

Time value of money

A bank deposit is offering a stated annual rate of 3% with interest payments every semester. How much should you deposit today in order to have 25,000€ ten years from now?

$$1) \frac{25,000}{\left(1 + \frac{5\%}{2}\right)^{10 \times 2}} = 18,561.76$$

18,561.76€

Using the same bank deposit as in the previous question, how much should you deposit every semester during 10 years (starting one semester from now) if you want to reach the same 25,000€ 10 years from now (instead of depositing only today)?

$$2) \frac{D}{1.5\%} \times \left[1 - \frac{1}{(1+1.5\%)^{10 \times 2}}\right] = 18,561.76 \rightarrow D = 1,081.14$$

1,081.14€

With a discount rate of 10%, how much are you willing to pay for a financial asset that pays 5€ tomorrow and is expected to pay annually forever, with a growth rate of 2%?

$$3) P = \frac{5}{10\% - 2\%} \times (1 + 10\%) = 68.75$$

68.75€

You want to save money for your Erasmus semester. You expect to leave Portugal 12 months from now and be 6 months abroad with monthly expenses of 400€ (starting to be paid one month after you arrive). If the effective annual interest rate in your bank is 8% and you will make 12 deposits, starting one month from now, how much should you deposit?

$$4) r_{\text{monthly}}^{\text{eq}} = (1 + 8\%)^{\frac{1}{12}} - 1 = 0.6434\%$$

$$\text{PV of expenses} = \frac{400}{0.6434\%} \times \left[1 - \frac{1}{(1 + 0.6434\%)^6}\right] = 2,173.03$$

$$\text{PV of deposits} = 2,173.03 = \frac{D}{0.6434\%} \times \left[1 - \frac{1}{(1 + 0.6434\%)^{12}}\right] \rightarrow D = 188.75$$

188.75€

What is the installment you have to pay for a bank loan of 100,000€ with a stated annual rate of 4% and 120 monthly installments, starting next month.

$$5) \frac{I}{\frac{4\%}{12}} \times \left[1 - \frac{1}{\left(1 + \frac{4\%}{12}\right)^{120}}\right] = 10,000 \Leftrightarrow I = 1,012.45$$

1,012.45€

Bonds

6) A 10-year corporate bond has an annual coupon of 10% (annual payments). The bond is currently selling at par. What is this bond's yield to maturity?

10%

Use the following info for questions 7-10: Today, the infamous McDonald Co issued three types of zero coupon bonds with face value of 100 and different maturities, here are the bond yields:

Maturity	Yields
1 Year	5%
2 Year	6%
3 Year	7%

How much McDonald's 2 year zero coupon bonds are currently trading for?

$$7) B = \frac{100}{(1 + S_2)^2} = 88.9996$$

88.9996

What is the forward rate for a one year bond one year from today ($f_{1,2}$)?

8) $f_{1Y,2Y} = \left[\frac{(1+6\%)^2}{(1+5\%)^1} \right] - 1 = 7.0095\%$

7.0095%

In that same day, McDonald also issued a 3-year annual coupon bond with a coupon rate of 10%. What was the price of this bond?

9) $B = \frac{10\%}{(1+5\%)^1} + \frac{10\%}{(1+6\%)^2} + \frac{100\%+10\%}{(1+7\%)^3} = 108.2165\%$

108.2165%

If you look up McDonald's 1-Year zero coupon bonds on the Bloomberg terminal half an year from today, assuming that the yield of this bond remain constant, what would be the clean price you would see?

10) $AI=0 \rightarrow DP=CP = \frac{100\%}{(1+5\%)^{\frac{1}{2}}} = 97.59$

97.59%

Stocks

ExxinMobile Company just paid a dividend of 0.97€. Investors expect this firm to grow forever at a 3% rate. What is the price of this stock if the discount rate is 13%?

