# Case and group work of Chapter 6, “Why net present value leads to better investment decisions than other criteria”

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## Case 1

### Refurbishment of an apartment in Halmstad.

The property “Domherren 36” in Halmstad underwent a major refurbishment in 1985. At that time everything in the apartments was renovated, but as time goes by you need to perform a new renovation in not so distant future. Instead of doing the whole building once again, one apartment at a time will be done. All the pipes and water drains are in good condition so it is enough to just do the surfaces. Currently you have just made an inspection in a cancelled apartment, this leaves you having three different alternatives for level of refurbishment.

1. A comprehensive refurbishment to the bathroom and kitchen. The walls will be repainted and a change of the floors to parquet flooring. This refurbishment costs 10,000€ and you will be able to increase the rent by 1,400€ per year.

2. The same as alternative 1 with the exception of changing anything in the kitchen, only the cabinet doors will just be repainted. It is still possible to increase the rent but just for 750€ per year. On the other hand it will only cost you 5,000€ in renovation costs.

3. The whole apartment will be repainted and the floors changed. Other equipment will also be changed if necessary, but just to the same standard. It will cost 1,600€ and increase the rent by 100€.

The life expectancy is estimated 15 years. The discount rate, opportunity cost of capital, is assessed to 8 percent.

Which alternative is the most favourable?

## Questions/Tasks

1. Please calculate the payback time for each alternative. Which one has the shortest payback period?
2. Please calculate the net present value for each alternative. Which alternative should be used according to the net present value rule?
3. Please calculate the IRR for each alternative. Which alternative should be chosen according to this method?

## Answers in Short

1. Alt. 1) 7.14 years, **Alt. 2) 6.67 years**, Alt. 3) 16 years
2. **Alt. 1) NPV = 1983€,** Alt. 2) NPV = 1420€, Alt. 3) NPV= -744€
3. Alt. 1) 11.1%, **Alt. 2) 12.4%,** Alt.3) -0.8%

## Answers with Explanations

## Question/Task 1 – The payback rule

The payback rule is easy to calculate and easy to understand. In general it tells us if we get our money back and during which time period. The payback period of a project is calculated by counting the number of years it takes before the forecasted cash flow equals the initial investment.

$$t = \frac{C_0}{C_t}$$

Alt. 1) $$t = \frac{10000}{1400} = 7.14$$

Alt. 2) $$t = \frac{5000}{750} = 6.67$$

Alt. 3) $t = \frac{1600}{100} = 16$

Since we had a life expectancy of 15 years, alternatives 1 and 2 will do. Number 2 is the one you should consider to invest in.

## Question/Task 2 – The Net present value rule

The ordinary formula for calculating the Net present value is:

Net present value (*NPV)* = $C_0 + PV = C_0 + \frac{C_1}{1+r_1} + \frac{C_2}{(1+r_2)^2} + \ldots..$

Since this is an annuity we can use the shortcut formula:

$$NPV = C_0 + \frac{C_1}{r} - \frac{C_1}{r(1+r)t}$$

$$NPV_{Alt1} = -10000 + \frac{1400}{0{,}08} - \frac{1400}{0{,}08(1{,}08)^{15}} = 1983$$

$$NPV_{Alt2} = -5000 + \frac{750}{0{,}08} - \frac{750}{0{,}08(1{,}08)^{15}} = 1419$$

$$NPV_{Alt3} = -1600 + \frac{100}{0{,}08} - \frac{100}{0{,}08(1{,}08)^{15}} = -744$$

One of the basic principals of finance is that *a Euro today is worth more than a Euro tomorrow*. That is because the Euro today can be invested and start earning interest immediately. This is *the time value of money*. The net present value rule is the only method which recognizes that statement.

The conclusion of the formula is that all investments whose net present value is:

- Zero, makes the same return as alternative investments
- Larger than zero, increases the capital of an investment
- Less than zero, makes a worse return than the alternative investment and may not recover the initial expenditure

Therefore the investment with a higher net present value, alternative 1, is the one you find most favourable.

## Question/Task 3 – The Internal rate of return rule

The conclusion of the IRR rule is, to invest in projects whose rate of return exceeds the opportunity costs of capital. In general

most financial managers' use excel to solve the equation. Otherwise you can always try the trial and error method but the easiest way without a computer is to plot at least four points of NPV and discount rate on a graph. Connect the points with a smooth line and read off the discount rate at which NPV = 0.

