

Video 23 - Evaluating Projects: Interpreting the Internal Rate of Return

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Hi everyone. Today, we will be learning about what the internal rate of return is, how to calculate the internal rate of return, and how to interpret the internal rate of return to decide whether to accept or reject an investment project. The internal rate of return, or the IRR, is the discount rate that would make the net present value of cash flows equal to 0. It is an important decision-making criteria we could use as an alternative to the NPV approach. The basic rationale behind the IRR is that it tries to find a single number that summarizes the merits of a project, or how profitable the investment project will be to the firm. The number is internal and does not depend on any other factors besides the cash flows of a project.

Video at 00:50

The internal rate of return is often used to determine whether or not a firm should accept or reject an investment project. There is a general decision that can be followed (decision rule): accept an investment project if the IRR is higher than the firm's cost of capital. Reject an investment project if the IRR is lower than the firm's cost of capital. Because the IRR is a percentage that represents the benefits of the project, while the project's cost of capital is the appropriate discount rate that captures the risk and time value of the project, then intuitively, comparing the IRR to the cost of capital will tell us whether the benefits of the project outweigh the costs of the project. You don't want to accept something that costs more (cost of capital) than what you gain (IRR). With the annuities formula, or even the simple PV formula, isolating for "r" is not possible or often cannot be done by hand. Financial calculators and Excel both have functions that allow you to calculate the IRR.

Video at 01:52

A project will initially cost \$10,000. However, the project is estimated to generate \$2,500 each year for 5 years. The discount rate the firm uses is 12%. This project is similar to projects that the firm usually takes on. Calculate the NPV and find out the internal rate of return for the project. Firstly, because the project is similar to ones that the firm has taken on in the past, we can assume that the firm's discount rate is also appropriate in capturing the riskiness of the project. By discounting the future cash flows of the project to date zero, using the given discount

rate, we discover that the NPV of the project is negative. Thus, this means the firm will reject the project, because the project will make the firm worse off by -\$988.

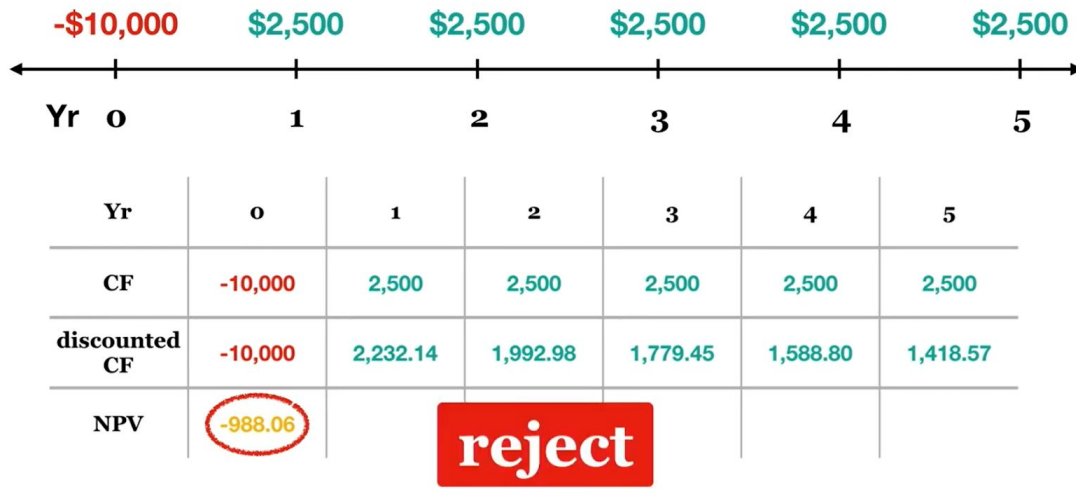


Figure 1

Relating back to the decision rule, we know, given a negative NPV, that the discount rate (cost) of the project must be *higher* than the project's internal rate of return (benefit).

