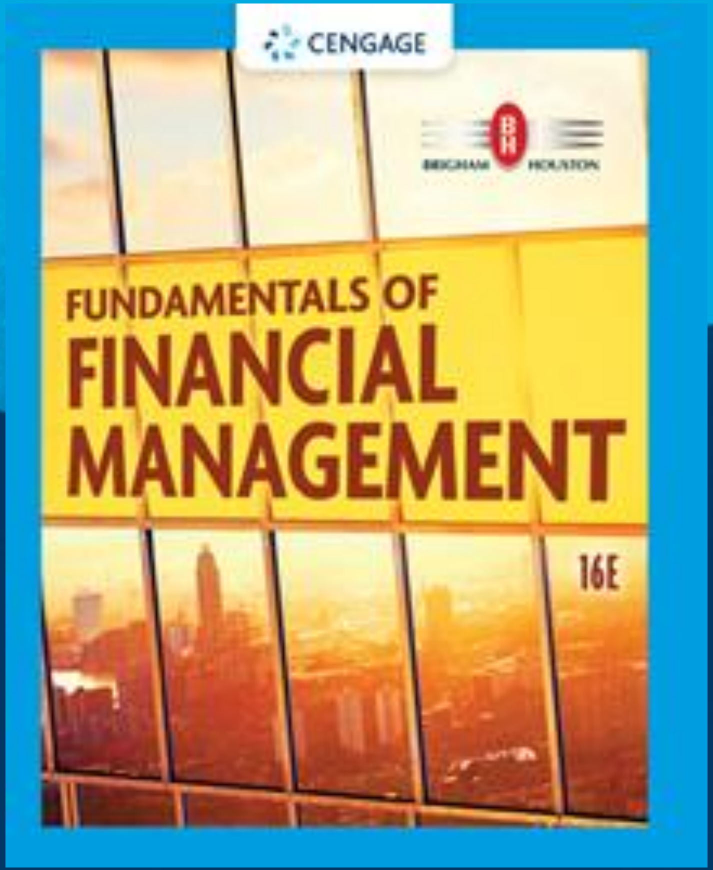
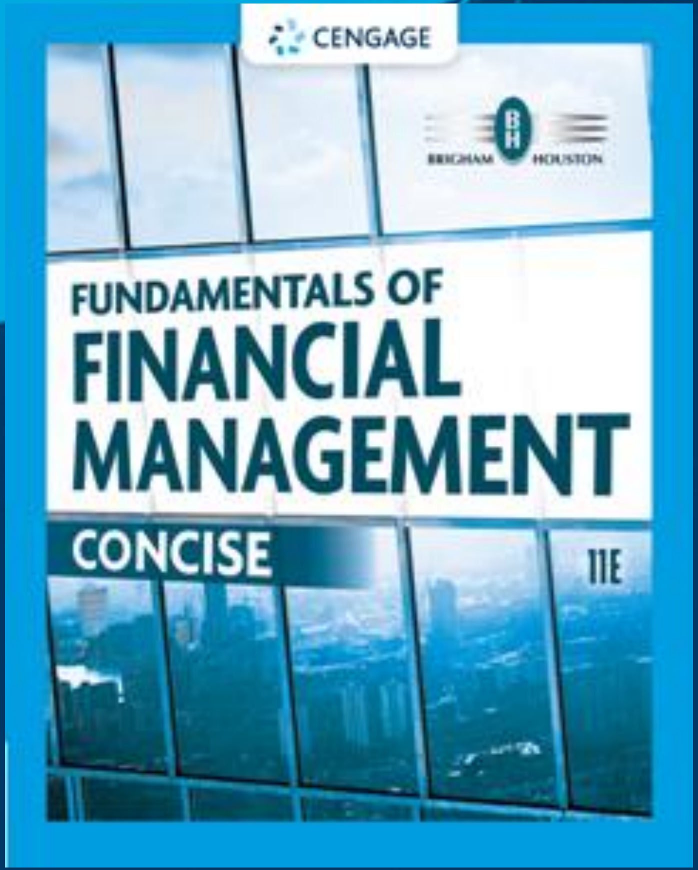




Chapter 11

The Basics of Capital Budgeting

Overview

- Net Present Value (NPV)
- Internal Rate of Return (IRR)
- Modified Internal Rate of Return (MIRR)
- Payback Methods: Regular vs. Discounted
- Multiple IRRs

What is capital budgeting?

