

Chapter 12

12-1

Project	Investment	NPV	PI	
A	\$25	\$10	0.40	
B	\$30	\$25	0.83	Accept
C	\$40	\$20	0.50	Accept
D	\$10	\$10	1.00	Accept
E	\$15	\$10	0.67	Accept
F	\$60	\$20	0.33	
G	\$20	\$10	0.50	Accept
H	\$25	\$20	0.80	Accept
I	\$35	\$10	0.29	
J	\$15	\$5	0.33	

b. Cost of Capital Rationing Constraint = NPV of rejected projects = \$45 million

12-2: Linear Programming Problem

Maximize

$$20X_1 + 20X_2 + 15X_3 + 20X_4 + 30X_5 + 10X_6 + 20X_7 + 35X_8 + 25X_9 + 10X_{10}$$

subject to

$$20X_1 + 25X_2 + 30X_3 + 15X_4 + 40X_5 + 10X_6 + 20X_7 + 30X_8 + 35X_9 + 25X_{10} = 100$$

$$10X_1 + 15X_2 + 30X_3 + 15X_4 + 25X_5 + 10X_6 + 15X_7 + 25X_8 + 25X_9 + 15X_{10} = 75$$

12-3

$$NPV(I) = -12,000 - 500/0.1 = -17,000$$

$$EAC(I) = -17,000 \times 0.1 = -1,700$$

Remember that this is a perpetuity: $PV = A/i$; $A = PV \times i$;

$$NPV(II) = -5,000 - 1,000(1 - (1.1)^{-20})/0.1 = -13,514 \quad EAC(II) = -1,587$$

$$NPV(III) = -3,500 - 1,200(1 - (1.1)^{-15})/0.1 = -12,627 \quad EAC(III) = -1,660$$

CHOOSE OPTION II (GAS HEATING SYSTEM)

12-4

$$NPV \text{ of Wood Siding} = -5,000 - 1,000 (PVA, 10, 10\%) = \$(11,145)$$

$$EAC \text{ of Wood Siding} = -11,145 * (APV, 10, 10\%) = \$(1,813.63)$$

$$EAC \text{ of Aluminum Siding investment} = -15,000 * .1 = -1,500$$

$$\text{Maintenance Cost for Aluminum Siding} = 1,813.63 - 1,500 = 313$$

12-5

$$EAC \text{ for 1-year subscription} = \$20.00$$

$$EAC \text{ for 2-year subscription} = \$36 (APV, 20\%, 2) = \$23.56$$

$$EAC \text{ for 3-year subscription} = \$45 (APV, 20\%, 3) = \$21.36$$

Hence you should choose the 1-year subscription.

12-6

a. Initial investment = 10 million (Distribution system) + 1 million (WC) = 11 million

b.

Incremental Revenues	10,000,000	
Variable Costs (40%)	40,00,000	
Advertising Costs	1,000,000	
BTCF	5,000,000	
Taxes	1,600,000	= (5,000,000-1,000,000)*0.4
ATCF	\$3,400,000	

c. NPV = -11,000,000 + 3,400,000 (PVA,10 years,8%) + 1,000,000 (PF, 10 years, 8%)
= \$12,277,470

d. Precise Breakeven :

$$(-10,000,000 - 0.1z) + (0.6z - 1,000,000 - 0.4(.6z - 1,000,000 - 1,000,000))(PVA, 10\text{yrs}, 8\%) + .1z/1.08^{10} = 0, \text{ i.e.}$$

$$(-10,000,000 - 0.1z) + (0.6z - 1,000,000 - 0.4(.6z - 1,000,000 - 1,000,000))(6.71) + .1z(0.4632) = 0$$

$$-.1z + 2.4156z + .04632z = 10,000,000 + 200,000(6.71)$$

$$2.36192z = 11,342,000$$

$$z = 4,802,025.47 \text{ or an increase } 4.80\% \text{ from initial level of } 10\%.$$

12-7

The existing machine has an annual depreciation tax advantage = $500000(0.40)/5 = 40,000$. The present value of this annuity equals $\frac{40000}{.1} \left(1 - \frac{1}{1.1^5}\right) = 151631.47$

The new machine has an annual depreciation tax advantage = $2000000(0.40)/10 = 80,000$. The present value of this annuity equals $\frac{80000}{.1} \left(1 - \frac{1}{1.1^{10}}\right) = 491565.37$.

However, it will be necessary to spend an additional 1.7m. to acquire the new machine. Net Cost of the New Machine = $-1,700,000 + 491,565 - 151,531 = \$1,360,066$. Solving, for the annual savings that we would need each year for the next 10 years, we get Annual Savings = $\$1,360,066$ (Annuity given PV, 10 years, 10%) = $\$221,344$ (I am assuming no capital gains taxes. If there are capital gains taxes, the initial investment will be net reduction because of capital losses from the sale of the old machine).

