

# Project 6

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## 1 Part 1

### 1.1 Objectives

Consider a mutual fund with beta of 0.8 which has an expected rate of return of 14%. If risk-free rate of return is  $r_f = 5\%$ , and you expect the rate of return on market portfolio to be 15%.

Use Python to address the following questions:

1. Would you be interested in investing in the fund? If so, what is the Alpha of the fund.
2. What passive portfolio comprised of a market-index portfolio and a money-market account would have the same beta as the fund?
3. Note: show that the difference between the expected rate of return on this passive portfolio and that of the fund equals the alpha from question 1.

## 1.2 Calculations

Let's find the alpha using CAPM:

$$R_{fund} - Rf = \alpha + \beta(R_{market} - Rf)$$

$$\alpha = R_{fund} - Rf - \beta(R_{market} - Rf) = 14 - 5 - 0.8(15 - 5) = 1$$

### 1.2.1 Question 1

Fund is less volatile and alpha is positive, so investing in the fund a good idea, however, fund provides less return than the market, so the final decision depends on risk profile of an investor (risk lover or risk averse)

### 1.2.2 Question 2

Let's introduce weights  $w$  for Market Index and  $(1-w)$  for money-market account. Then passive portfolio returns will be:

$$R_{portfolio} = w * R_{market} + (1 - w) * Rf$$

$$R_{portfolio} - Rf = Beta(R_{market} - Rf)$$

$$w * R_{market} + (1 - w) * Rf - Rf = Beta(R_{market} - Rf)$$

This gives us:

$$15w - 5w = 0.8(15 - 5) \implies w = 0.8$$

So the weight of Market Index is 0.8 that gives the weight of money-market account equal to 0.2

Let's check that the difference = 1:

$$R_{portfolio} = 0.8 * 15 + 0.2 * 5 = 13$$

$$R_{fund} - R_{portfolio} = 14 - 13 = 1.$$

## 2 Part 3

### 2.1 Objectives

Suppose the economy can be in one of the following two states: Boom or “good” state and Recession or “bad” state. Each state can occur with an equal opportunity. The annual return on the market and a certain security X in the two states of the economy are as follows:

1. Market: at the end of the year, the market is expected to yield a return of 30% in the good state and a return of (-10%) in the bad state;
2. Security X: at the end of the year, the security is expected to yield a return of 40% in the good state and a return of (-35%) in the bad state;

### 2.2 Calculations

Firstly, let's calculate the stock beta relative to the market:

$$\beta = 0.5 * (40/30) + 0.5 * (-35/-10) = 29/12$$

Secondly, using CAPM calculate required alpha:

$$E(R_{stock}) - Rf = \alpha + \beta(E(R_{market}) - Rf)$$

$$\alpha = E(R_{stock}) - Rf - \beta(E(R_{market}) - Rf)$$

$$E(R_{stock}) = 0.5 * 40 + 0.5(-35) = 2.5$$

$$E(R_{market}) = 0.5 * 30 + 0.5(-10) = 10$$

$$\alpha = 2.5 - 5 - (29/12)(10 - 5) = -14.58$$