

Annual Worth Analysis

- An alternative to Present Worth (PW) and Future Worth (FW) analysis is Annual Worth (AW) analysis.
- Annual worth analysis will select the same projects that would be selected by PW or FW analysis.
- The relationship between AW, PW and FW is:
 - $AW = PW(A/P, i, n) = FW(A/F, i, n)$
 - where n is the number of years in the planning horizon or LCM used to obtain PW or FW.

EGR 312 - 13

1

Annual Worth Analysis

- Annual Worth (AW) analysis is often desirable since an annual worth is often more intuitive to individuals who think in terms of annual cash flows.
- AW analysis is also desirable since AW has to be calculated for only one life cycle. It is not necessary to use LCM as we did for the PW and FW analyses.

EGR 312 - 13

2

Annual Worth Analysis

- When alternative have different lives, the AW method make the following assumptions:
 1. The services provided are needed for the indefinite future (forever)
 2. The selected alternative will be repeated for succeeding life cycles in exactly the same manner as for the first life cycle.
 3. All cash flows will have the same estimated values in every life cycle.

EGR 312 - 13

3

Annual Worth Analysis

Earlier PW analysis for different-life alternatives:

Service Example: You are evaluating the purchase of a new or used cars that needs to last you for 10 years. $i = 8\%$.

	<u>New Car</u>	<u>Used Car</u>
Purchase Price	\$20,000	\$10,000
Annual Maint.	\$ 750	\$ 1,000
Resale Value	\$ 4,000	\$ 4,000
Life, years	10	5
PW (LCM 10)	-\$23,180	-\$18,941

AW(New) = _____

AW(Used) = _____

What is AW when it is calculated using the PW (LCM 10) values?

EGR 312 - 13

4

Capital Recovery

- Capital Recovery (CR) is the equivalent annual cost of owning an asset plus the return on the initial investment.
 - Consider an alternative where P is the total of all initial investments, A is the equivalent of all annual cash flows (cost only in a service project, receipts and costs in revenue projects), and S is the salvage value. Then the relationship between CR and AW is:

$$AW = CR + A$$

- So that $CR = [-P(A/P, i, n) + S(A/F, i, n)]$.

EGR 312 - 13

5

Capital Recovery

Example: Recall the evaluation of two income properties. You expect a MARR of 15%. What is the Annual Worth of the larger home?

	<u>\$75K Home</u>
Purchase Price	\$15,000
Annual Maint.	\$ 6,000
Annual Income	\$ 7,500
Resale (after Expenses)	\$90,000
Life, years	15

CR = _____

$A = -\$1,500$

(Note, A represents a cost, but because a profit is being made, A in this case is negative)

AW = _____

EGR 312 - 13

6

Evaluation of Alternatives Using AW

To evaluate alternatives:

1. First, calculate the AW at the MARR. Then, for ...
 - A. One alternative: If $AW \geq 0$, then the MARR is met or exceeded.
 - B. Two or more alternatives: Choose the project with lowest cost AW value (service projects) or highest income AW value (revenue projects.)

EGR 312 - 13

7

Evaluation of Alternatives Using AW

Service Example: You are evaluating the purchase of a new or used cars that needs to last you for 10 years. MARR = 8%.

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$$AW(\text{new}) = -\$20,000(A/P, 8\%, 10) - \$750 + \$4000(A/F, 8\%, 10) = -\$3454.48$$

$$AW(\text{used}) = -\$10,000(A/P, 8\%, 5) - \$1000 + \$4000(A/F, 8\%, 5)$$

$$AW(\text{used}) = -\$2822.76$$

Decision?

EGR 312 - 13

8

AW of a Permanent Investment

For a permanent investment with an initial investment of P , the capital recovery is simply the annual interest earned, in other words:

$$CR = Pi$$

In addition, to find the annual worth, all cash flows must be converted to equivalent annual amounts, A .

Then,

$$AW = -CR - A$$

EGR 312 - 13

9

AW of a Permanent Investment

Example: A toll-road was just completed at a cost of \$1.5 billion, with major maintenance expenditures of \$500 million forecast every 10 years. Annual receipts minus maintenance results in a positive cash flow of \$150 million. What is the annual worth, assuming $i = 5\%$?

CR = _____

AW = _____

EGR 312 - 13

10

Life Cycle Cost (LCC)

LCC analysis is the present worth (PW) or annual worth (AW) of an alternative at a stated MARR, covering all costs from the early stages of design through the final stages of phase-out and disposal.

Example: A pharmaceutical company anticipates R&D cost of \$1.5 Billion for the development of a new drug. In addition, production startup costs are estimated at \$1.0 Billion. Annual marketing costs are expected to be \$50 million, annual production costs are \$100 million, and annual sales are expected to be \$500 million. At the end of production, the plant and equipment can be sold for \$100 million. This drug is to be phased out after 20 years. What is the LCC assuming a 10% MARR.

EGR 312 - 13

11

Life Cycle Cost (LCC)

Example: A pharmaceutical company anticipates R&D cost of \$1.5 Billion for the development of a new drug (in years 1&2). In addition, production startup costs are estimated at \$1.0 Billion (in year 3&4). Annual marketing costs are expected to be \$50 million, annual production costs are \$100 million (both starting in year 5). At the end of production, the plant and equipment can be sold for \$100 million (year 24). This drug is to be phased out after 20 years of production. What is the LCC assuming a 10% MARR.

(in millions)

PW = _____

AW = _____

EGR 312 - 13

12
