Chapter 11

Constrained Project Selection

11-1
A small surveying company identifies its available independent alternatives as follows:

	Alternative	Initial Cost	Rate of Return
A.	Repair existing equipment	$1,000	30%
B.	Buy EDM instrument	2,500	9%
C.	Buy a new printer	3,000	11%
D.	Buy equipment for an additional crew	3,000	15%
E.	Buy programmable calculator	500	25%

The owner of the company has $5,000 of savings currently invested in securities yielding 8% that could be used for the company.

a) Assuming his funds are limited to his savings, what is the apparent MARR?
b) If he can borrow money at 10%, how much should be borrowed?

Solution

a)

Alt	Investment	Cumulative Investment	IRR	
A	1,000	1,000	30%	
E	500	1,500	25%	
D	3,000	4,500	15%	← MARR = 15%
C	3,000	7,500	11%	
B	2,500	10,000	9%	

b) Do all projects with a rate of return > 10%. Thus Alternatives A, E, D, & C with a total initial cost of $7,500 would be selected. Since only $5,000 is available, $2,500 would need to be borrowed.

11-2
The capital structure of a firm is given below.

Source of Capital	Percent of Capitalization	Interest Rate
Loans	35	17%
Bonds	30	8%
Common Stock	35	12%

The combined state and federal income tax rate for the firm is 42%. What is the after-tax and before-tax cost of capital to the firm?

Solution

Before Tax Cost of Capital
0.35 x 17% + 0.30 x 8% + 0.35 x 12% = 12.55%

After Tax Cost of Capital
0.35 x 17% (1-0.42) + 0.30 x 8% (1-0.42) + 0.35 x 12% = 9.04%

11-3
A small construction company identifies the following alternatives that are independent, except where noted.

	Alternative	Initial Cost	Incremental Rate of Return	On Investment Over
1.	Repair bulldozer	$5,000	30.0%	0
2.	Replace Backhoe			
	With Model A	20,000	15.0%	0
	With Model B	25,000	10.5%	2A
3.	Buy new dump truck			
	Model X	20,000	20.0%	0
	Model Y	30,000	14.0%	3X
4.	Buy computer			
	Model K	5,000	12.0%	0
	Model L	10,000	9.5%	4K

(a) Assuming the company has $55,000 available for investment and it is not able to borrow money, what alternatives should be chosen, and what is MARR?
(b) If the company can also borrow money at 10%, how much should be borrowed, and which alternatives should be selected?

Solution

Rank the alternatives by ΔROR

Project	Incremental Investment	Cumulative Investment	ΔIRR

1	5,000	5,000	30.0%
3X	20,000	25,000	20.0%
2A	20,000	45,000	15.0%
3Y - 3X	10,000	55,000	14.0%
4K	5,000	60,000	12.0%
2B - 2A	5,000	65,000	10.5%
4L - 4K	5,000	70,000	9.5%

a) With $55,000 available choose Projects:
1 Repair bulldozer
2A Backhoe model A
3Y Dump truck model Y
No computer

Minimum Attractive-of Rate-of-Return = 14%

b) Borrow $10,000. choose Projects:
1 Repair bulldozer
2B Backhoe model B
3Y Dump truck model Y
4K Computer model K

11-4

The following independent and indivisible investment opportunities are available:

Investment	Initial Cost	Rate of Return
A	$200	20%
B	100	22%
C	50	19%
D	100	18%
E	50	15%
F	Unlimited	7%

(a) Which investment(s) should be selected if the minimum attractive rate of return (MARR) is greater then or equal to 18% assuming an unlimited budget?
(b) Which investment(s) should be selected if the available budget is $400 and the MARR is greater than or equal to 14%?

Solution

(a) A, B, C, D → Choose all IRR's $\geq$ 18% since budget is unlimited.

(b) A, B, D → Choose D instead of C because it yields a greater overall return and fully invests the $400 budget.

Investment	Initial Cost	Return$	Return in $
A	$200	20%	$40.00

B	100	22%	22.00
C	50	19%	9.50
D	100	18%	18.00

Total $ return on A + B + C = 40 + 22 + 9.50 +50(.14)* = $78.50
Total $ return on A + B + D = 40 + 22 +18 = $80.00

*Assumes the remaining $50 can be invested at the MARR. This is not always true. Thus yielding an even lower $ return.

