INTERNATIONAL BUSINESS SCHOOL

Capital Budgeting and Investment techniques

Principles and Practices of Business Finance

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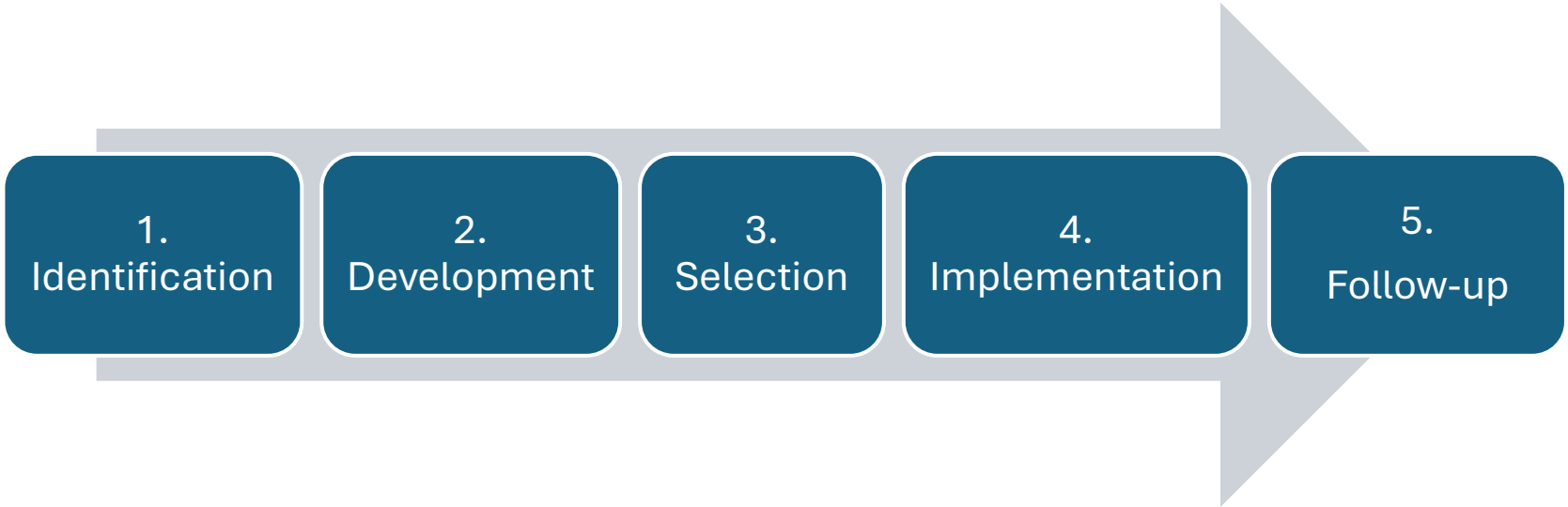
Agenda

1. Capital Budgeting
2. Net Present Value
3. Internal Rate of Return
4. Profitability Index
5. Payback Period
6. Discounted Payback Period

Capital Budgeting

Capital budgeting is the process of planning and managing long-term investments in projects such as purchasing equipment, launching new products, or expanding facilities.

Purpose: It helps firms decide which projects to undertake based on expected profitability and strategic goals.

