



CHAPTER 8.

CHOOSING THE BEST ALTERNATIVE

We continue the IRR analysis by using graphical technique in solving problems with mutually exclusive alternatives. We then compare the three main methods of project evaluation: present worth, annual worth, and IRR.



1. GRAPHICAL INCREMENTAL ANALYSIS

- We will continue to examine IRR using the *graphical approach*.
 - This approach is consistent with the calculation of incremental IRR.
 - It illustrates the size difference between alternatives.
 - We will first compare graphs of PW, EUAC or EUAW of many alternatives.
- Incremental analysis
 - Remember that the objective of incremental analysis is to select the best of the mutually exclusive alternatives in the IRR approach.
 - For two alternatives,
$$[\text{Higher-cost alt.}] = [\text{Lower-cost alt.}] + [\text{Increment between them}]$$
 - For more alternatives, a series of “challenger-defender” comparisons is required.

EXAMPLE 1-1. GRAPHICAL ANALYSIS (1)

- The student society is building a snack cart to raise money. It can build either a high capacity (150 customers) cart or a low capacity (100 customers) cart. The society is unsure of what interest rate to use. Make a recommendation.

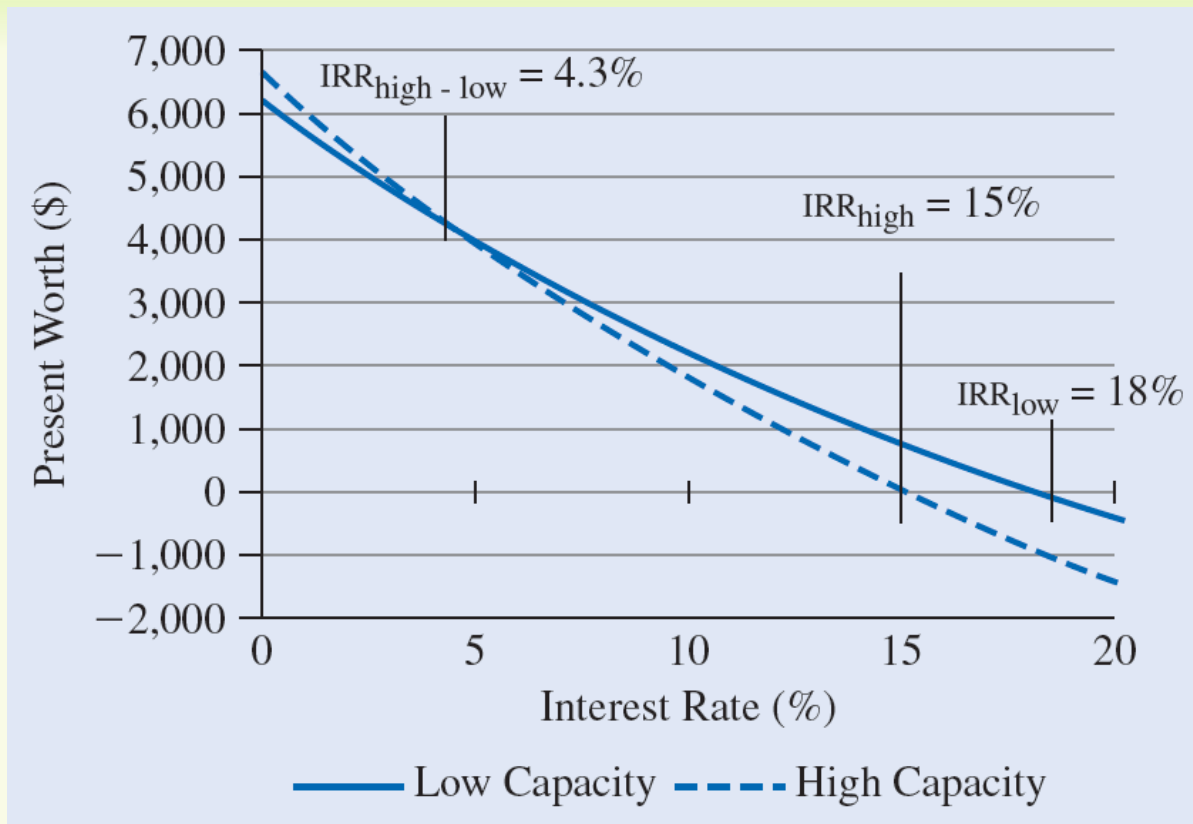
	High	Low	Increment
Initial cost	\$13,400	\$10,310	\$3,090
Annual benefit	\$4,000	\$3,300	\$700
Useful life (years)	5	5	

