

Part of the process of deciding which project to undertake (among many) is leveraging two calculation methods widely used in Finance today. First, we will cover Net Present Value (NPV) and then Internal Rate of Return (IRR).

## Net Present Value

NPV provides an indication to the wealth that is going to be created by the project in question. The final result is derived by: calculating the present value of cash flows, discounting this amount by the hurdle rate, and then subtracting the initial investment (cost) to attain the final result. If the result is positive, then we should proceed with the project. If the result is negative, then we should not move forward.

A word of caution is in order as NPV's hurdle rate is only an estimate therefore there may be uncertainty in NPV and, therefore, your decision to choose this project. Further, large-scale projects normally have NPV's very different from smaller project's NPV's. If you use NPV, the scale of the project must be considered.

## Net Present Value Example

Two projects are being considered – Project A and Project B. Below are the estimated cash flows for each project. Note that Year 0 is the year that the project is undertaken and there are costs realized to execute this project. That's why there is a negative value here. Subsequent years will have the cash flows as a direct result of implementing the project. This is the income to the organization that the project realizes.

Year	Project A	Project B
0 - 2020	-\$100	-\$100
1 - 2021	\$50	\$40
2 - 2022	\$50	\$40
3 - 2023	\$50	\$60

We will assume that the required rate of return is 10% which represents the percentage of return expected by executive management.

Now we will decide which project is better to undertake. We'll first start with Project A.

The formula to discover present values is:  $PV = PMT/(1+i)^n$

PV = Present Value

PMT = Payment

i = Expected rate of return

n = Number of years from time of payment (year 0)

The NPV for Project A can be written as:

$$NPV = \$50/1.1 + \$50/(1.1)^2 + \$50/(1.1)^3 - \$100 = \$24.34.$$

In regards to project B, the NPV formula can be written as:

$$NPV = \$40/1.1 + \$40/(1.1)^2 + \$60/(1.1)^3 - \$100 = \$14.50$$

If both of these projects were part of the same program, then both projects can be undertaken as they both provide positive value to the organization. However, if you only could choose 1 project then you'd select project A because it provides more value.

#### Use MS Excel to Calculate NPV

There is another way to calculate NPV without needing to use mathematical formulas or leveraging an HP-12C Finance calculator. You can use MS Excel which I will now detail below.

The first thing to do is to set up your Excel sheet as shown below:

H5								=NPV(\$A\$1, C5:G5) + B5	
	A	B	C	D	E	F	G	H	
1	10%	Expected Rate of Return							
2									
3	Project A								
4	Period	2020	2021	2022	2023	2024	2025	NPV	
5	Cash Flow	\$ (100)	\$ 50	\$ 50	\$ 50	\$ -	\$ -	\$24.34	
6									
7	Project B								
8	Period	2020	2021	2022	2023	2024	2025	NPV	
9	Cash Flow	\$ (100)	\$ 40	\$ 40	\$ 60	\$ -	\$ -	\$14.50	

There is an NPV formula in Excel that is highlighted in cell H5. The first argument in this function is \$A\$1 which represents the expected rate of return. This is an absolute reference because we can list multiple projects underneath and leverage this same percentage for each project without typing the expected rate of return over and over. Another benefit is that, if we change the expected rate of return, we can instantly see the effect on the NPV of the projects we're evaluating.

The range C5:G5 represents the cash flows ONLY and not the original expense of undertaking the project.

Cell B5 represents the cost of undertaking the project in "Year 0." Make sure that you enter a negative number in cell B5 as this is an outflow for the project. Taking a look at the NPV formula, you'll notice that you're adding cell B5 instead of subtracting it as in the mathematical formula listed at the top of page 2. In MS Excel we use the add operator since the value you're entering in cell B5 is negative.

If you're interested in learning more about MS Excel, please be on the lookout for one of my future courses – "MS Excel for Project Managers."