The IRR formula:

$$NPV = C_0 + \frac{C_1}{1+IRR} + \frac{C_2}{(1+IRR)^2} + .. + \frac{C_T}{(1+IRR)^T} = 0$$

Rearranged for annuity:

$$NPV = C_0 + \frac{C_1}{IRR} - \frac{C_1}{IRR(1+IRR)^t} = 0$$

Alternative. 1) 11.1%
**Alternative. 2) 12.4%**
Alternative. 3) -1%

As we can see there is a difference between the methods. However, alternative number 3 goes right into the trashcan.

# Case 2 – group work

In this next case we will use the same apartment as before but with different prerequisites.

## Question/Task A

Suppose your new tenant wants to pay off the investment in four years and to cover your costs they are prepared to pay as follows:

$C_1$ = 5000
$C_2$ = 4000
$C_3$ = 3000
$C_4$ = 2000

We have outlays of 10,000€ so we will get our money back.

Please calculate NPV, IRR and payback-time and compare them with case 1.

## Question/Task B

Since a major facelift of the kitchen was not done, it will be necessary to do another refurbishment after 15 years. You estimate the costs to 3,000€ at the end of year 15.
Please calculate the NPV and the IRR of the project. Do these two methods give us the same answer?

## Bonus case

To checkout whether the payback rule is trustworthy or not you should do an easy calculation. Please fill in the empty spaces below.

| | Investment | **Cash Flow (million €)** | | | Payback | | Interest |
|---|---|---|---|---|---|---|---|
| Project | $C_0$ | $C_1$ | $C_2$ | $C_3$ | period | NPV | Rate |
| C | -500 | 300 | 150 | 150 | ? | ? | 10% |
| D | -500 | 150 | 300 | 150 | ? | ? | 10% |

## Answers in Short

**A.** NPV=1911€, IRR=17.8%, 3 years
**B.** NPV=237€, IRR = 9.1 % and -17.7%
**Bonus case.** C) 3 years, NPV 9.4 D) 3 years, NPV -3

## Answers with Explanations

**A.**

$$NPV = -10000 + \frac{5000}{1+8\%} + \frac{4000}{(1+8\%)^2} + \frac{3000}{(1+8\%)^3} + \frac{2000}{(1+8\%)^4} = 1911$$

Using the trial and error method we will estimate the IRR to 17.8%

The payback period is less than 3 years

The conclusion of this case is, that if we choose to follow IRR it will lead us to a good short term investment; however, in the long run it will not be a good decision. The payback rule would lead us to the same conclusion. This project shows us that the IRR is greater than in case 1, but its' NPV is lower.

**B.**

NPV:

$$NPV = -5000 + \frac{750}{1+0{,}08} + \frac{750}{(1+0{,}08)^2} + .. - \frac{3000}{(1+0{,}08)^{15}} = 237$$

IRR:
Once again we use the trial and error method to find the IRR for the project. In the first calculation the IRR is calculated to 9.1 % which exceeds the opportunity cost of capital. If we try once again, with a negative IRR, we will eventually discover that -17. 7% also equals the NPV=0. This confuses us as to which IRR should be chosen? This never happens using the NPV-rule.

**Bonus case.**

There are two important things to be considered about the payback rule:
*The payback rule ignores all cash flows after the cut off period.*
Comparing the first example above, the NPV is lower although the Payback time is extremely short.
*The payback rule gives equal weight to all cash flows before the cut off date.*
Two different projects that repay at the same number of years are not necessarily equally attractive to the investor.

| | Investment | **Cash Flow (million €)** | | | Payback | | Interest |
|---|---|---|---|---|---|---|---|
| Project | $C_0$ | $C_1$ | $C_2$ | $C_3$ | period | NPV | Rate |
| A | -500 | 300 | 150 | 150 | 3 | 9.4 | 10% |
| B | -500 | 150 | 300 | 150 | 3 | -3.0 | 10% |

$$NPV_A = -500 + \frac{300}{1+0{,}1} + \frac{150}{(1+0{,}1)^2} + \frac{150}{(1+0{,}1)^3} = 9.4$$

$$NPV_B = -500 + \frac{150}{1+0{,}1} + \frac{300}{(1+0{,}1)^2} + \frac{150}{(1+0{,}1)^3} = -3.0$$

## The Remedy/Conclusion

Use the NPV-rule in all cases when you are about to make an investment decision.