J B GUPTA CLASSES

98184931932, drjaibhagwan@gmail.com,
www.jbguptaclasses.com

Chapter 7
Capital Budgeting
(Capital Expenditure decisions)

Chapter Index

(x) Certainty Equality Approach
(xi) Social Cost Benefit
(xii) Sensitivity Analysis

CAPITAL expenditure decisions are concerned with decisions regarding investment of funds in fixed and current assets for getting returns for a number of years. Such decisions are extremely important because of following reasons:

(i) Substantial sums of money are involved.

(ii) It may be difficult to reverse the decision.

(iii) Such decisions have considerable impact on the future of a firm. Sometimes, the success or failure of the firm may depend upon a single investment decision.

Before discussing capital expenditure decision methods, we may understand following three points:

(i) *Cost of capital.*

(ii) *Time Value of Money.*

(iii) *Cash inflow from operation:*

There are two criteria for capital expenditure decisions:

(a) Accounting profit,

(b) Cash flow. Under Cash flow criterion, we require cash inflow, i.e., post-tax profit before non-cash items. Important non-cash items are depreciation and apportioned fixed costs. By apportioned fixed costs we mean, such fixed costs which are not being incurred because of the proposal but which are just being charged for determining accounting profit.

CRITERIA FOR CAPITAL EXPENDITURE DECISIONS

As stated above, there are two criteria for capital expenditure decisions: (i) Accounting profit, (ii) Cash flow. Under Accounting profit criterion, only one method is there. It is known accounting rate of return or unadjusted rate of return. (It is known as unadjusted rate of return because for its calculations, we do not make any adjustment on account of time value of money). In case of cash flow criterion, cash inflows and cash outflows because of the proposal are considered for the decision. Cash inflow includes cash coming in as well as reduced outflows. Cash outflows include cash going out as well as reduced inflows. Cash flow criterion is preferred as compared to accounting profit criterion for following reasons:

(i) Use of cash flows avoids accounting ambiguities;

(ii) It is possible to consider time value of money.

Under cash flow criterion, two categories of methods are there:

(i) Payback period method,

(ii) Methods based on discounted cash flows.

There are three important methods based on the discounted cash flows:

(a) Net present value,

(b) Profitability index,

(c) Internal rate of return.

Let's discuss various methods of capital expenditure decisions one by one.

METHOD BASED ON ACCOUTING PROFIT

UNADJUSTED RATE OF RETURN

OR

ACCOUNTING RATE OF RETURN:

(a) On the basis of own funds invested:

$$= \frac{\text{Profit after depreciation and after interest on borrowed funds}}{\text{Own funds invested}}$$

This approach assumes that borrowed funds are not key factors. We can raise any amount of borrowed funds that we need. Hence, the return should be maximized on the basis of own funds invested.

Return is available to own funds (owners or shareholders of the business) only after paying interest. Hence, we take the profit after interest.

If tax is considered, the profit (considered in the above formula) should be taken as post- tax.

There is an alternative approach under which, instead of own funds, we take Average own funds invested.

(This approach is quite similar to Return on Equity as we study under Accounting ratios)

(b) On the basis of total funds invested:

$$\frac{\text{Profit after depreciation but before interest}}{\text{Total funds invested}}$$

This approach assumes that borrowed funds are key factors. We can raise only limited amount of borrowed funds. Hence, the return should be maximized on the basis of own as well borrowed funds invested i.e. on the basis of total funds.

Total return available on total funds ("owners or shareholders" as well as

"suppliers of borrowed funds") means EBIT i.e. before paying interest.

Hence, we take the profit before interest.

If tax is considered, the profit (considered in the above formula) should be taken as "before interest post- tax." This is calculated as follows: [EBIT – Interest] – Tax rate [EBIT – Interest] + interest.

There is an alternative approach under which, instead of total funds, we take Average total funds invested.

(This approach is quite similar to Return on capital employed as we study under Accounting ratios.)

Generally we calculate rates of return for capital expenditure decisions on the basis of own funds assuming that borrowed funds are available as per requirements.

If borrowed funds are available in limited amount only, we calculate rate of return on the basis of total funds invested.

METHODS BASED ON CASHFLOWS

(A) PAY BACK PERIOD (PBP) METHOD / APPROACH

- Pay back period is the period within which the project will pay back its cost.
- Smaller the pay back period, better the project.
- The main advantage of the method is its simplicity.
- The main disadvantage is that it does not consider post pay back period profitability.
- Pay back period can be calculated on the basis of simple cash flow or discounted cash flow.
- PBP method is quite suitable when rate of becoming obsolete is quite high.
- Generally it is calculated on the basis of undiscounted as follows. If there requirement of the question, we may calculate it on the basis of discounted as follows.

Example

	I Proposal	II Proposal
Investment	Rs.1,00,000	Rs.1,00,000
Cash inflow		
I year	30,000	20,000
II year	30,000	30,000
III year	30,000	30,000
IV year	30,000	40,000

V year	—	30,000
	1,20,000	1,50,000
Pay back period	3.33 years	3.50 years

If we go by PBP, we prefer the first proposal because of smaller PBP. While taking this decision, we have not considered the fact in first proposal post-pay back profit is only Rs.20,000 while it is Rs.50,000 in II proposal.

(B) DISCOUNTED CASH FLOW ANALYSIS

(a) NPV METHOD

NPV = PV of inflow – PV of outflow.

If NPV is positive the project may be taken up. If NPV is zero, project may be taken up only if non-financial benefits are there. If NPV is negative project may not be taken up.

(b) PROFITABLITY METHOD

$$\text{Profitability index (PI)} = \frac{\text{Present value of inflow}}{\text{PV of outflow}}$$

If PI is more than one the project may be taken. If PI is one project may be taken up only on the basis of non-financial considerations. If PI is less than one the project may not be taken up. It is also called benefit cost ratio or desirability Factor.

Suppose the PI of a five-years project is 1.50. It means that on an investment of rupee one, the present value of the return[1] that we will get over 5 years is Rs.0.50.

NPV v/s PI:

- If we have to evaluate only project, we may either calculate NPV or PI, both will give same result.
- If we have to evaluate two or more projects:

(i) We should apply NPV method if funds are not key factors, i.e., our aim is maximization of profits.

(ii) We should apply PI method if funds are key factors, i.e., we want to maximize the rate of return on funds employed.

Let's have an example to understand this point. A person is offered to two jobs and he can accept either. First job will give him Rs.350 per day of 7 hours (Rs.50.00 per hour). Second job will give him Rs.380 per day of 8 hours (Rs.47.50 per hour), which job he should accept? If time is key factor for him, i.e., if he wants to maximize his earning per hour he should go for the first job. If time is

[1] This return is exclusive of cost of capital i.e. this return is net of cost of capital. (We shall be studying this concept some time later on)

not key factor for him and he wants to maximize his total earnings, he should go for the second job.

Let's have another example. Suppose, a businessman has two capital expenditure proposals before him. First will require on investment of Rs.40,000 initially and will result in cash flows at present value amounting to Rs.60,000 (NPV = 20,000, PI = 1.50). Second will require on investment of Rs.50,000 and will result in cash inflows at present value amounting to Rs.72,000 (NPV = 22,000, PI = 1.44). If funds are key factor, he should go for the first project, i.e., he should maximize the rate of return. If funds are not key factor, i.e., he wants to maximize his profit, he should go for the second project[2].

(c) INTERNAL RATE OF RETURN: IRR is the rate of return on funds employed; it is calculated on the basis of discounted cash flow approach. It is inclusive of cost of capital. For example, cost of capital is 10% and IRR is 15%, it means the total return on the funds employed is 15%; out of which 10% is to meet the cost of capital and the balance it is extra profit over and above cost of capital.

IRR is that discounting rate at which NPV of a project is Zero. Hence,

- If NPV = 0 or PI = 1, than IRR is equal to discounting.
- If NPV is greater than zero or if PI is greater than one, IRR is greater than discounting rate.
- If NPV is less than zero or PI is less than one, than IRR is less than discounting rate.

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[2]The term fund here refers to the total funds i.e. promoters' own funds, funds raised through Public issue, funds raised through private placement, borrowed funds etc.

In the exam, if the question silent on the point whether the funds are the key factors or not, we assume that the funds are no the key factors. The reason is that in today's world, funds are not key factor (the main key factor of today's world is Vision which is the sum of Knowledge and Entrepreneurship). Fund is the most mobile factor of production in today's world. (Any amount of funds can be transferred from one country to another country simply at the click of mouse). From fund point of view, the world has become just like a global village. Funds of one country are invested not only in that country but also in many other countries of different continents.

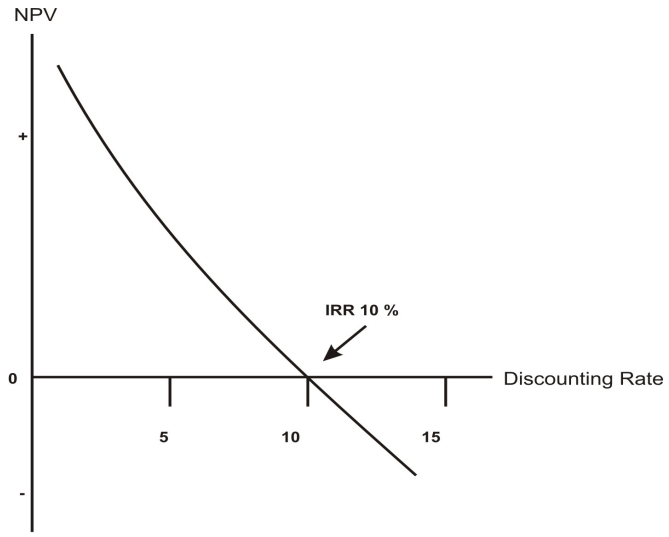


DIAGRAM - 1

Two steps for calculation of IRR:

(A) Discount all cash flows at two such rates that one gives you positive NPV and other gives you negative NPV.

(B) Apply formula:

$$\text{IRR} = \text{Lower rate} + \frac{\text{Lower rate NPV}}{\text{Lower rate NPV} - \text{Higher rate NPV}} \times \text{Diff. in rates}$$

If the two rates referred above are not given in the question, following steps are required:

- Calculate fake pay back period (undiscounted) on the basis of average cash flows.
- Locate the figure of fake payback period in annuity table against the number of years equal to life of the project. Find the rate of discount.
- Discount the cash flows at the rate found above, if NPV is positive, the other rate should be higher than this rate. If NPV is negative, the other rate should be lower than this rate.

Teaching note: not to be given in the exam. We shall be able to understand the concept given below only after having solved some (say 20 or so) practical questions of capital budgeting.

(I) **NPV**

(i) If the requirement of the question is calculation of NPV or if we, of our own, want to take capital expenditure decision on the basis of NPV :

NPV should be calculated by discounting the cash flows on the basis of the required rate of return. If the project or proposal does not involve special risk, the required rate of return is Cost of capital. If the project

involves special risk, the required rate of return should be "cost of capital + Risk premium."

(ii) When we calculate NPV for calculating IRR :

NPVs should be calculated on the basis of 2 discounting rates. The one rate should be such that results in Negative NPV and the other rate should be such that results in + NPV.

(iii) Given IRR or Given desired IRR or if we have calculated IRR :

If we calculate NPV, using this IRR as discounting rate, the NPV would be zero.

(II) NPV AND PI ARE EXCULSIVE OF COST OF CAPITAL.

Q.No.1: A company has an investment opportunity costing Rs.40,000 with following expected net cash flow (i.e., after taxes and before depreciation); Cost of capital 10 per cent.

Year	Net cash flow
1-5	Rs.7,000 each year
6	Rs.8,000
7	Rs.10,000
8	Rs.15,000
9	Rs.10,000
10	Rs.4,000

Determine (a) Payback period on the basis of undiscounted cash flows (b) Payback period on the basis of discounted cash flows (c) NPV, (d) Profitability Index. Also determine IRR with the help of 10 per cent and 15 per cent discounting factors.

Answer

(a) Calculation of Pay Back period:

Year	CF	Cum. CF
1-5	Rs.7,000 each year	Rs.35,000
6	Rs.8000	Rs.43,000

For payback, the cash inflow arising from the investment should be Rs.40000. During the first 5 years, the project will pay Rs.35000 [Rs.7000 each year for 5 year]. Remaining Rs.5000 would be recovered in a part of the year 6 as full year 6 will pay Rs.8000. Hence,
Pay Back Period = 5 + 5000/8000 = 5.625 years.

(b) Calculation of Pay Back period on Discounted cash flow basis

Year	CF	PV (Rupees)	Cum. CF at PV (Rs)

1-5	Rs.7,000 each year	Rs.7,000x3.791 = 26,537	26,537
6	Rs.8,000	8000 x 0.564 = 4512	31,049
7	Rs.10,000	10000 x 0.513 = 5130	36,179
8	Rs.15,000	15000 x 0.467 = 7005	43,184

During the first 7 years, the project will pay discounted cash flow of Rs.36,179. Remaining Rs.3,821 would be recovered in a part of the year 8 as full year 8 will pay Rs.7,005.

Hence, Pay Back Period = 7 + 3821 / 7005 = 7.5455 years.

(c) DCF Analysis of the project

Year	Cash flow (Rs.)	DCF (10%) (Rs.)	DCF (15%) (Rs.)
1-5	7,000 each year	26,537	23,464
6	8,000	4,512	3,456
7	10,000	5,130	3,760
8	15,000	7,005	4,905
9	10,000	4,240	2,840
10	4,000	1.544	988
		48,968	39,413

NPV = Present value of cash inflow – Present value of cash out flow
= 48969 – 40000 = 8969
The project may be taken up as NPV is Positive.

$$\text{PI} = \frac{\text{Present value of cash inflow}}{\text{Present value of cash outflow}}$$

$$\text{PI} = \frac{48{,}969}{40{,}000} = 1.22$$

The project may be taken up as PI is greater than 1.

IRR =

$$\text{Lower rate} + \frac{\text{Lower rate NPV}}{\text{Lower rate NPV} - \text{Higher rate NPV}} \times \text{Diff. in rates}$$

NPV at lower rate (10%) = 48,969 – 40,000 = 8,969

NPV at higher rate (15%) = -40,000 + 39,413 = -587

$$\text{IRR} = 10 + \frac{8968}{8969 - (-587)} \times 5 = 14.70\%$$

The project may be taken up as IRR is greater than the cost of capital.

Q. No. 2: A company wants to replace its old machine with a new automatic machine; two models A and B are available at the same cost of Rs.5 Lakh each. Salvage value of the old machine is Rs.1 Lakh.

The utilities of the existing machine can be used if the company purchases A. Additional cost of utilities to be purchased in that case are Rs.1 Lakh.

If the company purchases B then all the existing utilities will have to be replaced with new utilities costing Rs.2 Lakhs. The salvage value of the old utilities will be Rs.0.20 Lakhs.

The earnings after taxation are expected to be:

Year	Cash Inflows (Rupees)	
	A	B
1	1,00,000	2,00,000
2	1,50,000	2,10,000
3	1,80,000	1,80,000
4	2,00,000	1,70,000
5	1,70,000	40,000
Salvage value at the end of year 5	50,000	60,000

The target return on capital is 15%. You are required to (i) compute, for the two machines separately, discounted pay back period and (ii) advise which of the machines is to be selected?

Answer

Assumption: All salvage values given are post- tax.

Initial investment (Rs.Lakhs)

	A	B
Cost	5	5
Salvage of old mach.	-1	-1
Additional utilities	+ 1	+ 2
Sale of old utilities	----	-0.20
Total	5	5.80

DCF Analysis of A (Rs.Lakhs)

	Period	PVF	CF	PV	Cum. CF at Discounted Values
CFFO	1	0.87	+ 1	+ 0.87	0.87

CFFO	2	0.76	+ 1.50	+ 1.14	2.01
CFFO	3	0.66	+ 1.80	+ 1.19	3.20
CFFO	4	0.57	+ 2.00	+ 1.14	4.34
CFFO	5	0.50	+ 1.70	+ 0.85	5.19
Sale (scrap)	5	0.50	+ 0.50	+ 0.25	5.44

$$PBP = 4 + \frac{0.66}{1.10} = 4.60 \text{ YEARS}$$

DCF Analysis of B (Rs. Lakhs)

	Period	PVF	CF	PV	Cum. CF at Discounted Values
CFFO	1	0.87	+ 2.00	+ 1.74	1.74
CFFO	2	0.76	+ 2.10	+ 1.56	3.30
CFFO	3	0.66	+ 1.80	+ 1.19	4.49
CFFO	4	0.57	+ 1.70	+ 0.97	5.46
CFFO	5	0.50	+ 0.40	+ 0.20	5.66
Sale (scrap)	5	0.50	+ 0.60	+ 0.30	5.96

$$PBP = 4 + \frac{0.34}{0.50} = 4.68$$

Project A is recommended because lower PBP.

Q. No. 3: A firm is considering a project the details of which are:

Investment 70,000

Year	Cash flow
1	10,000
2	20,000
3	30,000
4	45,000
5	40,000

Determine the Pay Back period. Cost of capital 10%. Compute NPV, PI and I.R.R.

Answer: $PBP = 3 + \frac{10000}{45000} = 3.22$ years

DCF Analysis of the Project (Discount rate 10%)

	Period	PVF	CF	PV
Investment	0	1	-70000	-70000
Cash inflow	1	.909	+ 10000	+ 9090
-----do-----	2	.826	+ 20000	+ 16520
-----do-----	3	.751	+ 30000	+ 22530
-----do-----	4	.683	+ 45000	+ 30735
-----do-----	5	.621	+ 40000	+ 24840
Total				-70000 + 103715

NPV = 103715-70000 = 33715 (the project may be taken up as NPV is + .)
PI = (103715/70000) = 1.48 (the project may be taken up as PI is greater 1 than 1).

Teaching note[3] : IRR: It is the rate of return (profit) on funds employed. It is calculated on the basis of DCFs. It is inclusive of cost of capital. For example, if IRR is 15% and cost of capital is 10%, then total return is 15%, out which 10% is towards cost of capital and 5% is extra profit.
NPV=0, PI=1, IRR= Discounting rate
NPV>0, PI>1, IRR> Discounting rate
NPV<0, PI<1, IRR< Discounting rate
IRR is that discounting rate at which NPV is zero.

Average Cash flow = 29,000,
Fake PBP = 70,000/29,000 = 2.41. Approx. IRR= 30%.

DCF Analysis of project (Dis. rate 30%)

	Period	PVF	CF	PV
Investment	0	1	-70000	-70000
Cash inflow	1	0.769	+ 10000	+ 7690
-----do-----	2	0.592	+ 20000	+ 11840
-----do-----	3	0.455	+ 30000	+ 13650
-----do-----	4	0.350	+ 45000	+ 15750
-----do-----	5	0.269	+ 40000	+ 10760
NPV				-10310

As NPV is -, the other rate should be lower than 30 %. Let's take the other rate as 20%.

DCF Analysis of project (Dis. rate 20%)

	Period	PVF	CF	PV
Investment	0	1	-70000	-70000
Cash inflow	1	0.833	+ 10000	+ 8330
-----do-----	2	0.694	+ 20000	+ 13880
-----do-----	3	0.579	+ 30000	+ 17370
-----do-----	4	0.482	+ 45000	+ 21690
-----do-----	5	0.402	+ 40000	+ 16080
NPV				+ 7350

$$\text{IRR} = 20 + \frac{7350}{(7350)-(-10310)} \times 10 = 24.16$$

[3] It is for understanding of the concept. It is not a part of the answer.

IRR>cost of capital, project is recommended

Q. No. 4: *X Ltd.* has currently under examination a project which will yield the following returns over a period of time:

Year	*Gross Yield*
1	Rs.80,000
2	Rs.80,000
3	Rs.90,000
4	Rs.90,000
5	Rs.95,000

Cost of Machinery to be installed Rs.2,00,000. Depreciation 30 per cent p.a. on W.D.V., Tax 35 per cent. Cost of capital 12 per cent. Scrap value nil. Would you recommend accepting the project under IRR method?

Answer

Working note:

Assumptions (i) the term Gross Yield refers to profit before depreciation before tax.

(ii) The machine will be discarded in the beginning of 6^{th} year.

Year	Depreciation (Rupees)	WDV (Rupees)
1	60,000	1,40,000
2	42,000	98,000
3	29,400	68,600
4	20,580	48,020
5	14,406	33,614

Calculation of cash inflow from Operation

Year	PBDT	Depreciation	Tax	Cash flow
1	80,000	60,000	7,000	73,000
2	80,000	42,000	13,300	66,700
3	90,000	29,400	21,210	68,790
4	90,000	20,580	24,297	65,703
5	95,000	14,406	28,208	66,792
Total				3,40,985

Average				68,197

Main Answer

PBP = 2,00,000 / 68197 = 2.93 Approximate IRR = 21%

	Period	CF	PVF		PV	
			21%	23%	21%	23%
INVESTMENT	0	-2,00,000	1.000	1.000	-2,00,000	-2,00,000
Cash inflow	1	73,000	0.826	0.813	+ 60,298	+ 59349
---do----	2	66,700	0.683	0.661	+ 45556	+ 44089
---do----	3	68,790	0.564	0.537	+ 38798	+ 36940
---do----	4	65,703	0.467	0.437	+ 30683	+ 28712
---do----	5	66,792	0.386	0.355	+ 25,782	+ 23711
NAV					+ 1,117	-7,199

$$\text{IRR} = 21 + \frac{1{,}117}{(1{,}117) - (-7{,}199)} \times 2 = 21.27$$

IRR>cost of capital, project is recommended

The project may be taken up as IRR is more than the cost of capital.

Q. No. 5: A company, in need of additional storage facilities for 20 years, has two basic alternatives: to construct the facilities itself or to lease them from a firm. Three bids were secured from firms that would construct them and lease to the company on the following terms:

Lease amount per year (Payable at year end)

Bidders	For the first 10 years (Rs.Lakhs)	For the next 10 years (Rs.Lakhs)
Company *X*	30	10
Company *Y*	25	20
Company *Z*	32	5

All the three bidders agreed to lease for period of 10 years with an option for renewal for the remaining 10 years. The lease amounts included the ground rent payment to owners of the land to whom the land will be reverted, under all alternatives, together with all constructions thereon at the end of 20 years.

The alternative to lease involved the following costs:

(i) Total construction cost Rs.128Lakhs

(ii) Recurring cost per annum including ground rent to owner of land Rs.6Lakhs
The minimum rate of return required on the company's investment is 15 per cent. Which alternative should be selected? Ignore Tax.

Note: The present value of Re.1 received per year at 15 per cent rate of return for a period of 10 years is Rs. 5.02. the present value of Re.1 received after 10 years at Re. 0.247. You are not supposed to you use any mathematical table for solving this question.

Answer

Annuity of 20 years

$= [(1/1.15)^1 + (1/1.15)^2 + \cdots\cdots + (1/1.15)^{10}] + [(1/1.15)^{11} + \cdots\cdots + (1/1.15)^{20}]$

$= [5.02] + (1/1.15)^{10} [(1/1.15)^1 + \cdots\cdots\cdots\cdots + (1/1.15)^{10}]$
$= [5.02] + (.247)(5.02) = 6.26$

Annuity for 20 years = 6.26 Annuity of 10 years = 5.02
Annuity of 11-20 years = 6.26 – 5.02 = 1.24

Calculation of Present value of cost of each of four proposals

Own constriction	X	Y	Z
128L x 1	30 x 5.02 L	25 x 5.02 L	32 x 5.02 L
6 L x 6.26	10 x 1.24 L	20 x 1.24 L	5 x 1.24 L
Total = 165.56L	Total = 163L	Total = 150.30L	Total = 166.84L

As the present value of cost of Y is minimum, it is recommended that the company may take lease from Y.

Q. No. 6: X Company has two presses each capable of producing 20,000 specialized components a year selling for Rs.6 each. Production on each press is flexible with the sole limitation that the economic batch quantity is 5,000.

Production level	*Total cost per annum*	
	Press A (Rs. thousands)	*Press B* (Rs. thousands)
0	10	10
5,000	60	50
10,000	63	55
15,000	70	60
20,000	82	98

The total cost of each level includes for each press Rs.5,000 for depreciation and Rs.5,000 for apportioned production overhead. Management anticipates that the components will only be required for further 5 years, after that there will be no demand.

Calculate whether it would be of financial benefit to sell one press for Rs.90,000 on the assumptions that it would have a scrap value of only Rs.10,000 in five year's time and that the average annual demand during this period would be 30,000. Cost of Capital is 10 per cent.

Answer

WORKING NOTES

Three Alternatives:

(i) Keep press A, sell press B. Produce and sell…..?..... units

Output	Sale	Cost	Profit
5,000	30,000	60,000	-30,000
10,000	60,000	63,000	-3,000
15,000	90,000	70,000	20,000
20,000	1,20,000	82,000	38,000

If press B is sold, i.e. Press A is kept, the company should produce and sell 20,000 units as there is maximum profit under this alternative.

(ii) Keep press B, sell press A. Produce and sell…?..... units.

Output	Sale	Cost	Profit
5,000	30,000	50,000	- 20,000
10,000	60,000	55,000	+ 5,000
15,000	90,000	60,000	+ 30,000
20,000	1,20,000	98,000	+ 22,000

If press A is sold, i.e. Press B is kept; the company should produce and sell 15,000 units as there is maximum profit under this alternative.

(iii) Keep both the presses. Produce and sell ? Units.

Working Note

Output 25,000 units

5,000 from *A* 20,000 from *B* : 60,000 + 98,000	1,58,000
10000 from *A* and 15000 from *B* : 63000 + 60000	1,23,000
15000 from *A* and 10000 from *B* : 70000 + 55000	1,25,000
20000 from *A* and 5000 from *B* : 82000 + 50000	1,32,000

Output 30,000 units

10,000 from *A* and 20,000 from *B* : 63,000 + 98,000	1,61,000
15,000 from *A* and 15,000 from *B* : 70,000 + 60,000	1,30,000
20,000 from *A* and 10,000 from *B* : 82,000 + 55,000	1,37,000

Total production	Production		Total cost
	A	B	
25,000	10,000	15,000	63,000+ 60,000 = 1,23,000

30,000	15,000	15,000	70,000+ 60,000 = 1,30,000

Statement showing profit at different levels of sales

Sale units	Sales amount	Cost	Profit/loss
25000	1,50,000	123000	27000
30000	1,80,000	130000	50000

If both the presses are kept, the company should produce and sell 30,000 units as this situation will result in maximum amount of profit.
MAIN ANSWER:

DCF analysis of I alternative

	Period	PVF/ A	CF	PV
Sale of press B	0	1	90,000	90,000
Cash in flow from operation	1-5	3.791	48,000 each year	48,000 x 3.791
Sale of scrap	5	0.621	10,000	10,000 X 0.621
				NPV = 2,78,178

DCF analysis of II alternative

	Period	PVF/ A	CF	PV
Sale of press	0	1	90000	90000
Cash in flow from operation	1-5	3.791	40,000 each year	40000 x 3.791
Sale of scrap	5	.621	10,000	10000 X 0.621
				NPV = 2,47,850

DFC analysis of III alternative

	Period	PVF/ A	CF	PV
Sale of press	0	1	----	----
Cash in flow from operation	1-5	3.791	70,000 each year	70,000 x 3.791
Sale of scrap	5	0.621	20,000	20,000 X 0.621
				NPV = 2,77,790

I alternative is recommended i.e. the press B may be sold.

Q. No.7: Excel Ltd. manufactures a special chemical for sale at Rs. 30 per kg. The variable cost of manufacture is Rs. 15 per kg. Fixed cost excluding depreciation is Rs. 2,50,000. Excel Ltd. is currently operating at 50 per cent capacity. It can produce a maximum of 1,00,000 kg at full capacity.

The Production Manager suggests that if the existing machines are fully replaced the company can achieve maximum capacity in the next five years gradually increasing the production by 10 per cent per year.

The Finance Manager estimates that for each 10 per cent increase in capacity, the additional increase in fixed cost will be Rs.50,000. The existing machines with a current book value of Rs.10,00,000 can be disposed of for Rs.5,00,000. The Vice-President (finance) is willing to replace the existing machines provided the NPV on replacement is about Rs.4,53,000 at 15 per cent cost of capital after tax. Tax : 40%

(i) You are required to compute the total value of machines necessary for replacement.

For your exercise you may assume the following:

(a) The company follows the block assets concept and all the assets are in the same block. Depreciation will be on straight-line basis and the same basis is allowed for tax purposes.
(b) There will be no salvage value for the machines newly purchased. The entire cost of the assets will be depreciated over five-year period.
(c) Replacement outflows will be at the beginning of the year.
(d)

Year	0	1	2	3	4	5
Dis. Factor at 15%	1	0.87	0.76	0.66	0.57	0.49

(ii) On the basis of data given above, the managing director feels the replacement, if carried out, would at least yield post tax return of 15 per cent in the three years provided the capacity build up is 60 per cent, 80 per cent and 100 per cent respectively. Do you agree?

(May1997) (20 Marks)

Without replacement, old machine can be used for 5 years at 50 per cent capacity with no salvage value. So if we do not replace the machine, the NPV would be:

$[\{(50,000\times15)-(2,50,000)\}-0.40\{(50,000\times15)-(2,50,000)-(2,00,000)\}]\times3.35$

$=12,73,000.$

There is a phrase in the question "NPV on replacement is about Rs.4,53,000." We interpret this clause that the replacement will result in incremental NPV of Rs.4,53,000, i.e., total NPV would be Rs.17,26,000.

Let the total value of machinery necessary for replacement = Rs. X

Post replacement WDV = 10,00,000 + X-5,00,000 = X+ 5,00,000
Post replacement Annual depreciation = 0.20(X+ 5,00,000) = 0.20X+ 1,00,000
Incremental dep. = [Post replacement Dep. – Dep. without replacement] = (0.20x+ 100000)-(200000) = 0.20x -100000

Statement Showing Incremental Cash Flows As A Result Of Replacement

Year	Incre.	Incre.	Incre. Dep	Incre. Tax	Incre. Cash

	Cont.	FC			inflow from operation
1	1,50,000	50,000	0.20X -1,00,000	80,000 – 0.08X	20,000 + 0.08X
2	3,00,000	1,00,000	0.20X -1,00,000	1,20,000 – 0.08X	80,000 + 0.08X
3	4,50,000	1,50,000	0.20X -1,00,000	1,60,000 – 0.08X	1,40,000 + 0.08X
4	6,00,000	2,00,000	0.20X -1,00,000	2,00,000 – 0.08X	2,00,000 + 0.08X
5	7,50,000	2,50,000	0.20X -1,00,000	2,40,000 – 0.08X	2,60,000 + 0.08X

Calculation of NPV

	Period	PVF	CF	PV
Investment	0	1	– X + 5,00,000	-X + 5,00,000
Operation	1	0.87	20,000+ 0.08X	(20,000 + 0.08X).(0.87)
	2	0.76	80,000+ 0.08X	(80,000 + 0.08X).(0.76)
	3	0.66	1,40,000 + 0.08X	(1,40,000 + 0.08X).(0.66)
	4	0.57	2,00,000 + 0.08X	(2,00,000 + 0.08X).(0.57)
	5	0.49	2,60,000 + 0.08X	(2,60,000 + 0.08X).(0.49)
				– 0.732 X + 9,12,000

4,53,000 = – 0.732 X + 9,12,000

X = 6,27,049

(b) NPV at 15%

	Period	PVF	CF	PV
Investment	0	1	-6,27,049 + 5,00,000	– 1,27,049
Operation	1	0.87	(20,000) + (0.08)(6,27,049)	70,164 x (0.87)
	2	0.76	(1,40,000)+ (0.08)(6,27,049)	1,90,164 x (0.76)
	3	0.66	(2,60,000) + 0.08)(6,27,049)	3,10,000 x (0.66)
NPV				+ 2,83,119

As the NPV at 15% is positive, the replacement, if carried out, would yield more than 15 per cent post tax in the three years provided the capacity build up is 60 per cent, 80 per cent and 100 per cent respectively.

Q. No.8: T Ltd., an existing company ,is considering a new project for manufacturing of pocket video games involving a capital expenditure of Rs.600Lakh and working capital of Rs.150Lakh. The capacity of the plant is for an annual production of 12Lakh units and capacity utilization during the 6 years working life of the project is expected to be as indicated below:

Year	*Capacity Utilization %*
1	33.1/3
2	66.2/3
3	90
4-6	100

The average price per unit of the product is expected to be Rs.200 netting a contribution of 40 per cent. Annual fixed costs, excluding depreciation, are estimated to be Rs.480lakh per annum from the third year onwards; for the first and second year it would be Rs.240Lakh and Rs.360Lakh respectively. The average rate of depreciation for tax purposes is 33.1/3 per cent on the capital assets. The rate of income-tax may be taken at 50 per cent.

At the end of the third year, an additional investment of Rs.100Lakh would be required for working capital.

The company targets for a rate of return of 15 per cent.

You are required to indicate whether the proposal is viable giving you working notes and analysis.

Terminal value for the fixed assets may be taken a 10 per cent and for the current assets at 100 per cent. Calculation may be rounded off to Rs. Lakhs. Please give your answer under each of two assumptions:

(i) when there is no other assets of the Block of which capital assets of this project are related,

(ii) when there are other assets of the Block. The present value factors: 0.8696, 0.7561, 0.6575, 0.5718, 0.4972, 0.4323 & so on.

Answer

NO OTHER ASSETS OF THE BLOCK

Teaching note – not to be given in the exam. Under WDV method, if there is no other asset of the block), no depreciation is allowed for the year in which asset is sold, discarded, demolished or destroyed. (Income Tax, 1961 allows depreciation on closing WDV. If the asset is sold, discarded, demolished or destroyed (in case there is no other asset of the block), the closing WDV would be zero, hence no

depreciation.
In such situation, the difference between the written value of the last year and net scrap realization would be treated as short term capital gain/loss.
(Section 50, Income Tax Act, 1961)
"Short term capital loss cannot be set-off against the business income."

Assumptions
(1) Company has other incomes to absorb depreciation.
(2) In future year 6, the company shall have sufficient amount of STCG to set off the STCL of Rs.19 L arising in that year.

Year	Dep.	WDV
1	200	400
2	133	267
3	89	178
4	59	119
5	40	79
6	19 (STCL)	

Year	Contribution	F.C.	Dep.	Tax	C.F.
1	320	240	200	Savings of 60	140
2	640	360	133	74	206
3	864	480	89	148	236
4	960	480	59	211	269
5	960	480	40	220	260
6	960	480	19	231	249

Tax Position for future year 6 will be as follows

Tax on P/G/B/P	- 240
Savings on S.T.C.G.	+ 9.50
	- 230.50

DCF Analysis of the Project (Discounting Rate: 15%)

	Period	PVF / AF	C.F.	P.V.
Investment	0	1	- 750	- 750
Cash Flow from Operations	1	0.8696	+ 140	121.744
Cash Flow from Operations	2	0.7561	+ 206	155.76
Cash Flow from Operations	3	0.6575	+ 236	155.17
W.C. Investment	3	0.6575	- 100	- 65.75
Operations	4	0.5718	+ 269	153.81
Operations	5	0.4972	+ 260	129.27
Operations	6	0.4323	+ 249	107.67
Terminal Value of F.A. + Reversal of W.C.	6	0.4323	+ 310	134.01
NAV				141.663

Project is viable.

THERE ARE OTHER ASSETS IN THE BLOCK

Year	Dep.	WDV
1	200	400
2	133	267
3	89	178
4	59	119
5	40	79
6	6	13
7	4	9
8	3	6
9	2	4
10	1	3
11	1	2
12	1	1
13	1	

Teaching note – not to be given in the exam.

WDV at the end of 5th year	Rs.79
Sale of scrap in the 6th year	– Rs.60
WDV for 6th year Depreciation	19
Depreciation for 6th year	6
WDV for 7 the year Deprecation	13

And so on.

Though the machine has been sold at the end of 6th year, the WDV of the block continues to include some amount on account of the machine sold. Hence, depreciation will continue be allowed till thee total amount is fully written off.

Year	Contribution	F.C.	Dep.	Tax	C.F.
1	320	240	200	Savings of 60	140
2	640	360	133	74	206
3	864	480	89	148	236
4	960	480	59	211	269
5	960	480	40	220	260
6	960	480	6	237	243
7			4	Saving of 2	+ 2
8			3	Saving of 2	+ 2
9			2	Saving of 1	+ 1
10			1	Saving of 1	+ 1
11			1	Saving of 1	+ 1
12			1	Saving of 1	+ 1
13			1	Saving of 1	+ 1

DCF Analysis of the Project (Discounting rate 15%)

	Period	PVF/AF	C.F.	P.V.
Investment	0	1	- 750	- 750
Cash Flow form Operation	1	0.8696	+ 140	121.744
Cash Flow form Operation	2	0.7561	+ 206	155.76
Cash Flow form Operation	3	0.6575	+ 236	155.17
W.C. Investment	3	0.6575	- 100	- 65.75
Operations	4	0.5718	+ 269	153.81
Operations	5	0.4972	+ 260	129.27
Operations	6	0.4323	+ 243	105.05
Scrap + W.C. Reversal	6	0.4323	+ 310	134.013
Cash Flow	7	0.3759	+ 2	0.7518
Cash Flow	8	0.3269	+ 2	0.654
Cash Flow	9-13	1.0958	+ 1 annually	1.0958
NPV				140.47
As, NPV is positive is viable.				

Q No. 9: *X Ltd.* is contemplating the purchase of new machinery costing Rs.30,000 with an expected life of 5 years with salvage value Rs.750, in replacement of an old machine purchase 3 years ago for Rs.15,000 with expected life span of 8 years, scrap value on completion of full life Rs.250. Present market value of this old machine is Rs.16,500. Because of the purchase of new machinery annual profits before depreciation are expected to increase by Rs.6,000. The company follows diminishing balance method for depreciation. Income tax: 40 per cent. Cost of capital 15 per cent advise. Depreciation rate 30% WDV. PV factors may be taken at two decimal places.

Answer

Assumptions: The old machine is to be scrapped and new machine is to be purchased in the beginning of 4^{th} year of the old machine.

Working note:

WDV of old machine in the beginning of its 4^{th} year
(1^{st} year of new machine) : = 15000 x 0.70 x 0.70 x 0.70 = 5,145

WDV of new machine on replacement in the beginning of 4^{th} year of the old machine (1^{st} year of new machine) : 5,145 + 30,000 -16,500 = 18,645

Future years	No replacement		Replacement		Incremental Depreciation
	Dep./STCL	WDV	Dep.	WDV	
1	1544	3601	5594	13051	4050
2	1080	2521	3915	9136	2835

3	756	1765	2741	6395	1985
4	529	1236	1919	4476	1390
5	986 (STCL)		3726 (STCL)		2740 (STCL)

Statement showing incremental cash flows from operation

Future years	Incre. PBDT	Incre. Dep./STCL	Incre. Tax	Incre, Cash flow
1	6,000	4050	780	5220
2	6,000	2835	1266	4734
3	6,000	1985	1606	4394
4	6,000	1390	1844	4156
5	6,000	2740 (STCL)	1304	4696

It is assumed that in the future year 5, the company shall have sufficient amount of short term capital gain to set off the short term capital gain arising in that year.

Main Answer: DCF Analysis of the Project (Incremental cash flow basis)

	Period	PVF	CF	PV
Investment	0	1	- 13,500	-13,500
Operation	1	0.87	5220	4541
----do---	2	0.76	4734	3598
----do---	3	0.66	4394	2900
----do---	4	0.57	4156	2369
----d0---	5	0.49	4696	2301
Sale of scrap	5	0.49	+ 500	+ 245
NPV				2954

As NPV is Positive, the replacement is recommended.

Teaching note (FOR QUESTION 10)

IF WE WANT A PARTICULAR RATE OF RETURN, THE NPV AT THAT DISCOUNTING RATE SHOULD BE ZERO. For example, in question 10, we want a return of 15%, the NPV calculated using 15% discounting rate should be zero.↓

Q. No. 10: Gopal Ltd. specializes in the manufacture of novel transistors. They have recently developed technology to design a new radio transistor capable of being used as an emergency lamp also. They are quite confident of selling all the 8,000 units that they would be making in a year. The capital equipment that would be required

will cost Rs.25lakh. It will have an economic life of 4 years and no significant technical salvage value.

During each of the first four years promotional expenses are planned as under:

Year	*1*	*2*	*3*	*4*
Advertisement (Rupees)	1,00,000	75,000	60,000	30,000
Other expenses (Rupees)	50,000	75,000	90,000	1,20,000

Variable costs of producing and selling the unit would be Rs.250 per unit.

Additional fixed operating costs incurred because of this new product are budgeted at Rs. 75,000 per year.

The company's profit goals call for a discounted rate of return of 15 per cent after taxes on investments on new products. The income-tax rate on an average works out to 40 per cent. You can assume that the straight line method of depreciation will be used for tax.

Work out an initial selling price per unit of the product that may be fixed for obtaining the desired rate of return on investment. (Rs.408.47)

Answer

Year →	1	2	3	4
Advertising	1,00,000	75,000	60,000	30,000
Other Promotional expenses	50,000	75,000	90,000	1,20,000
Additional FC incurred	75,000	75,000	75,000	75,000
Total FC	2,25,000	2,25,000	2,25,000	2,25,000

Fixed Costs amount to be Rs.2,25,000 each year.
Let unit selling price = Rs. y

(A) Annual Profit before Dep. and tax = [(8000y – 8000 x 250 – 2,25,000)]
= [8000y – 22,25,000]
(B) Table Income = [8000y – 22,25,000 – 6,25,000] = 8000y – 28,50,000
(C) Tax = 0.40 [8000y –28,50,000] = 3200y – 11,40,000
(D) Annual cash flow from operation
= 8,000y – 22,25,000 -3,200y + 11,40,000
= 4,800y – 10,85,000
For obtaining 15% return from the project, NPV at 15% should be zero. Hence:
(4800y – 10,85,000)(2.855) – 25,00,000 = 0
13704 y = 55,97,675
y = 408.47 Unit Selling price = Rs.408.47

Teaching note (FOR QUESTION 11)

IF WE WANT A PARTICULAR RATE OF RETURN, THE NPV AT THAT DISCOUNTING RATE SHOULD BE ZERO. For example, in question 11, we want a return of 15%, the NPV calculated using 15% discounting rate should be zero.↓

Q. No. 11: *X Ltd.* specializes in the manufacture of novel transistors. They have recently developed technology to design a new radio-transistor capable of being used as an emergency lamp also. They are quite confident of selling all the 8,000 units that they would be making in a year. The capital equipment that would be required will cost Rs.30lakh. It will have an economic life of 4 years and no significant technical salvage value.

During each of the first four years promotional expenses are planned as under:

Year	*1*	*2*	*3*	*4*
Advertisement (Rs.)	1,00,000	75,000	60,000	30,000
Other expenses (Rs.)	60,000	85,000	80,000	1,20,000

Variable costs of producing and selling the unit would be Rs.250 per unit.

Additional fixed operating costs incurred because of this new product are budgeted at Rs.75,000 per year.The company's profit goals call for a discounted rate of return of 15 per cent after taxes on investments on new products. The income-tax rate on an average works out to 40 per cent. You can assume that the straight line method of depreciation will be used for tax.

Work out an initial selling price per unit of the product that may be fixed for obtaining the desired rate of return on investment. The relevant present value factors are: 0.8696, 0.7561, 0.6575, 0.5718.

