

# A Note on Net Present Values and Internal Rates of Return

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## Net present values

An investment is a business decision in which you expend some money now expecting to get some cash flows in the future. For instance, your company may consider expending now 100 million euros in building a facility and buying some machines to manufacture and sell a specific new product. You expect to obtain every year a cash flow of 25 million euros each of the next 6 years. The yearly cash flows associated with this opportunity are:

$$(-100, 25, 25, 25, 25, 25, 25)$$

To decide if this particular investment is a good opportunity, you have to add up all the cash flows involved in the investment. One should recognize that these cash flows cannot be added arithmetically, since everybody will agree that 25 million euros to be received one year from now have a smaller present value than 25 million euros received today, and the present value of 25 million euros to be received 6 years from now is even smaller.

To add cash flows that are spread over time one has to determine a rate for converting money of one year from now into present money.

In the same way that to sum 100 dollars and 100 euros you need an exchange rate that gives the equivalence between dollars and euros (say, 1 dollar = 1.1 euros), to sum money received at different dates you need a rate of conversion of money. Let us assume that 100 present euros are equivalent to 110 euros of one year from now. In this case we say that the annual conversion rate of money is 10%. This annual conversion rate is called discount rate. The way a company determines its discount rate is a complex issue that falls outside the scope of this note.

With a 10% discount rate, 25 million euros received in one year from now have a present value of:

$$\frac{25}{1.1} = 22.72$$

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25 million euros received in two years from now have a present value of:

$$\frac{25}{1.1^2} = 20.66$$

and so on: 25 million euros received 6 years from now have a present value of:

$$\frac{25}{1.1^6} = 14.11$$

Now we are in a position to evaluate the investment proposed above. The sum of all the cash flows, taking into account the timing of the flows, is:

$$-100 + \frac{25}{1.1} + \frac{25}{1.1^2} + \frac{25}{1.1^3} + \frac{25}{1.1^4} + \frac{25}{1.1^5} + \frac{25}{1.1^6} = 8.8$$

This amount of 8.88 million euros is what we call the net present value (NPV) of the investment at a discount rate of 10%:

$$NPV_{10\%} = 8.88 \text{ million euros.}$$

In general, if an investment has cash flows:

$$(F_0, F_1, \dots, F_T)$$

at years  $t = 0, t = 1, \dots, t = T$  (Typically, although not necessarily,  $F_0$  will be negative and  $F_1, \dots, F_T$  positive), the net present value of this investment at a discount rate  $r$  is:

$$NPV_r = F_0 + \frac{F_1}{1+r} + \frac{F_2}{(1+r)^2} + \frac{F_3}{(1+r)^3} + \dots + \frac{F_T}{(1+r)^T}$$

A positive net present value in an investment means that the sum, in present terms, of all the cash flows associated with the investment is positive and therefore the investment should be undertaken. A net present value of 8.88 million euros in an investment means – broadly speaking – that undertaking the investment makes you 8.88 million euros richer in present value terms (but you should not forget that this increase in your wealth will take place over the next 6 years, not now. The total value of the increment of wealth in the next 6 years in present money is 8.88 million euros).

Similarly, a negative net present value in an investment indicates that the investment should not be undertaken, otherwise you would be poorer in present terms.

Decision rule

If  $NPV_r > 0$  Take the project  
If  $NPV_r < 0$  Reject the project



## Excel calculations

To calculate in a Microsoft Excel spreadsheet the net present value of the previous investment, the following steps should be taken:

In cell A1 write 0.1 (depending on your computer you should write 0,1 or 0.1, that is, point or comma)

In cell A3 write -100

In cells A4 through A9 write 25

In cell A11 write = NPV(A1,A4:A9)+A3

Like in the following figure:

	A	B	C
1	0.1		
2			
3	-100		
4	25		
5	25		
6	25		
7	25		
8	25		
9	25		
10			
11	=npv(A1,A4:A9)+A3		
12			
13			

In cell A11 you get the net present value of the investment at a 10% discount rate. Your spreadsheet should look like this:

	A	B	C
1	0.1		
2			
3	-100		
4	25		
5	25		
6	25		
7	25		
8	25		
9	25		
10			
11	8.88		
12			
13			