Ec70 PS5 Solution

2023 Fall

1 Measuring the return on a stock

a

$$Dividend\ payout\ ratio = \frac{Annual\ dividend\ amount\ per\ share}{Earnings\ per\ share} = \frac{4.32}{10.80} = 0.4 = 40\%$$

b

$$Dividend - price\ ratio = \frac{Annual\ dividend\ amount\ per\ share}{Price\ per\ share} = \frac{4.32}{180} = 0.024 = 2.4\%$$

c

$$Price - earnings\ ratio(P-E) = \frac{Price\ per\ share}{Earnings\ per\ share} = \frac{180}{10.8} \approx 16.67$$

d

After the year the stock price increase from \$180 per share to \$190 per share. So the capital gain of the 100 shares you own is $100 \times \$10 = \$1000$. You get dividend of $100 \times \$4.32 = 432$. So the total return in dollars is:

$$Total\ return = Dividends + Capital\ gain = \$432 + \$1000 = \$1432.$$

e

The fraction of return that comes from dividends is $\frac{432}{1432} \approx 0.3017$. The fraction of return that comes from capital gain is $\frac{1000}{1432} \approx 0.6983$.

f

The rate of return is

$$R = \frac{Return\ in\ dollars\ per\ share}{Price\ per\ share} = \frac{14.32}{180} \approx 7.96\%.$$

2 The historical return on the US stock market

You shall find that the starting month is January 1871.

The two annualized returns are 2.466% and 6.916%.

The fraction from dividends be

$$\frac{6.916\% - 2.466\%}{6.916\%} = 64.34\%,$$

and the other 36% comes from capital gain.

Why do we say "dividends reinvested" rate contains both capital gain and dividends? That's because, if we want to calculate the average return from dividends, ideally we will convert all the historic dividends into current money, but the conversion is tricky. Instead, we can use the index fund itself as a "conversion" tool. For example, if we have an X amount of dividends in 1900, we simply assume that we invest all X to buy the index fund at 1900, and we sell the same amount of fund today to see how much money can we get back if we invest X in 1900.

3 Using the Normal Distribution

a.

See the spreadsheets solution.

b.

- The *NORM.DIST* function returns the normal distribution for the specified mean and standard deviation. It can return the cumulative distribution function or the probability density function.
- The first argument is the value for which you want the distribution. The second and third arguments are the mean and standard deviation of the normal distribution. The fourth argument is a boolean variable (if TRUE, the function returns the cumulative distribution function; if FALSE, the function returns the probability density function).
- We want to know the probability that the stock index fund earns a lower return than a money market fund, that is the return of the stock index fund in excess of the return of the money market fund is less than 0. We know the mean and standard deviation of the excess return and assume the return is normally distributed. Thus this function gives exactly what we are looking for!

c.

See the spreadsheets solution.

d.

The probabilities are decreasing. As the horizon increases, the ups and downs in the stock market tend to average out. In other words, the "dispersion" of future returns becomes smaller, and it is less likely that you will lose money in the stock market.

e.

The above reasoning helps to explain why Schwab and Vanguard ask about your investment horizon in Q1. As people's investment horizon increases, to the extent that people dislike losses, they will be more comfortable investing a larger share of their wealth in stocks. In this case, Schwab and Vanguard would recommend a more aggressive investment strategy.