MODULE 4

PRESENT, FUTURE, ANNUAL WORTH AND RATE OF RETURNS

OBJECTIVES

- To study Present Worth comparison; assets having equal, unequal and infinite lives. Future Worth comparison, Pay-back method
- To equivalent Annual Worth comparison method, assets with equal, unequal and infinite lives
- To learn Rate of return and its types

Introduction

In this method of comparison, the cash flows of each alternative will be reduced to time zero by assuming an interest rate *i*. Then, depending on the type of decision, the best alternative will be selected by comparing the present worth amounts of the alternatives. The sign of various amounts at different points in time in a cash flow diagram is to be decided based on the type of the decision problem.

In a cost dominated cash flow diagram, the costs (outflows) will be assigned with positive sign and the profit, revenue, salvages value (all inflows), etc. will be assigned with negative sign.

In a revenue/profit-dominated cash flow diagram, the profit, revenue, salvage value (all inflows to an organization) will be assigned with positive sign. The costs (outflows) will be assigned with negative sign.

In case the decision is to select the alternative with the minimum cost, then the alternative with the least present worth amount will be selected. On the other hand, if the decision is to select the alternative with the maximum profit, then the alternative with the maximum present worth will be selected.

Revenue-Dominated Cash Flow Diagram

A generalized revenue-dominated cash flow diagram to demonstrate the present worth method of comparison is presented in Fig. 4.1.

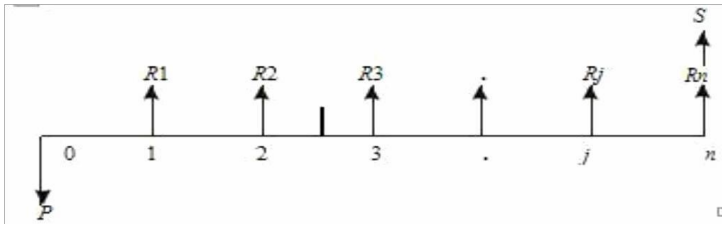


Fig. 4.1 Revenue-dominated cash flow diagram

In Fig. 4.1, *P* represents an initial investment and *Rj* the net revenue at the end of the j^{th} year. The interest rate is *i*, compounded annually. *S* is the salvage value at the end of the *n*th year. To find the present worth of the above cash flow diagram for a given interest rate.

In this expenditure is assigned a negative sign and revenues are assigned a positive sign.

If we have some more alternatives which are to be compared with this alternative, then the corresponding present worth amounts are to be computed and compared. Finally, the alternative with the maximum present worth amount should be selected as the best alternative.

Cost-Dominated Cash Flow Diagram

A generalized cost-dominated cash flow diagram to demonstrate the present worth method of comparison is presented in Fig. 4.2.

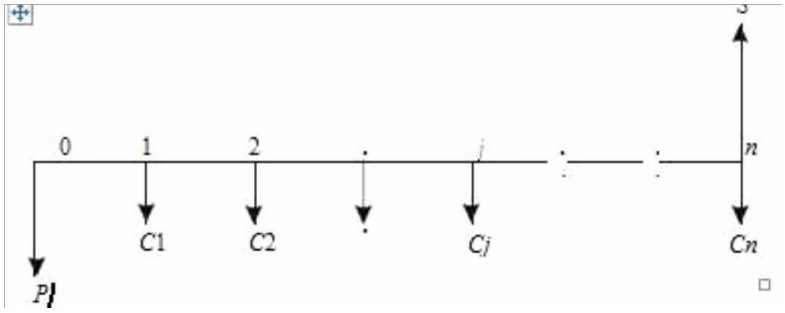


Fig. 4.2 Cost-dominated cash flow diagram

In Fig. 4.2, *P* represents an initial investment, *Cj* the net cost of operation and maintenance at the end of the j^{th} year, and *S* the salvage value at the end of the *n*th year. In this expenditure is assigned a positive sign and the revenue a negative sign. If we have some more alternatives which are to be compared with this alternative, then the corresponding present worth amounts are to be computed and compared. Finally, the alternative with the minimum present worth amount should be selected as the best alternative.

EXAMPLES

EXAMPLE 1 Alpha Industry is planning to expand its production operation. It has identified three different technologies for meeting the goal. The initial outlay and annual revenues with respect to each of the technologies are summarized in Table. Suggest the best technology which is to be implemented based on the present worth method of comparison assuming 20% interest rate, compounded annually.

	Initial outlay (Rs.)	*Annual revenue* (Rs.)	*Life* (years)
Technology 1	12,00,000	4,00,000	10
Technology 2	20,00,000	6,00,000	10
Technology 3	18,00,000	5,00,000	10

Solution In all the technologies, the initial outlay is assigned a negative sign and the annual revenues are assigned a positive sign.