- Analysis of potential additions to fixed assets.
- Long-term decisions; involve large expenditures.
- Very important to firm’s future.

Steps to Capital Budgeting

1. Estimate CFs (inflows & outflows).
2. Assess riskiness of CFs.
3. Determine the appropriate cost of capital.
4. Find NPV and/or IRR.
5. Accept if NPV > 0 and/or IRR > WACC.

What is the difference between independent and mutually exclusive projects?

- Independent projects: If the cash flows of one are unaffected by the acceptance of the other.
- Mutually exclusive projects: If the cash flows of one can be adversely impacted by the acceptance of the other.

What is the difference between normal and nonnormal cash flow streams?

- Normal cash flow stream: Cost (negative CF) followed by a series of positive cash inflows. One change of signs.

- Nonnormal cash flow stream: Two or more changes of signs.

- Most common: Cost (negative CF), then string of positive CFs, then cost to close project. Examples include nuclear power plant, strip mine, etc.

Net Present Value (NPV)

- Sum of the PVs of all cash inflows and outflows of a project:

$$NPV = \sum_{t=0}^{N} \frac{CF_t}{(1+r)^t}$$

Example

Projects we'll examine:

	Cash Flow		
YEAR	L	S	ΔCF
0	–100	–100	0
1	10	70	–60
2	60	50	10
3	80	20	60

ΔCF is the difference between CF_L and CF_S. We'll use ΔCF later.

What is Project L’s NPV?

WACC = 10%

Year	CF_t	PV of CF
0	–100	–$100.00
1	10	9.09
2	60	49.59
3	80	60.11
		NPV_L = $ 18.79

Excel: =NPV(rate,CF_1:CF_n) + CF_0

Here, CF_0 is negative.

What is Project S’ NPV?

WACC = 10%

Year	CF_t	PV of CF_t
0	–100	–$100.00
1	70	63.64
2	50	41.32
3	20	15.02
		NPV_S = $ 19.98

Excel: =NPV(rate,CF_1:CF_n) + CF_0

Here, CF_0 is negative.

Solving for NPV: Financial Calculator Solution

- Enter CFs into the calculator's CFLO register.

  $CF_0 = -100$

  $CF_1 = 10$

  $CF_2 = 60$

  $CF_3 = 80$

- Enter I/YR = 10, press NPV button to get NPV_L = $18.78.

Rationale for the NPV Method

NPV = PV of inflows – Cost

= Net gain in wealth

- If projects are independent, accept if the project NPV > 0.
- If projects are mutually exclusive, accept project with the highest positive NPV, one that adds the most value.
- In this example, accept S if mutually exclusive ($NPV_S > NPV_L$), and accept both if independent.

Internal Rate of Return (IRR)

- Solving for IRR with a financial calculator:

$$0 = \sum_{t=0}^{N} \frac{CF_t}{(1 + IRR)^t}$$

- Enter CFs in CFLO register.
  - Press IRR; IRR_L = 18.13% and IRR_S = 23.56%.
  - Solving for IRR with Excel:

    =IRR(CF_0:CF_n,guess for rate)

How is a project's IRR similar to a bond's YTM?

- They are the same thing.
- Think of a bond as a project. The YTM on the bond would be the IRR of the "bond" project.
- EXAMPLE: Suppose a 10-year bond with a 9% annual coupon and $1,000 par value sells for $1,134.20.
  - Solve for IRR = YTM = 7.08%, the annual return for this project/bond.

Rationale for the IRR Method

- If IRR > WACC, the project's return exceeds its costs and there is some return left over to boost stockholders' returns.