Answer

Year →	1	2	3	4
Advertising	1,00,000	75,000	60,000	30,000
Other Promotional expenses	60,000	85,000	80,000	1,20,000
Additional FC incurred	75,000	75,000	75,000	75,000
Total FC	2,35,000	2,35,000	2,15,000	2,25,000

Cash inflow from operation (I year)

(A) Annual Profit before Dep. and tax = [(8000y – 8000 x 250 – 2,35,000)]
= [8000y – 22,35,000]

(B) Table Income = [8000y – 22,35,000 – 7,50,000] = 8000y – 29,85,000

(C) Tax = 0.40 [8000y –29,85,000] = 3200y – 11,94,000

(D) Annual cash flow from operation = A – C
= 8,000y – 22,35,000 –3,200y + 11,94,000
= 4,800y – 10,41,000

Cash inflow from operation (II year) = 4800y – 10,41,000

Cash inflow from operation (III year)

= Cash inflow from operation (II year) + Savings of FC – increase in tax liability on account of savings in FC

= 4,800y – 10,41,000 + 20,000 – 8,000 = 4800y – 10,29,000

Cash inflow from operation (IV year)

= Cash inflow from operation (III year) – Increase in FC + tax savings on account of increase in FC

= 4,800y – 11,29,000 – 10,000 + 4,000 = 4800y – 10,35,000

For obtaining 15% return from the project, NPV at 15% should be zero. Hence:

$$-30,00,000 + (4,800y - 10,41,000) \times 0.8696$$
$$+ (4,800y - 10,41,000) \times 0.7561$$
$$+ (4,800y - 10,29,000) \times 0.6575$$
$$+ (4,800y - 10,35,000) \times 0.5718 = 0$$

y = 434.96 Unit Selling price = Rs.434.96

Teaching note (FOR QUESTION 12)

IF WE WANT A PARTICULAR RATE OF RETURN, THE NPV AT THAT DISCOUNTING RATE SHOULD BE ZERO. For example, in question 12, we want a return of 10%, the NPV calculated using 10% discounting rate should be zero.↓

Q. No.12 : Elite Builders a leading construction company have been approached by a foreign embassy to build for them a block of six flats to be used as guest-houses. As per contract the foreign embassy would provide Elite Builders the plans and the land costing Rs.25lakh. Elite Builders would build the flats at their own cost and lease them out of foreign embassy for 15 years at the end of which the flats will be transferred to foreign embassy for a nominal value of Rs.8lakh. Elite Builders estimates the cost of construction as follows:

Area per flat	1,000 sq. ft.
Construction cost	Rs.400 per sq. ft.
Registration and other costs	2.5% of cost of construction

Elite Builders will also incur Rs.4lakh each in year 14 and 15 towards repairs.

Elite Builders proposes to charge the lease rental as follows:

Year	Rentals
1 to 5	Normal
6 to 10	120% of Normal
11 to 15	150% of Normal

Elite Builders' present tax rate average at 50 per cent. The full cost of construction and registration will be written off over 15 years and will be allowed for tax purposes.

Calculate the normal lease rental per annum per flat.

For your exercise assume:

(a) Minimum desired return of 10 per cent.
(b) Rental and repairs will arise on the last day of the year.
(c) Construction registration and other costs will be incurred at time '0'.
(d) The relevant discount factors are:

Year	*Discount Factor*	*Year*	*Discount Factor*	*Year*	*Discount Factor*
1	.91	6	.56	11	.35
2	.83	7	.51	12	.32
3	.75	8	.47	13	.29
4	.68	9	.42	14	.26
5	.62	10	.39	15	.24

(Nov. 1993)

Answer

Let, normal lease rental per annum = y
Annual Depreciation for tax purpose = 24,60,000/15 = 1,64,000

Years	Calculation of cash inflow from operation	Cash inflow from operation	Present value
1-5	y – (y – 1,64,0000) x 0.50 each year	0.50y + 82,000 each year	(0.50y + 82000) x 3.79
6-10	1.20y – (1.20y – 1,64,0000) x 0.50 each year	0.60y + 82,000 each year	(0.60y + 82000) x 2.35
11-13	1.50y – (1.50y – 1,64,0000) x 0.50 each year	0.75y + 82,000 each year	(0.75y + 82000) x 0.96
14-15	1.50y – 4,00,000 –[1.5y-400000-164000](.5) each year	0.75y – 118000 each year	(0.75y – 118000) x 0.50
15	8,00,000 – 4,00,000	4,00,000 x 0.24	
		Total = 4.40y – 6,19,200	

For obtaining 10% return from the project, NPV at 15% should be zero.

Hence :
-24,60,000 = 4.40y - 6,19,200
y = 4,18,364

Normal rent = Rs.4,18,364 per annum for all the six flats.

↑ **Teaching note (Q. No. 12)** – not to be given in the exam. Total cost of construction of all the six flats is Rs.24,00,000; Registration and other costs 2.5% of cost of construction Rs.60,000. Total cost = Rs.24,60,000. This total amount is to be amortized (i.e. allowed as Depreciation) over 15 years (Read the underlined sentence of the question. It was not underlined when this question appeared in the exam).

Annual Depreciation = 24,60,000/15 = 1,64,000

A natural query : Why straight line method ? "Because WDV method does not write off full cost of the asset."

Tax on Short term capital gain :

Total cost	Rs.24,60,000
Depreciation 15 x 1,64,000	Rs.24,60,000
Written down value at the end of 15th year	Nil
Sale value	Rs.8,00,000

Capital gain = Net sale value – WDV = 8,00,000 – 0 = 8,00,000.

This is short term capital gain. (Section 50, Income Tax Act, 1961)

Tax on short term capital gain = Rs.4,00,000.

(Short term capital gain is taxed at the same rate as which other incomes like business incomes etc are taxed. (STCG arising on transfer of listed securities and redemption of equity oriented mutual funds is taxed at a concessional rate of 10%)

Teaching note (FOR QUESTION 13)

IF WE WANT A PARTICULAR RATE OF RETURN, THE NPV AT THAT DISCOUNTING RATE SHOULD BE ZERO. For example, in question 13, we want a return of 14%, the NPV calculated using 14% discounting rate should be zero. ↓

Q. No. 13: A Theatre, with some surplus accommodation, proposes to extend its catering facilities to provide light meals to its patrons. The management is prepared to make the initial funds available to cover the capital costs. It requires that these be repaid over a period of five years at a rate of interest of 14 per cent per annum.

The capital costs are estimated at Rs. 60,000 for equipment that will have a life 5 years and no residual value. Running costs of staff, etc., will be Rs.20,000 in the first year, increasing by Rs.2,000 in each subsequent year. The management proposes to charge Rs.5,000 per annum for electricity and Rs,2,500 for other expenses . Apart from this, the management is not looking for any profit as such from the extension of these facilities because it believes that this will enable more tickets to be sold for the cinema shows at the theatre. It is proposed that costs should be recovered by setting prices for the food at double the direct cost.

It is not expected that the full sales level will be reached until years 3. The proportion of that level reached in year 1 and 2 are 55 per cent and 65 per cent respectively. Calculate sales that need to be achieved in each of five years to meet the target tax. Ignore tax. PVF: 0.88, 0.77, 0.67, 0.59, 0.52.

Answer

Let full level Annual sale of each year = Rs.X

Year	Sale (A)	Direct Cost (B)	Fixed costs (C)	Cash flow (A-B-C)
1	0.55X	0.275 X	27,500	0.275 X -27,500
2	0.65X	0.325 X	29,500	0.325X -29,500
3	X	0.50 X	31,500	0.50X -31,500
4	X	0.50 X	33,500	0.50X -33,500
5	X	0.50 X	35,500	0.50X -35,500

NPV:

0 = -60,000 + (.275X -27500) (.88) + (.325X -29500) (.77)
+ (.50X -31500) (.67) + (.5X -33500) (.59) + (.5X -35500) (.52)

X = Full sale level (annual) = 1,20,271

Year	Sales (Rs.)
1	1,20,271.(0.55) = 66,149
2	1,20,271.(0.65) = 78,176
3-5	1,20,271 each year

Q. No. 14: Following are the data on a capital project being evaluated by the management of *X Ltd:*

	Project M
Annual cost saving	Rs.40,000
Useful Life	4 years
I.R.R.	15%
Profitability Index (PI)	1.064
NPV	?
Cost of Capital	?
Cost of Project	?
Pay back	?
Salvage value	0

Find the missing values considering the following table of discount factors.

Discount factor	15%	14%	13%	12%

1 year	0.869	0.877	0.885	0.893
2 years	0.756	0.769	0.783	0.797
3 years	0.658	0.675	0.693	0.712
4 years	0.572	0.592	0.613	0.636
	2.855	2.913	2.974	3.038

(Nov. 1998) (12 Marks)

Answer

(a) IRR is 15%.

IRR is that discounting rate at which the NPV of a project is zero i.e. if we discount the cash flows at the rate of 15%, the NPV would be zero. Applying this concept:

NPV = PV of cash inflow – PV of cash outflow

(At the discounting rate of 15%, the NPV should be zero)

0 = 40000 (2.855) – Cost of project

Cost of Project = 40000(2.855) = 1,14,200

(b)

$$PI = \frac{\text{PV of cash Inflow}}{\text{PV of cash outflow}}$$

$$1.064 = \frac{40{,}000 \text{ (Annuity)}}{1{,}14{,}200}$$

Annuity = 3.038 Life of the project: 4 years

From the table given in the question we find that annuity for 4 years is 3.038 at 12%. Hence, cost of capital is 12%.

(c) NPV = PV of cash inflow – PV of cash outflow

= 40000 x 3.038 – 114200 = 7309

(d) Payback period = 114200/ 40000 = 2.855 years

Q No.15: A machine is proposed to be purchased for Rs.2,00,000.

10 per cent capital subsidy is payable by Government immediately on purchase of the machine.

I.T. Rate is 50 per cent. 25 per cent depreciation is allowable on written down value. Tax benefits, if any, are available is the same year against total business income.

Rs.20,000 additional Working Capital will be required in the second year and another Rs.10,000 in the fourth year. In the eighth year Rs.20,000 will be paid back, and in the tenth year balance of Working Capital will be recouped. The estimated earning (before depreciation and taxation):

Year	1	2	3	4	5	6	7	8	9	10
Earnings ('000)	0	20	60	80	80	80	70	50	20	10

Calculate NPV of the Project. Discounting Rate of 10% is to be considered for D.C.F. Depreciation, I.T. calculations may be made in terms of thousands of Rupees. Sale value of scrap is Rs.20,000.

Answer

Teaching note – not to be given in the exam :Income Tax Act, 1961: Section 43 (i) Explanation 10 → Where a portion of the cost of an asset acquired by the assesses has been met directly or indirectly by the Central Government or a State Government or any authority established under any law or by any other person, in the form of a subsidy or grant or reimbursement (by whatever name called), then, so much of the cost as is relatable to such subsidy or grant or reimbursement shall not be included in the actual cost of the asset to the assesses:

Provided that where such subsidy or grant or reimbursement is of such nature that it can not be directly relatable to the asset acquired, so much of the amount which bears to the total subsidy or reimbursement or grant the same proportion as such asset bears to all the assets in respect of or with reference to which the subsidy or grant or reimbursement is so received, shall not be included in the actual cost of the asset to the assesses.

Assumption: There is no other asset in the same block.

Working Note

Year	Dep.	WDV
1	45	135
2	34	101
3	25	76
4	19	57

5	14	43
6	11	32
7	8	24
8	6	18
9	5	13
10	7 (STCG)	

Year→	1	2	3	4	5	6	7	8	9	10
Earnings→	0	20	60	80	80	80	70	50	20	10
Dep.→	45	34	25	19	14	11	8	6	5	7 (S.T.C.G.)
Tax→	Savings Rs. 23000	Savings Rs 7000	18	31	33	35	31	22	8	9
C F→	23	27	42	49	47	45	39	28	12	1

DCF Analysis of the Project

Discounting @ 10%

	Period	PVF	CF	PV
Net Investment	0	1	- 1,80,000	- 1,80,000
Operation	1	.909	+ 23,000	+ 20,907
W.C. Investment	1	.909	- 20,000	- 18,180
Operation	2	.826	+ 27,000	+ 22,302
Operation	3	.751	+ 42,000	+ 31,542
W.C. Investment	3	.751	- 10,000	- 7,510
Operation	4	.683	+ 49, 000	+ 33,467
Operation	5	.621	+ 47,000	+ 29,187
Operation	6	.564	+ 45,000	+ 25,380
Operation	7	.513	+ 39,000	+ 20,007
Operation	8	.467	+ 28,000	+ 13,076
W.C. Release	8	.467	+ 20,000	+ 9,340
Operation	9	.424	+ 12,000	+ 5,088
Operation	10	.386	+ 1,000	+ 386
Sale of scrap & Release of W.C.	10	.386	+ 30,000	+ 11,580
NPV = 2,22,262 – 2,05,690 = 16,572				+ 2,22,262
				_2,05,690

BORROWED FUNDS AND CAPITAL BUDGETING

Q.No.16: A company is setting up a project at a cost of Rs. 300 lakh. It has to decide whether to locate the plant in a forward area (FA) or backward area (BA). Locating in backward area means a cash subsidy of Rs. 15 lakh from the central government. Besides, the taxable profits to the extent of 20 per cent are exempt for 10 years. The project envisages a borrowing of Rs. 200 lakh in either case. The cost of borrowing will be 12 per cent in forward area and 10 per cent in backward area. However the revenue costs are bound to be higher in backward area. The borrowings have to be repaid in 4 equal annual installments beginning from the end of the fourth year. With the help of following information and by using DCF Techniques you are required to suggest the proper location for the project:

Year	Profit (Loss) Before Interest and Depreciation (Rs. in lakhs)		Present Value Factor (at 15%)
	F.A.	B.A.	
1.	(6.00)	(50.00)	0.87
2.	34.00	(20.00)	0.76
3.	54.00	10.00	0.66
4.	74.00	20.00	0.57
5.	108.00	45.00	0.50
6.	142.00	100.00	0.43
7.	156.00	155.00	0.38
8.	230.00	190.00	0.33
9.	330.00	230.00	0.28
10.	430.00	330.00	0.25

The annual depreciation may be taken at Rs. 30 lakh. Interest on borrowings may be worked out at the respective rates. Average rate of tax may be taken as 50 per cent. **(May, 1991)**

Working notes:

Assumptions: (i) Loss is to be carried forward

(ii)The subsidy is general purpose subsidy. It does not relate to fixed asset(s).

Teaching note – not to be given in the exam:

(i) The logic for the first assumption is that there is no indication of any other income in the question.

- The reason for assumption of set-off in Q. No. 8: T Ltd is existing company. There is possibility of some other income.
- The reason for assumption of set-off in Q. No.15: The question clearly specifies "Tax benefits, if any, are available is the same year against total business income."

(ii) The question states "The annual depreciation may be taken at Rs.30Lakh." This sentence does not discriminate between the two projects on the basis of depreciation, i.e. depreciation in both the cases may be taken at Rs.30Lakhs. It means : in the second case the subsidy has not affected by depreciation, in other words the subsidy does not relate to fixed assets. Putting it in a different way, we can say that the subsidy is a general purpose subsidy.

Forward area : (Calculation of cash flow from operation)

Year	PBDIT	DEP.	INT.	TAX	CF
1	-6	30	24	---	-30
2	34	30	24	---	+ 10
3	54	30	24	---	+ 30
4	74	30	24	---	+ 50
5	108	30	18	---	+ 90
6	142	30	12	50	+ 80
7	156	30	6	60	+ 90
8	230	30	---	100	+ 130
9	330	30	---	150	+ 180
10	430	30	---	200	+ 230

Loss carried forward

Year	Profit/loss	Loss c/f
1	-60	60
2	-20	80
3	0	80

4	+ 20	60
5	+ 60	----

Backward Area:

Year	PBDIT	DEP.	INT.	TAX	CF
1	-50	30	20	---	-70
2	-20	30	20	---	-40
3	10	30	20	---	-10
4	20	30	20	---	----
5	45	30	15	---	+ 30
6	100	30	10	---	+ 90
7	155	30	5	---	+ 150
8	190	30	---	40	+ 150
9	230	30	---	80	+ 150
10	330	30	---	120	+ 210

Loss carried forward

Year	Profit/loss	Loss c/f
1	-100	100
2	-70	170
3	-40	210
4	-30	240
5	0	240
6	+ 60	180
7	+ 120	60
8	+ 160	--

DCF Analysis of forward & Backward area proposal discounting @ 15%

	Period	PVF	Forward Area		Backward Area	
			C.F.	P.V.	C.F.	P.V.
Investment	0	1	-100	-100	-85	-85
Cash inflow from operating	1	.87	-30	-26.1	-70	-60.9

Cash inflow from operating	2	.76	+ 10	7.6	−40	−30.4
Cash inflow from operating	3	.66	+ 30	19.8	−10	−6.6
Cash inflow from operating	4	.57	+ 50	28.5	0	0
Loan Repayment	4	.57	−50	−28.5	−50	−28.5
Cash in flow	5	.50	+ 90	45	+ 30	15
Loan Repayment	5	.50	−50	−25	−50	−25
Cash in flow	6	.43	+ 80	34.4	+ 90	38.7
Loan Repayment	6	.43	−50	−21.50	−50	−21.5
Cash in flow	7	.38	+ 90	34.2	+ 150	57
Loan Repayment	7	.38	−50	−19	−50	−19
Cash in flow	8	.33	+ 130	42.9	+ 150	49.5
Cash in flow	9	.28	+ 180	50.4	+ 150	42
Cash in flow	10	.25	+ 230	57.5	+ 210	52.5
			NPV	100.20		−22.20

Hence, the Project should be located in forward area.

Q No.17: A bulldozer, which has a service life of 10 years, can be purchased for Rs.1,80,000. It can be hired at Rs.45,000 per annum payable at the beginning of each year. Operating costs are to be borne by the user.

A contractor requiring the use of the bulldozer only for a period of two years, seeks your advise. If purchased, he expects to use it for 2 years and then sell it at 80 per cent of the purchase price. He can finance its purchase by his own resources to the extent of Rs.80,000 and the balance by borrowing at an interest rate of 18 per cent per annum. The interest on the loan is: payable annually at the end of each year and the loan can be repaid out of the sale proceeds of the bulldozers. Tax 50 per cent cost of capital 10 per cent, Dep. 25 per cent W.D.V. Suggest. The present value factors are : 0.9091. 0.8264.

Answer

DCF Analysis of Proposal regarding purchase of bulldozer.

	Period	PVF	C.F.	P.V.
Investments	0	1	−80,000	−80,000
Tax savings on Dep.	1	0.9091	+ 22,500	+ 20,455
Interests Tax Savings	1	0.9091	−9,000	−8,182
----do-----	2	0.8264	−9,000	−7,438
Sale of scrap less (i) Tax & (ii) Bank Loan	2	0.8264	+ 39,500	+ 32,643
			NPV	−42,977

Working note :	
Cost	1,80,000
Less depreciation for 1st year	-45,000
WDV in the beginning of 2nd year	1,35,000
(assuming sale of used item at the end of 2nd year, no depreciation for 2nd year will be allowed)	
Sale of used item :	1,44,000
STCG	9,000
Tax on STCG	4,500
Sale of used item	1,44,000
Tax	-4,500
Loan repayment	-1,00,000
Cash inflow (at the end of 2nd year)	1,35,000

DCF Analysis of Proposal regarding lease of bulldozer.

	Period	PVF	C.F.	P.V.
Lease rent	0	1	-45,000	-45,000
Tax savings	1	0.9091	+ 22,500	+ 20,455
Lease rent	1	0.9091	-45,000	-40,910
Tax savings	2	0.8264	+ 22,500	+ 18,594
			NPV =	-46,861

As NPV cost of purchasing bulldozer is lesser, it is recommended.

Q. No. 18: A large profit making company is considering the installation of a machine to process the waste produced by one of its existing manufacturing process to be converted into a marketable product. At present, the waste is removed by a contractor for disposal on payment by the company of Rs.50Lakh per annum for the next four years. The contract can be terminated upon installation of the aforesaid machine on payment of a compensation of Rs.30Lakh before the processing operation starts. This compensation is not allowed as deduction for tax purposes.

The machine required for carrying out the processing will cost Rs.200Lakh to be financed by a loan repayable in 4 equal installments commencing from the end of year 1. The interest rate is 16 per cent per annum. At the end of the 4th year, the machine can be sold for Rs.20Lakh and the cost of dismantling and removal will be Rs.15Lakh.

Sales and direct costs of the product emerging from waste processing for 4 years are estimated as under:

(Rs. Lakhs)

Year	1	2	3	4
Sales	322	322	418	418
Material consumption	30	40	85	85
Wages	75	75	85	100
Other expenses	40	45	54	70

Factory overheads	55	60	110	145
Deprecation as per Income tax rules	50	38	28	21

Initial stock of materials required before commencement of the processing operations is Rs.20Lakh at the start of year 1. The stock levels of materials to be maintained at the end of year 1, 2 and 3 will be Rs.55Lakh and the stocks at the end of year 4 will be nil. The storage of materials will utilize space which would otherwise have been rented out for Rs.10lakh per annum. Labor costs include wages of 40 workers, whose transfer to this process will reduce idle time payments of Rs.15Lakh in year 1 and Rs.10Lakh in year 2. Factory overheads include apportionment of general factory overheads except to the extent of insurance charges of Rs.30Lakh per annum payable on this venture. The company's tax rate is 50 per cent.

Present value factors for four years are as under:

Year	1	2	3	4
Present	0.870	0.756	0.658	0.572

Advise the management on the desirability of installing the machine for processing the waste. All calculations should form part of the answer.

(May, 1999) (20 Marks)

Working note:

Calculation of Annual Cash Flow

Calculation of Annual Cash Flows				
Year	1	2	3	4
Sales	322	322	418	418
Savings of Payment to Contractor	50	50	50	50
	372	372	468	468
Material	30	40	85	85
Wages	60	65	85	100
Other Expenses	40	45	54	70
Insurance	30	30	30	30
Loss of Rent	10	10	10	10
Interest	32	24	16	8
Depreciation	50	38	28	21
PBT	120	120	160	144
Less: Tax @ 50%	60	60	80	72
PAT	60	60	80	72
Add: Depreciation	50	38	28	21
Cash Flows	110	98	108	93

DCF Analysis of the Project

	Project	PVF/A	C.F.	P.V.
Compensation	0	1	-30	-30
Investment in Stock	0	1	-20	-20
Investment in Stock	1	0.870	-35	-30.45
Annual Cash Flow	1	0.870	110	95.70
Annual Cash Flow	2	0.756	98	74.088
Annual Cash Flow	3	0.658	108	71.064
Annual Cash Flow	4	0.572	93	53.196
Payment of Loan	1-4	2.856	-50	-142.80
Release of W. Cap.	4	0.572	+ 55	31.46
Sale of Machine	4	0.572	+ 5	2.86
			NPV =	+ 105.118

As, NPV of the Project is positive, the machine for processing the waste may be installed.

Teaching note – not required in the exam

- As per the question, the machine will be sold at the end of the fourth year.
- We should not have allowed depreciation for 4th year as WDV depreciation is not allowed for the year in which the asset is sold.
- But, we have allowed depreciation as the question says that this depreciation is as per Income Tax rules.
- WDV = 200 – 50 – 38 – 28 – 21 = 63. Sale value (net) is 5. STCL is Rs.58. This has not been considered for income tax purposes as both Depreciation as well as short term capital loss are not allowed in the same year.

THEORETICAL ASPECTS OF BORROWED FUNDS AND CAPITAL BUDGETING

There are two approaches of treating the borrowed funds in case of capital budgeting:

I (a) The amount of initial investment is reduced by the amount of borrowings.
(b) Interest on such borrowings is considered in the DCF analysis
(c) Tax savings on interest on such borrowings is considered in the DCF analysis.
(d) Repayment of borrowings is considered in the DCF analysis.

II The second approach is applied when the first approach (all the four elements) can not be applied. In this case, we assume that the cost of capital given in the question s inclusive of cost of borrowings. Hence, borrowing is not considered separately i.e. (i) we do not reduce the amount of initial investment by the amount of borrowings.(ii) we do not consider the interest on borrowings in the DCF analysis (iii) we do not consider the tax savings on interest on borrowings in the DCF analysis (iv) we do not consider the repayment of borrowings in the DCF analysis.
In other words, in this case, we solve the problem the way we would have solved it if there was no borrowings.

Q. No.19: Find the NPV of project X which requires initial investment of Rs.500Crores (Partly met by borrowings). Cost of capital 15%. PV factors may be taken up to two decimal places. Use the following data :

Period	PAT (Rs. Lakhs)	Dep. (Rs. Lakhs)	Interest (Rs. Lakhs)
1	185	50	60
2	110	50	50
3	195	50	40
4	225	50	30
5	175	50	20

Answer

Assumption: Tax rate: 30%

Statement Showing Cash Inflow from operation

Period	Cash inflow from operation
1	185+ 50+ 42 = 277
2	110+ 50+ 35 = 195
3	195+ 50+ 28 = 273
4	225+ 50+ 21 = 296
5	175+ 50+ 14 = 239

DCF Analysis of the project (Rs. Crores)

	Period	PVF	CF	PV
Investment	0	1	- 500	-500
Operation	1	0.87	277	241
----do---	2	0.76	195	148
----do---	3	0.66	273	180
----do---	4	0.57	296	169
----d0---	5	0.49	239	117
NPV				355

The project may be taken up as the NPV is positive.

CAPITAL RATIONING

Capital rationing occurs whenever there is a ceiling on the amount of funds that can be invested during a specific period of time, i.e., it is a situation in which a firm has several attractive investment opportunities but does not have enough funds to invest in all of them. In other words, capital rationing involves the allocation of a fixed amount of capital among competing and economically desirable projects.

Non-Divisible Projects and Capital Rationing

In this case, we define all feasible combinations of the project and choose the combination that has highest NPV.

Divisible Projects and Capital Rationing

In this case, we calculate net profitability index. Net profitability index is obtained by dividing the NPV with investments out of limited funds.

Q. No.20: A company has investible funds of Rs.40 Lakh and is considering the following projects:

Project	Outlay (Rs)	N.P.V. (Rs.)
A	20,00,000	8,00,000
B	17,50,000	7,50,000
C	16,00,000	6,00,000
D	18,00,000	6,50,000
E	10,00,000	4,50,000
F	11,00,000	5,00,000
G	5,00,000	2,20,000

Project *B* and *C* are mutually exclusive. Similarly, project *E* and *F* are also mutually exclusive Any un-invested amount results in a negative NPV of one rupee for every ten rupees of un-invested amount.

Select the most desirable combination of projects.

Answer

With Rs.40,00,000 investment limit, we may go for 3 projects or 2 projects or 1 project.

Max. No. of Combinations of Projects (investment limit Rs.40,00,000)

$$= {}^{7}c_1 + {}^{7}c_2 + {}^{7}c_3$$

$$= 7 + \frac{7!}{2!.5!} + \frac{7!}{3!.4!}$$

$$= 7 + 21 + 35 = 63$$

Statement showing NPV of feasible Combinations

Combination	NPV
AEG	8,00,000 + 4,50,000 + 2,20,000 – 50,000 = 14,20,000
AFG	8,00,000 + 5,00,000 + 2,20,000 – 40,000 = 14,80,000
BEG	7,50,000 + 4,50,000 + 2,20,000 – 75,000 = 13,45,000
BFG	7,50,000 + 5,00,000 + 2,20,000 – 65,000 = 14.05,000
CDG	6,00,000 + 6,50,000 + 2,20,000 – 10,000 = 14,60,000
CEG	6,00,000 + 4,50,000 + 2,20,000 – 90,000 = 11,80,000
CFG	6,00,000 + 5,00,000 + 2,20,000 -80,000 = 12,40,000
DEG	6,50,000 + 4,50,000 + 2,20,000 – 70,000 = 12,50,000
DFG	6,50,000 + 5,00,000 + 2,20,000 – 60,000 = 13,10,000
AB	8,00,000 + 7,50,000 – 25,000 = 15,25,000

AC	8,00,000 + 6,00,000 – 40,000	= 13,60,000
AD	8,00,000 + 6,50,000 – 20,000	= 14,30,000
AE	8,00,000 + 4,50,000 – 40,000	= 12,10,000
AF	8,00,000 + 5,00,000 – 90,000	= 12,10,000
AG	8,00,000 + 2,20,000 –1,50,000	= 8,70,000
BD	7,50,000 + 6,50,000 – 45,000	= 13,55,000
BE	7,50,000 + 4,50,000 – 1,25,000	= 10,75,000
BG	7,50,000 + 2,20,000 – 1,75,000	= 7,95,000
CD	6,00,000 + 6,50,000 – 60,000	= 11,90,000
CE	6,00,000 + 4,50,000 –1,40,000	= 9,10,000
CF	6,00,000 + 5,00,000 –1,30,000	= 9,70,000
CG	6,00,000 + 2,20,000 –1,90,000	= 6,30,000
DE	6,50,000 + 4,50,000 – 1,20,000	= 9,80,000
DF	6,50,000 + 5,00,000 –1,10,000	= 10,40,000
DG	6,50,000+ 2,20,000 –1,70,000	= 7,00,000
EG	4,50,000 + 2,20,000 –2,50,000	= 4,20,000
FG	5,00,000 + 2,20,000 –2,40,000	= 4,80,000
A	8,00,000 – 2,00,000 =	= 6,00,000
B	7,50,000 – 2,25,000 =	= 5,25,000
C	6,00,000 – 2,40,000 =	= 3,60,000
D	6,50,000 – 2,20,000 =	= 4,30,000
E	4,50,000 – 3,00,000 =	= 1,50,000
F	5,00,000 – 2,90,000 =	= 2,10,000
G	2,20,000 – 3,50,000 =	=–1,30,000

Q..No.21: *S. Ltd.* has Rs.10,00,000 allocated for capital budgeting purposes. The following proposals and associated profitability indexes have been determined:

Project	*Amount*	*Profitability Index*
1.	3,00,000	1.22
2.	1,50,000	0.95
3.	3,50,000	1.20
4.	4,50,000	1.18
5.	2,00,000	1.20
6.	4,00,000	1.05

Which of the above investment should be undertaken? Assume that projects are indivisible and there is no alternative use of the money allocated for capital budgeting. **(Nov. 1998) (8 marks)**

Answer

- Project 2 should not be taken up as P1 is less than 1 i.e. NPV is negative i.e. there will be loss on this project.

Project 1:

PV of cash inflow
P1 = 1.22 = ----------
3,00,000
PV of cash inflow = 3,66,000. Hence, NPV = 3,66,000 – 3,00,000 = 66,000

Project 3:

PV of cash inflow
P1 = 1.20 = ----------
3,50,000
PV of cash inflow = 4,20,000. Hence, NPV = 4,20,000 – 3,50,000 = 70,000

Similarly

NPV of 4 = 81,000
NPV of 5 = 40,000
NPV of 6 = 20,000

Various possible combinations:

1,3,4 (Infeasible)	1,3,5	1,3,6 (Infeasible)	1,4,5	1,4,6 (Infeasible)
1,5,6	3,4,5	3,4,6 (Infeasible)	3,5,6	4,5,6 (Infeasible)
1,3	1,4	15	1,6	3,4
3,5	3,6	4,5	4,6	5,6
1	3	4	5	6

Table showing NPV of Feasible Combinations

1,3,5	66000 Plus 70000 plus 40000 = 176000
1,4,5	66000 Plus 81000 plus 40000 = 187000
1,5,6	66000 Plus 40000 plus 20000 = 126000
3,4,5	70000 Plus 81000 plus 40000 = 191000
3,5,6	70000 + 40000 + 20000 = 130000
1,3	66000 + 70000 = 136000
1,4	66000 + 81000 = 145000
1,5	66000 + 40000 = 106000
1,6	66000 + 20000 = 86000
3,4	70000 + 81000 = 151000
3,5	70000 + 40000 = 110000
3,6	70000 + 20000 = 90000
4,5	81000 + 40000 = 121000
4,6	81000 + 20000 = 101000
5,6	40000 + 20000 = 60000
1	66000
3	70000
4	81000
5	40000
6	20000

Projects 3, 4 and 5 are recommended.

Q. No. 22 : Laxmi Ltd. has a cost of capital of 10 per cent and has a limit of Rs.1,00,000 for investment. The following indivisible projects are being considered. All these projects have 5 years' life.

Project	*A*	*B*	*C*	*D*	*E*
Investment	35,000	40,000	65,000	48,000	23,000
NPV	17,500	22,500	38,000	31,500	9,000

Surplus funds can be invested to produce 12 per cent p.a. for 5 years. Optimal investment plan?

Answer

Feasible Combinations	NPV
ABE	(17500+ 22500+ 9000) + [2000 $(1.12)^5$ x .6209 – 2000] = 49189
AB	(17500+ 22500) + (25000 x 189/2000) = 42363
AC	(17500 + 38000) = 55500
AD	(17500 + 31500) + (17000 x 189/2000) = 50606.50
AE	(17500 + 9000) + (42000 x 189/2000) = 30469
BE	(22500 + 9000) + (37000 x 189/2000) = 34997
CE	(38000 + 9000) + (12000 x 189/2000) = 48134
DE	(31500 + 9000) + (29000 x 189/2000) = 43241
A	17500 + 65000 x 189/2000 = 23543
B	22500 + 60000 x 189/2000 = 28170

C	38000 + 35000 x 189/2000 = 41308
D	31500 + 52000 x 189/2000 = 36414
E	9000 + 77000 x 189/2000 = 16277
BD	22500 + 31500 + 12000 x 189/2000 = 55134

As, AC gives Maximum NPV, it is the requisite solution.

Q. No.23 : Alpha Limited is considering five capital projects for the year 1994 and 1995. The company is financed by equity entirely and its cost of capital is 12 per cent. The expected cash flows of the projects are as below (Rs. '000):

Project	*1994*	*1995*	*1996*	*1997*
A	(70)	35	35	20
B	(40)	(30)	45	55
C	(50)	(60)	70	80
D	—	(90)	55	65
E	(60)	20	40	50

Note : Figures in brackets represent cash outflows.

All projects are divisible, i.e., size of investment can be reduced, if necessary in relation to availability of funds. None of the projects can be delayed or undertaken more than once.

Calculate which project Alpha Limited should undertake if the capital available for investment is limited to Rs. 1,10,000 in 1994 and with no limitation in subsequent years. For your analysis, use the following present value factors:

Year	*1994*	*1995*	*1996*	*1997*
Factor	1.00	0.89	0.80	0.71

(May, 1993)

Working note:

NPV of A = (-70 x 1) + (35 x 0.89) + (35 x 0.80) + (20 x 0.71) = 3.35
NPV of B = (-40 x1) + (-30x 0.89) + (45 x 0.80) + (55 x 0.71) = 8.35
NPV of C = (-50 x1) + (-60x 0.89) + (70 x 0.80) + (80 x 0.71) = 9.40
NPV of D = (0) + (-90x 0.89) + (55 x 0.80) + (65 x 0.71) =10.05
NPV of E = (-60 x1) + (20 x 0.89) + (40 x 0.80) + (50 x 0.71) = 25.30

Project	Net profitability Index
A	3.35 / 70 = 0.0478
B	8.35 / 40 = 0.20875
C	9.40 / 50 = 0.188
D	10.05 / 0 = Infinity
E	25.30 / 60 = 0.4217

Statement showing choice of Projects

Project	N.P.V.	Investment
D	10.05	0
E	25.30	60
B	8.35	40
1/5 C	1.88 (9.4/5)	10
	45.58	110

INFLATION

Inflation is a fall in the purchasing power of money. This is equivalent to a rise in the general (on an average basis) level of prices of goods and services in the economy. Inflation affects two aspects of capital budgeting: (i) Projected cash flows, and (ii) discounting rate.

There are two approaches regarding capital budgeting under inflationary conditions:

(i) **Real cash flows and real cost of capital:** Under this approach cash flows are taken on constant purchasing power basis, i.e., we estimate the cash flows that would be there if there is no change in price level. Similarly, cost of capital is also taken on the assumption of no change in price level. The projects are evaluated on the basis of real cash flows and real cost of capital.

(ii) **Nominal cash flows and nominal cost of capital:** Under this approach, cash flows are taken considering (incorporating) changes in price levels. Similarly cost of capital is taken as that it would be in case of estimated inflation.

Two types of problems : (a) All the cash flows as well as discounting rate are affected by a single rate of inflation (this rate is referred as general inflation rate). (This situation is unlikely to happen in practical life).

(b) Different items may be affected by differing price change rates. For example, material prices may increase by 5 per cent, wage rates by 9 per cent and overall price rise (affecting the cost of capital) may be 10 per cent.

In the first situation, either of the two approaches can be applied.
In the second situation, only second approach (nominal cash flows and nominal cost of capital) can be applied.

Q. No. 24 : A company intends to purchase a machine costing Rs. 8,000. Life 5 years. Salvage Nil. Straight line depreciation cost of capital 10 per cent. The machine will

result is annual wages savings of Rs. 3,000 (at current prices). Annual rate of inflation 20 per cent compounded from first year. Tax 40 per cent. For 1 per cent increase in general price level, wage rises by 0.75 per cent. NPV?

Answer

Year	Savings of wages (A)	Tax (B)	Net savings (cash flows) (A - B)
1	$3,000(1.15)^1 = 3,450$	0.40(3,450-1,600) = 740	2.710
2	$3,000(1.15)^2 = 3,968$	0.40(3,968-1,600) = 947	3,021
3	$3,000(1.15)^3 = 4,563$	0.40(4,563-1,600) = 1,185	3,378
4	$3,000(1.15)^4 = 5,247$	0.40(5,247-1,600) = 1459	3,788
5	$3,000(1.15)^5 = 6,034$	0.40(6,034-1,600) = 1,774	4,260

D.C.F. Analysis of the Project

	Period	PVF	CF	PV
Investment	0	1	- 8000	- 8000
Cash in flow	1	(0.909) (0.833)	+ 2710	+ 2052
Cash in flow	2	(0.826) (0.694)	+ 3021	+ 1732
Cash in flow	3	(0.751) (0.579)	+ 3378	+ 1469
Cash in flow	4	(0.683) (0.482)	+ 3788	+ 1247
Cash in flow	5	(0.621) (0.402)	+ 4260	+ 1063
				- 437

The project may not be taken up as NPV is negative.

Q. No. 25: A firm has projected the following cash flows from a project under evaluation :

Year	Rs.Lakhs
0	-70
1	30
2	40
3	30

The above cash flows have been made at the expected prices after recognizing inflation. The firm's cost of capital is 10%. The expected annual rate of inflation is 5%. Show how the viability of the project is to be evaluated. **(May, 2005) (Marks 8)**

Answer

Teaching note – not to be given in the exam:
THE FISHER EFFECT
According to Prof. Fisher, the expected inflation rate for a country has an important effect on money-interest rate (also referred as nominal-interest rate) in the country. In other words, nominal rate of interest is affected by inflation rate.

The Fisherian Principal of interest rates is :

(1+ real interest rate) (1+ inflation rate) = (1+ nominal interest rate)

For example, if real rate of interest is 10%, inflation rate is 20%, nominal rate of interest is 32%.

Assumption: The cost of capital of 10% is real.

(1+ real interest rate) (1+ inflation rate) = (1+ nominal interest rate)
(1.10)(1.05) = 1 + Nominal interest rate
Nominal interest rate : 0.155 = 15.50%

DCF Analysis of the project (Rs. Crores)

	Period	PVF	CF	PV
Investment	0	1	−70	−70.00
Operation	1	0.87	30	+ 26.10
---do---	2	0.75	40	+ 30.00
---do---	3	0.65	30	+ 19.50
NPV				+ 5.60

The proposal may be accepted as the NPV is positive.

Q. No. 26 : The following figures have been presented to you in support of a proposal to invest in an extension to manufacturing capacity.

Investment required : £ 200,000

Anticipated annual cash flows:

Revenue		£ 150,000
Less: Direct Costs		
Material	£ 37,500	
Labour	25,000	
Overhead	37,500	100,000

Expected life : 8 years Cost of capital : 12 per cent per annum

The above given data assumes constant price level. However, the management anticipates inflation.

The effect of inflation is expected to be that selling prices will rise by 8 per cent per annum, material costs by 5 per cent per annum, labor costs by 10 per cent per annum and overheads by 2 per cent per annum. General inflation is expected to run at the rate of 5 per cent per annum.

Evaluate the project. Ignore tax.

Working note

Year	Revenue	Material	Lab.	Over.	CF
1	162000	39375	27500	38250	56,875
2	174960	41344	30250	39015	64,351

3	188957	43411	33275	39795	72,476
4	204073	45581	36603	40591	81,298
5	220399	47861	40263	41403	90,872
6	238031	50254	44289	42231	1,01,257
7	257074	52766	48718	43076	1,12,514
8	277640	55405	53590	43937	1,24,708

(1+ real rate)(1+ inf. Rate) =1+ nom. Rate
(1+ .12)(1.05) =1.176
Hence, dis. Rate = 0.176 =17.60%

DCF Analysis of the project (Rs)

	Period	PVF	CF	PV
Investment	0	1	-2,00,000	-2,00,000
Operation	1	0.850	56,875	+ 48,344
----do---	2	0.723	64,351	+ 46,531
----do---	3	0.615	72,476	+ 44,573
----do---	4	0.523	81,298	+ 42,519
----do---	5	0.445	90,872	+ 40438
----do---	6	0.378	1,01,257	+ 38,275
----do---	7	0.321	1,12,514	+ 36,117
----do---	8	0.273	1,24,708	+ 34,045
NPV				+ 1,30,842

As NPV is positive, the project may be taken up.

Q. No 27 : A firm is considering a project the details of which are:
Investment 70,000

Year	1	2	3	4	5
Cash flow	10K	20K	30K	45K	40K

Cost of capital 10 per cent. The above given data assumes constant price level. However, the management anticipates inflation @ 9.0909 % p.a. from the 1st year itself. NPV ?

Answer:

I Method: Real Cash Flows and Real Discount rate :

DCF Analysis of the Project (Discount rate 10%)

	Period	PVF	CF	PV
Investment	0	1	-70,000	-70,000
Cash inflow	1	0.909	+ 10,000	+ 9,090
-----do-----	2	0.826	+ 20,000	+ 16,520
-----do-----	3	0.751	+ 30,000	+ 22,530
-----do-----	4	0.683	+ 45,000	+ 30,735
-----do-----	5	0.621	+ 40,000	+ 24,840

Total				-70,000 + 1,03,715

NPV = 1,03,715-70,000 = 33,715
(the project may be taken up as NPV is + .)
Alternative Solution:
Nominal Cash flows and Nominal Discount rate

(1+ real Rate)(1+ inf. Rate) =1+ nom. Rate
(1+ .10)(1.0909) =1.20
Hence, dis. Rate = 0.20 = 20%

Year	Nominal cash Flows
1	$10,000\ (1.0909)^1 = 10,909$
2	$20,000\ (1.0909)^2 = 23,810$
3	$30,000\ (1.0909)^3 = 38,947$
4	$45,000\ (1.0909)^4 = 63,731$
5	$40,000\ (1.0909)^5 = 61,799$

DCF Analysis of project (Dis. rate 20%)

	Period	PVF	CF	PV
Investment	0	1	-70,000	- 70,000
Cash inflow	1	0.833	+ 10,909	+ 9,087
-----do-----	2	0.694	+ 23,810	+ 16,524
-----do-----	3	0.579	+ 38,947	+ 22,550
-----do-----	4	0.482	+ 63,731	+ 30,718
-----do-----	5	0.402	+ 61,799	+ 24,843
NPV				+ 33,722

CAPITAL RECOVERY FACTOR (CRF)

Capital recovery factor = 1 / Annuity i.e. 1 / Sum of PVFs

CRF is used to convert zero period CF into equivalent annual CF, i.e., if we multiply zero period CF with CRF, we get equivalent annual CF.

