Initial Project Screening Method: Payback Period
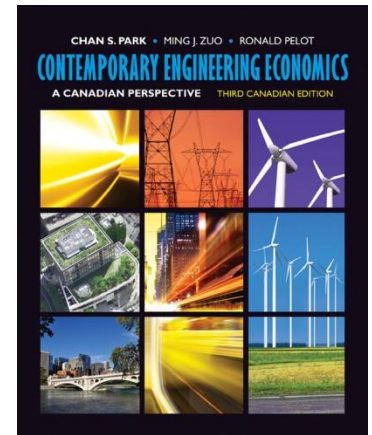
Lecture No. 12

Chapter 5

Contemporary Engineering Economics

Third Canadian Edition
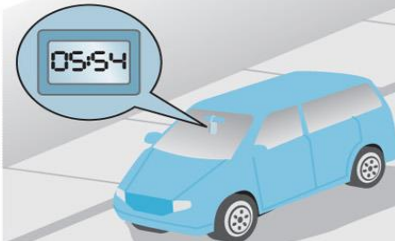
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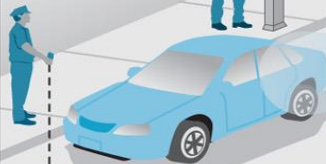
Chapter Opening Story

Fort Lauderdale, FL
In-car meters
Drivers can load up to $100 onto a prepaid meter that dangles from the rearview mirror, above; the meter counts down remaining parking minutes.

Montreal, QC
Multispace meters, handheld alerts
Each meter governs 10 to 15 spaces. After parking, drivers type in the space number and pay with a credit card or cash. Meters send real-time, block-by-block information to enforcement officers' handheld devices.

Coral Gables, FL
Pay with cellphone
Drivers register their cellphone, credit card and license plate numbers online. After they park, they dial a number and enter a lot and space number to begin their parking session.

Pacific Grove, CA
Smart meters
Sensors embedded in the concrete under a parking space can tell when a car pulls out, resetting the meter to zero.

CELLPHONE ENABLED
1-800-555-5555
Lot 28
Space 6

Handheld device
Cars parked legally are displayed as green squares, while those that have exceeded their time limit turn red.

Sacramento, CA
Infrared license plate scanners
Enforcement vehicles traveling as fast as 30 mph use cameras to scan license plates. Using a global positioning system lets officers check whether a car has outlasted its time on the meter. The system also can match license plates against databases of unpaid parking tickets and stolen vehicles.

Ultimate Questions

- **Municipalities' Point of View:** *Returns*
  - Would there be <u>enough new revenues</u> from installing the expensive parking monitoring devices?
  - How many devices could be installed to maximize the revenue streams? *Opportunity*

- **Manufacturer's Point of View:**
  - Would there be enough demand for their product to justify the investment required <u>in new facilities</u> and <u>marketing</u>?
  - What would be the potential financial risk if the actual demand is far less than its forecast or adoption of technology is <u>too slow</u>? *Time factor*

Chapter 5 Objectives

- How do firms screen potential investment opportunities?

- How do firms evaluate the profitability of an investment project by considering the time value of money?

- How do you determine the net present worth (cost), net annual worth (cost), net future worth (cost), and the internal rate of return of a project?

  IRR (leave it to 2nd half of the term)

Chapter 5 Objectives (continued)

- How do you determine the capital recovery cost when you purchase an asset?

- How do you determine unit cost or unit profit?

- What is the meaning of the rate of return? *RoR*

- What are some of the various methods to compute the rate of return?

- How do you resolve the multiple rates of return problem?