  If IRR > WACC, accept project.

  If IRR < WACC, reject project.

- If projects are independent, accept both projects, as both IRR > WACC = 10%.
- If projects are mutually exclusive, accept S, because $IRR_S > IRR_L$.

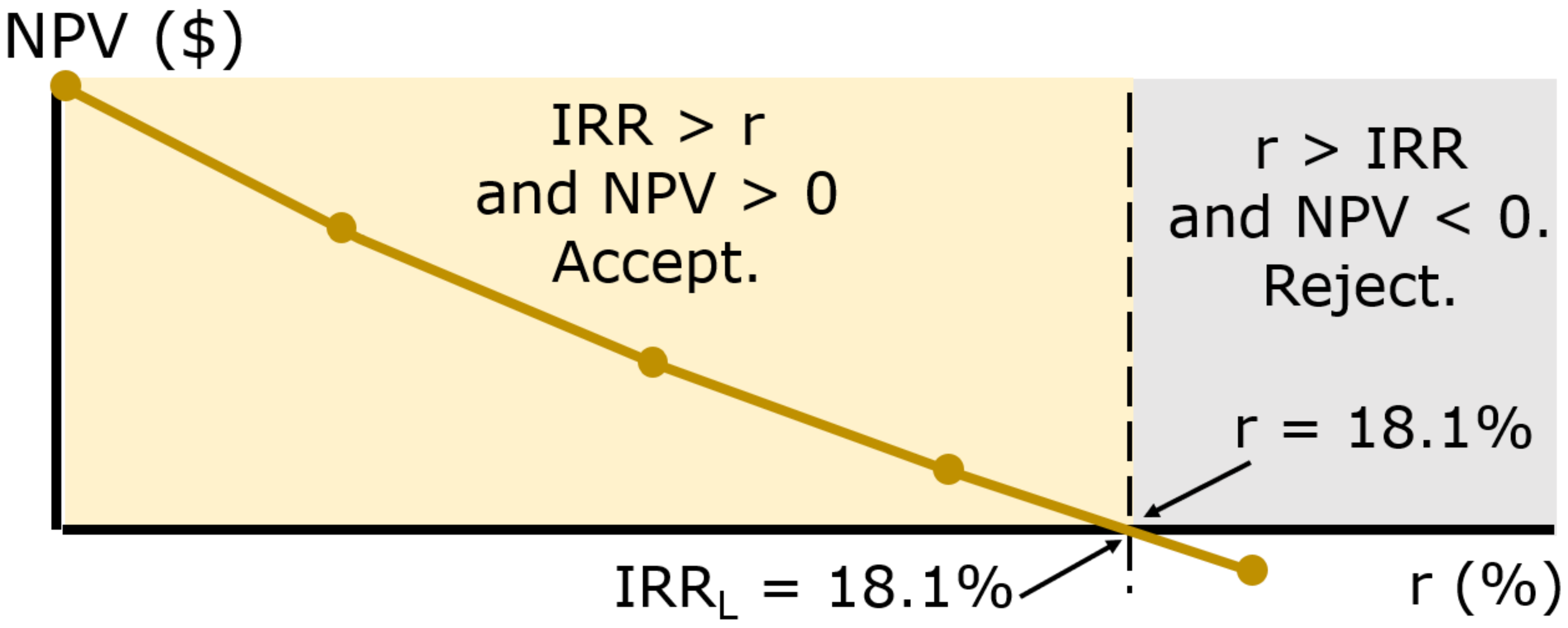
NPV Profiles

- A graphical representation of project NPVs at various different costs of capital.