Examples

(a) Borrowed Rs. 1,00,000 at interest of 10% p.a. on 1.1.2004. Repayable in five equal annual installments with interest. The first installment to be paid on 31.12.2004. Find the amount of each installment

Answer :

Date	Amount of installment (Rs.)
31.12.2004	20,000 (Principal) + 10,000 (interest) = 30,000
31.12.2005	20,000 (Principal) + 8,000 (interest) = 28,000
31.12.2006	20,000 (Principal) + 6,000 (interest) = 26,000
31.12.2007	20,000 (Principal) + 4,000 (interest) = 24,000
31.12.2008	20,000 (Principal) + 2,000 (interest) = 22,000

(b) Borrowed Rs. 1,00,000 at interest of 10% p.a. on 1.1.2004. Repayable in five equal annual installments including interest. The first installment to be paid on 31.12.2004. Find the amount of each installment. Also find the amount of interest included in each installment.

Answer :

$$\text{Amount of each installment} = \frac{1,00,000}{3.791} = 26,378$$

	Amount due	Payment towards Principal	Payment towards Interest
1.1.2004	1,00,000		
31.12.2004	-16,378	16,378	10,000
1.1.2005	83,622		
31.12.2005	-18,016	18,016	8,362
1.1.2006	65,606		
31.12.2006	-19,817	19,817	6,561
1.1.2007	45,789		
31.12.2008	-21,799	21,799	4,579
1.1.2008	23,990		
31.12.2008	-23990	23,990	2,388 (Bal. fig.)
1.1.2008	nil		

(c) Borrowed Rs. 1,00,000 at interest of 10% p.a. on 1.1.2004. Repayable in five equal annual payments interest. The first payment to be made on 1.1.2004 itself. Find the amount of each payment. Also find the amount of interest included in each

payment.

Answer :

$$\text{Amount of each payment} = \frac{1{,}00{,}000}{1 + 3.17} = 23{,}981$$

	Amount due	Payment towards Principal	Payment towards Interest
1.1.2004 Bal.	1,00,000		
1.1.2004 Payment	-23,981	23,981	Nil
1.1.2004 Bal.	76,019		
1.1.2005 Payment	-16,379	16,379	7,602
1.1.2005 Bal.	59,640		
1.1.2006 Payment	-18,017	18,017	5,964
1.1.2006 Bal.	41,623		
1.1.2007 Payment	-19,819	19,819	4,162
1.1.2007 Bal.	21,804		
1.1.2008 Payment	-21,804	21,804	2,177
1.1.2008 Balance	nil		

There are four **uses of capital recovery factors**:

(i) Converting zero period cash flow into equal amounts of cash flows.

(ii) Calculating equivalent annual amount of depreciation and interest. When we multiply zero period net cost of fixed asset with capital recovery factor, we get equivalent annual amount of depreciation and interest. (This amount of depreciation and interest is not considered in cash flow techniques, this amount is not allowed for income tax purpose). This amount is considered for decision making in techniques other than cash flow techniques.

(iii) cost comparison of projects with unequal lives

(iv) cost comparison of projects with unequal lives and unequal outputs per period.

Q. No.28: XYZ Ltd., an infrastructure company is evaluating a proposal to build, operate and transfer a section of 35 km of road at a project cost of Rs. 200 crore to be financed as follows:

Equity Share Capital Rs. 50 Crores, loans at the rate of interest of 15 per cent p.a. from financial institutions Rs. 150 Crores. The Project after completion will be opened to traffic and a toll will be collected for a period of 15 years from the vehicles using the road. The company is also required to maintain the road during the

above 15 years and after the completion of that period, it will be handed over to the Highway authorities at zero value. It is estimated that the toll revenue will be Rs. 50 crore per annum and the annual toll collection expenses including maintenance of the roads will amount to 5 per cent of the project cost. The company considers to write off the total cost of the project in 15 years on a straight line basis. For corporate income-tax purposes the company is allowed to take depreciation @ 10 per cent on WDV basis. The financial institutions are agreeable for the repayment of the loan in 15 equal annual installments- consisting of principal and interest.

Calculate Project IRR and Equity IRR. Ignore corporate taxation.
(November 2001) (14 Marks)

Answer
Equity IRR :
Loan installment = 150/5.847 = 25.65
Annual CF = 50 – 10 -25.65 = 14.35
Fake PBP = 50/14.35 = 3.484

Consulting annuity table for 15 years, Approximate IRR = 28%

NPV at 28%: -50 + 14.35(3.483) = - 0.02
NPV at 27%: -50 + 14.35(3.601) = + 1.67

$$\text{Equity IRR} = 27 + \frac{1.67}{1.67 - (-0.02)} \times 1$$
= 27.99%

Project IRR:
Annual CF = 50 -10 = 40
Fake PBP = 200/40 = 5

Consulting annuity table, APP. IRR = 18%

NPV at 18% = 3.664
NPV at 20% = -12.98
IRR= 18.44

Q. No.29; Your company has a proposal to install a conveyor system for transport of materials at a works site. Two alternative systems *A* and *B* are offered for this purpose. Conveyor system *A* will cost Rs. 5 lakh to install and Rs. 1.20 lakh a year to operate. System *B* will cost Rs. 3.20 lakh installed and Rs. 2.00 lakh a year to operate. The required service period is 5 years. The cost of this equipment can be written off for tax purposes over the service period of 5 years on a straight line

basis. The income-tax rates is 55 per cent. Use incremental analysis. CRF for 5 years at 15 per cent = 0.298329.

Teaching note

(i) Annuity = Reciprocal of CRF

(ii) In case of Incremental Analysis we may go either for *A* minus *B* or for *B* minus *A*. If we take *A* minus *B*, we should favour *A* if NPV is positive, we should favour *B* if NPV is negative. If we take *B* minus *A*, we should favour *B* if NPV is positive, we should favour *A* if NPV is negative.

Answer

DCF Analysis (Incremental Basis) of Two Conveyor Systems, A&B

	Period	PVF/ Annuity	CF			PV of Incre. CF
			A	B	Incre. CF	
Investment	0	1	-5,00,000	-3,20,000	-1,80,000	-1,80,000
Tax saving on Dep.	1-5	3.352	+ 55,000 Annual	+ 35,200 Annual	+ 19,800	+ 66,370
Operating cost less tax savings	1-5	3.352	-54,000 Annual	-90,000 Annual	+ 36,000	+ 120672
NAV						+ 7,042

Alternative Solution: A results in additional cost of Rs.1,80,000 in zero period, its equivalent annual amount is 180000×0.298329, i.e., Rs.53699. Additional annual cost of *A* Rs.53699.

Additional annual savings of *A*:	
Tax savings on dep.	19,800
Operating cost less tax savings	36,000
	55,800

As annual savings of A is more than its annual cost, it (A) is recommended.

Teaching note _ Not to be given in the exam.

Verification : Net additional savings of *A* = 55,800 – 53,699 = 2,101

These savings will be for 5 years.

Present value of these savings =2,101×3.352 =7,043.

This is almost equal to NPV.

Q.No.30: The present output details of a manufacturing department are as follows:

Average output per week 48,000 units from 160 employees

	Rupees.
(i) Saleable value of output	1,50,000
(ii) Contribution made by output towards fixed expenses and profit	60,000

The Board of directors plans to introduce more mechanization into the Department at a capital cost of Rs.4,00,000. The effect of this will be to reduce the number of employees to 120, but to increase the output per individual employee by 40 per cent. To provide the necessary incentive to achieve the increased output, the board intends to offer a 1 per cent increase on the piece rate of 25 paisa per article for every 2 per cent increase in average individual output achieved. To sell the increase output, it will be necessary to decrease the selling price by 4 per cent. Evaluate the proposed change assuming:

(i) the amount incurred on fixed overheads would be reduced by Rs.8,000 per week.

(ii) there are 50 weeks in a year.

(iii) Cost of capital 10 per cent.

(iv) Life of machine 5 years with salvage value of Rs. 1000 and

(v)Tax to be ignored.

Calculate the payback period of the proposal..

Answer

	Existing	*Proposed*
Output per worker	300	420
No. of workers	160	120
Total output	48000	50400
VC per unit	1.875	1.875+ 0.05 = 1.925
S.P.	3.125	3.000
Cont. per unit	1.25	1.075
Total cont.	60000	54180

Reduction in cont. per week = Rs.5,820

Reduction in FC per week = Rs.8,000

Increase I n profit per week = Rs.2,180

Payback period of the proposal: 4,00,000 / 2180 = 183 weeks

Reduction in annual cont. = 5820×50 = 291000

Reduction in annual F.C. = 400000

DCF Analysis of the Project

	Period	PVF/Annuity	CF	PV
Investment	0	1	-4,00,000	-4,00,000
Reduction in contribution	1-5	3.791	-2,91,000 Annual	-11,03,181
Savings in FC Incurred	1-5	3.791	+ 4,00,000 Annual	+ 15,16,400
Scarp	5	0.621	+ 1000	+ 621
NPV				+ 13,840

As NPV is +, more mechanization is recommended.

Alternative Solution:

Cost Benefit Analysis of the proposal (Annual Basis)

	Cost	Benefit
Savings in FC		4,00,000
Reduction in Contribution	2,91,000	
Equivalent* annual amount of depreciation and interest	1,05,349	
Total	3,96,349	4,00,000

*Equivalent annual cost of investment =

[400000-(1000×.621)]× [1/3.791] = 105349

As annual benefit is more than annual cost, more mechanization is recommended.

Teaching note _ Not to be given in the exam.
Verification: Net annual benefit = 109000-105349 = 3651

PV of 5 years Annual Benefit = 3651×3.791 =13841
(This is almost equal to NPV).

COST COMPARISON OF FIXED ASSETS/ PROPOSALS WITH UNEQUAL LIVES (INCLUDING THE FIXED ASSETS/PROPOSALS WITH UNEQUAL LIVES AND UNEQUAL OUTPUT PER PERIOD

Remember: In this type of situations, our assumption is that fixed asset is required for infinite period i.e. when the life of the fixed asset will we over, we will immediately again purchase that fixed asset.

There are three types of questions on the situations mentioned above:

I TYPE

There are two or more fixed assets. Similar details are given for all of them. We have to select one fixed asset. In this type of situations, we find equivalent annual cost of each fixed asset.

- If output per period is same, we take the decision of the basis of equivalent annual cost of each fixed asset. We recommend the fixed asset with lower equivalent annual cost.
- If output per period is not same, we calculate comparative cost per unit and take decision on the basis of comparative cost per unit. We recommend the fixed asset with lower comparative cost per unit.

Q. No. 31: A firm is considering to install either of the two machines which are mutually exclusive. The details of their purchase price and operating costs are:

	Year	*Machine X*	*Machine Y*
Purchase cost	0	Rs.10,000	Rs.8,000
Operating cost	1	Rs.2,000	Rs.2,500
Operating cost	2	Rs.2,000	Rs.2,500
Operating cost	3	Rs.2,000	Rs.2,500
Operating cost	4	Rs.2,500	Rs.3,800
Operating cost	5	Rs.2,500	Rs.3,800
Operating cost	6	Rs.2,500	Rs.3,800
Operating cost	7	Rs.3,000	
Operating cost	8	Rs.3,000	
Operating cost	9	Rs.3,000	
Operating cost	10	Rs.3,000	

Machine *X* will recover salvage value of Rs.1,500 in the year 10, while Machine *Y* will recover Rs.1,000 in the year 6. Determine which machine is cheaper at 10 per cent cost of capital, assuming that both the machines operate at the same efficiency.

Answer

PV of cost of using X machine for 10 years and Y machine for 6 six years

Period	X	Y
0	10000x1	8000x1
1	2000x.909	2500x.909
2	2000x.826	2500x.826
3	2000x.751	2500x.751
4	2500x.683	3800x.683
5	2500x.621	3800x.621
6	2500x.564	(3800-1000)x.564
7	3000x.513	
8	3000x.467	
9	3000x.424	
10	(3000-1500)x.386	
PV of net cost	24436	20751

Equivalent . Annual cost:

X machine : 24434/6.145 =3976

Y machine : 20752/4.355 =4765

X is recommended because lower amount of Equivalent annual cost

Alternative way: Calculation of PV of cost of using each of two machines for 30 years

X	Y
24434xPVF_0	20752x PVF_0
24434xPVF_{10}	20752x PVF_6
24434xPVF_{20}	20752x PVF_{12}
	20752x PVF_{18}
	20752x PVF_{24}
37506	44.923

PVF_0 =1,PVF_{10} =0.386, PVF_{20} =0.149 , PVF_6 =0.564

PVF_{12} =0.319 PVF_{18} =0.180 PVF_{24} =(.319x.319)

X recommended because lower amount of PV of cost for using for same period of 30 years.

Q. No. 32: Company *X* is to choose between two machines *A* and *B*. The two machines are designed differently, but have identical capacity and to exactly the same job. Machine *A* cost Rs.1,50,000 and will last for 3 years. It costs Rs.40,000 per year to run. Machine *B* is an 'economy' model costing only Rs.1,00,000, but will last only for 2 years, and costs Rs.60,000 per year to run. These are real cash flows. The costs are forecasted in rupees of constant purchasing power. Ignore tax. Opportunity cost of capital is 10 per cent. Which machine the company *X* should buy? **(May 2000) (12 Marks)**

Answer

	Calculation of Equivalent amount	Equivalent amount
Machine A	$\frac{150000+(40000\times2.487)}{2.487}$	Rs.1,00,314
Machine B	$\frac{100000+(60000\times1.736)}{1.736}$	Rs.1,17,604

A recommended because of lower EAC.

Q. No. 33: A manufacturing unit engaged in the productions of automobile parts is considering a proposal of purchasing one of the two plants, details given below :

	Machine A	Machine B

Cost	Rs.20,00,000	Rs.38,00,000
Installation charges	Rs.4,00,000	Rs.2,00,000
Life	20 years	15 years
Scrap value after full life	Rs.4,00,000	Rs.4,00,000
Output per minute	200	400

The annual cost of the two plants are to taken as follows

	A	B
Running hours per annum	2,500	2,500
Costs	Rupees	Rupees
Wages	1,00,000	1,40,000
Indirect material	4,80,000	6,00,000
Repairs	80,000	100000
Power	2,40,000	2,80,000
Fixed cost	60,000	60,000

Will it be advantageous to buy A or B? Substantiate your answer with the help of comparative unit cost of the plants. Assume interest for capital as 10 per cent. Make other relevant assumptions.

Note 10 per cent interest tables:	20 years	15 years
Present value of Re.1	0.1486	0.2394
Annuity of Re. 1 (Capital recovery factor with 10% interest)	0.1175	0.1315

Answer

	A Machine	B Machine
Annual Output	2500 x 60 x 200 = 3 crore units	2500 x 60 x 400 = 6 crore units
Annual Cost		
Wages	1,00,000	1,40,000
Sundry Indirect Material	4,80,000	6,00,000
Repairs & Maintenance	80,000	1,00,000
Power & Steam	2,40,000	2,80,000
Fixed Costs	60,000	80,000
Dep. & Interest	2,75,015	5,13,408
Annual Total Cost	12,35,015	17,13,408

Cost per unit	0.041167	0.0286

As the unit cost is less in proposed plant, it may be recommended that new plant is advantageous to buy.

Zero Period cost of B Plant = 40,00,000 – (4,00,000 x 0.2394)
= 39,04,240

Equivalent annual cost
(i.e. Equivalent annual amount
of Depreciation & Interest) = 39,04,240 x Cap. Recover Factor
= 39,04,240 x 0.1315
= Rs.5,13,408

Zero Period cost of A Plant = 24,00,000 – 4,00,000 x 0.1486
= 23,40,560

Equivalent Annual Cost
(i.e. Equivalent annual amount
of Depreciation & Interest) = 23,40,560 x Cap. Recovery Factor
= 23,40,560 x 0.1175
= 2,75,015

Q. No. 34: A company is to select one of following two mechanical systems:

I : Cost of the system Rs.5,00,000; Life : Infinite; Annual Maintenance cost Rs.50,000

II : Cost of the system Rs.1,00,000; Life : 15 years; Annual Maintenance cost Rs.40,000

Advise. Assume cost of capital 10% Ignore tax.

Answer

I System :

PV of I system 500000 + 50000 $[(1/1.10)^1 + (1/1.10)^2 +$ …….Infinity]	10,00,000
Equalized Annual cost [10,00,000] / $[(1/1.10)^1 + (1/1.10)^2 +$ …..[Infinity]	1,00,000

II System

PV of II system = 100000 + 40000 $[(1/1.10)^1 + (1/1.10)^2 +$ …..$(1.1.10)^{15}$]	4,04,240
Equalized Annual cost =	

$[404240] / [(1/1.10)^1 + (1/1.10)^2 + \cdots.. (1/1.10)^{15}]$	53,148

II system is recommended.

COST COMPARISON OF FIXED ASSETS/ PROPOSALS WITH UNEQUAL LIVES
II TYPE

The question refers to only one fixed asset. It does not exist or we have no information about existing project / proposal / fixed asset. We have to decide its replacement period.

In this type of situations, we find equivalent annual cost of each proposed replacement period. We recommend the replacement period that has minimum equivalent annual cost.

Q. No. 35: The cost of new machine is Rs.10,000. Decide the replacement period using following cost information:

Age of machine	Annual repair cost	Salvage value as year end
1	5,000	8,000
2	10,000	6,400
3	10,000	5,120

Assume that repairs are made at the end of each year only if machine is to be retained and are not necessary if the machine is to be sold for salvage value. Cost of capital 10 per cent. Tax Ignored. **(Nov., 1982)**

Answer

Statement showing P.V. of Cost of Replacement after 1,2 or 3 years.

Replacement	1 Year	2 Years	3 Years
Cost	- 10,000	- 10,000	- 10,000
Repair (End of year1)	-	- 5,000 x .909	-5,000 x .909
Repair (End of year 2)	-	-	-10,000 x .826
Salvage Value	+ 8,000 x .909	+ 6,400 x .826	+ 5,120 x .751
P.V. of Cost	- 2,728	- 9,259	- 18,960

Equivalent Annual Cost = NPV of cost / Sum of PV factors

	1 Year	2 Years	3 Years
Equivalent Annual Cost	- 2728	9259	18960
	.909	1.736	2.487
	= Rs. 3001	= Rs. 5334	= Rs. 7624

Replacement after 1 year is recommended as equivalent cost is least in the case.

Q. No. 36: A company wishes to decide when to replace the vehicles that it operates in its transport fleet. What should be replacement period, 3 years or 4 years?

The capital cost of a vehicle is Rs.6,000

Its estimate trade in value is:
If replaced after 3 years = Rs.1,000
If replaced after 4 years = Rs.700

Assume that corporation tax is 50 per cent and that there are taxable profits to absorb any following deduction. Dep. is 100 per cent in the first year. Cost of capital = 10 per cent

Operating costs (excluding depreciation) (Rupees)

Year	Annual repairs	Tyres	Fixed costs	Fuel	Total
1	290	–	900	2500	3690
2	840	250	900	2500	4490
3	1120	–	900	2500	4520
4	1340	250	900	2500	4990

Answer

DCF Analysis of 3 years and 4 years Replacement Proposals

	Period	PVF	3 years		4 years	
			CF	PV	CF	PV
Investment	0	1	-6,000	-6,000	-6,000	-6,000
Tax savings on depreciation	1	0.909	+ 3,000	+ 2,727	+ 3,000	+ 2,727
Operating cost less tax savings	1	0.909	-1,845	-1,677	-1,845	-1,677
-----do------	2	0.826	-2,245	-1,854	-2,245	-1,854
-----do------	3	0.751	-2,260	-1,697	-2,260	-1,697
Sale of scrap less tax	3	0.751	+ 500	+ 376	---	---
Operating cost less tax savings	4	0.683	---	---	-2,495	-1,704
Sale of scrap	4	0.683	---	---	+ 350	+ 239

NPV				-8,125		-9,966

3 years Replacement Proposal:

NPV = Rs.8,125 Equivalent annual cost: 8,125/2.4860 = Rs3,268

4 years Replacement Proposal:

NPV = Rs.9966 Equivalent annual cost: 9,966/3.1700 = Rs.3,144

4 years replacement proposal is recommended on account of its lower equivalent annual cost.

COST COMPARISON OF FIXED ASSETS/ PROPOSALS WITH UNEQUAL LIVES
III TYPE

There is one existing machine. It is being used for quite some time. We want to replace it with some other machine etc. We have to decide: when to replace.

In this case we divide all the cash flows in two parts (i) Repetitive cash flows and (ii) Non repetitive cash flows. Repetitive cash flows are those cash flows which will be repeating over infinite period. These cash flows are calculated assuming for a minute that the existing machine does not exist i.e. these are calculated ignoring the existing machine. Non repetitive cash flows are the cash flows which will be there for limited period; these arise on account of existing machine.

Q. No. 37 : Company Y is operating an elderly machine that is expected to produce a net cash inflow of Rs.40,000 in the coming year and Rs.40,000 next year. Current salvage value is Rs.80,000 and next year's value is Rs.70,000. The machine can be replaced now with a new machine, which costs Rs.1,50,000, but is much more efficient and will provide a cash inflow of Rs.80,000 a year for 3 years. Company Y wants to know whether it should replace the equipment now or wait a year with the clear understanding that the new machine is the best of the available alternatives and that it in turn be replaced at the optimal point. Ignore tax. Take opportunity cost of capital as 10 per cent. Advise with reasons.
(May 2000) (8 Marks)

Answer

(Teaching note – not to be given in the exam) If you use the old machine for 1 year, the project is for total 4 years. If the replace the machine now, the total project life is 3 years. This situation refers to projects with unequal lives.

Repetitive Cash flows

PV of cost of using new machine for 3 years:
-1,50,000 (investment) + 80,000 (Annual cash flow from operation) x 2.486 = 48,880

Equalized annual NPV = 48,880 / 2.486 = 19,662

If we replace the machine now, our equalized annual net cash flow would be Rs.19,962 from year one (for ever)

If we replace the machine after 1 year, our equalized annual net cash flow would be Rs.19,962 from year two (for ever)

Non-Repetitive Cash flows

NPV of using the old machine for one year:
- 80,000 (forgone scrap) + 40,000 x 0.909 (cash inflow form operation) + 70,000 x 0.909 (sale of scrap after using the old machine for one year)
= 19,990

Equalized annual NPV = 19,990 / 0.909 = 21,991

Year	Equalized NPV	
	Replace now	Replace after 1 year
1	19,962	21,991
2 onwards	19,962	19,962

From the above table, we conclude that the machine should be replaced after 1 year.

Q. No. 38: S. Engineering Company is considering to replace or repair a particular machine, which has just broken down. Last year this machine cost Rs.20,000 to run and maintain. These costs have been increasing in real term in recent years with the age of the machine. A further useful life of 5 years is expected, if immediate repairs of Rs.19,000 are carried out. If the machine is not repaired it can be sold immediately to realize about Rs.5,000 (ignore loss/gain on such disposal).

Alternatively, the company can buy a new machine for Rs.49,000 with an expected life of 10 years with no salvage value after providing depreciation on straight line basis. In this case, running and maintenance costs will reduce to Rs.14,000 each year and are not expected to increase much in real terms for a few years at least. S. Engineering Company regard a normal return of 10 per cent p.a. after tax as a minimum requirement on any new investment. Considering capital budgeting technique, which alternative will you choose? Take corporate tax rate of 50 per cent and assume that depreciation on straight line basis will be accepted for tax purposes also. **(May, 1998) (20 Marks)**

Answer:

PV of repair alternative:

Foregone sale of old machine	-5,000 x 1.000
Repair	-19,000 x 1.000
Tax Saving On Repair	+ 9,500 x 0.909

Annual Cost Less Tax Savings	-10,000 x 3.791
	-53,275

Equal. Annual Cost = 53275/3.791= 14,053

PV of Replace. Alternative

Net Investment	-49,000 x 1.000
Running Cost (Net of Tax Savings)	-7,000 x 6.145
Tax Saving on Dep.	+ 2,450 x 6.145
	-76,960

Equal. Annual cost = 76,960 /6.145 = 12,524

Q. No. 39: A Co. is contemplating whether to replace an existing machine now or wait for a year. A co. currently pays no taxes. The replacement machine costs Rs.90,000 now and requires maintenance of Rs.10,000 at the end of every year for 8 years. At the end of eight years it would have a salvage value of Rs.20000 and would be sold. The details regarding the existing machine are as follows:

Year	Maintenance (Rupees)	Salvage (Rupees)
0	0	35,000
1	10,000	25,000

The opportunity cost of capital is 15%. Should the machine be replaced now or after 1 year.

Answer

Replacing the machine now :

Cost of machine	-90,000 x 1.000
Annual maintenance cost for 8 years	-10,000 x 4.487
Salvage value after 8 years	+ 20,000 x 0.327
PV of cost of using the machine for 8 years	1,28,330

EA cost = 1,28,330 / 4.487 = Rs.28,600

II Using old machine for 1 year

Opportunity cost	-35,000 x 1.00
Maintenance	-10,000 x 0.870
Salvage	+ 25,000 x 0.870
PV of cost of using old machine for 1 year	21,950

E A cost = 21,950 / 0.870 = 25,230

Statement year EA cost under each of 2 alternatives

Year	Replace now	Wait for a year
1	28,600	25,230
2nd year onwards	28,600	28,600

Recommendation: Wait for a year

Q. No.40: A Co. is contemplating whether to replace an existing machine or to spend money on overhauling it. A co. currently pays no taxes. The replacement machine costs Rs.90,000 now and requires maintenance of Rs.10,000 at the end of every year for 8 years. At the end of eight years it would have a salvage value of Rs.20,000 and would be sold. The existing machine requires increasing amounts of maintenance each year and its salvage value falls each year as follows:

Year	Maintenance (Rupees)	Salvage (Rupees)
0	0	40,000
1	10,000	25,000
2	20,000	15,000
3	30,000	10,000
4	40,000	0

The opportunity cost of capital is 15%. When should the machine replaced? **(Nov. 2004) (10 Marks)**

Answer

(A) New Machine (Repetitive cash - flows)

Cost of machine	-90000 x 1.000
Annual maintenance cost for 8 years	-10000 x 4.487
Salvage value after 8 years	+ 20000 x 0.327
PV of cost of using the machine for 8 years	128330

EA cost = 128330 / 4.487 = 28600

Whenever we replace the machine, after replacement year after year the equivalent annual cost would be Rs.28,600 (for infinite period)

(B) Other cash flows (NON-REPETITIVE CASH FLOWS)

PV of the cash flows associated with the use of old machine for one year:

Loss of salvage value	- 40,000 x 1.000
Maintenance	- 10,000 x 0.870
Salvage value	+ 25,000 x 0.810
	26,950

E A cost = 26950 / .870 = 30977

PV of the cash flows associated with the use of old machine for 2 years:

-40,000 x 1.000
-10,000 x 0.870
- 20,000 x 0.756
+ 15,000 x 0.756

PV of cost: 52,480

E A cost = 52,480 / 1.626 = 32,276

PV of the cash flows associated with the use of old machine for 3 years:
-40,000 x 1.000
-10,000 x 0.870
-20,000 x 0.756
-30,000 x 0.658
+ 10,000 x 0.658

PV of cost = 76,980

E A cost = 76,980 / 2.283 = 33,719
PV of the cash flows associated with the use of old machine for 4 years:
-40000 x 1
-10000 x 0.870
-20000 x 0.756
-30000 x 0.658
-40000 x 0.572

PV of cost = 1,06,440

E A cost = 1,06,440 / 2.855 = 37,281

Statement showing EA cost under each of 5 alternatives

Year	I	II	III	IV	V
1	28,600	30,977	32,276	33,719	37,281
2	28,600	28,600	32,276	33,719	37,281
3	28,600	28,600	28,600	33,719	37,281
4	28,600	28,600	28,600	28,600	37,281
5^{th} year onwards	28,600	28,600	28,600	28,600	28,600

Alternative 1^{st} is recommended.

FOREIGN EXCHANGE AND CAPITAL BUDGETING

Q. No. 41: Murali Ltd, an Indian firm, is considering a project in Switzerland, which will involve an initial investment of CHF 22m. The real interest rate is same in both the countries. Inflation rate in India is 5% p.a. The project will have 5 years of life. Current spot exchange rate is Rs.24 per CHF. The risk free rate in Switzerland is 8% and the same in India is 12%. Cash inflows from the project are as follows:

Year →	1	2	3	4	5
Cash inflow CHF →	4.00m	5.00m	6.00m	8.00m	10.00m

Calculate the NPV of the project using home currency approach. Required rate of return on this project is 14%. How your answer will change if you have to follow the foreign currency approach.

Answer

HOME CURRENCY APPROACH

Spot rate	1 CHF = Rs.24.00
1 year forward	1 CHF = Rs.24.89
2 years forward	1 CHF = Rs.25.81
3 years forward	1 CHF = Rs.26.77
4 years forward	1 CHF = Rs.27.76
5 years forward	1 CHF = Rs.28.79

NPV = - 22m x 24
+ 4m x 24.89 x 0.877
+ 5m x 25.81 x 0.769
+ 6m x 26.77 x 0.675
+ 8m x 27.76 x 0.592
+ 10m x 28.79 x 0.519 = Rs.47.86m

FOREIGN CURRENCY APPROACH

NPV =[-22m + 4m (1/1.0992857) + 5m $(1/1.0992857)^2$ + …… +
10m$((1/1.0992857)^5]$ x 24 = Rs.48.02m

Q. No. 42: A UK firm is considering an investment of $1m in a USA project, life of the project is 5 years. Total investment is divided in machine and working capital in the ratio of 0.40: 0.60. The project will result in annual before depreciation profit of $0.60m. Straight line depreciation is allowed for tax purposes. Tax rate is 30%. The required rate of the UK firm is 10%. Current Foreign exchange rate is 1£ = 2$. Interest rate in UK is 8% and in USA it is 6%. Should the project be taken up?

Answer

Spot rate	1£ = 2.0000$.
1 year forward	1£ = 1.9630$.
2 years forward	1£ = 1.9266$.
3 years forward	1£ = 1.8909$.
4 years forward	1£ = 1.8559$.
5 years forward	1£ = 1.8215$.

Annual cash flow ($) = Annual before depreciation profit – Tax
= 0.60m – 0.156m = 0.444m

NPV = - 0.50m + (0.444m /1.9630)(1/1.10) + (0.444m / 1.9266)$(1/1.10)^2$ + (0.444m / 1.8909)$(1/1.10)^3$ + (0.444m / 1.8559)$(1/1.10)^4$ + (1.044m / 1.8215)$(1/1.10)^5$ = $ 0.5917m

Q. No. 43 : An Indian firm enters in to a joint venture with an Tanzanian firm on 50:50 basis. The total investment in both the firms is estimated at 2m Tanzanian shillings. This amount is to be contributed by both the ventures' equally. The following cash flows are expected:

Year – end	Tanzanian Shillings
1	1.00m
2	1.50m
3	2.00m

Cost of capital of the Indian firm is 10%. The current foreign exchange spot rate is : Re.1 = 20 T.Sh. Interest rate in India is expected to remain at 8% p.a. while in Tanzanian it is expected to be 8% in 1st year, 9% in 2nd year and 10% in 3rd year. (a)Find NPV assuming 100% payout ratio. (b) How your answer will change if the pay-out ratio is 50% and the balance cash will be distributed by the two parties in the beginning of the 4th year.

Answer

Spot rate Re. 1.00 = 20 T.Sh.
1 year forward Re. 1.00 = 20 T. Sh.
2 year forward Re. 1.00 = 20 T. Sh.(1.09/1.08) = 20.18
3 year forward Re. 1.00 = 20.18 T Sh.(1.10/1.08) = 20.56

(a) NPV =[-1m/20]+ [(0.50m/20) x (0.909)]+ [(0.75m/20.18) x (0.826)]
+ [(1.00m/20.56)(0.751)]
= = Rs. 39,951.

(b) NPV =[-1m/20]+ [(0.25m/20 x (0.909)] + [(0.375m/20.18) x (0.826)]
+ [(0.50m/20.56) x (0.751)] + [(1.125 /20.56) x (0.751)]
= Rs. 36,068.

Q. No. 44 : Galeplus plc has been invited to purchase and operate a new telecommunications centre in the republic of Perdia. The purchase price is 2,000 million Rubbits. The centre would be sold back to the Perdian government for an agreed price of 4,000 million Rubbits after 3 years. Galeplus would supply three years technical expertise and training for local staff, for three years, for an annual fee of 40 million Rubbits..

Inflation during the next three years is expected to be between 10% per year. Inflation in the UK is expected to be negligible.
Galeplus's bankers have suggested using a currency swap for the purchase price of the factory, with a swap of principal immediately and in three years' time, both swaps at today's spot rate. The bank would charge a fee of 0.25% per year (in sterling) for arranging the swap.
Exchange rates:

Spot 85.4 Rubbits/£
3 year forward rate Not available

Assuming the swap takes place as described, provide a reasoned analysis, as to whether or not Galeplus should accept the invitation or not. The relevant risk adjusted discount rate may be assumed to be 15% per year. Ignore Tax. (Adapted ACCA Dec. 2004)

Answer:

Working notes :

(i) 2000 m Rubbits = 2000m / 85.40 = £ 23.4192 m

Bank charges = 23.4192m x .0025 = £ 0.0585m p.a.

(ii) Spot rate: 1£ = 85.4 Rubbits

1 year forward rate :

1£ (1+ 0) = 85.4 (1.10) Rubbits

1£ = 93.94

2 year forward rate :

1£ (1+ 0) = 93.94(1.10) Rubbits

1£ = 103.334 Rubbits

3 year forward rate :

1£ = 103.334 (1.10) Rubbits

1£ = 113.67 Rubbits.

(iii) Net receipt in Rubbits after three years = 4000m – 2000m = 2000m

Cash flows in £

	Period	Cash flow
	0	- £23.4192 m
Bank charges	1-3	- 0.0585 p.a.
Annual fees	1	+ 40m/93.94 = + 0.4258m
Annual fees	2	+ 40m / 103.334 =+ 0.3871m
Annual fees	3	+ 40m / 113.67 = + 0.3519m
Contractual payments (swap)	3	+ 23.4192m
Contractual payment (others)	3	+ 2000m / 113.67 = + 17.5948m

DCF Analysis of the project (£ million)

	Period	PVF	CF	PV
Swap payment	0	1	-23.4192	-23.4192
Bank charges	1-3	2.283	-0.0585 p.a.	-0.1336
Annual fees	1	0.870	+ 0.4258	0.3704
Annual fees	2	0.756	+ 0.3871	0.2926
Annual fees	3	0.658	+ 0.3519	0.2316

Contract receipt (swap)	3	0.658	+ 23.4192	15.4098
Contract receipt (other)	3	0.658	+ 17.5948	11.5773
NPV				+ 4.3289

Q. No. 45

A US company has been offered a contract of constructing a dam in an underdeveloped country for which it shall be paid Peasas, the local currency of that country. The construction will take be completed in one year. On completion the US Company will receive 3,000m Peasas. The project requires an immediate spending of 2,000m Peasas. The US company requires a return of 10% in Dollar terms. Given the following rates, should the project be accepted :

Spot rate: 1 USD = 50 Peasas

1 year forward rate: 1 USD = 48 Peasas.

Will your answer change if a bank offers a currency swap on the following terms?

(i) the US company may lend $ 40m to the bank for 1 year at zero interest rate

(ii) The bank will lend the US company 2000m Peasas for 1 year at 10% p.a. interest; the loan and the interest to be paid in Peasas.

Answer:

Period	Cash flow (USD)
0	−2000m/50 = − 40m
1	+ 3000m/48 = + 62.50m

DCF Analysis of the Project

	Period	PVF	CF	PV
Investment	0	1	−40m	−40m
Realization	1	0.909	+ 62.50m	+ 56.8125m
NPV				+ 16.8125

As the NPV is positive, the project may be accepted.

Swap: Period Cash flows (USD)

0 −40m

1 + 40m

1 + (3000 −2200)/48 = 16.67m

DCF Analysis of the Project

	Period	PVF	CF	PV
Investment	0	1	−40m	−40m
Realization	1	0.909	+ 56.67m	+ 51.5131
NPV				+ 11.5131

The Swap option has reduced the NPV.

Q. No.46:

A Canadian company has been awarded a contract to build a Power House in XYZ country, the currency of that currency is XYZ Mark. The contract price is 140m XYZ Mark, to be paid on the completion of the work. The contract will be completed in

one year .The Canadian company will be required to spend 60m XYZ Marks immediately and another 60m after 9 months. The required rate of return is 12%.

- A bank has offered the following swap:

(i) A currency swap of 60m XYZ Mark @ 12 XYZ Mark per Canadian Dollar immediately and a reverse currency swap for the same amount at the same exchange rate after 1 year.

(ii) The Canadian company will pay interest @ 15% p.a., payable in XYZ Mark after 1 year. The Bank will pay interest @ 10% p.a., payable in Canadian Dollars after one year.

- Applying the following Foreign Exchange rates and assuming that the swap is undertaken, advise whether the contract should be taken :

Spot rate: 1 Canadian Dollar = 12 XYZ Marks
1 year forward: 1 Canadian Dollar = 13 XYZ Marks

Answer

Working notes:
(i) Spot 12 XYZ Mark
1 year forward 13 XYZ Mark
LHS increases by 12, RHS increases by 1
LHS increases by 1, RHS increases by 1/12
LHS increase by 9, RHS increases by 0.75
9 months forward rate: 12 + 0.75 = 12.75
(ii) Spending after 9 months = 60m/12.75 = 4.7059m Canadian Dollars
(iii) Cash flows at the end of the year:
Contract price 140m XYZ Mark
Payment under swap with interest – 69m XYZ Mark 71m XYZ Mark
Converted into Canadian Dollars on forward basis:
71m XYZ Mark/ 13 XYZ Mark = 5.4615m CDs

(iv) PV factor of 9 months = 1/1.09 = 0.917

DCF Analysis of the Project (Canadian Dollars Millions)

	Period	PVF	CF	PV
Payment to bank under swap	0	1	– 5	–5
Spending	0.75	0.917	–4.7059	–4.3153
Receipt under swap with interest	1	0.893	+ 5.50	+ 4.9115
Other realizations	1	0.893	+ 5.4615	+ 4.8771
NPV				+ 0.4733

The project may be taken up as NPV is + .

RISK AND UNCERTAINITY

Capital expenditure decisions are taken on the basis of estimates of future cash flows. Actual results may or may not correspond to the estimates. This fact incorporates risk and uncertainty in capital expenditure decisions. The term risk is used to denote the possibility of variability of actual results (as compared with estimates) if the probability of this possibility is known. The term uncertainty is used, if the probability of this possibility is not known. Both risk and uncertainty refer to an uncertain decision-making situation. There are four important methods of decision-making about capital expenditure in the uncertain situations:

(i) Probability Distribution,

(ii) Decision Tree

(iii) Risk Adjusted Discount Rate

(iv) Certainty Equivalent Approach.

(v) Sensitivity Analysis

Probability Distribution (Hiller's model)

If the cash flows are independent over time, i.e., cash flow of one year is independent of cash flow of the other year, probability distribution approach is considered for estimating the risk. Under this project there are four steps:

(i) Expected N.P.V. of project,

(ii) Standard deviations for various periods,

(iii) Standard deviation[4] for project as a whole

$$= \sqrt{[(S.D._1 \times PVF_1)^2 + (S.D._2 \times PVF_2)^2 + \text{-- -- --} + (S.D._n \times PVF_n)^2\ ]}$$

(iv) Determining probability of positive NPV using normal distribution.

Q. No 47: The cost of a project is Rs.16Lakh. The following data present the details about the distribution of cash flows:

Year 1		Year 2	
Cash inflows (Rs.Lakh)	Probability	Cash inflows (Rs.Lakh)	Probability
5	0.10	10	0.30
7	0.40	14.05	0.20
8	0.30	15	0.50
10	0.20	11	0.00

Cost of capital = 10 per cent. Cash flows are independent. Find probability of making profit if project undertaken.

---

[4] It is also referred as the standard deviation of the present value distribution.

Answer

N.P.V. of project = 1.993

Standard Deviation of Period 1

X	P	PX	$(X\text{-mean})^2$	$P(X\text{-}mean)^2$
5	0.10	0.5	7.29	.729
7	0.40	2.8	0.49	.196
8	0.30	2.4	0.09	.027
10	0.20	2.0	5.29	1.058
		7.7	13.16	2.010

$S.D._1 = 1.4177$

Standard Deviation of Period 2

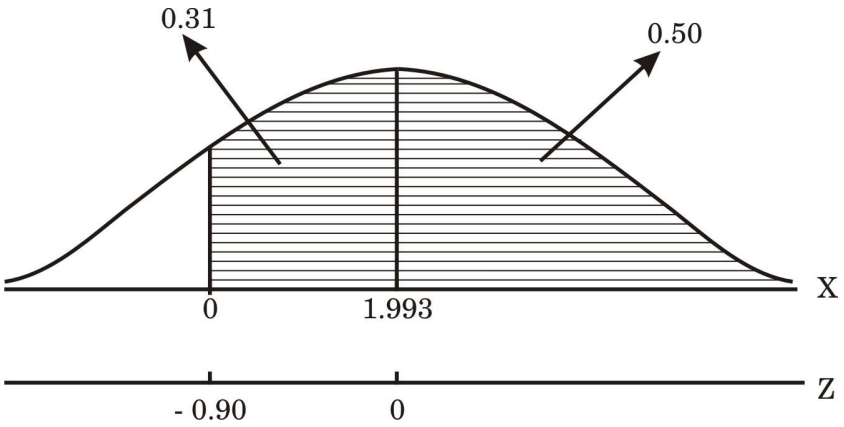
X	P	PX	$(X\text{-}Mean)^2$	$p\ (X\text{-}Mean)^2$
10	0.30	3.00	10.9561	3.28683
14.05	0.20	2.81	0.5476	0.10952
15	0.50	7.50	2.8561	1.42805
		13.31	14.3598	4.8244

$S.D._2 = 2.1965$

S.D. of the project: $\sqrt{(1.4177 \times .909)^2 + (2.1965 \times .826)^2}$

$= 2.225$

$$Z = \frac{0 - 1.993}{2.225} = -0.90$$



Looking at the normal table, probability of making profit is 0.81.

Q. No. 48: Skylark Airways is planning to acquire a light commercial aircraft for flying class clients at on investment of Rs.50,00,000. The expected cash flow after tax for the next three years in as follows: (Rupees).

YEAR 1		YEAR 2		YEAR 3	
CFAT	Probability	CFAT	Probability	CFAT	Probability
1.40 m	0.10	1.50 m	0.10	1.80 m	0.20
1.80 m	0.20	2.00 m	0.30	2.50 m	0.50
2.50 m	0.40	3.20 m	0.40	3.50 m	0.20
4,00 m	0.30	3.50 m	0.20	4.80 m	0.10

The Company wishes to take into consideration all possible risk factors relating to airline operations. The company wants to know:

(i) The expected NPV of this venture assuming independent probability distribution with 6 per cent risk-free of interest.

