



Chapter 5

Present Worth Analysis

Lecture slides to accompany

Engineering Economy

8th edition

Leland Blank

Anthony Tarquin



LEARNING OUTCOMES

- 1. Formulate Alternatives**
- 2. PW of equal-life alternatives**
- 3. PW of different-life alternatives**
- 4. Future Worth analysis**
- 5. Capitalized Cost analysis**

Formulating Alternatives

Two types of economic proposals

★ **Mutually Exclusive (ME) Alternatives:** _____ **one** can be selected;
Compete against each other

★ **Independent Projects:** _____ **one** can be selected;
Compete only against DN

Do Nothing (DN) – An ME alternative or independent project to maintain the current approach; no new costs, revenues or savings

Formulating Alternatives

Two types of cash flow estimates

- ✦ **Revenue:** Alternatives include estimates of costs (cash outflows) _____ revenues (cash inflows)
- ✦ **Cost:** Alternatives include _____ costs; revenues and savings assumed _____ for all alternatives

PW Analysis of Alternatives

- ✦ Convert all cash flows to PW using _____
 - ✦ Precede **costs** by _____ sign; **receipts** by _____ sign
-

EVALUATION

- ✦ For one project, if PW _____ 0, it is justified
- ✦ For mutually exclusive alternatives, select **one** with *numerically* _____ **PW**
- ✦ For independent projects, select _____ with **$PW \geq 0$**

Selection of Alternatives by PW

For the alternatives shown below, which should be selected if they are (a) mutually exclusive; (b) independent?

<u>Project ID</u>	<u>Present Worth</u>
A	\$30,000
B	\$12,500
C	\$-4,000
D	\$ 2,000

Solution: (a) Select numerically largest PW; alternative ____
(b) Select all with $PW \geq 0$; projects _____

Example: PW Evaluation of Equal-Life ME Alts.

Alternative X has a first cost of \$20,000, an operating cost of \$9,000 per year, and a \$5,000 salvage value after 5 years. Alternative Y will cost \$35,000 with an operating cost of \$4,000 per year and a salvage value of \$7,000 after 5 years. At an MARR of 12% per year, which should be selected?

Solution: Find PW at MARR and select numerically _____ PW value

$$\begin{aligned}PW_X &= -20,000 - 9000(P/A, 12\%, 5) + 5000(P/F, 12\%, 5) \\ &= -\$49,606\end{aligned}$$

$$\begin{aligned}PW_Y &= -35,000 - 4000(P/A, 12\%, 5) + 7000(P/F, 12\%, 5) \\ &= -\$45,447\end{aligned}$$

Select alternative _____

PW of Different-Life Alternatives

Must compare alternatives for _____ service
(i.e., alternatives must end at the _____ time)

Two ways to compare equal service:

- ★ **Least common multiple (LCM) of lives**
- ★ **Specified study period**

(The LCM procedure is used unless otherwise specified)

Assumptions of LCM approach

- ☐ Service provided is needed over the _____ or more years
- ☐ Selected alternative can be repeated over each life cycle of LCM in exactly the _____ manner
- ☐ Cash flow estimates are the same for each life cycle

Example: Different-Life Alternatives

Compare the machines below using present worth analysis at $i = 10\%$ per year

	<u>Machine A</u>	<u>Machine B</u>
First cost, \$	20,000	30,000
Annual cost, \$/year	9000	7000
Salvage value, \$	4000	6000
Life, years	3	6

Solution: LCM = 6 years; _____ A after 3 years

$$PW_A = -20,000 - 9000(P/A, 10\%, 6) - 16,000(P/F, 10\%, 3) + 4000(P/F, 10\%, 6)$$

$$= \$-68,961$$

$$PW_B = -30,000 - 7000(P/A, 10\%, 6) + 6000(P/F, 10\%, 6)$$

$$= \$-57,100$$

_____ in
year 3

Select alternative _____

PW Evaluation Using a Study Period

- ❖ Once a study period is specified, all cash flows after this time are _____
- ❖ Salvage value is the estimated _____ value at the end of study period