12-8

	1	2	3	4	5	
Revenues	\$15,000	\$15,750	\$16,538	\$17,364	\$18,233	
- Op. Exp.	\$7,500	\$7,875	\$8,269	\$8,682	\$9,116	
- Depreciation	\$8,000	\$8,000	\$8,000	\$8,000	\$8,000	
EBIT	\$(500)	\$(125)	\$269	\$682	\$1,116	
- Taxes	\$(200)	\$(50)	\$108	\$273	\$447	
EBIT (1-t)	\$(300)	\$(75)	\$161	\$409	\$670	
+ Depreciation	\$8,000	\$8,000	\$8,000	\$8,000	\$8,000	
ATCF	\$7,700	\$7,925	\$8,161	\$8,409	\$8,670	
PV at 12%	\$6,875	\$6,318	\$5,809	\$5,344	\$4,919	\$29,266

a. $NPV = -50,000 + \$29,266 + \$10,000/1.12^5 = \$(15,060)$

b. Present Value from Additional Book Sales

Year	Sales	Pre-tax Operating margin	After-tax operating margin
0			
1	20000	8000	4800
2	22000	8800	5280
3	24200	9680	5808
4	26620	10648	6388.8
5	29282	11712.8	7027.68
		NPV (@12%)	\$20,677

The present value of the cashflows accruing from the additional book sales equals \$20,677

c. The net effect is equal to $\$20,677 - \$15,060 = \$5,617$. Hence, the coffee shop should be opened.

12-9

NPV of less expensive lining = $-2000 - 80 (AF, 20\%, 3 \text{ years}) = \$(2,169)$

EAC of less expensive lining = $-2168.52 / (AF, 20\%, 3 \text{ years}) = \$(1,029)$

Key question: how long does the more exp. lining have to last to have an EAC < -1029.45?

NPV of more expensive lining = $-4000 - 160 (AF, 20\%, n \text{ years})$

EAC of more expensive lining = $NPV / (AF, 20\%, n \text{ years})$

Try different lifetimes. You will find that the EAC declines as you increase the lifetime and that it becomes lower than 1,029.45 at 14 years.

12-10

NPV(A) = $-50,000 - 9,000 (AF, 8\%, 20 \text{ years}) + 10,000/1.08^{20} = \$(136,218)$

EAC(A) = $NPV / (AF, 8\%, 20 \text{ years}) = \$13,874$

NPV(B) = $-120,000 - 6,000 (AF, 8\%, 40 \text{ years}) + 20,000/1.08^{40} = \$(190,627)$

EAC(B) = $NPV / (AF, 8\%, 40 \text{ years}) = \$15,986$

Hence it is optimal to go with the first option.

12-11

NPV of Project A = $-5,000,000 + 2,500,000 (PVA, 10\%, 5) = \$4,476,967$

Equivalent Annuity for Project A = $4,476,967 (APV, 10\%, 5) = \$1,181,013$

NPV of Project B = $1,000,000 (PVA, 10\%, 10) + 2,000,000/1.1^{10} = \$6,915,654$

Equivalent Annuity for Project B = $6,915,654 (APV, 10\%, 10) = \$1,125,491$

NPV of Project C = $2,500,000/.1 - 10,000,000 - 5,000,000/1.1^{10} = \$13,072,284$

Equivalent Annuity for Project C = $13,072,284 * 0.1 = \$1,307,228$.

In this case, we'd go with project C, which has the highest equivalent annuity.

12-12

Equivalent Annual Cost of inexpensive machines = $- 2,000 (APV, 12\%, 3) - 150 = \(983)

Equivalent Annual Cost of expensive machines = $- 4,000(APV, 12\%, 5) - 50 = \$(1,160)$

I would pick the more expensive machines. They are cheaper on an annual basis.

12-13

Annualized Cost of spending \$400,000 right now = $\$400,000 (.10) = \$40,000$

Maximum Additional Cost that the Town can bear = $\$100,000 - \$40,000 = \$60,000$

Annual expenditures will have to drop more than \$40,000 for the second option to be cheaper.

12-14

Initial Cost of First Strategy = \$10 million

Initial Cost of Second Strategy = \$40 million

Additional Initial Cost associated with Second Strategy = \$30 million

Additional Annual Cash Flow needed for Second Strategy to be viable:

= $\$30 \text{ million } (APV, 12\%, 15 \text{ years}) = \4.40 million.

Size of Market under First Strategy = $0.05 * \$200 \text{ million} = \10 million

Size of Market under Second Strategy = $0.10 * \$200 \text{ million} = \20 million

Additional Sales Associated with Second Strategy = \$10 million

After-tax Operating Margin needed to break even with second strategy = 44%

12-15

Project	Initial Investment	NPV	PI	IRR
I	10	3	0.30	21%
II	5	2.5	0.50	28%
III	15	4	0.27	19%
IV	10	4	0.40	24%
V	5	2	0.40	20%

a. The PI would suggest that the firm invest in projects II, IV and V.

b. The IRR of project I is higher than the IRR of project V.

c. The differences arise because of the reinvestment rate assumptions ; with the IRR, intermediate cash flows are reinvested at the IRR; with the PI, cash flows are reinvested at the cost of capital.