- Calculate PW of each alternative for an unknown i .

$$\text{PW (low)} = -10,310 + 3,300(P/A, i, 5)$$

$$\text{PW (high)} = -13,400 + 4,000(P/A, i, 5)$$

EXAMPLE 1-1. GRAPHICAL ANALYSIS (2)



- $0\% \leq MARR \leq 4.3\% \Rightarrow$ Choose High capacity
- $4.3\% \leq MARR \leq 18\% \Rightarrow$ Choose Low capacity
- $18\% \leq MARR \Rightarrow$ Do nothing

EXAMPLE 1-2. GRAPHICAL ANALYSIS (1)

- Consider the three mutually exclusive alternatives.

	A	B	C
First cost	\$2,000	\$4,000	\$5,000
Uniform annual benefit	\$410	\$639	\$700

- If MARR is 6% and the service life is 20 years, which alternative should be selected?

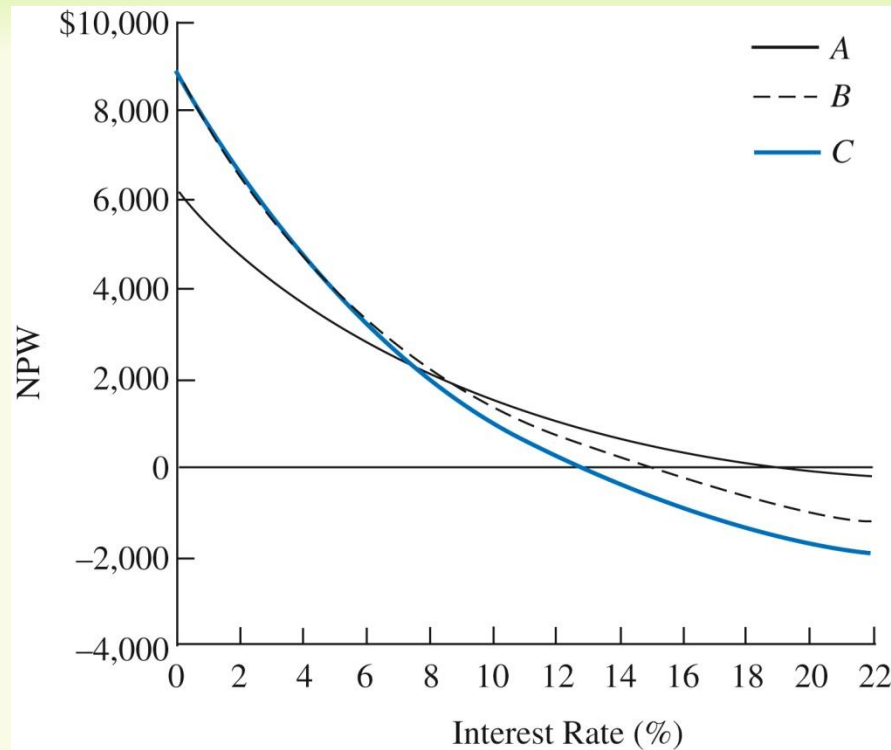
We can calculate PW of each alternative for unknown i .

$$PW(A) = -2,000 + 410(P/A, i, 20)$$

$$PW(B) = -4,000 + 639(P/A, i, 20)$$

$$PW(C) = -5,000 + 700(P/A, i, 20)$$

EXAMPLE 1-2. GRAPHICAL ANALYSIS (2)



- $0\% \leq \text{MARR} \leq 2\% \Rightarrow \text{Choose C}$
- $2\% \leq \text{MARR} \leq 9.6\% \Rightarrow \text{Choose B}$
- $9.6\% \leq \text{MARR} \Rightarrow \text{Choose A}$

Since MARR is 6%, you should select alternative B.

