TEXTILE ECONOMICS AND COSTING

CHAPTER 4: COST COMPARISON OF ALTERNATIVE METHOD

Introduction

- Every need that arises in our industrial society can be satisfied in multiple ways
- For instance, there are alternative manufacturing processes for producing a commodity, and there are alternative designs for constructing a bridge.
- Consequently, the engineering economist has the task of identifying the most desirable way of satisfying each need that arises – considering time value of expenditure

Interest Rate

- We assume that all savings that accrue from using one method in preference to the others are invested at the same interest rate, and this is the rate to be applied in the cost comparison

Description of Simplified Model

In formulating *standard techniques of cost comparison*, we shall construct a simplified model of the industrial world with the following characteristics

1. All economic and technological conditions remain completely static (interest rates & costs constant; each asset is replaced with an exact duplicate when it is retired)

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2. The future can be foreseen with certainty. Consequently, all forecasts and projections prove to be accurate in every respect

3. Interest is compounded annually

4. All disbursements and receipts associated with an asset occur at the beginning or end of a year

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- The payments associated with a given method of performing a task are classified as *ordinary payments* and *capital payments*, according to whether they have short- or long-term effects, respectively.

- Thus, expenditures for the daily operation of a machine are ordinary payments, and an expenditure for major repairs that extends the life of the machine is a capital payments.

Present Worth of Costs

- Where two alternative assets are to be compared with respect to cost, a basis of comparison can be established in this manner:

1. Select a period of time that encompasses an integral number of lives of each asset,
2. select the beginning of this time period as the valuation date, and
3. find the value at this date of the entire set of payments associated with each asset during this time period.

This value is called the *present worth of costs*, and the period of time selected is known as the *analysis period.*

Example 4.1

Two types of equipment are available for performing a manufacturing operation; the cost data associated with each type are recorded in the accompanying table. Applying an interest rate of 8 percent, determine which type is more economical.

	Type A	Type B
First cost, $	88,000	45,000
Salvage value, $	7,500	4,000
Annual maintenance, $	4,300	5,200
Life, years	12	6

Solution

- Select a 12-year analysis period; this encompasses one life of type A and two lives of type B
- With respect to type A, the salvage value pertaining to the first life falls within the analysis period, but the first cost of the second life *falls* beyond this period; Similar comments apply with respect to type B.
- Payments for annual maintenance are treated as lump-sum, end-of-year expenditures

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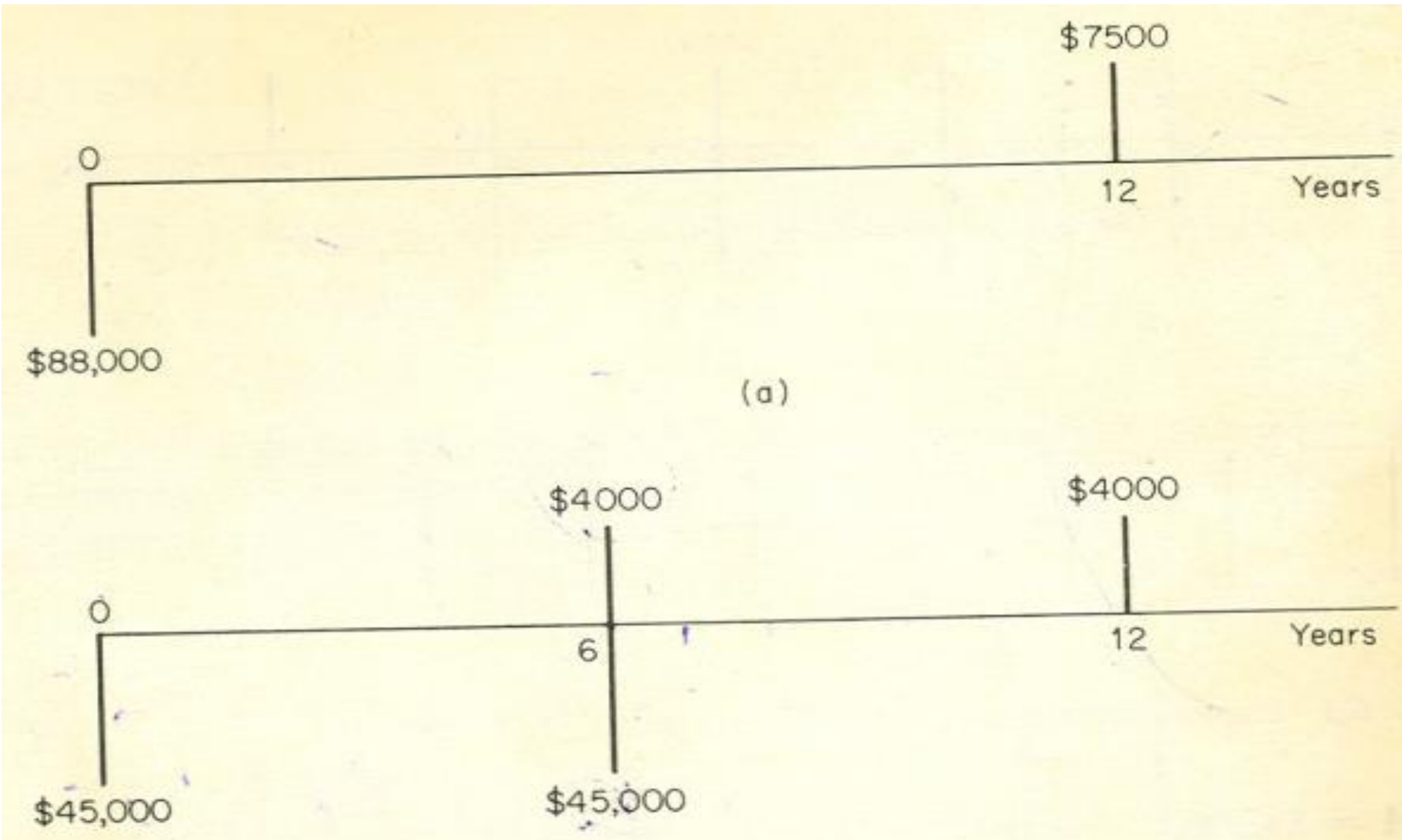

