2. FINANCIAL PRINCIPLES

Objectives: After reading this chapter, the students will be able to
1. Calculate the cost of capital of a firm.
2. Apply the concepts of value creation and net present value in making investment decision at a firm.

2.1 Cost of Capital

Firms need *capital* to invest in plant and equipment. They need *cash* to pay their workers and to buy raw materials. Capital is the lifeblood of any company. What is capital? Capital is simply the money that companies need to do their business. The *investors* supply the capital to the corporations.

There are two forms of capital: *equity* and *debt*. Firms can raise equity by selling shares of their *stock*. A corporation can raise debt capital by selling its *bonds*. It is also possible for a corporation to issue a hybrid security, such as a convertible bond.

Suppose a corporation, say, Ford Motor Company, needs $100 million to expand its manufacturing facilities. It can raise the capital by first contacting an *underwriter*, such as Merrill Lynch. After some negotiations, Merrill Lynch may buy the entire stock issue by paying Ford, perhaps, $94 million. Ford gets $94 million and is now out of the picture. Merrill Lynch gets $6 million for selling the stock to the public. Since they have an extensive network of retail brokerage outlets, they are able to sell the stock to their customers. If they have some unsold stock, they will just keep it in their own investment portfolio.

Suppose a company, such as Home Depot, wants to borrow $300 million for expansion of its business. It can do so by selling its bonds. It has to go through an underwriter once again. The underwriting fees on bonds are somewhat lower, perhaps around 3%. The bonds must carry an attractive coupon rate, say, 6%.

Capital does not come free. There is always a cost of capital. In the second example, the *cost of debt* capital to Home Depot is 6%. It is paying 6% to the investors who have bought their bonds. We can also find the *cost of equity* capital by using either *Gordon's growth model*, or by using the *Capital Asset Pricing Model*, or CAPM, for short.

Suppose we know the expected long-term growth rate g of the dividends of a firm, its current price per share, P_0, and its dividend for next year, D_1. Then the cost of equity for this firms, k_e, is given by the expression for Gordon's growth model,

$$k_e = \frac{D_1}{P_0} + g \tag{2.1}$$

On the other hand, if we know the beta of a stock, β, the risk-free rate, *r*, and the expected return on the market, $E(R_m)$, then we can find the cost of equity capital for the firm by using the relationship representing capital asset pricing model,

$$k_e = r + \beta\,[E(R_m) - r] \tag{2.2}$$

Consider a company that has just paid its annual dividend of $2.00. This investors expect that the dividend will grow at the rate of 6% for the long haul. Its dividend next year will be 2(1.06) = $2.12. Suppose the price of the stock is $25. Then its cost of equity, by (2.1), is

$$k_e = \frac{2.12}{25} + .06 = .1448 = 14.48\%$$

Let us assume that the β of this stock is 1.45, the risk-free rate is 6%, and the expected return of the market is 12%. Putting these numbers in (2.2), we find

$$k_e = .06 + 1.45(.12 - .06) = .1470 = 14.70\%$$

We have to keep in mind that neither of these two methods of calculating the cost of equity is very accurate. They give only an approximate result.

Since the corporations mix the two forms of capital when they apply it to their business, it is necessary to find the weighted *average cost of capital*. We can find this from the following result

$$WACC = (1 - t)k_d \frac{B}{V} + k_e \frac{S}{V} \tag{2.3}$$

In this equation, *WACC* is the weighted average cost of capital, *t* is the income tax rate of the firm, *B* is the market value of the debt, *S* is the market value of the equity of the firm, and *V* is the total (market) value of the company.

Suppose a company has $30 in debt and $70 million in equity capital. The total value of the company is thus $100 million. Further, the debt/assets ratio, or B/V = .3, and likewise S/V = .7. Assume that the pretax cost of debt is 10%, the cost of equity is 15%, and the tax rate of the company is 30%. Suppose the tax rate is 30%. Putting these numbers in (2.3), we get

$$WACC = (1 - .3)(.1)(.3) + .15(.7) = .126 = 12.6\%$$

2.2 Value Creation

Corporations are constantly trying to upgrade their facilities, incorporate new technology, and improve their existing methods and procedures. The basic reason for this ongoing effort is to create value for the firm.