11-5
A city engineer calculated the present worth of benefits and costs of a number of possible projects, based on 10% interest and a 10 year analysis period.

	Costs and Benefits in 1000's						
Project:	A	B	C	D	E	F	G
Present Worth of Costs	75	70	50	35	60	25	70
Present Worth of Benefits	105	95	63	55	76	32	100

If 10% is a satisfactory minimum attractive rate of return (MARR), which project(s) should be selected if $180,000 is available for expenditure?

Solution

Project:	A	B	C	D	E	F	G
Present Worth of Costs	75	70	50	35	60	25	70
Present Worth of Benefits	105	95	63	55	76	32	100
NPW	30	25	13	20	16	7	30
NPW/C	.400	.357	.260	.571	.267	.280	.428
Rank	3	4	7	1	6	5	2

D + G + A = 35 K + 70 K + 75 K = 180 K

Choose projects D, G, A

11-6
Barber Brewing is in the process of determining the capital budget for the coming year. The following projects are under consideration.

	A	B	C	D
First Cost	$10,000	$13,000	$20,000	$33,000
Annual Income	10,000	9,078	16,000	16,455
Annual Cost	7,362	5,200	11,252	7,300

All projects have a five year useful life. Which alternative(s) should be selected if Barber's budget is set at $50,000?

Solution

NPW = 0 at IRR.

0 = -First cost + net income (P/A, i%, n) Therefore (P/A, i%, n) = First cost/net income

			Rank
IRR_A	P/A = 10,000/2,638 = 3.791	IRR = 10%	3
IRR_B	P/A = 13,000/3,878 = 3.352	IRR = 15%	1
IRR_C	P/A = 20,000/4,748 = 4.212	IRR = 6%	4
IRR_D	P/A = 33,000/9,155 = 3.605	IRR = 12%	2

Choose projects B and D. Total = 13,000 + 33,000 = $46,000

11-7

Abby Industries Inc. has the following capital structure:

Type	Amount	Average Minimum Return
Mortgages	$25,000,000	7%
Bonds	180,000,000	9%
Common Stock	100,000,000	10%
Preferred Stock	50,000,000	8%
Retained Earnings	120,000,000	10%

Determine the WACC for P&J.

Solution

$$\text{WACC} = \frac{25\text{M}(.07) + 180\text{M}(.09) + 100\text{M}(.10) + 50\text{M}(.08) + 120\text{M}(.10)}{(25\text{M} + 180\text{M} + 100\text{M} + 50\text{M} + 120\text{M})} = 9.25\%$$

11-8

ABC Builders has asked each of its four regional managers to submit requests for capital outlays for the following fiscal year. The CEO of ABC has decided to fund the top request from each region and to fund two additional requests with the provision that no region has more than two projects funded. Using the information provided below determine which projects should be funded.

Region	Project	Cost	Annual Benefit	Life (Years)
Southern (S)	A	$ 90,000	$16,400	15
	B	40,000	15,000	5
	C	60,000	20,400	5
	D	120,000	27,600	20
Midwest (MW)	A	50,000	10,000	20

	B	120,000	36,700	15
	C	75,000	21,600	5
	D	50,000	16,200	5
New England (NE)	A	50,000	16,700	20
	B	80,000	23,500	5
	C	75,000	26,100	10
Pacific (P)	A	60,000	16,900	15
	B	50,000	15,300	10

Solution

Region	Project	Cost	IRR
Southern (S)	A	$ 90,000	16.3%
	B	40,000	25.4
	C	60,000	20.8
	D	120,000	22.6
Midwest (MW)	A	50,000	19.4
	B	120,000	30.0
	C	75,000	13.5
	D	50,000	18.6
New England (NE)	A	50,000	33.3
	B	80,000	14.4
	C	75,000	32.8
Pacific (P)	A	60,000	27.4
	B	50,000	28.0

Choose (S)B, (MW)B, (NE)A, (P)B, (NE)C, and (P)A

Capital Budget = 40,000 + 120,000 + 50,000 + 50,000 + 75,000 + 60,000
= $395,000