(ii) The possible deviation in the expected value.

(iii) How would standard deviation of the present value distribution help in Capital Budgeting decisions? **(Nov. 2002) (14 marks)**

Answer

(i) Expected CFAT of I year (Rs Lakhs)
= [(14 x 0.1) + (18 x 0.2) + (25 x 0.4) + (40 x 0.3) = 27.0

Expected CFAT of II year

= [(15 x 0.1) + (20 x 0.3) + (32 x 0.4) + (35 x 0.2) = 27.30

Expected CFAT of III year
= [(18 x 0.2) + (25 x 0.5) + (35 x 0.2) + (48 x 0.1) = 27.90

Expected NPV
= [(27)(0.943) + (27.3)(0.890) + (27.9)(0.840)] −50 = 23.194

(ii) Calculation of SD of year 1

X	p	pX	x	px^2
14	.1	1.4	−13	16.9
18	.2	3.6	− 9	16.2
25	.4	10	− 2	1.6
40	.3	12	+ 13	50.7
		∑ pX = 27		∑ px^2 =85.4

SD of year 1 = $\sqrt{85.4}$ = 9.241

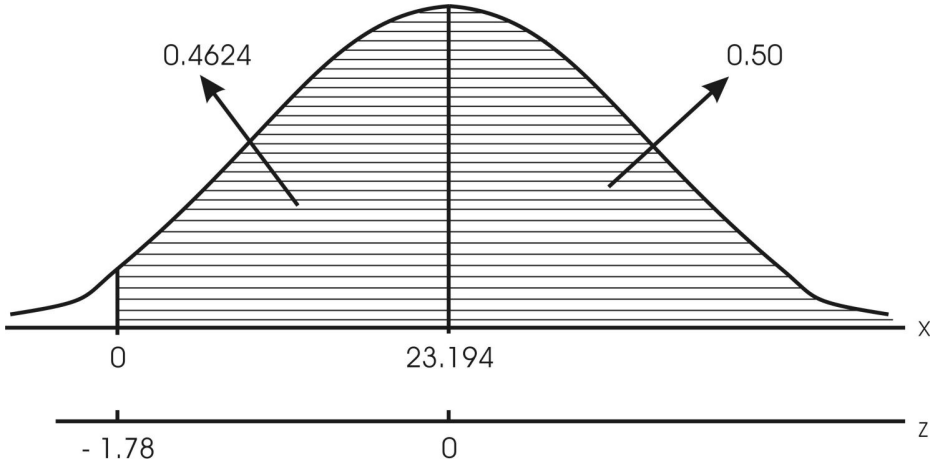
Similarly, SD of year 2 = 7.198 and SD of year 3 = 8.619

Possible Deviation in the expected value i.e. SD of the project as a whole (It is also referred as the SD of the present value distribution)

$$= \sqrt{[(9.241 \times 0.943)^2 + (7.198 \times 0.890)^2 + (8.619 \times 0.840)^2]}$$
$$= 13.015$$

(iii) Using the SD of the present value distribution, we can find the probability of the NPV being + .

$$Z = \frac{X - \text{mean}}{SD} = \frac{0 - 23.194}{13.015} = -1.78$$



Probability of NPV being + = 0.9624

Probability of NPV being – = 0.0376
(This is indicator of risk of the project)

Q. No. 49: Project X and Project Y are under evaluation of XY Co. The estimated cash flows and their probabilities are as below:

Project X: Investment (Year 0) Rs.70Lakhs.

Probability →	0.30	0.40	0.30
Year ↓			
1	Rs.3.00m	Rs.5.00m	Rs.6.50m
2	Rs.3.00m	Rs.4.00m	Rs.5.50m
3	Rs.3.00m	Rs.4.00m	Rs.4.50m

Project Y: Initial investment (Year 0) = Rs.8.00m

Probability	Annual cash flows through life Rs. Million
0.20	4.00
0.50	4.50
0.30	5.00

(a) Which project is better, based on NPV criterion with a discount rate of 10%?

(b) Compute the standard deviation of the present value distribution and analyze the inherent risk of the projects. **(May,2005) (12 Marks)**

Answer

(a) Project X

Expected CF of I year = [(30 x 0.3) + (50 x 0.4) + (65 x 0.3) = 48.50
Expected CF of II year = [(30 x 0.3) + (40 x 0.4) + (55 x 0.3) = 41.50
Expected CF of III year = [(30 x 0.3) + (40 x 0.4) + (45 x 0.3) = 38.50
Expected NPV =

[(48.50)(0.909) + (41.50)(0.826) + (38.50)(0.751)] -70 = 37.279

Project Y
(Assumption: Life of the project is 3 years)
Expected Annual CF = [(40 x 0.2) + (45 x 0.5) + (50 x 0.3) = 45.50
Expected NPV =

[(45.5)(0.909) + (45.5)(0.826) + (45.5)(0.751)] -80 = 33.113

Based on NPV criterion, project X is recommended.

(b) Project X

Calculation of SD of year 1

X	p	pX	x	px^2
30	0.30	9	-18.50	102.675
50	0.40	20	1.50	0.900
65	0.30	19.50	16.50	81.675
		∑ pX = 48.50		∑ px2 =185.25

SD of year 1 = $\sqrt{185.25}$ = 13.61

Calculation of SD of year 2

X	p	pX	x	px^2
30	0.30	9.00	-11.50	39.675
40	0.40	16.00	- 1.50	0.900
55	0.30	16.50	13.50	54.675
		∑ pX = 41.50		∑ px2 = 95.25

SD of year 2 = $\sqrt{95.25}$ = 9.76

Calculation of SD of year 3

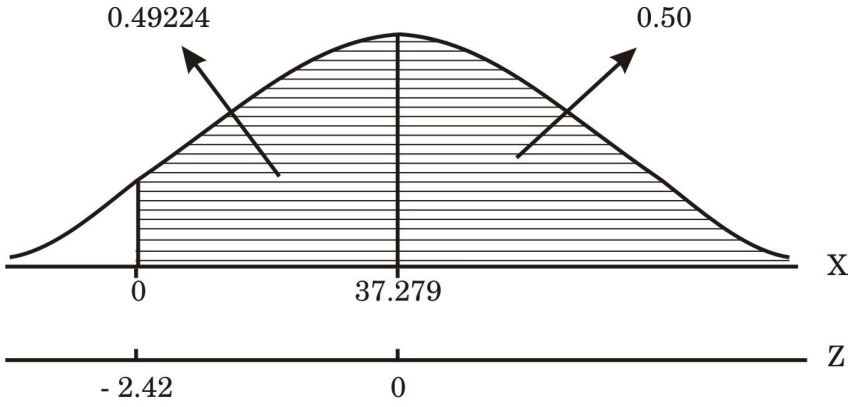
X	p	pX	x	px^2
30	.30	9.00	- 8.50	21.675
40	.40	16.00	1.50	0.900
45	.30	13.50	6.50	12.675
		∑ pX = 38.50		∑ px2 = 35.25

SD of year 3 = $\sqrt{35.50}$ = 5.94

SD of the project as a whole (It is also referred as the SD of the present value distribution)

$= \sqrt{[(13.61 \times 0.909)^2 + (9.76 \times 0.826)^2 + (5.94 \times 0.751)^2]} = 15.43$

$Z = [0-37.279] / 15.43 = -2.42$



Probability of positive NPV

The probability of loss (Inherent risk of the project) = 0.00776

Project Y

Calculation of Annual SD

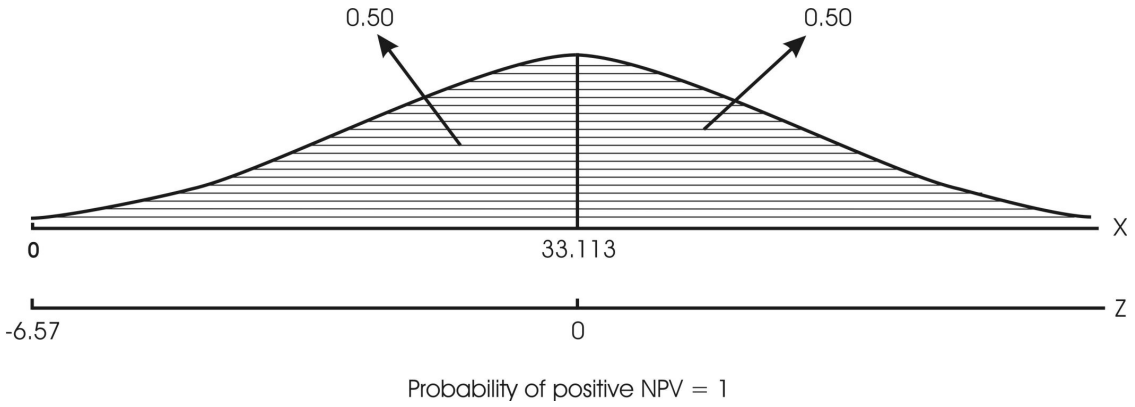
X	p	pX	x	px^2
40	0.20	8.00	-5.50	6.050
45	0.50	22.50	-0.50	0.125
50	0.30	15.00	4.50	6.075
		∑ pX = 45.5		∑ px2 = 12.25

Annual SD $= \sqrt{12.25} = 3.50$

SD of the project as a whole (It is also referred as the SD of the present value distribution)

$= \sqrt{[(3.50 \times 0.909)^2 + (3.50 \times 0.826)^2 + (3.50 \times 0.751)^2]} = 5.04$

$Z = [0-33.113] / 5.04 = -6.57$



Probability of positive NPV = 1

The probability of loss (Inherent risk of the project) = 0

Though the inherent risk in case of X is quite less; the probability of loss in this case is less 1%. However, in case of Y, there is no risk at all. Hence, Y is recommended.

Q.No.50 :

Cyber Company is considering two mutually exclusive projects. Investments outlay of both the projects is Rs.5,00,000 each and each is expected to have a life of 5 years. Under three possible situations their annual cash flows and probabilities are:

Situations	Probabilities	Cash flows (rupees)	
		A	B
Good	0.30	6,00,000	5,00,000
Normal	0.40	4,00,000	4,00,000
Worse	0.30	2,00,000	3,00,000

The cost of capital is 7%, which project should be accepted? Explain with the workings. **(May, 2003) (3 Marks)**

Answer

Project A (Rupees Lakhs)
Expected annual cash flow: [{6 x 0.30} + {4 x 0.40} + {2 x 0.30}] = 4
Expected NPV: -5 + [4 x 4.1] = 11.40

Annual SD Let cash flows of A = X

X	X	x^2	p	px^2
6	2	4	.3	1.2
4	0	0	.4	0
2	-2	4	.3	1.2
				Total = 2.40

SD = $\sqrt{2.40 / 1}$ = 1.55

Project B (Rs. Lakhs)
Expected annual cash flow : [{5x0.30} + {4x0.40} + {3x0.30}] = 4
Expected NPV : -5 + [4 x 4.1] = 11.40

Annual SD
Let cash flows of B = X

X	X	x^2	p	px^2
5	1	1	.3	.3
4	0	0	.4	0
3	-1	1	.3	.3
				Total = 0.60

SD = $\sqrt{0.60 / 1}$ = 0.77

NPV of both the projects is same. Project B is recommended as its risk is lower.

Q.No.51: A company is considering projects X and Y with the following information:

Project	Expected NPV (Rupees)	Standard Deviation
X	1,22,000	90,000
Y	2,25,000	1,20,000

(i) Which project will you recommend based on the above data?

(ii) Explain whether your opinion will change, if you use coefficient of variation as a measure of risk.

(iii) Which measure is more appropriate in this situation and why? **(May, 2003) (3 Marks)**

Answer

(i) Project X is recommended to a conservative investor as its risk is lower. [A conservative investor prefers lower risk even if return is lower]
Project Y is recommended to an aggressive investor as its return is higher. [An aggressive investor prefers higher return even if risk is higher].

(ii) Project Coefficient of variation
X 90,000 / 1,22,000 = 0.74
Y 1,20,000/ 2,25,000 = 0.53
On the basis of coefficient of variation, Y is recommended. There is no change in our recommendation regarding the aggressive investor but there is change in our recommendation regarding the conservative investor.

(iii) Coefficient of variation is better measure of decision making in this situation as it considers both risk and return.

DECISION TREE APPROACH

A decision tree is a diagram that exhibits the outcomes of an **act** under various **events.** Acts are those strategies about which we have to take decision. Acts are also referred as Actions, Courses of actions, strategies or alternatives.

Events are uncertain situations, their result (i.e. whether these will happen or not) will be known in future. Events have probabilities.

Decision tree is an excellent tool for choosing between several courses of actions. It is a map of reasoning process. The technique is particularly helpful in situations of complex multistage decision problems. It is used to identify the best strategy.

This diagram is read from left to right. In this diagram:

□→ Square precedes Acts. (Squares represent decisions we can make)

○→circle precedes events. (Circles show various uncertain outcomes)

In Capital Budgeting, this approach is used for decision making if the cash flows of a period are dependent upon cash flows of the other period. We find various possible NPV estimates by making a decision tree. (The term NPV estimate means event – based NPV i.e. NPV that would be there if a particular event takes place). We calculate mean and S.D. of these NPV estimates.

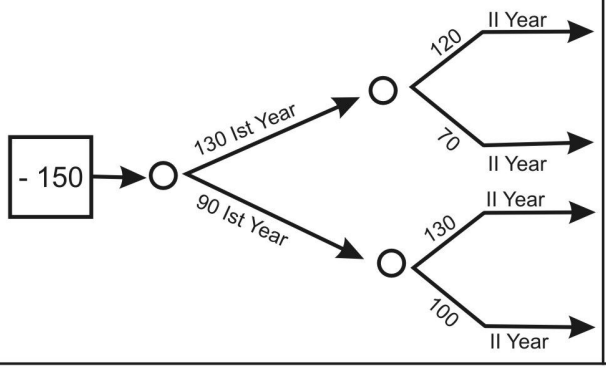
Q. No. 52: A project cost Rs.150 to initiate. After one year it could return Rs. 130 with probability of 0.70 or Rs. 90 with probability 0.30. If Rs. 130 return materializes then there is a 0.40 chance of a return of Rs. 120 and a 0.60 chance of return of Rs. 70 after 2 years. If the return of Rs. 90 occurred in the first year then the return in year 2 may be Rs. 130 with a probability of 0.50 and Rs. 100 with probability 0.50. Assuming cost of capital 10 per cent, find coefficient of variation after making decision tree.

Answer

Possible Cash inflow		Probability
(i)	130 in I year & 120 in II year	0.70 × 0.40 = 0.28
(ii)	130 in I year & 70 in II year	0.70 × 0.60 = 0.42
(iii)	90 in I year & 130 in II year	0.30 × 0.50 = 0.15
(iv)	90 in I year & 100 in II year	0.30 × 0.50 = 0.15

N.P.V. Estimates

(i)	– 150 + 130 x 0.909 + 120 x 0.826 67	(ii)	– 150 + 130 x 0.909 + 70 x 0.826 26
(iii))	– 150 + 90 x 0.909 + 130 x 0.826 39	(iv)	– 150 + 90 x 0.909 + 100 x 0.826 14

Rs. Lakhs	NPV Estimate	Probability	Expected NPV Estimate
			
	67	0.28	18.76
	26	0.42	10.92
	39	0.15	5.85
	14	0.15	2.10
	EXPECTED NPV		37.63

Expected NPV or mean

$67 \times 0.28 + 26 \times 0.42 + 39 \times 0.15 + 14 \times 0.15 = 37.63$

Calculation of S.D.

X	(X−mean)	P	P (X−mean)^2
67	29.37	0.28	241.53
26	− 11.63	0.42	56.81
39	1.37	0.15	0.28
14	23.63	0.15	83.76
			382.38

S.D. = $\sqrt{382.38} = 19.55$

Coefficient of variation = 19.55 / 37.63 = 0.52

Q. No. 53: A firm has an investment proposal, requiring an outlay of Rs.40,000. The investment proposal is expected to have 2 years' economic life with no salvage value. In year I, there is a 0.4 probability that cash inflow after tax will be Rs.25,000 and 0.6 probability that cash inflow after tax will be Rs.30,000. The probabilities assigned to cash inflows after tax for the year II are as follows:

Cash inflow year I →	Rs.25,000		Rs.30,000	
	Cash inflow year II		Cash inflow year II	
	Amount	Probability	Amount	Probability
	Rs.12,000	0.20	Rs.20,000	0.40
	Rs.16,000	0.30	Rs.25,000	0.50
	Rs.22,000	0.50	Rs.30,000	0.10

The firm uses a 10 per cent discount rate for this type of investment:

(a) Construct a decision tree for the proposed investment project.

(b) What net present value will the project yield if worst outcome is realized? What is the probability of occurrence of this NPV?

(c) What will be the best and the probability of that occurrence?

(d) Will the project be accepted?

(10% Discount factor: 1 year 0.909; 2 year 0.826)

(e) Do the profitability index and the NPV criterion of evaluating investment proposals lead to the same acceptance — rejection and ranking decisions? In what situations will they give conflicting results? **(November 1999) (20 Marks)**

Answer : (WORKING NOTE)

Possible event	
A	Rs.25000 in I Yr. & Rs.12000 in II yr.
B	Rs.25000 in I Yr. & Rs.16000 in II yr
C	Rs.25000 in I Yr. & Rs.22000 in II yr
D	Rs.30000 in I Yr. & Rs.20000 in II yr
E	Rs.30000 in I Yr. & Rs.25000 in II yr
F	Rs.30000 in I Yr. & Rs.30000 in II yr

Event	NPV Estimate	Probability
A	(25000 X 0.909) + (12000 X 0.826) -40000 = -7363	(0.4 x 0.2) = .08
B	(25000 X 0.909) + (16000 X 0.826) -40000 = -4059	(0.4 x 0.3) = .12
C	(25000 X 0.909) + (22000 X 0.826) -40000 = + 897	(0.4 x 0.5) = .20
D	(30000 X 0.909) + (20000 X 0.826) -40000 = + 3790	(0.6 x 0.4) = .24
E	(30000 X 0.909) + (25000 X 0.826) -40000 = + 7920	(0.6 x 0.5) = .30
F	(30000 X 0.909) + (30000 X 0.826) -40000 = + 12050	(0.6 x 0.1) = .06

(a)

Rs. Lakhs	NPV Estimate	Probability	Expected NPV Estimate
- 40,000 → 25,000 Ist Year → 12,000 → II Year	- 7363	0.08	- 589
- 40,000 → 25,000 Ist Year → IInd year 16,000	- 4059	0.12	- 487
- 40,000 → 25,000 Ist Year → 22,000 → II Year	+ 897	0.20	+ 179
- 40,000 → 30,000 Ist Year → 20,000 → II Year	+ 3790	0.24	+ 910
- 40,000 → 30,000 Ist Year → IInd year 25,000	+ 7920	0.30	+ 2376
- 40,000 → 30,000 Ist Year → 30,000 → II Year	+ 12050	0.06	+ 723
	Expected NPV		+ 3112

(b) If worst happens, NPV will be – Rs.7,363. Its probability is 0.08

(c) If best happens, NPV will be Rs.12,050. Its probability is 0.06.

(d) The project may be accepted, as the Expected NPV of the project is Positive.

(e) NPV v/s PI:

- If we have to evaluate only project, we may either calculate NPV or PI, both will give same result.
- If we have to evaluate two or more projects:

(iii) We should apply NPV method if funds are not key factors, i.e., our aim is maximization of profits.

(iv) We should apply PI method if funds are key factors, i.e., we want to maximize the rate of return on funds employed.

Let's have an example to understand this point. A person is offered to two jobs and he can accept either. First job will give him Rs.350 per day of 7 hours (Rs.50.00 per hour). Second job will give him Rs.380 per day of 8 hours (Rs.47.50 per hour), which job he should accept? If time is key factor for him, i.e., if he wants to maximize his earning per hour he should go for the first job. If time is not key factor for him and he wants to maximize his total earnings, he should go for the second job.

Let's have another example. Suppose, a businessman has two capital expenditure proposals before him. First will require on investment of Rs.40,000 initially and will result in cash flows at present value amounting to Rs.60,000 (NPV = 20,000, PI = 1.50). Second will require on investment of Rs.50,000 and will result in cash inflows at present value amounting to Rs.72,000 (NPV = 22,000, PI = 1.44). If funds are key factor, he should go for the first project, i.e., he should maximize the rate of return. If funds are not key factor, i.e., he wants to maximize his profit, he should go for the second project[5].
NPV and PI give different results only if the investment amounts are different.

Q. No. 54: A manufacturer of electrical components for the motor vehicle industry is faced with the problem of building a new plant for the manufacture of electronic components for vehicles. Estimates of the size of the new plant to be built have been made and two sizes are selected based on forecast of future new vehicle demand. A

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[5]The term fund here refers to the total funds i.e. promoters own funds, funds raised through Public issue, funds raised through private placement, borrowed funds etc.

In the exam, if the question silent on the point whether the funds are the key factors or not, we assume that the funds are no the key factors. The reason is that in today's world, funds are not key factor (the main key factor of today's world is Vision which is the sum of Knowledge and Entrepreneurship). Fund is the most mobile factor of production in today's world. (Any amount of funds can be transferred from one country to another country simply at the click of mouse). From fund point of view, the world has become just like a global village. Funds of one country are invested not only in that country but also in many other countries of different continents.

large plant is estimated to cost Rs. 3 million and a small plant Rs. 1.4 million. The net cash inflows per annum of each size of plant according to the demand are:

Size of plant	*Demand*	
	High (Rs.'000)	Low (Rs.'000)
Large	1200	300
Small	500	400

Based on a manufacturing plant life of six years, the following possible outcomes are assessed:

1. Demand will be high for the first two years and will then fall to a low level. A probability of 20 per cent is given to this outcome.
2. Demand will be high for the first two years and will remain at a high level for the final four years. A 40 per cent probability is assigned to this event.
3. Demand will be low for the first two years and will remain low for the final four years. This outcome is given a 15 per cent probability.
4. Demand will be low for the first two years, but will then recover to high level for the final four years. This is given a 25 per cent probability of occurring.

The relevant capital costs and net cash inflows, at present values are given in the table for the two alternative plant sizes at the high and low demand levels referred to above:

Plant	*Demand*	Net Cash inflow at present values	
		Year 1 & 2 (Rs.'000)	Year 3 to 6 (Rs.'000)
Large	High	2082	3143
	Low	521	786
Small	High	868	1310
	Low	694	1040

The net present values have been calculated, for the two periods covered by the predictions, at the rate of 10 per cent per annum which is the expected cost of capital. You are required to:

(a) draw the decision tree diagram for the above information.

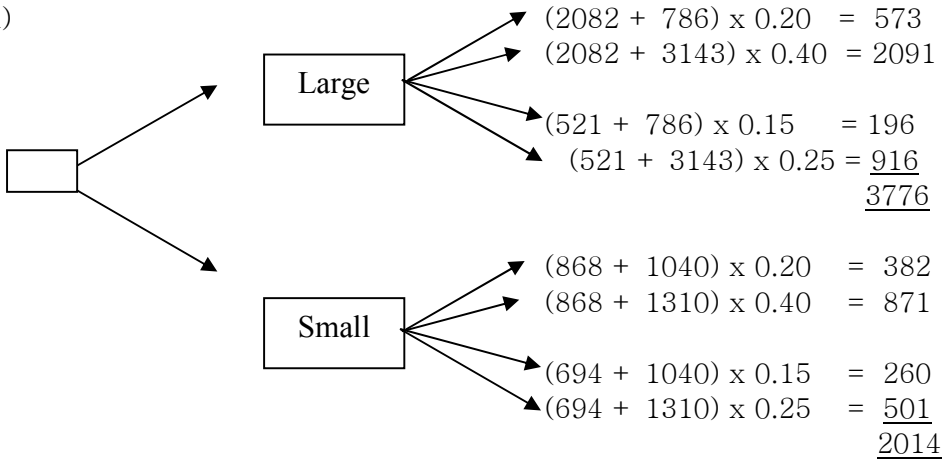
(b) evaluate the decision tree and advise management which plant, if either should be built. Apply each of the following criteria separately to

(i) maximize the net present value of the project
(ii) maximize the rate of return on capital.

(You are not required to calculate predicted rates of return, only to deduce which would be the higher.)

Answer

(i)



Decision Tree

(A decision tree Exhibits various outcomes of an act under various events)
Demand high for first 2 years, then fall to low level for next 4 years.

(i) Large Size = (2082 + 786) x 0.20 = 573.6
Small Size = (868 + 1040) x 0.20 = 382

(ii) Demand high for 2 years , high for next 4 years
Large Size = (2082 + 3143) x 0.40 = 2090
Small Size = (868 + 1310) x 0.40 = 871

(iii) Demand low for 2 yrs. & then remain at low level for 4 years
Large Size = (521 + 786) x 0.15 = 196.05
Small Size = (694 + 1040) x 0.15 = 260.10

(iv) Demand low for 2 yrs. & then high for 4 yrs.

Large Size = (521 + 3143) x .25 = 916
Small Size = (694 + 1310) x .25 = 501

Expected Cash Flow
Large Size Plant = 573.6 + 2090 + 196.05 + 916
= 3775.65
Small Size Plant = 381.60 + 871.2 + 260.10 + 501
= 2013.90

(ii) (a) Maximize NPV
N.P.V. of Large Size = 3775.65 – 3000 = 775.65 thousands
N.P.V. of Small Size = 2013.90 – 1400 = 613.90 thousands
Large Size Plant is recommended.

(b) Maximize the rate of return on Capital

We can have approximate idea about rate of return with the help of P.I.

P.I. of Large = $\frac{37,76,000}{30,00,000}$ = 1.2586

P.I. of small = $\frac{20,14,000}{14,00,000}$ = 1.43857

To Maximize rate of return, small is recommended.

Q. No. 55: Big Oil is wondering whether to drill for oil in Westchester Country. The prospects are as follows:

Depth of well (feet)	Total cost $ (Millions)	Cumulative Probability of finding oil	PV of Oil (if found) $ Millions
2,000	4	0.50	10
4,000	5	0.60	9
6,000	6	0.70	8

Draw a decision tree showing the successive drilling decisions to be made by Big Oil. How deep should it be prepared to drill?

(Nov. 2000) (8 Marks)

Answer

Up to 2000 ft.

	Oil	No oil	Exp. profit
Drill	6x.5	-4x.5	+ 1
No drill	--------	--------	-------

Drilling up to 2000 feet is recommended as the expected result of this alternative is + . (The expected result of not drilling alternative is zero)

2000-4000 ft.

Cum p of finding oil up to 4000 =

P of finding oil up to 2,000
+ (p of not finding oil up to 2000 x p of finding oil between 2000-4000)

0.60 = 0.50 + (0.50 x p of finding oil between 2000 -4000)

Solving equation, p of finding oil between 2000-4000 =0.20

Between 2000 - 4000 ft.

	Oil	No oil	Exp. profit
Drill	8x.2	-1x.8	+ 0.80
No drill	-------	--------	------

Drilling between 2000-4000 is recommended as the expected result of this alternative is + 0.80. (The expected result of not digging between 2000-4000 alternative is zero)

4000-6000 ft.

Cum p of finding oil up to 6000 =

Cum. P of find. Oil up to 4000
+ (cum. P of not finding oil up to 4000xp of finding oil between 4000-6000)

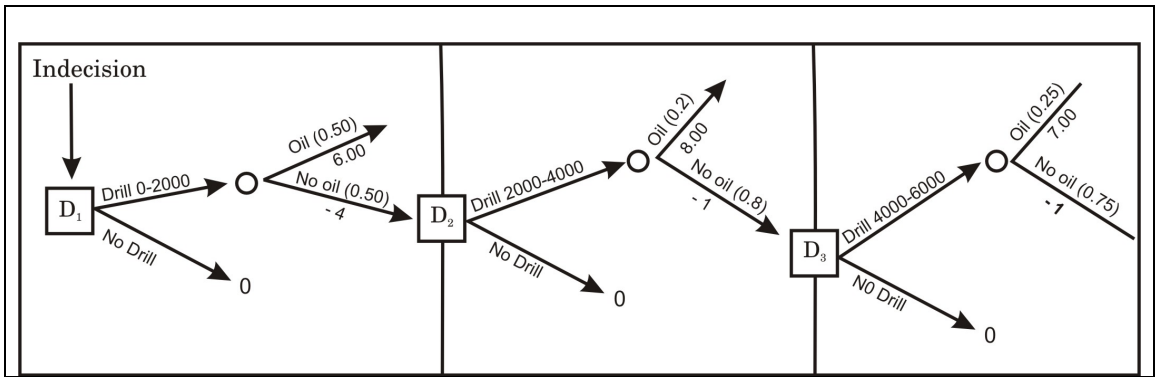
0.70 = 0.60 + (0.40 x p of finding oil between 4000 -6000)

Solving equation, p of finding oil between 4000-6000 =0.25

Between 4000 -6000 ft.

	Oil	No oil	Exp. profit
Drill	7x.25	-1x.75	+ 1.00
No drill	-------	--------	------

Drilling between 4000-6000 is recommended as the expected result of this alternative is + 1.00. (The expected result of not drilling between 4000-6000 alternative is zero)



[D_1 refers to the situation that we have to decide whether to drill up to 2000 feet or not.]

[D_2 refers to the situation that we have already drilled up to 2000, oil has not been found. Now we have to decide whether to drilled between 2000-4000 feet or not.]

[D_3 refers to the situation that we have already drilled up to 4000, oil has not been found. Now we have to decide whether to drill between 4000-6000 feet or not.]

Expected Result:

	D_1	D_2	D_3
Drilling :			
Oil	6 x 0.50	8 x 0.20	7 x 0.25
No oil	-4 x 0.50	-1 x 0.80	-1 x 0.75
Expected result	+ 1.00	+ 0.80	+ 1.00
No drilling :			
Expected result	0	0	0

Recommendation
(a) Drill up to 2,000; if oil found, no further drilling
(b) If no oil up to 2,000, drill between 2,000-4,000. If oil is found, no further drilling.
(c) If no oil up to 4,000, drill between 4000-6000.

Q. No. 56: A project requires Rs.100 Lakhs to invest. The present value of the cash inflows is Rs.140Lakhs if the project is successful; it will be only Rs.50L if the project is unsuccessful. The probability of being successful is 0.50. What is NPV? Suppose the project's Plant and Machinery can be sold for Rs.90L (without using the same) if the project is unsuccessful. What is the NPV? What is abandonment value of the Project?

Answer
NPV = -100L + 140L x 0.50 + 50L x 0.50 = -5L

Not required in the exam as answer to this question:

Rs. Lakhs	Rs. Lakhs		Rs. Lakhs
	NPV Estimate	Probability	Expected NPV Estimate
- 100 → successful → + 140	+ 40	0.50	+ 20
- 100 → unsuccessful → + 50	- 50	0.50	- 25
Expected NPV			- 5

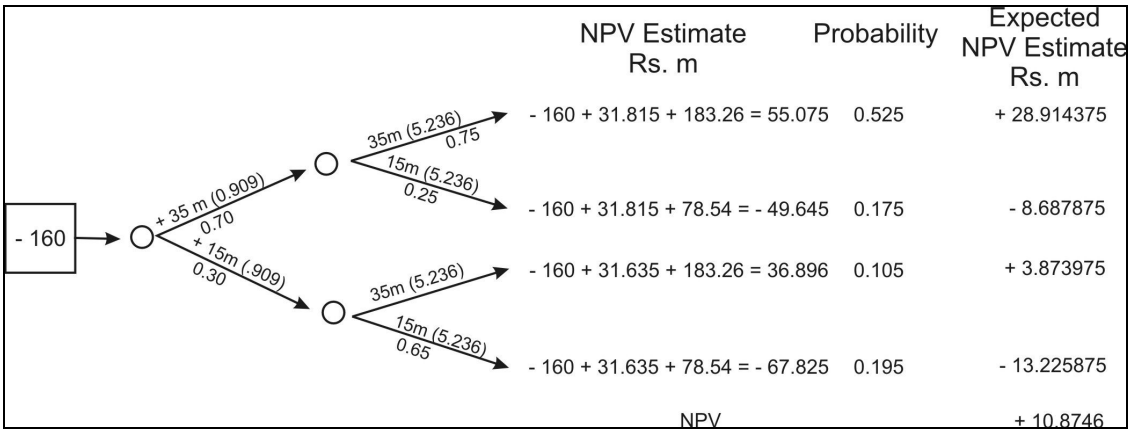
NPV = -100L + 140L x 0.50 + 90L x 0.50 = + 15L
Abandonment value = + 20L

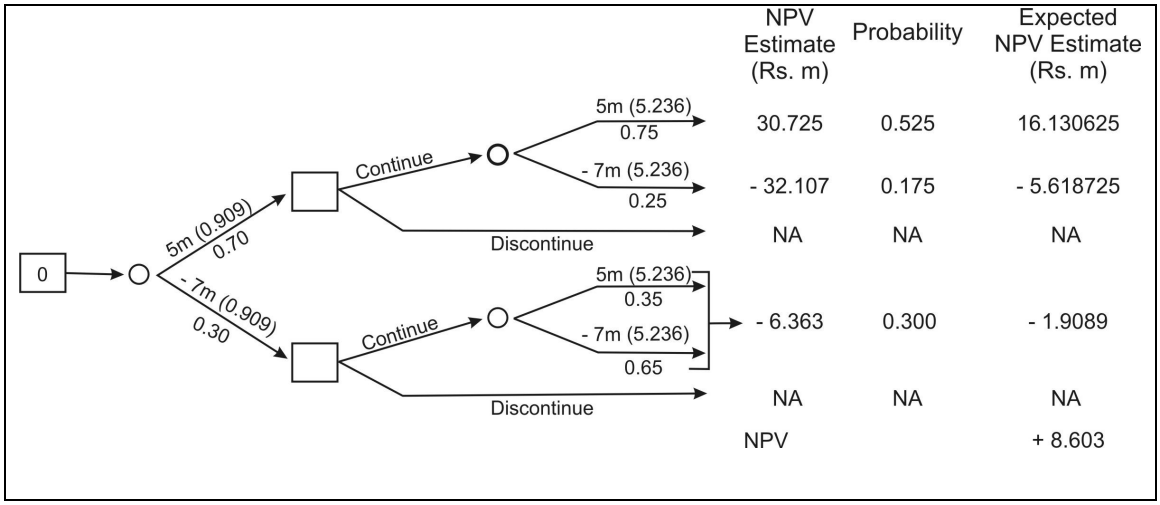
Q. No. 57: Baldev and Krishan are planning to start a new Audio-video recoding service studio. Their cost of capital is 10%. Annual cost of operating the studio is expected to be Rs.4Crores irrespective of demand. The annual revenue is expected to be Rs.7.50Crores if the demand is high; it will be only Rs.5.50Crores if the demand is low. The probability distribution of demand profile is as follows:

I Year →	High Demand↓		Low Demand↓	
	0.70		?	
Subsequent 9 years →	High Demand ↓	Low Demand ↓	High Demand ↓	Low Demand ↓
	?	0.25	0.35	?

The equipment required will cost Rs.16crores, life 10 years, no salvage value after its purchase.
Alternatively, it can be acquired on the basis of sharing 40% of the revenue. Advise. You may draw the decision tree diagram.

Answer





Q.. No. 58: You own an unused gold mine that will cost Rs.10,00,000 to reopen. If you open the mine, you expect to be able to extract 1000 ounces of gold a year for each of three years. After that the deposit will be exhausted. The gold price is currently Rs.5,000 an ounce, and each year the price is equally likely to rise or fall by Rs.500 from its level at the start of the year. The extraction cost is Rs.4,600 an ounce and the discount rate is 10%.

(a)Should you open the mine now or delay one year in the hope of a price rise.

(b) What difference would it make to your decision if you could costlessly (but irreversibly) shut down the mine at any stage? Show the value of abandonment option. **(Nov. 2004) (20 Marks)**

Answer : Working notes (a) Open Mine now:

Year 1

Price	Probability	Expected sales price
5,500	0.50	2750
4,500	0.50	2250
Expected price of Year 1 =		5000

Year 2

Price	Probability	Expected sales price
6,000	0.25	1,500
5,000	0.25	1,250
5,000	0.25	1,250
4,000	0.25	1,000
Expected price of year 2 =		5,000

Year 3

Price	Probability	Expected sales price
6500	0.125	812.50
5500	0.125	687.50
5500	0.125	687.50
5500	0.125	687.50
4500	0.125	562.50
4500	0.125	562.50
4500	0.125	562.50
3500	0.125	437.50
Expected price of year 3 =		5,000

(Expected sale price in each of 3 years : Price in the beginning of the project)

Delay 1 year:

If price after 1 year is Rs.5,500 :

The expected sale price of year 2, 3 and 4 will be Rs,5,500.

If price after 1 year is Rs.4,500 :

Expected sales price in year 2, 3 and 4 will be Rs.4,500

Main Answer (a)

Expected NPV if mine is opened now = -10,00,000 + (1000x400x2.487)

= -5200

Delay of 1 year :

If Price after 1 year is Rs.5,500

NPV = -10,00,000(.909) + (1,000x900x2.261) = 11,25,900

If Price after 1 year is Rs.4500

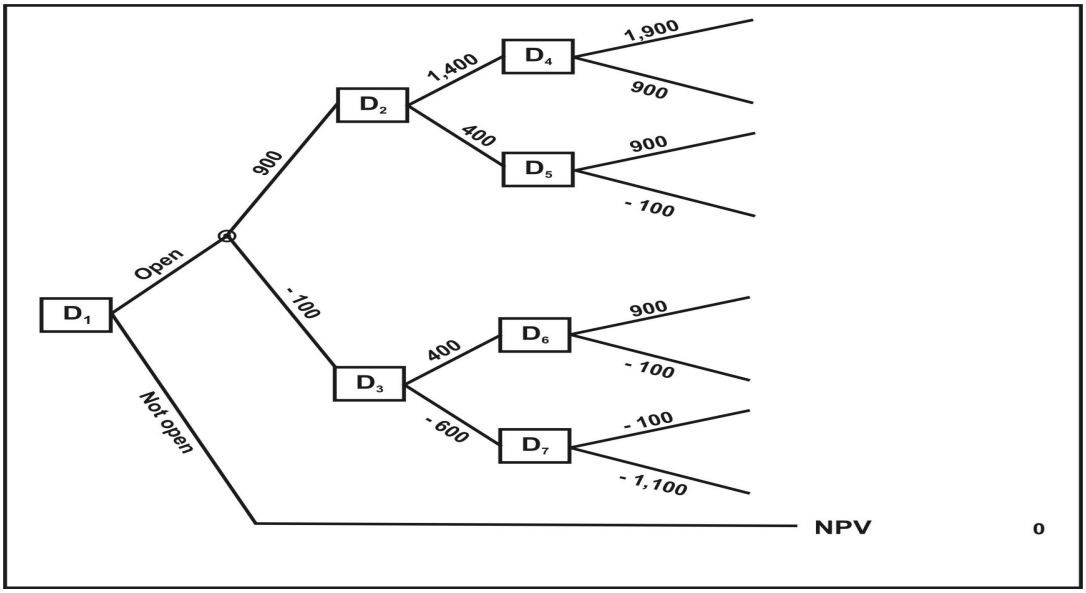
NPV is negative (the mine won't be opened)

Recommendation :

- Mine may not be opened now as NPV of this proposal is negative.
- Opening of mine may be delayed for 1 year
  - (i) it should be opened if the price in the first year is Rs.5,500.
  - (ii) It should not be opened if the price in the first year is Rs.4500

Answer (b)
WITH ABANDONMENT FACILITY

Opening the mine now



D_4 : Expected NPV Positive : No abandonment
D_5 ; Expected NPV Positive : No abandonment
D_6 ; Expected NPV Positive : No abandonment
D_7 : Expected NPV Negative: Abandon.
D_2 : Expected NPV Positive: No abandonment.
D_3: Expected value of cash flow :

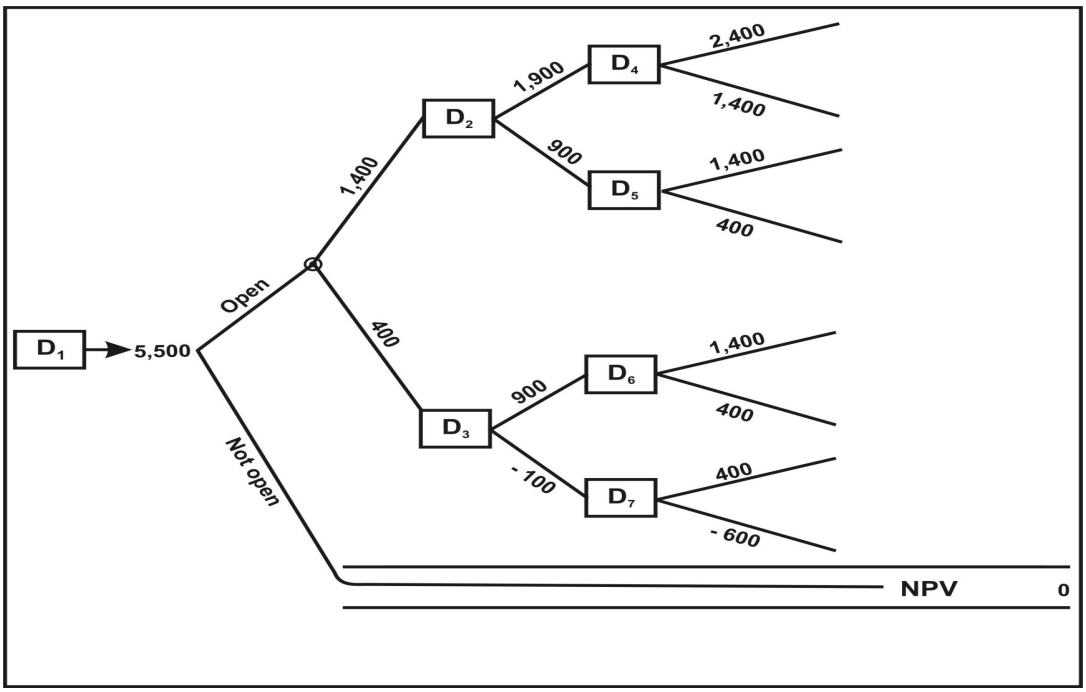
(400x0.826 + 900x0.751) x 0.25 = 252
(400x0.826-100x.751) x0.25 = 63.825
(-600x.826) x0.50 = - 247.80
---
68 Thousands

Expected NPV Positive : No abandonment

The project may be abandoned at the end of 2nd year of if the sales price during the 2nd year is Rs.4,000. The present value of savings on account of this abandonment facility is 1,200 x .125 x 0.751 i.e. 112.65 thousands
NPV without abandonment facility = - 5.20 thousands
NPV with abandonment facility = - 5.20 + 112.65 = 107.45 thousands

Delay the opening for 1 year

If Price after 1 year is Rs.5500



NPV without abandonment facility: 1125.90 thousands

Abandonment facility will avoid the loss of D_7.