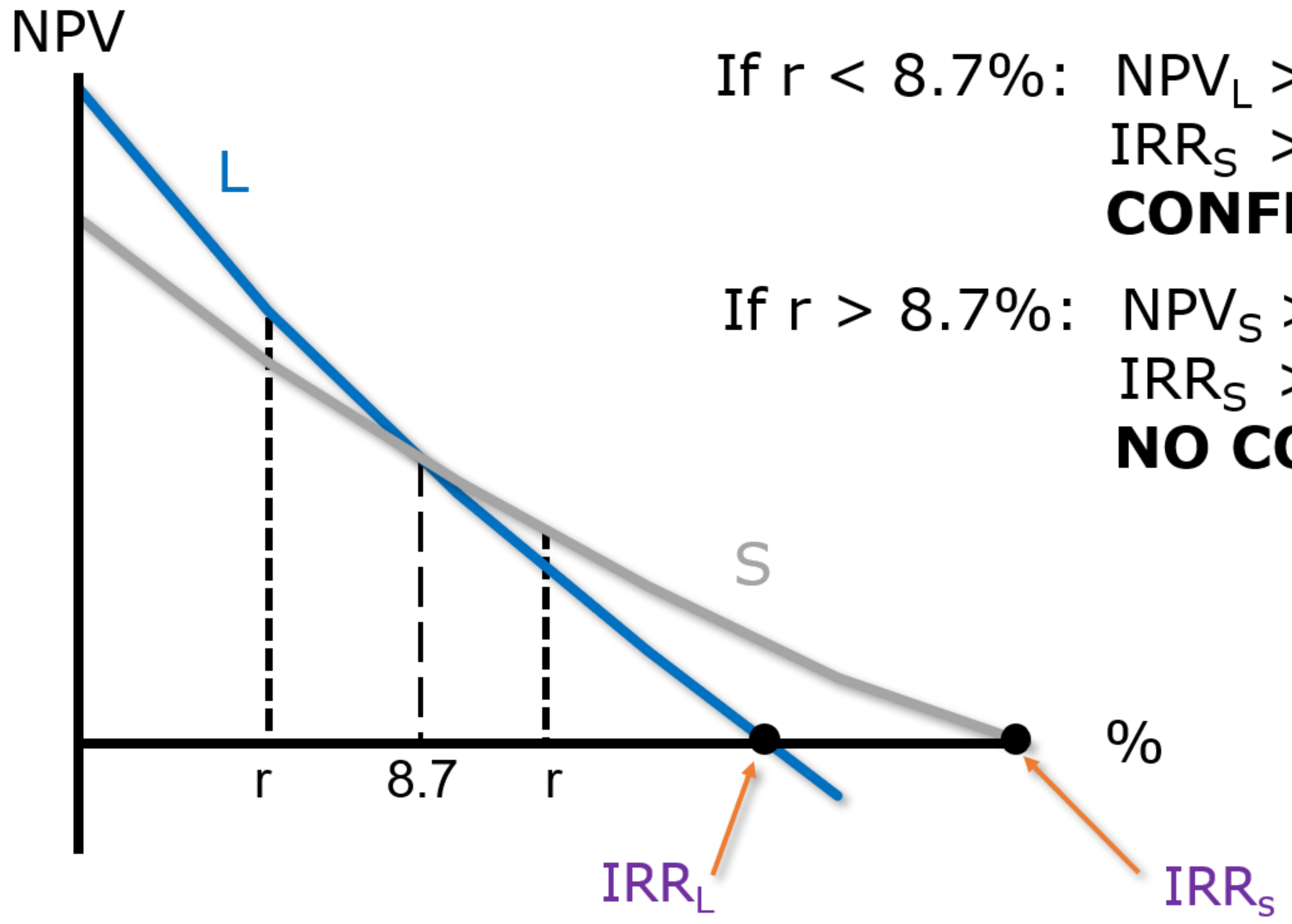
WACC	NPV_L	NPV_S
0	$50	$40
5	33	29
10	19	20
15	7	12
20	(4)	5

Independent Projects

NPV and IRR always lead to the same accept/reject decision for any given <u>independent project</u>.



Mutually Exclusive Projects



If $r < 8.7\%$: $NPV_L > NPV_S$
$IRR_S > IRR_L$
CONFLICT

If $r > 8.7\%$: $NPV_S > NPV_L$,
$IRR_S > IRR_L$
NO CONFLICT

Finding the Crossover Rate

- Find cash flow differences between the projects. See Slide 11-8.
- Enter the ΔCFs in CF_j register, then press ■ IRR. Crossover rate = 8.68%, rounded to 8.7%.
- If profiles don’t cross, one project dominates the other.

