

CHAPTER 8

CAPITAL BUDGETING DECISIONS

Problem 1

Year	Cash flow	PVF 0%	PV	PVF 10%	PV	PVF 40%	PV	PVF 50%	PV	PVF 100%	PV
0	-5,400	1.0000	-5,400	1.0000	-5,400	1.0000	-5,400	1.0000	-5,400	1.0000	-5,400
1	3,600	1.0000	3,600	0.9091	3,273	0.7143	2,571	0.6667	2,400	0.5000	1,800
2	14,400	1.0000	14,400	0.8264	11,901	0.5102	7,347	0.4444	6,400	0.2500	3,600
NPV			12,600		9,774		4,518		3,400		0

Problem 2

Year	Cash flow	PVF, 15%	PV	PVF, 19%	PV	PVF, 20%	PV
0	-100,000	1.0000	-100,000	1.0000	-100,000	1.0000	-100,000
1	30,000	0.8696	26,087	0.8403	25,210	0.8333	25,000
2	30,000	0.7561	22,684	0.7062	21,185	0.6944	20,833
3	30,000	0.6575	19,725	0.5934	17,802	0.5787	17,361
4	30,000	0.5718	17,153	0.4987	14,960	0.4823	14,468
5	30,000	0.4972	14,915	0.4190	12,571	0.4019	12,056
6	30,000	0.4323	12,970	0.3521	10,564	0.3349	10,047
NPV			13,534		2,293		-235
IRR	19.9%						

IRR lies between 19% and 20%. It is approximated as follows:

$$19\% + 1\% \times [2,293 / (2,293 + 235)] = 19.9\%$$

Problem 3

Year	Cash flow	PVF, 12%	PV	PVF, 18%	PV
0	-81,000	1.0000	-81,000	1.0000	-81,000
1	40,000	0.8929	35,714	0.8475	33,898
2	35,000	0.7972	27,902	0.7182	25,136
3	30,000	0.7118	21,353	0.6086	18,259
NPV			3,969		-3,706
IRR	15%				

IRR is about 15%: $12\% + 6\% \times [3,969 / (3,969 + 3,706)] = 15.0\%$

Problem 4

Year	0	1	2	3	4	5
Cash flows		1,000	800	600	400	200
PVF, 12%		0.8929	0.7972	0.7118	0.6355	0.5674
PV	2,325	893	638	427	254	113

Problem 5

Year	PVF, 12%	Project X		Project Y		Project Z	
		Cash flow	PV	Cash flow	PV	Cash flow	PV
0	1.0000	-2,500	-2,500	-2,500	-2,500	-2,500	-2,500
1	0.8929	0	0	1,540	1,375	2,875	2,567
2	0.7972	3,305	2,635	1,540	1,228	0	0
NPV			135		103		67
IRR			15%		15%		15%

Problem 6

Year	0	1	2	3	4
Cash flow	-10,000	3,700	3,700	3,700	3,700
PVF, 14%	1.0000	0.8772	0.7695	0.6750	0.5921
PV	-10,000	3,246	2,847	2,497	2,191
NPV		781			
IRR		18%			

IRR:18%:[10,000/3,700=2.7027 implies approx. 18% IRR]

Problem 7

Year	Project X	Project Q
	Cash flow	Cash flow
0	-20,000	-20,000
1	8,326	0
2	8,326	0
3	8,326	24,045
IRR	12.0%	6.3%

(by trial & error)

Problem 8

Year	PVF 12%	Project A		Project B	
		Cash flow	PV	Cash flow	PV
0	1.0000	-25,000	-25,000	-28,000	-28,000
1	0.8929	5,000	4,464	12,672	11,314
2	0.7972	5,000	3,986	12,672	10,102
3	0.7118	25,640	18,250	12,672	9,020
NPV			1,700		2,436
IRR			15.0%		17.0%

Problem 9

Year	0	1	NPV, 15%	IRR
Cash flow	50,000	-56,000	1,304	12%

Yes, NPV is positive or borrowing rate is less than the opportunity cost of capital.

