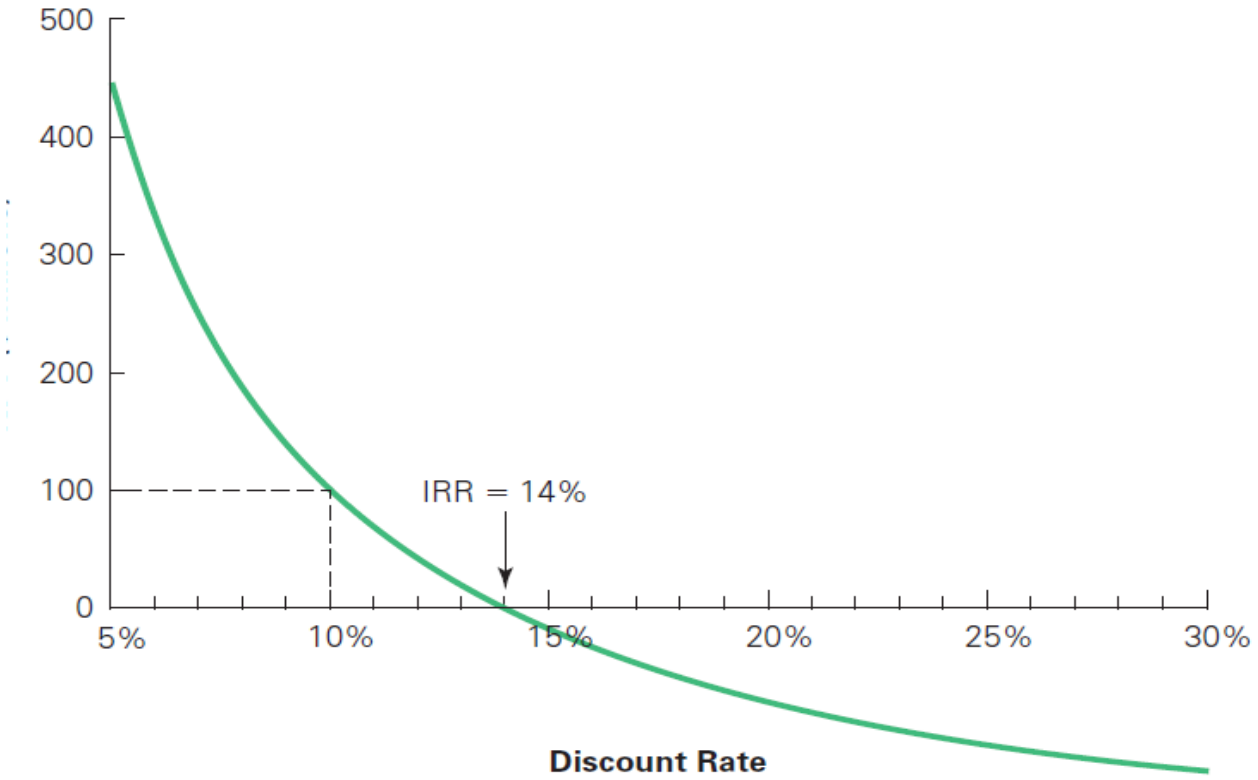
Investment Decision Rules

Net Present Value Rule

- **When making an investment decision among projects, take the alternative with the highest NPV**. Choosing this alternative is equivalent to receiving its NPV in cash today.
- **In the case of a stand-alone project**, we must choose between accepting or rejecting the project. The NPV rule then says we should compare the project's NPV to zero (the NPV of doing nothing) and **accept the project if its NPV is positive**.
- NPV of a perpetual cash flow stream which gives a constant cash flow of C, given a discount rate *r* is given by

$$\textbf{NPV=- Cost + C/r}$$

- The **NPV of the project depends on the appropriate cost of capital**. Often, there may be some uncertainty regarding the project's cost of capital. In that case, it is helpful to compute an **NPV profile**: a graph of the project's NPV over a range of discount rates.



- **The internal rate of return (IRR) of an investment is the discount rate that sets the NPV of the project's cash flows equal to zero**. For a project, if the cost of capital estimate is more than the IRR, the NPV will be negative. Notice that the NPV is positive only for discount rates that are less than 14%. When r = 14%, the NPV is zero.
- The IRR of a project provides useful information regarding the sensitivity of the project's NPV to errors in the estimate of its cost of capital.
- **The difference between the cost of capital and the IRR is the maximum estimation error in the cost of capital that can exist without altering the original decision.**

Internal rate of return rule

- The IRR rule is that **if the average return on the investment opportunity (i.e., the IRR) is greater than the return on other alternatives in the market with equivalent risk and maturity** (i.e., the project's cost of capital), you should undertake the investment opportunity.
- Like the NPV rule, the internal rate of return investment rule is applied to single, standalone projects within the firm. The IRR investment rule will give the correct answer (that is, the same answer as the NPV rule) in many—but not all—situations.
- **The IRR rule is only guaranteed to work for a stand-alone project (i.e. coincide with the NPV rule) if all of the project's negative cash flows precede its positive cash flows.** If this is not the case, the IRR can lead to incorrect decisions. No matter what the cost of capital is, the IRR rule and the NPV rule will give exactly opposite recommendations.

- For most investment opportunities, expenses occur initially and cash is received later. If you get cash *upfront* and incurs the costs later, it is as if you borrowed money—receiving cash today in exchange for a future liability—and **when you borrow money you prefer as *low* a rate as possible**.
- In this case the IRR is best interpreted as the rate you are paying rather than earning, and so the optimal rule is to borrow money so long as this rate is *less* than his cost of capital.