This will increase the NPV by :

+ 400 thousands x 0.50 x 0.50 x 0.50 x 0.683

-600 thousands x 0.50 x 0.50 x 0.50 x 0.683 = 17.075 thousands

NPV with abandonment facility : 1142.975 thousands

If Price after 1 year is Rs.4500

NPV would be negative

Final Answer to part (b)

- Opening of mine may be delayed for 1 year and it should be opened if the price is Rs.5,500.
- Value of abandonment facility = 17.075 thousands

Q. No. 59 A firm has an investment proposal, requiring an outlay of Rs.40,000. The investment proposal is expected to have 2 years' economic life with no salvage value. In year I, there is a 0.4 probability that cash inflow after tax will be Rs.25,000 and 0.6 probability that cash inflow after tax will be Rs.30,000. The probabilities assigned to cash inflows after tax for the year II are as follows:

Cash inflow year I →	Rs.25,000		Rs.30,000	
	Cash inflow year II		Cash inflow year II	
	Amount	Probability	Amount	Probability
	Rs.12,000	0.20	Rs.20,000	0.40
	Rs.16,000	0.30	Rs.25,000	0.50
	Rs.22,000	0.50	Rs.30,000	0.10

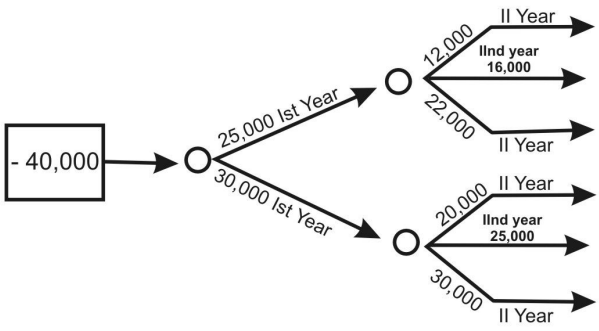
(a) Find the probability of Positive NPV. (b) Assuming that the outcomes are normally distributed, find the probability of Positive NPV. K_0 = 10%

Answer : (WORKING NOTE)

Possible event	
A	Rs.25000 in I Yr. & Rs.12000 in II yr.
B	Rs.25000 in I Yr. & Rs.16000 in II yr
C	Rs.25000 in I Yr. & Rs.22000 in II yr
D	Rs.30000 in I Yr. & Rs.20000 in II yr
E	Rs.30000 in I Yr. & Rs.25000 in II yr
F	Rs.30000 in I Yr. & Rs.30000 in II yr

Event	NPV estimate	Probability
A	(25000 X .909) + (12000 X .826) -40000 = -7363	(0.4 x 0.2) = .08
B	(25000 X .909) + (16000 X .826) -40000 = -4059	(0.4 x 0.3) = .12
C	(25000 X .909) + (22000 X .826) -40000 = + 897	(0.4 x 0.5) = .20
D	(30000 X .909) + (20000 X .826) -40000 = + 3790	(0.6 x 0.4) = .24
E	(30000 X .909) + (25000 X .826) -40000 = + 7920	(0.6 x 0.5) = .30
F	(30000 X .909) + (30000 X .826) -40000 = + 12050	(0.6 x 0.1) = .06

Not required from exam point of view.

Rs. Lakhs	NPV Estimate	Probability	Expected NPV Estimate
	- 7363 - 4059 + 897 + 3790 + 7920 + 12050	0.08 0.12 0.20 0.24 0.30 0.06	- 589 - 487 + 179 + 910 + 2376 + 723
	Expected NPV		+ 3112

(a) probability of Positive NPV = 0.80

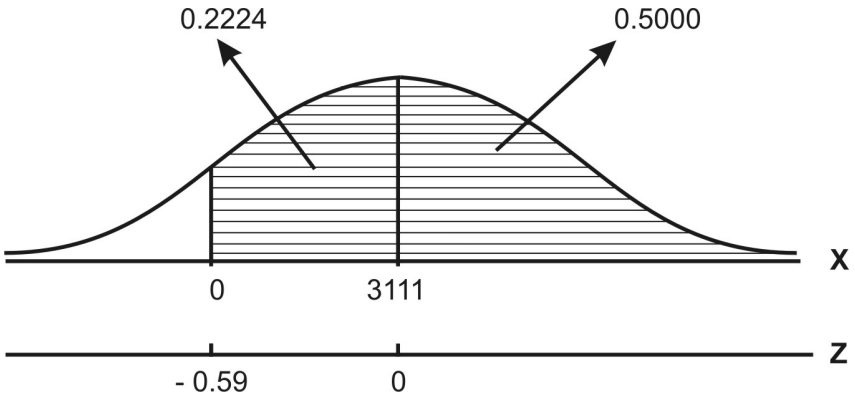
(b)

X	p	pX	x	px^2
-7363	0.08	-589	-10,474	87.76,374
-4059	0.12	-488	-7,170	61,69,068
+ 897	0.20	+ 179	-2214	9,80,359
+ 3790	0.24	+ 910	+ 679	1,10,650
+ 7920	0.30	+ 2,376	+ 4809	69,37,944
+ 12050	0.06	+ 723	+ 8939	47,94,343
		$\sum pX$= + 3,111		$\sum px^2$ =2,77,68,738

Mean = $\sum pX$ = 3,111

SD = $\sqrt{\sum px^2}$ = 5269.60

Z = (0 -3111) / 4713 = -0.59



The probability of Positive NPV = 0.7224

Risk Adjusted Discount Rate

This method of risk analysis adjusts the cost of capital upward as projects become riskier. Greater the risk, higher the adjusted discount rate, and therefore lower the project's risk-adjusted NPV. The difference between the risk-adjusted discount rate and risk-free discount rate is an index of the required risk premium. The critical problem, of course, is to decide by how much the risk-free discount rate should be increased to take care of risk. One way is that the finance manager decide it arbitrarily after giving the consideration to the probability of variation of actual results with the budgeted one. The other way, a better one, to decide the risk premium is to apply CAPM.

Once this rate is determined, the normal procedure of capital expenditure decision is followed.

Certainty Equivalent Approach

Under this approach, we multiply the cash flow estimates with certainty — equivalent coefficient (CEC) before discounting them by risk-free discount rate. CEC depends upon management's attitude towards risk. Suppose acceptance of a risky project is likely to result in 5 annual cash flows of Rs. 10,000 each. As it is a risky project, i.e., actual results may vary with the estimated ones, a smaller amount may be acceptable to the firm provided that there is no uncertainty. Suppose management is willing to accept Rs. 6,000 (certain amount) in place of Rs. 10,000 (uncertain amount). In that case CEC = 0.60.

$$CEC = \frac{\text{Certain cash flow}}{\text{Uncertain cash flow}}$$

Q. No.60: The Globe Manufacturing Company Ltd. is considering an investment in one of the two mutually exclusive proposals — Projects *X* and *Y*, which require cash outlays of Rs. 3,40,000 and Rs. 3,30,000 respectively. The certainty-equivalent (C.E.) approach is used in incorporating risk in capital budgeting decisions. The

current yield on government bond is 8 per cent and this be used as the risk-free rate. The expected net cash flows and their certainty-equivalents are as follows:

Year -end	Project X		Project Y	
	Cash flow (Rs)	CE	Cash flow (Rs.)	CE
1	1,80,000	0.80	1,80,000	0.90
2	2,00,000	0.70	1,80,000	0.80
3	2,00,000	0.50	2,00,000	0.70

Present value factor of Re. 1 discounted at 8 per cent at the end of year 1, 2 and 3 are 0.926, 0.857 and 0.794 respectively.

(i) Which project should be accepted?

(ii) If risk adjusted discount rate method is used, which project would be analyzed with a higher rate? **(November 1999) (6 Marks)**

Answer

(i) NPV of Project X

= [(1,80,000 x 0.8 x 0.926)+ (2,00,000 x 0.7 x 0.857)
+ (2,00,000 x 0.5 x 0.794)] – 3,40,000 = -7,276

Similarly, NPV of Y = 54,580

Y may be accepted.

(ii)There is less certainty in case of X. Less the certainty means more uncertainty i.e. more risk. Hence, if risk adjusted rate method is used, higher risk adjusted rate should be applied for X.

Q. No. 61 :The XXX company uses a certainty – equivalent approach in its evaluation its risky investment. Currently company is considering an investment, details given below.

Year	Cash flows (in Rs. '000)	CE
0	-45	1.00
1	24	095
2	27	0.90
3	30	0.55

If the after-tax free rate is 4%, find NPV. If the firm were to use risk-adjusted discount rate instead of certainty equivalent approach, what risk- adjusted rate would be used in order to obtain an equivalent solution.

Answer

NPV of the Proposal

$= -45 + [24 \text{ X } 0.95 \text{ X } (1/1.04)] + [27 \text{ X } 0.90 \text{ X } (1/1.04)^2] +$
$[30 \text{ X } 0.55 \text{ X } (1/1.04)^3]$
$= 14.08$

We have to find the discount rate at which NPV of the proposal is 14.08.

We want that NPV of the proposal should be 14.08.

Putting the above facts in figures, we have to find the discounting rate of PVFs of the following equation:

$$-45 + (24 \times PVF1 + 27 \times PVF2 + 30 \times PVF3) = 14.08$$

- Putting the above facts in figures in a different way, we have to find the discounting rate of PVFs of the following equation:

$$-59.08 + (24 \times PVF1 + 27 \times PVF2 + 30 \times PVF3) = 0$$

This situation is similar to the situation in which investment is 59.08 and NPV is 0.

In other words, we have to find IRR assuming that investment is 59.08

- Fake PBP = 59.08/27 = 2.188
- Consulting the annuity table we find app. IRR = 18%
- NPV at 18% = -59.08 + (24x0.847) + (27x0.718) + (30x0.609)
  = -1.096

As NPV is negative the other rate should be lower. The amount of negative NPV is quite small, so difference between the two rates may be quite small. Hence, the other rate may be taken as 16%.

NPV at 16 % = -59.08 + (24x0.862) + (27x0.743) + (30x0.641) = + 0.899

$$IRR = 16 + \frac{0.899}{0.899 - (-1.096)} \times 2 = 16.90$$

Q. NO. 62: A project is expected to generate cash inflows of Rs.1,10,000 in the first year and Rs.1,21,000 in the second year. Risk free rate of return is 5%. Expected risk premium on the market is 10%. The beta of the project is 0.50. The project is being evaluated on the basis of risk-adjusted discount rate. What should be the certainty- equivalent- coefficients of each of the two years so as to give the same NPV as is given by Risk-Adjusted Discount method?

Answer

Required rate of return : 5 + 0.50(10) = 10%

Under certainty -equivalent method, the cash flows are discounted at risk free rate of return.

Period	PV at 10%	PV under CE approach	CEC
1	1,10,000 x 0.909 =99,990	1,10,000 x CEC x 0.952	1,10,000 x CEC x 0.952 = 99,990 CEC = 0.9548
2	1,21,000 x 0.826 =99,946	1,21,000 x CEC x 0.907	1,21,000 x CEC x 0.907 = 99,946 CEC = 0.9107

SENSITIVITY ANALYSIS

The five important determinants of NPV, besides some others, are:

(i) Selling price
(ii) sales quantity
(iii) cash cost
(iv) cost of capital, and
(v) Amount of investment.

Sensitivity analysis is a tool to measure the risk surrounding a capital expenditure project. The analysis measures how responsive/sensitive the project's NPV is to change in the variables that determine NPV.

This analysis is carried on the projects reporting positive Net Present Values. It requires the calculation of % change, in value of each determinant of the NPV that may reduce the NPV to zero. These percentages are put in ascending order. The item corresponding to minimum change is considered to be most sensitive / risky. The concept of the sensitivity suggests that management should pay maximum attention to this item as small adverse change in this item may result in big unfavorable results. Sensitivity analysis therefore provides an indication of why a project might fail.

Critics of this concept opine that the management should not pay maximum attention towards most sensitive item, rather they should pay maximum attention to wards the item where there is highest probability of adverse change.

Q. No. 63: Vanshu Ltd. is considering a project, the details are as follows. Cost of project: Rs.2,00,000. Life of the project is 3 years. Scrap value is expected to be Rs.5000. Annual expected sale 1000 units @ Rs.300. Unit variable cost Rs.200. Cost of capital 16%. Ignore tax. Perform sensitivity Analysis.

Answer

(i) Cost of project: Let cost of project = x

- x + 1,00,000 (2.246) + 5,000(0.641) = 0

x = 2,27,805

% sensivity : (27805/2,00,000) x 100 = 13.90%

(ii) Sales volume :

Let sales volume = x

-2,00,000 + 100x(2.246) + 5000(0,641) = 0

x= 876

% Sensivity = (124/1000) x 100 = 12.40%

(iii) Unit cost;

Let unit cost = x

-2,00,000 + (300 -x)(1000)(2.246) + 5000(0.641)

x= 212.38

% sensitivity = (12.38/200) x 100 = 6.19%

(iv) Selling price

Let selling price = x

- 2,00,000 + 1,000(x-200)(2.246) + 5,000(0.641) = 0

X = 287.62

% Sensitivity = (12.38/300) x 100 = 4.12%

(v)Discounting rate :

Average cash flow = (1,00,000 + 1,00,000 + 1,05,000) / 3 = 1,01,667

Fake payback period = 2,00,000 / 1,01,667 = 1.97

Approximate IRR = 24%

NPV at 24% = -2,00,000 + 1,00,000 x 1.981 + 5,000 x 0.524 = + 720

NPV at 25% = -2,00,000 + 1,00,000 x 1.952 + 5,000 x 0.512 = -2,240

$$\text{IRR} = 24 + \frac{720}{720 - (-2240)} \times 1 = 24.24\ \%$$

% Sensitivity = (8.24 / 16) x 100 = 51.50 %

Sensitivity Analysis

Factor affecting NPV	% change leading to zero NPV
Selling price	4.12
Unit cost	6.19
Sales volume	12.40
Cost of project	13.90
Discounting rate	51.50

As per Sensitivity Analysis approach, the management should pay maximum attention towards SP (as even a small decline of 4.12% will result in zero NPV i.e. a small decline of slightly above 4.12% will make the project unviable), followed by unit cost, then followed by sales volume, then by cost of project and then finally by discounting rate.

Q. No. 64: XYZ Ltd is considering a project. The following estimates are available:

Sales volume I II III	 20,000 Units 30,000 Units 30,000 Units
Initial cost of the project	Rs.10,00,000
Selling price /unit	Rs.60
Cost / unit	Rs.40

You are required to measure the sensitivity of the project in relation to each of the following parameters: (i) Sales price / unit (ii) unit cost (iii) sales Volume (iv) Initial outlay (v) Project life. Ignore tax. Discount rate 10%. **(May, 2007) (16 marks)**

Answer (i) **Selling price** Let selling price = x

- 10,00,000 + 20,000(x-40)(0.909) + 30,000(x-40)(0.826) + 30,000(x-40)(0.751) = 0
  x = Rs.55.26
  % Sensitivity = (4.74/60) x 100 = 7.90%

(ii) **Unit cost**

Let unit cost = x

- 10,00,000 + 20,000(60-x)(0.909) + 30,000(60-x)(0.826) + 30,000(60-x)(0.751) = 0

x = Rs.4.74

% Sensitivity = (4.74/40) x 100 = 11.85%

(iii) **Sales volume**

Let the sales volume of first year = 2x
Let the sales volume of second year = 3x
Let the sales volume of third year = 3x

- 10,00,000 + 2x(60-40)(0.909) + 3x(60-40)(0.826) + 3x(60-40)(0.751) = 0

x= 7,635 2x = 15,270

% Sensitivity = (4,730 / 20,000) x 100 = 23.65 %

(iv) **Initial outlay**

Let the initial outlay = x

- x + 20,000(60-40)(0.909) + 30,000(60-40)(0.826) + 30,000(60-40)(0.751) = 0

x= 13,09,800

% Sensitivity = (3,09,800 / 10,00,000) x 100 = 30.98 %

(v) **Life of project**

NPV for 2 years	NPV for 3 years
-10,00,000 + 4,00,000 x 0.909 + 6,00,000 x 0.826 = -140,800	-10,00,000 + 4,00,000 x 0.909 + 6,00,000 x 0.826 + 6,00,000 x 0.751 = + 3,09,800

NPV increases by 4,50,600, when life of the project increases by 1 year

NPV increases by 1, when life of the project increases by 1/450600 year

NPV increases by 140800, when life of project increases by

(1/450600) x 140800 i.e. by 0.3125 year

Life of project for zero NPV = 2.3125 years

% Sensitivity = (0.6875 / 3) x 100 = 22.92%

Sensitivity Analysis

Factor affecting NPV	% change leading to zero NPV
Selling price	7.90
Unit cost	11.85
Life of project	22.92
Sales volume	23.65
Cost of project	30.98

As per Sensitivity Analysis approach, the management should pay maximum attention towards SP (as even a small decline of 7.90% will result in zero NPV i.e. a small decline of slightly above 7.90% will make the project unviable), followed by unit cost, then followed by life of project, then by sales volume and then finally by cost of project.

Q. No. 65: From th following details relating to a project, anlyze the sensitivity of the project to changes in project cost, annual cash and cost of capital:
Initial cost = Rs. 1,20,000
Annual cash flow Rs. 45,000
Life of the project 4 years
Cost of capital = 10%
To which of the three factors, the project is most sensitive? (use annuity factors :for 10% …3.169 and 11% … 3.109)factor **(NOV 2009)**

Answer

(i) Cost of project: Let cost of project = x

- x + 45,000 (3.169) = 0

x = 142605

% sensitivity : (22605/1,20,000) x 100 = 18.8375%

(ii) Annual cash flows : Let annual cash flow = x

- 1,20,000 + x (3.169) = 0

x = 37,867

% sensitivity : [(45000-37867)/45000] x 100 = 15.8511%

(iii)Cost of capital :

Payback period = 120000/45000 = 2.667

Annuity at 10 % = 3.169

Annuity at 11 % = 3.109

RHS decreases by 0.060, LHS increases by 1%

RHS decreases by 1, LHS increases by 1/0.06 i.e 16.67%

RHS increase by 0.502, LHS increases by 16.67 x 0.502 i.e. 8.368%

Rough estimate is that annuity at 18.368 % for 4 years is 2.667

This is an indication that IRR is about 18%

NPV at 18% : -1,20,000 + 45000(2.69) = + 1050

NPV at 20% : -1,20,000 + 45000(2.589) = -3495

$$\text{IRR} = 18 + \frac{1050}{1050 - (-3495)} \times 2 = 18.46\ \%$$

% Sensitivity = (8.46 / 10) x 100 = 84.60 %

Annual cash flow is most sensitive factor. As per Sensitivity Analysis approach, the management should pay maximum attention towards annual cash flow (as even a small decline of 15.8511% will result in zero NPV i.e. a small decline of slightly above 15.8511% will make the project unviable,

ACCOUNTING RATE OF RETURN

Q. No. 66 The Progressive Co. Ltd. decide to increase its productive capacity to meet an anticipated increase in demand for its products. The extent of this increase in capacity has still to be determined and a management meeting has been called to decide which of the following two mutually exclusive proposals *I* and *II* should be undertaken. On the basis of the information given below, you are required to (ignoring tax):

(a) Evaluate the profitability of each of the proposals and

(b) On the assumption of cost of capital of 8 per cent, suggest the proposal to be undertaken.

	I (*Rs*).	*II* (*Rs*.)
Buildings	50,000	1,00,000
Plant	2,00,000	3,00,000
Installation	10,000	15,000
Working capital	50,000	65,000
Net income-annual-pre-depreciation Profits (Note i)	70,000	95,000
Other relevant income/expenditure:		
Sales promotion (Note ii)	—	—
Plant, scrap value	10,000	15,000
Building disposable value (Note ii)	30,000	60,000

Note :(i) The investment life is 10 years.

(ii) As exceptional amount of expenditure on sales promotion of Rs. 15,000 will required to be spend in year 2 on proposal II. This has not been taken into account in calculating pre-depreciation profits.

(iii) It is not the intention to dispose of the buildings in ten years, however, it is company policy to take a national figure into account for a project evaluation proposes.

Answer

I Proposal

(a) Profitability (ARR) $= \frac{70,000 - 22,000}{3,10,000} \times 100 = 15.48\ \%$

II Proposal

Average annual profit

= [10 years profit – special advertising – Dep. for 10 years] /10

[9,50,000 – 15,000 – 3,40,000] / 10 = 59,500

Profitability (ARR) = [59500 / 4,80,000] x 100 = 12.40 %

On the basis of profitability, 1st Project is recommended.

(b) DCF Analysis of each of two proposals (Discounting @ 8%)

	Period	PVF/AF	I		II	
			C.F.	P.V.	C.F.	P.V.
Investment	0	1	- 3,10,000	- 3,10,000	- 4,80,000	- 4,80,000
Cash in Flow	1	0.9259	+ 70,000	64,813	+ 95,000	+ 87,961
Cash in Flow	2	0.8573	+ 70,000	60,011	+ 80,000	+ 68,584
Cash in Flow	3-10	4.9268	+ 70,000	3,44,876	+ 95,000	+ 4,68,046
Scrap & reversal of W. Cap.	10	0.4632	+ 90,000	41,688	+ 1,40,000	+ 64,848
			NPV	+ 2,01,388		+ 2,09,439

On the Basis of NPV, II Project is recommended.

Overall Recommendation: - The Company may go for II Project as the decisions based on NPV are more reliable because of consideration of time value of money. (Tax is ignored in (b) part also to make the alternatives comparable.)

Q. No. 67 : An automatic ancillary unit is proposing to set-up a manufacturing establishment whose project cost is Rs.320 lakh. The cost of land building included in the project cost is Rs.40Lakh, whose break-up is as follows:

Land (4,400 sq. yards) Rs.15 lakh

Building (area 25,000 sq. ft.) Rs.25 lakh

It is anticipated that in the first 4 years profitability will be low due to time required for cultivating the market. To meet the situation management is planning to hire factory premises of the same size at Re. 0.80 per square foot per month for the first four years, instead of own buildings. Repairs and maintenance, taxes, etc., to be borne by the landlord.

In the present project, provision has been made for depreciation at 7 per cent p.a. on original cost of buildings. Provision has also been made for repairs, maintenance taxes, etc., on buildings at Rs. 1,20,000 p.a.

The annual sales and profit figures are projected in the project report are as follows:

Year	*Sales* (*Rs. lakh*)	*Net Profit* (*Rs. lakh*)	*Capacity Utilization*
I Year	200	(- 5)	60%
II Year	275	5	75%
III Year	350	10	90%
IV Year	450	20	100%

After the fourth year the profit is expected to be steady at Rs. 40 lakh per annum. Institutional finance is available up to 200 lakh under both alternatives.

(a) You are required to work out the average rate of return for the first four years on shareholders' initial investment under both alternatives.

(b) If the lease is available for 4 years only, would you recommend leasing the premises if it is anticipated that the cost of land will increase by 40 per cent and cost of construction by 20 per cent at the end of the four-year period? For this purpose, opportunity cost of finance may be taken at 10 per cent p.a.

Answer

(a) Change in Annual Profit on account of lease

= – 2,40,000 (Rent)
+ 1,75,000 (Savings of Depreciation)
+ 1,20,000 (Repairs & Maintenance)
= 55,000

	Own	Lease
Rate of return on shareholders fund	(Average profit/ shareholders fund) X 100 =[7.50/120]x100= 6.25%	(Average profit/ shareholders fund) X 100 = [8.05/80] x100 = 10.0625 %

(b) PV of cost of Construction of building now = Rs.40,00,000.

P.V. of cost of construction of building after 4 years

= [21,00,000 + 30,00,000] x 0.683 + [1,20,000 x 3.1699]

= Rs.38,63,688.00

Building may be Constructed after 4 years.

CPM, PERT AND SIMULATION MODEL

CRITICAL PATH METHOD (CPM)

The CPM is a technique for:

- analyzing,
- planning, and
- scheduling large complex projects.
- The technique can be applied only if the project can be divided into a number of well defined activities. (An activity is a specific task. It gets something done).

A project consists of different types of activities. Start activity is one which does not have any preceding activity. Finish or terminal activity is one which does not have any succeeding activity. CPM is used to coordinate and schedule the sequential activities of a project.

It presents the activities and events (The term event here means beginning or end of an activity) of a project as a net work. Net work graphically presents the how each activity is related to the others. When all the activities are connected with each other in a logical manner, it gives rise to a net work.

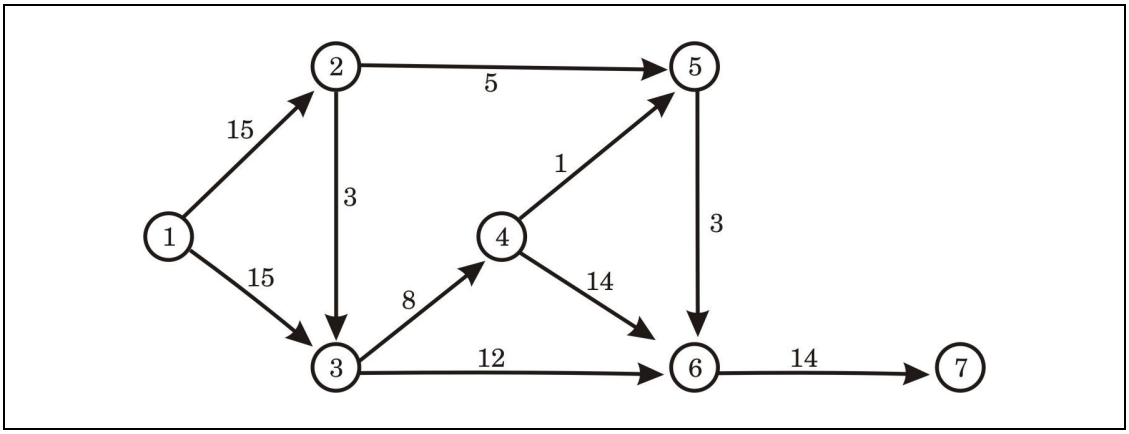
The network is drawn using the NODE –ARC principle. Nodes are circles indicating either the start of an activity or finish of an activity or start of one activity and finish of the other activity. A line joining any two nodes is called as ARC and each ARC represents a given activity on the net work.

The longest path through the net work is known as critical path (It is the minimum time required to complete the project). Activities that lie along the critical path cannot be delayed without delaying the finishing time for the entire project.

- Because of its impact on the entire project, critical path analysis is an important aspect of project planning.

Q. No.68

Activity	1-2	1-3	2-3	2-5	3-4	3-6	4-5	4-6	5-6	6-7
Duration	15	15	3	5	8	12	1	14	3	14



Paths:

Path	Duration
1-2-5-6-7	15 + 5 + 3 + 14 = 37
1-3-6-7	15 + 12 + 14 = 41
1-2-3-4-5-6-7	15+ 3 + 8 + 1 + 3 + 14 = 44
1-3-4-6-7	15 + 8 + 14 + 14 = 51
1-3-4-5-6-7	15 + 8 + 1+ 3 + 14 = 41
1-2-3-6-7	15 + 3 + 12 + 14 = 44
1-2-3-4-6-7	15 + 3 + 8 + 14 + 14 = 54

Critical path : 1-2-3-4-6-7

PERT

Programme Evaluation and review technique This technique is used when the durations of the activities are uncertain. Average duration or expected duration of the each activity is calculated on the basis of weighted mean of the optimistic, pessimistic and most likely estimated time; weights being 1, 1 and 4 respectively. SD of duration of each activity = (pessimistic time –optimistic time) / 6. SD of the critical path is square root of sum of variances of all the activities on the critical path. (The calculation of mean and SD are based on what is described as Beta Distribution in Statistics.)

Q. No.69

A small project is composed of 7 activities whose time estimates are listed below:

Activity	Optimum duration in weeks	Most likely duration in weeks	Pessimistic duration in weeks
1-2	1	1	7
1-3	1	4	7
1-4	2	2	8
2-5	1	1	1
3-5	2	5	14
4-6	2	5	8
5-6	3	6	15

Draw project net work. Find expected duration and variance of each activity. What is the expected time of completion of the project? Calculate SD of the project length. What is probability of project being at least three weeks before the expected date of completion? What is the probability of the project being completed not more than 3 weeks of expected completion date?

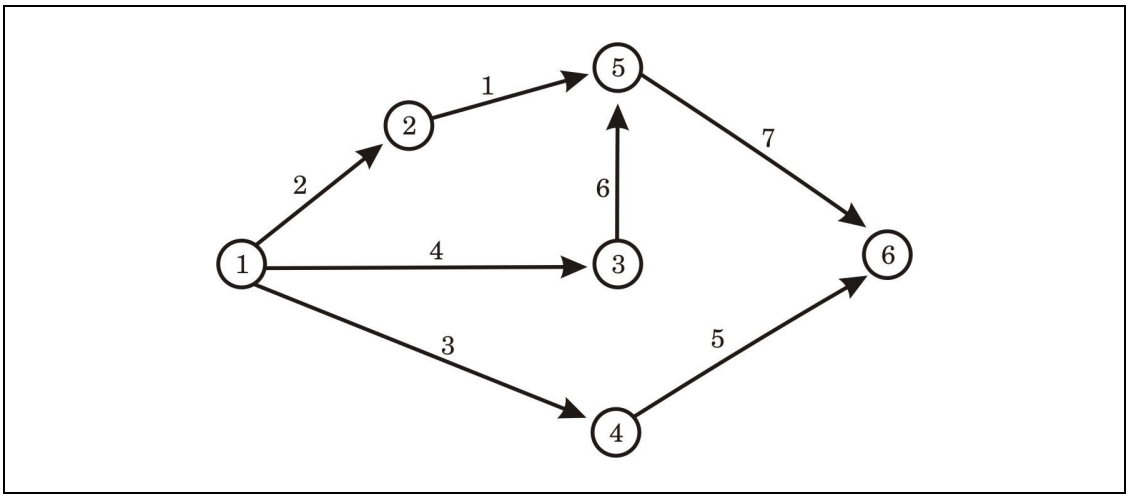
Answer

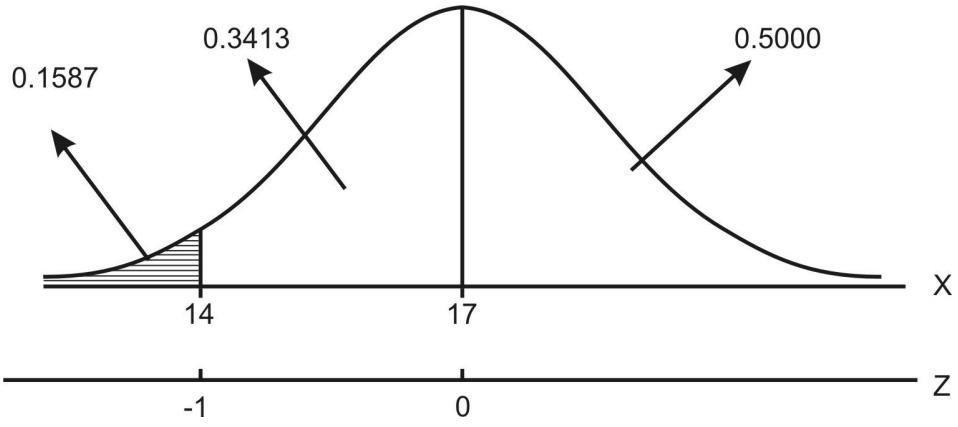
Activity	Optimum duration in weeks	Most likely duration in weeks	Pessimistic duration in weeks	Expected duration of activity	Variance of activity
1-2	1	1	7	2	1
1-3	1	4	7	4	1
1-4	2	2	8	3	1
2-5	1	1	1	1	0
3-5	2	5	14	6	4
4-6	2	5	8	5	1
5-6	3	6	15	7	4

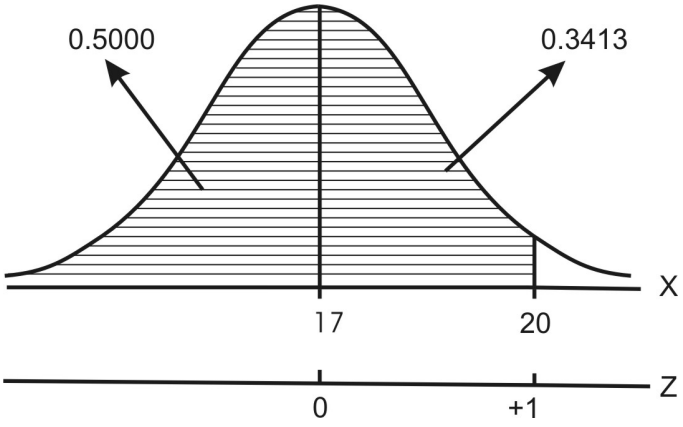
Path	Duration
1-2-5-6	2 + 1+ 7 = 10
1-3-5-6	4 + 6+ 7 = 17
1-4-6	3 + 5 = 8

Expected time of completion of the project = 17 weeks

SD of the project : 3







SIMULATION / HERTZ MODEL

- Simulation is a mathematical technique which is used to predict the expected outcome when several outcomes are possible.
- The technique is based on random number. (A set of numbers is said to be random number when the probability of its selection is equal to the probability of selection of any other number i.e. the set of number is said to be random when the probability of selection of all members is equal).
- For business applications, Monte Carlo simulation is which is based on probabilities. Hertz used it for evaluation of risky investment decisions by calculating average of various possible returns. (Hertz's capital budgeting model) Hertz suggested that simulation can be used to estimate return on capital employed on a proposed project facing various uncertainties.

There are three steps in his model (i) Estimate various possible factors affecting the return on CE, also estimate their probabilities (ii) Calculate ROCE on the basis of various factors using random numbers. Taking the help of computer this trial may be repeated for a very large number of times. (iii) The average return obtained for all these trials is considered as possible ROCE under his mode.

Q. No.70: Frontier Bakery keeps stock of a particular brand of cake. Daily demand based on past experience is as given below:
Experience indicates:

Daily demand	0	15	25	35	45	50
Probability	0.01	0.15	0.20	0.50	0.12	0.02

Consider the sequence of random number:
48, 78, 09, 51, 56, 77, 15, 14, 68, 09
Using the sequence, simulate the demand for the next 10 days.

Answer

Daily demand	Probability	Cum. Probability	Cumulative probability range	Random no. adjusted cumulative probability range
0	0.01	0.01	0-0.01	0-0
15	0.15	0.16	0.01-0.16	0.01-0.15
25	0.20	0.36	0.16-0.36	0.16-0.35
35	0.50	0.86	0.36-0.86	0.36-0.85
45	0.12	0.98	0.86-0.98	0/86-0.97
50	0.02	1.00	0.98-1.00	0.98-0.99

Simulation of demand for next 10 days

	Demand
1	35
2	35
3	15
4	35
5	35
6	35
7	15
8	15
9	35
10	15

Q. No.71: A company manufactures around 200 mopeds. Depending upon the availability of raw materials and other conditions, the daily production has been varying from 196 mopeds to 204 mopeds, whose probability distribution is as given below:

Production per day	Probability
196	0.05
197	0.09
198	0.12
199	0.14
200	0.20
201	0.15
202	0.11
203	0.08
204	0.06

The finished mopeds are transported in a specially designed three storey lorry that can accommodate only 200 mopeds. Using the following 15 random numbers 82, 89,78,24,53,61,18,45,04,23,50,77,27,54,10, simulate the process to find out : what will be average number of mopeds waiting in the factory?

Answer

Production per day	Probability	Cum. Probability	Cumulative probability range	Random no. adjusted cumulative probability range
196	0.05	0.05	0-0.05	0 - 0.04
197	0.09	0.14	0.05-0.14	0.05-0.13
198	0.12	0.26	0.14-0.26	0.14-0.25
199	0.14	0.40	0.26-0.40	0.26-0.39
200	0.20	0.60	0.40-0.60	0.40-0.59
201	0.15	0.75	0.60-0.75	0.60-0.74
202	0.11	0.86	0.75-0.86	0.75-0.85
203	0.08	0.94	0.86-0.94	0.86-0.93
204	0.06	1.00	0.94-1.00	0.94- 0.99

Day	Production	Dispatch	Stock
1	202	200	2
2	203	200	5
3	202	200	7
4	198	200	5
5	200	200	5
6	201	200	6
7	197	200	3
8	200	200	3
9	196	199	0
10	198	198	0
11	200	200	0
12	202	200	2
13	199	200	1
14	200	200	1
15	197	198	0
Total			40

Average No. of moped waiting for transportation: 2.67

HERTZ MODEL

The object of the model is to estimate the rate return on investments when various uncertainties are their.

Steps

(i) identify the factors affecting the return on investment. For example, these factors are investment, demand and profit per unit.

(ii) Determine the probability distribution of above identified factors.

(iii) Estimate demand, profit per unit and investment using respective random numbers for each of these factors (The technique suggested here is referred as Simulation[6]). Repeat this trial for a very large number of times. Hertz suggested use of computer for this purpose so that the number of trials is very large.

(iv) The average of returns obtained in the preceding step is the likely ROI as Hertz Model.

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[6] Simulation is a mathematical technique which is used to predict the expected outcome when several outcomes are possible. The technique is based on random number. (A set of numbers is said to be random number when the probability of its selection is equal to the probability of selection of any other number i.e. the a set of number is said to be random when the probability of selection of all members is equal). For business applications, Monte Carlo simulation is which is based on probabilities.

Q. No.72: XYZ Co. Ltd. evaluates the investment proposals on the basis of three factors: demand, profit per unit and required amount of investment. The data for a proposal under the consideration of its Board are given below:

Annual demand (Kgms.)	Probability
20,000	0.10
30,000	0.20
40,000	0.14
45,000	0.16
50,000	0.10
55,000	0.25
70,000	0.05

Profit per Kgm :	Probability
10	0.25
20	0.15
30	0.10
40	0.20
50	0.15
60	0.10
70	0.05

Investment :	Probability
20,00,000	0.30
30,00,000	0.40
50,00,000	0.30

Using simulation process, repeat the trial 10 times, compute the ROI for each trial and the average ROI. Use the following random numbers:

Demand 67, 63, 39, 55, 29, 78, 70, 06, 78, 76
Profit per unit 28, 57, 60, 17, 64, 20, 27, 58, 61, and 30
Investment 76, 78, 06, 70, 78, 29, 55, 39, 63, 67

Answer

Cumulative probability range Table

Daily Demand	Random no. adjusted cumulative probability range	Profit per kgm	Random no. adjusted cumulative probability range	Investment	Random no. adjusted cumulative probability range
20,000	0-0.09	10	0-0.24	20,00,000	0 – 0.29
30,000	0.10-0.29	20	0.25-0.39	30,00,000	0.30-0.69
40,000	0.30-0.43	30	0.40-0.49	50,00,000	0.70-0.99
45,000	0.44-0.59	40	0.50-0.69		
50,000	0.60-0.69	50	0.70-0.84		
55,000	0.70-0.94	60	0.85-0.94		
70,000	0.95-0.99	70	0.95-0.99		

Statement showing ROCE under various trials

Trial	Demand	Profit per Kgm	Investment	ROCE
1	50,000	20	50L	20.00%
2	50,000	40	50L	40.00%
3	40,000	40	20L	80.00%
4	45,000	10	50L	9.00%
5	30,000	40	50L	24.00%
6	55,000	10	20L	27.50%
7	55,000	20	30L	36.67%
8	20,000	40	30L	26.67%
9	55,000	40	30L	73.33%
10	55,000	20	30L	36.67%
Average return on CE				37.38%

MUTUAL EXCLUSIVE PROJECTS

Mutually exclusive projects exist where the acceptance of one project excludes the acceptance of another project. Sometimes, the task of choosing one of these projects becomes difficult for finance manager because NPV and IRR may give contradictory rankings. The conditions under which contradictory ranking can occur are: (i) Size disparity, (ii) Time disparity and (iii) Life disparity.

Size Disparity

If the initial investments of the two projects are different, NPV and IRR may give different rankings.

Example: Cost of capital 10 per cent.

Projects	*Initial*	*Year End Cash Flows*			*NPV*	*IRR*
	Invest.	*I Yr.*	*II Yr.*	*III Yr.*		
A	7,000	3,430	3,430	3,430	1,530	22
B	12,000	5,520	5,520	5,520	1,728	18

Project *B* has larger NPV, project *A* has higher IRR which project would you recommend? The answer is *B* because choosing *B* adds more wealth to the firm. As the goal of finance manager is to maximize the wealth of the firm, he should follow NPV whenever there is a conflict between NPV and IRR. In other words, when NPV and IRR give different rankings on account of size of disparity, we should go for NPV because as the objective is to maximize the firm's wealth, NPV provides correct measure. (NPV of a project is defined as the amount by which firm's wealth will increase on implementation of the project.)

[In case of capital rationing with divisible projects, net PI is considered better than even NPV (refer Capital Rationing)].

For better understanding of the size disparity, let's have another example. A person has two M.E. investment opportunities. Under the first, he invest Re. 1 today, he will get Rs.2 tomorrow, i.e., a return of 100 per cent in one day. Under second, if he

invests Rs.1,000 today, he gets Rs.1,200 tomorrow, i.e., a return of 20 per cent in one day. He has enough funds for investments. Which project should he select? The answer is quite obvious, i.e., *B* because by doing so he shall be adding to Rs 200 to his wealth in spite of lower rate of return.

Time Disparity

Sometimes contradictory rankings result because of different patterns of cash in flows from operations in spite of same initial outlays, i.e., in case of one project there may be larger cash inflows in earlier years and smaller cash inflows in later years, in case of other project it may be vice versa.

Example : Cost of Capital : 10%

	A	*B*
Initial outlay	– 24,000	– 24,000
Year end cash inflows		
1	+ 8,000	+ 16,000
2	+ 12,000	+ 10,000
3	+ 16,000	+ 8,000
NPV	5,200	4,812
IRR	20.65	22.80

What has caused the difference in ranking in this case? The answer is: implied assumptions in the two methods (NPV and IRR) have caused the difference in rankings. The implied assumption in case of NPV is that funds released by the project are invested (till the time of completion of project) at a rate equal to cost of capital of firm. On the other hand, the IRR method assumes that the funds released by the project are invested (till completion of the project) at a rate equal to IRR itself. This assumption of IRR is quite unrealistic. Suppose, we are evaluating two projects *A* and *B*, while calculating IRRs we assume that cash generated by *A* will be invested at 20.65 per cent and cash generated by *B* will be invested at 22.80 per cent. This is quite unrealistic situation. There is no difference in quality of cash generated by project *A* or project *B*. There is no reason that if cash generated by *B* can be invested at 22.80 per cent, cash generated by *A* has to be invested at a lower rate of 20.65 per cent. Hence, in case of contradictory rankings resulting from time disparity we would take our decision on the basis of NPV because IRR suffers from superficiality of reinvestment rate assumption.

Life Disparity

If the lives of the two projects differ, NPV and IRR may give different rankings. In such cases also, we prefer NPV because its reinvestment assumption is superior to that of IRR assumption. However, in such cases we have to modify NPV. This modified NPV is known as equivalent annualized net present value (EANPV).

Example : Cost of Capital : 15%

Year	*Cash Flows* (*A*)	*Cash Flows* (*B*)
0	– 12,000	– 22,000
1	+ 7,000	+ 8,000
2	+ 7,000	+ 8,000
3	+ 7,000	+ 8,000
		+ 8,000
		+ 8,000
NPV	3,982	4,818
EANPV	$3{,}982 \times \frac{1}{2.2832}$	$4{,}818 \times \frac{1}{3.3522}$
	= 1,744	= 1,437

NPVs of the two machines are not comparable because they cover different periods. Comparison of NPVs is not fair it neglects the cash flows from *A* in periods four and five. Consequently, a direct comparison of NPVs introduces a bias in favour of projects with longer life. To overcome this problem, we annualized the NPVs by multiplying NPVs with their relatives CRFs and the resultant result is EANPV. Now, both the machines are on comparable footing because of the same time horizon. Comparing the two EANPVs, we conclude that *A* is more profitable.

