Seminar 28

1. Your company uses a machine in its production department which costs $12000 at the beginning of 1983. The machine will be replaced after five years usage by a new machine at the end of 1988. During the five years of operation of the machine it is estimated that the net cash inflows at the beginning of each year will be as follows :

Year	1984	1985	1986	1987	1988
Net cash inflow ($)	6600	6000	4500	(1000)	(2600)

a. If the machine is being purchased with a five year loan, which is compounded annually at 15%, produce an amortization schedule for five equal annual repayments of the loan.

b. If the $12000 debt, which is compounded annually at 15%, is to be discharged in 1988 by a sinking fund method, under which equal annual deposits will be made into a fund paying 10% annually, produce the schedule for the sinking fund.

c. Calculate the net present value of the net cash flows over the five years of operation of the machine at the 10% and 15% discount rates.

d. Determine the Internal Rate of Return and comment on and compare the three sets of results ignoring taxation with a view to making payment for the machine.

Seminar 28 (Suggested Solution)

1.

a. We are given that : P=12000; i=0.15; n=5. Putting the amortization payment as A, we must have that :

$$12000 = A/1.15 + A/1.15^2 + \ldots + A/0.15^5$$
$$= A(0.86957 + 0.75614 + 0.65752 + 0.57175 + 0.49718)$$
$$= A(3.35216)$$

Therefore, A =12000/3.35216=3579.79. That is, amortization payment = $3579.79

The amortization schedule is tabulated as follows :

Year	Amount outstanding (beginning)	Interest	Payment
1983	12000.00	1800.00	3579.79
1984	10220.21	1533.03	3579.79
1985	8173.45	1226.02	3579.79
1986	5819.68	872.95	3579.79
1987	3112.84	466.93	3579.79
1988	(0.02)		

b. Here, there are two interest rates. The investment rate, j=0.1 and the borrowing rate, i=0.15. Also, P=12000 and n=5. The calculations for the sinking fund payment (ordinary annuity) is given in the following.
The debt will amount to 12000(1.15)5 =$24,136.29 after 5 years. Thus, the sinking fund must mature to this amount. If A is the annual deposit into the fund, then we must have that :

$$24136.29 = A + A(1.1) + A(1.1)^2 + A(1.1)^3 + A(1.1)^4$$
$$= A(1 + 1.1 + 1.21 + 1.331 + 1.4641)$$
$$= A(6.1051)$$

Therefore, A = 24136.29/6.1051 = $3953.46

The Sinking Fund schedule is tabulated as follows :

Year	Debt outstanding	Interest on debt	Deposit	Amount in fund	Interest on fund
1983	12000.00	1800.00	0	0	0
1984	13800.00	2070.00	3953.46	3953.46	395.35
1985	15870.00	2380.50	3953.46	8302.27	830.23
1986	18250.00	2737.58	3953.46	13085.96	1308.60
1987	20988.08	3148.21	3953.46	18348.02	1834.80
1988	24136.29		3953.46	24136.28	

c. Discounted cash flow table for calculation of NPV :

Year	Net cash flow	Discount factor (10%)	Discount factor (15%)	Present value (10%)	Present value (15%)
1983	(12000)	1.0000	1.0000	(12000.00)	(12000.00)
1984	6600	0.9091	0.8696	6000.06	5739.36
1985	6000	0.8264	0.7561	4958.40	4536.60
1986	4500	0.7513	0.6575	3380.85	2958.75
1987	(1000)	0.6830	0.5718	(683.00)	(571.80)
1988	(2600)	0.6209	0.4972	(1614.34)	(1292.72)
			NPV	41.97	(629.81)

d. Using the formula method to determine the IRR, we have :

I_1=10; N_1=41.97; I_2=15; N_2=−629.81

and IRR = $(N_1I_2 - N_2I_1)/(N_1 - N_2)$= [41.97(15)−(−629.81)10]/[41.97−(−629.81)]
= (629.55 + 6298.1)/671.78

giving : IRR = 10.3%

The IRR gives the rate which makes NPV = 0.