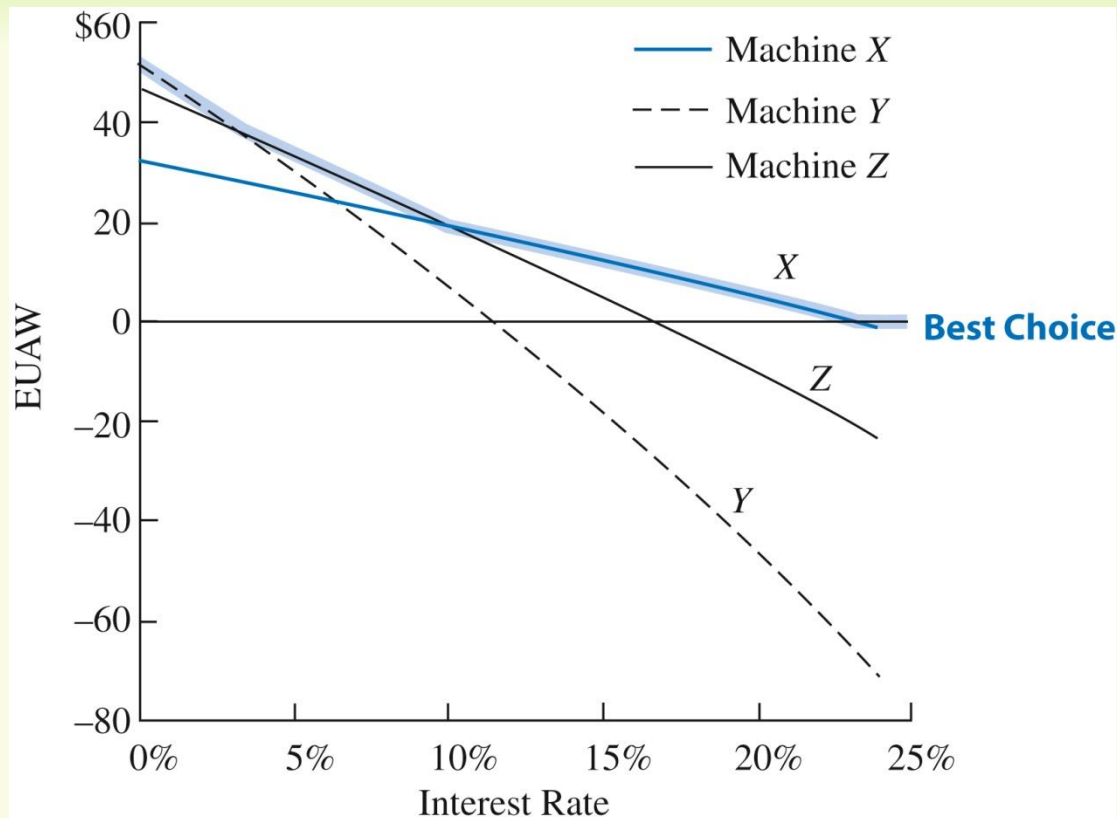
EXAMPLE 1-3. GRAPHICAL ANALYSIS (1)

- Among the three mutually exclusive alternatives, which one should be chosen for an unknown MARR.

	Machine X	Machine Y	Machine Z
Initial cost	\$200	\$700	\$425
Annual benefit	\$65	\$110	\$100
Life (years)	6	12	8

- The lives of the three alternatives are different.
- If we want to use PW approach, we have to consider least common multiple or the analysis period.
- However, assuming a series of replacements, we can simply calculate the annual worth of the service lives of each alternative.

EXAMPLE 1-3. GRAPHICAL ANALYSIS (2)



- $0\% \leq \text{MARR} \leq 3.5\% \Rightarrow \text{Choose Y}$
- $3.5\% \leq \text{MARR} \leq 10\% \Rightarrow \text{Choose Z}$
- $10\% \leq \text{MARR} \leq 23\% \Rightarrow \text{Choose X}$

EXAMPLE 1-4. INCREMENTAL ANALYSIS (1)