Reasons Why NPV Profiles Cross

- Size (scale) differences: The smaller project frees up funds at t = 0 for investment. The higher the opportunity cost, the more valuable these funds, so a high WACC favors small projects.

- Timing differences: The project with faster payback provides more CF in early years for reinvestment. If WACC is high, early CF especially good, $NPV_S > NPV_L$.

Reinvestment Rate Assumptions

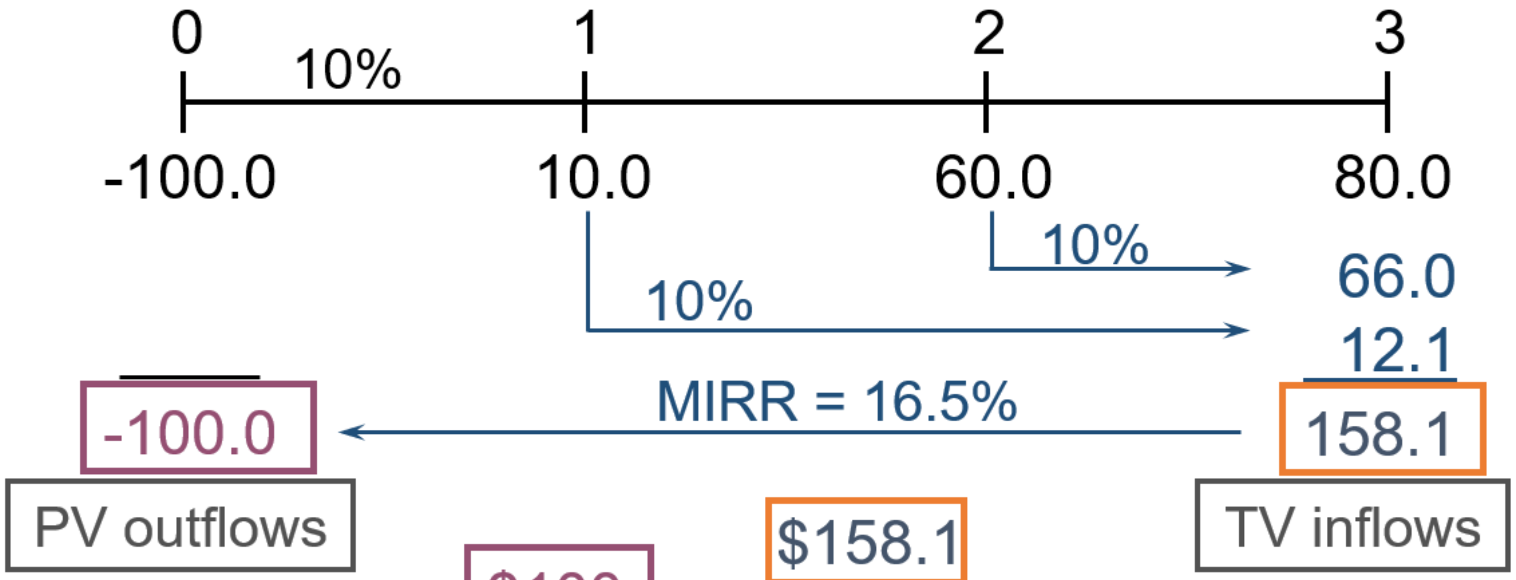
- NPV method assumes CFs are reinvested at the WACC.
- IRR method assumes CFs are reinvested at IRR.
- Assuming CFs are reinvested at the opportunity cost of capital is more realistic, so NPV method is the best. NPV method should be used to choose between mutually exclusive projects.
- Perhaps a hybrid of the IRR that assumes cost of capital reinvestment is needed.

Managers prefer the IRR to the NPV method; is there a better IRR measure?