	NPER	RATE	PV	PMT	FV	Excel Formula
Given	3		1,000,000	−500,000	**0**	
Solve for I		**23.38%**				=RATE(3,−500000,1000000, 0)

- **Other Pitfalls of IRR- non-existent IRR, multiple IRRs for the same project.**

- Picking one project over another simply because it has a larger IRR can lead to mistakes. In particular, **when projects differ in their scale of investment, the timing of their cash flows, or their riskiness, then their IRRs cannot be meaningfully compared.**
- If a project has a positive NPV, then if we can double its size, its NPV will double: By the Law of One Price, doubling the cash flows of a investment opportunity must make it worth twice as much.
- However, **the IRR rule does not have this property—it is unaffected by the scale of the investment opportunity because the IRR measures the average return of the investment**. Hence, we cannot use the IRR rule to compare projects of different scales.

- Even when projects have the same scale, **the IRR may lead you to rank them incorrectly due to differences in the timing of the cash flows**. The IRR is expressed as a return, but the rupee value of earning a given return—and therefore its NPV—depends on how long the return is earned. Earning a very high annual return is much more valuable if you earn it for several years than if you earn it for only a few days.

- **Ranking projects by their IRRs ignores risk differences.** To know whether the IRR of a project is attractive, we must compare it to the project's cost of capital, which is determined by the project's risk. Thus, an IRR that is attractive for a safe project need not be attractive for a risky project. As a simple example, while you might be quite pleased to earn a 10% return on a risk-free investment opportunity, you might be much less satisfied to earn a 10% expected return on an investment in a risky start-up company.

Payback rule

- **The payback investment rule states that you should only accept a project if its cash flows pay back its initial investment within a pre-specified period.**
- To apply the payback rule, you first calculate the amount of time it takes to pay back the initial investment, called the **payback period**. Then you accept the project if the payback period is less than a pre-specified length of time—usually a few years. Otherwise, you reject the project.
- The payback rule is **typically used for small investment decisions**—for example, whether to purchase a new copy machine or to service the old one. In such cases, the cost of making an incorrect decision might not be large enough to justify the time required to calculate the NPV. The payback rule also provides **budgeting information regarding the length of time capital will be committed** to a project. Some firms are unwilling to commit capital to long-term investments without greater scrutiny.
- The payback rule is **not as reliable as the NPV rule** because it (1) ignores the project's cost of capital and the time value of money, (2) ignores cash flows after the payback period, and (3) relies on an ad hoc decision criterion (what is the right number of years to require for the payback period?).

Project Selection with Resource Constraints

- In principle, the firm should take on all positive-NPV investments it can identify. **In practice, there are often limitations on the number of projects the firm can undertake**. For example, when projects are mutually exclusive, the firm can only take on one of the projects even if many of them are attractive. Often this limitation is due to resource constraints— for example, there is only one property available in which to open either a coffee shop, or book store, and so on.
- In some situations, different projects will demand different amounts of a particular scarce resource. For example, different products may consume different proportions of a firm's production capacity, or might demand different amounts of managerial time and attention.

- If there is a fixed supply of the resource so that you cannot undertake all possible opportunities, then the **firm must choose the best *set* of investments it can make given the resources** it has available.
- Often, individual managers work within a budget constraint that limits the amount of capital they may invest in a given period. In this case, the manager's goal is to choose the projects that maximize the total NPV while staying within her budget.
- Suppose, however, that you have a budget of at most Rs 100 crore to invest. While Project A has the highest NPV of Rs 110 crore , it uses up the entire budget. Projects B and C can both be undertaken (together they also take up the entire budget), and their combined NPV is Rs 130 crore which exceeds the NPV of Project A. **Thus, with a budget of Rs 100 crore , the best choice is to take Projects B and C for a combined NPV of Rs 130 crore, compared to just Rs 110 crore for Project A alone**.

Profitability Index

- The ratio of the project's NPV to its initial investment how efficiently a project will utilize the budget.
- In actual situations replete with many projects and resources, finding the optimal combination can be difficult. Practitioners often use the **profitability index** to identify the optimal combination of projects to undertake in such situations.

Profitability index= Value created(NPV)/ Resource Consumed(Initial Investment)

- Although the profitability index is simple to compute and use, for it to be completely reliable, two conditions must be satisfied:

➢ **The set of projects taken following the profitability index ranking completely exhausts the available resource.**

➢ **There is only a single relevant resource constraint**

- In many cases, the firm may face multiple resource constraints. For instance, there may be a budget limit as well as a headcount constraint. **If more than one resource constraint is binding, then there is no simple index that can be used to rank projects**. Instead, linear and integer programming techniques have been developed specifically to tackle this kind of problem.
- Even if the set of alternatives is large, by using these techniques on a computer we can readily calculate the set of projects that will maximize the total NPV while satisfying multiple constraints.

Q. A large networking company, has put together a project proposal to develop a new home networking router. The expected NPV of the project is Rs 15 crore, and the project will require 50 software engineers. The company has a total of 180 engineers available, and the router project must compete with the following other projects for these engineers.

Project	NPV (crores)	Engineering Headcount
Router	15	50
Project A	22.7	47
Project B	8.1	44
Project C	14.0	40
Project D	11.5	61
Project E	20.6	58
Project F	12.9	32