Suppose a firm is streamlining its operations, and it is thus able to save *C* dollars per year. Suppose further that these savings will last for the next *n* years. Assume the cost of capital for the firm is *r*. Did the company create value by adopting this procedure? Yes. The additional value is equal to the *present value* of all the savings. We may write this value added, *V*, to be

$$V = \sum_{i=1}^{n} \frac{C}{(1+r)^i} \tag{2.4}$$

We can write this summation as

$$\sum_{i=1}^{n} \frac{C}{(1+r)^i} = \frac{C[1-(1+r)^{-n}]}{r} \tag{2.5}$$

Next, we assume that the firm is able to incorporate a permanent change in its operations that will save it *C* dollars per year forever. The value created in this case is

$$V = \sum_{i=1}^{\infty} \frac{C}{(1+r)^i} \tag{2.6}$$

We can write the infinite summation as follows,

$$\sum_{i=1}^{\infty} \frac{C}{(1+r)^i} = \frac{C}{r} \tag{2.7}$$

Let us consider a couple of examples to illustrate these ideas. Suppose you sign a lease with the owner of an apartment. You agree to pay $300 a month, in advance each month. The property owner uses a *risk-adjusted discount rate* of 12% in the valuation of this lease. What is the value of this lease for him?

In valuation models, we frequently use the concept of risk-adjusted discount rate. Suppose the owner in this example has borrowed the money at the rate of 8% to finance the purchase of the apartment house. He has to make at least 8% to pay for the financing of this business. However, he is also taking additional risk. Perhaps the tenants will not pay the rent and leave. Perhaps they will cause damage to the property, and not pay for it. Perhaps he cannot rent the apartment for some time. In order to take into account all these unforeseen events, he simply adds a risk premium to this original cost of capital. The risk-adjusted discount rate will then become 12%.

The present value of the first month's rent is $300, because you are paying it in advance. The remaining 11 installments will have a present value given by (2.4). The proper discount rate is the monthly rate, namely, 1% per month. Thus

$$\text{Value of lease} = 300 + \sum_{i=1}^{11} \frac{300}{1.01^i} = 300 + \frac{300[1-1.01^{-11}]}{.01} = \$3410.29$$

Let us look at another example. A company has decided to switch to a new method for the production that will save it \$5 million annually forever. The company uses a discount rate of 8% to evaluate such innovations. This improvement will increase the value of the company by the following amount, given by (2.7).

Increase in value = 5/.08 = \$62.5 million.

2.3 Net Present Value

One of the most important tools in financial analysis is the concept of *net present value*. We can use this concept in the evaluation of projects, or investments. We also use it in the working capital management of a company.

The concept of net present value is based on the cost-benefit analysis. However, it looks at the costs and benefits in terms of their present value. By using proper risk-adjusted discount rate, we can convert the future cash flows to their present values. Thus, we are able to capture the risk of the project in its NPV. This is a major advantage of this methodology.

In general, a project requires several cash inflows and outflows at different times. As a particular case, we can consider a project that requires a single investment I_0 at the beginning, but it generates regular cash flows C in the future. If the proper risk-adjusted discount rate in this case is r, then we may define the net present value as follows,

$$\text{NPV} = -I_0 + \sum_{i=1}^{n} \frac{C}{(1+r)^i} \tag{2.8}$$

Here I_0 = the initial investment in the project
C = the cash flow from the project
r = risk-adjusted discount rate
n = life of the project in years

We may use (2.5) to carry out the summation in (2.8)

Suppose we define the *after-tax cash flow C* in (2.8) as earnings after taxes, then

$$\begin{aligned} C &= \text{Earnings} - \text{taxes} \\ &= \text{Earnings} - (\text{income tax rate}) \times (\text{taxable income}) \\ &= \text{Earnings} - (\text{income tax rate}) \times (\text{earnings} - \text{depreciation}) \\ &= E - t(E - D) \\ &= E - tE + tD = E(1 - t) + tD \end{aligned}$$

The after-tax cash flow, C, is thus

$$C = E(1 - t) + tD \tag{2.9}$$

We may write equation (2.8) as

$$\text{NPV} = -I_0 + \sum_{i=1}^{n} \frac{E(1-t)+tD}{(1+r)^i} \tag{2.10}$$

Let us consider a few examples from corporate finance where we can apply this concept.