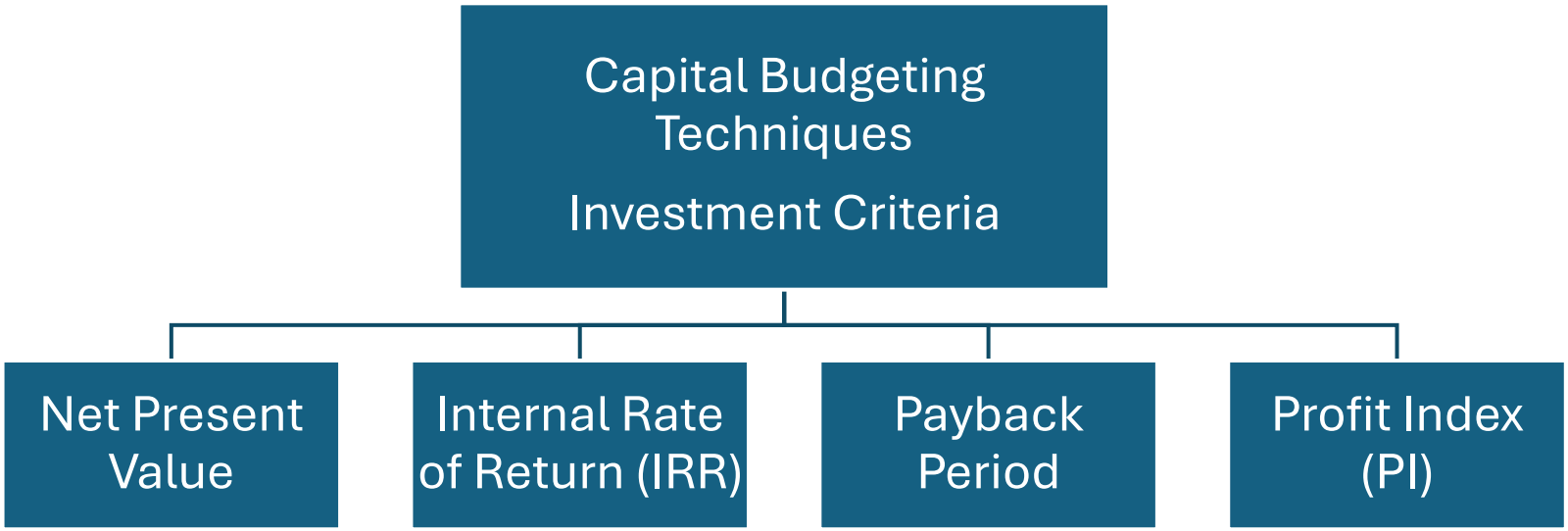


Capital Budgeting Techniques

Capital Budgeting Techniques / Investment Criteria are the quantitative methods used to assess investment decisions within capital budgeting.

Examples:

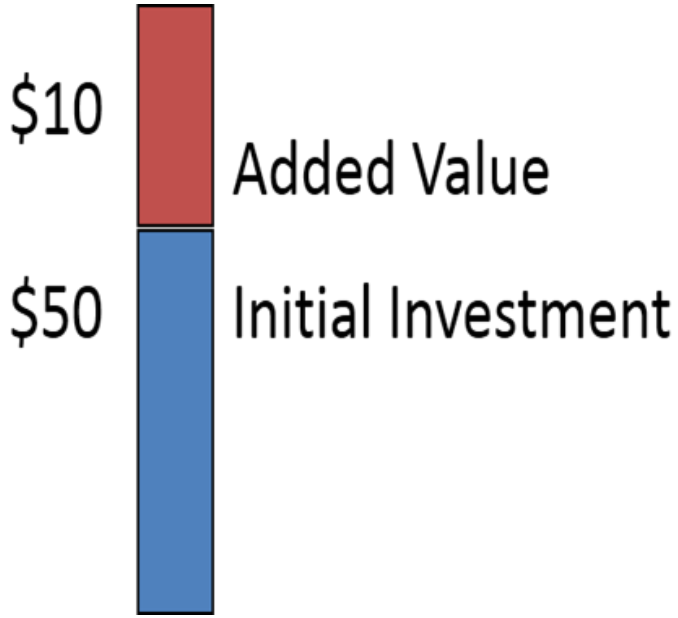
- Net Present Value (NPV)
- Internal Rate of Return (IRR)
- Payback Period
- Profitability Index (PI)



Net Present Value

- **Example.**
  - **Suppose we can invest $50 today & receive $60 later today. What is our increase in value?**

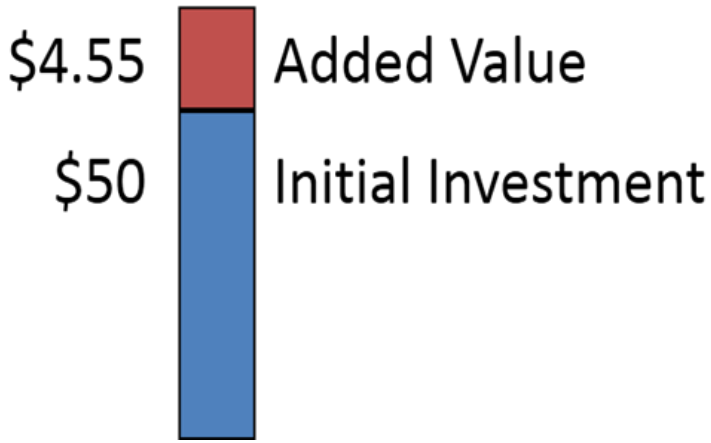
$$\text{Profits} = -\$50 + \$60$$
$$= \$10$$



Net Present Value

- **Example.**
  - **Suppose we can invest $50 today and receive $60 in one year. What is our increase in value given a 10% expected return?**

$$\text{Profit} = -\$50 + \frac{\$60}{1.10} = \$4.55$$



- This is the definition of NPV:

Net Present Value - Present value of cash flows minus initial investments.