IRR COMPLICATIONS

The IRR method has some complications. For example, some projects may have more than one IRR and others may have no IRR. The financial manager should be aware of these peculiarities to avoid making costly mistakes.

Multiple IRRs

Most investment projects involve a cash outflow at the time of initial outlay, followed by net cash inflow in all future years. The sign applicable to all cash flows is reversed only once, it is negative for initial investment and positive for all subsequent cash flows. However a project can have more than one sign reversal. For example, the initial outlay may be followed by positive cash inflows in one or more periods, followed by negative cash flows in some periods, again to be followed by positive cash flows in one or more periods. This type of situation can cause a single project to have more than one IRR.

Example: (Cost of Capital 20%).

Year	*Cash Flows*
0	– 2,000
1	+ 7,000
2	– 6,000
NPV	– 333

The clear message of NPV is that the project should not be accepted. On the other hand, IRR method gives us two IRRs, i.e., 50 per cent and 100 per cent. The project will reduce the value of the company in spite of the fact that both IRRs are far above the required rate of return. Clearly, the investment proposal should be rejected.

In case of multiple sign reversal of cash flows, the IRR may be indeterminate.

Example: Cost of capital 10%.

Year	*Cash Flows*
0	– 1,000
1	+ 1,500
2	– 1,000
NPV	– 463

Calculation of IRR

$$-1{,}000 + \frac{1{,}500}{1 + r} - \frac{1{,}000}{(1 + r)^2} = 0$$

$-1{,}000\,(1 + r)^2 + 1{,}500\,(1 + r) - 1{,}000 = 0$

$1 + r = + .75 \pm .66 \quad - 1$

$r = - 0.25 \pm .66 \quad - 1$

As -1 is imaginary number, IRR cannot be determined.

Conclusion about IRR Complications

IRR should not be used when more than one sign reversal occurs in the cash flows estimates of the proposed investments.

TERMINAL VALUE METHOD

The implied assumption of NPV method is that the funds released by the project can be reinvested (till the time of completion of the project) at a rate equal to cost of capital of the firm. Sometimes we find that cash generated by project can be reinvested at a rate which is not equal to cost of capital. In that case we find that this NPV of the project is calculated using terminal value method. Under this method, cash released by the project is compounded at a rate at which reinvestment is possible and then NPV is calculated.

Example: Investment Rs. 15,000

Life of project 6 years annual cash inflow Rs. 7,000

Cost of capital 10 per cent, Reinvestment rate = 8 per cent

Year	*Cash inflow*	*Compounded Amount*
1.	7,000	10,283
2.	7,000	9,520
3.	7,000	8,820
4.	7,000	8,162
5.	7,000	7,560
6.	7,000	7,000
		51,345

NPV = 51,345 × .564 – 15,000 = 13,959.

ADJUSTED PRESENT VALUE (APV)

There are two approaches regarding making capital expenditure decisions.

- The first approach (the approach that we have studied so far) is based on cost of capital.
- The second approach is referred as APV approach. The advocates of this approach opine that this a superior approach of capital budgeting.
  It evaluates a proposal strictly from the point of view of existing equity share holders.

Two Steps For Calculating APV [APV is also called as ANPV].

(i) Calculate Base NPV: It is calculated on the assumption that the project will be implemented on the basis of existing equity.

[Base NPV is also called as Base Case NPV]

(ii) Adjusted NPV= Base NPV ± side effects of financing the project

- The side effects are issue expenses etc. (relating to the project), tax savings on issue expenses and tax savings on interest.
- Tax savings on account of debt should be discounted on the basis of interest rate.

Q. No. 73: Govind Ltd is considering the installation of a computer system that requires an investment of Rs.32.50m. The company's required return on equity is 10%. The company shall be raising a 9% Loan of Rs.20m for the purpose of the project. The principal amount of the loan shall be repaid at the end of complete life of the project which is 5 years. Income tax rate 30%. Straight line Depreciation is

allowed for tax purpose. The operating income before deprecation is estimated to be Rs.10m p.a. Calculate (i) NPV (ii) APV. Why the two values differ?

Answer

(i) Calculation of NPV of the Project

			Rupees Millions	
	Period	PVF	CF	PV
Investment less loan	0	1	−12.50	−12.50
Cash inflow	1	0.909	+ 7.69	+ 6.99021
-----do-----	2	0.826	+ 7.69	+ 6.35194
-----do-----	3	0.751	+ 7.69	+ 5.77519
-----do-----	4	0.683	+ 7.69	+ 5.25227
-----do-----	5	0.621	+ 7.69	+ 4.77549
Loan repayment	5	0.621	−20.00	−12.42
NPV				+ 4.2251

(ii) APV

Base NPV

			Rupees Millions	
	Period	PVF	CF	PV
Investment	0	1	−32.50	−32.50
Cash inflow	1	0.909	+ 8.95	8.13555
-----do-----	2	0.826	+ 8.95	7.39270
-----do-----	3	0.751	+ 8.95	6,72145
-----do-----	4	0.683	+ 8.95	6.11285
-----do-----	5	0.621	+ 8.95	5.55795
Base NPV				+ 1.4205

Adjusted PV = Base NPV + PV of Tax savings on interest

= 1.4205 + 0.54 (3.890) = 3.5211

APV method considers the project from the point of equity investors i.e. the method assumes that if we borrow money for the project, this increases the risk (financial risk) for the firm; this fact increases the cost of equity. This increased risk is considered by taking cost of equity for the entire investment (though a part of the investment is met through a loan, a cheaper source of finance). The increase in cost of equity, on account of borrowing, is not considered by NPV.

Reconciliation of NPV with APV :

NPV		+ 4,22510
Difference in cost of project		
Under NPV	−12.50−12.42 = − 24.92	
Under APV	−32.50	−7.58000
Interest costs	1.80 x 3.791	+ 6.82380
Tax savings on Interest	0.54 x 3.89	
	0.54 x 3.791	+ 0.05346
		3.52236

Q. No. 74. Shyam Sunder Ji Ltd is considering to undertake a project that requires an investment of Rs.32.50m. Life of the project is 5 years. 50% of the investment is proposed to be financed by way of 9% Loan, 25% from fresh equity issue and balance from existing equity. Income tax rate 30%. Straight line Depreciation is allowed for tax purpose. The operating income before depreciation is estimated to be Rs.10m in 1st year, Rs.11m in the 2nd year, and so on, Rs.14m in the 5th year. Calculate APV. Assume that the equity beta of the company is 1.50, risk free rate of return is 4% and risk premium on the market portfolio is 4%.

Answer

Ke = 4 + 1.50(4) = 10%

Cash inflow from operation

Year	Profit before depreciation	Depreciation	Tax	Cashinflow
1	10m	6.50m	1.05m	8.95m
2	11m	6.50m	1.35m	9.65m
3	12m	6.50m	1.65m	10.35m
4	13m	6,50m	1.95m	11.05m
5	14m	6.50m	2.25m	11.75m

Base NPV

			Rupees Millions	
	Period	PVF	CF	PV
Investment	0	1	−32.50	−32.50
Cash inflow	1	0.909	+ 8.95	+ 8.13555
-----do-----	2	0.826	+ 9.65	+ 7.9709
-----do-----	3	0.751	+ 10.35	+ 7.77285
-----do-----	4	0.683	+ 11.05	+ 7.54715
-----do-----	5	0.621	+ 11.75	+ 7.29675
Base NPV				6.2232

Adjusted PV = Base NPV + PV of Tax savings on interest
= 6.2232 + 0.43875 (3.890) = 7.9299375m

GENERAL PROBLEMS

Q. No.75 New Projects Ltd is evaluating 3 projects, P-1, P-II and P-III. The following information is available in respect of these projects:

	P-I	P-II	P-III
Cost	Rs. 15,00,000	Rs.11,00,000	Rs.19,00,000
Inflows- year 1	6,00,000	6,00,000	4,00,000
- year 2	6,00,000	4,00,000	6,00,000
- year 3	6,00,000	5,00,000	8,00,000
- year 4	6,00,000	2,00,000	12,00,000
Risk Index	1.80	1.00	0.60

Minimum required return of the firm is 15% and applicable tax rate is 40%. The risk free interest rate is 10%. Required :

(i) Find out the risk adjusted discount rate (RADR) for these projects.

(ii) Which project is the best ? **(Nov. 2009)**

Answer RADR = Risk free rate + risk premium

15 = 10 + Risk premium

Risk premium is 5%. It is the risk premium for normal risk i.e. when the risk index is 1. For Risk index 1.80, risk premium should be 5x1.80 i.e. 9% and for risk index of 0.60, it should be 5x0.60 i.e. 3%

Project Required return (Discounting Rate)

P –I 10 + 9 = 19%

P-II 10 + 5 = 15%

P-III 10 + 3 = 13%

Calculation of NPV of each of three projects:

		P –I	P –II	P –III
	Period	PV OF CASH FLOWS		
Investment	0	- 15,00,000	-11,00,000	-19,00,000
INFLOWS	1	+ 600000x.840	+ 600000x.870	+ 400000x.885
	2	+ 600000x.706	+ 400000x.756	+ 600000x.783
	3	+ 600000x.593	+ 500000x.658	+ 800000x.693
	4	+ 600000x.499	+ 200000x.572	+ 1200000x.613
NPV		+ 82800	+ 1,67,800	+ 2,13.800

Project – III may be implemented as it s NPV is the highest.

Q. No. 76: Following are the estimates of the net cash flows and probability of a new project of M/s. X Ltd; (Cost of capital is 10%.)

	Year	P = 0.30	P = 0.50	P = 0.20
Initial investment	0	4,00,000	4,00,000	4,00,000
Estimated net after tax cash flows per year	1-5	1,00,000	1,10,000	1,20,000
Estimated salvage value (after tax)	5	20,000	50,000	60,000

FIND

(i) The expected NPV of the project.

(ii) The best case and the worst case NPV.

(iii) The probability of occurrence of the worst case if the cash flows are perfectly dependent overtime/ independent overtime.

(iv) Standard deviation and coefficient of variation assuming that there are only three streams of cash flow, which are represented by each column of the table with the given probabilities.

(v) Coefficient of variation of X Ltd on its average project which is the range of 0.95 to 1.00. If the coefficient of variation of the project is found to be less risky than average, 100 basis point are deducted from the cost of capital. Should the project be accepted by X Ltd. **(Nov. 2006) (16 Marks)**

Answer (i)

Let Probability 0.30 is that of event A
Probability 0.50 is that of event B
Probability 0.20 is that of event C

Statement Showing Expected NPV

A	B	C
[-4,00,000 + 1,00,000 x 3.791 + 20,000 x 0.621] x 0.30 = -2,544	[-4,00,000 + 1,10,000 x 3.791 + 50,000 x 0.621] x 0.50 = + 24,030	[-4,00,000 + 1,20,000 x 3.791 + 60,000 x 0.621] x 0.20 = 18,436
Expected NPV = -2,544 + 24,030+ 18,436 = 39,922		

(ii) Best case NPV is happening of event C : 92,180
Worst case NPV is happening of A : -8,480

(iii) The probability of occurrence of worst case (If the cash flows are independent) = 0.30 x 0.30 x 0.30 x 0.30 x 0.30 = 0.00243
The probability of occurrence of worst case (If the cash flows are dependent) = 0.30

(iv)

Event	NPV (X)	p	pX	x	px^2
X	-8,480	0.30	-2,544	-48402	70,28,26,081
Y	48,060	0.50	24,030	+ 8,138	3,31,13,552
Z	92,180	0.20	18,436	+ 52258	54,61,79,712
			39,922		1.28.21.19,315

SD 35807
Expected NPV = MEAN NPV = 39,922
Coefficient of variation = 35807/39922 =0.8969
(v) Statement Showing Expected NPV

A	B	C
[-4,00,000 + 1,00,000 x 3.89 + 20,000 x 0.650] x 0.30 = 600	[-4,00,000 + 1,10,000 x 3.89 + 50,000 x 0.650] x 0.50 = + 30,200	[-4,00,000 + 1,20,000 x 3.89 + 60,000 x 0.650] x 0.20 = 21,160
Expected NPV = 51,960		

The project may be taken up as NPV is positive.

Q.No.77: Nav Brindavan Ltd is considering the investment in a stone-query. The query is being offered at a price of $ 4m. The total quantity of stones that can be extracted from the query depends upon the type of rock formations in the area and that the following three mutually exclusive possibilities exist:

Rock Type	Total tin output	Probability
A	2,400 tonnes	0.40
B	1,200 tonnes	0.40
C	720 tonnes	0.20

At present the query is non-operational. To make it operational, the company has to spend $ 7.60m in the first year, this amount will be paid at the year end. In the first year of production, special equipment will have to be purchased at a cost of $ 38m. This equipment will be sold immediately on the cessation of production, at an amount expected to equal its purchase price, less $16,000 for every tonne of stone extracted during its life. Production will start at the beginning of the second year @ 20 tonnes per month; this production rate will remain unchanged until the query is exhausted. During the first year of production, the stone will be sold at the rate of $1,00,000 per tonne and that labour and other production costs will be $15m. These revenues and costs are expected to rise by 10% per annum in subsequent years.

Nav Brindavan Ltd is considering to get the geological survey done before investing in the stone-query. The survey will reveal the type of rock formation. The seller of the query has no objection on this matter. The survey would cost $0.90m.

Ignore tax and assume the cost of capital to be 10%, you are required to (a) calculate the expected net present value of purchasing the query, assuring that the geological survey is not undertaken, (b)advise whether or not the geological survey should be undertaken.

Answer

Working note:

(i) Present value of investment: 4m + 0.909(45.60m) = 45.4504m

(ii) Present value of cash inflow from operation (2nd year of the project i.e. the first year of operation) = 0.826 (0.10m x 240 – 15m) = 7.434m

(iii) Present value of cash inflow from operation (Rock Type A) = 74.34m

(iv) Present value of cash inflow from operation (Rock B) = 37.17m

(v) Present value of cash in flow form operation (Rock C) = 22.302m

(vi) Present value of sale of equipment after use (Rock B) =
0.564 (38m – 16,000 x 1200) = 10.6032m

(vii) PV of sale of equipment after use (Rock C) =
0.683 (38m – 16,000 x 720) = 18.08584m

Calculation of expected NPV of the project ($ Millions)

		P	P x NPV
Rock A	-45.4504 + 74.34 = 28.8896	0.40	+ 11.55584
Rock B	-45.4504 + 37.17 + 10.6032 = + 2.3229	0.40	+ 0.92916
Rock C	-45.4504+ 22.302+ 18.08584 = -5.06256	0.20	- 1.012512
			11.472488

The project may be taken up as the NPV is Positive.

Geological Survey : NPV with Survey :

= (28.8896 – 0.90) x 0.40 + (2.3229 – 0.90) x 0.40 – (0.90) x 0.20 = 11.585m

As NPV with survey is more than the NPV without survey, Survey is recommended.

Q.No.78: The Mayfair Rubber Industry Ltd. (MRIL) manufactures small rubber components for the local market. It is presently using 8 machines which were acquired 3 years ago at a cost of Rs. 18 lakh each having a useful life of 8 years with no salvage value. The policy of the company is to depreciate all machines in 5 years. Their production capacity is 37 lakh units while the annual demand is 30 lakh units. The MRIL has received an order from a leading automobile company of Singapore for the supply of 20 lakh rubber bushes at Rs. 15 per unit. The existing machines can be sold @ Rs. 12 lakh per machine. It is estimated that the removal cost of each machine would be Rs. 60,000. In order to meet the increased demand, the MRIL can acquire 3 new machines at an estimated cost of Rs. 100 lakh each which will have a combined production capacity of 52 lakh units.

The operating parameters of the existing machines are as follows:

(i). Labour requirements (Unskilled18; Skilled – 18; Supervisor – 3; and Maintenance – 2) and their per month salaries are Rs.3,500; Rs.5,500; Rs.6,500 and Rs.5,000 each respectively with an increase of 10 per cent to adjust inflation.

(ii). Raw materials cost, inclusive of wastage is 60 per cent of revenues.

(iii). Maintenance cost – years 1–5 (Rs. 22.5 lakh), and years 6–8 (Rs.67.5 lakh).

(iv) Operating expenses – Rs.52.10 lakh expected to increase annually by 5 percent.

(v). Insurance cost/premium year1, 2 percent of the original cost of the machine, afterwards discounted by 10percent.

(vi). Selling price – Rs. 15 per unit.
The projected operating parameters with the replacement by the new machines are as follows:

i. Additional working capital – Rs.50 lakh.

ii. Savings in cost of utilities – Rs. 2.5 lakh.

iii. Maintenance cost : years 1-2 (Rs. 7.5 lakh); years 3.-5 (Rs.37.5 lakh).

iv. Raw materials cost – 55 percent of sales.

v. Employee requirement (6 skilled at monthly salary of Rs.7,000 each and one for maintenance at monthly salary of Rs.6,500)

vi. Laying off cost of 34 workers(Unskilled18; skilled12; Supervisors3;and maintenance1) Rs.9,21,000, that is equivalent to six months salary.

vii. Insurance cost/premium 2 percent of the Purchase cost of machine in the first years and discounted by 10 percent in subsequent years.

viii. Life of machines – 5 years and salvage value – Rs.10 lakh per machine.

The company follows straight line method of depreciation and the same is accepted for tax purposes. Corporate tax rate is 35 percent and the cost of capital is 20 percent.

As the Finance Manager of MRIL, prepare a report for submission to the top management with your recommendations about the financial viability of the replacement of the existing machines. **(Nov. 2008)**

Answer
Assumption: There shall be no change in operating expenses i.e. the amount incurred on operating expenses will not change.

Working notes
(i) Change in material cost

Material cost at present :	30,00,000 x 15 x 0.60 = 270 Lakhs
Material cost under proposal	50,00,000 x 15 x 0.55 = 412.50 Lakhs
Change (increase)	142.50 Lakhs

(ii) Labour cost:
Labour cost at present: [18x3500 + 18x5500 + 3x6500 + 2x5000]x[12]
= 22,98,000
Labour cost under the proposal :[6x7000 + 1x6500]x[12] = 5,82,000

Decrease in labour cost In first year = 17,16,000

Year→	1	2	3	4	5
Savings	17.1600L	18.8760L	20.7636L	22.8400	25.1240L

(iii) Maintenance cost (Rs. Lakhs)

Year→	1	2	3	4	5
Savings	22.50 -7.50 =15	22.5 -7.50 =15	67.5-37.5 =30	67.5-37.5 =30	67.5-37.5 =30

(iv) Insurance(Rs. Lakhs)

Year→	1	2	3	4	5
increase	6.00-2.10 = 3.90	5.40 - 1.89 =3.51	4.86 - 1.70 = 3.16	4.37-1.53 = 2.84	3.93-1.38 = 2.55

(v) Depreciation (Rs.Lakhs)

Year→	1	2	3	4	5
Dep.(old)	28.80	28.80	-	-	-
Dep.(new)	54.00	54.00	54.00	54.00	54.00
Increase	25.20	25.20	54.00	54.00	54.00

(vi) Net cash outflow in zero period (Rs. Lakhs)

Purchase of new machines	= 300.00	
Working capital	= 50.00	
Cost of lay off	= 9.21	
Total	359.21	
Less net proceeds	-91.20	268.01

(vii) Profit / loss on sale of old machines :

Sale	91.20
Book value	-57.60
Profit	33.60
Tax	11.76(Rs. Lakhs)

INCREMENTAL CASH INFLOW FROM OPERATION (Rs. Lakhs)

YEAR	1	2	3	4	5
Sales	300.00	300.00	300.00	300.00	300.00
Savings of					
(i) Labour	17.16	18.88	20.76	22.84	
(ii) maint.	15.00	15.00	30.00	30.00	
(iii)Utilities	2.50	2.50	2.50	2.50	
Total (A)	334.66	336.38	353.26	355.34	357.62
Increase in cost					
(i) R.Mat.	142.50	142.50	142.50	142.50	142.50
(ii) Dep.	25.20	25.20	54 .00	54.00	54.00
(iii) Insu.	3.90	3.51	3.16	2.84	2.55
Total (B)	171.60	171.21	199.66	199.34	199.05
EBT(A-B)	163.06	165.17	153.60	154.00	158.76
Tax	57.07	57.81	53.55	53.90	55.57
EAT	105.99	107.36	100.05	100.10	103.19
Add Dep.	25.20	25.20	54.00	54.00	54.00
Cash in flow	131.19	132.56	154.05	154.10	157.19

DCF Analysis of the Project on incremental cash flow basis. (Dis. rate 20%)

	Period	PVF	CF(Rs.Lakhs)	PV(Rs.Lakhs)
Net investment	0	1	-268.0100	-268.0100
Tax on STCG	1	0.833	-11.7600	-9.7961
Tax savings of Lay off cost	1	0.833	+ 3.2235	+ 2.6852
Operation	1	0.833	+ 131.1900	+ 109.2813
Operation	2	0.694	+ 132.5600	+ 91.9967
Operation	3	0.579	+ 154.0500	+ 89.1950
Operation	4	0.482	+ 154.1000	+ 74.2280
Operation	5	0.402	+ 157.1900	+ 63.1904
Sale of scrap and release of WC	5	0.402	+ 80.0000	+ 32.16
NPV				184.9305

As NPV (on increment basis) of the replacement is positive, the replacement is recommended.

Q. No. 79:

Given the cash flows of the two projects, find the discounting rate at which both the projects will have same NPV?

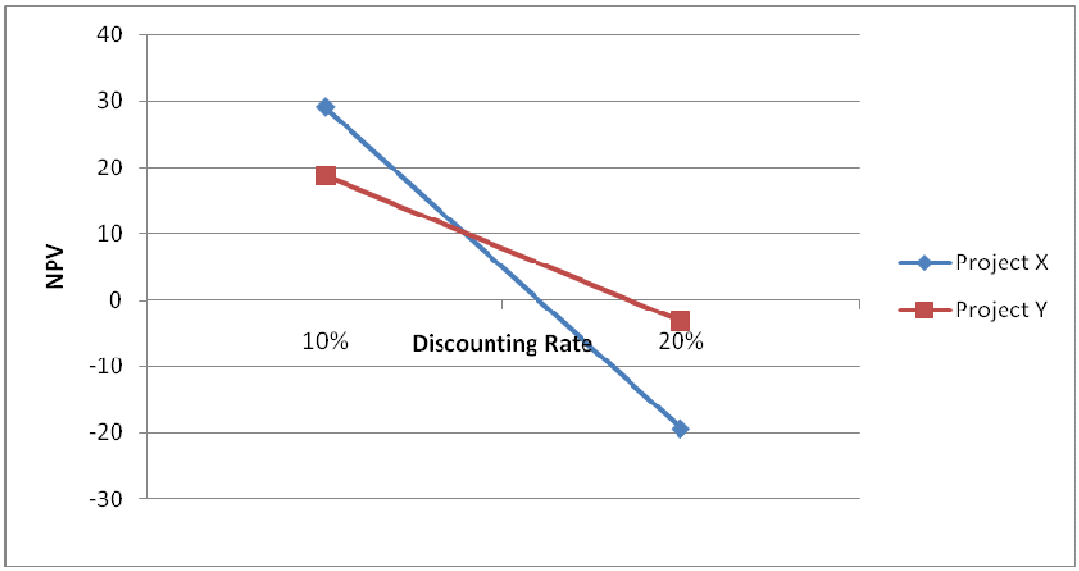
Year	*0*	*1*	*2*	*3*	*4*	*5*
Project *X*	(200)	35	80	90	75	20
Project *Y*	(200)	218	10	10	4	3

The discount factors are as follows:

Year	*0*	*1*	*2*	*3*	*4*	*5*
Discount Factors						
(10%)	1	0.91	0.83	0.75	0.68	0.62
(20%)	1	0.83	0.69	0.58	0.48	0.41

Answer

	X	Y
NPV at 10%	29.15%	+ 18.76
NPV at 20%	-19.35%	-3.21



Alternative solution:

Statement Showing incremental CFs

Year	1	2	3	4	5
Project X	35	80	90	75	20
Project Y	218	10	10	4	3
Incremental CF	-183	70	80	71	17

Average cash flows : (70 + 80 + 71 + 17) / 4 = 59.50

Fake payback period : 183/59.50 = 3.08

Consulting the table for period 4 : Approximate IRR = 11 %

NPV at 11% =

-183 x 0.901 + 70 x 0.812 + 80 x 0.731 + 71 x 0.659 + 17 x 0.593

= + 7.307

NPV at 14%

=-183 x 0.877 + 70 x 0.769 + 80 x 0.675 + 71 x 0.592 + 17 x 0.519

= - 1.806

$$\text{IRR} = 11 + \frac{7.307}{7.307 - (-1.806)} \times 3 = 13.41$$

Q. No. 80: Mansukha Ltd has been awarded a contract to build a road. The contract price is Rs.25m, to be paid immediately on the completion of the work. The work can be completed in two ways:

(a) Slow work scheme: it requires a spending of Rs.10m at the end of each of year 1 and year 2.

(b) Fast work plan: it requires spending of Rs.22m at the end of year 1.

At what discounting rate, the second scheme would be more attractive than the first one.

Answer:

	Period 1	Period 2
Slow work	-10m	-10m + 25m = + 15m
Fast work	+ 3m	0
Incremental CF	-13m	+ 15m

Let IRR of incremental cash flows : r

$-13(1/1+r) + 15\,(1/1+r)^2 = 0$

Let $1 + r = x$

$-13(1/x) + 15(1/x^2) = 0$

$-13x + 15 = 0$

$x = 1.153846 = 1 + r$

$r = 0.153846 = 15.3846\%$

If the discounting rate is 15.3846%, both the projects will be equally attractive i.e. both the projects will have same NPV.

Teaching note – not to be given in exam. NPV of Slow : $-10m(1/1.53846) + 15m((1/1.53846)^2 = 2.60m$ NPV of fast : $+3m(1/1.53846) = 2.60m$

	Period 1	Period 2	NPV @ 16%
Slow	−10m(0.862)	+ 15m(0.743)	2.525
Fast	+ 3m(0.862)	nil	2.586

The second scheme would be more attractive if the discounting rate exceeds 15.3846%.

Q. No. 81: Shivam Ltd. is considering two mutually exclusive projects A and B. Project A costs Rs.36,000 and project B Rs.30,000. You have been given below the net present value probability distribution for each project.

Project A		Project B	
NPV estimates (Rs.)	Probability	NPV estimates (Rs.)	Probability
15,000	0.20	15,000	0.10
12,000	0.30	12,000	0.40
6,000	0.30	6,000	0.40
3,000	0.20	3,000	0.10

(i) Compute the expected net present values of projects A and B.
(ii) Compute the risk attached to each project i.e. standard deviation of each probability distribution.
(iii) Compute the profitability index of each project.
(iv) Which project do you recommend? State with reasons. **(June 2009)**

Answer

NPV and SD of A (Rupees thousands)

NPV estimate(X)	p	pX	x	px^2
15	0.20	3	6	7.20
12	0.30	3.6	3	2.70
6	0.30	1.8	−3	2.70
3	0.20	0.6	−6	7.20
		$\sum pX = 9$		$\sum px^2 = 19.8$

NPV of A = 9 thousands

SD of A = $\sqrt{\sum px^2/\sum p}$ = $\sqrt{(19,80)/1}$ = 4.45

NPV and SD of B ('Rs. 000)

NPV estimate(Y)	p	Py	y	py^2
15	0.10	1.50	6	3.60
12	0.40	4.80	3	3.60
6	0.40	2.40	-3	3.60
3	0.10	0.30	-6	3.60
		$\sum pY = 9$		$\sum py^2 = 14.40$

NPV of B = 9 thousands

SD of B = $\sqrt{\sum py^2/\sum p}$ = $\sqrt{14.40}$ = 3.79 thousands

A is riskier as its SD is higher.

NPV of A	= PV of cash inflow of A – PV of cash outflow of A
9 thousands	= PV of cash inflow of A – 36 thousands
PV of cash inflow of A	= 45 thousands
PI of A	= PV of cash inflow/ PV of cash outflow = 45,000 / 36,000 = 1.25

NPV of B	= PV of cash inflow of B – PV of cash outflow of B
9 thousands	= PV of cash inflow of B – 30 thousands
PV of cash inflow of B	= 39 thousands
PI of B	= PV of cash inflow/ PV of cash outflow = 39 thousand / 30 thousand = 1.30

EXTRA PRACTICE (MUST DO)

Q. No. 82: DL services are in the business of providing home services like plumbing, sewerage line cleaning etc. There is a proposal before the company to purchase a mechanized sewerage cleaning line for a sum of Rs.20 Lacs. The life of the machine is 10 years. The present system of the company is to use manual labor for the job. You are provided the following information:

Cost of machine	Rs.20 lacs
Depreciation	20% p.a. straight line
Operating cost	Rs.5 lacs per annum
Present system	
Mannual labour	200 persons
Cost of Mannual labour	Rs.10,000 (ten thousand) per person per annum

The company has an after tax cost of funds of 10% per annum. The applicable rate of tax inclusive of surcharge and cess is 35%.

Based on the above you are required to:
(i) State whether it is advisable to purchase the machine.
(ii) Compute the savings/ additional cost as applicable, if the machine is purchased. **(May 2008) (12 Marks)**

Answer:

Statement showing annual Savings of cost (years 1-5) :

Labour cost at present	Operating cost	Depreciation	Annual savings of cost
Rs.20L	Rs.5L	Rs.4L	Rs.11L

Annual tax : 0.35(11L) = Rs.3.85L
Annual cash flow = 20L – 5L -3.85L = Rs.11.15L

DCF Analysis of the machine Proposal (Cost of capital: 10%)

			Rs. Lakhs	
	Period	PVF/Annuity	CF	PV
Investment	0	1	-20	-20
Cash in flow from operations	1-5	3.791	11.15 annually	42.27
----do----	6-10	2.354	9.75 annually	22.95
NPV				45.22

The project may be taken up as the NPV is Positive.

Q.No.83 : A company is considering two mutually exclusive project *K* will require an initial cash investment in machinery of Rs.2,68,000. It is anticipated that the machinery will have a useful life of ten years at the end of which it salvage will realize Rs.20,500. The project will also required an additional investment in cash sundry debtors and stock of Rs. 40,000. At the end of five years from the commencement of the project, balancing equipment for Rs.45,000 has to be installed to make the unit workable. The cost of additional machinery will be written off to depreciation over the balance life of the project. The project is expected to yield a net cash flow (before depreciation) of Rs.1,00,000 annually.

Project *R*, which is the alternative one under consideration, requires an investment of Rs.3,00,000 in machinery and as in project *K* investment in current assets of Rs.40,000. The residual salvage value of the machinery at the end of its useful life of ten years is expected to be Rs.25,000. The annual cash inflow (before depreciation) from the project is worked at Rs.80,000 p.a. for the first five years and Rs.1,80,000 per annum for the next five years.

Depreciation is written off by the company on sum-of-the-year's digits method (i.e., if the life of the assets is 10 years, then in the ratio of 10, 9, 8 and so on). Income tax rate is 50 per cent. A minimum rate of return objective has been calculated at 16 per cent. The present value of Re. 1 at interest of 16 per cent p.a. is .86, .74, .64, .55, .48, .41, .35, .30, .26, .23 for years 1 to 10 respectively.

Answer

Working note : Project K

Year	Depreciation	
1	(2,68,000 -20500)(10/55)	= 45000
2	(2,68,000 -20500)(9/55)	= 40500
3	(2,68,000 -20500)(8/55)	= 36000
4	(2,68,000 -20500)(7/55)	= 31500
5	(2,68,000 -20500)(6/55)	= 27000
6	(2,68,000 -20500)(5/55) + (45000)(5/15)	= 37500
7	(2,68,000 -20500)(4/55) + (45000)(4/15)	= 30000
8	(2,68,000 -20500)(3/55) + (45000)(3/15)	= 22500
9	(2,68,000 -20500)(2/55) + (45000)(2/15)	= 15000
10	(2,68,000 -20500)(1/55) + (45000)(1/15)	= 7500

Project R

Computation of Depreciation

Year	Dep.
1	(3,00,000 – 25,000) x 10/55 = 50,000
2	45,000
3	40,000
4	35,000
5	30,000
6	25,000
7	20,000
8	15,000
9	10,000
10	5,000

Statement showing cash inflow from operation (K)

Period	Profit Before Dep.	Dep.	Tax	CF
1	1,00,000	45000	27500	72500
2	1,00,000	40500	29750	70250
3	1,00,000	36000	32000	68000
4	1,00,000	31500	34250	65750
5	1,00,000	27000	36500	63500
6	1,00,000	37500	31250	68750
7	1,00,000	30000	35000	65000
8	1,00,000	22500	38750	61250
9	1,00,000	15000	42500	57500
10	1,00,000	7500	46250	53750

No tax will be levied on sale of scrap as WDV = sale value of scrap. No STCG/STCL.

Statement showing cash inflow from operation (R)

Period	Profit Before Dep.	Dep.	Tax	CF
1	80,000	50,000	15,000	65,000
2	80,000	45,000	17,500	62,500
3	80,000	40,000	20,000	60,000
4	80,000	35,000	22,500	57,500
5	80,000	30,000	25,000	55,000
6	1,80,000	25,000	77,500	1,02,500
7	1,80,000	20,000	80,000	1,00,000
8	1,80,000	15,000	82,500	97,500
9	1,80,000	10,000	85,000	95,000
10	1,80,000	5,000	87,500	92,500

No tax will be levied on sale of scrap as WDV = sale value of scrap. No STCG/STCL.

Main Answer :

DCF ANALYSIS OF THE PROJECT K

	PERIOD	PV	CF	PV
Investment	0	1	-308000	-308000
CFO	1	.86	+ 72500	+ 62350
CFO	2	.74	+ 70250	+ 51985
CFO	3	.64	+ 68000	+ 43520
CFO	4	.55	+ 65750	+ 36163
CFO	5	.48	+ 63500	+ 30480
Cost of mach.	5	.48	-45000	-21600
CFO	6	.41	+ 68750	+ 28188
CFO	7	.35	+ 65000	+ 22750
CFO	8	.30	+ 61250	+ 18375
CFO	9	.26	+ 57500	+ 14950
CFO	10	.23	+ 53750	+ 12363
Sale of scrap & Release of WC	10	.23	+ 60500	+ 13915
NPV				+ 5438

DCF ANALYSIS OF THE PROJECT R

	PERIOD	PV	CF	PV
Investment	0	1	-3,40,000	-3,40,000
CFO	1	.86	65,000	+ 55,900
CFO	2	.74	62,500	+ 46,250
CFO	3	.64	60,000	+ 38,400
CFO	4	.55	57,500	+ 31,625
CFO	5	.48	55,000	+ 26,400
CFO	6	.41	1,02,500	+ 42,025
CFO	7	.35	1,00,000	+ 35,000
CFO	8	.30	97,500	+ 29.250
CFO	9	.26	95,000	+ 24,700
CFO	10	.23	92,500	+ 21,275
Sale of scrap & Release of WC	10	.23	65,000	+ 14,950
NPV				25,775

Project R may be taken up as its NPV is higher than that of K.

Q.No.84: Welcome Limited is considering the manufacture of a new product. The accountant has prepared the following estimate of profit in the first year of manufacture:

	Rs.	Rs.
Sale 9,000 Units @ Rs.32		2,88,000
Cost of goods sold: Labor 40000 hours @ Rs.3,50 / hour Material and other variable cost Depreciation ---------- Cost of goods produced Less : closing stock	 1,40,000 65,000 45,000 2,50,000 25,000	 2,25,000
Profit		63,000

The product is expected to have a life of four years. Annual sales volume is expected to be constant over that period at 9,000 units. Production which was estimated at 10,000 units in the first would be only 9,000 units each in year two and three and 8,000 units in year four. Creditors at the end of each year would be 10 per cent of materials and other variable costs. If sales differed from the forecast level, stock would be adjusted in proportion. Debtors at the end of each year would be 20 per cent of sales of the year.

Depreciation relates machinery which would be purchased especially for the manufacture of the new product and is calculated on the straight line basis assuming that the machinery would last for four years and have no terminal scrap value. There is a high level of confidence concerning the accuracy of all the above estimates except the annual sales volume. Cost of capital is 20 per cent per annum. You may assume that debtors are realized and creditors are paid in the following year. No change in the prices of inputs or outputs is expected over the next four years.

You are required to show whether; the manufacture of the new product is worthwhile. Ignore taxation.

Note: Present value Re. 1 at 20 per cent discount rate is as follows:

Year	*1*	*2*	*3*	*4*	*5*
P.V.	.83	.69	.58	.48	.40

(Nov. 1986)

Answer

Year	Production	Rupees		
		Labor	Material and other VC	Sales
1	10,000	1,40,000	65,000	2,88,000
2	9,000	1,26,000	58,500	2,88.000
3	9,000	1,26,000	58,500	2,88,000
4	8,000	1,12,000	52,000	2,88,000

Table Showing Annual cash flow

Year	Rupees			
	Receipt from Drs. (A)	Payment for materials and other VC (B)	Payment for labour (C)	CF (A–B–C)
1	2,30,400	58,500	1,40,000	+ 31,900
2	2,88,000	59,150	1,26,000	+ 1,02,850
3	2,88,000	58,500	1,26,000	+ 1,03,500
4	2,88,000	52,650	1,12,000	+ 1,23,350
5	57,600	5,200	---	+ 52,400

DCF analysis of the project (Discounting rate : 20%)

	Period	PVF	CF	PV
Investment	0	1	- 1,80,000	-1,80,000
Operation	1	0.83	31,900	+ 26,477
Operation	2	0.69	1,02,850	+ 70,967
Operation	3	0.58	1,03,500	+ 60,030
Operation	4	0.48	1,23,350	+ 59,208
Operation*	4	0.48	52,400*	+ 25,152
				+ 61,834

The project may be taken up as the NPV is Positive.

* This cash flow shall be there within 2.40 months of the year 5. It may better be taken at the end of the 4^{th} year. [Alternatively this cash flow may be discounted on the basis of PVF_5 as it is given in the question. In this case the NPV would be Rs.57,642]

Q. No. 85 : A company has an old machine having book value zero – which can be sold for Rs.50,000. The company is thinking to choose one from following two alternatives:
(i) To incur additional cost of Rs.10,00,000 to upgrade the old existing machine.
(ii) To replace old machine with a new machine costing Rs.20,00,000 plus installation cost Rs.50,000.
Both above proposals envisage useful life to be five years with salvage value to be nil.
The expected after tax profits for the above three alternatives are as under :

Year	Old existing Machine	Upgraded Machine	New Machine
1.	5,00,000	5,50,000	6,00,000
2.	5,40,000	5,90,000	6,40,000
3.	5,80,000	6,10,000	6,90,000
4.	6,20,000	6,50,000	7,40,000
5.	6,60,000	7,00,000	8,00,000

The tax rate is 40 per cent. The company follows straight line method of depreciation. Assume cost of capital to be 15 per cent.
P.V.F. of 15%, 5 = 0.870, 0756, 0.658, 0.572 and 0.497. You are required to advise the company as to which alternative is to be adopted. (NOV. 2008 SFM)

Answer :

Working notes :

(i) Depreciation :

(a) Upgrade cost (it is not repair, it is improvement) will be allowed for tax purpose in the form of depreciation. Annual depreciation = 2,00,000.

(b) Cost of new machine 20,50,000. Annual depreciation = 4,10,000

(c) No annual depreciation on existing machine, its book value is zero.

Annual cash flow from operation (Upgraded machine)

Year	EAT	Depreciation	Cash flow
1	5,50,000	2,00,000	7,50,000
2	5,90,000	2,00,000	7,90,000
3	6,10,000	2,00,000	8,10,000
4	6,50,000	2,00,000	8,50,000
5	7,00,000	2,00,000	9,00,000

Annual cash flow from operation (new machine)

Year	EAT	Depreciation	Cash flow
1	6,00,000	4,10,000	10,10,000
2	6,40,000	4,10,000	10,50,000
3	6,90,000	4,10,000	11,00,000
4	7,40,000	4,10,000	11,50,000
5	8,00,000	4,10,000	12,10,000

DCF analysis of existing machine proposal

	Period	PVF	CF	PV
Cash flow from operation	1	0.870	5,00,000	4,35,000
	2	0.756	5,40,000	4,08,240
	3	0.658	5,80,000	3,81,640
	4	0.572	6,20,000	3,54,640
	5	0.497	6,60,000	3,28,020
NPV				19,07,540

DCF analysis of upgraded machine proposal

	Period	PVF	CF	PV
Net investment	0	1	-9,50,000	-9,50,000
Tax on sale of old machine	1	0.870	- 30,000	- 26,100
Cash flow from operation	1	0.870	7,50,000	6,52,500
	2	0.756	7,90,000	5,97,240
	3	0.658	8,10,000	5,32,980
	4	0.572	8,50,000	4,86,200
	5	0.497	9,00,000	4,47,300
NPV				17,40,120

DCF analysis of new machine proposal

	Period	PVF	CF	PV
Net investment	0	1	-20,00,000	-20,00,000
Tax on sale of old machine	1	0.870	- 30,000	- 26,100
Cash flow from operation	1	0.870	10,10,000	8,78,700
	2	0.756	10,50,000	7,93,800
	3	0.658	11,00,000	7,23,800
	4	0.572	11,50,000	6,57,800
	5	0.497	12,10,000	6,01,370
NPV				16,29,370

The company may continue with existing machine as NPV of this proposal is maximum.

Q.No.86: The XXX Company uses a certainty equivalent approach in its evaluation of risky investments. Currently the company is faced with two alternative investment proposals. The expected value of net cash flows for each investment are as follows:

Year	Cash flows (in Rs. '000) for Investment	
	I	II
0	-45	-60
1	24	30
2	27	30
3	30	30

Risk analysis of cash flow distribution has provided certain equivalents (CE's) as follows:

Year	CEs	
	I	II
0	1.00	1.00
1	0.95	0.90
2	0.90	0.85
3	0.55	0.65

If the after-tax free rate is 4 per cent which of two alternative should be selected?

Answer

NPV OF I PROPOSAL =

$- 45 + [(24 \text{ X } 0.95) \text{ X } (1/1.04)] + [(27 \text{ X } 0.90) \text{ X } (1/1.04)^2] + [(30 \text{ X } 0.55) \text{ X } (1/1.04)^3] = 14.08$

NPV OF II PROPOSAL =

$-60 + [(30 \text{ X } 0.90) \text{ X } (1/1.04)] + [(30 \text{ X } 0.85) \text{ X } (1/1.04)^2] + [(30 \text{ X } 0.65) \text{ X } (1/1.04)^3] = 6.90$

I PROPOSAL IS RECOMMENDED.

Q. No.87: Swastik Ltd. manufacturers of special purpose machine tools, have two divisions which are periodically assisted by visiting teams of consultants. The management is worried about the steady increase of expenses in this regard over the years. An analysis of last year's expenses reveals the following:

	Rs.
Consultants' Remuneration	2,50,000
Travel and Conveyance	1,50,000
Accommodation Expenses	6,00,000
Boarding Charges	2,00,000
Special Allowances	50,000

The management estimates accommodation expenses to increase by Rs.2,00,000 annually.

As part of a cost reduction drive, Swastik Ltd. are proposing to construct a consultancy centre to take care of the accommodation requirement of the consultants. This centre will additionally save the company Rs.50,000 in boarding charges and Rs.2,00,000 in the cost of Executive Training Programs hitherto conducted outside the company's premises, every year.

The following details are available regarding the construction and maintenance of the new centre:

(a) Land: at a cost of Rs.8,00,000 already owned by the company, will be used.

