Q1. What is net present value and Equivalent Annual cost? What is the benefit of Benefit-cost ratio?

ANS:

Net present value:

Net present value (NPV) is the difference between the present value of cash inflows and the present value of cash outflows over a period of time. NPV is used in capital budgeting and investment planning to analyse the profitability of a projected investment or project.

In very simple terms, is important because it tells you what financial value a project adds to your company, taking into account the money you have to spend to realize the project (initial spending to acquire equipment or whatever you are investing in, and all the money you will earn subsequently with the initial investment). What makes the NPV more meaningful than just deducting the cash out from the subsequent cash in (which would give you the payback) is that the NPV takes into account when you spend the money and when you get how much money back. After all, if you spend **PKR100, 000** now and get back **PKR110, 000** you want to know when you get the **PKR110, 000** back. If you get it back in one year, that is an outstanding project. If it is only in 3 years, forget your idea.

Equivalent annual cost:

Equivalent annual cost (EAC) is the annual cost of owning, operating, and maintaining an asset over its entire life. EAC is often used by firms for capital budgeting decisions, as it allows a company to compare the cost-effectiveness of various assets that have unequal lifespans.

Benefit–cost ratio:

A benefit–cost ratio (BCR) is an indicator, used in cost–benefit analysis that attempts to summarize the overall value for money of a project or proposal. A BCR is the ratio of the benefits of a project or proposal, expressed in monetary terms, relative to its costs, also expressed in monetary terms.

A cost-benefit analysis is a popular tool with the following benefits/advantages-

- ✓ A cost-benefit analysis simplifies the complex decisions in a project.
- ✓ The analysis gives clarity to unpredictable situations. The listing of costs and benefits helps the analyst to identify and later evaluate each cost and benefit.
- ✓ It helps to figure out whether the benefits outweigh the cost and is it financially strong and stable to pursue it.
- ✓ It is easy to compare projects of every type in spite of being dissimilar
- ✓ The cost-benefit analysis removes any emotional element and helps to overcome biases.
- ✓ It takes into account a broad spectrum of benefits and costs and converts them into currency to simplify matters.
- ✓ Suitable for all projects small or large.

i) The construction cost of a service reservoir for supplying water to a housing estate is estimated to be PKR 9,000,000,000. The annual operation and maintenance cost are estimated to be PKR 375,000,000 per year. The annual income from the collection of water supply fee from the users will be PKR 1,050,000,000. Assuming a time horizon of 30 years and taking i as 5% p.a., find out if the project is financially feasible. Use both methods equivalent annual costs and present value method also use benefit-cost ratio.

Solution:

A) Present Value Method:

Present Value of F = F x [{(1+i)^n-1} / i(1+i)^n]

(i) Present Value of benefits in 30 year:

= 1050,000,000 x [{(1+i)^n-1} / i(1+i)^n]

For i = 0.05 and n =30, from appendix value of [{(1+i)^n-1} / i(1+i)^n] = 15.3724

= 1050,000,000 x 15.3724

= PKR 16,141,073,578.

(ii) Present Value of construction cost = PKR 9,000,000,000

Present Value of operation and maintenance

= 375,000,000 x 15.3724

= PKR 5,764,650,000

Total cost of revenue = 9,000,000,000 + 5,464,650,000 = PKR 14,764,650,000

(iii) Net Present Value (NPV) = 16,141,073,578 - 14,764,650,000

= PKR 1,376,423,578

The positive net present value indicates that the project is feasible.

B) Equivalent Annual Cost Method:

(i) Annual Benefit = PKR 1,050,000,000

(ii) Annual cost of operation and maintenance = PKR 375,000,000

Using Formula A = F x [i(1+i)^n/{(1+i)^n-1}]

Equivalent Annual Cost of Construction = 9,000,000,000 x [i(1+i)^n/{(1+i)^n-1}]

For i = 0.05 and n =30, from appendix value of [i(1+i)^n/{(1+i)^n-1}] = 0.06505

= 9,000,000,000 x 0.06505

= PKR 585,450,000.

Total Equivalent cost of revenue = 375,000,000 + 585,450,000

= PKR 960, 450,000

(iii) Net Annual Benefits (NAB) = 1,050,000,000 - 960,450,000

= PKR 89,550,000

The positive net annual benefits indicate that the project is feasible.

Both method (A) and method (B) have consistent result, so any one method is sufficient for project feasibility.

Benefit-Cost Ratio:

a) B/C Ratio = Present worth of total benefits / Present worth of total cost

b) B/C Ratio = Equivalent annual total benefits / Equivalent annual total cost

Putting the values

a) B/C Ratio = 16,141,073,578/14,764,650,000 = 1.093

b) B/C Ratio = 1,050,000,000/960,450,000 = 1.093

As B/C Ratio is greater than 1, the project is feasible.

Q2. What is Internal rate of Return. What is the difference between IRR and NPV? Also please explain Inflation.