Net Present Value

$$NPV = C_0 + \frac{C_1}{(1+r)^1} + \frac{C_2}{(1+r)^2} + \ldots + \frac{C_t}{(1+r)^t}$$

- C_0 = Initial cash flow (often negative).
- C_1 = Cash flow at time 1.
- C_2 = Cash flow at time 2.
- C_t = Cash flow at time t.
- t = Time period of the investment.
- r = Opportunity cost of capital.

Net Present Value Rule:

- Managers increase shareholders' wealth by accepting projects that are worth more than they cost.
- Therefore, they should accept all projects with a positive net present value.

NPV - Office Building

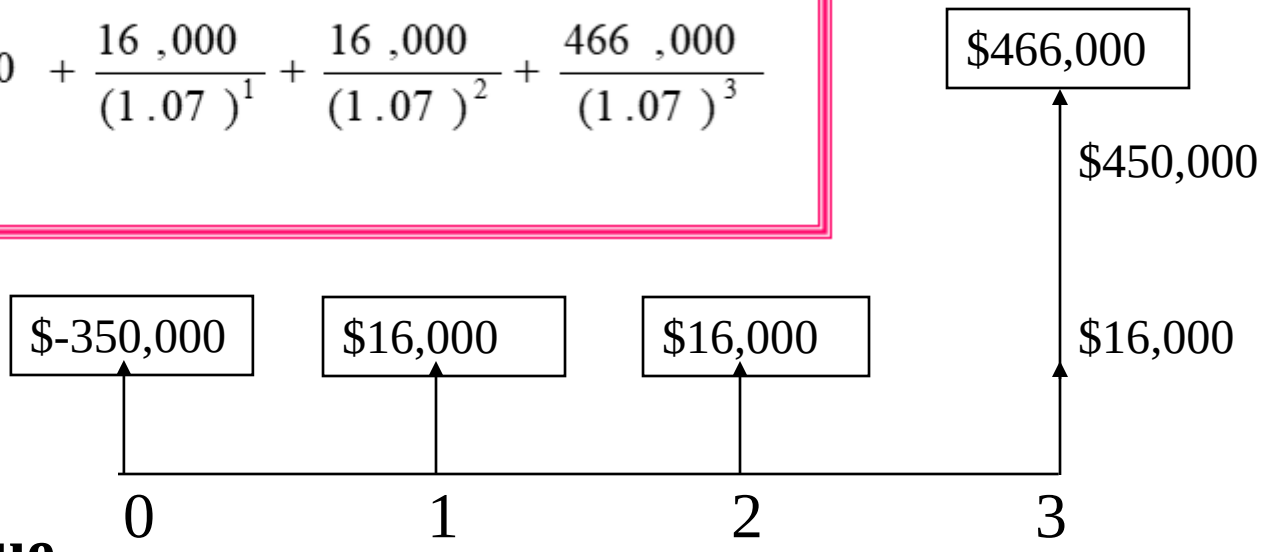
Example

You have the opportunity to purchase an office building for $350000. You have a tenant lined up that will generate $16,000 per year in cash flows for three years. At the end of three years you anticipate selling the building for $450,000. Would you buy this office building if the opportunity cost of capital is 7% ?

NPV - Office Building

$$NPV = -350,000 + \frac{16,000}{(1.07)^1} + \frac{16,000}{(1.07)^2} + \frac{466,000}{(1.07)^3}$$

$$NPV = \$59,323$$



Present Value

14,953

13,975

380,395

$409,323

NPV - Office Building 2

Step 1: Forecast cash flows

Cost of building = C_0 = 350,000
Rent for 3 years = 16000 per year
Sale price in Year 3 = 450,000

Step 2: Estimate opportunity cost of capital.