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- PW_A = 88,000 + 4300*(Pu/A,12)* - 7500*(P/F,12)*

  = 88,000+4300(7.53608) - 7500(0.39711)

  = $117,430
- PW_B = 45,000+(45,000-4000)*(P/F,6)*+5200*(Pu/A,12)*-4000*(P/F,12)*

  =45,000+41,000(0.63017) +5200(7.53608) - 4000(0.39711)

  = $108,440
- Therefore, Type B equipment is more economical.

Capitalized Cost

- By extending, the analysis period to encompass an infinite number of lives, and the cost calculations can be simplified.

- The present worth of costs for an infinite period is known as the *capitalized cost* (CC) of the asset.

- Where the life of an asset may be considered infinite, the present worth of costs and the capitalized cost are coincident.

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- Mathematically, the capitalized cost of an asset may be interpreted as the *sum of money that must be deposited in a fund at the date of purchase at the stipulated interest rate to just provide all payments for perpetual service*. The notational system is as follows:

  B_o = first cost of asset

  L = salvage value

  n = service life of asset, years

  C = annual operating cost, including maintenance and normal repairs

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- A *standard* asset is one having these characteristics: The only capital payments are $B_{o,}$ L and C remains constant during the life of the asset. The equation for the capitalized cost of a standard asset is:

$$CC = B_0 + \frac{(B_0 - L)(A/F_{u,y}n)}{i} + \frac{C}{i}$$

$$CC = \frac{(B_0 - L)(A/P_{u,y}n)}{i} + L + \frac{C}{i}$$

Cont.d

- In the special case where the life of the asset is infinite, we have:

  $CC = B_o + (C/i)$

EXAMPLE 4.3

Two alternative machines have the cost data shown in the accompanying table. Compare these machines on the basis of capitalized cost, applying an interest rate of 11.5 percent.

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	Machine A	Machine B
First cost, $	95,000	63,000
Salvage value, $	6,000	5,000
Annual maintenance, $	9,200	12,500
Life, years	8	5

SOLUTION

- As the compound-interest tables do not include the specified interest rate.

Cont.d

$$CC = \frac{(B_0 - L)(A/P_u,n)}{i} + L + \frac{C}{i}$$

$$(A/P_u,8,11.5\%) = \frac{0.115}{1 - 1/(1.115)^8} = 0.19780$$

$$(A/P_u,5,11.5\%) = \frac{0.115}{1 - 1/(1.115)^5} = 0.27398$$

$$CC_A = \frac{89{,}000(0.19780)}{0.115} + 6000 + \frac{9200}{0.115} = \$239{,}080$$

$$CC_B = \frac{58{,}000(0.27398)}{0.115} + 5000 + \frac{12{,}500}{0.115} = \$251{,}880$$

So, Machine A is less costly

Equivalent Uniform Annual Cost

- To formulate a third technique of cost comparison, transform the set of payments associated with an asset to an equivalent uniform series having the following characteristics:

- Its origin date and terminal date coincide, respectively, with the purchase date and retirement date of the asset;

- It consists of payments made at the end of each year.

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- The periodic payment under this equivalent uniform series is known as the *equivalent uniform annual cost* (EUAC) (or simply *annual cost)* of the asset.
- Since we are assuming that each life of the asset is a duplicate of the original life.
- For a standard asset, the EUAC is given by the following alternative equations:

$$EUAC = (B_o - L)(A/Fu,n) + B_o i + C \quad \text{or}$$

$$EUAC = (B_o - L)(A/Pu,n) + Li + C$$

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- The EUAC of an asset is an equivalent end-of-year payment that is assumed to recur indefinitely, and the CC of the asset is the present worth of costs for an endless period of time. Therefore, we have the following relationship between the two quantities:

- EUAC = $(CC)i$

EXAMPLE 4.12

Two alternative tools have the cost data shown in the accompanying table. Identify the tool that is more economical if money is worth (a) 8 percent or (b) 12 percent. Compute the difference in EUAC corresponding to each interest rate.

	Tool A	Tool B
First cost, $	4000	9000
Salvage value, $	500	800
Annual maintenance, $	1000	950
Life, years	3	8

SOLUTION

$EUAC_A = (4000 – 500)(A/Pu,3,8\%) + 500(0.08) + 1000$

$= 1358 + 40 + 1000$

$= \$2398$

$EUAC_B = 8200(A/Pu,8,8\%) + 800(0.08) + 950$

$= 1427 + 64 + 950$

$= \$2441$

Therefore, Tool A is more economical.

Difference = 2441 - 2398 = $43

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Part b: similarly

$EUAC_A = 1457 + 60 + 1000 = \$2517$

$EUAC_B = 1651+96 + 950 = \$2697$

- Again, tool A is more economical. Difference = 2697 - 2517 = $180
- As the foregoing calculations disclose, the asset requiring the higher initial investment becomes increasingly disadvantageous as the firm increases the rate of return it can earn on alternative investments.