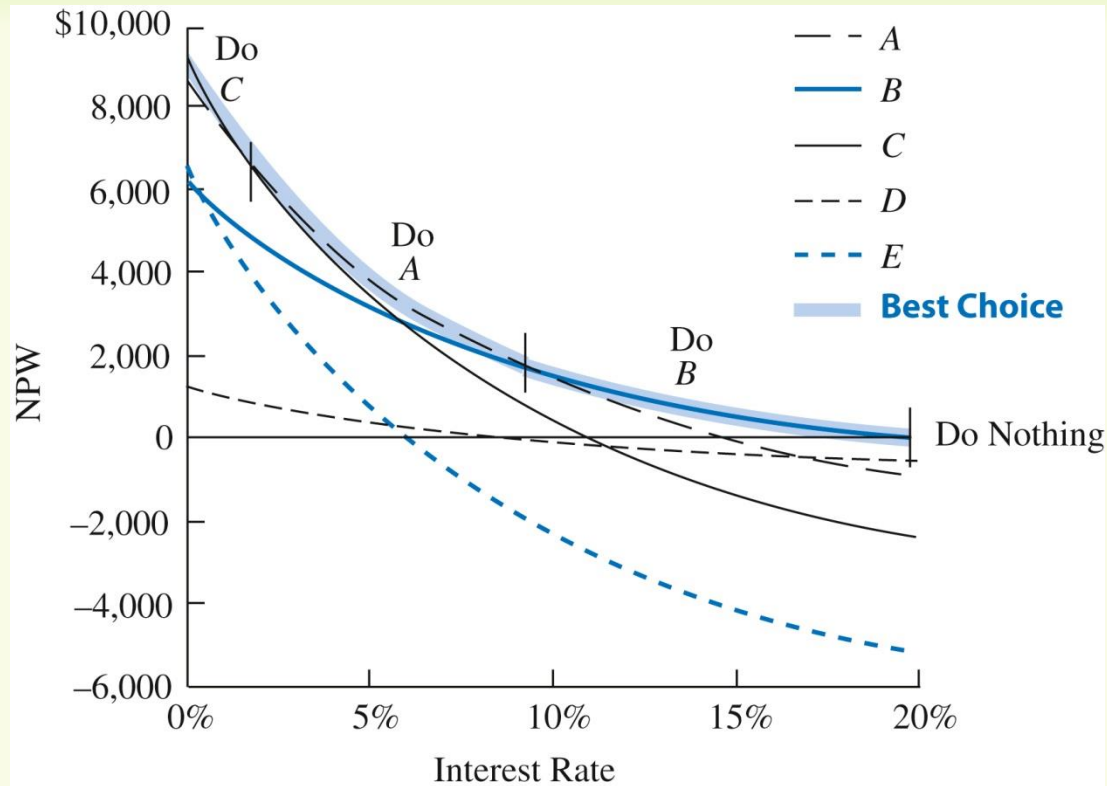
- The following five alternatives with 20-year service life are being considered. Given an MARR of 10%, which alternative is best?

	A	B	C	D	E
First cost	\$4,000	\$2,000	\$6,000	\$1,000	\$9,000
Annual benefits	\$639	\$410	\$761	\$117	\$785

Start with the lowest cost, D. The order is D – B – A – C – E.

EXAMPLE 1-4. INCREMENTAL ANALYSIS (2)

EXAMPLE 1-4. INCREMENTAL ANALYSIS (3)



- $0\% \leq \text{MARR} \leq 2\% \Rightarrow \text{Choose C}$
- $2\% \leq \text{MARR} \leq 9.6\% \Rightarrow \text{Choose A}$
- $9.6\% \leq \text{MARR} \leq 20\% \Rightarrow \text{Choose B}$

2. CHOOSING AN APPROPRIATE METHOD

- All analysis methods (PW, EUAW and IRR) provide a consistent solution (If not, you made a mistake!).
- Rate of return analysis
 - Easier to explain.
 - Most frequently used.
 - Does not require a minimum attractive rate of return (MARR).
 - More difficult to calculate manually.
 - May have multiple rates of return.
- Present worth or annual worth analysis
 - Easy to understand.
 - Easier to calculate without Excel.
 - Require a known MARR in calculation.

EXAMPLE 2-1. COMPARISON OF APPROACHES (1)

- KWLeisure Co. plans to add one of the two new operations in its service: gliding or canoeing.

	Gliding	Canoeing
First cost	\$100,000	\$10,000
Uniform annual benefit	\$15,000	\$2,000

- Both projects have zero salvage value after 15 years and the MARR is 10%.

- Using the PW approach, find which one is better.

EXAMPLE 2-1. COMPARISON OF APPROACHES (2)

2. Using the rate of return approach, find which one is better.

SUMMARY OF CHAPTER 8

- Graphical incremental analysis
- Algorithm of incremental analysis
 - Defender-Challenger comparison
- Comparison of different approaches

- There is no selective end-of-chapter problems. You just need to read the lecture note carefully.