If equally risky investments in the capital market offer a return of 7%, then:

Cost of capital = r = 7%.

- **Step 3: Discount future cash flows.**

$$PV = \frac{16,000}{(1.07)^1} + \frac{16,000}{(1.07)^2} + \frac{466,000}{(1.07)^3}$$

- **Step 4: Accept if PV of payoff exceeds investment.**

$$NPV = -350,000 + \frac{16,000}{(1.07)^1} + \frac{16,000}{(1.07)^2} + \frac{466,000}{(1.07)^3}$$

$$NPV = \$59,323$$

Net Present Value - Annuities

$$NPV = C_0 + \frac{C_1}{(1+r)^1} + \frac{C_2}{(1+r)^2} + \ldots + \frac{C_t}{(1+r)^t}$$

When C_1, C_2, …, C_t represent annuities, the formula:

$$\mathbf{NPV = C0 + C\left[\frac{1}{r} - \frac{1}{r(1+r)^t}\right]}$$

Choose among several investment possibilities

- The simple NPV rule helps to decide whether a given investment should be done or not.

- If you need to choose among several positive NPV projects, select the highest NPV.

Net Present Value

- Example – You have the possibility to invest in one of the following two projects. The opportunity cost of capital is 8%.

Year	Project A	Project B
0	–$200	–$200
1	80	100
2	80	100
3	80	100
4	80	

- Which formula could you use to simplify the calculations?

Net Present Value - Example

- If the Cash Flows are constant, we can use the Present Value of Annuity formula to simplify the calculations.

- Project A:
- NPV=-200 + 80×$\left(\frac{1}{0.08} - \frac{1}{(0.08\times(1+0.08)^4)}\right)$= $64.9

- Project B:
- NPV=-200 + 100×$\left(\frac{1}{0.08} - \frac{1}{(0.08\times(1+0.08)^3)}\right)$= $57.7

Main Limitations of the NPV method

1. It requires some guesswork about the firm's opportunity cost of capital. Assuming a cost of capital that is too low will result in making suboptimal investments. Assuming a cost of capital that is too high will result in forgoing too many good investments.

2. It is not useful for comparing two projects of different size. Because the NPV method results in an answer in dollars, the size of the net present value output is determined mostly by the size of the input.

Internal Rate of Return

Internal Rate of Return (IRR)

- Discount rate at which NPV = 0.

Rate of Return Rule

- Invest in any project offering a rate of return that is higher than the opportunity cost of capital.
- When you are choosing among different projects, go for the higher IRR (this rule has its limitation).

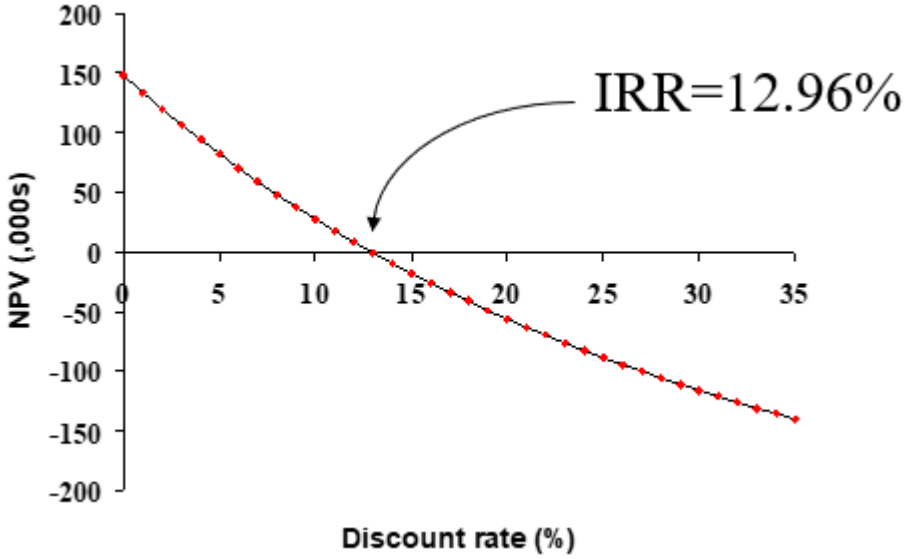
Internal Rate of Return

Example

You can purchase a building for $350,000. The investment will generate $16,000 in cash flows (i.e. rent) during the first three years. At the end of three years, you will sell the building for $450,000. What is the IRR on this investment?

$$0 = -350{,}000 + \frac{16{,}000}{(1+IRR)^1} + \frac{16{,}000}{(1+IRR)^2} + \frac{466{,}000}{(1+IRR)^3}$$

IRR = 12.96%



Internal Rate of Return

Calculating the IRR can be a laborious task. Fortunately, financial calculators or excel can perform this function easily.