Examples

2.1. *Basic*: Aachen Company plans to make an investment that requires an initial outlay of $10,000, but it will pay back $1,000 annually for 20 years with the first payment after one year. The proper discount rate is 12%. Should Aachen accept the investment?

Here I_0 = 10,000, C = 1000, r = .12, n = 20. Using (2.9) and (2.10), we get

$$\text{NPV} = -10{,}000 + \sum_{i=1}^{20} \frac{1000}{1.12^i} = -10{,}000 + \frac{1000[1-1.12^{-20}]}{0.12} = -\$2530.56.$$

Since the NPV of the project is negative, we should reject it. ♥

Another way to look at the problem is that its annual rate of return is $1000/$10,000 = .1 = 10%. It will never be profitable at a discount rate of 12%. If the discount rate were, say, 7%, it would become profitable. We may see this as

$$\text{NPV} = -10{,}000 + \sum_{i=1}^{20} \frac{1000}{1.07^i} = -10{,}000 + \frac{1000[1-1.07^{-20}]}{0.07} = \$594.01.$$

To verify the calculation with Maple, type in

```
NPV:=-10000+sum(1000/(1+r)^i,i=1..20);
eval(subs(r=.12,NPV));
eval(subs(r=.07,NPV));
```

To verify the answer with Wolfram|Alpha, try the following:

```
-10000+Sum[1000/1.12^i,{i,1,20}]
-10000+Sum[1000/1.07^i,{i,1,20}]
```

2.2. *Uneven cash flows*: Augsburg Corporation intends to invest in a project whose initial cost is $100,000 and the proper discount rate is 12%. The project will generate $15,000 annually for years 1 through 5 and then $10,000 annually for the years 6 through 10. Should Augsburg accept the project?

Because the cash flows are different for different periods, we have to set the problem up as two summations, one for years 1-5, and the second for years 6-10. Thus

$$NPV = -100{,}000 + \sum_{i=1}^{5} \frac{15{,}000}{1.12^i} + \sum_{i=6}^{10} \frac{10{,}000}{1.12^i}$$

Another way of looking at the cash flows is as follows: there is $10,000 coming in every year for years 1-10, plus and additional $5,000 for the years 1-5. We may represent this as follows,

$$NPV = -100{,}000 + \sum_{i=1}^{10} \frac{10{,}000}{1.12^i} + \sum_{i=1}^{5} \frac{5000}{1.12^i}$$

We can perform the summation by using (2.5),

$$NPV = -100{,}000 + \frac{10{,}000(1-1.12^{-10})}{0.12} + \frac{5000(1-1.12^{-5})}{0.12} = -\$25{,}474, \text{ reject it } ♥$$

The Maple instruction for this problem is

```
NPV=-100000+sum(15000/1.12^i,i=1..5)+sum(10000/1.12^i,i=6..10);
```

To do it on WolframAlpha, copy and paste the following expression,

```
-100000+Sum[15000/1.12^i,{i,1,5}]+Sum[10000/1.12^i,{i,6,10}]
```

2.3. *Uncertain cash flow*: Bamberg Corporation wants to set up an ice cream stand at an amusement park for the next 5 years. The initial investment in the project is $20,000. The ice cream sales will depend on the weather. The following table gives the subjective probability for different weather conditions and cash flows.

Weather	Probability	Annual cash flow
Hot	25%	$8,000
Average	60%	$5,000
Cool	15%	$3,000

Would you recommend setting up the shop if the discount rate is 8%?