11) $S = \frac{0.97 \times (1+3\%)}{13\% - 3\%} = 9.9910$

9.9910€

Facebar is expected to have earnings per share of €10 by the end of the year. Their stock is trading at €100. What is their payout ratio if the market expects them to grow at a 3% rate forever and the discount rate is currently at 8%?

12) $S = 100 = \frac{P/O \times 10}{8\% - 3\%} \rightarrow P/O = 50\%$

50%

What is the Price-Earnings Ratio of a firm that has constant growth of 2% pays 30% of its earnings as dividends to the shareholders, has total earnings of €500,000, and 100,000 shares outstanding? The discount rate is 12%.

13) $PER = \frac{30\% \times \frac{500,000}{100,000}}{\frac{12\% - 2\%}{500,000}} = 3$

3

Spacebar just announced earnings per share of €8. They are expected to grow at a constant rate forever, have an ROE of 20% and retain 40% of its earnings forever. What is the net present value of growth opportunities (NPVGO) if discount rate is 16%?

14) $S = \frac{EPS}{r} + NPVGO \Leftrightarrow \frac{8 \times 60\%}{16\% - 20\% \times 40\%} = \frac{8}{16\%} + NPVGO \Leftrightarrow NPVGO = 10$

10

Capital budgeting

Use the following information for questions 15-18:

MG is a company that produces moulds for car manufacturing. This factory is currently producing and selling 100 moulds every year, for an average price of 5,000€. This company is planning an immediate 100,000€ investment that will increase yearly production to 110 moulds forever. This increase in production will generate more revenues (keeping the unit price) but it will also require extra operating expenses. For each extra mould, the company will have an operating cost of 2,500€. The initial investment has an economic life of 10 years and it will be fully depreciated using the straight-line method depreciation. Every year the company does replacement investment, with yearly capital expenditure equal to yearly depreciation. Corporate tax rate is 25% and the discount rate is 10%.

(values in €)	0	1 and thereafter
Revenues		50,000
Costs		25,000
Depreciation		10,000
EBIT		15,000
Taxes		3,750
NOPAT		11,250
OCF		21,250
CAPEX	-100,000	-10,000
Inv. CF	-100,000	-10,000
Free CF	-100,000	11,250

15) What is the free cash flow of the 1st year of this project? 11,250€

16) What is the NPV of this project?

$$NPV = -I_0 + \frac{FCF}{r} = -€100,000 + \frac{11,250}{10\%} = 12,500$$
12,500€

17) What is the payback period of this project?

$$Payback\ period = \frac{I_0}{FCF} = \frac{100,000}{11,250} = 8.89$$
8.89 years

18) What is the IRR of this project?

$$NPV = -I_0 + \frac{FCF}{r} = 0 \Leftrightarrow -€100,000 + \frac{11,250}{10\%} = 0 \Leftrightarrow r = 11.25\%$$
11.25%

Risk and Return

Moon Microsystems' stocks presented the following returns in the past 4 years.

Year	Return
1	12%
2	-3%
3	4%
4	20%

19) What is the holding period return of an investor who purchased Moon's stock on the beginning of year 2 and sold it at the end of year 4?

$$Return = (1-3\%) \times (1+4\%) \times (1+20\%) - 1 = 21.06\%$$
21.06%

Use the information about returns and standard deviations of different investments to solve the next question.

Investment	Average Annual Return	Standard Deviation
Small Company Stocks	17.40%	32.90%
Long-Term Corporate Bonds	6.20%	8.50%
Long-Term Government Bonds	5.80%	9.20%
U.S. Treasury Bills	3.80%	3.10%
Inflation	3.10%	4.30%

20) We have invested €1 million in an index of Small Company Stocks. What is the biggest drop in value that we could expect over the year with a 1 per cent probability? (Hint: $z_{0.01} = 2.33$)

$$VaR = 1,000,000 \times (17.4\% - 2.33 \times 32.9\%) = 592,570$$
592,570€