TECHNOLOGY 1

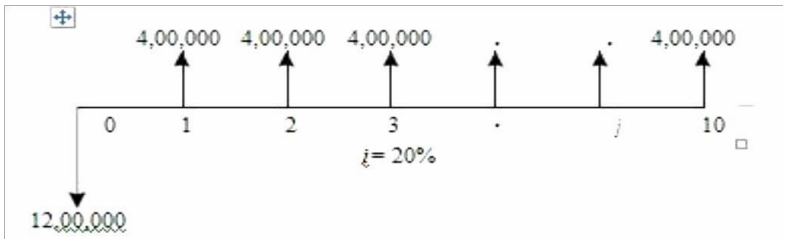
Initial outlay, P = Rs. 12, 00,000

Annual revenue, A = Rs. 4, 00,000

Interest rate, i = 20%, compounded annually

Life of this technology, n = 10 years

The cash flow diagram



1 The present worth expression for this technology is

$$PW(20\%)1 = -12,00,000 + 4,00,000 * (P/A, 20\%, 10)$$

$$= -12,00,000 + 4,00,000 * (4.1925)$$

$$= -12,00,000 + 16,77,000$$

$$= \text{Rs. } 4, 77,000$$

TECHNOLOGY 2

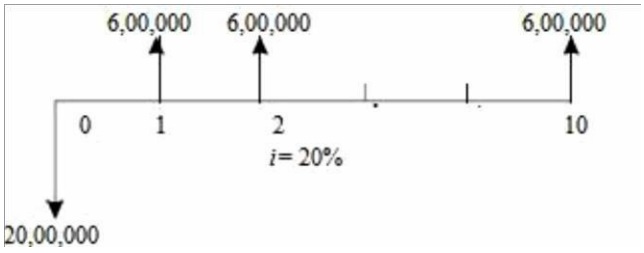
Initial outlay, P = Rs. 20,00,000

Annual revenue, A = Rs. 6,00,000

Interest rate, i = 20%, compounded annually

Life of this technology, n = 10 years

The cash flow diagram



The present worth expression for this technology i

$$PW(20\%)2 = -20,00,000 + 6,00,000 * (P/A, 20\%, 10)$$

$$= -20,00,000 + 6,00,000 \times (4.1925)$$

$$= -20,00,000 + 25,15,500 = \text{Rs. } 5,15,500$$

TECHNOLOGY 3

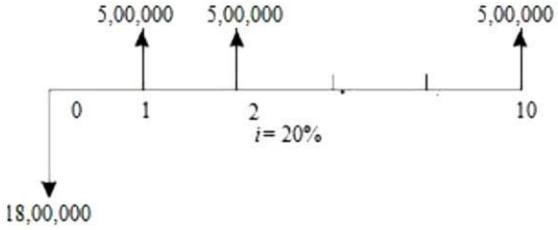
Initial outlay, P = Rs. 18,00,000

Annual revenue, A = Rs. 5,00,000

Interest rate, i = 20%, compounded annually

Life of this technology, n = 10 years

The cash flow diagram



The present worth expression for this technology is

$$PW(20\%)3 = -18,00,000 + 5,00,000 * (P/A, 20\%, 10)$$

$$= -18,00,000 + 5,00,000 \times (4.1925)$$

$$= -18,00,000 + 20,96,250$$

$$= \text{Rs. } 2,96,250$$

From the above calculations, it is clear that the present worth of technology 2 is the highest among all the technologies. Therefore, technology 2 is suggested for implementation to expand the production.

EXAMPLE 2 An engineer has two bids for an elevator to be installed in a new building. The details of the bids for the elevators are as follows:

Bid	*Engineer's estimates*		
	Initial cost (Rs.)	*Service life* (years)	*Annual operations & maintenance cost* (Rs.)
Alpha Elevator Inc.	4,50,000	15	27,000
Beta Elevator Inc.	5,40,000	15	28,500

Determine which bid should be accepted, based on the present worth method of comparison assuming 15% interest rate, compounded annually.

Solution

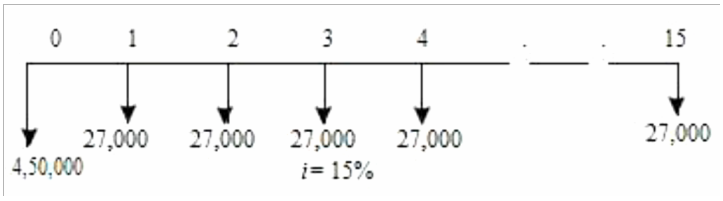
Bid 1: Alpha Elevator Inc.

Initial cost, P = Rs. 4,50,000

Annual operation and maintenance cost, A = Rs. 27,000 Life = 15 years

Interest rate, i = 15%, compounded annually.

The cash flow diagram



The present worth of the above cash flow diagram is computed as follows:

$$PW(15\%) = 4,50,000 + 27,000(P/A, 15\%, 15)$$

$$=4,50,000 + 27,000 \times 5.8474$$

$$=4,50,000 + 1,57,879.80$$

$$=\text{Rs. } 6,07,879.80$$

Bid 2: Beta Elevator Inc.