First, we calculate the expected annual cash flow by multiplying each probability by the outcome. This gives us

$$E(C) = .25*8000 + .6*5000 + .15*3000 = \$5{,}450$$

We find the NPV to be

$$NPV = -20{,}000 + \sum_{i=1}^{5} \frac{5450}{1.08^i} = -20{,}000 + \frac{5450(1-1.08^{-5})}{0.08} = \$1760$$

The project is acceptable. ♥

To do it on WolframAlpha, copy and paste the following expression,

```
-20000+Sum[5450/1.08^i,{i,1,5}]
```

2.4. *Taxes and depreciation*: Berlin Company plans to buy a machine that costs $12,000. Berlin will depreciate the machine over 6 years, on a straight-line and then junk it. It will generate pre-tax revenue of $4,000 for Berlin, which has a tax rate of 30%. The after-tax discount rate is 8%. Should Berlin buy the machine?

The amount of annual depreciation will be $12,000/6 = $2000, because the machine does not have any residual value. The after-tax cash flow, *C*, is given by (2.9)

$$C = 4000(1 - .3) + .3(2000) = \$3400$$

From (2.8) and (2.5), we have

$$\text{NPV} = -\ 12{,}000 + \sum_{i=1}^{6} \frac{3400}{1.08^i} = -12{,}000 + \frac{3400(1 - 1.08^{-6})}{.08} = \$3718$$

Yes, the company should buy the machine. ♥

To verify the answer on WolframAlpha, copy and paste the following expression,

```
-12000+Sum[3400/1.08^i,{i,1,6}]
```

2.5. *Uncertain life of the project*: Bonn Company wants to start a project with an investment of $24,000. It will give annual cash inflow of $6,000. The life of the project is uncertain: it may run for 5 years (probability 60%) or 6 years (probability 40%). If the proper discount rate is 10%, should Bonn undertake the project?

In this type of problem it is incorrect to start by first calculating the expected life of the project. One should find the expected NPV by multiplying the probability of a given life by the dollar outcome of that life, and then adding together the results. We may do it as follows:

$$\text{NPV} = -24{,}000 + .6\left(\sum_{i=1}^{5} \frac{6000}{1.1^i}\right) + .4\left(\sum_{i=1}^{6} \frac{6000}{1.1^i}\right)$$

$$= -\ 24{,}000 + \frac{0.6(6000)[1 - 1.1^{-5}]}{0.1} + \frac{0.4(6000)[1 - 1.1^{-6}]}{0.1}$$

$$= \$99.46, \text{ accept it.}$$ ♥

To verify the answer on WolframAlpha, copy and paste the following expression,

```
-24000+.6*Sum[6000/1.1^i,{i,1,5}]+.4*Sum[6000/1.1^i,{i,1,6}]
```

2.6. *Unknown life of the project*: Bremen Corporation plans to acquire a machine costing $32,000, which will save the firm $3,000 annually. The proper discount rate for this outlay is 12%. The company is not paying any income tax. At least how many years must the machine run before it becomes profitable?
In this case, we do not worry about taxes or depreciation. Assume that the machine rus for *x* years. To break even, the NPV of the machine must be zero.

$$\text{NPV} = -32{,}000 + \sum_{i=1}^{x} \frac{3000}{1.12^i} = 0$$

Cancel the zeroes. To find the answer on WolframAlpha, copy and paste the following expression,

```
32=Sum[3/1.12^i,{i,1,n}]
```

It provides the solution as $x \approx 11.2325 - 27.7211i$, which is not a real solution. This means no solutions exist. In other words, it will never become profitable.

We may look at the problem from another point of view. Suppose the machine is purchased by borrowing money at 12% interest rate, then the interest payments alone will be 0.12(32,000) = $3,840 per year. The $3,000 generated by the machine will never cover its cost. ♥

2.7. *Unknown cash flow*: Brunswick Corporation is interested in buying a machine that costs $10,000 and it will be depreciated along a straight line during its 5 year useful life. The tax rate of Brunswick is 30%, and its discount rate is 14%. Find the minimum annual earnings generated by this machine to justify its purchase.