- Yes, MIRR is the discount rate that causes the PV of a project's terminal value (TV) to equal the PV of costs. TV is found by compounding inflows at WACC.

- MIRR assumes cash flows are reinvested at the WACC.

Calculating MIRR



$$\$100 = \frac{\$158.1}{(1 + MIRR_L)^3}$$

$MIRR_L = 16.5\%$

Excel: MIRR(CF_0:CF_n,Finance_rate,Reinvest_rate)

We assume that both rates = WACC.

Why use MIRR versus IRR?

- MIRR assumes reinvestment at the opportunity cost = WACC. MIRR also avoids the multiple IRR problem.
- Managers like rate of return comparisons, and MIRR is better for this than IRR.

What is the payback period?

- The number of years required to recover a project's cost, or "How long does it take to get our money back?"
- Calculated by adding project's cash inflows to its cost until the cumulative cash flow for the project turns positive.

Calculating Payback

Project L's Payback Calculation

	0	1	2	3
CF_t	-100	10	60	80
Cumulative	-100	-90	-30	50

$$Payback_L = 2 + 30 / 80$$

$$= 2.375 \text{ years}$$

$$Payback_S = 1.600 \text{ years}$$

Discounted Payback Period

Uses discounted cash flows rather than raw CFs.

Timeline (r = 10%): periods 0, 1, 2, 3

	0	1	2	3
CF_t	-100	10	60	80
PV of CF_t	-100	9.09	49.59	60.11
Cumulative	-100	-90.91	-41.32	18.79

$$\text{Disc Payback}_L = 2 + 41.32 / 60.11 = 2.7 \text{ years}$$

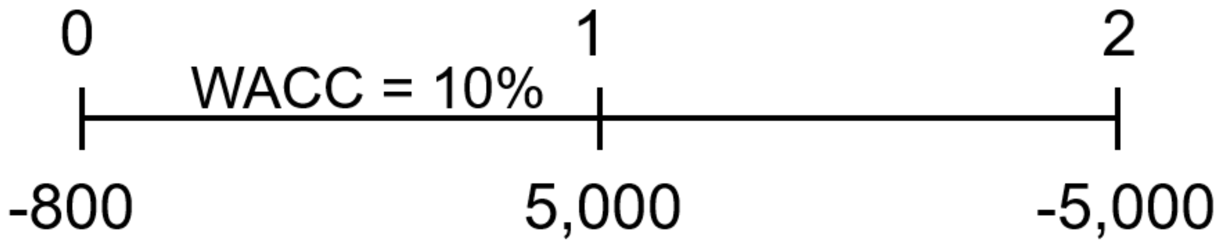
Strengths and Weaknesses of Payback

- Strengths
  - Provides an indication of a project's risk and liquidity.
  - Easy to calculate and understand.
- Weaknesses
  - Ignores the time value of money (TVM).
  - Ignores CFs occurring after the payback period.
  - No relationship between a given payback and investor wealth maximization.

Discounted payback considers TVM, but other 2 flaws remain.