(b) Construction cost: Rs.15,00,000 including special furnishings.

(c) Cost of annual maintenance : Rs.1,50,000.

(d) Construction cost will be written off over 5 years being the useful life.

Assuming that the write-off of construction cost as aforesaid will be accepted for tax purposes, that the rate of tax will be 50 per cent and that the desired rate of return is 15 per cent; you are required to analyze the feasibility of the proposal and make recommendations.

The relevant Present Value Factors are:

Year	1	2	3	4	5
PV Factor	0.87	0.76	0.66	0.57	0.50

(Nov. 1994)

Answer: Working Note

Annual savings less tax (Year 1)	
(i) Cost of Executive Development program	2,00,000
(ii) Accommodation charges	8,00,000
(iii) Boarding charges	50,000
	10,50,000
Less Depreciation and Maintenance charge	4,50,000
	6,00,000
Less tax	3,00,000
	3,00,000
Cash inflow of Year 1 = Annual Savings + Annual Depreciation i.e. 300000+ 300000 = 600000	
From Next Year : Annual Cash inflow will Increase by Rs.1,00,000 [Savings of Increased Accommodation cost Less Tax]	
Assumption: No alternative use for land.	

DCF Analysis Of The Project

	Period	PVF	CF	PV
Invest.	0	1	-15,00,000	-15,00,000
CF	1	0.870	+ 6,00,000	?
CF	2	0.760	+ 7,00,000	?
CF	3	0.660	+ 8,00,000	?
CF	4	0.570	+ 9,00,000	?
CF	5	0.500	+ 10,00,000	?
NPV				+ …?.....

As NPV is positive, the Project is financially viable.

Q. No. 88: A Ltd. is an all equity financed company. The current market price of share is Rs. 180. It has just paid a dividend of Rs. 15 per share and expected growth rate is 12%. Currently, it is evaluating a proposal requiring funds of Rs 20 lakhs with annual cash inflows of Rs. 10 Lakhs for 3 years. Find the NPV of the proposal, if (i) It is financed from the retained earnings; and (ii) It is financed by issuing fresh equity at market price with a flotation cost of 5% of issue price. **(May, 2002)**

Answer

(i) $Ke = (D_1 / P) + g = (16.80 / 180) + 0.12 = 21.33\%$
$Ke = Kr = Ko$

NPV

$$= -20 + \frac{10}{(1.2133)^1} + \frac{10}{(1.2133)^2} + \frac{10}{(1.2133)^3} = \ldots\ldots\ldots.$$

(ii) $Ke = (D_1 / P) + g = (16.80 / 171) + 0.12 = 21.82\%$
$Ko = 21.82$

NPV

$$= -20 + \frac{10}{(1.2182)^1} + \frac{10}{(1.2182)^2} + \frac{10}{(1.2182)^3} = \ldots\ldots..$$

Q. No.89: *ABC Company Ltd.* has been producing a chemical produce by using machine *Z* for the last two years. Now the management of the company is thinking to replace this machine either by *X* or by *Y* machine. The following details are furnished to you:

	Z	X	Y
Book value (Rs.)	1,00,000	-	-
Resale value Now (Rs)	1.10,000		
Purchase Price (Rs.)	-	1,80,000	2,00,000
Annual fixed cost (including Depreciation) (Rs.)	92,000	108000	132000
Variable running costs (including labour) per unit (Rs.)	3	1.50	2.5
Production per hour (Units)	8	8	12
Salvage value (Rs)	10,000	15,000	18,000

You are also provided with the following details:

Selling price per unit	Rs.20
Cost of materials per unit	Rs.10
Annual Operating hours	2,000

Working life of each of the three machines (as from now): 5 yrs.

The company charges depreciation using straight line method. It is anticipated that an additional cost of Rs.8,000 per annum would be incurred on special advertising to sell the extra output of machine *Y*. Assume tax rate of 50 per cent and cost of capital 10 per cent.

Required: Using NPV method, you are required to analyze the feasibility of the proposal and make recommendations. **(Nov. 1999) (14 Marks)**

Working note:

Annual cash flow from each of three machines (Rs.)

	Z	X	Y
Sales	3,20,000	3,20,000	4,80,000
Less :			
Material	-1,60,000	-1,60,000	-2,40,000
VC (including labour)	-48,000	-24,000	-60,000
Fixed cost	-92,000	-1,08,000	-132,000
Special advertising			- 8,000
PBT	20,000	28,000	40,000
Tax	10,000	14,000	20,000
PAT	10,000	14,000	20,000
+ DEP.	18,000	33,000	36,400
Cash flow	28,000	47,000	56,400

DCF Analysis of the replacement proposal:

	Period	Z	X	Y
Net investment	0	0	-70,000	-90,000
Tax on short term capital gain	1	-	-5,000 x 0.909	-5,000 x 0.909
Cash inflow from operation	1-5	28,000 x 3.79	47,000 x 3.79	56,400 x 3.79
Sale of scrap	5	10,000 x 0.621	15,000 x 0.621	18,000 x 0.621
NPV		1,12,330	1,12,900	1,30,389

Machine Y is recommended because of highest amount of NPV.

Note: We have not considered block of asset approach because block approach is not relevant for straight line method.

Q. No.90 : SCL Limited, highly profitably company, is engaged in the manufacture of power intensive products. As part of its diversification plans, the company proposes to put up a Windmill to generate electricity. The details of the scheme are as follows:

(1) Cost of the Windmill Rs. 300 lakh

(2) Cost of Land Rs. 15 lakh

(3) Subsidy from State Government to be Received at the end of first year of installation Rs. 15 lakh

(4) Cost of electricity will be Rs. 2.25 per unit in year 1. This will increase by Re. 0.25 per unit every year till year 7. After that it will increase by Re. 0.50 per unit.

(5) Maintenance cost will be Rs. 4 lakh in year 1 and the same will increase by Rs.2 lakh every year.

(6) Estimated life 10 years.

(7) Cost of capital 15 per cent.

(8) Residual value of Windmill will be nil. However; land value will go up to Rs. 60 lakh, at the end of year 10.

(9) Depreciation will be 100 per cent of the cost of the Windmill in year 1 and the same will allowed for tax purposes.

(10) As Windmills are expected to work based on wind velocity, the efficiency is expected to be an average 30 per cent. Gross electricity generated at this level will be 25 lakh units per annum. 4 per cent of this electricity generated will be committed free to the State Electricity Board as per the agreement.

(11) Tax rate 50 per cent.

(a) Calculate the net present value. (Ignore tax on capital profits)

(b) List down two non-financial factors that should be considered before taking a decision.

For your exercise use the following discount factors:

Year	1	2	3	4	5	6	7	8	9	10
PVFs	0.87	0.76	0.66	0.57	0.50	0.43	0.38	0.33	0.28	0.25

(Nov. 1995)

Answer

Assumption; The subsidy is general purpose subsidy i.e. it does not relate to any fixed asset. (Paragraph 16 of AS-12 refers to this type of subsidy as promoters' contribution)

Alternatively, it could be assumed that the subsidy is towards the cost of windmills. In that case, the tax savings on depreciation would be Rs.142.50Lakhs (in place of Rs.150Lakhs) and the NPV would be reduced by Rs.6,525Lakhs (reduced tax savings x PVF_1 i.e. 7.50Lakhs x 0.87)

Cash in flow from operation

Year	Savings of Energy cost	Maintenance Cost	Tax	CF
1	24x2.25	4	25	25
2	24x2.50	6	27	27
3	24x2.75	8	29	29
4	24x3.00	10	31	31
5	24x3.25	12	33	33
6	24x3.50	14	35	35
7	24x3.75	16	37	37
8	24x4.25	18	42	42
9	24x4.75	20	47	47
10	24x5.25	22	52	52

			(Rs Lakhs)	
	Period	PVF	C.F.	P.V.
Investment	0	1	- 315	- 315
Subsidy	1	0.87	+ 15	+ 15 x 0.87
Tax savings on Depreciation	1	0.87	+ 150	+ 150 x 0.87
Cash in flow from operation	1	0.87	25	25 x 0.87
---------d0---------	2	0.76	27	27 x 0.76
---------d0---------	3	0.66	29	29 x 0.66
---------d0---------	4	0.57	31	31 x 0.57
---------d0---------	5	0.50	33	33 x 0.50
---------d0---------	6	0.43	35	35 x 0.43
---------d0---------	7	0.38	37	37 x 0.38
---------d0---------	8	0.33	42	42 x 0.33
---------d0---------	9	0.28	47	47 x 0.28
---------d0---------	10	0.25	52	52 x 0.25
Sale of land	10	0.25	60	60 x 0.25
NPV				+ 8.26

Note : Long term capital gain on Land has not been considered because of item No. 11(a) of the question. Other wise also, we are not given 'index numbers", which is a requirement of calculation of tax on LTCGs. [Land is a non- depreciable asset, the gain or loss on sale of such asset is LTCG/LTCL]

Non – financial factors to be considered before the decision:

(i) Velocity of wind – the success of wind mill depend proper velocity of the winds. Expert advice on this matter may be taken on this matter.

(ii) It may be assured that the company is getting the latest technology which is again a key factor of success. (If some more advanced technology is expected to hit the market in near future, if possible, the project may be postponed to take advantage of that).

Q. No.91 A USA based company is planning to set up a software development unit in India. Software developed at the Indian unit will be bought back by the US parent at a transfer price of US $10 millions. The unit will remain in existence in India for one year; the software is expected to get developed within this time frame.

The US based company will be subject to corporate tax of 30 per cent and a with holding tax of 10 per cent in India and will not be eligible for tax credit in the US. The software developed will be sold in the US market for US $ 12.0 millions. Other estimates are as follows :

Rent for fully furnished unit with necessary hardware in India	Rs.15,00,000
Man power cost (80 software professional will be working for 10 hours each day)	Rs.400 per man hour
Administrative and other costs	Rs.12,00,000

Advise the US company on financial viability of the project. The rupee-dollar rate is Rs.48/$. **(Nov. 2008)** (4 Marks)

Answer

Statement showing profit from Indian operations:

Transfer price	48,00,00,000
Rent	-15,00,000
Man power cost (assuming 365 working days in a year)	-11,68,00,000
Administrative and other cost	-12,00,000
EBT	36,05,00,000
Tax	- 10,81,50,000
EAT	25,23,50,000
Less withholding tax[7]	- 2,52,35,000
	22,71,15,000

The company can remit 22,71,15,000/48 i.e. $4.70m to USA. Besides there will be profit of $2m as the difference between sale consideration and transfer price. The total profit will be $ 6.70m.
The project is financially viable.

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[7] Income-tax Act, 1961 provides for levy of income-tax on the income of foreign companies and non-residents, but only to the extent of their income sourced from India. The Act also requires deduction of tax at source from certain types of income, and for withholding tax on all chargeable income remitted outside India.

Q. No. 92: ABC Ltd is considering a project in US, which will involve an initial investment of US $ 11m. The project will have 5 years of life. Current spot exchange rate is Rs.48 per $. The risk free rate in US is 8% and the same in India is 12%. Cash inflows from the project are as follows:

Year →	1	2	3	4	5
Cash inflow US$ →	2.00m	2.50m	3.00m	4.00m	5.00m

Calculate the NPV of the project using the foreign currency approach. Required rate of return on this project is 14%. **(NOV. 2006) (5 marks)**

Answer :

DCF Analysis pf the project 9 Discounting rate: 9.9286 %)

			$ Million	
	Period	PVF	C.F.	
Investment	0	1	-11.00	-11.00
	1	0.910	+ 2.00	+ 1.820
	2	0.828	+ 2.50	+ 2.070
	3	0.753	+ 3.00	+ 2.259
	4	0.686	+ 4.00	+ 2.744
	5	0.624	+ 5.00	+ 3.120
NPV				+ 1.013

Q. No.93 : Norish Investment Ltd. possesses Rs. 90,000 cash and has the opportunity to invest in 3 projects, the outcomes of which depend on two states of economic circumstances (that is, states of nature). Each outcome will last one year and the cash flows for each alternative are estimated to be as follows:

States of nature	*I*	*II*
Probability of states of nature	0.5	0.5
Cash inflows less		
Cash outflows (Rs.)		
Project *A*	- 40,000	+ 60,000
Project *B*	+ 50,000	- 50,000
Project *C*	+ 9,000	+ 8,000

The cash flows are arrived at after deducting initial outlays of Rs. 40,000 for the Project *A*, Rs. 50,000 for project *B* and Rs. 90,000 for project *C*. The following alternatives are available for an investment of Rs. 90,000:

(i) Accept any one of the project *A*, *B* and *C* and reject the other two project.

(ii) Accept both projects *A* and *B*. What is your recommendation?

Answer

Alternative I
Accept any one of the project A, B & C and reject the other two projects.

Expected Return		Rupees.
Project A =	- 40,000 x 0.5 + 60,000 x 0.5 =	10,000
Project B =	+ 50,000 x 0.5 + 50,000 x 0.5 =	NIL
Project C =	+ 9,000 x 0.5 + 8,000 x 0.5 =	8,500

Alternative II – Accept both Projects A and B

Expected Return

Project A & B = + 10,000 x 0.5 + 10,000 x 0.5 = 10,000

Recommendation:- The company should go for Projects A & B as there would be maximum income (same amount of income as under alternative I) with no risk.

EXTRA PRACTICE QUESTIONS (OPTIONAL)

Q. No.94 :X Ltd. an existing profit-making company, is planning to introduce a new product with a projected life of 8 years. Initial equipment cost will be Rs. 120 lakhs and additional equipment costing Rs. 10 lakhs will be needed at the beginning of third year. At the end of the 8 years, the original equipment will have resale value equivalent to the cost of removal, but the additional equipment would be sold for Rs. 1 lakhs. Working Capital of Rs. 15 lakhs will be needed. The 100% capacity of the plant is of 4,00,000 units per annum, but the production and sales-volume expected are as under:

Year	Capacity in percentage
1	20
2	30
3-5	75
6-8	50

A sale price of Rs. 100 per unit with a profit-volume ratio of 60% is likely to be obtained. Fixed Operating Cash Cost are likely to be Rs. 16 lakhs per annum. In addition to this the advertisement expenditure will have to be incurred as under:

Year	1	2	3-5	6-8
Expenditure in Rs. lakhs each year	30	15	10	4

The company is subject to 50% tax, straight-line method of depreciation, (permissible for tax purposes also) and taking 12% as appropriate after tax Cost of Capital. Should the project be accepted ? (14 marks) **(May 2002)**

Answer

Year	Contribution	Cash FC	Depreciation	Tax	Cash inflow from operation
1	48,00,000	46,00,000	15,00,000	Savings 6,50,000	+ 8,50,000
2	72,00,000	31,00,000	15,00,000	13,00,000	28,00,000
3	1,80,00,000	26,00,000	16,50,000	68,75,000	85,25,000
4	1,80,00,000	26,00,000	16,50,000	68,75,000	85,25,000
5	1,80,00,000	26,00,000	16,50,000	68,75,000	85,25,000
6	1,20,00,000	20,00,000	16,50,000	41,75,000	58,25,000
7	1,20,00,000	20,00,000	16,50,000	41,75,000	58,25,000
8	1,20,00,000	20,00,000	16,50,000	41,75,000	58,25,000

DCF ANALYSIS OF THE PROJECT

	PERIOD	PV	CF	PV
Investment	0	1	-1,35,00,000	-1,35,00,000
CFO	1	0.893	+ 8,50,000	+ 7,59,050
CFO	2	0.797	+ 28,00,000	+ 22,31,600
Cost of mach.	2	0.797	-10,00,000	-7,97,000
CFO	3	0.712	+ 85,25,000	+ 60,69,800
CFO	4	0.636	+ 85,25,000	+ 54,21,900
CFO	5	0.567	+ 85,25,000	+ 48,33,675
CFO	6	0.507	+ 58,25,000	+ 29,53,275
CFO	7	0.452	+ 58,25,000	+ 26,32,900
CFO	8	0.404	+ 58,25,000	+ 23,53,300
Sale of scrap & Release of WC	8	0.404	+ 16,00,000	+ 6,46,400
			NPV	+ 1,36,04,900

The project may be taken up as the NPV is positive.

TEACHING Note – not to be given in the exam: The first sentence of the question hints that set-off of loss should be assumed.

Q.No.95: Nine Gems Ltd. has just installed Machine *R* at a cost of Rs.2,00,000. The machine has a five years life with no residual value. The annual volume of production is estimated at 1,50,000 units, which can be sold at Rs.6 per unit. Annual operating costs are estimated at Rs.2,00,000 (excluding depreciation) at this output level. Fixed costs are estimated at Rs.3 per unit for the same level of production.

Nine Gems Ltd. has just come across another model called Machine *S* capable of giving the same output at an annual operating cost of Rs.1,80,000 (exclusive of depreciation). There will be no change in fixed costs: Capital cost of this machine is Rs.2,50,000 and the estimated life is for five years with nil residual value.

The company has an offer for sale of Machine *R* at Rs.1,00,000. But the cost of dismantling and removal will amount to Rs.30,000. As the company has not yet commenced operations, it wants to sell Machine *R* and purchase Machine *S*.

Nine Gems Ltd. will be a zero-tax company for seven years in view of several incentives and allowances available.

The cost of capital may be assumed at 14 per cent P.V. factors for five years are as follows:

Year	*P.V. Factor*
1	0.877
2	0.769
3	0.675
4	0.592
5	0.519

(i) Advise whether the company should opt for the replacement.

(ii) Will there be any change in your view, if Machine *R* has not been installed but the company is in the process of selecting one or the other machine?

Support your view with necessary workings. **(Nov. 1996) (12 Marks)**

Answer

[i] Replacement:

Initial net investment

= Cost of new machine – (Sale of Machine R – Cost of dismantling etc)

= 250000 – (100000 – 30000) = 180000

Savings in annual cash cost = 200000 – 180000 = 20000

DCF ANALYSIS OF REPLACEMENT PROPOSAL

	Period	PVF/ Annuity	Cash flow	PV of cash flow
Initial net investment	0	1	-1,80,000	-1,80,000
Savings in annual cost	1-5	3.432	20,000	68,640
				NPV= -1,11,360

As NPV of the replacement proposal is negative, the replacement is not recommended.

[ii]

Annual cash inflow of Machine R :	Rupees
Sales	1,50,000 x 6
Operating cost	- 2,00,000
FC	- 4,50,000
	2,50,000

Annual cash inflow of Machine S :	Rupees
Sales	1,50,000 x 6
Operating cost	- 1,80,000
FC	- 4,50,000
	2,70,000

DCF ANALYSIS OF R

	Period	PVF/ Annuity	Cash flow	PV of cash flow
Initial net investment	0	1	-2,00,000	-2,00,000
Savings in annual cost	5	3.432	2,50,000	8,58,000
				NPV = + 6,58,000

DCF ANALYSIS OF S

	Period	PVF/ Annuity	Cash flow	PV of cash flow
Initial net investment	0	1	-2,50,000	-2,50,000
Savings in annual cost	5	3.432	2,70,000	9,26,640
				NPV= + 6,76,640

As NPV of S is higher than that of R, S is recommended.

Q. No.96: Modern Enterprises Ltd. is considering the purchase of a new computer system for its R & D Division, which would cost Rs.35Lakhs. The operation and maintenance costs (excluding depreciation) are expected to be Rs.7Lakhs p.a. It is estimated that the useful life of the system would be 6 years, at the end of which the disposal value is expected to be Rs.1Lakh.

The tangible benefits expected from the system in the form of reduction in design and draughtsmanship cost would be Rs.1 Lakh p.m. Besides, the disposal of the used drawings, equipment and furniture, initially, is anticipated to net Rs.9 Lakhs.
Capital expenditure in research and development would attract 100% write off for tax purposes. The gains arising from the disposal of used assets may be considered tax free. The company's tax rate is 50%. Cost of capital 12%. After appropriate analysis of cash flows, please advise the company of the financially viability of the proposal. **(Nov. 1991)**

Answer :
DCF ANALYSIS OF PROJECT

	Period	PVF/Annuity	CF	PV
Net Invest.	0	1	-26	-26
Tax saving on dep.	1	.892	+ 17.50	+ 15.61
Operating cost less Tax saving	1-6	4.108	-3.50	-14.38
Benefit less Tax	1-6	4.108	+ 6.00	+ 24.65
Sale (scrap)	6	0.506	1.00	+ 0.506
NPV				+ ..?...

NPV + , hence recommended.

Q.No.97: A company is considering a proposal of installing a drying equipment. The equipment would involve a cash outlay of Rs.6,00,000 and net working capital of Rs.80,000. The expected life of the project is 5 years without any salvage value. Assume that the company is allowed to charge depreciation on straight-line basis for Income-tax purpose. The estimated before-tax cash inflows are given below:

Before-tax Cash inflows (Rs.'000)					
Year	1	2	3	4	5
	240	275	210	180	160

The applicable Income-tax rate to the company is 35%. If the company's opportunity cost of capital is 12%, calculate the equipment's discounted payback period, payback period, net present value and internal rate of return.

The PV factors at 12%, 14% and 15% are:

Year	1	2	3	4	5
PV factor at 12%	0.8929	0.7972	0.7118	0.6355	0.5674
PV factor at 14%	0.8772	0.7695	0.6750	0.5921	0.5194
PV factor at 15%	0.8696	0.7561	0.6575	0.5718	0.4972

Answer

Statement showing cash inflow from operation

	Rs. thousands				
Year	1	2	3	4	5
Before-tax Cash inflows (A)	240	275	210	180	160
Depreciation	120	120	120	120	120
Taxable income	120	155	90	60	40
Tax (B)	42	54.25	31.50	21	14
Cash inflow from operation	198	220.75	178.50	159	146

DCF analysis of the project:

			Rupees thousands		
	Period	PVF	CF	PV	Cum. Amount of PV of Cash flow
Cash in flow from operation	1	0.893	198.00	176.81	176.81
------do----	2	0.797	220.75	175.94	352.75
------do----	3	0.712	178.50	127.09	479.84
------do----	4	0.636	159.00	101.12	580.96
------do----	5	0.567	146.00	82.78	663.74
Release of WC	5	0.567	80.00	45.36	709.10
Investment	0	1	-680.00	-680	
NPV				+ 29.10	

Discounted CF Payback period : 4 + (99.04) / 128.14 = 4.77 years
: 4 years 9 months and 8 days

Pay Back period :

Year	CF	Cumulative CF
1	198.00	198.00
2	220.75	418.75
3	178.50	597.25
4	159.00	756.25

Pay back period = 3 + 82.75/159.00 = 3.52 years
= 3 years 6 months 7 days

Estimating the other discounting rate :
PI = 709.10/680 = 1.0428
PV of return (exclusive of cost of capital) = 0.0428
Annual return (exclusive of cost of capital) = 0.0428/3.605
= 0.0118 = 1.18%
Approximate rate of return = 13.18%.
Let's take the other discounting rate = 15%

NPV at 15 % = - 680 + 198 x 0.870
+ 220.75 x 0.756
+ 178.50 x 0.658
+ 159.00 x 0.572
+ 226.00 x 0.497
- 20.13

$$\text{IRR} = \text{Lower rate} + \frac{\text{Lower rate NPV}}{\text{Lower rate NPV} - \text{Higher rate NPV}} \times \text{Diff. in rates}$$

$$IRR = 12 + \frac{29.10}{29.10 - (-20.13)} X\ 3 = 13.77\ \%$$

Q. No. 98

(a) Consider the following mutually exclusive projects :

Cash Flows (Rs.)					
Projects	C_0	C_1	C_2	C_3	C_4
A	-10,000	6,000	2,000	2,000	12,000
B	-10,000	2,500	2,500	5,000	7,500
C	-3,500	1,500	2,500	500	5,000
D	-3,000	0	0	3,000	6,000

Required:

(i) Calculate the payback period for each project.

(ii) If the standard payback period is 2 years, which project will you select? Will your answer differ, if standard payback period is 3 years ?

(iii) If the cost of capital is 10%, compute the discounted payback period for each project. Which projects will you recommend, if standard discounted payback period is (1) 2 years; (ii) 3 years ?

(iv) Compute NPV of each project. Which project will you recommend on the NPV criterion ? The cost of capital is 10%. What will be the appropriate choice criteria in this case ? The PV factors at 10% are :

Year	1	2	3	4
PV factor at 10%	0.9091	0.8264	0.7513	0.6830

(Nov. 2007 PE II)

Answer :

(i) Table showing cumulative cash flows :

Year	A	B	C	D
1	6000	2500	1500	0
2	8000	5000	4000	0
3	10000	10000	4500	3000
4	22000	17500	9500	9000

Project	Payback period
A	3 years
B	3 years
C	1 year + 2000/2500 year = 1.80 year = 1 year 9 months 18 days
D	3 years

(ii) If the standard payback period is 2 years, C may be taken up.
If standard payback period is 3 years, any one of the four may be taken

(iii) Table showing cumulative cash flows :

Year	A	B	C	D
1	5,455.00	2,273.00	1,364.00	0
2	7,108.00	4,339.00	3,430.00	0
3	8,611.00	8,096.00	3,806.00	2,254.00
4	16,807.00	13,217.00	7,221.00	6,352.00

Project	Payback period
A	3 years + 1389/8196 year=3.17 years=3 years 2 months 1day
B	3 years + 1904/5123 year=3.37 years=3 years 4 months 6 days
C	2 year + 70/376 year = 2.1862 years = 2 years 2 months 7 days
D	3 year + 746/4098 year = 3 years 2.18 months = 3 years 2 months 6 days

If the standard discounted payback period is 2 years, none of the projects should be accepted.
If the standard discounted payback period is 3 years, C may be accepted.

(iv)

Period	A	B	C	D
0	-10,000	-10,000	-3,500	-3,000
1	6,000 x 0.9091	2,500 x 0.9091	1,500 x 0.9091	0
2	8,000 x 0.8264	5.000 x 0.8264	4,000 x 0.8264	0
3	10,000 x 0.7513	10,000 x 0.7513	4,500 x 0.7513	3000 x 0.7513
4	22,000 x 0.6830	17,500 x 0.6830	9,500 x 0.6830	9000 x 0.6830
NPV	6806	3218	3720	3352

On the basis of NPV, A may be accepted as its amount of NPV is the highest.

Q. No.99 : A company is considering the proposal of taking up a new project which required an investment of Rs. 400 lakh on machinery and other assets. The project is expected to yield the following earnings (before depreciation and taxes) over the next five years :

Year	Earning (Rs. in lakh)
1	160
2	160
3	180
4	180
5	150

The cost of raising the additional capital is 12% and assets have to be depreciated at 20% on 'Written Down Value' basis. The scrap value at the end of the five years' period may be taken as zero. Income-tax applicable to the company is 50%.
You are required to calculate the net present value of the project and advise the management to take appropriate decision. Also calculate the Internal Rate of Return of the Project.

Note: Present value of Rs. 1 at different rates of interest are as follows:

Year	10%	12%	14%	16%
1	0.91	0.89	0.88	0.86
2	0.83	0.80	0.77	0.74
3	0.75	0.71	0.67	0.64
4	0.68	0.64	0.59	0.55
5	0.62	0.57	0.52	0.48

(May, 2007 PE II)

Working note:

	Rupees Lakhs	
Year	Depreciation / STCL	WDV
1	80	320
2	64	256
3	51	205
4	41	164
5	33	131

	Rupees Lakhs			
Year	PBD	Depreciation	Tax	CF
1	160	80	40.00	120.00
2	160	64	48.00	112.00
3	180	51	64.50	115.50
4	180	41	69.50	110.50
5	150	33	58.50	91.50

DCF Analysis of the project (Discounting rate : 12%)

	Rupees Lakhs			
	Period	PVF	CF	PV
Investment	0	1	-400.00	-400
Operation	1	0.89	120.00	106.80
Operation	2	0.80	112.00	89.60
Operation	3	0.71	115.50	82.005
Operation	4	0.64	110.50	70.72
Operation	5	0.57	91.50	52.155
NPV				1.28

The project may be taken up as the NPV is positive.

Calculation of IRR :
NPV at 16% = -400 + 103.20 + 82.88 + 73.92 + 60.78 + 43.92 = - 35.30

$$\text{IRR} = \text{Lower rate} + \frac{\text{Lower rate NPV}}{\text{Lower rate NPV} - \text{Higher rate NPV}} \times \text{Diff. in rates}$$

$$\text{IRR} = 12 + \frac{1.28}{1.28 - (-35.30)} \text{ X } 4 = 12.14\%$$

The project may be taken up as IRR is more than the cost of additional funds.

Q. No. 100 Company UVW has to make a choice between two identical machines, in terms of capacity, 'A' and 'B' They have been designed differently but do exactly they same job..

	Cost	Life	Annual cost to run
Machine A	Rs.7,50,000	3 years	Rs.2,00,000
Machine B	Rs.5,00,000	2 years	Rs.3,00,000

The cash flows of A and B are real cash flows. The costs are forecasted in rupees of constant purchasing power. Opportunity cost of capital is 9%. Ignore tax. Which machine the company UVW should buy? **(PE II Nov. 2006)**

The answer to this question can be given by any one of the following three ways:

Answer I

Statement showing equivalent annual cost of each of the two machines

	Equivalent Annual Cost
A	2,00,000 + 7,50,000/2.531 = 4,96,326
B	3,00,000 + 5,00,000/1.759 = 5,84,252

Capacity of both machines is same. A's annual cost is lower than that of B. Hence, A is recommended.

Answer II

Statement showing PV of cost of using Machine A for 3 years and Machine B for 2 years

A	B
7,50,000 + 2,00,000 x 2.531 = 12,56,200	5,00,000 + 3,00,000 x 1.783 = 10,34,900
Equivalent annual cost = 12,56,200/2.531 =4,96,326	Equivalent annual cost = 10,34,900 / 1.759 = 5,84,252

Answer III

Let's assume that the time origin is 6 years.

Statement showing PV of cost of using each of the two Machines A and B for 6 years.

	Period	A	B
Cost	0	7,50,000	5,00,000
Operation cost	1	2,00,000 x 0.917	3,00,000 x 0.917
Operation cost	2	2,00,000 x 0.842	3,00,000 x 0.842
Cost (beginning of 3rd year)	2	------	5,00,000 x 0.842
Operation cost	3	2,00,000 x 0.772	3,00,000 x 0.772
Cost (beginning of 4th year)	3	7,50,000 x 0.772	3,00,000 x 0.772
Cost (beginning of 5th year)	4	--------	5,00,000 x 0.708
Operation cost	4	2,00,000 x 0.708	-------
Operation cost	5	2,00,000 x 0.650	3,00,000 x 0.650
Operation cost	6	2,00,000 x 0.596	3,00,000 x 0.596
NPV of cost		22,26,200	26,20,800

Machine A is recommended a because lower amount of PV of cost.

Q. No. 101: X & Co. is contemplating whether to replace an existing machine or to spend money in overhauling it. X & Co. currently pays no taxes. The replacement machine costs Rs. 95,000 and requires maintenance of Rs.10,000 every year at the year end for eight years. At the end of eight years, it would have a salvage value of Rs.25,000 and would be sold. The existing machine requires increasing amounts of maintenance each year
and its salvage value falls each year as follows:

Year	Maintenance (Rs.)	Salvage (Rs.)
Present	0	40,000
1	10,000	25,000
2	20,000 1	15,000
3	30,000	10,000
4	40,000	0

The opportunity cost of capital for X & Co. is 15%. You are required to state, when should the firm replace the machine:
(Given : Present value of an annuity of Re. 1 per period for 8 years at interest rate of 15% - 4.4873; present value of Re.1.00 to be received after 8 years at interest rate of 15% - 0.3269) (10 Marks)**(June 2009)**

Answer; Answer

(A) New Machine (Repetitive cash - flows)

Cost of machine	-95000 x 1.000
Annual maintenance cost for 8 years	-10000 x 4.4873
Salvage value after 8 years	+ 25000 x 0.3269
PV of cost of using the machine for 8 years	-131700

EA cost = 131700 / 4.4873 = 29350

Whenever we replace the machine, after replacement year after year the equivalent annual cost would be Rs.29,350 (for infinite period)

(B) Other cash flows (NON-REPETITIVE CASH FLOWS)

PV of the cash flows associated with the use of old machine for one year:

Loss of salvage value	- 40,000 x 1.000
Maintenance	- 10,000 x 0.870
Salvage value	+ 25,000 x 0.870
	26,950

E A cost = 26950 / .870 = 30977

PV of the cash flows associated with the use of old machine for 2 years:

-40,000 x 1.000
-10,000 x 0.870
- 20,000 x 0.756
+ 15,000 x 0.756

PV of cost: 52,480

E A cost = 52,480 / 1.626 = 32,276

PV of the cash flows associated with the use of old machine for 3 years:
-40,000 x 1.000
-10,000 x 0.870
-20,000 x 0.756
-30,000 x 0.658
+ 10,000 x 0.658

PV of cost = 76,980

E A cost = 76,980 / 2.283 = 33,719

PV of the cash flows associated with the use of old machine for 4 years:
-40000 x 1
-10000 x 0.870
-20000 x 0.756
-30000 x 0.658
-40000 x 0.572

PV of cost = 1,06,440

E A cost = 1,06,440 / 2.855 = 37,281
Statement showing EA cost under each of 5 alternatives

Year	I	II	III	IV	V
1	29350	30,977	32,276	33,719	37,281
2	29350	29350	32,276	33,719	37,281
3	29350	29350	29350	33,719	37,281
4	29350	29350	29350	29350	37,281
5^{th} year onwards	29350	29350	29350	29350	29350

Alternative 1^{st} is recommended.

NPV = 1.013m $ x Rs.48/$ = Rs.48.624m

Q. No. 102: A small project is composed of seven activities, whose time estimates are listed below. Activities are identified by their beginning (i) and ending (j) node numbers.

Activity	Estimated durations (in days)		
(i-j)	Optimistic	Most likely	Pessimistic
1-2	2	2	14
1-3	2	8	14
1-4	4	4	16
2-5	2	2	2
3-5	4	10	28
4-6	4	10	16
5-6	6	12	30

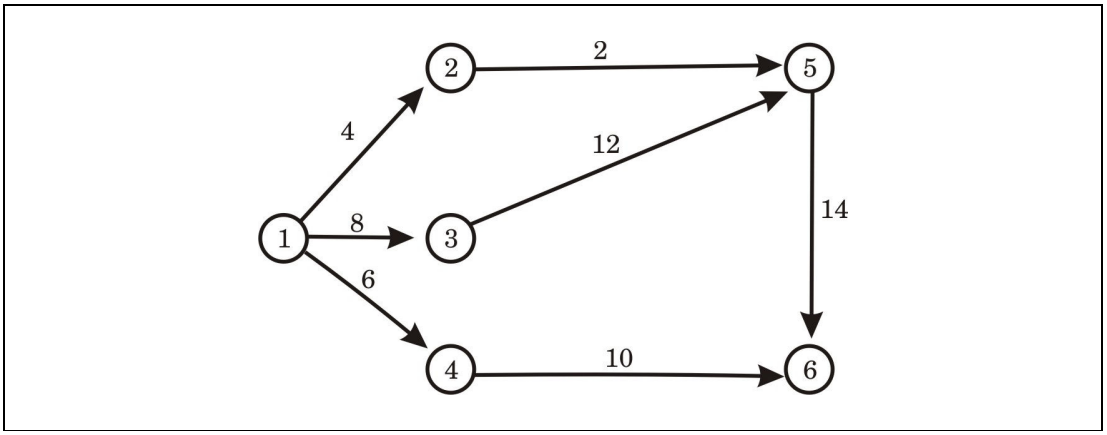
(a) Draw the project network.

(b) Find the expected duration and variance for each activity. What is the expected project length ?

(c) If the project due date is 38 days. What is the probability of meeting the due date?

Answer :

(a)



(b)

Activity	Expected Duration	Variance
1-2	4	4
1-3	8	4
1-4	6	4
2-5	2	0
3-5	12	16
4-6	10	4
5-6	14	16

Path	Duration
1-2-5-6	4 + 2 + 14 = 20
1-3-5-6	8 + 12+ 14 = 34
1-4-6	6 + 10 = 16

Various paths:

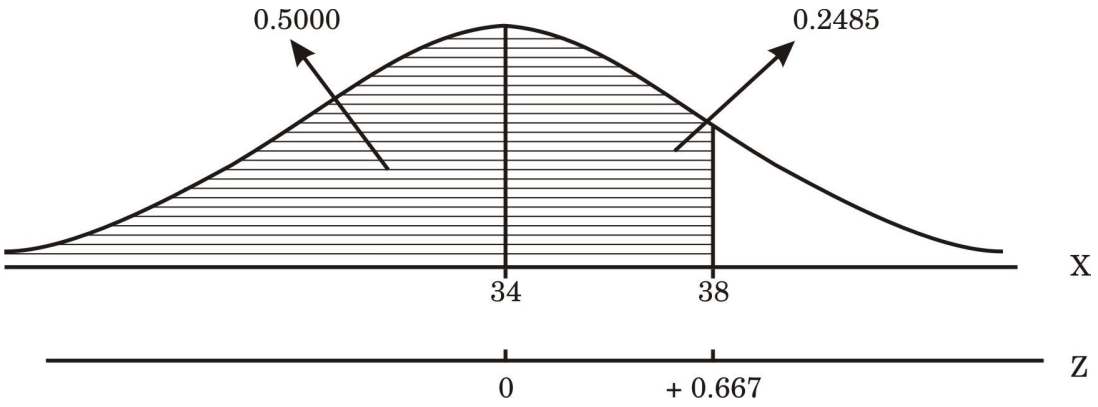
The critical path is 1-3-5-6.

(b) The expected duration is 8 + 12 + 14 = 34 days.

(c) Variance of the project length is 4+ 16+ 16 = 36 days.

SD of the project length is 6 days.

Z = (38-34)/6 = 0.667



The probability of completing the project in 38 days or less is 0.7485.

Q. No. 103:

A project consists of the following activities with the time estimates noted against each :

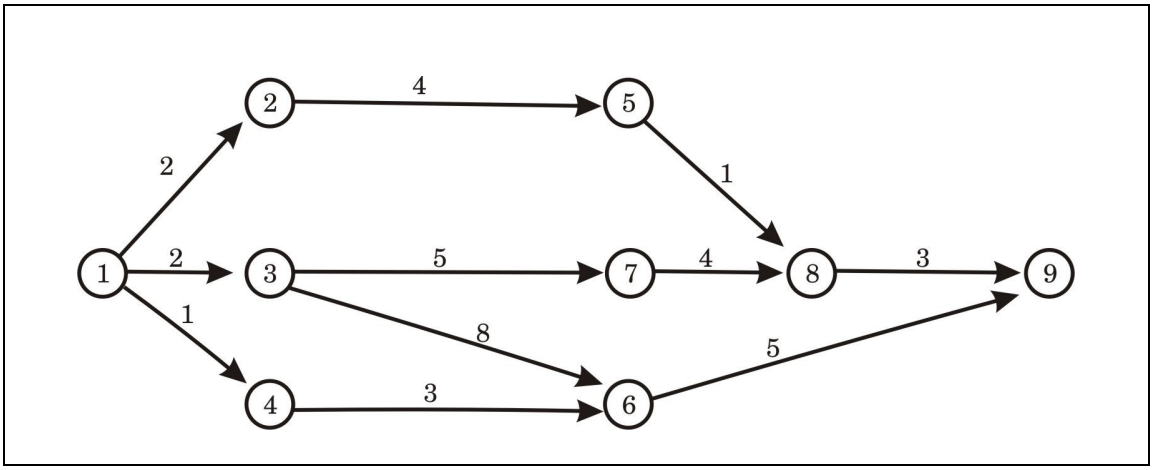
Activity	Time Estimate (Weeks)	Activity	Time Estimate (Weeks)
1-2	2	3-7	5
1-3	2	4-6	3
1-4	1	5-8	1
2-5	4	6-9	5
3-6	8	7-8	4
		8-9	3

Required :

(i) Draw a network diagram

(ii) Determine the critical path and its duration

(i)



(ii)

Path	Duration
1-2-5-8-9	2 + 4 + 1 + 3 = 10
1-3-7-8-9	2 + 5 + 4 + 3 = 14
1-3-6-9	2 + 8 + 5 = 15
1-4-6-9	1 + 3 + 5 = 9

The critical path is 1-3-6-9. Its duration is 15 weeks.

Q. No. 104: A Publishing house has bought out a new monthly magazine, which sells at Rs. 37.5 per copy. The cost of producing it is Rs.30 per copy. A Newsstand estimates the sales pattern of the magazine as follows :

Demand Copies	Probability
0 < 300	0.18
300 < 600	0.32
600 < 900	0.25
900 < 1200	0.15
1200 < 1500	0.06
1500 < 1800	0.04

The newsstand has contracted for 750 copies of the magazine per month from the publisher.

The unsold copies are returnable to the publisher who will take them back at cost less Rs. 4 per copy for handling charges.
The newsstand manager wants to simulate of the demand and profitability. The of following random number may be used for simulation :

27, 15, 56, 17, 98, 71, 51, 32, 62, 83, 96, 69.

You are required to-

(i) Allocate random numbers to the demand patter forecast by the newsstand.

(ii) Simulate twelve months sales and calculate the monthly and annual profit/loss.

(iii) Calculate the loss on lost sales.

Answer (a)

Monthly demand	Probability	Cum. Probability	Cumulative probability range	Random no. adjusted cumulative probability range
150	0.18	0.18	0-0.18	0-0.17
450	0.32	0.50	0.18-0.50	0.18-0.49
750	0.25	0.75	0.50-0.75	0.50-0.74
1050	0.15	0.90	0.75-0.90	0.75-0.89
1350	0.06	0.96	0.90-0.96	0.90-0.95
1650	0.04	1.00	0.96-1.00	0.96-0.99

(b) Statement showing 12 months profit on simulation basis

Month	Demand	Sales (Rs)	Cost of sales	Profit
1	450	450 x 37.50	14,700	2,175
2	150	150 x 37.50	6,900	-1275
3	750	750 x 37.50	22,500	5,625
4	150	150 x 37.50	6,900	-1275
5	1650	750 x 37.50	22,500	5,625
6	750	750 x 37.50	22,500	5,625
7	750	750 x 37.50	22,500	5,625
8	450	450 x 37.50	14,700	2,175
9	750	750 x 37.50	22,500	5,625
10	1050	750 x 37.50	22,500	5,625
11	1650	750 x 37.50	22,500	5,625
12	750		22,500	5,625
				Rs.46,800

(c) Loss on lost sales : (900 + 300 + 900) x 7.50 = 15,750

Q.No.105: Forward Ltd. is considering whether to invest in a project which would entail immediate expenditure on capital equipment of Rs. 40,000. Expected sales from project are as follows:

Sales Volume (units)	2000	6000	8000	10000	14000
Probability	0.10	0.25	0.40	0.15	0.10

Once sales are established at a certain volume in the first year, they will continue at the same volume in subsequent year. SP Rs.10, VC per unit Rs.6. Annual cash Fixed costs Rs.20,000. Cost of capital 10 per cent. Scrap value of equipment Rs.3,000 after 6-year life of the project. Find (a) NPV, (b) minimum annual (units) to justify the project. Ignore Tax.

Answer

Working note:

(a) Expected Sales Units =

2000 x 0.10 + 6000 x 0.25 + 8000 x 0.40 + 10,000 x 0.15 + 14,000 x 0.10

= 7800 units

Selling Price = Rs.10 / Unit
Variable Cost = Rs.6/ Unit
Contribution = Rs.4/ Unit
Exp. Profit = 7800 x 4 – 20,000 = Rs.11,200
Scrap value of Equipment (after 6 years) = Rs.3,000.