Short study periods are often defined by management when business goals are short-term

Study periods are commonly used in equipment replacement analysis

Example: Study Period PW Evaluation

Compare the alternatives below using present worth analysis at $i = 10\%$ per year and a 3-year study period

	<u>Machine A</u>	<u>Machine B</u>
First cost, \$	-20,000	-30,000
Annual cost, \$/year	-9,000	-7,000
Salvage/market value, \$	4,000	6,000 (after 6 years) 10,000 (after 3 years)
Life, years	3	6

Solution: Study period = 3 years; _____ all estimates after 3 years

$$PW_A = -20,000 - 9000(P/A, 10\%, 3) + 4000(P/F, 10\%, 3) = \$-39,376$$

$$PW_B = -30,000 - 7000(P/A, 10\%, 3) + 10,000(P/F, 10\%, 3) = \$-39,895$$

Marginally, select ___; different selection than for LCM = 6 years

Future Worth Analysis

FW exactly like PW analysis, except calculate _____

Must compare alternatives for _____ ***service***
(i.e. alternatives must ***end*** at the _____ time)

Two ways to compare equal service:

★ **Least common multiple (LCM) of lives**

★ **Specified study period**

(The LCM procedure is used unless otherwise specified)

FW of Different-Life Alternatives

Compare the machines below using future worth analysis at $i = 10\%$ per year

	<u>Machine A</u>	<u>Machine B</u>
First cost, \$	-20,000	-30,000
Annual cost, \$/year	-9000	-7000
Salvage value, \$	4000	6000
Life, years	3	6

Solution: **LCM = 6 years; repurchase A after 3 years**

$$\begin{aligned}FW_A &= -20,000(F/P, 10\%, 6) - 9000(F/A, 10\%, 6) - 16,000(F/P, 10\%, 3) + 4000 \\ &= \$-122,168\end{aligned}$$

$$\begin{aligned}FW_B &= -30,000(F/P, 10\%, 6) - 7000(F/A, 10\%, 6) + 6000 \\ &= \$-101,157\end{aligned}$$



Select (Note: **PW** and **FW** methods will result in **selection**)

Capitalized Cost (CC) Analysis

CC refers to the present worth of a project with a very long life, that is, PW as n becomes _____

Basic equation is: $CC = P = \frac{A}{i}$

“**A**” essentially represents the _____ on a _____ investment

For example, in order to be able to withdraw \$50,000 per year forever at $i = 10\%$ per year, the amount of capital required is $50,000/0.10 = \$500,000$



For _____ *life* alternatives, convert all cash flows into an A value over _____ *life cycle* and then divide by _____

Example: Capitalized Cost

Compare the machines shown below on the basis of their capitalized cost. Use $i = 10\%$ per year

	<u>Machine 1</u>	<u>Machine 2</u>
First cost,\$	-20,000	-100,000
Annual cost,\$/year	-9000	-7000
Salvage value, \$	4000	-----
Life, years	3	∞

Solution: Convert machine 1 cash flows into ____ and then divide by ____

$$A_1 = -20,000(A/P, 10\%, 3) - 9000 + 4000(A/F, 10\%, 3) = \$-15,834$$

$$CC_1 = -15,834 / 0.10 = \$-158,340$$

$$CC_2 = -100,000 - 7000 / 0.10 = \$-170,000$$

Select machine ____

Summary of Important Points

- ★ PW method converts all cash flows to *present value at* _____
- ★ Alternatives can be *mutually* _____ or _____
- ★ Cash flow estimates can be for _____ or _____ alternatives
- ★ PW comparison must always be made for _____ *service*
- ★ Equal service is achieved by using _____ or _____
- ★ Capitalized cost is PW of project with _____ *life*;
 $CC = P =$ _____

HOMEWORK

1. Please solve every Examples in your textbook. You do not have to submit your works.
2. Please upload following “PROBLEMS” solution file on “Assignment” menu in e-Class.
 - ① 5.16
 - ② 5.26
 - ③ 5.31
 - ④ 5.47
 - ⑤ 5.51