Iqra National University

Final Term Exam Paper

Subject: Construction Financial Management

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Answer Sheet

Q1. What is net present value and Equivalent Annual cost? What is the benefit of Benefit-cost ratio? (5)

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.

Q1Answer:

Part 1:

NPV:

Net Present Value (NPV) is the value of all future cash flows (positive and negative) over the entire life of an investment discounted to the present. NPV analysis is a form of intrinsic valuation and is used extensively across finance and accounting for determining the value of a business, investment security, capital project, new venture, cost reduction program, and anything that involves cash flow.

or simply we can say that (present value of total benefit-present value of total cost)

It also indicate that the project is variable or not and show us the feasibility of project.

NPV analysis is used to help determine how much an investment, project, or any series of cash flows is worth. It is an all-encompassing metric, as it takes into account all revenues, expenses, and capital costs associated with an investment in its Free Cash Flow (FCF).

In addition to factoring all revenues and costs, it also takes into account the timing of each cash flow that can result in a large impact on the present value of an investment. For example, it's better to see cash inflows sooner and cash outflows later, compared to the opposite

EAC:

In finance, the equivalent annual cost (EAC) is the cost per year of owning and operating an asset over its entire lifespan. It is calculated by dividing the NPV of a project by the "present value of annuity factor.

It will be used in following scenarios:

- ✓ Assessing alternative projects of unequal lives (where only the costs are relevant) in order to address any built-in bias favoring the longer-term investment.
- ✓ Determining the optimum economic life of an asset, through charting the change in EAC that may occur due to the fluctuation of operating costs and salvage values over time.
- ✓ Assessing whether leasing an asset would be more economical than purchasing it.
- ✓ Assessing whether increased maintenance costs will economically change the useful life of an asset.
- ✓ Calculating how much should be invested in an asset in order to achieve a desired result (i.e., purchasing a storage tank with a 20-year life, as opposed to one with a 5-year life, in order to achieve a similar EAC).
- ✓ Comparing to estimate annual cost savings, in order to determine whether it makes economic sense to invest.
- ✓ Estimating the cost savings required to justify the purchase of new equipment.
- ✓ Determining the cost of continuing with existing equipment.
- ✓ Where an asset undergoes a major overhaul and the cost is not fully reflected in salvage values, to calculate the optimum life (i.e., lowest EAC) of holding on to the asset.

Benefit of BCR:

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. All benefits and costs should be expressed in discounted present values. A BCR can be a profitability index in for-profit contexts. A BCR takes into account the amount of monetary gain realized by performing a project versus the amount it costs to execute the project. The higher the BCR the better the investment. The general rule of thumb is that if the benefit is higher than the cost the project is a good investment.
The practice of cost–benefit analysis in some [*which?*] countries refers to the BCR as the cost–benefit ratio, but this is still calculated as the ratio of benefits to costs.
The ratio of BCR is defined as below:

$$\frac{B}{C} Ratio = \frac{Present\ worth\ of\ total\ benefits}{Present\ worth\ of\ total\ cost}\ OR$$

$$\frac{B}{C} Ratio = \frac{Equivalent\ annual\ total\ benefit}{Equivalent\ annual\ total\ cost}\ OR$$

If above ration grater then 1 then we can say project is worthwhile, if the ration is equal to 1 it mean the project break even and if it's less than 1 it mean the project is in loss.

Part 2:

i): Given data

Construction cost =PKR 9,000,000,000

Operation and maintenance cost per year=PKR375, 000,000

Annual income cost=1,050,000,000

Time horizon=30 years

i= 5%pa

1st present value method:

A: present value of benefit in 30years=1050000000× $\left[\frac{(1+0.05)^{30}-1}{(1+0.05)^{30}\times 0.05}\right] = 1050000000 \times 57.4 = PKR\ 6.02 \times 10^{10}$

B: Preset Construction cost =PKR 9000,000,000

C: Present value of operation cost =375000000× $\left[\frac{(1+0.05)^{30}-1}{(1+0.05)^{30}\times 0.05}\right] = 375000000 * 57.4 = 2.15 \times 10^{10}$

Now will calculate the NPV= (present value of total benefit-present value of total cost) = 2.97×10^{10}

Positive NPV mean the project is feasible.

2nd EAC Method:

i) annual benefit =PKR1,050,000,000,
j) Annual operation cost=PKR375,000,000
k) Now annual construction cost=9,000,000,000× $\frac{[(1+0.05)^{30}\times 0.05]}{[(1+0.05)^{30}-1]} = 9{,}000{,}000{,}000 \times \frac{0.22}{3.32} = 9{,}000{,}000{,}000 \times 0.066 = PKR\ 585462916$

No NAB=1,050,000,000-(375,000,000+585462916) = PKR 89537084

The positive NAB show us that the project is feasible.

