the historical means.

Figure B.2 shows the portfolio share of each asset as returns range from 0 to 0.0743 for the initial portfolio frontier (red line in Figure A). Clearly the asset choice is different from the portfolio only considering historical data. The plot for the third frontier (green line in Figure A), is very similar to Figure B.2.

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C. Interpretations

The efficient frontier expanded once the Black-Litterman model is added with the given views. The confidence levels form the three views appeared to be greater than the historical average due to the increase of the efficient frontier. By setting the τ=.025, we see that the efficient frontier tighten a bit. The fact that the frontier did not tighten drastically shows the weight that this scalar has to the entire weight of the Black-Litterman Model is far less than that of the confidence matrix.

With the individual asset allocation change according to the expected returns, we see that all the assets, except for US Bonds and US Small Growth, have a concave relationship. The US Bonds have a steep downward slope initially and US Small Growth has a steep upward slope given towards the maximum expected slope. US Bonds have the lowest expected return but lowest standard deviation, making sense that it is the largest allocation with the lower expected returns. US Small Growth has the highest expected return, making sense that it has the bulk of allocation with the highest expected returns.