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FINANCIAL MANAGEMENT – FINAL EXAM 16/12/2024

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EXERCISE 1

In a perfectly competitive market where the interest rate R remains constant over time, a security pays 1210 euro after two years, and it costs 1000 euro. The monthly inflation rate is always equal to 0.5%. What is the annual real interest rate R_r?

The annual nominal interest rate is:

$$1000 = \frac{1210}{(1+R)^2}$$

$$(1+R)^2 = 1.21$$

$$1 + R = \sqrt{1.21}$$

$$R = 1.1 - 1 = 0.1$$

So, the annual nominal interest rate is 10%.

The annual inflation rate is:

$$i = (1 + i_m)^n - 1 = (1 + 0.005)^{12} - 1 \approx 0.0617$$

So, the real interest rate is:

$$R_r = \frac{1+R}{1+i} - 1 = \frac{1+0.10}{1+0.0617} - 1 \approx 0.0361 = 3.61\%$$

EXERCISE 2

A corporation has 1 million shares outstanding. Its cost of equity is 5%, in 2024 it has paid a dividend of 2 euro per share, and it has repurchased shares for an amount of 3 million euro.
If we expect that the future total payouts will grow at a constant rate of 2% per year forever starting from 2025, what is the share price according to the total payout model?

The total dividends paid in 2024 are given simply by

$$Div_{2024} = 2 * 1000000 = 2000000$$

Which means that the total payout for 2024 has been

$$Div_{2024} + Repurchases_{2024} = 2000000 + 3000000 = 5000000$$

Given that the total payouts will grow forever at a constant rate, we can compute the present value of all the future dividends and repurchases using the formula of the present value of a growing perpetuity:

$$PV(Future\ total\ dividends\ and\ repurcheses) = \frac{Div_{2025} + Repurchases_{2025}}{R_E - g} =$$

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$$\frac{Div_{2024} + Repurchases_{2024} + g(Div_{2024} + Repurchases_{2024})}{R_E - g} =$$

$$\frac{5000000 + 0.02 * 5000000}{0.05 - 0.02} = 170000000$$

So, the share price according to this model should be:

$$P_0 = \frac{PV(Future\ total\ dividends\ and\ repurcheses)}{Shares\ Outstanding_0} = \frac{170000000}{1000000} = 170$$

EXERCISE 3

A coupon bond whose current price is 950 euro will pay a coupon of 50 euro 1 year from now, and another coupon of 50 euro plus the face value of 1000 euro 2 years from now.
Assuming that the interest rates stay the same over time, and that the law of one price holds, what should it be the price of a zero-coupon bond that will pay a face value of 500 euro 9 months from now?

First, we need to compute the interest rate, i.e., the yield to maturity:

$$950 = \frac{50}{1 + YTM} + \frac{1050}{(1 + YTM)^2}$$

$$950 = \frac{50(1 + YTM) + 1050}{(1 + YTM)^2}$$

$$950(1 + 2YTM + YTM^2) = 50 + 50YTM + 1050$$

$$950YTM^2 + 1850YTM - 150 = 0$$

$$YTM = \frac{-1850 \pm \sqrt{1850^2 + 570000}}{1900} = \frac{-1850 \pm 1998.124}{1900}$$

The two solutions are $YTM \approx 0.078$ and $YTM \approx -2.025$. The second does not make sense, so the interest rate is 7.8%

Therefore, the price of the zero-coupon bond with maturity equal to $9/12 = 0.75$ years must be:

$$P = \frac{500}{1.078^{0.75}} \approx 472.61$$

EXERCISE 4

Answer (shortly) to the following questions:

1. *What is the bid-ask spread? (2 points)*
2. *What is the diluted Earnings per share (Diluted EPS)? (2 points)*

3. *In an efficient market where the yearly interest rate is always equal to 5%, what is the price of a security that pays 100 euro per year forever? (3 points)*
4. *A coupon bond has a price of 1000 euro, a yield to maturity of 3%, and its modified duration is equal to 1.5. What happens to the price if the yield to maturity decreases to 2%? (3 points)*

1. It is the difference between the price at which it is possible to buy the stock (bid price) and the price at which it is possible to sell the stock (ask price).
2. It is the EPS in case all stock options are exercised, and all convertible bonds are converted into shares.
3. This is a perpetuity. Its price in an efficient market is $100/0.05 = 2000$
4. If the YTM decreases by 1%, the price should increase by 1.5% (because the modified duration is 1.5). So the new price is 1015 euro.