The depreciation per year is $2,000. Suppose the required minimum earnings before taxes is *E*. Using (2.9), we find the cash flow as

$$C = E(1 - .3) + .3(2000) = .7\,E + 600$$

To break even,

$$\text{NPV} = 0 = -\,10{,}000 + \sum_{i=1}^{5} \frac{.7\,E + 600}{1.14^i}$$

Or,
$$10{,}000 = \frac{(.7\,E + 600)(1 - 1.14^{-5})}{.14}$$

Or,
$$1400 = .3364419349\,E + 288.3788013$$

Or,
$$E = \$3{,}304 ♥$$

To verify the answer on Maple, copy and paste the following instructions.

```
C:=x*(1-t)+t*Dep; Dep:=Io/n;
NPV:=-Io+sum(C/(1+r)^i,i=1..n);
subs(Io=10000,n=5,t=.3,r=.14,NPV);
solve(0=%,x);
```

To verify the answer on WolframAlpha, copy and paste the following expression,

```
0=-10000+Sum[(.7x+600)/1.14^i,{i,1,5}]
```

2.8. *Resale value*: Coburg Airlines plans to buy an airplane for $30 million, depreciate it on a straight line basis for 6 years, and then sell it for $12 million. The airplane will generate pre-tax earnings of $4 million annually. The income tax rate of Coburg is 30%, and the appropriate discount rate is 10%. Should the airline buy the plane?

We will assume that the airline chooses to depreciate the plane from its full value to its resale value, 30 − 12 = $18 million over 6 years. The depreciation per year is thus $3 million. The cash flow per year is, from (2.9),

$$C = 4*(1 - .3) + .3*3 = \$3.7 \text{ million.}$$

The company will sell the plane after 6 years creating $12 million in cash. There is no tax on this because the book value of the plane equals its sale price. We should include the present value of this $12 million in the calculation. Thus

$$\text{NPV} = -30 + \sum_{i=1}^{6} \frac{3.7}{1.1^i} + \frac{12}{1.1^6} = -\ \$7.1118 \text{ million}$$

The airline should not buy the plane. ♥

To verify the answer on WolframAlpha, copy and paste the following expression,

```
-30+Sum[3.7/1.1^i,{i,1,6}]+12/1.1^6
```

2.9. *Unknown initial investment*: Darmstadt Corporation wants to buy a machine that would save them $2,000 before taxes per year. This machine will last for 5 years and Darmstadt will depreciated it over that period with no resale value. The tax rate of the company is 30%, and the proper discount rate is 12%. Find the maximum price that Darmstadt should pay for this machine.

Suppose the purchase price of the machine is P, and the depreciation per year will be $P/5$. The relevant cash flow C, from (2.9), is:

$$C = 2000(1 - .3) + .3(P/5) = 1400 + .06P$$

Just to break even, the initial cost of the machine is equal to the present value of subsequent cash flows. This means,

$$P = \sum_{i=1}^{5} \frac{1400 + .06P}{1.12^i}$$

Or, $$P = \sum_{i=1}^{5} \frac{1400}{1.12^i} + P\sum_{i=1}^{5} \frac{.06}{1.12^i} = 5046.69 + .216287\,P$$

Or, $$P(1 - .216287) = 5046.69$$

Or, $$P = 6439.45$$

Thus Darmstadt Corporation should pay at most $6439 for this machine. ♥

To verify the answer on WolframAlpha, copy and paste the following expressions,

```
2000*(1-.3)+.3*x/5
x=Sum[(.06x+1400)/1.12^i,{i,1,5}]
```

The highlighted term in the second line is the result of the calculation of the first line.