- How do make an accept or reject decision with each of the PW, FW, AE, and IRR criteria?
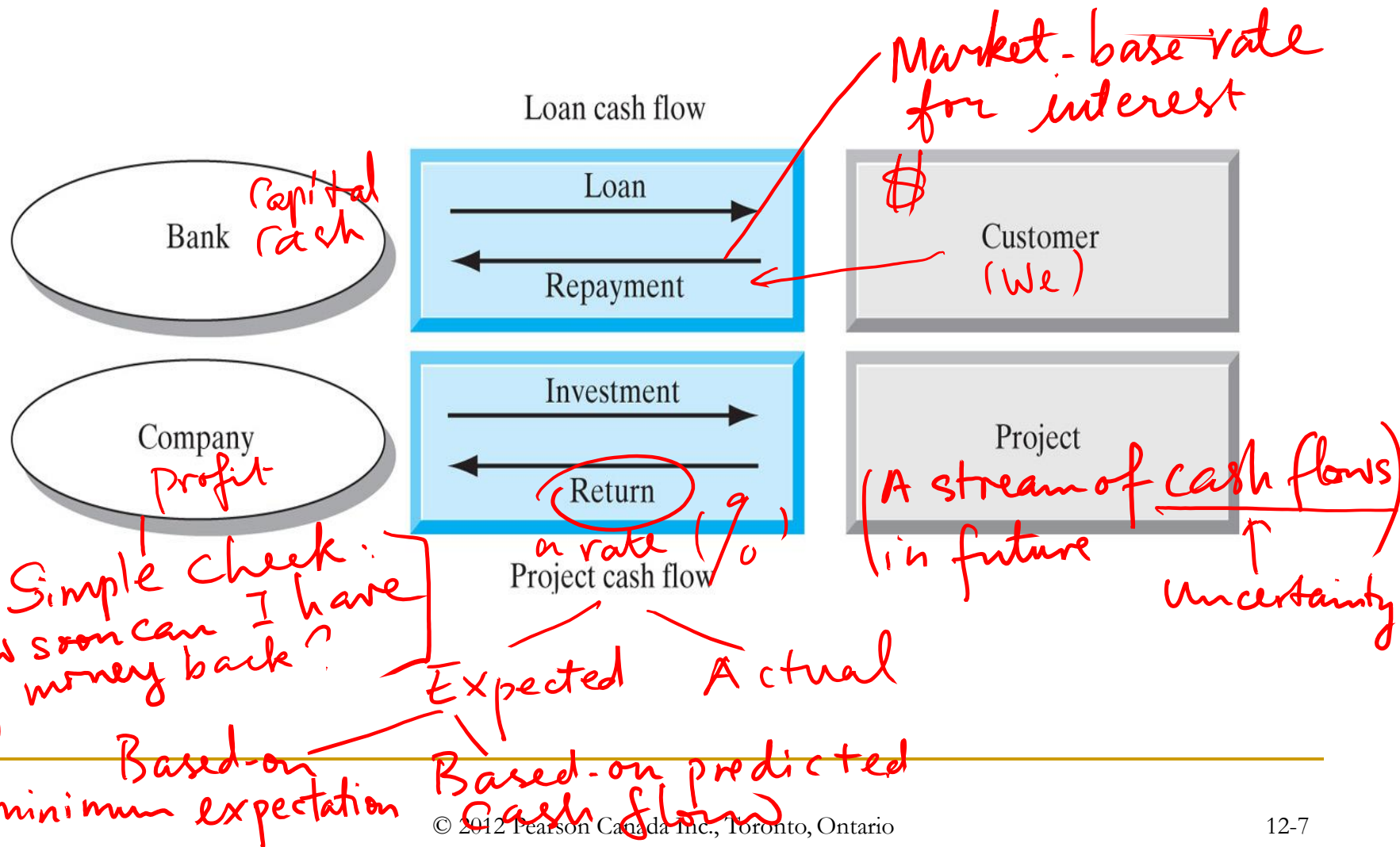
Not now

Lecture 12 Objectives

- How do firms screen potential investment opportunities?

- How do firms evaluate the profitability of an investment project by considering the time value of money?

Discounting

Bank Loan vs. Investment Project

Loan cash flow

Bank — Loan → Customer
Repayment

Company — Investment → Project
Return

Project cash flow

Handwritten annotations:

Market-base rate for interest

Capital cash

$ Customer (We)

Profit

A stream of cash flows (in future) ↑ Uncertainty

Simple check: How soon can I have my money back?