EXERCISE 5

We have a portfolio of two assets over three periods. Their weights and the log-returns are:

Period 1: $w_1 = 0.3 \quad w_2 = 0.7 \qquad r_1 = 0.05 \quad r_2 = -0.04$

Period 2: $w_1 = 1.1 \quad w_2 = -0.1 \qquad r_1 = 0.08 \quad r_2 = 0.05$

Period 3: $w_1 = 0.6 \quad w_2 = 0.4 \qquad r_1 = -0.02 \quad r_2 = 0.06$

What is the cumulative return of the portfolio over the three periods?

First, we need to compute the portfolio return in each period. As log-returns are not asset additive, we have to convert them to simple returns:

Period 1: $w_1 = 0.3 \quad w_2 = 0.7 \qquad R_1 = \exp(0.05) - 1 \approx 0.0513 \quad R_2 = \exp(-0.04) - 1 \approx -0.0392$

Period 2: $w_1 = 1.1 \quad w_2 = -0.1 \qquad R_1 = \exp(0.08) - 1 \approx 0.0833 \quad R_2 = \exp(0.05) - 1 \approx 0.0513$

Period 3: $w_1 = 0.6 \quad w_2 = 0.4 \qquad R_1 = \exp(-0.02) - 1 \approx -0.0198 \quad R_2 = \exp(0.06) - 1 \approx 0.0618$

Therefore, the portfolio returns are:

$$R_{p,1} = 0.3 * 0.0513 + 0.7 * (-0.0392) \approx -0.012$$

$$R_{p,2} = 1.1 * 0.0833 - 0.1 * 0.0513 \approx 0.0865$$

$$R_{p,3} = 0.6 * (-0.0198) + 0.4 * 0.0618 \approx 0.0128$$

So finally, we compute the cumulative return:

$$R_{p,cum} = \prod_{t=1}^{3}(1 + R_t) - 1 = (1 - 0.012)(1 + 0.0865)(1 + 0.0128) - 1 \approx 0.0872$$

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EXERCISE 6

The vector of weights and the covariance matrix of a portfolio are:

$$\boldsymbol{w} = \begin{bmatrix} 0.2 \\ 0.5 \\ 0.3 \end{bmatrix} \qquad \Sigma = \begin{bmatrix} 0.005 & -0.001 & 0.002 \\ -0.001 & 0.004 & 0.003 \\ 0.002 & 0.003 & 0.006 \end{bmatrix}$$

Compute the standard deviation of the portfolio.

The variance of a portfolio is given by:

$$Var(R_p) = \boldsymbol{w}'\Sigma\boldsymbol{w} = [0.2 \quad 0.5 \quad 0.3] \begin{bmatrix} 0.005 & -0.001 & 0.002 \\ -0.001 & 0.004 & 0.003 \\ 0.002 & 0.003 & 0.006 \end{bmatrix} \begin{bmatrix} 0.2 \\ 0.5 \\ 0.3 \end{bmatrix}$$

$$= [0.2 * 0.005 + 0.5 * (-0.001) + 0.3 * 0.002 \quad 0.2 * (-0.001) + 0.5 * 0.004 + 0.3 * 0.003 \quad 0.2 * 0.002 + 0.5 * 0.003 + 0.3 * 0.006] \begin{bmatrix} 0.2 \\ 0.5 \\ 0.3 \end{bmatrix}$$

$$= [0.0011 \quad 0.0027 \quad 0.0037] \begin{bmatrix} 0.2 \\ 0.5 \\ 0.3 \end{bmatrix}$$

$$= 0.0011 * 0.2 + 0.0027 * 0.5 + 0.0037 * 0.3 = 0.00268$$

Therefore, the standard deviation is:

$$SD(R_p) = \sqrt{Var(R_p)} = \sqrt{0.00268} \approx 0.0518$$

EXERCISE 7

Suppose that the conditions for the CAPM are fully respected. The market portfolio expected return is 5% and the risk-free rate is 1%. We create a portfolio in which 80% of the wealth is placed in the security A whose beta is $\beta_A = 0.5$, 50% in the security B whose beta is $\beta_B = 1.5$, and we short the risk-free asset.
What is the expected return of the portfolio? And what is the beta of the portfolio?