2.10. *Useful life more than depreciable life*: Dortmund Corporation would like to buy a machine for $45,000. It will depreciate the machine over a 5-year period with no resale value. The machine, however, is expected to run for 7 years and generate $10,000 in pretax revenue annually. The income tax rate of Dortmund is 31%, and the proper discount rate is 11%. Should Dortmund buy the machine?

Let us first find the cash flows, using $C = E(1 - t) + tD$,

$C = 10{,}000(1 - .31) + .31*9000 = 9690$, for the first five years.

$C = 10{,}000(1 - .31) = 6900$, for sixth and seventh year. The machine is fully depreciated, and the tax benefit of depreciation is no longer available. Considering the present values,

$$\text{NPV} = -\,45{,}000 + \sum_{i=1}^{5} \frac{9690}{1.11^i} + \frac{6900}{1.11^6} + \frac{6900}{1.11^7} = -\,\$2174.29, \text{ no.}$$ ♥

To verify the answer on WolframAlpha, copy and paste the following expression,

```
-45000+Sum[9690/1.11^i,{i,1,5}]+6900/1.11^6+6900/1.11^7
```

2.11. *Resale value*: Dresden Company wants to buy a machine for $40,000, depreciate it fully in four years using straight line method, and then sell it for $5,000. The income tax rate of the company is 30%, and the appropriate discount rate is 12%. The expected annual pretax earnings from the machine is $11,000. Should Dresden buy the machine?

We can also set the problem up as follows:

$$C = E(1 - t) + tD = 11{,}000(1 - .3) + .3(10{,}000) = \$10{,}700$$

Since the machine is fully depreciated, its sales value, $5000, is fully taxable.

$$\text{NPV} = -\,40{,}000 + \sum_{i=1}^{4} \frac{10{,}700}{1.12^i} + \frac{5000(1-.3)}{1.12^4} = -\,\$5276.05, \text{ reject. } \heartsuit$$

To verify the answer on WolframAlpha, copy and paste the following expression,

```
-40000+Sum[10700/1.12^i,{i,1,4}]+5000*(1-.3)/1.12^4
```

In an older textbook of finance, you may see the following approach to the above problem. The discount factors are available in a table.

Year	Income (expense) 1	Depre-ciation 2	Taxable income 3 = 1 – 2	Income taxes 4 = .3*3	After-tax income 5 = 3 – 4	Add back depreciation 6 = 5 + 2	Discount factor 7	Present value 8 = 7*6
0	(40,000)	0	0	0	0	0	0	(40,000)
1	11,000	10,000	1000	300	700	10,700	.8929	9553.57
2	11,000	10,000	1000	300	700	10,700	.7972	8529.97
3	11,000	10,000	1000	300	700	10,700	.7118	7616.05
4	11,000	10,000	1000	300	700	10,700	.6355	6800.04
4	5,000	0	5,000	1500	3500	3500	.6355	2224.31

$$\text{NPV} = -\,40{,}000 + 9553.57 + 8529.97 + 7616.05 + 6800.04 + 2224.31 = -\,\$5{,}276.06$$

The negative NPV makes the project unacceptable.

It is quite apparent that our current approach to the capital begetting problems is efficient, convenient, and accurate.

Key terms

After-tax cash flow, 20
Net present value, 19
Present value, 18
Risk-adjusted discount rate, 18

Problems

2.12. Koblenz Company 6.125% bonds will mature on January 15, 2013. On January 15, 2008, they were priced as 105.874. The income tax rate of Koblenz is 32%. Calculate the pretax and after-tax cost of debt for Koblenz. 4.809%, 3.270% ♥

2.13. Leipzig Corporation stock is trading at $45 a share while its price has been rising steadily at 4% annually. Leipzig has just paid its annual dividend of $4. Find the cost of equity for Leipzig. 13.24% ♥

2.14. Luneburg Company has debt/assets ratio of .45, its WACC is 10%, and its cost of equity is 14%. If the tax rate of Luneburg is 30%, find its cost of debt. 7.3% ♥