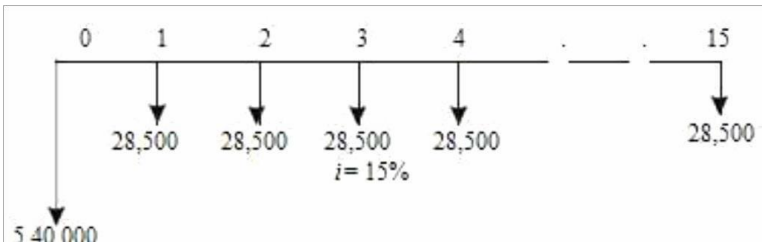
Initial cost, P = Rs. 5,40,000

Annual operation and maintenance cost, A = Rs. 28,500

Life = 15 years

Interest rate, i = 15%, compounded annually.

The cash flow diagram



The present worth of the above cash flow diagram is computed as follows:

$$PW(15\%) = 5{,}40{,}000 + 28{,}500(P/A, 15\%, 15)$$

$$= 5{,}40{,}000 + 28{,}500 \times 5.8474$$

$$= 5{,}40{,}000 + 1{,}66{,}650.90$$

$$= \text{Rs. } 7{,}06{,}650.90$$

The total present worth cost of bid 1 is less than that of bid 2. Hence, bid 1 is to be selected for implementation. That is, the elevator from Alpha Elevator Inc. is to be purchased and installed in the new building.

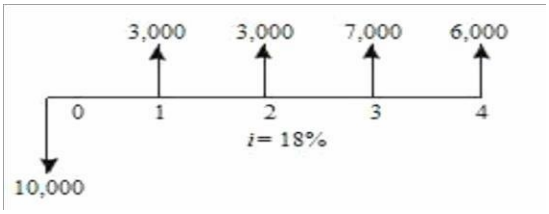
EXAMPLE 3 Investment proposals A and B have the net cash flows as follows:

Proposal	*End of years*				
	0	1	2	3	4
A (Rs.)	−10,000	3,000	3,000	7,000	6,000
B (Rs.)	−10,000	6,000	6,000	3,000	3,000

Compare the present worth of A with that of B at i = 18%. Which proposal should be selected?

Solution

Present worth of A at i = 18%. The cash flow diagram of proposal A



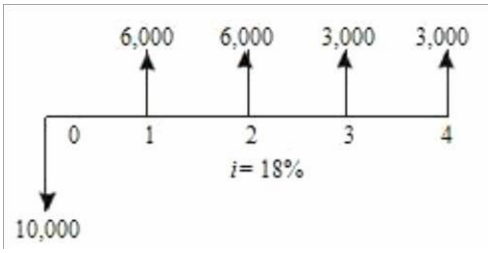
The present worth of the above cash flow diagram is computed as

$$PWA(18\%) = -10{,}000 + 3{,}000(P/F, 18\%, 1) + 3{,}000(P/F, 18\%, 2) + 7{,}000(P/F, 18\%, 3) + 6{,}000(P/F, 18\%, 4)$$

$$= -10{,}000 + 3{,}000\,(0.8475) + 3{,}000(0.7182) + 7{,}000(0.6086) + 6{,}000(0.5158)$$

$$= \text{Rs. } 2{,}052.10$$

Present worth of B at *i* = 18%. The cash flow diagram of the proposal B



The present worth of the above cash flow diagram is calculated as

$$PWB(18\%) = -10{,}000 + 6{,}000(P/F, 18\%, 1) + 6{,}000(P/F, 18\%, 2) + 3{,}000(P/F, 18\%, 3) + 3{,}000(P/F, 18\%, 4)$$

$$= -10{,}000 + 6{,}000(0.8475) + 6{,}000(0.7182) + 3{,}000(0.6086) + 3{,}000(0.5158)$$

$$= \text{Rs. } 2{,}767.40$$

At i = 18%, the present worth of proposal B is higher than that of proposal A. Therefore, select proposal B.

EXAMPLE 4 A granite company is planning to buy fully automated granite cutting machine. If it is purchased under down payment, the cost of the machine is Rs. 16,00,000. If it is purchased under installment basis, the company has to pay 25% of the cost at the time of purchase and the remaining amount in 10 annual equal installments of Rs.2, 00,000 each. Suggest the best alternative for the company using the present worth basis at *i*= 18%, compounded annually.

Solution There are two alternatives available for the company:

1. Down payment of Rs. 16,00,000
2. Down payment of Rs. 4,00,000 and 10 annual equal installments of Rs. 2,00,000 each

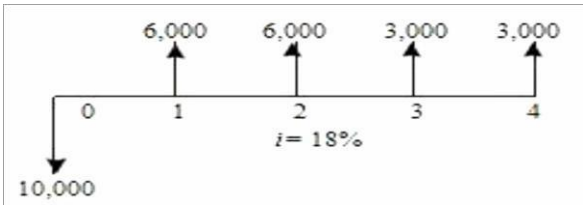
Present worth calculation of the second alternative. The cash flow diagram of the second

$$PWA(18\%) = -10{,}000 + 3{,}000(P/F, 18\%, 1) + 3{,}000(P/F, 18\%, 2) + 7{,}000(P/F, 18\%, 3) + 6{,}000(P/F, 18\%, 4)$$

