FINANCE: TIME VALUE OF MONEY

Present Value and Future Value

Time value of money: Money in the present is worth more than the same amount of money in the future.

Present value: The value of a sum of money today.

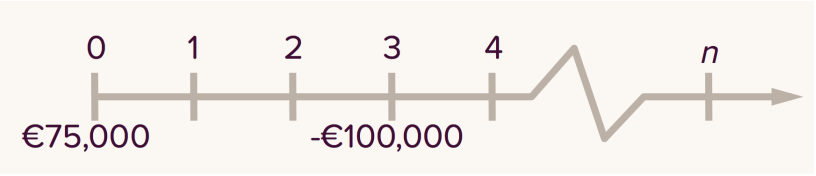
Present value calculations move money *backwards* in time.

Future value: The value of a sum of money at a specific time in the future.

Future value calculations move money *forwards* in time.

The Timeline

Timeline: A tool used for visualizing a time value of money scenario.



The periods of a timeline must always be equal.

Inflows of cash are *positive* numbers and outflows of cash are *negative* numbers.

Compounding and Discounting

Compounding is the process used to move money forward in time:

- Increases the value of a sum of money
- Involves multiplication
- Calculates future value

Discounting is the process used to move money backward in time:

- Decreases the value of a sum of money
- Involves division
- Calculates present value

The formula for compounding a cash flow over n years:

$$FV_n = C_0 \times (1 + r)^n$$

Formula for discounting a cash flow over n years:

$$PV = \frac{C_n}{(1 + r)^n}$$

C : cash flow
n : time
r : return earned (in decimal form)

Net Present Value

Net present value (NPV): The difference between the present value of all benefits and present value of all costs of a particular investment.

Benefits are represented by *cash inflows* (positive).

Costs are represented by *cash outflows* (negative).

Net present value is represented by this equation:

NPV = PV(benefits) – PV(costs)

A positive NPV (inflows > outflows) is an indication that a firm should invest in a project.

Moving Money Over Time

To compare or combine cash flows, they must be moved forward or backward to *the same point in time*.

The following images demonstrate how to use present and future values with multiple cash flows.

Present Value:

$$\text{PV} = \frac{€12{,}000}{(1+r)^0} + \frac{€12{,}000}{(1+r)^1} + \frac{€12{,}000}{(1+r)^2} + \cdots + \frac{€12{,}000}{(1+r)^9}$$

Future Value:

$$\text{FV}_6 = €2{,}000 \times (1+r)^0 + €2{,}000 \times (1+r)^1 + \cdots + €2{,}000 \times (1+r)^6$$

Present and future values of multiple cash flows can be calculated with the following formulas:

$$\text{PV} = \sum_{n=0}^{N} \frac{C_n}{(1+r)^n}$$

$$\text{FV}_N = \sum_{n=0}^{N} C_n \times (1+r)^n$$