As the weights for the risky assets sum to $0.8 + 0.5 = 1.3$, it means that the weight for the risk-free asset is -0.3. Since the CAPM holds, the expected return of A is:

$$E[R_A] = R_f + \beta_A * (E[R_M] - R_f) = 0.01 + 0.5 * (0.05 - 0.01) = 0.01 + 0.02 = 0.03$$

The expected return of B is:

$$E[R_B] = R_f + \beta_B * (E[R_M] - R_f) = 0.01 + 1.5 * (0.05 - 0.01) = 0.01 + 0.06 = 0.07$$

Hence, the expected return of the portfolio is:

$$E[R_P] = 0.8 * 0.03 + 0.5 * 0.07 - 0.3 * 0.01 = 0.056 = 5.6\%$$

The beta of the portfolio is given by the weighted average of the beta of the assets it contains:

$$\beta_P = 0.8 * 0.5 + 0.5 * 1.5 - 0.3 * 0 = 1.15$$

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EXERCISE 8

Consider the following series of <u>unadjusted</u> monthly closing prices (in euro) of a stock that undergoes the corporate events indicated next to the price.

January: 8

February: 7

March: 10 1 for 1.5 stock split

April: 11

May: 9 Dividend of 1 euro per share is paid

June: 12

Compute the adjusted stock returns.

First, we adjust the prices to account for the stock split:

January: $8 * 1.5 = 12$

February: $7 * 1.5 = 10.5$

March: 10

April: 11

May: 9

June: 12

Now we compute the returns, accounting for the dividend in May:

$$R_{Feb} = \frac{10.5 - 12}{12} = -0.125$$

$$R_{Mar} = \frac{10 - 10.5}{10.5} \approx -0.048$$

$$R_{Apr} = \frac{11 - 10}{10} = 0.1$$

$$R_{May} = \frac{9 + 1 - 11}{11} \approx -0.091$$

$$R_{Jun} = \frac{12 - 9}{9} \approx 0.333$$

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EXERCISE 9

Answer (shortly) to the following questions:

1. *If an portfolio manages to achieve returns that are not explained by its beta, the Jensen alpha of this portfolio is lower, equal, or greater than zero? (2 points)*
2. *What is the difference between the capital market line and the security market line? (3 points)*
3. *In a perfect capital market, what happens to the share price when the stock begins to trade ex-dividend? (2 points)*
4. *In a perfect capital market, the cost of equity of a firm is 10%, its cost of debt is 5%, and its weighted average cost of capital is 7%. What is the unlevered cost of equity of the firm? (3 points)*
5. *Are finance leases recorded in some financial statements? If yes, in which one? (2 points)*
6. *What is the strike price of an option? (2 points)*
7. *What is the difference between American, European, and Asian options? (3 points)*
8. *What is the payoff of a put option from the point of view of the writer of the option? (3 points)*

1. The Jensen alpha in this situation is greater than zero.
2. The capital market line is drawn using the standard deviation as measure of risk (i.e., total risk), while the security market line is drawn using the beta (i.e., only systematic risk).
3. The share price drops by the amount of the dividend.
4. In a perfect capital market the unlevered cost of equity is equal to the weighted average cost of capital. Therefore, it is equal to 7%.
5. They are recorded in the balance sheet.
6. It is the price at which the holder buys or sells the share of stock when the option is exercised.
7. American options allow their holders to exercise the option on any date up to and including the expiration date.
   European options allow their holders to exercise the option only on the expiration date, not before.
   Asian options are options where the payoff depends on the average price of the underlying asset over a certain period of time.
8. The writer's payoff of a put option is a loss equal to the difference between the strike price and the value of the option, if the option is exercised. Otherwise, it is equal to zero.