	Calculating IRR by using a spreadsheet					
Year	**Cash Flow**				**Formula**	
0	(350 000,00)		IRR =	12,96%	=IRR(B3:B7)	
1	16 000,00					
2	16 000,00					
3	466 000,00					

Limitations of IRR

- Pitfall 1 - Mutually Exclusive Projects

  IRR ignores the magnitude of the projects.

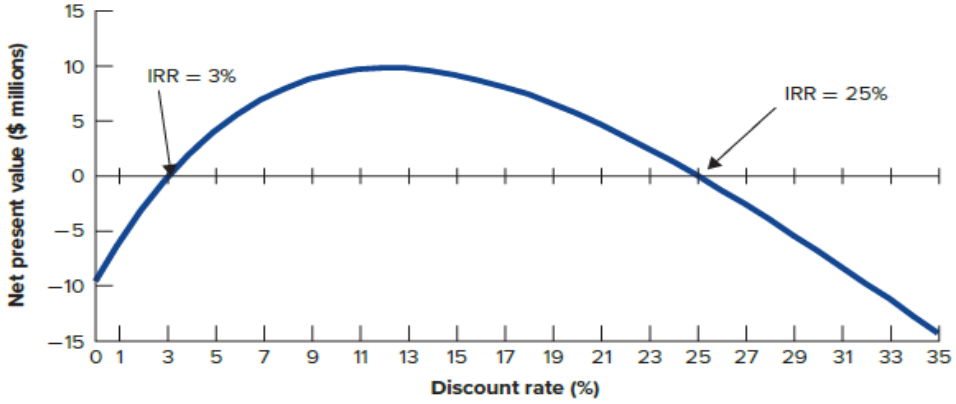
- Pitfall 2 - Lending or Borrowing

  With some Cash Flows the NPV of the project increases as the discount rate increases.

  This is contrary to the normal relationship between NPV and discount rates

- Pitfall 3 - Multiple Rates of Return

  Certain projects will have 0 NPV at several different discount rates



Limitations of the IRR – Pitfall 1

Pitfall 1: IRR ignores the magnitude of the projects

Example

You have two proposals to choose between. The initial proposal has a cash flow that is different than the revised proposal. Using IRR, which do you prefer?

Project	C_0	C_1	C_2	C_3	IRR	NPV@7%
Initial Proposal	-350,000	400,000			14.29%	$ 23,832
Revised Proposal	-350,000	16,000	16,000	466,000	12.96%	$ 59,323

Limitations of the IRR – Pitfall 2.

Pitfall 2 - Lending or Borrowing

With some Cash Flows the NPV of the project increases as the discount rate increases.

This is contrary to the normal relationship between NPV and discount rates

This can occur when the cash flow refers not to an investment, but to a loan (i.e. when the first cash flow is positive and all the others are negative)

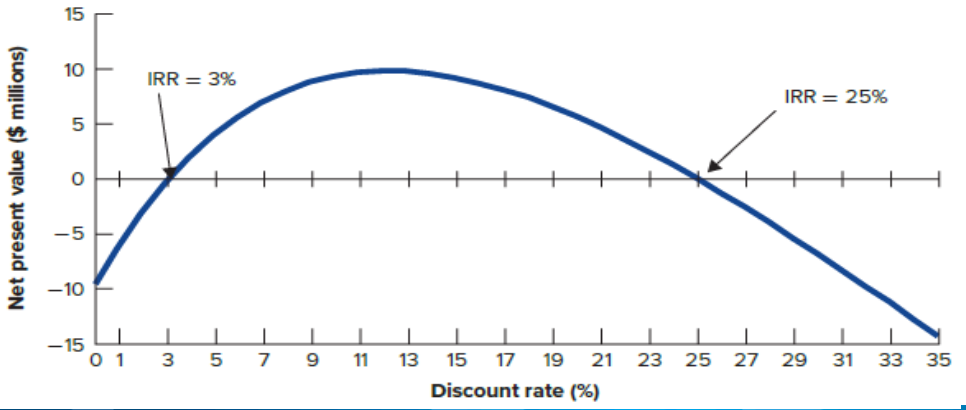
	Cash Flows (dollars)			
Project	C_0	C_1	IRR, %	NPV at 10%
H	−100	+150	+50	+$36.4
I	+100	−150	+50	− 36.4

Limitations of the IRR – Pitfall 3.