Return — a rate (%)

Expected — Based on minimum expectation

Actual — Based on predicted cash flow

Example 5.1: Identifying Project Cash Flows

- XL Chemicals: 40% of its time is used to produce demulsification products, i.e. operating 3500 hrs per year, 30,000 kg/yr @ $15/kg

- The other 60% of the time produce other specialty chemicals

- It plans to install computer control system, which costs $650,000 upfront and additional maintenance $53,000/yr with the following benefits:

  - Higher purity, then $2/kg price increase

  - Production increase of 4,000 kg/yr due to better yield at no additional costs

  - Reduced operators, leading to saving of $25/hr

New beneficial cash flows generated:
- Revenue increase due to price increase: 30,000 kg/yr x $2/kg = $60,000/yr
- Added production volume: 4,000 kg/yr x $17/yr = $68,000/yr
- Manpower saving: $25/hr x 3500 hrs/yr = $87,500/yr
- Total benefits in cash incomes: $215,500/yr
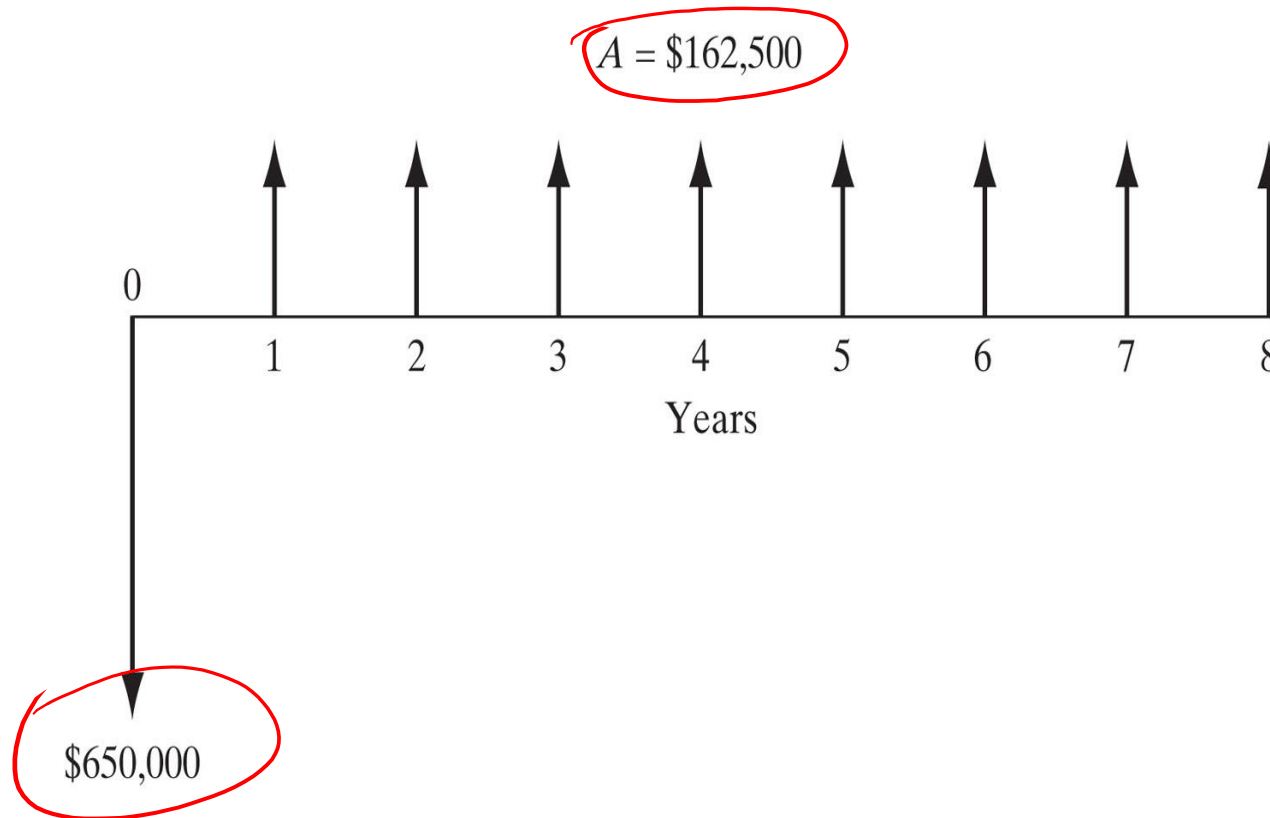
(handwritten annotations: "one operator?", "① ② ③", "new price = 15 + 2")

Example 5.1: Describing Project Cash Flows

Year (*n*)	Cash Inflows (Benefits) (+)	Cash Outflows (Costs) (−)	Net Cash Flows
0	0	$650,000	-$650,000 ✓
1	215,500 ✓	53,000 *maint*...	162,500
2	215,500 ✓	53,000	162,500
…	…	…	…
8	215,500 ✓	53,000	162,500

Example 5.1: Identifying Project Cash Flows

$A = \$162,500$

Years

$\$650,000$

Independent versus Mutually Exclusive Investment Projects

- ## Independent: *project*
  - Costs and benefits of one project do not depend on whether another is chosen.
  - Example: Computer process control project, Waste heat recovery boiler, etc.