$$= -10{,}000 + 3{,}000\,(0.8475) + 3{,}000(0.7182) + 7{,}000(0.6086) + 6{,}000(0.5158)$$

$$= \text{Rs. } 2{,}052.10$$

Present worth of B at *i* = 18%. The cash flow diagram



B The present worth of the above cash flow diagram is calculated as

$$PWB(18\%) = -10{,}000 + 6{,}000(P/F, 18\%, 1) + 6{,}000(P/F, 18\%, 2) + 3{,}000(P/F, 18\%, 3) + 3{,}000(P/F, 18\%, 4)$$

$$= -10{,}000 + 6{,}000(0.8475) + 6{,}000(0.7182) + 3{,}000(0.6086) + 3{,}000(0.5158)$$

$$= \text{Rs. } 2{,}767.40$$

At i = 18%, the present worth of proposal B is higher than that of proposal A. Therefore, select proposal B.

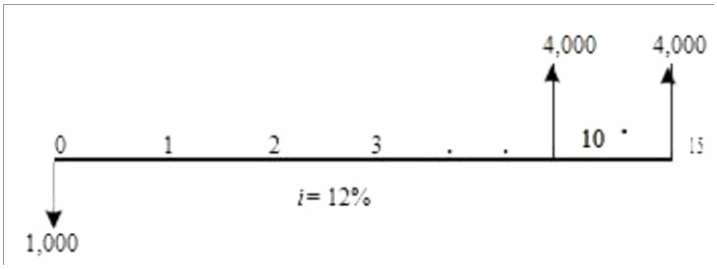
EXAMPLE 5 A granite company is planning to buy a fully automated granite cutting machine. If it is purchased under down payment, the cost of the machine is Rs. 16,00,000. If it is purchased under installment basis, the company has to pay 25% of the cost at the time of purchase and the remaining amount in 10 annual equal installments of Rs. 2,00,000 each. Suggest the best alternative for the company using the present worth basis at I = 18%, compounded annually.

Solution There are two alternatives available for the company:

Down payment of Rs. 16,00,000

Down payment of Rs. 4,00,000 and 10 annual equal installments of Rs. 2,00,000 each

Present worth calculation of the second alternative. The cash flow diagram of the second



The present worth of the above cash flow diagram is computed as

$$PW(12\%) = -1{,}000 + 4{,}000(P/F, 12\%, 10) + 4{,}000(P/F, 12\%, 15)$$

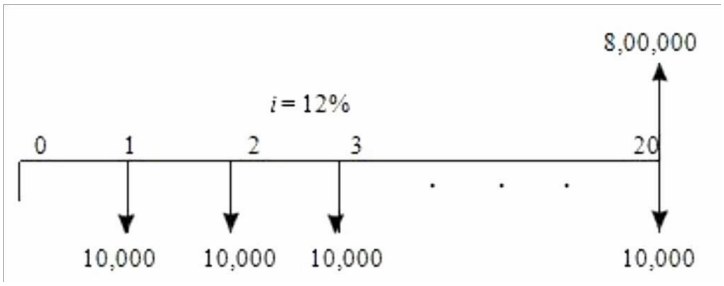
$$= -1{,}000 + 4{,}000(0.3220) + 4{,}000(0.1827)$$

$$= \text{Rs. } 1{,}018.80$$

The present worth of plan 1 is more than that of plan 2. Therefore, plan 1 is the best plan from the investor's point of view.

EXAMPLE 6 Novel Investment Ltd. accepts Rs. 10,000 at the end of every year for 20 years and pays the investor Rs. 8,00,000 at the end of the 20th year. Innovative Investment Ltd. accepts Rs. 10,000 at the end of every year for 20 years and pays the investor Rs. 15,00,000 at the end of the 25th year. Which is the best investment alternative? Use present worth base with i = 12%.

Solution: Novel Investment Ltd's plan.The cash flow diagram of NovelInvestment Ltd's plan is shown below



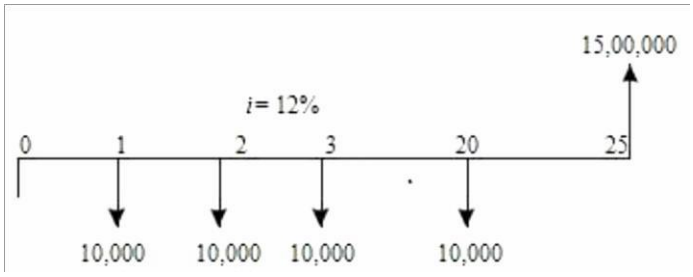
The present worth of the above cash flow diagram is computed as

$$PW(12\%) = -10{,}000(P/A, 12\%, 20) + 8{,}00{,}000(P/F, 12\%, 20)$$

$$= -10{,}000(7.4694) + 8{,}00{,}000(0.1037)$$

$$= \text{Rs. } 8{,}266$$

Innovative Investment Ltd's plan. The cash flow diagram



The present worth of the above cash flow diagram is calculated as

$$PW(12\%) = -10{,}000(P/A, 12\%, 20) + 15{,}00{,}000(P/F, 12\%, 25)$$

$$= -10{,}000(7.4694) + 15{,}00{,}000(0.0588)$$

$$= \text{Rs. } 13{,}506$$

The present worth of Innovative Investment Ltd's plan is more than that of Novel Investment Ltd's plan. Therefore, Innovative Investment Ltd's plan is the best from investor's point of view.