Video at 02:51

Thus, we can relate both the NPV and IRR approach to make a decision:

NPV = 0 is where $r = \text{IRR}$.

NPV > 0 is where $r < \text{IRR}$, and

NPV < 0 is where $r > \text{IRR}$.

Using the trial and error approach, we find the IRR of the above investment project (where NPV is equal to zero) is 7.93%. As the discount rate is 12%, we know that with a *higher* discount rate, the NPV will be negative, and thus we will reject the project.

Video at 03:29

Using both the NPV and IRR approaches, as well as other methods to evaluate a project, are very common. Some firms choose to rely on the IRR for a few reasons. Advantages of IRR: it is easy for investors to understand. We talked about our cost of capital in percentage terms, so it makes sense to use the same method to express our return. Also, when we only have a limited amount of money to spend, it is more helpful to know how we can maximize our percent return -- that is, our return for each dollar we spend -- rather than an absolute dollar value, such as NPV. Furthermore, if the IRR is sufficiently larger than our cost of capital (our minimum rate of

return) we don't have to worry as much about estimating our cash flows with perfect accuracy. After all, it can often be difficult to predict future cash flows and expenses.

Video at 04:22

IRR generally leads us to make the same investment decision as the NPV rule, as long as the NPV of a project declines smoothly as the discount rate increases. For this to hold, cash flows must be somewhat uniform, meaning that they are spread over the life of the project and are not too front- or back-loaded.

Video at 04:41

However, there are some disadvantages to using IRR to make investment decisions.

Disadvantages of internal rate of return: first, unlike NPV, which assumes that cash flows you receive during the project can be reinvested at the company's cost of capital, IRR assumes that these cash flows can be reinvested at the IRR. However, if the IRR is too high, this may not be realistic. We may not be able to find another investment that can yield such a high return. This issue is sometimes described as the "aggressive reinvestment rate assumption". If this assumption does not hold, then our actual return will be lower than the IRR.

Video at 05:22

Taking this idea further, we discover that, if our investment options have substantially different cash flows, our IRR cannot always tell us which one is better. It will depend on our actual discount rate. For example, suppose I am deciding between two investments: investment A and investment B. Both investments have the same initial cash outflow, but different cash flows throughout the life of the project. When we calculate IRR, we get an IRR of 36% for investment A and 32% for investment B. So investment A sounds like the better option, right?

	Yr 0	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	IRR
Investment A	-1,000	600	600	600			36%
Investment B	-1,000			1,000	1,000	1,000	32%

Figure 2

Video at 06:00

Well, what if I told you that the firm's cost of capital was 10%, and they could only reinvest their cash flows at 10%. Let's calculate the NPV of these investments:

$$NPV \text{ of Investment A} = \$600 \times \left[\frac{1-(1.10)^{-3}}{0.10} \right] - \$1,000 = \$492.11$$

$$NPV \text{ of Investment B} = \$1,000 \times \left[\frac{1-(1.10)^{-3}}{0.10} \right] \times (1.10)^{-2} - \$1,000 = \$1,055.25$$

Thus, if the discount rate is 10%, we would actually prefer investment B, even though the IRR is lower. We can graph the net present values of these investments at different discount rates. The rate at which NPV= 0 is our IRR. The rate at which we would be indifferent between these two investments, that is, the rate that yields the same NPV for both, is known as our crossover rate.

