Problem Set 5

Econ 136, Spring 2024

This problem set is due on April 2nd, by 5PM (on Gradescope).

1. **Efficient markets**

   Are the following statements true or false? Explain your answer in no more than two sentences.

   (a) Good News, Inc., just announced an increase in its annual earnings, yet its stock price fell. This may be consistent with the efficient markets hypothesis.

   (b) If the stock market is efficient in the semi-strong sense, there should be, on average, no increase in a company's stock price before the company announces good news about its business.

   (c) If risky stocks on average have higher returns than safe stocks, the efficient market hypothesis may still hold.

   (d) The efficient markets hypothesis must fail, because lots of investors do crazy things in the market.

2. **A biotech company**

   A biotechnology company is testing a new drug, which is an improved version of a veterinary product widely used to treat dogs. The company plans to conduct two successive trials. In the first trial, the drug will be evaluated for safety in humans. If it passes this trial, it will be approved for a second trial of efficacy in humans; if it fails, the second trial will be for efficacy in dogs. The company estimates that the market value of its drug patent will be $80 million if the drug passes both trials, $55 million if it passes the first trial but fails the second, $25 million if it fails the first trial but passes the second, and zero if it fails both trials. The company believes that each trial has a 25% chance of success.

   (a) Draw the event tree for this situation.

   (b) What is the rational expectation of the drug patent value, conditional on success in the first trial? What is the rational expectation of the drug patent value, conditional on failure in the first trial?

   (c) What is the rational expectation of the drug patent value before the results of the first trial are known?

(d) Use the notation X for the drug patent value, $\mathbb{E}_0[X]$ for the rational expectation of the drug patent value formed before the first trial, and $\mathbb{E}_1[X]$ for the rational expectation of the drug patent value formed after the first trial but before the second trial. Show that $\mathbb{E}_0[X] = \mathbb{E}_0[\mathbb{E}_1[X]]$. Show that $\mathbb{E}_0[X - \mathbb{E}_1[X]] = 0$. Explain why these results make sense.

(e) Show that $\mathbf{Var}_0(X) > \mathbf{Var}_0(\mathbb{E}_1[X]) > \mathbf{Var}_0(\mathbb{E}_0[X])$. Explain why this result makes sense.

3. **Covariance and correlation**

Suppose there are three states of the world, which are all equally likely, and two different financial assets. In the first state of the world, the first asset returns 8% and the second asset returns -6%. In the second state, the first asset returns -4% and the second asset returns 14%. In the third state, the first asset returns 11% and the second asset returns 7%.

(a) What is the mean return on each asset? What is the variance and standard deviation of the return on each asset? Use natural units, not percentages (i.e., use 0.09 instead of 9 for 9%).

(b) What is the covariance of the returns of the two assets? What is the correlation between the two returns?

(c) Consider an equal weighted portfolio of the two assets. Compute the mean return, variance and standard deviation.

(d) How would a mean-variance optimizing investor rank the three portfolios (asset 1, asset 2, equal weighted)? Does your answer depend on the coefficient of risk aversion A? Explain.

4. **Historical returns**

Download the Excel file "returns.xls" from the course website. The file contains the following data in its various columns: (A) years; (B)-(F): annual nominal simple net returns for portfolios of big growth stocks, big value stocks, small growth stocks, small value stocks, and a broad market portfolio.

(a) Use Excel to calculate the average simple return for all five of these portfolios (hint: use the AVERAGE function). Rank the returns. Explain.

(b) In H3, write =ln(1+B3/100) which computes the log return in year 1927 for the growth portfolio. By copying the cell H3, compute the log return for all five portfolios and all years. What is the average log return for the five portfolios?

(c) Our next goal is to compute the cumulative log return for all five portfolios. In N3, write =SUM(H$3:H3). The $ sign ensures that when you copy this cell, the number following $ (3 in this case) will not change. Copy the cell N3 to compute the cumulative log return for all five portfolios and all years.

(d) To compute the value of $1 invested at the beginning of 1927, in cell T3 write =EXP(N3). Fill in the cells for the other portfolios and years by copying this. What is the value of this investment in 2011 for each of the five portfolios? Rank the five portfolios by their performance during 1927-2011.

(e) Create a plot for the performance of all five portfolios (use a logarithmic scale). Turn in a printout of your figure in your solution.

(f) Use Excel to compute the standard deviation of the simple net return for all five portfolios (hint: use the STDEV function). What do you find? Does it make sense?

(g) In column Z, compute the net simple return for an equal weighted portfolio invested in big growth, big value, small growth, and small value stocks. Use Excel to compute the mean and standard deviation of this return. How do these numbers compare to the mean and standard deviation of the big growth, big value, small growth, and small value portfolios? Does this make sense?