Pitfall 3 - Multiple Rates of Return
Certain projects will have 0 NPV at several different discount rates

This is true for cash flows where there is a change of sign in the cash flows: initial investment followed by positive cash flows followed by costs at the end. Such end-of-project costs can include environmental costs (taking care of a nuclear plant after you close it, demolish a building, pay severance to workers, replant a tree farm, etc). In this case, the IRR will have two zero points, the NPV will be positive between them, but not before and not after the IRR = 0 points.

This problem can be corrected using MIRR (Modified Internal Rate of Return).



Profitability Index

- **Profitability Index:**
  - Ratio of net present value to initial investment.

- $$Profitability\ Index = \frac{Net\ Present\ Value\ of\ Future\ CF}{Investment}$$

Profitability Index

Example:

Assume you plan to invest $1,000 today and will receive $600 each year for two years (assume the cash is received at the end of the year). What is the net present value if there is a 10% opportunity cost of capital?

C_0 = -$1,000
C_1 = $600
C_2 = $600

$$NPV = -\$1,000 + \frac{\$600}{(1+.10)^1} + \frac{\$600}{(1+.10)^2} = \$41.32$$

PI = 41.32/1,000 = 0.0413 = 4.13%

Payback Period

Payback Period:

- Time until cash flows recover the initial investment of the project.

Payback period = Investment/Yearly CF

The *payback rule:*

- Accept a project if its payback period is less than a specified cutoff period.
- The following example will demonstrate a major problem with this statement.

Project	C_0	C_1	C_2	C_3	Payback	NPV @ 10%
F	–2,000	+1,000	+1,000	+10,000	2	**+7,249**
G	–2,000	+1,000	+1,000		2	–264
H	–2,000		+2,000		2	–347

Limitations of the Payback Period

- Ignores the Time value of money.
- Ignores Cash Flows after the payback period, thus ignores profitability.

Discounted Payback Period

- **Discounted Payback Period** is an improved method of the traditional Payback Period, which takes into consideration the time value of money.

Year	Cash Flow	PV of CF @ 8%	Accumulated PV of CF
0	-300	-300	-300
1	120	111.1	-188.9
2	120	102.9	-86
3	120	95.3	9.3

Payback Period= 300/120= 2.5 years

Discounted Payback Period= 2+ (86/95.3)= 2.9 years

Capital Budgeting Techniques

Criterion	Definition	Investment Rule	Comments
Net present value (NPV)	Present value of cash flows minus initial investment	Accept project if NPV is positive. For mutually exclusive projects, choose the one with the highest (positive) NPV.	The "gold standard" of investment criteria. Only criterion necessarily consistent with maximizing the value of the firm. Provides appropriate rule for choosing between mutually exclusive investments. Only pitfall involves capital rationing, when one cannot accept all positive-NPV projects.
Internal rate of return (IRR)	The discount rate at which project NPV equals zero	Accept project if IRR is greater than opportunity cost of capital.	If used properly, results in same accept-reject decision as NPV in the absence of project interactions. However, beware of the following pitfalls: IRR cannot rank mutually exclusive projects—the project with higher IRR may have lower NPV. The simple IRR rule cannot be used in cases of multiple IRRs or an upward-sloping NPV profile.
Profitability index	Ratio of net present value to initial Investment	Accept project if profitability index is greater than 0. In case of capital rationing, accept projects with highest profitability index.	Results in same accept-reject decision as NPV in the absence of project interactions. Useful for ranking projects in case of capital rationing, but potentially misleading in the presence of interactions or in comparing projects of different size.
Payback period	Time until the sum of project cash flows equals the initial Investment	Accept project if payback period is less than some specified number of years.	A quick and dirty rule of thumb, with several critical pitfalls. Ignores cash flows beyond the acceptable payback period. Ignores discounting. Tends to improperly reject long-lived projects.