3rd the BCR:

$$\boldsymbol{\frac{B}{C}\ Ration = \frac{Present\ worht\ of\ total\ binifit}{present\ worth\ of\ total\ cost} = \frac{PKR\ 6.02 \times 10^{10}}{30500000000} = 1.97}$$

$$\frac{\boldsymbol{B}}{\boldsymbol{C}}\boldsymbol{Ration} = \frac{Equivalent\ annual\ total\ benefit}{Equivalent\ annual\ total\ cost} = \frac{1{,}050{,}000{,}000}{\mathbf{960462916}} = \mathbf{1.1}$$

As ration more than 1 so project is worthwhile

Q2:

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

i) 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)

Q2 Answer:

Part 1:

A: What is IRR?

Internal rate of return (IRR) is a capital budgeting measurement used by companies to determine the profitability of a potential investment or project based on predicted cash flows. The IRR formula is complex and relies on a certain amount of trial and error to get correct.

This is because IRR makes the net present value (NPV) of all cash flows equal to zero. The NPV is the difference between the present value of cash inflows (predicted profits) and the current value of cash outflows (predicted expenditure) over a period of time.

If this metric is made to equal zero, then it equates to identical cash inflows and outflows, which has led IRR to be criticized as overly simplistic.

IRR formula:

With the NPV set to zero, the IRR formula then works out the discounted future cash flows from a project or investment. It does this from an estimate of the value of a future project, based on its predicted profits compared with predicted expenditure.

However, because of the complexity of the calculation, few traders calculate IRR manually, instead opting for specifically designed computer software.

$$IRR = NPV = \sum_{t=1}^{t} \frac{C_t}{(1+r)^t} = C_0 = 0$$

Where:

Ct = net cash inflow during the period t

C0 = total initial investment cost

r = discount rate

t = number of time periods

B: Difference between IRR and NPV:

The main difference between NPV and IRR is given below:

1. Outcome value:

The net present value (NPV) technique of investment appraisal shows the estimated net value of return in monetary terms that the project would generate. It considers the discounted value of all the possible cash outflows and inflows regarding a specific project and then compares the two to get a net positive or negative cash flow known as net present value.

The internal rate of return (IRR) method shows the value of return for a project in percentage terms. If IRR is applied to the cash flows of a project instead of cost of capital, the NPV of the project would be zero.

2. Basis of decision:

Generally, a project is accepted if its NPV is positive or it shows surplus funds at the end of the project. However, it is possible that a project generates positive cash flows but the business is still not ready to accept it because the positive NPV does not match the NPV set by the management of the business.

IRR is used to appraise the sensitivity of cost of capital which is used to appraise a project. IRR effectively shows a percentage below which NPV would start to fall negative. Therefore if IRR is greater than the cost of capital, the project is accepted and otherwise rejected.

3. Assumptions:

The NPV technique assumes that the cash inflows generated by the project are reinvested at the cost of capital of the business. This assumption is somehow realistic because the cost of capital of a business indicates the risk that a business is already facing in its investments.

The IRR method assumes that the cash inflows are reinvested at IRR or internal rate of return.

4. Cash flow variations:

The NPV calculation accommodates any cash outflows after the initial outflow of cash. If a later cash outflow occurs after the initial cash outflow, it can be discounted at applicable discount factor or cost of capital and included in the calculation easily.

The IRR calculation is disturbed by the cash outflows that occur after the initial cash outflow because in such a situation its calculations could produce more than one IRR's which would be unrealistic. An alternative method of calculation available to overcome this problem is known as the modified internal rate of return (MIRR) method which is beyond the scope of this discussion.

5. Applications:

NPV enables a business to make constructive investment decisions because not only it accounts for whole project life but also takes into account the discounting factor which indicates the minimum amount of return the investors of business would agree upon or the level of return the business is already earning on its other investments.

IRR is used to indicate the risks attached to the project for which NPV is calculated. As the cash flows increase/decrease by an increase/decrease in the cost of capital of the company, IRR shows the percentage at which the project will be neither positive nor negative, which would indicate the sensitivity level of the cost of capital of that project.

NPV versus IRR – tabular comparison:

A tabular comparison of NPV and IRR is given below:

NPV	**vs**	**IRR**
Outcome Value		
In monetary terms.		In percentage terms.
Basis of Decision		
Project is accepted if NPV is positive.		Project is accepted if IRR is greater than the cost of capital.
Assumptions		
Cash flows are reinvested at the cost of capital.		Cash flows are reinvested at the IRR.
Cash outflow variations		
NPV calculation can accommodate for variable cash flows.		Simple IRR calculation method do not accommodate variable cash flows. Modified IRR or MIRR calculation can accommodate variable cash flows.
Applications		
Is used for appraising the outcome of a project.		Is used to measure the sensitivity of cost of capital of a company.