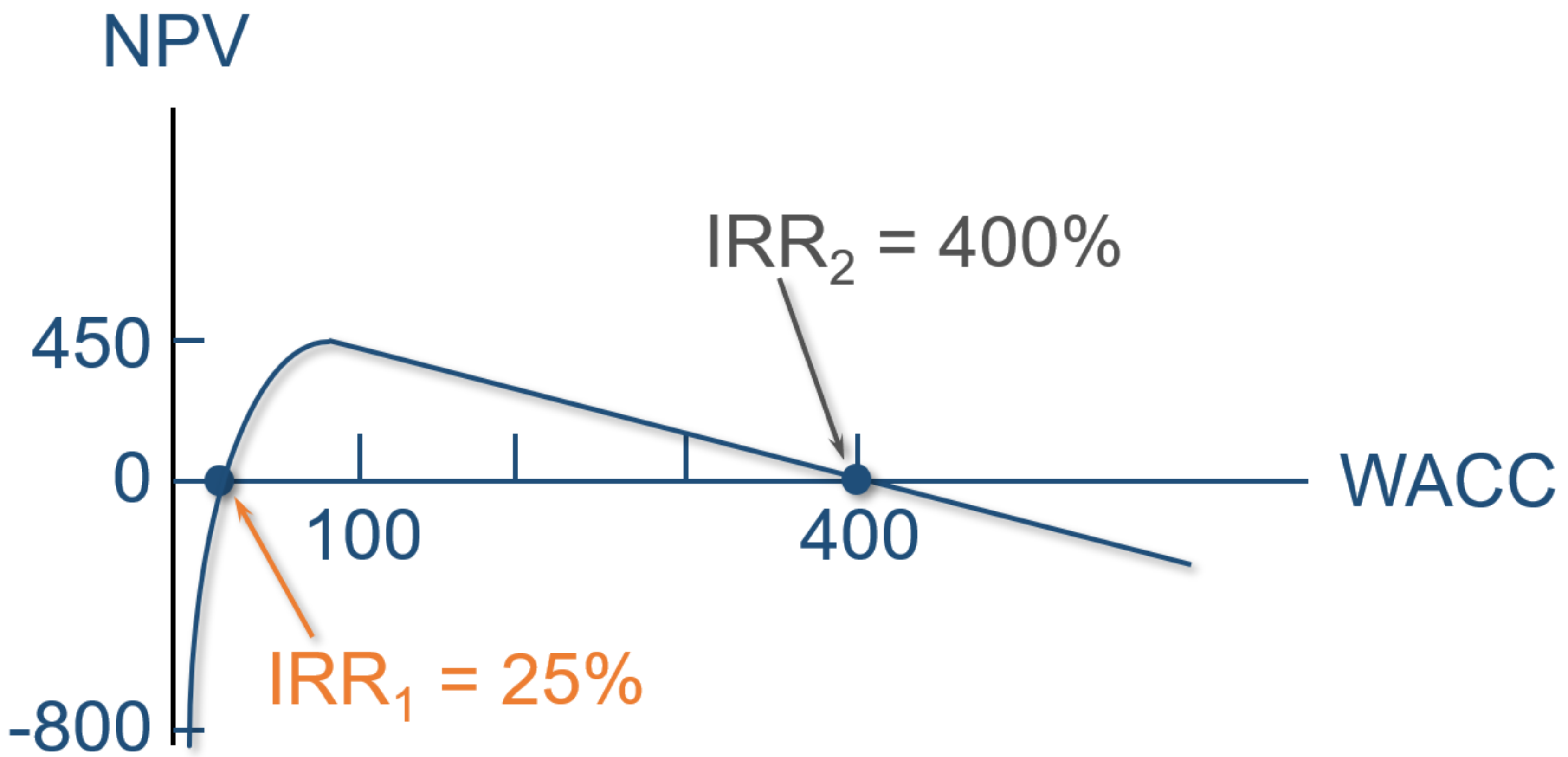
Find Project P's NPV and IRR

Project P has cash flows (in 000s): CF_0 = -$800, CF_1 = $5,000, and CF_2 = −$5,000.



- Enter CFs into calculator CFLO register.
- Enter I/YR = 10.
- NPV = -$386.78.
- IRR = ERROR Why?

Multiple IRRs



Why are there multiple IRRs?

- At very low discount rates, the PV of CF_2 is large and negative, so NPV < 0.
- At very high discount rates, the PV of both CF_1 and CF_2 are low, so CF_0 dominates and again NPV < 0.
- In between, the discount rate hits CF_2 harder than CF_1, so NPV > 0.
- Result: 2 IRRs.

When to use the MIRR instead of the IRR? Accept Project P?

- When there are nonnormal CFs and more than one IRR, use MIRR.
  - PV of outflows @ 10% = -$4,932.2314.
  - TV of inflows @ 10% = $5,500.
  - MIRR = 5.6%.
- Do not accept Project P.
  - NPV = -$386.78 < 0.
  - MIRR = 5.6% < WACC = 10%.