2.15. Mainz Corporation has 2 million shares of common stock priced at $25 per share and its 3% coupon bonds have a face value of $40 million. The bonds will mature in 10 years and currently they sell at 60. The tax rate of Mainz is 25%. Find its *WACC*. The cost of equity to Mainz is 15%. 12.26% ♥

2.16. Marburg Corporation has *WACC* 10%, tax rate 30%, cost of debt 9% and cost of equity 12%. The total debt of Marburg is $10 million. Find the value of the stock of Marburg Corporation. $18.5 million ♥

2.17. Potsdam Co has 3 million shares of common stock, each selling for $30. The debt of Potsdam is in the form of bonds with face value $60 million and coupon 5%. The bonds are selling at 70, and they will mature after 10 years. The tax rate of Potsdam is 30%, and its *WACC* is 10%. Find the cost of equity for Potsdam. 11.59% ♥

2.18. *Uneven cash flows*: Düsseldorf Company wants to invest in a project that requires an initial outlay of $12,000, and gives a return of $1,000 annually for years 1-5 and then $2,000 annually for years 6-10. Is this project acceptable if the proper discount rate is 12%? NPV = − $4,304, no. ♥

2.19. *Uneven cash flows*: Emden Company wants to undertake a project that requires an investment of $400 now, and another expense of $500 at the end of the first year. The riskless discount rate is 5%. The project gives cash inflows of $300 at the end of year 3, $400 at the end of year 4, and $800 at the end of year 5. The required rate of return for Emden is 11%. Is the project acceptable? Hint: Discount the second expense, $500, at the rate of 5%. NPV = $81.42, yes. ♥

2.20. *Uneven cash flows*: Erfurt Company is interested in a project that costs $40,000, which will run for 10 years. The cash flow from the project for the first five years is $6000 annually and for the next five years $5000 annually. The discount rate for the project is 11%. Should Erfurt accept the project? No, NPV = − $6858 ♥

2.21. *Depreciation and taxes*: Erlangen Corporation needs a new machine that will cost $50,000. It will run for 5 years and the firm will depreciate it on a straight line basis, with no resale value. The machine will add $14,000 annually to Erlangen's earnings before taxes. The proper discount rate is 12% and the tax rate is 32%. Should Erlangen install the machine? NPV = −$4147, no ♥

2.22. *Depreciation and taxes*: Essen Corporation is planning to buy a machine for $50,000 and depreciate it over its useful life of 5 years. While the machine is running, its pretax revenue is expected to be $17,000 annually. The income tax rate of Essen is 30%, and the discount rate for this investment is 12%. Should Essen buy the machine?

Yes, NPV = $3711 ♥

2.23. *After-tax cash flows*: Frankfurt Company has the opportunity to invest $10,000 in a project that will generate after-tax return of $2,880 annually for the next ten years. Frankfurt's after-tax required rate of return is 15%. Should Frankfurt make the investment? NPV = $4454, yes ♥

2.24. *Resale value*: Freiburg Company wants to buy a machine that has expected life of 6 years. It costs $30,000, and increases the income of the company by $7,000 annually. It has a salvage value of $5,000. The proper discount rate is 12%, and the company pays no taxes at present. Should Freiburg purchase this machine? NPV = $1,313, yes. ♥

2.25. *Resale value*: Fulda Hospital is tax exempt. It would like to install a new computer costing $232,000 with a useful life of 8 years. The hospital plans to sell the computer for $20,000 after 5 years. The proper discount rate to the hospital is 9%. Find the minimum annual savings due to this computer to justify its purchase. $56,304 ♥

2.26. *Uncertain life*: Fürth Hospital is planning to buy an x-ray machine whose total useful life is 4 years. However, there is a 25% chance that it may break down completely after 3 years. The machine will save $4,500 annually, and it will cost $11,000. The hospital is a tax-exempt entity, and it uses a discount rate of 7% for this investment. Should Fürth Hospital buy the machine? NPV = $3,384, buy ♥