C: What is Inflation?

Inflation meaning: Inflation refers to the rise in the prices of most goods and services of daily or common use, such as food, clothing, housing etc.

Inflation refers to the rise in the prices of most goods and services of daily or common use, such as food, clothing, housing, recreation, transport, consumer staples, etc. Inflation measures the average price change in a basket of commodities and services over time. The opposite and rare fall in the price index of this basket of items is called 'deflation'. Inflation is indicative of the decrease in the purchasing power of a unit of a country's currency. This is measured in percentage.

What are the effects of Inflation?

The purchasing power of a currency unit decreases as the commodities and services get dearer. This also impacts the cost of living in a country. When inflation is high, the cost of living gets higher as well, which ultimately leads to a deceleration in economic growth. A certain level of inflation is required in the economy to ensure that expenditure is promoted and hoarding money through savings is demotivated.

As money generally loses its value over time, it is important for people to invest the money. Investing ensures the economic growth of a country.

How is Inflation measured?

In India, inflation is primarily measured by two main indices — WPI (Wholesale Price Index) and CPI (Consumer Price Index), which measure wholesale and retail-level price changes, respectively. The CPI calculates the difference in the price of commodities and services such as food, medical care, education, electronics etc, which Indian consumers buy for use.

On the other hand, the goods or services sold by businesses to smaller businesses for selling further is captured by the WPI. In India, both WPI (Wholesale Price Index) and CPI (Consumer Price Index) are used to measure inflation.

What are the main causes of Inflation?

The main causes of inflation in India have been subject to considerable debates and discussions. These are some of the chief reasons for the increase in prices:

- High demand and low production or supply of multiple commodities create a demand-supply gap, which leads to a hike in prices.
- Excess circulation of money leads to inflation as money loses its purchasing power.

- With people having more money, they also tend to spend more, which causes increased demand.

Also, note the following pointers:

- Spurt in production prices of certain commodities also causes inflation as the price of the final product increases. This is called cost-push inflation.
- Increase in the prices of goods and services is also a factor to consider as the involved labor also expects and demands more costs/wages to maintain their cost of living. This spirals to further increase in the prices of goods.

Is Inflation bad for everyone?

Inflation is perceived differently by everyone depending upon the kind of assets they possess. For someone with investments in real estate or stocked commodity, inflation means that the prices of their assets is set for a hike. For those who possess cash, they may be adversely affected by inflation as the value of their cash erodes.

Part 2:

End of year	NCF	$\left[\frac{1}{(1+i)^n}\right]$ I=8%, n=4	DCF of 8%	$\left[\frac{1}{(1+i)^n}\right]$ I=3%, n=4	DCF of 13%
0	-9,000,000	1	-9,000,000	1	-9,000,000
1	2,100,000	0.926	1944600	0.885	1858500
2	2,700,000	0.857	2313900	0.783	2114100
3	3,450,000	0.794	2739300	0.693	2390850
4	4,200,000	0.735	3087000	0.613	2574600
			1084800		-61950

$$i' = 8\% + \left[\frac{1084800}{1084800 + 61950}\right] \times (13 - 8)\% = 12.72\%(i.e. aparent\ IRR)$$

As we know that $i' = (1+i)(i+f) - 1\ or\ 0.1272 = (1+i)(1+0.04) - 1$

1.04i=0.1272-1.04+1

I = 0.084 = 8.4%

Answer: so the real is 8.4%

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.

Q3 Answer:

Contribution per unit expressed in percentage=$\left[\left(\frac{p-v}{p}\right)\right] \times 100$

Contribution for per unit due to cast iron pipe=$\frac{450000-300000}{450000} \times 100 = 33.33\%$

Contribution for per unit due to steel pipe=$\frac{525000-375000}{525000} \times 100 = 28.57\%$

Contribution for per unit due to steel pipe=$\frac{600000-450000}{450000} \times 100 = 25\%$

	Contribution		% of sell
Cost iron pipes	33.33%	x	25%=8.33%
Steel pipes	28.57%	x	35%=10%
Concrete pipe	25%	x	40%=10%
			Total 28.33%

This 28.33% is the total contribution of pipes

a) BEP=$\frac{FC}{Contribution} = \frac{200}{0.2833} = \$\,706\ m, BEP = \frac{706}{900} = 78.4\%$
b) at 95% of capacity:

Profit=TR-TC= (900X0.95%)-VC-FC=855-810(1-0.2833)-200=$75 m

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

Q4 Answer:

Scheme A:

Equivalent annul cost of installation and maintenance

=$ 120,000× $\{0.05(1+0.05)^{14}/ (1+0.05)^{14} - 1\}$ + $200,000 × $\{0.05(1+0.05)^{30} / (1+0.05)^{30} – 1\}$ + $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 × $\{0.05(1+0.05)^{16}/ (1+0.05)^{16}-1\}$ +$160,000× $\{0.05(1+0.05)^{30}/ (1+0.05)^{30}-1\}$ +$16,500

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

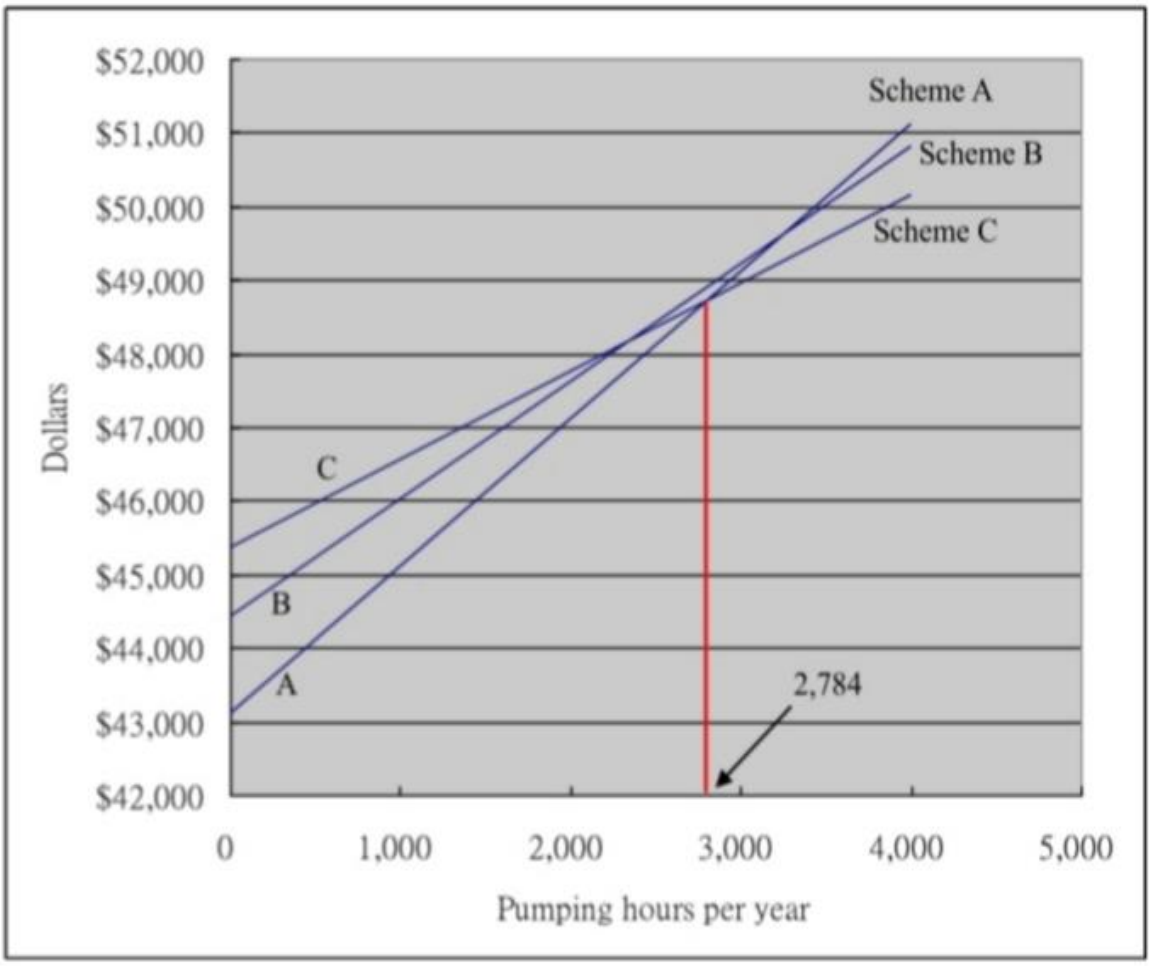
Scheme C:

Equivalent annual cost of installation and maintenance

=$285,000× $\{0.05(1+0.05)^{20}/ (1+0.05)^{20}-1\}$ +$100,000 × $\{0.05(1+0.05)^{30}/ (1+0.05)^{30}-1\}$ +$16,000

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

The break-even chart is:



Break-even Chart for the scheme choice decision problem.

In Above Fig. the slope of the line for the scheme A is 2, and those for scheme B and C are 1.6 and 1.2 respectively. The fixed costs for Scheme 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 hour 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.