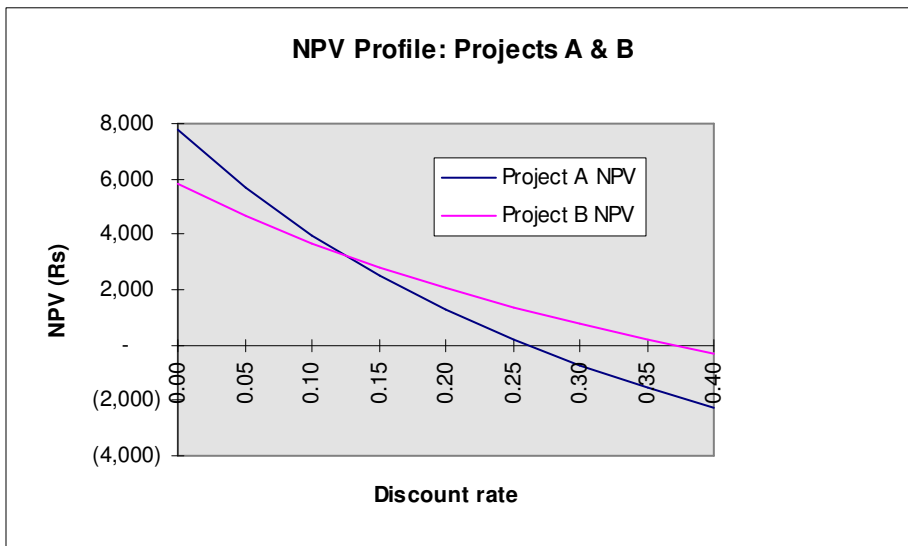
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Problem 10

Year	0	1	2	3	4
Cash flow	100,000	-33,625	-33,625	-33,625	-33,625
PVF, 10%	1.0000	0.9091	0.8264	0.7513	0.6830
PV	100,000	-30,568	-27,789	-25,263	-22,966
NPV	-6,587				
IRR	13.0%				
No					

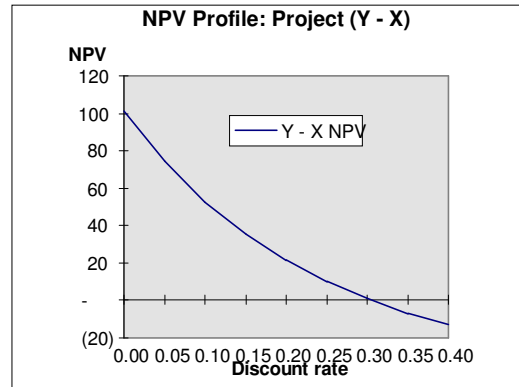
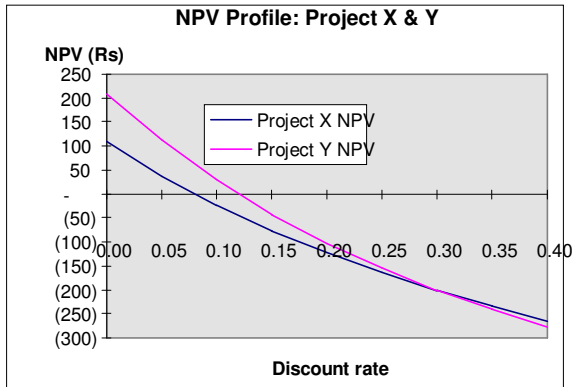
Problem 11

Year	Project A Cash flow	Project B Cash flow	Discount rate	Project A NPV	Project B NPV
0	-10,000	-10,000	0.00	7,784	5,830
1	2,000	10,000	0.05	5,712	4,690
2	4,000	3,000	0.10	3,977	3,696
3	11,784	2,830	0.15	2,512	2,825
IRR	26%	37%	0.20	1,264	2,054
			0.25	193	1,369
			0.30	(731)	756
			0.35	(1,534)	204
			0.40	(2,236)	(295)



Problem 12

Year	Project X Cash flows	Project Y Cash flows	Project Y-X Cash flows	Discount rate	Project X NPV	Project Y NPV	(Y - X) NPV
0	-750	-750	0	0.00	109	210	101
1	350	250	-100	0.05	38	112	74
2	350	250	-100	0.08	0	61	61
3	159	460	301	0.10	(23)	29	53
IRR	8.0%	12.0%		0.12	(45)	(0)	45
				0.15	(76)	(41)	35
				0.20	(123)	(102)	21
				0.25	(165)	(154)	10
				0.30	(201)	(200)	1
				0.35	(234)	(241)	(7)
				0.40	(263)	(276)	(13)