EXAMPLE 7 A small business with an initial outlay of Rs. 12,000 yields Rs. 10,000 during the first year of its operation and the yield increases by Rs. 1,000 from its second year of operation up to its 10th year of operation. At the end of the life of the business, the salvage value is zero. Find the present worth of the business by assuming an interest rate of 18%, compounded annually.

Solution

Initial investment, P = Rs. 12,000

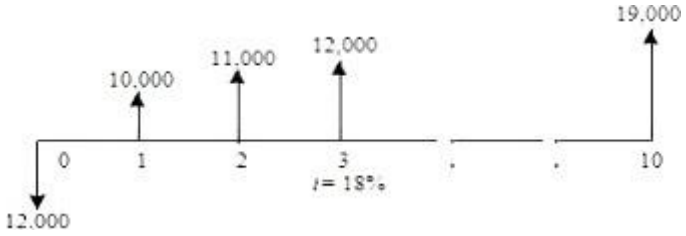
Income during the first year, A = Rs. 10,000

Annual increase in income, G = Rs. 1,000

n = 10 years

i = 18%, compounded annually

The cash flow diagram



business The equation for the present worth is

$$PW(18\%) = -12{,}000 + (10{,}000 + 1{,}000 * (A/G, 18\%, 10)) * (P/A, 18\%, 10)$$

$$= -12{,}000 + (10{,}000 + 1{,}000 \times 3.1936) \times 4.4941$$

$$= -12{,}000 + 59{,}293.36$$

$$= \text{Rs. } 47{,}293.36$$

The present worth of the small business is Rs. 47,293.36.

ANNUAL EQUIVALENT METHOD

Introduction

In the annual equivalent method of comparison, first the annual equivalent cost or the revenue of each alternative will be computed. Then the alternative with the maximum annual equivalent revenue in the case of revenue-based comparison or with the minimum annual equivalent cost in the case of cost-based comparison will be selected as the best alternative.

Revenue-Dominated Cash Flow Diagram

A generalized revenue-dominated cash flow diagram to demonstrate the annual equivalent method of comparison is presented in Fig. 3.1.

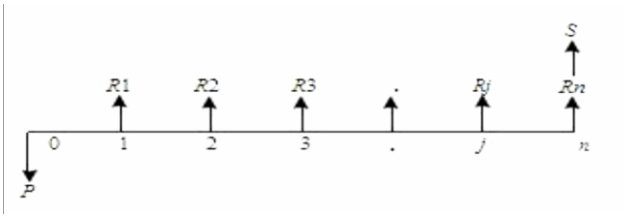


Fig. 3.1 Revenue-dominated cash flow diagram

In Fig. 3.1, *P* represents an initial investment, *Rj* the net revenue at the end of the j^{th} year, and *S* the salvage value at the end of the *n*th year.

The first step is to find the net present worth of the cash flow diagram using the following expression for a given interest rate, *i*:

$$PW(i) = -P + R1/(1+i)^1 + R2/(1+i)^2 + \ldots + Rj/(1+i)^j + \ldots + Rn/(1+i)^n + S/(1+i)^n$$

In the above formula, the expenditure is assigned with a negative sign and the revenues are assigned with a positive sign.

If we have some more alternatives which are to be compared with this alternative, then the corresponding annual equivalent revenues are to be computed and compared. Finally, the alternative with the maximum annual equivalent revenue should be selected as the best alternative.

Cost-Dominated Cash Flow Diagram

A generalized cost-dominated cash flow diagram to demonstrate the annual equivalent method of comparison is illustrated in Fig. 3.2.

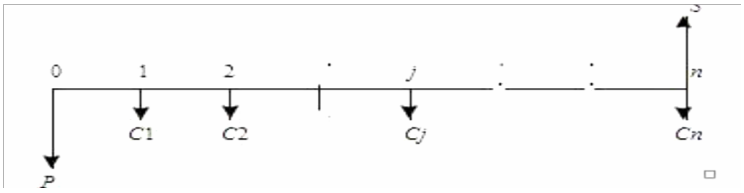


Fig. 3.2 Cost-dominated cash flow diagram

In Fig. 3.2, *P* represents an initial investment, *Cj* the net cost of operation and maintenance at the end of the *j*th year, and *S* the salvage value at the end of the *n*th year.The first step is to find the net present worth of the cash flow diagram using the following relation for a given interest rate, *i*.

$$PW(i) = P + C1/(1+i)^1 + C2/(1+i)^2 + \ldots + Cj/(1+i)^j + \ldots + Cn/(1+i)^n - S/(1+i)^n$$

In the above formula, each expenditure is assigned with positive sign and the salvage value with negative sign. Then, in the second step, the annual equivalent cost is computed using the following equation:

$$A = PW(i)\frac{i(1+i)^n}{(1+i)^n - 1} = PW(i)(A/P, i, n)$$

where $(A/P, i, n)$ is called as equal-payment series capital recovery factor.

