GEPM-375
Professional Practices and Construction Management

Internal Rate of Return (IRR)

IRR

What Is Internal Rate of Return (IRR)?

- **Internal rate of return (IRR) is a metric used in financial analysis to estimate the profitability of potential investments.**
- IRR is a **discount rate** that makes the net present value (**NPV) of all cash flows equal to zero** in a discounted cash flow analysis.
- IRR is not the actual dollar value of the project; it is the **annual return that makes the NPV equal to zero.**

Generally speaking, the **higher an internal rate of return**, the more desirable an investment is to undertake. IRR is uniform for investments of varying types and, as such, can be used to rank multiple prospective investments or projects on a relatively even basis. In general, when comparing investment options with other similar characteristics, the **investment with the highest IRR probably would be considered the best.**

IRR

Importance of IRR:

- Generally speaking, the **higher an internal rate of return**, the **more desirable an investment is to undertake.**
- **IRR is uniform for investments of varying types** and, as such, can be **used to rank** multiple prospective investments or projects on a relatively even basis.
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IRR

Calculation of IRR

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

where:

CF_t=Net cash inflow during the period t

C_0=Total initial investment costs

IRR=The internal rate of return

t=The number of time periods

IRR

Understanding IRR:

- Ultimate goal of IRR is **to identify the rate of discount**, which makes the present value of the sum of annual nominal cash **inflows equal to the initial net cash outlay** for the investment.
- Several methods can be used when **seeking to identify an expected return**, but **IRR is often ideal method for analyzing the potential return of a new project** that a company is considering undertaking.
- Consider IRR as the **rate of growth that an investment is expected to generate annually**.
- Most similar to a **Compound Annual Growth Rate** (CAGR).
- In reality, **an investment will usually not have the same rate of return each year**.
- Usually, the **actual rate of return that a given investment ends up generally will differ** from its estimated IRR.

IRR

What Is IRR Used for?

- In capital planning, one popular scenario for IRR is **comparing the profitability of establishing new operations** with that **of expanding existing operations**. For example, an energy company may use IRR in deciding whether to open a new power plant or to renovate and expand an existing power plant.

- Individuals can also **use IRR when making financial decisions**—for instance, when evaluating different insurance policies using their premiums and death benefits. The general consensus is that **policies that have the same premiums and a high IRR are much more desirable.**

- Another common use of **IRR is in analyzing investment returns**. In most cases, the advertised return will assume that any **interest payments or cash dividends** are reinvested back into the investment. What if you **don't want to reinvest dividends** but **need them as income when paid**? And if dividends are not assumed to be reinvested, are they paid out, or are they left in cash?

IRR

Using IRR With WACC:

- Most IRR **analyses will be done in conjunction** with a view of a company's weighted average cost of capital (WACC) and NPV calculations. IRR is typically a relatively high value, which allows it to arrive at an NPV of zero.

- Most companies will require an **IRR calculation to be above the WACC**.

- WACC is a measure of a **firm's cost of capital** in which each category of capital is proportionately weighted. **All sources of capital**, including common stock, preferred stock, bonds, and any other long-term debt, **are included in a WACC calculation**.

- Any project with **an IRR greater than its cost of capital should be profitable**. In planning investment projects, firms will often establish a Required Rate of Return (RRR) to **determine the minimum acceptable return percentage** that the investment in question must earn to be worthwhile. RRR will be higher than the WACC.

IRR

IRR vs. Compound Annual Growth Rate (CAGR):

- CAGR **measures the annual return on an investment over a period of time**.
- **IRR is also an annual rate of return**; however, the **CAGR typically uses only a beginning and ending value t**o provide an estimated annual rate of return.
- **IRR differs in that it involves multiple periodic cash flows**—reflecting that cash inflows and outflows often constantly occur when it comes to investments.
- Another distinction is that **CAGR is simple enough that it can be calculated easily**.

IRR

IRR vs. Return on Investment (ROI)

- Companies and analysts may also look at the **Return on Investment (ROI)** when making capital budgeting decisions.

- **ROI tells an investor about the total growth**, start to finish, of the investment. It is not an annual rate of return.
- **IRR tells the investor what the annual growth rate is**. The two numbers normally would be the same over the course of one year but won't be the same for longer periods of time.