- ## Mutually Exclusive: *Optional*
  - A project is excluded if another is chosen.
  - Example: a mortgage, from Bank A, Bank B, or Bank C?

Payback Period
(Simple)

- **Principle**:
  How fast can I recover my initial investment?
- **Method**:
  based on the cumulative *net* cash flow (also called project balance or accounting profit)
- **Screening Guideline**: *Who?*
  If the payback period is shorter than a maximum acceptable specified payback period, the project would be considered for further analysis.
- **Weakness**:
  does not consider the time value of money

Example 5.2: Conventional Payback Period

- How long does it take to recover the initial investment for the computer process control system project in Example 5.1?

$$\text{Payback Period} = \frac{\text{Initial Cost}}{\text{Uniform annual benefit}}$$

$$= \frac{\$650,000}{\$162,500}$$

$$= 4 \text{ years}$$
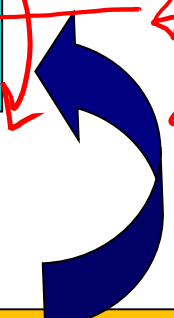
4.05 → 5

3.9 → 4

(3.5) → 4

3.2 → 4

Example 5.3: Conventional Payback Period With Salvage Value

- Autonumerics Company has just bought a new spindle machine at a cost of $105,000 to replace one that had a salvage value of $20,000. The projected annual after-tax savings via improved efficiency, which will exceed the investment cost, are provided in the next slide.
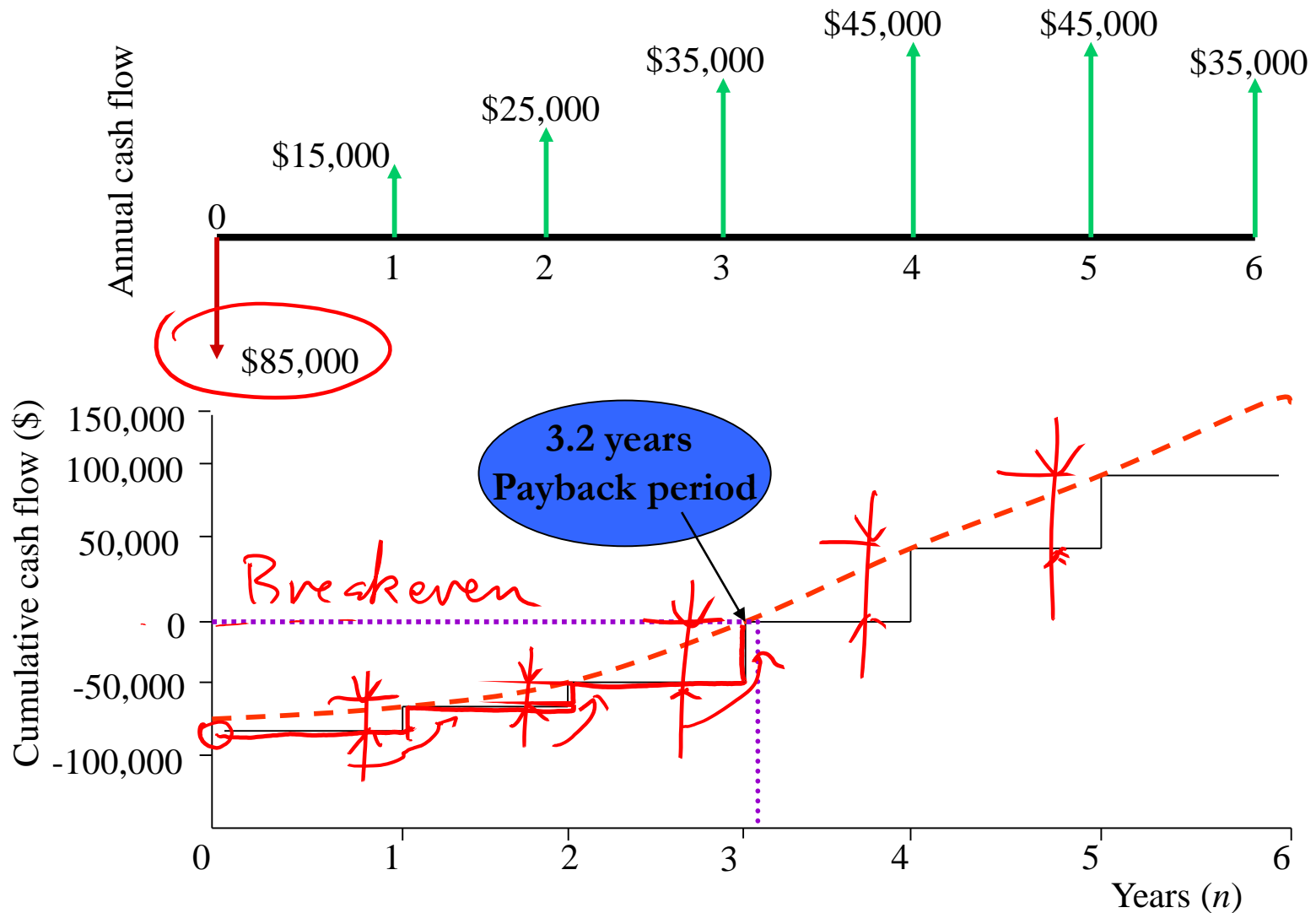
Example 5.3: Conventional *simple* Payback Period With Salvage Value