As in the previous case, if we have some more alternatives which are to be compared with this alternative, then the corresponding annual equivalent costs are to be computed and compared. Finally, the alternative with the minimum annual equivalent cost should be selected as the best alternative.

If we have some non-standard cash flow diagram, then we will have to follow the general procedure for converting each and every transaction to time zero and then convert the net present worth into an annual equivalent cost/ revenue depending on the type of the cash flow diagram. Such procedure is to be applied to all the alternatives and finally, the best alternative is to be selected.

Alternate Approach

Instead of first finding the present worth and then figuring out the annual equivalent cost/revenue, an alternate method which is as explained below can be used. In each of the cases presented in Sections 3.2 and 3.3, in the first step, one can find the future worth of the cash flow diagram of each of the alternatives. Then, in the second step, the annual equivalent cost/revenue can be obtained by using the equation:

$$A = F\frac{i}{(1+i)^n - 1} = F(A/F, i, n)$$

where $(A/F, i, n)$ is called *equal-payment series sinking fund factor.*

EXAMPLES

EXAMPLE 1: A company provides a car to its chief executive. The owner of the company is concerned about the increasing cost of petrol. The cost per litre of petrol for the first year of operation is Rs. 21. He feels that the cost of petrol will be increasing by Re.1 every year. His experience with his company car indicates that it averages 9 km per litre of petrol. The executive expects to drive an average of 20,000 km each year for the next four years. What is the annual equivalent cost of fuel over this period of time?. If he is offered similar service with the same quality on rental basis at Rs. 60,000 per year, should the owner continue to provide company car for his executive or alternatively provide a rental car to his executive? Assume i = 18%. If the rental car is preferred, then the company car will find some other use within the company.

Solution

Average number of km run/year = 20,000 km

Number of km/litre of petrol = 9 km

Therefore,

Petrol consumption/year = 20,000/9 = 2222.2 litre

Cost/litre of petrol for the 1st year = Rs. 21

Cost/litre of petrol for the 2nd year = Rs. 21.00 + Re. 1.00 = Rs. 22.00

Cost/litre of petrol for the 3rd year = Rs. 22.00 + Re. 1.00 = Rs. 23.00

Cost/litre of petrol for the 4th year = Rs. 23.00 + Re. 1.00 = Rs. 24.00

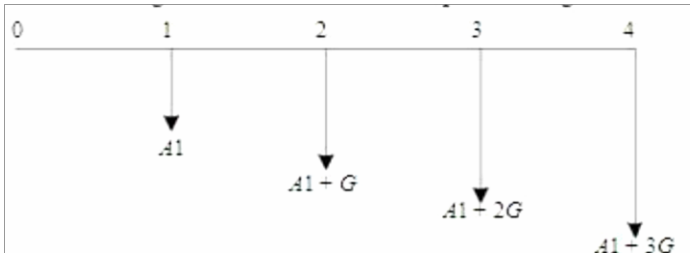
Fuel expenditure for 1st year = 2222.2 * 21 = Rs. 46,666.20

Fuel expenditure for 2nd year = 2222.2 * 22 = Rs. 48,888.40

Fuel expenditure for 3rd year = 2222.2 * 23 = Rs. 51,110.60

Fuel expenditure for 4th year = 2222.2 * 24 = Rs. 53,332.80

The annual equal increment of the above expenditures is Rs. 2,222.20 (*G*). The cash flow diagram for this situation is depicted



Series cash flow diagram.

In Fig. 6.3, *A*1 = Rs. 46,666.20 and *G* = Rs. 2,222.20

A = *A*1 + *G*(*A*/*G*, 18%, 4)

=46,666.20 + 2222.2(1.2947)

=Rs. 49,543.28

The proposal of using the company car by spending for petrol by the company will cost an annual equivalent amount of Rs. 49,543.28 for four years. This amount is less than the annual rental value of Rs. 60,000. Therefore, the company should continue to provide its own car to its executive.

EXAMPLE 2: A company is planning to purchase an advanced machine centre. Three original manufacturers have responded to its tender whose particulars are tabulated as follows:

Manufacturer	*Down payment* (Rs.)	*Yearly equal installment* (Rs.)	*No. of installments*
1	5,00,000	2,00,000	15
2	4,00,000	3,00,000	15
3	6,00,000	1,50,000	15

Determine the best alternative based on the annual equivalent method by assuming *i* = 20%, compounded annually.

Solution

Alternative 1

Down payment, *P* = Rs. 5,00,000

Yearly equal installment, *A* = Rs. 2,00,000

n = 15 years

i = 20%, compounded annually

The cash flow diagram for manufacturer 1 is shown in Fig. 3.4.