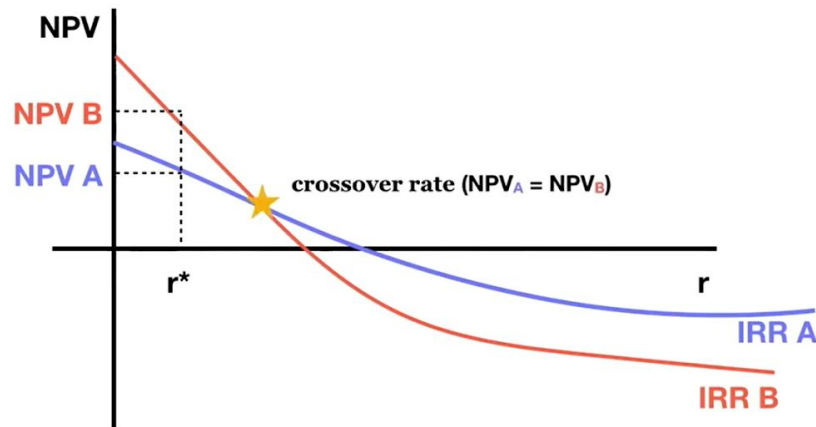


Figure 3

Video at 06:46

Second, if the project has both positive and negative cash flows throughout the life of the project, it can actually have more than one IRR. The project's NPV function at different discount rates becomes a polynomial function, rather than a straight line, meaning that it can intersect the x-axis at more than one point. Thus, there can be more than one rate that will result in an NPV of 0. We can solve for these rates using algebra.

Video at 07:13

Suppose I find an investment that will pay me \$1,100 today. I must pay \$3,000 in one year, and then I receive \$2,000 in two years. We can solve for the rate that will set our NPV=0 by taking

$$NPV = \$1,100 - \frac{\$3,000}{(1+IRR)} + \frac{\$2,000}{(1+IRR)^2} = 0$$

However, this equation actually has two solutions, at both IRR = 16% and IRR = 57%.

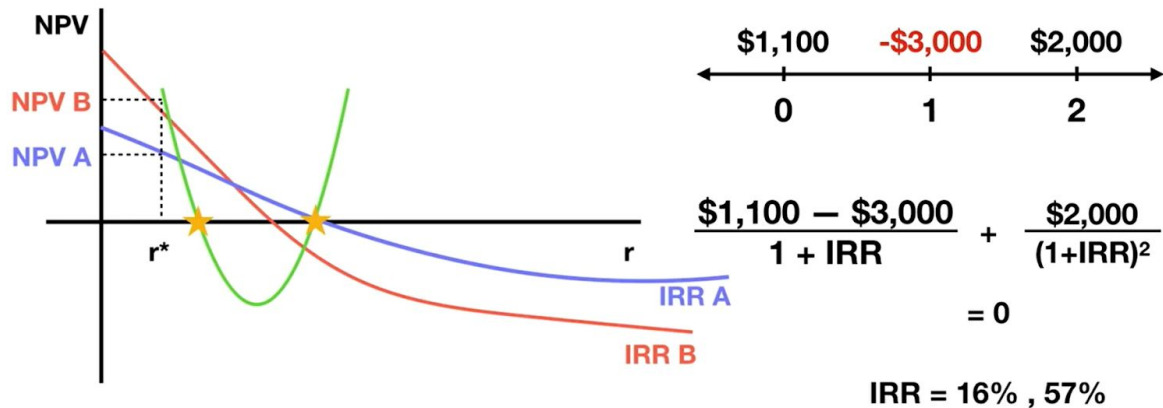


Figure 4

Thus, we should look to the NPV of this investment instead to determine whether it is a worthwhile opportunity or not.

Video at 07:53

Thirdly, IRR does not take into account the scale of the project. For example, let's compare two investments: a \$1,000 investment with a 50% return, or a \$1,000,000 investment with a 40% return. Even though the first investment has a higher percentage return, it is not necessarily better. We can see that the second investment has a higher absolute, or dollar return. If we can choose only one of these two projects, that is if they are mutually exclusive, then we would choose the \$1,000,000 investment, which maximizes our return in dollars (\$500 vs. \$400,000). This will allow us to generate as much value as possible.

Video at 08:36

Thus, to conclude, IRR is an approach that many firms use in capital budgeting and investment project decisions. Generally, we can follow the decision rule to determine whether or not an investment project should be accepted or rejected. If the cost of capital is lower than the internal rate of return, we will accept the project. If vice versa, we reject the project. This approach can be combined with other approaches to determine the best investment projects to take on. Hope this video helps you understand IRR a little better and how it can be used. Until next time!