- ROI is the **percentage increase or decrease of an investment** from beginning to end. It is calculated by taking the difference between the current or expected future value and the original beginning value, divided by the original value, and multiplied by 100.

- ROI figures can be **calculated for nearly any activity into which an investment has been made and an outcome can be measured;** however, ROI is not necessarily the most helpful for lengthy time frames.

IRR

Limitations of IRR:

- IRR is generally **ideal for use in analyzing capital budgeting projects**. It can be misconstrued or misinterpreted if used outside of appropriate scenarios. **In the case of positive cash flows followed by negative ones and then by positive ones, the IRR may have multiple values.**

- IRR is a very popular metric for estimating a project's annual return; however, **it is not necessarily intended to be used alone.** IRR is typically **a relatively high value**, which allows it to arrive at an NPV of zero. The IRR itself is only a single estimated figure that provides an annual return value based on estimates.

- Most companies **do not rely on IRR and NPV analyses alone**. These calculations are usually also studied in conjunction **with a company's WACC and an RRR**, which provides for further consideration.

IRR

Investing Based on IRR:

- IRR rule is a **guideline for evaluating** whether to proceed with a project or investment.
- IRR rule states that if the IRR on a project or investment is **greater than the minimum RRR**—typically the cost of capital, then the project or investment can be pursued.
- If the IRR on a project or investment is lower than the cost of capital, then the best course of action may be to reject it.
- Overall, while there are some limitations to IRR, it is an industry standard for analyzing capital budgeting projects.

IRR

IRR Example:

Assume a company is **reviewing two projects**. Management must decide whether to move forward with one, both, or neither. Its cost of capital is 10%. The **cash flow patterns** for each are as follows:

Project A

Initial Outlay = $5,000

Year one = $1,700

Year two = $1,900

Year three = $1,600

Year four = $1,500

Year five = $700

IRR

Project B

Initial Outlay = $2,000

Year one = $400

Year two = $700

Year three = $500

Year four = $400

Year five = $300

IRR

The company **must calculate the IRR** for each project. Initial outlay (period = 0) will be negative. Solving for IRR is an iterative process using the following equation:

$$\$0 = 0 = NPV = \sum_{t=1}^{T} \frac{CF_t}{(1+IRR)^t} - C_0$$ where:

CF_t = net cash flow

IRR = internal rate of return

t = period (from 0 to last period)

-or-

$$\$0 = (initial\ outlay * -1) + (CF_1 \div (1 + IRR)^1) + (CF_2 \div (1 + IRR)^2) + \ldots + (CF_x \div (1 + IRR)^n)$$

Using the above examples, the company can calculate IRR for each project as:

IRR Project A

$0 = (−$5,000) + $1,700 ÷ (1 + IRR)1 + $1,900 ÷ (1 + IRR)2 + $1,600 ÷ (1 + IRR)3 + $1,500 ÷ (1 + IRR)4 + $700 ÷ (1 + IRR)5

IRR Project A = **16.61 %**

IRR Project B

$0 = (−$2,000) + $400 ÷ (1 + IRR)1 + $700 ÷ (1 + IRR)2 + $500 ÷ (1 + IRR)3 + $400 ÷ (1 + IRR)4 + $300 ÷ (1 + IRR)5

IRR Project B = **5.23 %**

Given that the company's cost of capital is 10%, management should **proceed with Project A** and reject Project B.

Example Calculation:

Consider a project with an initial investment of -$10,000 and expected cash flows of $4,000 per year for the next 3 years:

- **Year 1:** Cash flow = $4,000
- **Year 2:** Cash flow = $4,000
- **Year 3:** Cash flow = $4,000

Trial and Error Calculation:

Guess 1:

Discount rate = 10%

NPV = ($4,000 / (1+0.1)) + ($4,000 / (1+0.1)²) + ($4,000 / (1+0.1)^3) - $10,000 = $1,069.99 (Positive NPV)

Guess 2:

Discount rate = 15%NPV = ($4,000 / (1+0.15)^1) + ($4,000 / (1+0.15)^2) + ($4,000 / (1+0.15)^3) - $10,000 = -$420.23 (Negative NPV)

Interpolate:

Since the first guess resulted in a positive NPV and the second a negative NPV, the IRR lies between 10% and 15%.

By further iterations (trying rates closer to 10% and 15%), you can eventually find a discount rate that brings the NPV very close to zero, which will be your IRR.

Thanks