

**Economics 70, Personal Finance:  
Making Better Decisions and Building a Better Financial System**

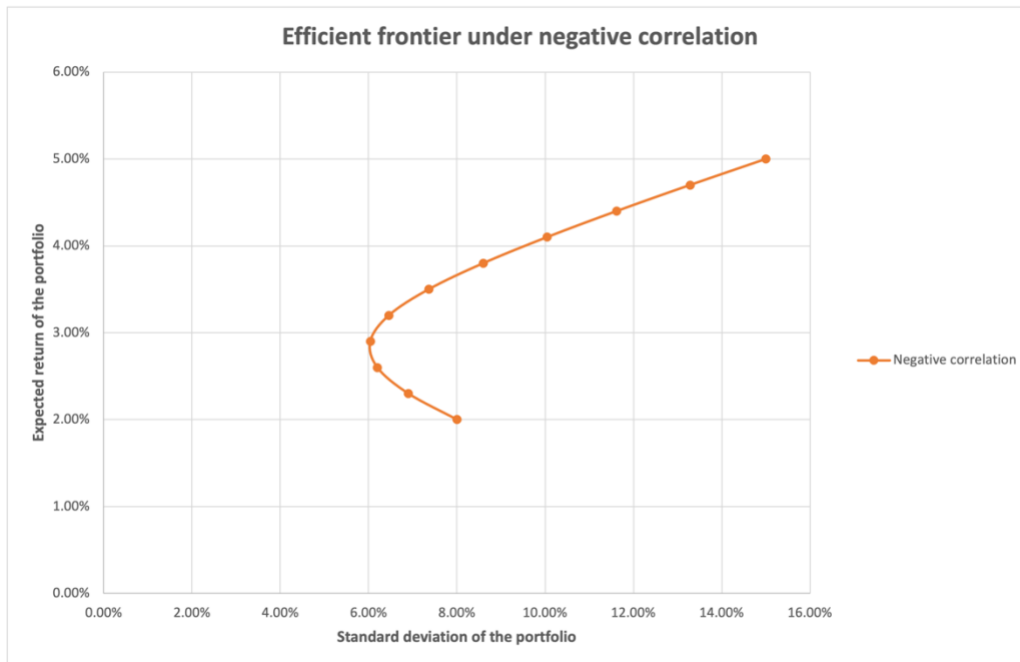
**Assignment 6, due on Canvas by 11:59pm on Wednesday October 18**

**1. Diversification with stocks and bonds**

In class we looked at how diversification works with two correlated risky assets. This problem asks you to work out an example based on the changing correlation between bonds and stocks from the late 20<sup>th</sup> Century to the early 21<sup>st</sup> Century.

Consider two risky asset classes (you can think of these as mutual funds): bonds with an expected real return of 2% per year and a standard deviation of 8% per year, and stocks with an expected real return of 5% per year and a standard deviation of 15% per year. First, assume that the correlation is -0.3 as has been the case during the early 21<sup>st</sup> Century.

- a) Consider a portfolio with the two risky asset classes. Let  $w_B$  denote the portfolio weight on bonds. Let  $R_B$  and  $R_A$  denote the real returns of bonds and stocks. Let  $\sigma_B$  and  $\sigma_A$  denote the standard deviations of bond and stock returns. Let  $\rho$  denote the correlation between the returns on these two asset classes. Consulting the slides from Lecture 10 (specifically slide 19), write the expected real return and standard deviation of the portfolio return using the symbols defined above.
- b) In the Excel spreadsheet provided, `Econ70_Assignment6_Question1.xlsx`, in tab “CORRELATION\_NEGATIVE”, implement your formulas from part (a) to calculate the expected real return and standard deviation for the 11 possible portfolios of the two asset classes, with portfolio weights varying in 10% increments from 0% bonds, 100% stocks to 100% bonds, 0% stocks.
- c) Create a corresponding plot with expected real return on the vertical axis and standard deviation on the horizontal axis. Follow the instructions below.
  - Select the cells containing returns and standard deviations. Under the tab “Insert”, select the chart type “Scatter with smooth lines and markers”.
  - Right click the plot. In “Select data”, change “X values” to be standard deviations and “Y values” to be returns.
  - The line we plot is called the “efficient frontier” in finance. Add the title and labels for axes.
  - Your plot should look like this:



- d) Are there portfolios in your table that no investor who likes mean return and dislikes standard deviation would ever hold? Explain.
- e) Calculate the ratio of mean to standard deviation for each portfolio. This is called the Sharpe ratio. It helps investors understand the return of an asset comparing to its risk. Which portfolio has the highest Sharpe ratio? What is that ratio?
- f) Now suppose that you can also invest in money market funds, which have an expected real return of 0% and a standard deviation of 0%. Where do money market funds appear on your plot?
- g) If you scale back your investment in a portfolio of risky asset classes so that you put only a fraction  $F$  of your wealth in them, with the remainder  $1-F$  in money market funds, this multiplies both the expected real return and the standard deviation by  $F$ . Draw on the plot above (by hand) the points that you can reach by varying  $F$  between 0 and 1.

(Bonus exercise, not required.) Try to plot this using Excel. You may find the instructions below helpful.

- First note that for any portfolio among the 11 given, we can combine it with money market funds. Let's first try with portfolio 1. You can see two empty tables in tab "CORRELATION\_NEGATIVE", one for the expected return of your portfolio if combined with money market funds, one for the standard deviation. In cells B28-B38, C28-C38, you can see some possible values of  $(1-F, F)$ . These are the possible weights on the money market fund and the corresponding weights on the portfolio 1. Now calculate the expected return (cells D28 – D38) and the standard deviation (cells D43-D53) of the new portfolio from the money market funds and portfolio 1, under different possible weights given.

- Add this set of data to the plot from part (c).
  - Repeat steps 1 and 2 for portfolios 2-11.
- h) (This part and the following parts are once again required.) Now assume that the correlation between bonds and stocks is not  $-0.3$  but  $+0.3$  as it was during the late 20<sup>th</sup> Century. Repeat parts a) through e) under this assumption in tab POSITIVE. What do you notice about the ratios of mean to standard deviation that are available in this environment?
- i) Copy your answers for returns and standard deviations under the negative correlation and the positive correlation to the table in tab COMBINED. The plot there should automatically show the two efficient frontiers for you. Comment on what you see.
- j) University endowments and other institutional investors have invested aggressively in stocks and bonds in recent years. Explain in words the rationale for this investment approach, focusing particularly on the negative bond-stock correlation. What would be the challenge for these investors if the correlation becomes positive again?

## 2. The impact of mutual fund fees

Look at the fee structure for Davis New York Venture Fund summarized in Exhibit 16-2 of Kapoor et al. Compare Class A and Class C shares, since Class B shares are no longer offered for sale.

- a) If you spend \$1,000 to purchase Class A shares, how much money is actually invested in the fund? What if you spend \$1,000 to purchase Class C shares?
- b) Suppose the fund's return before fees is 5% per year. What return per year do you earn after fees on Class A shares? What return per year do you earn after fees on Class C shares?
- c) Suppose you sell your shares after 5 years. What fee do you pay the fund upon sale, if your shares are Class A or Class C?
- d) How much money do you end up with after selling your Class A shares? How much money do you end up with after selling your Class C shares?
- e) What factors should lead an investor to choose one class of shares or the other if investing in Davis New York Venture Fund? Explicitly calculate when it would be more profitable to hold Class A vs. Class C shares.
- f) Comment more generally on the choice between load funds (such as Davis New York Venture Fund) and no-load funds.

### 3. Shopping for a green mutual fund

You are looking for a green mutual fund that will express your values with regard to the environment, and particularly climate change. You are considering the Vanguard FTSE Social Index Fund (VFTAX), Thornburg Better World International Fund (TBWAX), and iShares MSCI ACWI Low Carbon Target ETF (CRBN). Using [marketwatch.com](https://www.marketwatch.com), please research these funds and compare them.

Specifically, please compare

- a) The fund category
- b) The investment policy (including the fund's ESG orientation)
- c) Fees (front load, total expense ratio, 12b-1 fee)
- d) Turnover
- e) Standard deviation
- f) Minimum investment
- g) Yield
- h) Asset allocation to stocks and cash
- i) Top two sectors
- j) Top five stocks
- k) Do you think any of these funds are better or worse investments than the others? Why?