ANS:

Internal Rate of Return:

The internal rate of return is a discount rate that makes the net present value (NPV) of all cash flows from a particular project equal to zero. Another way of thinking about it is you want the net present value to be equal to the cost of your investment, or better. You can use that information to determine whether you want to invest or not.

Difference between IRR and NPV:

- Net Present Value is the difference between the present value of benefits and present value of costs of a capital investment while IRR is the projected returns of a capital investment over its economic life.
- NPV is expressed in currency value, while IRR is expressed in percentage value.
- Whereas NPV has a straightforward calculation formula, IRR is calculated on trial-and-error basis.

- Moreover, NPV is calculated using a market-based discount rate, while IRR is calculated using returns generated by invested capital.
- NPV is more realistic than the IRR by virtue of its assumption that discount rate is earned from the reinvestment of cash inflows generated by a capital investment.
- NPV maintains consistency of solutions regardless of periodical changes in cash flows, while IRR gives varied solutions with changes in cash flows from one period to another.

INFLATION:

In economics, inflation is a sustained increase in the general price level of goods and services in an economy over a period of time. When the general price level rises, each unit of currency buys fewer goods and services; consequently, inflation reflects a reduction in the purchasing power per unit of money – a loss of real value in the medium of exchange and unit of account within the economy.

ii) An Asset was purchased four years ago at PKR 9,000,000 and had a life of four years. This investment resulted in actual annual cash receipt of PKR 2,100,000, 2,700,000, 3,450,000, 4,200,000 respectively in the past four years. These figures are found from the accounting record of each year in the past four years. The average inflation rate in these four years was 4% p.a. find the real Internal Rate of Return (IRR).

Solution

Assume i = 8% and i = 13% for calculating IRR. Values of column 2 and column 4 are taken from the appendix for i=8%, i=13% and n=0 to 4

	1	2	3	4	5
End of Year	NCF	[1/{(1+n)^n}] i= 8%, n= 0 to 4	(DCF) 8% (1) x(2)	[1/{(1+n)^n}] i= 13%, n= 0 to 4	(DCF) 13% (1) x(4)
0	-9000000	1.0000	-9000000	1.0000	-9000000
1	2100000	0.9259	1944390	0.8850	1858500
2	2700000	0.8573	2314710	0.7831	2114370
3	3450000	0.7938	2738610	0.6931	2391195
4	4200000	0.7350	3087000	0.6133	2575860
			1084710		-60075

DCF Method for finding IRR

The DCF for 8% is positive (1084710) and DCF for 13% is negative (-60075), so the value of IRR is greater than 8% and less than13%.

The apparent IRR i' is calculated as follows:

i'= 8% + {1084710/(1084710+60075)} x (13 – 8)%

= 8% + 1084710/1144785 x (13 – 8) %

= 8% + .947 x (5) % = 12.74%.

Apparent IRR = 12.74%

Putting the values in the formula

i' = (1+i)(1+f) – 1

0.1274 = (1+i) (1+0.04) -1

1.1274 = (1+i) (1.04)

(1+i) = 1.1274/1.04

(1+i) = 1.084

i'= 1.084 -1

i'= 0.0841 =8.4%

Therefore, the real IRR is 8.41 % per annum.

Q3. A subcontractor specialized in wastewater disposal makes and sells cast iron pipes, steel pipes and concrete pipes. The following variable costs and selling prices/sales volumes are obtained from the cost accounting department and sales department respectively.

Pipe	p	v	Volume (% Rs Sales)
Cast iron	Rs 450,000	Rs 300,000	25%
Steel	Rs 525,000	Rs 375,000	35%
Concrete	Rs 600,000	Rs 450,000	40%

The company capacity in terms of total (maximum) sales volume is $900 million in a year. The annual fixed cost is $200 million. a) Find the BEP of the subcontractor, b) Find the profit if the subcontractor is operating at 95% of its capacity.

SOLUTION:

	1	2	3	4	5	6	7
Pipe	p	v	p-v	Contribution = (p-v)/p	Volume (% 0f sales)	% Contribution per unit	Contribution per overall sale = Col 5 x Col 6
Cast Iron	450000	300000	150000	0.3333	25%	33.33%	8.33%
Steel	525000	375000	150000	0.2857	35%	28.57%	10.00%
Concrete	600000	450000	150000	0.2500	40%	25.00%	10.00%
Total contribution per overall sales							28.33%

28.33% is the total contribution per overall sales .

a) Break even (BEP) = Fixed Cost (FC) / Contribution

= $ 200 m/0.2833 = $ 705.9654 m

Say **$ 706 m**

At BEP the operating capacity of subcontractor = BEP Capacity / Maximum Capacity

= ($ 706/$ 900) x100 =78.44%

b) At 95% of capacity:

Profit = TR – TC

= TR – (VC – FC)

= (900 m x 95%) – 810 m (1 - 0.2833) - 200 m

= 855 m – 580 m -200 m

= **$ 75 million**.

