Case Study Series

Linear Programing in Investment Portfolio Creation

Kenneth George*   Randi George

Abstract
This study explores the decision procedures of investing client's money in a portfolio using linear programming to help maximize their profits. The case has many different constraints that a fund manager must address in the portfolio creation. Once the linear program has been developed, it creates a useful tool to help managers to manage client's portfolios based on each of the different goals and needs of each client.   The hypothetical scenario provides an opportunity to understand how linear programming can be a tool for portfolio creation using forecasted returns and risk assessments to increase profits. Lastly, it provides a tool for managers to show clients how their risk tolerance impacts returns on their portfolio.

Keywords: Linear Programing, Risk, Portfolio, Forecast, Returns

Learning Objectives
1. Explain how to develop linear programming models to solve financial problems.
2. Be able to interpret the computer solution of a linear programming problem.
3. Explain how investing in securities to maximize one's returns and minimize risk to achieve maximum profits.
4. Develop risk and return that measures for a portfolio of assets.
5. Create a model based on risk preferences that drive the optimal asset allocation decisions.

Introduction
Joseph Randal, a recent college graduate in finance, has scored an interview of a lifetime. Joseph has been asked multiple pre-interview questions by the investment firm, but he is struggling with one question in particular. The question that Joseph is having hard time asks him to create a hypothetical scenario on how he would manage $100 million dollars in funds for numerous clients. The question asks him to create a portfolio that maintains diversity in each client's portfolio, based on only three funds. Joseph is struggling to create an asset allocation model that allows him to only use three funds for client's investment.

The Problem
Joseph has decided that he is going to create a portfolio that places limits on the percentages of each portfolio that may be invested in each of the three funds. He is going to keep it simple by placing the clients' money into three accounts; growth stock funds, balanced stock funds and United States Inflation Protection Bond funds. Though the portfolio is vague, he is using the ambiguity to his advantage.

Joseph has placed the following percentage investment guidelines to the account:

Funds	Investment Guidelines
Growth Fund	20 to 40%
Balanced Fund	20 to 50%
Government Bonds	At Least 30%

Case Study Series

In addition, the firm wants to assess the risk tolerance of each client and make sure each portfolio meets the needs of the individual investor. In the hypothetical scenario, the firm wants to know how Joseph will assess risk with the new investors. The firm wants Joseph to apply his investment strategy to individual risk tolerance. Joseph is going to use a risk index of .05 for the hypnotical client. Joseph assigns the following risk for the three funds as follows:

Funds	Risk Assessment
Growth Fund	0.2
Balanced Fund	0.08
Government Bonds	0.01

Joseph wants to create an overall portfolio risk index that is computed as the weighted average of the individual of the three funds, with the weight of each of the funds.

Joseph wants to go a step further when answering the interview question. He wants to create a linear program based on the information provided. He also wants to provide a highest return for the investor based off their risk and forecasted returns of the three funds. The three funds have the following returns:

Funds	Forecasted Returns
Growth Fund	20%
Balanced Fund	12%
Government Bonds	5%

Based on this information, how would Joseph's fund allocate $1,000,000 of new client's money in the three funds to maximize returns?

Questions to be answered
1. Create a linear program that will recommend how much a new client in the case study will invest in the three different funds based off their risk.
2. Using a linear program, explain how you could increase and decrease the risk of how the investment choices change, but more importantly, how the returns change.
3. Provide your recommendation as to whether to use this model with clients and how it would benefit new employees.

Authors

Kenneth George*
Assistant Professor of Finance, Department Online Education, California Baptist University, Riverside, CA, USA, kgeorge@calbaptist.edu

Randi George, Ed. D
Course Instructor, Department of Research Fundamentals, Western Governors University, Salt Lake City, Utah, USA, Randi.george@wgu.edu

*corresponding author