2.27. *Useful life more than depreciable life*: Gera Corporation is planning to install a new computer that will cost $25,000. The computer will increase the pre-tax earnings of the company by $6,000. The computer will become obsolete after 5 years (probability 30%) or after 6 years (probability 70%). Gera will depreciate the computer over five years. The tax rate of Gera is 30%, and the proper discount rate is 12%. Should Gera buy the computer? No, NPV = − $2963 ♥

2.28. *Unknown cash flow*: Giessen Corporation has income tax rate of 32% and it uses a discount rate of 9%. Giessen plans to buy a machine for $53,000, and depreciate it on a straight-line basis for 6 years with no salvage value. What is the minimum annual pretax income generated by this machine per year to justify its purchase? $13,218 ♥

2.29. *Resale value*: Görlitz Company needs a new machine that costs $40,000. It will sell the machine for $4000 after 4 years. The machine will add $13,000 annually to the EBIT (earnings before interest and taxes) of the company. The tax rate of Görlitz is 35% and it uses straight line depreciation. The risk-adjusted discount rate is 9%. Find if Görlitz should buy the machine under these assumptions:

(a) The company depreciates the machine fully in 4 years. NPV = $556.56, yes. ♥
(b) It depreciates the machine to its resale value in 4 years. NPV = $414.45, yes. ♥

2.30. *Useful life more than depreciable life*: Göttingen Co. needs a new machine that costs $120,000, which may run for 3 years (probability 35%) or 4 years (probability 65%). The firm will depreciate the machine completely over a 3-year period. The machine should produce an income of $40,000 a year while it is running. The tax rate of

Göttingen is 33% and the proper discount rate is 12%. Should Göttingen buy the machine? No, NPV = −$12,856 ♥

2.31. *Useful life more than depreciable life*: Hamburg Company needs a new machine that costs $50,000 with a useful life of 6 years with no resale value. The company will depreciate the machine fully in 5 years using straight-line method. The machine will generate $16,000 in pretax revenue annually. The discount rate is 11% and its income tax rate 30%. Should Hamburg buy the machine? Yes, NPV = $8470 ♥

2.32. *Unknown initial investment*: Hanover Corporation wants to buy a machine that would save them $2,000 before taxes per year. This machine would last for 5 years. The company uses straight-line depreciation. The tax rate of Hanover is 30%, and the proper discount rate is 12%. Find the maximum price that Hanover should pay for this machine. $6439 ♥

2.33. *Unknown initial investment*: Heidelberg University, a tax-exempt institution, needs a new computer that will produce annual savings of $13,000 for the next 10 years. Using a discount rate of 7%, find the breakeven price for the computer. $91,307 ♥

2.34. *Useful life more than depreciable life*: Heilbronn Corporation needs a machine that costs $40,000. The company will depreciate the machine fully over 4 years. The machine, however, has a useful life of 5 years during which it will generate $10,000 annually in pretax revenue. The discount rate for the investment is 11%, and Heilbronn's income tax rate 30%. Should Heilbronn buy the machine? No, NPV = −$4821 ♥

2.35. *Depreciation and taxes*: Jena Corporation needs a new computer that costs $75,000. Jena will depreciate it along a straight line over 5 years. There is no resale value. The computer will save the company $20,000 annually. The discount rate for this computer is 11%. The income tax rate is 32%. Should Jena buy the computer? No, NPV = −$6995 ♥

2.36. *Unknown cash flow*: Kassel Company plans to buy a machine that will cost $65,000. Kassel will depreciate it over 6 years to a resale value of $5,000. (Total depreciation available is $60,000.) The tax rate of the company is 28% and the discount rate is 12%. Calculate the minimum earnings before taxes per year generated by this machine to justify its purchase. $17,213 ♥

2.37. *Depreciation and taxes*: Kiel Corporation is considering the purchase of a machine whose initial cost is $10,000. Kiel will depreciate it on a straight-line basis over 5 years with no resale value. The pre-tax income from the machine will be $3600 per year. The tax rate of the company is 35%, and it uses 12% discount rate for this investment. Should Kiel buy the machine? Yes, NPV = $959 ♥