12-16

	Years 1- 10
ATCF : Store	10,000
- CF from Lost Sales	-1,200
Net ATCF	8,800

$$NPV = -50,000 + 8,800 (PVA, 14\%, 10 \text{ years}) = \$(4,098)$$

I would not open the store.

12-17

Initial Investment = - \$150,000

Annual Cash Flows from Baby-sitting Service

Additional Revenues \$1,000,000

$$ATCF = \$1,000,000 (.10) - \$ 60,000 (1-0.4) = \$64,000$$

(I used a tax rate of 40%)

$$NPV = -150,000 + \$64,000 (PVA, 12\%, 10 \text{ years}) = \$211,614$$

Yes. I would open the service.

12-18

$$\text{Total Cost of Buying Computers} = \$2,500 * 5,000 = \$12,500,000$$

$$\text{- PV of Salvage} = \$2,500,000/1.1^3 = \$1,878,287$$

$$\text{- PV of Depreciation} = \$3,333,333 * .4 * (PVA, 10\%, 3) = \$3,315,802$$

$$\text{Net Cost of Buying Computers} = \$7,305,911$$

$$\text{Annualized Cost of Buying Computers} = \$7,305,911 (APV, 10\%, 3) = \$2,937,815$$

$$\text{Annualized Cost of Leasing} = \$5,000,000 (1-.4) = \$3,000,000$$

It is slightly cheaper to buy the computers rather than lease them.

12-19

a. There is no cost the first three years. The after-tax salary paid in last two years is an opportunity cost = $80,000 * 0.6 / 1.1^4 + 80,000 * 0.6 / 1.1^5 = \$62,589$

b. The opportunity cost is the difference in PV of investing in year 4 instead of year 8 = $250,000 / 1.1^4 - 250,000 / 1.1^8 = \$54,126$

If you consider depreciation, you would have to include the fact that there will be more depreciation tax benefits between years 4 and 8 as well.

c. The present value of after-tax rental payments over five years is the opportunity cost = $(3000 * 0.6) (PVA, 10\%, 5 \text{ years}) = \$6,823$

$$\text{d. After-tax cash flow} = (400,000 - 160,000) - (240,000 - 100,000) * 0.4 = \$184,000$$

$$\text{e. NPV} = -500,000 - 62,589 - 54,126 - 6,823 + 184,000 (1 - (.11)^{-5}) / .1 = \$73,967$$

12-20 a.

Year	Old	New	Excess/Shortfall
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	Product	Product		
1	50	30	20	
2	52.5	33	14.5	
3	55.13	36.3	8.58	
4	57.88	39.93	2.19	
5	60.78	43.92	-4.7	OUT OF CAPACITY
6	63.81	48.32	-12.13	
7	67	53.15	-20.15	
8	70.36	58.46	-28.82	
9	73.87	64.31	-38.18	
10	77.57	70.74	-48.3	

b. Contribution margin for 1% of capacity for OLD = $(100-50)/50 = \$1.00$
for NEW = $(80-44)/30 = \$1.20$

You will lose less cutting back on old product.

Year	Lost Capacity	\$BT loss (m)	\$AT loss (m)	PV (loss)
5	-4.7	(\$4.70)	(\$2.82)	(\$1.75)
6	-12.13	(\$12.13)	(\$7.28)	(\$4.11)
7	-20.15	(\$20.15)	(\$12.09)	(\$6.20)
8	-28.82	(\$28.82)	(\$17.29)	(\$8.07)
9	-38.18	(\$38.18)	(\$22.91)	(\$9.72)
10	-48.3	(\$48.30)	(\$28.98)	(\$11.17)

Total opportunity cost = \$(41.02)

c. PV of Building facility in year 5 = \$31.05

PV of depreciation benefits on this building

$$= 2 \text{ million} * 0.4 * (\text{PVA}, 10\%, 25) * (\text{PF}, 10\%, 5) = \$4.51$$

Year in which you would have run out of capacity without new product = YEAR 14
(14.206699)

(Remember that growth rate on old product is 5%)

PV of building facility in year 14 = \$13.17

PV of depreciation benefits on this building = $2 \text{ million} * 0.4 * (\text{PVA}, 10\%, 25) * (\text{PF}, 10\%, 14) = \1.91

Net opportunity cost = (PV of Building in year 5 - PV of Depreciation on this building)

- (PV of Building in year 14

- PV of Depreciation on this building)

$$= (31.05 - 4.51) - (13.17 - 1.91) = \$15.28$$

12-21

Year	Potential sales	Lost sales	Lost profits	PV lost profits
1	27,500	0	\$0	\$0
2	30,250	250	\$9,000	\$7,438
3	33,275	3,275	\$117,900	\$88,580
4	36,603	6,603	\$237,690	\$162,345
5	40,263	10,263	\$369,459	\$229,405
6	44,289	14,289	\$514,405	\$290,368
7	48,718	18,718	\$673,845	\$345,789
8	50,000	20,000	\$720,000	\$335,885
9	50,000	20,000	\$720,000	\$305,350
10	50,000	20,000	\$720,000	\$277,591

OPPORTUNITY COST \$2,042,753