DCF Analysis of the Project (Discounting rate : 10%)

	Period	PVF	C.F.	P.V.
Investment	0	1	– 40,000	– 40,000
Cash Inflow from Operations	1 – 6	4.3553	+ 11200	+ 48,779
Scrap Value	6	0.5645	+ 3000	+ 1693
			NPV =	+ 10,472

(b) Let, minimum annual units = y

[4y – 20,000] x 4.553 + 3000 x .5645 – 40,000 = 0

17.4212y – 87106 + 1694 – 40,000 = 0

17.4212y = 125412

y = 7199

Minimum Annual (Units) sale to justify the project = 7199 units.

Q. No.106 : The Textile Manufacturing Company Ltd., is considering one of two mutually exclusive proposals, Projects M and N, which require cash outlays of Rs.8,50,000 and Rs.8,25,000 respectively. The certainty-equivalent (C.E) approach is used in incorporating risk in capital budgeting decisions. The current yield on government bonds is 6% and this is used as the risk free rate. The expected net cash flows and their certainty equivalents are as follows :

	Project M		Project N	
Year-end	Cash Flow Rs.	C.E.	Cash Flow Rs.	C.E.
1	4,50,000	0.8	4,50,000	0.9
2	5,00,000	0.7	4,50,000	0.8
3	5,00,000	0.5	5,00,000	0.7

(i) Which project should be accepted ?

(ii) If risk adjusted discount rate method is used, which project would be appraised with a higher rate and why?. (12 marks) **(November, 2003)**

Answer

NPV OF M PROPOSAL (Rs. Lakhs) =

$- 8.50 + [(4.50 \times 0.80) \times (1/1.06)] + [(5.00 \times 0.70) \times (1/1.06)^2] + [(5 \times 0.50) \times (1/1.06)^3] = 0.1098$

NPV OF N PROPOSAL =

$-8.25 + [(4.50 \times 0.90) \times (1/1.06)] + [(4.50 \times 0.80) \times (1/1.06)^2] + [(5 \times 0.70) \times (1/1.06)^3] = 1,71,315$

II PROPOSAL IS RECOMMENDED.

Q. No107: A company is considering two mutually exclusive projects *X* and *Y*. Project *X* costs Rs.30,000 and Project *Y* Rs.36,000. You have been given below the net present value, probability distribution for each project:

Project X		Project Y	
NPV Estimate (Rs)	Probability	NPV Estimate (Rs)	Probability
3,000	0.10	3,000	0.20
6,000	0.40	6,000	0.30
12,000	0.40	12,000	0.30
15,000	0.10	15,000	0.20

(i) Compute the expected net present value of Projects *X* and *Y*.

(ii) Compute the risk attached to each project, i.e., Standard Deviation of each probability distribution.

(iii) Which project do you consider more risky and why?

(iv) Compute the profitability index of each project.**(May,1999)**

Answer

NPV and SD of X (Rupees thousands)

NPV estimate(X)	p	pX	x	px^2
3	0.1	0.3	−6	3.6
6	0.4	2.4	−3	3.6
12	0.4	4.8	3	3.6
15	0.1	1.5	6	3.6
		$\sum pX = 9$		$\sum px^2 = 14.40$

NPV of X = 9 thousands

SD of X = $\sqrt{\sum px^2/\sum p}$ = $\sqrt{(14.40)/1}$ = 3.79 thousands

NPV and SD of Y ('Rs. 000)

NPV estimate(Y)	p	Py	y	py^2
3	0.2	0.6	−6	7.2
6	0.3	1.8	−3	2.7
12	0.3	3.6	3	2.7
15	0.2	3.0	6	7.2
		$\sum pY = 9$		$\sum py^2 = 19.8$

NPV of Y = 9 thousands

SD of Y = $\sqrt{\sum py^2/\sum p}$ = $\sqrt{19.8}$ = 4.45 thousands

Y is riskier as its SD is higher.

NPV of X	= PV of cash inflow of X – PV of cash outflow of X
9 thousands	= PV of cash inflow of X – 30 thousands
PV of cash inflow of X	= 39 thousands
PI of X	= PV of cash inflow/ PV of cash outflow = 39,000 / 30,000 = 1.30

NPV of Y	= PV of cash inflow of Y – PV of cash outflow of Y
9 thousands	= PV of cash inflow of Y – 36 thousands
PV of cash inflow of Y	= 45 thousands
PI of Y	= PV of cash inflow/ PV of cash outflow = 45 thousand / 36 thousand = 1.25

Q. No.108: Determine the risk adjusted NPV of the following projects:

	A	B	C
Net cash outlays (Rs.)	1,00,000	1,20,000	2,10,000
Project life	5 years	5 years	5 years
Annual cash inflow (Rs.)	30,000	42,000	70,000
Coefficient of variation	0.40	0.80	1.20

The company selects the risk-adjusted rate of discount on the basis of the coefficient of variation:

Coefficient of variation	Risk adjusted rate of discount	Present value factor 1 to 5 years at risk adjusted rate of discount
0.00	10%	3.791
0.40	12%	3.605
0.80	14%	3.433
1.20	16%	3.274
1.60	18%	3.127
2.00	22%	2.864
More than 2.	25%	2.689

(May, 1999) (10 Marks)

Answer

	Coefficient of variation	Risk-adjusted discount rate	NPV
A	0.40	12%	30,000 x 3.605 – 1,00,000 = 8,150
B	0.80	14%	42,000 x 3.433 – 1,20,000 = 24,186
C	1.20	16%	70,000 x 3.274 – 2,10,000 = 19,180

Q. No.109: Determine the risk adjusted net present value of the following projects:

	X	Y	Z
Net cash outlays (Rs.)	2,10,000	1,20,000	1,00,000
Project life	5 years	5 years	5 years
Annual Cash inflow (Rs.)	70,000	42,000	30,000
Coefficient of variation	1.2	0.8	0.4

The Company selects the risk-adjusted rate of discount on the basis of the coefficient variation :

Coefficient of Variation	Risk-Adjusted Rate of Return	P.V. Factor 1 to 5 years At risk adjusted rate of discount
0.0	10%	3.791
0.4	12%	3.605
0.8	14%	3.433
1.2	16%	3.274
1.6	18%	3.127
2.0	22%	2.864
More than 2.0	25%	2.689

(6 Marks) (November, 2005)

Answer:

	Coefficient of variation	Risk-adjusted discount rate	NPV
X	1.20	16%	70,000 x 3.274 – 2,10,000 = 19,180
Y	0.80	14%	42,000 x 3.433 – 1,20,000 = 24,186
Z	0.40	12%	30,000 x 3.605 – 1,00,000 = 8,150

Q. No.110: A firm has an investment proposal, requiring an outlay of Rs.80,000. The investment proposal is expected to have two years economic life with no salvage value. In year 1, there is a 0.4 probability that cash inflow after tax will be Rs.50,000 and 0.6 probability that cash inflow after will be Rs.60,000. The probability assigned to cash inflow after tax for the year 2 are as follows:

The cash inflow year 1	Rs.50,000		Rs.60,000	
The cash inflow year 2	Probability		Probability	
	Rs.24,000	0.2	Rs.40,000	0.4
	Rs.32,000	0.3	Rs.50,000	0.5
	Rs.44,000	0.5	Rs.60,000	0.1

The firm uses a 10% discount rate for this type of investments.

(i) Construct a decision tree for the proposed investment project and calculate the expected NPV.

(ii) What NPV will the project yield if the worst outcome is realized? What is the probability of occurrence of this NPV?

(iii) What will be the best outcome and probability of that occurrence?

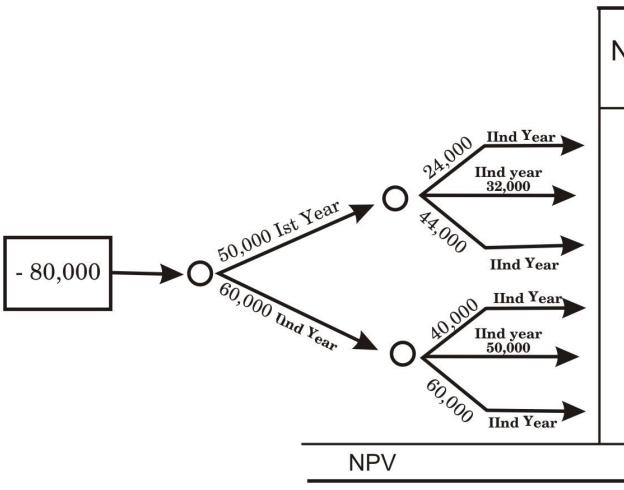
(iv) Will the project be accepted? **(May, 2004)** (16 Marks)

Answer : (WORKING NOTE)

Possible event	
A	Rs.50000 in I Yr. & Rs.24000 in II yr.
B	Rs.50000 in I Yr. & Rs.32000 in II yr
C	Rs.50000 in I Yr. & Rs.44000 in II yr
D	Rs.60000 in I Yr. & Rs.40000 in II yr
E	Rs.60000 in I Yr. & Rs.50000 in II yr
F	Rs.60000 in I Yr. & Rs.60000 in II yr

Event	NPV Estimate	Probability
A	(50,000 X 0.909) + (24000 X 0.826) – 80,000 = -14,726	(0.4 x 0.2) = 0.08
B	(50,000 X 0.909) + (32,000 X 0.826) – 80,000 = -8,118	(0.4 x 0.3) = 0.12
C	(50,000 X 0.909) + (44000 X 0.826) – 80,000 = + 1794	(0.4 x 0.5) = 0.20
D	(60,000 X 0.909) + (40000 X 0.826) – 80,000 = + 7580	(0.6 x 0.4) = 0.24
E	(60,000 X 0.909) + (50000 X 0.826) – 80,000 = + 15840	(0.6 x 0.5) = 0.30
F	(60,000 X 0.909) + (60000 X 0.826) – 80,000 = + 24100	(0.6 x 0.1) = 0.06

(a)



NPV Estimate	Probability	Enpected NPV Estimate
- 14,726	0.08	- 1,178
- 8,118	0.12	- 974
+ 1,794	0.20	+ 359
+ 7,580	0.24	+ 1,819
+ 15,840	0.30	+ 4,752
+ 24,100	0.06	+ 1,446
NPV		+ 6,224

(b) If worst happens, NPV will be – Rs.14,726. Its probability is 0.08

(c) If best happens, NPV will be Rs.24,100. Its probability is 0.06.

(d) The project may be accepted, as the Expected NPV of the project is Positive.

Q. No. 111: A company is considering which of two mutually exclusive projects it should undertake. The Finance Director thinks that the project with the higher NPV should be chosen whereas the Managing Director thinks that the one with the higher IRR should be undertaken especially as both projects have the same initial outlay and length of life. The company anticipates a cost of capital of 10 per cent and the net after tax cash flows of the projects are as follows: (Cash flow figs' 000)

Year	*0*	*1*	*2*	*3*	*4*	*5*
Project *X*	(200)	35	80	90	75	20
Project *Y*	(200)	218	10	10	4	3

Required to:

(a) Calculate the NPV and IRR of each project.

(b) State, with reasons, which project you would recommend.

(c) Explain the inconsistency in the ranking of the two projects.

The discount factors are as follows:

Year	*0*	*1*	*2*	*3*	*4*	*5*
Discount Factors						
(10%)	1	0.91	0.83	0.75	0.68	0.62
(20%)	1	0.83	0.69	0.58	0.48	0.41

(May, 1995) (20 Marks)

Answer (a)

Project X

Computation of NPV at 10% (Rs. Thousands)

= - 200 +
(35 x 0.91) + (80 x 0.83) + (90 x 0.75) + (75 x 0.68) + (20 x 0.62)
= - 200 + 229.15
= 29.15

Computation of IRR
NPV at 20%

= - 200 +
(35 x 0.83) + (80 x 0.69) + (90 x 0.58) + (75 x 0.48) + (20 x 0.41)
= - 200 + 180.65
= - 19.35

$$\text{IRR} = 10\% + \frac{29.15}{29.15 + 19.35} \times 10 = 16.01\%$$

Project Y

Computation of NPV at 10%

= - 200 +
(218 x 0.91) + (10 x 0.83) + (10 x 0.75) + (4 x 0.68) + (3 x 0.62)
= - 200 + 218.76
= + 18.76

Computation of IRR
NPV at 20%
= - 200 +
(218 x 0.83) + (10 x 0.69) + (10 x 0.58) + (4 x 0.48) + (3 x 0.41)
= - 200 + 196.79
= - 3.21

$$\text{IRR} = 10\% + \frac{18.76}{18.76 + 3.21} \times 10 = 18.5389\%$$

(b) Project X is recommended for following two reasons:

- Its NPV is higher, i.e. it is consistent with the financial management's objective of wealth maximization.
- IRR is not a reliable measurement of project evaluation because of its reinvestment rate assumption. (IRR assumes that funds generated by project can be invested at the rate of IRR itself.)

(c) The inconsistency in the rankings of the two projects arises because of patterns of cash flows. In case of 2nd project, the major amount of cash in recovered in

earlier years and only small amount is being coming in later years while it is not so in case of the first project. This situation is referred as time disparity.

- In case of time disparity, the projects may have different rankings because of the implied assumptions in the two methods (NPV and IIR).
- The implied assumption in case of NPV is that funds released by the project are invested (till the time of completion of project) at a rate equal to cost of capital of firm.
- On the other hand, the IRR method assumes that the funds released by the project are invested (till completion of the project) at a rate equal to IRR itself.

Q. No.112 : XY Ltd. has under its consideration a product with an initial investment of Rs.1,00,000. Three probable cash inflow scenarios with their probabilities of occurrence have been estimated as below:

Annual cash inflow (Rs.)	20,000	30,000	40,000
Probability	0.1	0.7	0.2

The project life is 5 years and the desired rate of return is 20%. The estimated terminal values for the project assets under three probabilities alternatives, respectively are Rs.0, 20000 and 30,000. You are required to :

(i) Find the probable NPV

(ii) Find the worst-case NPV and the best-case NPV; and

(iii) State the probability occurrence of worst case, if the cash flows are perfectly positively correlated over time. **(May,2010)**

Answer

(i)

Probability ↓	NPV Estimate
0.1	-1,00,000 + 20,000 x 2.991 + 0 = - 40,180
0.7	-1,00,000 + 30,000 x 2.991 + 20,000 x 0.402 = - 2,230
0.2	-1,00,000 + 40,000 x 2.991 + 30,000 x 0.402 = + 31,700

Calculation of probable NPV:

-40,180(0.10) – 2230(0.7) + 31,700(0.2) = + 761

(ii) Worst-case NPV : - 40,180

Best-case NPV : + 31,700

(iii) Probabilities of occurrence of worst (CF + correlated) = 0.10

APPENDIX A

SOME ASSUMPTIONS IN CAPITAL BUDGETING

(i) As far as permissible, we assume that there is no other asset of the block.(The assumption of other assets in the block makes the solution of question quite lengthy).

But remember, in case of replacement, the old machine and the new machine are of same type and they constitute the block (Example: Q. No.9 of the Module IV)

(ii) Discardment of the fixed asset may be assumed in the beginning of the next year. For example, if the life of the asset/project is 5 years and the asset is to be discarded after that (i.e. we are not given any scrap value in the question), it may be assumed that the asset would be discarded in the beginning of the 6^{th} year

(iii) Sale of scrap may be assumed at the end of the last year of the project. For example, if the life of the project is five years and there is sale of scrap of the machine, it may be assumed that the sale of scrap will take place at the end of the 5^{th} year.

(iv) Straight line Depreciation: The amount of depreciation would be (cost-scrap)/ life of the asset. This depreciation may be allowed even in the last year. [We know that the straight line deprecation is not allowed for tax purposes (except the power generating units), but as we allow for earlier years, we may consider for last year as well]

In some questions [For example Q. No. 12 (Elite Builders) Capital Budgeting], we have calculated depreciation ignoring the scrap value; the reason is that these questions require full cost to be written off over the useful life.

(v) Sum of digit method: Amount of deprecation is calculated considering the scrap value. Deprecation may be allowed in even in the last year [We know that this depreciation is not allowed for the tax purpose, but as we allow it for earlier years, we may consider it for last year as well]

(vi) Diminishing Balance Method: Depreciation should be considered ignoring the scrap value on the basis of the deprecation rate given in the question. If no rate is given, the depreciation rate applicable for the Income tax purposes may be considered (For example: we may consider depreciation rate of 15% as it is depreciation rate for tax purposes on General Plant and Machinery .
Depreciation should not be allowed for the year in which the asset is sold, discarded, demolished or destroyed. (We have allowed Diminishing Balance depreciation in the last year, i.e. the year in which the asset has been sold in Q. No. 18 of Capital Budgeting, because the question specifically says that this depreciation is as per Income Tax Rules).

Q. NO. 113 Write a note on PROJECT Planning.

Answer

A PROJECT is a specific activity with a specific starting point and specific ending point intended to accomplish a specific objective, Projects are building blocks used to meet the enterprise objectives.

Robert K.W. has defined a project as follows:

> A project is a sequence of unique, complex and connected activities which have one goal and are to be completed by a specific time within budget and according to specifications.

Important characteristic of a project:

(1) **Specific Goal:** A project must have a single and specific goal.

(2) **Unique nature:** It is unique because it is most unlikely to be repeated in exactly the same way by the same group of people to give the same results.

(3) It generally involves complex activities to be per-formed by people having different types of skills.

(4) It consists of activities that are linked together because they all contribute to the desired result.

(5) Projects have specific time framework.

(6) Projects use resources such as people, money, machines, materials, etc. These represent budget for the project.

(7) **Projects are dynamic:** They have flexibility of incorporating developments which could not be foreseen at the time of conceiving the project.

(8) Project work has to be carried out according to specifications.

PROJECT PLANNING

Project planning is a common thread that interwines all the activities from conception to completion of the project. Project planning determines what, how, when, why, by whom and for whom the tasks are to be done.

Elements of Project Planning:

(1) Define the objectives of the project.

(2) Define the scope and size of the project.

(3) Define the tasks to be completed. Work breakdown structure (dividing a major task into many minor tasks) should also be planned.

(4) Identify the requirement and sources of resources.

(5) Estimate the time schedule.

(6) Establish reporting and controlling procedures.

(7) Establish the procedure for incorporating the revisions (which may be required later on).

(8) Establish the acceptance criteria for successful completion.

PROJECT REPORT

A project report is a document that contains all known details of the proposed project such as objectives, scope and size, technical, financial and commercial details, requirement and sources of various resources and social cost benefit analysis. A project report is a plan of action for implementation of the project. It is referred as blue print of project planning.

There are four major aspects of a project report (1) location, (2) scope and size, (3) resources, and (4) management.

Location of project is generally decided by comparing cost and advantages of various locations. Sometimes, the decision regarding location is taken on the basis of availability of skilled labour, government policy, tax advantage, availability of various factors like power, water, transportation, etc.

The scope and size should be determined considering both financial and non-financial aspects. The financial aspects include availability of finance, profit, economies of scale, etc. Non-financial aspects may be environment aspects, employment opportunities, etc.

The project report should estimate the requirement of various sources such as finance, human resources, raw materials, technology, power, etc. It should also cover the sources.

The fourth aspect of the project report is management aspects. This includes organization structure, project management, planning, control, revision of plan, etc.

Advantages of a Project Report:

(1) A project report is prepared after considering the technical, commercial and economical feasibilities of the project. This enhances the chances of success of the project.

(2) It helps in completion of the project in scheduled time.

(3) It is must for raising funds for the project.

(4) It is required for getting various permissions from governmental bodies including environmental clearances.

(5) It provides for corrective actions in case of unfavourable developments during its implementation.

(6) It helps in gathering support from the society as it contains the benefit which the society is going to get from the project.

(7) It is forward looking. Hence, it provides all the advantages of planning. Resources and their sources are planned in advance. Hence, future hurdles are minimized.

Q. NO. 114: EXPLAIN THE CONCEPT OF FEASIBILITY STUDY OF THE PROJECT.

Answer

Project appraisal refers to the process of judging the sound feasibility and soundness of the project. Project analysis is indispensable because projects require resources which are scarce and have alternative uses. There are three parts of project appraisal:

(1) **Market analysis:** The potential market for the output of the project should be examined thoroughly. Demand and supply should be estimated. The import threats should be anticipated.

(2) Studying the feasibility of the project.

(a) **Financial feasibility**: It implies that the firm shall be able to bear the cost of whatever resources it will be using. Financial feasibility of the project requires consideration of four points (i) requirement of resources and identification of their sources, (ii) cost of sources, (iii) demand, market and life-cycles of the output of the project. Internal and foreign competition should also be considered, and (iv) taxation.

(b) **Technical feasibility**: It is concerned with materials, plant, technology, plant size, plant location. Technical feasibility is made to ensure that the implementation of plant is feasible, hurdles coming in the way of implementation on account of technical factors will be overcome and it will be possible to obtain output at such costs that their sale will provide margin required for servicing the investment.

(c) **Economic feasibility**: It ensures that implementation of the project will be beneficial for the economy as a whole. It may pay taxes, it may earn foreign exchange, it may generate employment, it may help in implementation of other projects, etc.

(3) **Ecology analysis**: the project may disturb the ecological balance, damage environment or dislocate some persons acquiring their land for the project. The majors efforts regarding restoring the damages should also be considered.

Q.115 : Write a note on PROMOTERS' CONTRIBUTION IN PROJECT FINANCING IN INDIA. **(May, 1997)**

Answer :

Large industrial and infrastructure projects require huge amount of funds, some times it runs into thousands of crores of rupees. It is not possible for the promoters of the projects to provide such huge amount of funds from their own resources. Hence, they take the help of development financial institutions. Such institutions include IFCI, IDBI, ICICI, SIDBI, IFC, etc. When the promoters require huge funds, even one bank/development institution may not find it feasible/desirable to arrange all the finance. This leads to syndicated financing. The banks/development institutions, etc., form a syndicate to provide the finance. They among themselves decide about the proportion of funds each of them will be providing. The promoters have to deal with any one of them only.

This type of project financing requires that the promoters must contribute a portion of the project finance. This confirms promoter's interest and seriousness of the promoters. Promoter's contributions assure the financial institutions that a large amount of promoter's money is at stake in successful completion of the project and that the promoters are not fly over night promoters, i.e., promoters contribution to assure the dedication and commitment of the promoters towards to the project. This also assures safety of funds of financial institutions and banks as in case of project failure, the promoters will be among the maximum losers (as their contribution is either in the form of equity or unsecured loan).

The promoter's contributions may be any one of the following forms:

(i) Equity share capital.

(ii) Preference share capital.

(iii) Convertible debentures.

(iv) Unsecured loan .

(v) Seed capital (to be provided by Seed Capital Foundation).

(vi) Venture Capital.

(vii) Retained earnings of the business. The promoter's contribution should not be less than 20 per cent of total project cost. In case of backward areas, this condition is relaxed by the FIs.

Q. No116: Distinguish between Net present value and IRR. **(May, 2002)**

Answer

There are two important methods for evaluating the desirability of investments or projects (i) NPV (ii) IRR. Both the methods consider the time value of money. NPV is defined as the difference between PV of inflow and PV of outflow.

	C_1	C_2	C_n

$$NPV = -C_0 + \frac{}{(1+r)^1} + \frac{}{(1+r)^2} + \cdots + \frac{}{(1+r)^n}$$

Internal rate of Return (IRR) is that discount rate at which the NPV of a project is zero.

$$NPV = -C_0 + \frac{C_1}{(1+IRR)^1} + \frac{C_2}{(1+IRR)^2} + \cdots + \frac{C_n}{(1+IRR)^n} = 0$$

Some of the points of distinction between NPV and IRR have been outlined in the following table :

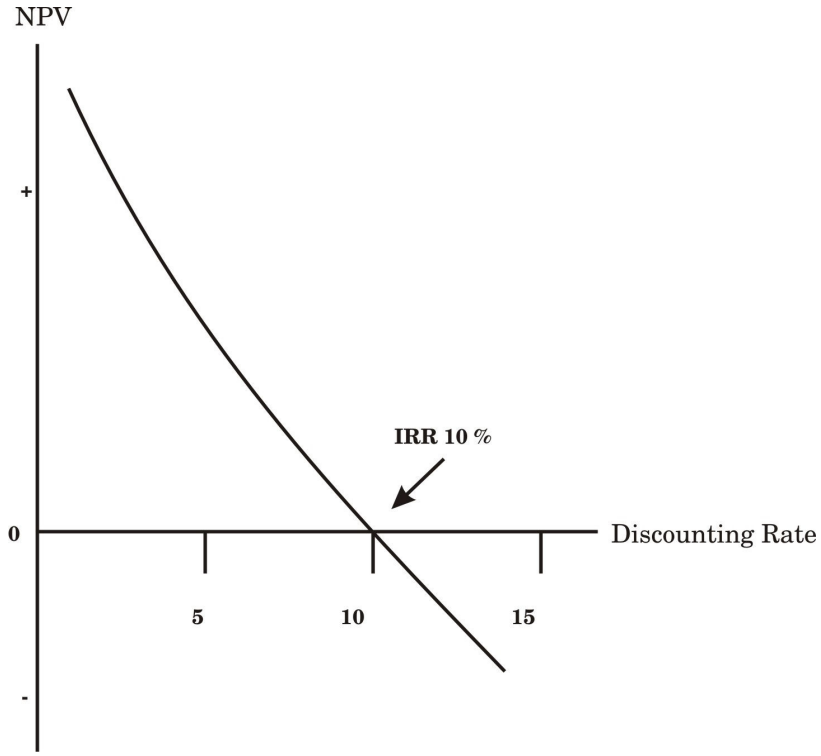
NPV	IRR
(1) NPV is calculated in terms of amount.	(1) IRR is expressed in terms of the percentage return a firm expects the capital project to return;
(2) It is the amount by which the shareholders wealth will change on its implementation.	(2) IRR does not measure the change in the shareholders on the implementation of the project. Even a very high IRR may result in only small increase in the shareholders wealth as the amount of investment may be very small. A very low IRR may result in substantial increase in the shareholders wealth if the amount of investment is very large.
(3) NPV assume that the cash generated by the project are reinvested at the rate equal to cost of capital.	(3) IRR assume that the cash generated by the project are reinvested at the rate of IRR itself.
(4) Even if a project has more than one sign reversal (For example, the initial outlay may be followed by positive cash inflows in one or more periods, followed by negative cash flows in some periods, again to be followed by positive cash flows in one or more periods) calculation of NPV does not face any problem.	(4)If a project has more than one sign reversal (For example, the initial outlay may be followed by positive cash inflows in one or more periods, followed by negative cash flows in some periods, again to be followed by positive cash flows in one or more periods) calculation of IRR may create complications. if a project has more than one sign reversal (For example, the initial outlay may be followed by positive cash inflows in one or more periods, followed by negative cash flows in some periods, again

	to be followed by positive cash flows in one or more periods) calculation of NPV does not face any problem.
(5) NPV of different projects is not easy to compare as there may be different initial investments.	(5) IRR presents the financial effect of all the factors affecting the project by way of single figure which is easy to understand and compare.
(6) Cost of capital (Required rate of return) is required for calculating the NPV.	(6) Cost of capital (Required rate of return) is not required for calculating the IRR.
(7) Decision criterion : If NPV is positive the project may be taken up. If NPV is zero, project may be taken up only if non-financial benefits are there. If NPV is negative project may not be taken up.	(7) The project may be accepted if IRR is greater than the cost of capital. It may not be accepted if it is less than the cost of capital. If it is equal to cost of capital, project may be taken up only if non-financial benefits are there.

Q. No.117: Write a short note on Internal Rate of Return. **(May 1996)**

Answer

- Internal rate of Return (IRR) is that discount rate at which the NPV of a project is zero.



$$NPV = -C_0 + \frac{C_1}{(1+IRR)^1} + \frac{C_2}{(1+IRR)^2} + \cdots + \frac{C_n}{(1+IRR)^n} = 0$$

- It is the rate of return on the investment calculated on the basis of discounted cash flow approach.
- It is inclusive of cost of capital. For example, if the cost of capital is 12%, and IRR is 20%; then our total return (inclusive of cost of capital) is 20%, out of which 12% meets the cost of capital and 8% is the return over and above cost of capital.
- For calculating IRR, (i) we find approximate pay back period (undiscounted) on the basis of average cash flows. (ii) locate the figure of Approximate pay back period in the annuity table against no. of years equal to the life of the project, the corresponding rate is Approximate IRR (iii) find NPV at this rate (iv) if NPV is positive find the NPV at some other higher rate and vice –versa (v) find IRR by interpolating the two NPVs using the following formula :

$$IRR = \text{Lower rate} + \frac{\text{NPV at lower rate}}{\text{Lower rate NPV} - \text{Higher rate NPV}} \times \text{Difference in rates}$$

- IRR presents the financial effect of all the factors affecting the project by way of single figure which is easy to understand and compare.
- The assumption of the IRR method is that the funds released by the project are invested (till completion of the project) at a rate equal to IRR itself. This assumption of IRR is quite unrealistic.
- The IRR method has some complications. For example, some projects may have more than one IRR and others may have no IRR.
- Decision criterion: The project may be accepted if IRR is greater than the cost of capital. It may not be accepted if it is less than the cost of capital. If it is equal to cost of capital, project may be taken up only if non-financial benefits are there.

Q. No.118: Do the profitability index and the NPV criterion of evaluating investment proposals lead to the same acceptance – rejection and ranking decisions? In what situations will they give conflicting results? **(Nov. 1999)**

Answer

If we have to evaluate only one project, we may either calculate NPV or PI, both will give same result.

If we have to evaluate two or more projects:

(i) if funds are not key factors we should evaluate the project on the basis of NPV as our aim is maximization of wealth of the shareholders. (NPV of a project is

defined as the amount by which firm's wealth will increase on implementation of the project.)

(ii) If funds are key factors we should evaluate the project on the basis of P.I. In other words, if we want to maximize the rate of return on funds employed, PI should be applied.

Let's have an example to understand this point. A person is offered two jobs and he can accept either. First job will give him Rs.350 per day of 7 hours (Rs.50.00 per hour). Second job will give him Rs.380 per day of 8 hours (Rs.47.50 per hour), which job he should accept? If time is key factor for him, i.e., if he wants to maximize his earning per hour he should go for the first job. If time is not key factor for him and he wants to maximize his total earnings, he should go for the second job. Let's have another example.

Suppose, a businessman has to evaluate two capital expenditure proposals. First will require on investment of Rs.40,000 initially and will result in cash flows at present value amounting to Rs.60,000 (NPV = 20,000, PI = 1.50). Second will require on investment of Rs.50,000 and will result in cash inflows at present value amounting to Rs.72,000 (NPV = 22,000, PI = 1.44). If funds are key factor, he should go for the first project, i.e., he should maximize the rate of return. If funds are not key factor, i.e., he wants to maximize his profit, he should go for the second project.

Q. No.119: What are the issues that need to be considered by an Indian investor and incorporated within the NPV model for the evolution of foreign investment proposals? **(Nov. 2000)**

Answer

An Indian investor investing in foreign country should consider the following points and incorporate them in the NPV model:

(i)Political uncertainties: Political uncertainties affect economics. Change in government may affect the outcome of the project. This uncertainty should be incorporated by considering various probabilities for calculating expected NPV.

(ii) Possibilities of change in economic policies particularly regarding overseas investments. Even without political uncertainties, it is possible that the government of host country may change its economic policies particularly regarding overseas investments. This may affect the out come of the investment This uncertainty should be incorporated by considering various probabilities for calculating expected NPV.

(iii) Possibility of change in policy regarding repatriation of money back to the investor's country. This uncertainty should be incorporated by considering various probabilities for calculating expected NPV.

(iv) Taxation: (a) whether there is double taxation avoidance agreement with the host country or not. (b) Whether the host country is highly taxed nation, moderately taxed nation, low taxed nation or tax haven. (c) What are deductions and exemptions? *These factors will affect cash flows and in turn affect the NPV.*

(v) Inflation: Inflation affects the outcome of the investment. It can be considered either by taking nominal cash flows and nominal cost of capital or by taking real cash flows and real cost of capital.(for more details refer to the note regarding capital budgeting under inflationary conditions)

(vi) Interest rates: If borrowed funds are to be used for the investment, change in interest rate should be considered using various probabilities.

(vii) Currency exchange rates: NPV should be considered on the basis of probable exchange rate between rupee and host country's currency.

Q. No120: Write a short on project appraisal under inflationary conditions.
(May 1998; Nov. 2003)
Answer
The term project appraisal refers to the process of judging the sound feasibility and soundness of the project. Project analysis is indispensable because projects require resources which are scarce and have alternative uses. There are three parts of project appraisal: (1) Market Analysis (2) Studying the feasibility of the project, and (3) Making the ecological study.

The term **inflation** refers to rise in general (on an average basis) price level of goods and services in the economy, i.e., fall in purchasing power of money. It creates a number of uncertainties because of rising prices of inputs, outputs and factors of production. Inflation also muddies project planning. Hence, while appraising the projects under inflationary conditions, the finance manager may consider the following points:

(i) Inflation makes the project riskier. Hence, project with smaller pay back period may be preferred.

(ii) Inflationary conditions may result in requirement of additional funds (for fixed assets as well as working capital) to be invested. Such funds may be planned; arrangements with the suppliers of funds may be made.

(iii) Inflation may necessitate the rise in the sale price of the output. Its impact on demand may be considered.

(iv) Inflation may result in increase in the cost of output. This affects the profitability of the project. This fact may be considered while appraising the project.

(v) If the project is to be evaluated on discounted cash flow techniques, all the cash flows may be taken on nominal basis and discounted by nominal cost of capital. If all the components of the cash flow are affected by general rate of inflation, in that case an alternative approach can also be followed. In this alternative approach, all the cash flows are taken on real basis and discounted at the rate of real cost of capital.

(vi) Financial viability of the project may change on account of the inflation. The finance manager should examine this fact very carefully.

(vii) Reliable measure of rate of inflation should be developed / recognized.

Inflation makes the task of project appraisal quite difficult. Hence, the finance manager should consult various experts on specific matters. For example, economists may be consulted for possible inflation rate and the impact on the interest rates, marketing experts may be consulted for possible increase in selling prices and impact on the demand, production manager may be consulted for possible increase on cost of production, purchase manager may provide some clue for possible increase in material price and also about possible substitute of material.

Q. No121: Write A Note on Capital Budgeting under Inflationary Conditions.

Answer

Inflation is a fall in the purchasing power of **money**. This is equivalent to a rise in the general (on an average basis) level of prices of goods and services in the economy. Inflation affects two aspects of capital budgeting: (i) Projected cash flows, and (ii) discounting rate.

Inflation will change the projected cash flows, i.e., in case of inflation (which was not considered at the time of making projections about future cash flows) the cash flows would be different than these would have in the absence of inflation. Inflation also affects interest rates and this in turn may change the cost of capital. Also, the investor should get the returns only in real terms, otherwise he may not get what he expects or he may even suffer loss (in terms of purchasing power of money). Without consideration of inflation, the project may appear to be much more attractive than it really is and this may mislead the decision makers. Hence, the decision about capital expenditure should be taken only after considering the inflation.

There are two approaches regarding capital budgeting under inflationary conditions:

(i) **Real cash flows and real cost of capital:** Under this approach cash flows are taken on constant purchasing power basis, i.e., we estimate the cash flows that would be there if there is no change in price level. Similarly, cost of capital is also taken on the assumption of no change in price level. The projects are evaluated on the basis of real cash flows and real cost of capital.

(ii) **Nominal cash flows and nominal cost of capital:** Under this approach, cash flows are taken considering (incorporating) changes in price levels. Similarly cost of capital is taken as that it would be in case of estimated inflation.

Inflation in classified into two categories: (i) Differential and (ii) Synchronized. In the first situation, different elements of costs, revenues and cost of capital, are all not affected by a single rate, i.e., different items may be affected by differing rates. For example, material prices may increase by 5 per cent, wage rates by 9 per cent

and overall price rise (affecting the cost of capital) may be 10 per cent. In the second case, all these items are affected by the same rate (this situation is unlikely to happen in practical life).

In first category of inflation (the differential inflation), only second approach (nominal cash flows and nominal cost of capital) can be applied. In the second category (synchronized inflation), either of the two approaches can be applied.

Q. No.122: Write a short note on capital rationing. **(May, 2004; May 2006; June 2009)**
Answer

Capital rationing occurs whenever there is a ceiling on the amount of funds that can be invested during a specific period of time, i.e., it is a situation in which a firm has several attractive investment opportunities but does not have enough funds to invest in all of them. In other words, capital rationing involves the allocation of a fixed amount of capital among competing and economically desirable projects. The ceiling on the amount of funds to invest can be caused by an internal budget ceiling being imposed by management (it referred as soft capital rationing), or by external limitations being applied to the company, i.e. when additional borrowed funds cannot be obtained (it is referred as hard capital rationing)

Suppose A company has investible funds of Rs.20 Lakh and is considering the following projects:

Project	*Outlay (Rs.)*	*N.P.V. (Rs.)*
A	20,00,000	8,00,000
B	17,50,000	7,50,000
C	16,00,000	6,00,000
D	18,00,000	6,50,000

Non-Divisible Projects and Capital Rationing

In this case, we define all feasible combinations of the project and choose the combination that has highest NPV. In other words, we select a package of the projects that is within our resources yet givens the highest amount of NPV. Assuming that in the above example the projects are indivisible, we shall find NPVs all possible combinations and we shall recommend the combination with highest amount of NPV.

Divisible Projects and Capital Rationing

By divisible project, we mean that if a project meets our selection criterion but we cannot finance it fully, then there are other persons who are willing to join us i.e. they are willing to become our partner in the project. Naturally, we shall be sharing the NPV on the basis of proportion of the investment. The feature of such projects is that we shall not be left with any un-invested amount.

In this case, we calculate net profitability index. Net profitability index is obtained by dividing the NPV with investments out of limited funds.. (For example, in the above referred case, Net Profitability Index of Project A is (8,00,000 / 20,00,000) i.e. 0.40. Assuming that in the above example the projects are divisible, we shall find Net Profitably Index of all the projects and we shall take investment decisions on the basis of Net Profitably Index; our first choice of investment will be the project with Highest Net Profitability Index, then the project with second highest profitability index and so on.

Q. No.123: Write short note on Certainty Equivalent Approach.**(May,02)**

Answer

The certainty equivalent approach adjusts downwards the value of the expected annual after-tax cash flows on account of uncertainty In other words, a risk less set of cash flows is substituted for the original set of cash flows between both of which the management is indifferent.

Under this approach, we multiply the cash flow estimates with certainty — equivalent coefficient (CEC). Once risk is taken out of the cash flows, those cash flows are discounted back to present at the risk-free rate of interest and the project's net present value or profitability index is determined.

CEC depends upon management's attitude towards risk. Suppose acceptance of a risky project is likely to result in 5 annual cash flows of Rs.10,000 each. As it is a risky project, i.e., actual results may vary with the estimated ones, a smaller amount may be acceptable to the firm provided that there is no uncertainty. Suppose management is willing to accept Rs. 6,000 (certain amount) in place of Rs. 10,000 (uncertain amount). In that case CEC = 0.60.

$$CEC = \frac{\text{Certain cash flow}}{\text{Uncertain cash flow}}$$

The certainty equivalent method allows each cash flow to be treated individually. For example, the CEC of first year may be different from that of second year and so on.

Q. No.124: Write short note on Social cost Benefit analysis. **(Nov. 2003) (May, 2008)**

Answer

Social Cost Benefit Analysis (SCBA) is a part of process of evaluating the proposal regarding undertaking a project. The concept of SCBA is that while evaluating the proposal regarding investment in a project, the entrepreneur should consider not only its financial soundness and technical feasibility but also make cost benefit analysis of the project from the point of society and economy as a whole. A project be financially and technically feasible but from the viewpoint society in general and economically as a whole may not be viable and vice-versa. For example, a project of

providing rail links to some under developed area may be financially unsound but from the social and economic angles it is quite desirable (it will help in development of that area).

For every action, there is reaction. For (almost) every project, there are some hidden social-economical disadvantages (these are referred as negative externalities) and also there are such advantages (these are referred as positive externalities). The examples of disadvantages (negative externalities) are: dislocations of the persons whose land is acquired for the project, environmental damage, ecological disturbances, damage to heritage buildings in the long run, etc. The advantages (positive externalities) may be: employment opportunities, availability of merit quality products at reasonable prices, foreign exchange earnings, construction of road, etc., for the project which may be used by other persons of that area and which may help in development of some other economic activities, etc. Hence, besides financial and technical angles, a project should also be evaluated on the basis of its social costs and social benefits.

There are two schools of thought regarding projects' evaluation.

As per **first school of thought** a project should be accepted,

- Either when the social benefits are more than its social costs,
- or the entity which wants to implement the project should try to make good the loss of the society — for example — restoration of environmental damages, providing employment of dislocated persons, etc.

As per the **second school of thought**, project evaluation should involve three steps:

(i) Identify all costs and benefits of the project. The costs of the project are divided into two parts (a) private cost and (b) negative externalities. The benefits of the projects are also divided into two parts (a) private benefits, and (b) positive externalities.

(ii) Use money as a unit of measuring all above costs and benefits. Measurement of private costs and benefits generally does not pose any problem. Measurement of externalities in terms of money is certainly a difficult task and requires some thoughtful steps.

(iii) Find NPV of the project (using the concept of time value of the money) on the basis of above-mentioned all costs and benefits.

Example: Currently there is no bus or rail service between two towns “A” and “B”. A large numbers of persons commute between these two towns everyday. They use either their own vehicles (which is quite costly and tiresome) or tempos (which are costly, tiresome and inconvenient). A company is planning a project of operating a bus service between these two towns. Considering the details given below, opine whether the project should be undertaken or not (as per the second school of thought):

Cost of bus Rs.10,00,000
Scrap value Rs.1,00,000
Annual operating cash cost Rs.3,00,000
Savings of time 100000 hours annually which can be valued@ Re. 1 per hour
Life 10 years
Scrap value Rs.1,00,000
Cost of capital 10 per cent
Noise and other damage to environment, its cost can be taken as Rs.25000 each year
Annual revenue Rs.7,00,000

NPV=[-1000000]+[(700000+100000-300000-25000)x(6.145)]+[100000x0.386]= 19,57,47

Q. No.125: What is the sensitivity analysis is capital budgeting? **(Nov. 2002)**

Answer

There are seven important determinants of NPV, besides some others :

(vi) Selling price
(vii) sales quantity
(viii) cash cost
(ix) cost of capital, and
(x) Amount of investment .
(xi) Value of scrap
(xii) Life of the project

Sensitivity analysis is a tool to measure the risk surrounding a capital expenditure project. The analysis measures how responsive/sensitive the project's NPV is to change in the variables that determine NPV.

This analysis is carried on the projects reporting positive NPVs. It requires the calculation of % change, in value of each determinant of the NPV, that may reduce the NPV to zero. These percentages are put in ascending order. The item corresponding to minimum change is considered to be most sensitive/risky. The concept of the sensitivity suggests that management should pay maximum attention to this item as even a small adverse change in this item may result in big unfavorable results. Sensitivity analysis therefore provides an indication of why a project might fail.

Critics of sensitivity analysis suggest that the management should pay maximum attention to the item which has the highest probability of adverse change.