Problem 13

Year	PVF, 10%	Project I		Project II	
		Cash flows	PV	Cash flows	PV
0	1.0000	-25,000	-25,000	-25,000	-25,000
1	0.9091	30,000	27,273	0	0
2	0.8264	0	0	0	0
3	0.7513	0	0	0	0
4	0.6830	0	0	43,750	29,882
NPV			2,273		4,882
IRR			20.0%		15.0%

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Problem 14

Year	PVF, 10%	Project A		Project B		Project C		Project D	
		Cash flow	PV	Cash flow	PV	Cash flow	PV	Cash flow	PV
0	1.0000	-1,000	-1,000	-1,000	-1,000	-300	-300	-300	-300
1	0.9091	600	545	200	182	100	91	0	0
2	0.8264	200	165	200	165	100	83	0	0
3	0.7513	200	150	600	451	100	75	300	225
4	0.6830	1,000	683	1,000	683	600	410	600	410
NPV			544		481		358		335
IRR			31.2%		25.2%		42.4%		35.3%
Payback			3		3		3		3
Discounted PB			3.20		3.30		3.12		3.18

Problem 15

Year	0	1	2	3	4	Average
Cost	10,000	10,000	7,500	5,000	2,500	
SL dep.		2,500	2,500	2,500	2,500	
BV	10,000	7,500	5,000	2,500	0	5,000
Profit before dep.		3,000	3,000	4,000	4,000	3,500
Less: dep.		2,500	2,500	2,500	2,500	2,500
PBT		500	500	1,500	1,500	1,000
Less: tax.		175	175	525	525	350
PAT		325	325	975	975	650
ARR:						
Before-tax						20.0%
After-tax						13.0%

Problem 16

Year	0	1	2	3	Average
(a) ARR:					
Cost	12,000	12,000	8,000	4,000	
Depreciation		4,000	4,000	4,000	
BV	12,000	8,000	4,000	0	6,000
Revenue		16,000	14,000	12,000	14,000
Expenses		8,000	7,000	6,000	7,000
Gross profit		8,000	7,000	6,000	7,000
Depreciation		4,000	4,000	4,000	4,000
Net profit		4,000	3,000	2,000	3,000
ARR					50.0%
(b) ARR (modified cash flows):					
Cost	9,000	9,000	6,000	3,000	
Dep.		3,000	3,000	3,000	
BV	9,000	6,000	3,000	0	4,500

Revenue	16,000	14,000	12,000	14,000	
Expenses	9,000	8,000	7,000	8,000	
Gross profit	7,000	6,000	5,000	6,000	
Depreciation	3,000	3,000	3,000	3,000	
Net profit	4,000	3,000	2,000	3,000	
ARR					66.7%
Cash flow	-9,000	7,000	6,000	5,000	
PVF, 9%	1.0000	0.9174	0.8417	0.7722	
PV	-9,000	6,422	5,050	3,861	
NPV					6,333
IRR					48%

Problem 17

Year	0	1	2	IRR	NPV @ 10%
Cash flow	-150	450	-300	100%	11.16
				0%	

Project could be accepted as it has positive NPV at the required rate of return (10%).

$$-150 + \frac{450}{(1+r)} - \frac{300}{(1+r)^2} = 0$$

$$ax^2 + bx + c = 0$$

$$-300x^2 + 450x - 150 = 0$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$x = \frac{1}{(1+r)}$$

$$a = -300; b = 450; c = -150; b^2 = 202,500; ac = 45000; (b^2 - 4ac) = 22,500; (b^2 - 4ac)^{1/2} = 150; 2a = -600$$

$$x = \frac{-450 \pm \sqrt{202,500 - 4 \times 45,000}}{2 \times -300}$$

$$x = 0.50; x = 1.00$$

$$r = (1-x)/x = 100\%$$

$$r = (1-x)/x = 0\%$$

Problem 18

Year	0	1	2	3	4	5	NPV	IRR
Cash flow	-50,000	11,300	12,769	14,429	16,305	18,421		
PVF, 10%	1.0000	0.9091	0.8264	0.7513	0.6830	0.6209		
PV	-50,000	10,273	10,553	10,841	11,137	11,438	4,241	13.0%
Discount rate	0.10	0.10	0.10	0.12	0.12	0.13		
PVF	1.0000	0.9091	0.8264	0.7118	0.6355	0.5428		
PV	-50,000	9,339	8,721	7,716	7,077	6,208	-10,938	