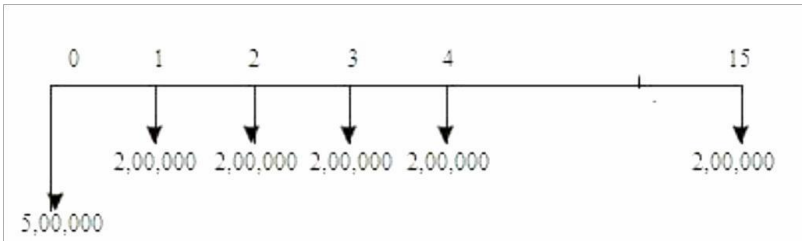


Fig. 3.4 Cash flow diagram for manufacturer 1

The annual equivalent cost expression of the above cash flow diagram is

$AE1(20\%) = 5,00,000(A/P, 20\%, 15) + 2,00,000$

$=5,00,000(0.2139) + 2,00,000$

$=3,06,950$

Alternative 2

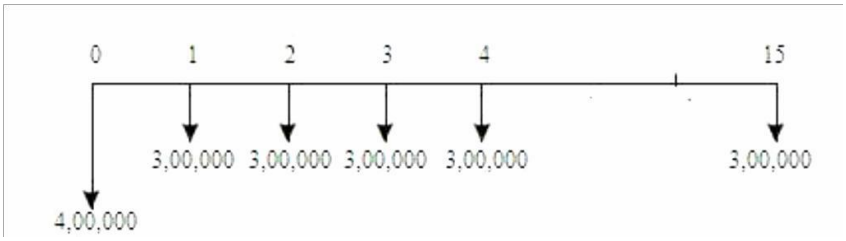
Down payment, P = Rs. 4,00,000

Yearly equal installment, A = Rs. 3,00,000

n = 15 years

i = 20%, compounded annually

The cash flow diagram



The annual equivalent cost expression of the above cash flow diagram is

$AE2(20\%) = 4,00,000(A/P, 20\%, 15) + 3,00,000$

$=4,00,000(0.2139) + 3,00,000$

= Rs. 3,85,560.

Alternative 3

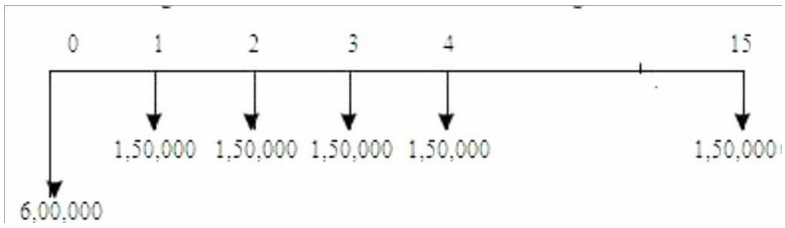
Down payment, P = Rs. 6,00,000

Yearly equal installment, A = Rs. 1,50,000

n = 15 years

i = 20%, compounded annually

The cash flow diagram



The annual equivalent cost expression of the above cash flow diagram is $AE3(20\%) = 6,00,000(A/P, 20\%, 15) + 1,50,000$

$=6,00,000(0.2139) + 1,50,000$

$= Rs.\ 2,78,340.$

The annual equivalent cost of manufacturer 3 is less than that of manufacturer 1 and manufacturer 2. Therefore, the company should buy the advanced machine centre from manufacturer 3

EXAMPLE 3: A company invests in one of the two mutually exclusive alternatives. The life of both alternatives is estimated to be 5 years with the following investments, annual returns and salvage values.

	Alternative	
	A	B
Investment (Rs.)	− 1,50,000	− 1,75,000
Annual equal return (Rs.)	+ 60,000	+ 70,000
Salvage value (Rs.)	+ 15,000	+ 35,000

Determine the best alternative based on the annual equivalent method by assuming i =25%.

Solution:

Alternative A

Initial investment, P = Rs. 1,50,000

Annual equal return, A = Rs. 60,000

Salvage value at the end of machine life, S = Rs. 15,000

Life = 5 years

Interest rate, i = 25%, compounded annually

The cash flow diagram

Fig. 3.7 Cash flow diagram for alternative A

The annual equivalent revenue expression of the above cash flow diagram is as follows:

AEA(25%) = −1,50,000(*A*/*P*, 25%, 5) + 60,000 + 15,000(*A*/*F*, 25%, 5)

=−1,50,000(0.3718) + 60,000 + 15,000(0.1218)

= Rs. 6,057

Alternative B

Initial investment, *P* = Rs. 1,75,000

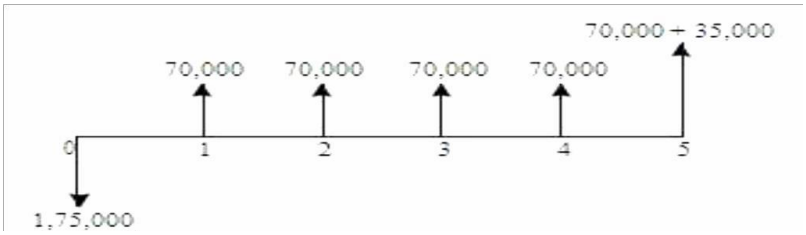
Annual equal return, *A* = Rs. 70,000

Salvage value at the end of machine life, *S* = Rs. 35,000

Life = 5 years

Interest rate, *i* = 25%, compounded annually

The cash flow diagram for alternative B is shown in Fig. 3.8.