Q4. A sewage pumping station is being designed. Three possible pumping schemes are proposed and the itemized costs of each scheme are shown below:

What is the most economical range of pumping time in hours/year for each scheme? (Take i = 5% p.a. and maximum pumping hours in a year = 8,760 hours).

Scheme number		Scheme A	Scheme B	Scheme C
Pump	Cost of pumps ($) Life (years) Maintenance ($/year)	120,000 14 18,000	190,000 16 16,500	285,000 20 16,000
Pipe	Cost of pipes ($) Life (years) Cost of pumping ($/hour)	200,000 30 2.00	160,000 30 1.60	100,000 30 1.20

SOLUTION:

Scheme A:

Equivalent annual cost of installation and maintenance

=\$120,000 × [.05 (1+.05)^14/(1+.05)^14-1] + \$200,000 × [.05 (1+.05)^10/(1+.05)^10-1] + \$18,000

= \$120,000 × 0.1010 + \$200,000 × 0.0651 + \$18,000 = \$43,140

Scheme B:

Equivalent annual cost of installation and maintenance

= \$190,000 × [.05 (1+.05)^16/(1+.05)^16-1] + \$160,000 × [.05 (1+.05)^30/(1+.05)^30-1] + \$16,500

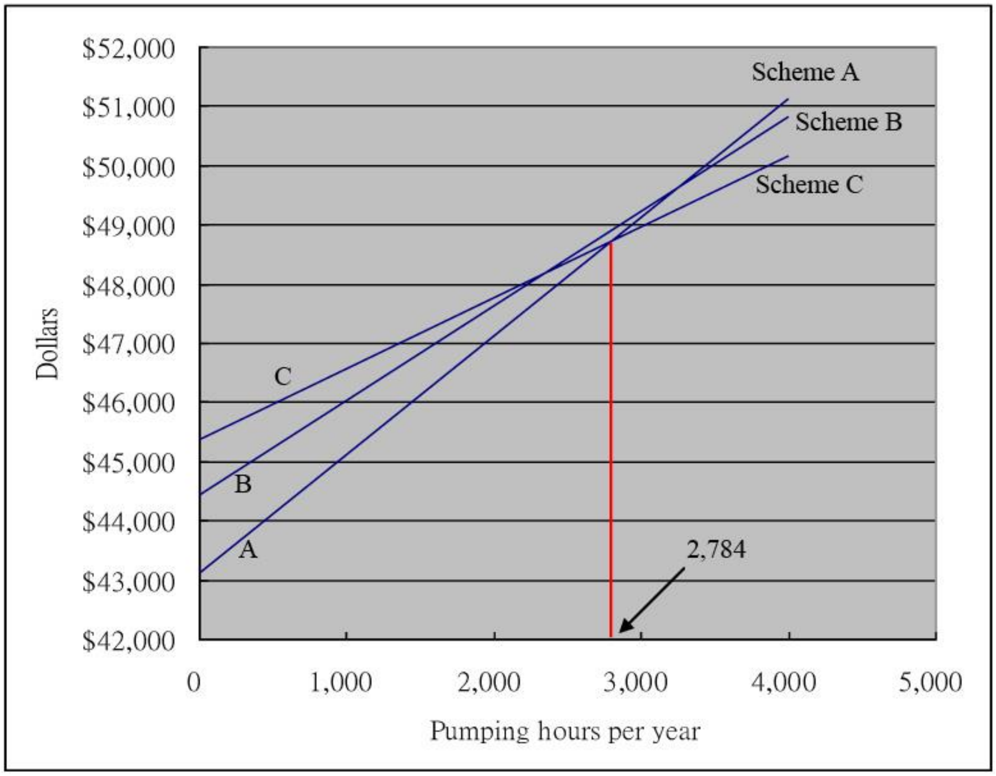
= \$190,000 × 0.0923 + \$160,000 × 0.0651 + \$16,500 = \$44,453

Scheme C:

Equivalent annual cost of installation and maintenance

= \$285,000 × [.05 (1+.05)^20/(1+.05)^20-1] + \$100,000 × [.05 (1+.05)^30/(1+.05)^30-1] + \$16,000

= \$285,000 × 0.0802 + \$100,000 × 0.0651 + \$16,000 = \$45,367



The Break-Even Chart for the Scheme Choice Decision Problem

The slope of the line for Scheme A is 2, and those for Schemes B and C are 1.6 and 1.2 respectively. The fixed costs for Schemes A, B and C are **$43,140, $44,453 and $45,367** respectively. From this break-even chart, we see that for pumping time smaller than **2,784 hours per year, Scheme A is the best**. For pumping time larger than 2,784 hours per year, Scheme C is the best. Scheme B is never to be used because it is in no situation better than Scheme A or Scheme C.