

Chapter 2: Corporate Finance Models

2.1) Basic Financial Calculations

This chapter covers

- Net present value (NPV)
 - Internal rate of return (IRR)
 - Payment schedules and loan tables
 - Future value
- ❑ Almost all financial problems center on finding the present values of future cash flows.

- ❖ The *present value* of a cash flow anticipated to be received at time t (CF_t) is:

$$PV = \sum \frac{CF_t}{(1 + r)^t}$$

- ❖ The numerator of this expression is usually understood to be the *expected time- t cash flow*, and the discount rate r in the denominator is adjusted for the riskiness of this expected cash flow—the higher the risk, the higher the discount rate.

- ❖ The basic concept in present-value calculations is the concept of *opportunity cost*. Opportunity cost is the return that would be required of an investment to make it a viable alternative to other, similar, investments. In the financial literature there are many synonyms for opportunity cost, among them discount rate, cost of capital, and interest rate.
- ❖ When the opportunity cost is applied to risky cash flows, we will sometimes call it the risk-adjusted discount rate (RADR) or the weighted average cost

Example

- ❖ Suppose we are valuing an investment that promises \$100 per year at the end of this and the next four years. We suppose that there is no doubt that this series of five payments of \$100 each will actually be paid. If a bank pays an annual interest rate of 10 percent on a five-year deposit, then this 10 percent is the investment's opportunity cost, the alternative benchmark return to which we want to compare the investment. We may calculate the value of the investment by discounting its cash flows using this opportunity cost as a discount rate.

- ❖ In standard finance terminology, the present value of a series of cash flows is the value today of the cash flows starting in year 1:

$$\text{Present value} = \sum \frac{\text{CF}}{(1+i)^t}$$

$$\text{PV} = 100/(1+0.1)^1 + 100/(1+0.1)^2 + 100/(1+0.1)^3 + 100/(1+0.1)^4 + 100/(1+0.1)^5 = \underline{379.08}$$

- ❖ The *present value*, 379.08, is the *value today* of the investment.

Net Present Value

- ❖ Net present value (NPV) is the difference between the present value of cash inflows and the present value of cash outflows over a period of time.
- ❖ NPV is used in capital budgeting and investment planning to analyze the profitability of a projected investment or project.
- Capital budgeting is the process of allocating resources to capital projects and investments. Capital Budgeting is defined as the process by which a business determines which fixed asset purchases or project investments are acceptable and which are not.

Net Present Value (NPV) Formula

If there's one cash flow from a project that will be paid one year from now, then the calculation for the NPV of the project is as follows:

$$NPV = \sum \frac{\text{Cash flow}}{(1+i)^t} - \text{initial investment}$$

where: i = Required return or discount rate
 t = Number of time periods

Example

- Suppose, for example, that the series of five cash flows of \$100 in previous example is sold for \$250. What is the NPV of five years constant cash flows of \$100?

NPV=

$$100/(1+0.1)^1 + 100/(1+0.1)^2 + 100/(1+0.1)^3 + 100/(1+0.1)^4 + 100/(1+0.1)^5 - 250$$

$$\text{NPV} = 129.08.$$

Present Value of an Annuity—Some Useful Formulas

- An *annuity* is a security that pays a constant sum in each period in the future. Annuities may have a finite or infinite series of payments.
- If the annuity is finite and the appropriate discount rate is r , then the value today of the annuity is its present value:

$$\text{PV of finite annuity} = C \frac{1 - (1 + r)^{-n}}{r}$$

- ❖ If the annuity promises an infinite series of constant future payments, then formula is:

$$\text{PV of infinite annuity} = C/r$$

where C represents Periodic payment and r represents discount rate.

Example: Compute the value of an infinite annuity If Periodic payment, C= \$1,000 and Discount rate, r= 12%

$$\text{PVA(infinite)} = \underline{8,333.33}$$

- ❖ A *growing annuity* pays out a sum C that grows at a periodic growth rate g . If the annuity is finite, its value today is given by:

$$\text{PV of finite growing annuity} = \frac{C}{(1+r)} + \frac{C(1+g)}{(1+r)^2} + \frac{C(1+g)^2}{(1+r)^3} + \dots$$

$$\text{Or PV of finite growing annuity} = \frac{C(1-(1+g/1+r)^n)}{r-g}$$

Examples

④ Computing the value of a growing finite annuity

If the first payment, C is \$1,000, growth rate of payments, g is 6%, number of future periods paid, n is 5 years and discount rate, r is 12%

Using the formula, Present value of annuity becomes 4,010.91.

PV of infinite growing annuity

- We can also compute the value of an *infinite growing annuity* using the following formula:

PV of infinite growing annuity = $C/(r-g)$

E.g. Calculate the value of a growing infinite annuity, given periodic payment, $C = \$1,000$, growth rate of payments, g is 6% and discount rate, r is 12%. Therefore, the present value of infinite growing annuity will be **16,666.67.**

Internal Rate of Return and Loan Tables

- *The Internal Rate of Return (IRR) is the discount rate that makes the net present value (NPV) of a project zero. In other words, It is the rate of return that equates the initial cash investment for the beginning period to the present value of the future [cash flows](#) of that investment.*
- Calculating the internal rate of return can be done in three ways:
 1. Using the IRR or XIRR function in Excel or other spreadsheet programs
 2. Using a financial calculator
 3. Using an iterative process where the analyst tries different discount rates until the NPV equals zero .

The IRR formula is as follows:

$$0 = CF_0 + \frac{CF_1}{(1 + IRR)} + \frac{CF_2}{(1 + IRR)^2} + \frac{CF_3}{(1 + IRR)^3} + \dots + \frac{CF_n}{(1 + IRR)^n}$$

Or

$$0 = NPV = \sum_{n=0}^N \frac{CF_n}{(1 + IRR)^n}$$

Where:

CF_0 = Initial Investment / Outlay

$CF_1, CF_2, CF_3 \dots CF_n$ = Cash flows

n = Each Period

N = Holding Period

NPV = Net Present Value

IRR = Internal Rate of Return

Practical Example

- ✚ A company is deciding whether to purchase new equipment that costs \$500,000. Management estimates the life of the new asset to be four years and expects it to generate an additional \$160,000 of annual profits. In the fifth year, the company plans to sell the equipment for its salvage value of \$50,000.
- ✚ Meanwhile, another similar investment option can generate a 10% return. This is higher than the company's current hurdle rate of 8%. The goal is to make sure the company is making the best use of its cash.
- To make a decision, the IRR for investing in the new equipment is calculated below.
- Excel was used to calculate the IRR of 13%, using the function, $=IRR()$. From a financial standpoint, the company should make the purchase because the IRR is both greater than the hurdle rate and the IRR for the alternative investment.

Year	Cash Flows	PV of Cash Flows
0	-\$500,000	-\$500,000
1	\$160,000	\$141,247
2	\$160,000	\$124,692
3	\$160,000	\$110,077
4	\$160,000	\$97,176
5	\$50,000	\$26,808

NPV	0
IRR	13%