## Internal Rate of Return

The Internal Rate of Return (IRR) evaluates the cost of a project. It is the rate of return at which the present value of a project's cash outflows and the present value of project's cash inflows are equal (NPV is equal to 0). If the IRR is greater than the expected rate of return then the project should be accepted as this project will earn more benefit to the organization.

### Use MS Excel to calculate IRR

For example, we'll start by leveraging our original project's cash flows...

Year	Project A	Project B
0 - 2020	-\$100	-\$100
1 - 2021	\$50	\$40
2 - 2022	\$50	\$40
3 - 2023	\$50	\$60

From the above statistics, we'll construct our MS Excel spreadsheet as below...

	A	B	C	D	E	F	G	H	I
1	10%	Expected Rate of Return							
2									
3	Project A								
4	Period	2020	2021	2022	2023	2024	2025	2026	IRR
5	Cash Flow	\$ (100)	\$ 50	\$ 50	\$ 50	\$ -	\$ -	\$ -	23.38%
6									
7	Project B								
8	Period	2020	2021	2022	2023	2024	2025	2026	IRR
9	Cash Flow	\$ (100)	\$ 40	\$ 40	\$ 60	\$ -	\$ -		17.50%

If you look at the IRR formula in cell I5, you will notice that the expected rate of return (cell A1) is not leveraged. However, we still want to see the expected rate of return on this sheet as a comparison point with our calculated IRR's in cells I5 and I9.

The IRR formula just leverages the IRR function and the range of values that represent the project's cash flows (cells B5 through H5 and cells B9 through H9).

Since the IRR of both projects are above the 10% expected rate of return threshold, both projects are acceptable to undertake. If you only had one choice of project to choose from, you'd select Project A. This leads us to the below consideration for using IRR.

#### Pitfall of using IRR

A pitfall of using IRR is that it does not distinguish between the timing of negative and positive cash flows. For example, the below cash flows represent projects C and D.

Year	Project C	Project D
2020	-\$10,000	\$10,000
2021	\$12,000	-\$12,000

If you calculate the IRR for these projects, you will arrive at the MS Excel Calculations as noted below...

=IRR(B5:H5)									
	A	B	C	D	E	F	G	H	
1	10%	Expected Rate of Return							
2									
3	Project A								
4	Period	2020	2021	2022	2023	2024	2025	2026	
5	Cash Flow	\$(10,000)	\$ 12,000	\$ -	\$ -	\$ -	\$ -	\$ -	
6									
7	Project B								
8	Period	2020	2021	2022	2023	2024	2025	2026	
9	Cash Flow	\$ 10,000	\$(12,000)	\$ -	\$ -	\$ -	\$ -	\$ -	

As you can see, both projects are above the expected rate of return so both apparently can proceed. However, let's take a look when you calculate the NPV of these projects...

=NPV(\$A\$1, C5:G5) + B5								
	A	B	C	D	E	F	G	
1	10%	Expected Rate of Return						
2								
3	Project A							
4	Period	2020	2021	2022	2023	2024	2025	
5	Cash Flow	\$(10,000)	\$ 12,000	\$ -	\$ -	\$ -	\$ -	
6								
7	Project B							
8	Period	2020	2021	2022	2023	2024	2025	
9	Cash Flow	\$ 10,000	\$(12,000)	\$ -	\$ -	\$ -	\$ -	

Now, project B does not look appealing at all and should NOT be undertaken despite having the same IRR as project A. What is happening here?

What's going on is that the IRR formula is not differentiating if the cash flow for a particular year is positive (cash flow) or negative (payment) for a project.

## Conclusion

Both NPV and IRR methods are useful to determine whether to accept a project. They each come with advantages and disadvantages:

Advantages:

- NPV is a direct measure of the dollar contribution of the project.
- The IRR shows the return on the original money invested.

Disadvantages:

- For NPV, the project size is not measured.
- IRR can provide conflicting answers when compared to NPV for mutually exclusive projects (when you only have a choice between Project A or Project B).

If you are generating presentations as to which project to undertake it would be a good idea to leverage a combination of both the IRR and NPV so that a thorough financial analysis can be performed to justify why you need to undertake a specific project.