AAIT

School of Civil and Environmental Engineering

Engineering Economics (CEng 5211)

Chapter 3:Economic Evaluation

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Economic Evaluation

- Present worth analysis
- Future worth analysis
- Payback period
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3.2 Future Worth Analysis

Future Worth (Net Future Value) Method

- A corollary to the present value and net present worth is the **future value** and the **net future worth** (NFW).
- In this method **all cash inflows** and **outflows** of a given project (having a given project life) are **brought** to **time n**.
- If the difference between the inflows minus the outflows is positive then the project is acceptable.
  - NFW>0, Accept the investment
  - NFW=0, remain indifferent to the investment
  - NFW<0, reject the investment
- Future worth analysis calculates the **future worth** of an investment undertaken.
- If it is to **compare among** various **projects**, the **one having more positive value** is **economically** the **best alternative**.

3.2 Future Worth Analysis

Future Worth (Net Future Value) Method

Example

Your company is looking at purchasing the front-end loader at cost of $120,000. The loader would have a useful life of five years with a salvage value of $12,000 at the end of the fifth year. The annual profit of loader [revenue less operation cost] is $48,000. Determine the future worth for the purchase of the loader using a MARR of 20%. Should your company purchase the loader?

Solution:

The future value of the purchase price is determined as follows:

$$F_{PP} = -\$120{,}000\ (1+0.20)^5 = -\ \$120{,}000*2.4883 = -\ \$298{,}598$$

- The future value of the purchase price is negative because it is a cash disbursement.
- The FW of the annual profits is determined as follows:

$$F_{AP} = \$48{,}000*\ [((1+0.20)^5 - 1)\ /\ 0.20] = \$48{,}000*7.4416 = \mathbf{\$357{,}197}$$

3.2 Future Worth Analysis

Future Worth (Net Future Value) Method

Solution:

- F_{AP} = \$48,000* [(1+0.20)^5 - 1] / 0.20 = \$48,000*7.4416=**\$357,197**

- The FW of the annual profits is **positive** because it is a cash receipt.
- The future value of the salvage value is equal to the salvage value because the future value is measured at the end of the study period. The FW of the salvage value is positive because it is a cash receipt. [F_{SV} = \$12,000]
- The future worth for purchasing the loader equals the sum of the future values of the individual cash flows and is calculated as follows:
- $FW = F_{PP} + F_{AP} + F_{SV}$
- FW = - \$298,598 + \$357,197+ \$12,000= **\$70,599** >0(Better that the company's MARR)

→ So, it is attractive for the company to purchase the front-end loader .

3.3 Payback Period Analysis

- Estimates the time (payback period) required **to recover the initial investment in a project**.
- Payback period is the period of time required for the project's *benefit to equal to the project's cost.*
- It is an approximate, rather than an exact, economic analysis calculation.
- Often used as a **screening technique/ preliminary analysis tool**.
- May or may not select the correct alternative.
- All the economic consequences beyond the payback period are completely ignored.
- Two forms:
  - Ignoring TVOM, with 0% interest: **Conventional PB method**
  - With an assumed interest rate : **Discounted payback analysis**
- It is important to note that PBA is not an end to itself, but rather a method of screening out certain obvious unacceptable investment alternatives before progressing to an analysis of potentially acceptable ones.
  - **Compare PBP Vs maximum acceptable PBP.**

3.3 Payback Period Analysis

Example: Payback period:

- **A. Ignoring TVOM(i=0%)**
- **B. Perform Discounted payback at i=10%**

A. i=0%

E.O.Y	CF	Cumulative CF
0	-30,000	-30,000
1	-4,000	-34,000
2	15,000	-19,000
3	16,000	-3,000
4	8,000	5,000
5	8,000	13,000
	13,000	

- n_p=3.375 years

3.3 Payback Period Analysis

Example:

B. i=10%

E.O.Y	CF (1)	(P/F,i%,t) (2)	Dis. Inc (3)=(1)*(2)	Accum. Disc. Amts. (4)=Cuml. Sum of (3)
0	-30,000	1	-30,000.00	-30,000
1	-4,000	0.9091	-3,636.36	-33,636.36
2	15,000	0.8265	12,396.69	-21,239.67
3	16,000	0.7513	12,021.04	-9,218.63
4	8,000	0.6806	5,464.11	-3,754.52
5	8,000	0.6209	4,967.37	1,212.85

- n_p=4.76 years
- At 10% the PB is b/n years 4 and 5 (4.76 years).
- At 0% the PB is b/n years 3 and 4 (3.375 years).

3.3 Payback Period Analysis

- **Example:** Suppose the company requires a rate of return of 15%. Determine the period necessary to recover both the capital investment and the cost of funds required to support the investments given the cash flow (Column 2)in table below.

Period	CF	Cost of fund 15%	Cumulative CF
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

- The project must remain in use for about 4.2 years in order for the company to cover the cost of capital and also recover the fund invested in the project

3.3 Payback Period Analysis

Interpretation of PBA

- ❑ A managerial philosophy is: a **shorter payback period is preferred to a longer payback period.**
- ❑ Not a preferred method for final decision making but rather, use as a screening tool.
- ❑ Ignores all cash flows after the payback time period.
- ❑ **Example:** Three investments are available but only one can be purchased.

E.O.Y	CF (1)	CF (2)	CF (3)
0	-10,000	-10,000	-10,000
1	5,000	5,000	2,500
2	5,000	4,000	2,500
3	0	3,000	2,500
4	0	2,000	2,500
5	1,000	1,000	12,500

3.3 Payback Period Analysis

Example: Three investments are available but only one can be purchased.

E.O.Y	CF (Alt1)	C. C.F (Alt1)	CF (Alt 2)	C. C.F (Alt 2)	CF (Alt 3)	C.C.F (Alt 3)
0	-10,000	-10,000	-10,000	-10,000	-10,000	-10,000
1	5,000	-5,000	5,000	-5,000	2,500	-7,500
2	5,000	0	4,000	-1,000	2,500	-5,000
3	0	0	3,000	2,000	2,500	-2,500
4	0	0	2,000	4,000	2,500	0
5	1,000	1,000	1,000	5,000	12,500	12,500
PBP		2yrs		2.33yrs		4yrs
PW(10%)	-701.39		2,092.13		5,686.18	

- PBP: 1>2>3
- PW: 3>2>1
- Shorter payback period is preferred to a longer payback period.
- Not a preferred method for final decision making – rather, use as a screening tool.

3.3 Payback Period Analysis

Example:

E.O.Y	CF (1)	Cumulative C.F.	P/F,i%,t (2)	Dis. Inc (3)=(1)*(2)	Accum. Disc. Amts. (4)=Cuml. Sum of (3)
0	-10,000	-10,000	1	-10,000	-10,000
1	2,000	-8,000	0.9259	1,851.85	8,148.15
2	6,000	-2,000	0.8573	5,144.03	-3,004.12
3	8,000	6,000	0.7938	6,350.66	3,346.54
4	4,000	10,000	0.7350	2,940.12	6,286.66
5	1,000	11,000	0.6806	680.58	6,967.25

- PB is b/n years 2 and 3 (2.45 years=3years). The C.F of years 4 and 5 are not used in the calculations.
- None of the cash flows AFTER the payback period are considered.

Thank You