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Problem 19

PI	1.12
Investment	500,000
Life (years)	5
Required rate	0.08
PV of inflows	
=500,000 x 1.12	560,000
PVAF, 8%, 5	3.9927
Annual inflows	
= 560,000/3.9927	140,256

Problem 20

Year	0	1	2	IRR	NPV
Cash flow	-800	1,200	-400	0%	-96
				-50%	

Project should be rejected as it has negative NPV at the required rate of return (25%).

$$-800 + \frac{1,200}{(1+r)} - \frac{400}{(1+r)^2} = 0$$

$$ax^2 + bx + c = 0$$

$$-400x^2 + 1,200x - 800 = 0$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$x = \frac{1}{(1+r)}$$

a = -400; b = 1,200; c = -800; b² = 1,440,000; ac = -320,000; (b² - 4ac) = 1,600,000; (b² - 4ac)^{1/2} = 1,264.91; 2a = -800

$$x = 1.00; x = 2.00$$

$$r = (1-x)/x = (1-1)/1 = 0\%$$

$$r = (1-x)/x = (1-2)/2 = -50\%$$

CASES

Case 8.1: G. S. Petropull Company (GSPC)

This case illustrates the computation of various methods of investment evaluation. The instructor may like to ensure that the students know the underlying assumptions of all methods and understand their merits and demerits. The NPV method is the most consistent investment evaluation criterion as it is consistent with the shareholder value maximisation objective.

	Year	Cash flows (Rs mn.)	Cum. cash flows (Rs mn.)	
Cost of project (Rs mn.)	250	0	-250	-250
Revenue from SEB (Rs mn.)	120	1	40	-210
Revenue from other users (Rs mn.)	80	2	40	-170
Total revenue (Rs mn.)	200	3	40	-130
Cash profit, 20% from year 1 to 12 (Rs mn.)	40	4	40	-90
Cash profit, 17% from year 13 to 20 (Rs mn.)	34	5	40	-50
Average cash profit: $(40 \times 12 + 34 \times 8) / 20$ (Rs mn.)	37.6	6	40	-10
Average investment: $(250 + 0) / 2$ (Rs mn.)	125	7	40	30 } Payback
ROI	30.1%	8	40	70
		9	40	110
Discount rate	15%	10	40	150
PVFA 12, 15%	5.4206	11	40	190
PVFA 20, 15%	6.2593	12	40	230
PVFA (20, 12), 15%	0.8387	13	34	264
PV of Cash profit, year 1-12 (Rs million)	216.82	14	34	298
PV of Cash profit, years 13-20 (Rs million)	28.52	15	34	332
NPV (Rs millions)	-4.66	16	34	366
		17	34	400
		18	34	434
		19	34	468
		20	34	502
	NPV		-4.66	
	IRR		14.65%	
	Payback		>6 years	

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Case 8.2: Calmex Company Ltd.

The objective of this case is to compute the viability of two mutually exclusive projects and make a choice using the most appropriate investment evaluation criterion. The IRRs of the two options are almost equal and hence they are equally attractive. But NPV method clearly shows that the large machine option has Rs 2 million higher NPV. Therefore, this option is definitely better than the alternative option.

The instructor may use this case to further illustrate the difference between IRR and NPV methods of investment evaluation.

Number of tanks	120,000
Price (Rs)	1500
Revenue (Rs million)	180
<i>Small machines</i>	
Cost of four small machines (Rs million)	460
Op. and mfg. cost (Rs)	535
Total op. and mfg. cost (Rs million)	64.2
Net revenue (Rs million)	115.8
Discount rate	12%
Project life (years)	6
PVFA 6, 12%	4.1114
NPV (Rs million)	16.1
IRR	13.23%
<i>Large machine</i>	
Cost of large machine (Rs million)	500
Op. and mfg. cost (Rs)	450
Total op. and mfg. cost (Rs million)	54
Net revenue (Rs million)	126
Discount rate	12%
Project life (years)	6
PVFA 6, 12%	4.1114
NPV (Rs million)	18.0
IRR	13.26%
<i>Incremental cash flows (large - small machines)</i>	
Cost (Rs million)	40
Net revenue (Rs million)	10.2
Discount rate	12%
Project life (years)	6
PVFA 6, 12%	4.1114
NPV (Rs million)	1.94
IRR	13.69%