The annual equivalent revenue expression of the above cash flow diagram is

*AE*B(25%) =−1,75,000(*A*/*P*, 25%, 5) + 70,000 + 35,000(*A*/*F*, 25%, 5)

=−1,75,000(0.3718) + 70,000 + 35,000(0.1218)

=Rs. 9,198

The annual equivalent net return of alternative B is more than that of alternative A. Thus, the Company should select alternative B.

EXAMPLE 4: A certain individual firm desires an economic analysis to determine which of the two machines is attractive in a given interval of time. The minimum attractive rate of return for the firm is 15%. The following data are to be used in the analysis:

	Machine X	*Machine Y*
First cost	Rs. 1,50,000	Rs. 2,40,000
Estimated life	12 years	12 years
Salvage value	0	Rs 6,00
Annual maintenance cost	0	Rs 4,50

Which machine would you choose? Base your answer on annual equivalent cost.

Solution

Machine X

First cost, *P* = Rs. 1,50,000 Life,

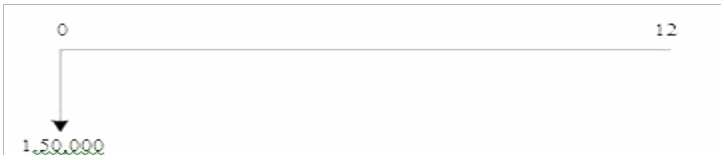
n = 12 years

Estimated salvage value at the end of machine life, S =

Rs. 0. Annual maintenance cost, A = Rs. 0.

Interest rate, i = 15%, compounded annually.

The cash flow diagram



The annual equivalent cost expression of the above cash flow diagram is $AEX(15\%) = 1,50,000(A/P, 15\%, 12)$

$=1,50,000(0.1845)$

$=$Rs. 27,675

Machine Y

First cost, P = Rs. 2,40,000 Life,

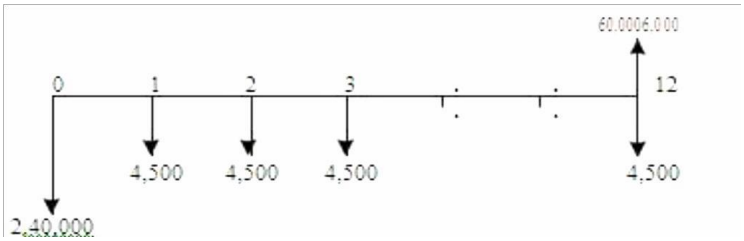
n = 12 years

Estimated salvage value at the end of machine life, S = Rs.

60,000 Annual maintenance cost, A = Rs. 4,500

Interest rate, i = 15%, compounded annually.

The cash flow diagram



The annual equivalent cost expression of the above cash flow diagram is $AEY(15\%) = 2,40,000(A/P, 15\%, 12) + 4,500 - 6,000(A/F, 15\%, 12)$

$=2,40,000(0.1845) + 4,500 - 6,000(0.0345)$

$=$ Rs. 48,573

The annual equivalent cost of machine X is less than that of machine Y. So, machine X is the more cost effective machine.

OUTCOMES:

At the end of the module, the students are able to:

- Define present worth comparison and identify conditions for using it.
- Apply present worth comparison method to identify better alternatives when the assets

have equal, unequal and infinite lives.

- Apply future worth and pay-back comparison methods to identify better investment alternatives.
- Solve the numerical problems.
- Define Equivalent Annual Worth and its comparison with present worth.
- Apply Equivalent Annual Worth to find better alternatives for assets having equal, unequal and infinite lives.

SELF-TEST QUESTIONS:

1. Define how cash flows are compared based on present worth.
2. Differentiate between Cost-Dominated Cash Flow Diagram and Revenue-Dominated Cash Flow Diagram.
3. Analyse and take decision on the following proposals based on engineering economics analysis. Proposal 1 has life of 3 years with an investment of Rs 10,000/- and proposal 2 has a life of 4 years with an investment of 12,000/-. Annual gain and operated expense in both the cases are Rs1, 000/- and Rs 500/- respectively. Assume an interest rate of 10% which gets doubled at LCM midway. Comment on the proposal using Current method.
4. An investor can make 3 end of year payment of Rs 15,000/- which are expected to generate receipts of Rs 10,000/- at the end of year 4 that will increase annually by Rs 2,500/- for the following four years. If the investor can earn a rate of returns of 10% on the eight year investment is this an attractive offer?

FURTHER READING:

1. **Engineering Economy,** Tarachand, 2000.
2. **Industrial Engineering and Management**, OP Khanna, Dhanpat Rai & Sons. 2000
3. **Financial Mangement,** Prasanna Chandra, 7th Ed., TMH, 2004
4. **Finacial Management,** IM PANDEY, Vikas Pub. House, 2002