N	Cash Flow	Cum. Cash Flow *Project Balance (PB)*
0	-$105,000+$20,000	-$85,000
1	$15,000	-$70,000
2	$25,000	-$45,000
3	$35,000	-$10,000
4	$45,000	$35,000
5	$45,000	$80,000
6	$35,000	$115,000

milestone — 4

4 yrs

Payback period occurs somewhere between $N = 3$ and $N = 4$. We say it is 4 years if the end-of-period convention is followed.

Example 5.3: Conventional Payback Period Calculation

Annual cash flow

$15,000 $25,000 $35,000 $45,000 $45,000 $35,000

0   1   2   3   4   5   6

$85,000

Cumulative cash flow ($)

150,000
100,000
50,000
0
-50,000
-100,000

Breakeven

3.2 years
Payback period

0   1   2   3   4   5   6

Years (*n*)

Advantages and Disadvantages of the *Simple* Payback Period Method

Advantages

- easy to understand
- adjusts for uncertainty of later cash flows
- reduces time spent analyzing some alternatives

(Simple)

Disadvantages

- fails to measure profitability
- ignores the time value of money
- biased against long-term projects

Discounted Payback Period

- **Principle**:

  How fast can I recover my initial investment plus interest?

- **Method**:

  Based on the cumulative discounted cash flow

- **Screening Guideline**:

  If the discounted payback period (DPP) is less than or equal to some specified payback period, the project would be considered for further analysis.

- **Weakness**:

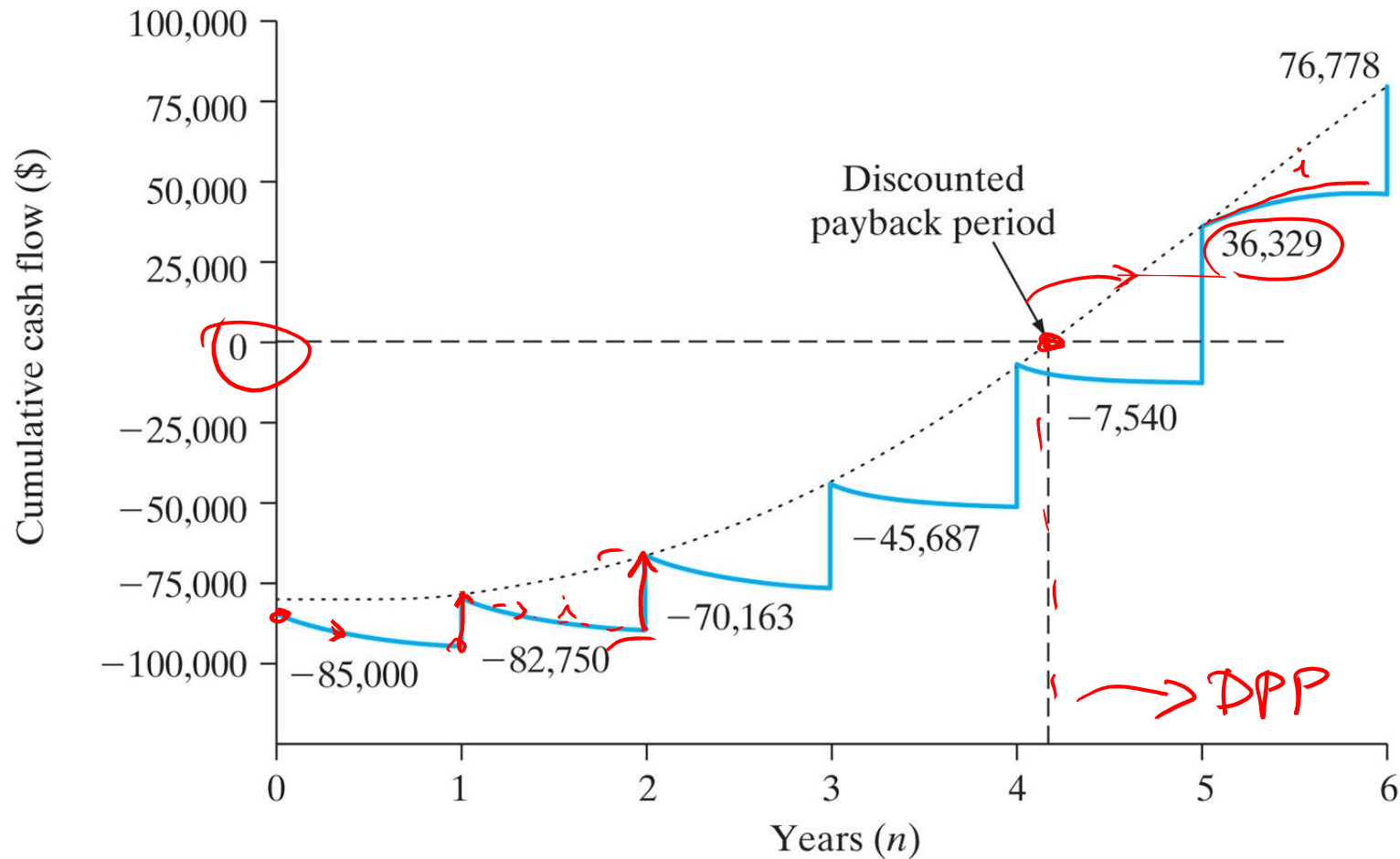 Cash flows occurring after DPP are ignored

Example 5.3: Discounted Payback Period Calculation

Period	Cash Flow	Cost of Funds (15%)*	Cumulative Cash Flow
0	-$85,000	0	-$85,000
1	15,000	-$85,000(0.15) = -$12,750	-82,750
2	25,000	-$82,750(0.15) = -12,413	-70,163
3	35,000	-$70,163(0.15) = -10,524	-45,687
4	45,000	-$45,687(0.15) =-6,853	-7,540
5	45,000	-$7,540(0.15) = -1,131	36,329
6	35,000	$36,329(0.15) = 5,449	76,778

* **Cost of funds = (Unrecovered beginning balance) X (interest rate)**

Example 5.3: Discounted Payback Period Calculation

Extra Example: Problem 5.11

[handwritten: Cost of fund]

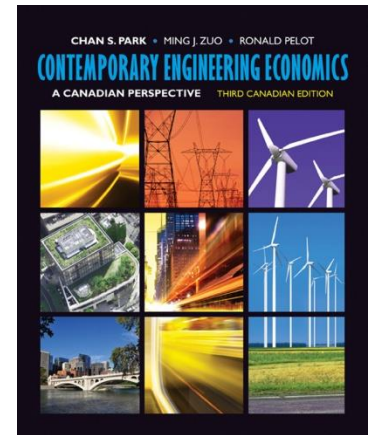| Period	Cash Flow	Project Balance
0	-$1,000	-$1,000
1	100 ? *200*	-1,100
2	520 ? *220*	-800
3	460 *160*	-500
4	600 ? *100*	0

[handwritten annotations: 300, ±300]

* Find the interest rate used and the missing cash flows.

[handwritten]

✱ Consider cost fund

$$I_3 = 460 - 300$$
$$= 160$$

$$i = \frac{160}{800} = 20\%$$

Summary

Independent projects are considered one at a time and are either accepted or rejected. Payback periods can be used as a screening tool for liquidity, but we need a measure of investment worth for profitability.