Chapter 6

6-1

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

6-2: Linear Programming Problem
Maximize
20X1+ 20 X2 + 15 X3 + 20 X4+ 30X5+ 10 X6 + 20 X7+ 35 X8 + 25 X9 + 10 X10

subject to
$20X1 + 25X2 + 30X3 + 15X4 + 40X5 + 10X6 + 20X7 + 30X8 + 35X9 + 25X10 \leq 100$
$10X1 + 15X2 + 30X3 + 15X4 + 25X5 + 10X6 + 15X7 + 25X8 + 25X9 + 15X10 \leq 75$

6-3
NPV(I) = -12,000 - 500/0.1 = -17,000
EAC(I) = -17000 x 0.1 = -1,700
Remember that this is a perpetuity: PV = A/i; A = PV x i;
NPV(II) = -5,000 - 1,000$(1-(1.1)^{-20})$/.1 = -13,514 EAC(II) = -1,587
NPV(III) = -3,500 -1,200$(1-(1.1)^{-15})$/0.1 = -12,627 EAC(III) = -1,660
CHOOSE OPTION II (GAS HEATING SYSTEM)

6-4
NPV of Wood Siding = -5,000 - 1,000 (PVA.10,10%) = $(11,145)
EAC of Wood Siding = -11,145*(APV,10,10%) = $(1,813.63)

EAC of Aluminum Siding investment = -15,000*.1 = -1,500
Maintenance Cost for Aluminum Siding = 1,813.63-1,500 = 313

6-5
EAC for 1-year subscription = $20.00
EAC for 2-year subscription = $ 36 (APV,20%,2) = $23.56
EAC for 3-year subscription = $ 45 (APV,20%,3) = $21.36
Hence you should choose the 1-year subscription.

6-6

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

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

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

2.36192*z* = 11,342,000

z = 4,802,025.47 or an increase 4.80% from initial level of 10%.

6-7

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).

6-8

	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.

6-9
NPV of less expensive lining = - 2000 - 80 (AF, 20%, 3 years) = $(2,169)
EAC of less expensive lining = -2168.52 /(AF,20%,3 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 years)
EAC of more expensive lining = NPV/(AF,20%,n 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.

6-10
NPV(A) = -50,000 -9,000 (AF,8%, 20 years) + 10,000/1.08^{20} = $(136,218)
EAC(A) = NPV/(AF,8%,20 years) = $13,874
NPV(B) = -120,000 - 6,000(AF,8%,40 years) +20,000/1.08^{40} = $(190,627)
EAC(B) = NPV/(AF,8%,40 years) = $15,986.

Hence it is optimal to go with the first option.

6-11
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.

6-12
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.

6-13
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.

6-14
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 million (APV, 12%, 15 years) = $4.40 million.
Size of Market under First Strategy = 0.05 * $200 million = $10 million
Size of Market under Second Strategy = 0.10 * $200 million = $20 million
Additional Sales Associated with Second Strategy = $10 million
After-tax Operating Margin needed to break even with second strategy = 44%

6-15

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.

6-16

	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 years) = $(4,098)
I would not open the store.

6-17
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%,10years) = $211,614
Yes. I would open the service.

6-18
Total Cost of Buying Computers = $2,500 * 5,000 = $12,500,000
- PV of Salvage = $2,500,000/$1.1^3$ = $1,878,287
- PV of Depreciation = $3,333,333*.4*(PVA,10%,3) = $3,315,802
Net Cost of Buying Computers = $7,305,911
Annualized Cost of Buying Computers = $7,305,911 (APV,10%,3) = $2,937,815
Annualized Cost of Leasing = $5,000,000 (1-.4) = $3,000,000
It is slightly cheaper to buy the computers rather than lease them.

6-19
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 + 80000*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 years) = $6,823

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

e. NPV = -500,000 -62,589 - 54,126 - 6,823 + 184,000(1-(.1.1)$^{-5}$)/.1 = $73,967

6-20 a.

Year	Old	New	Excess/Shortfall

	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 million * 0.4 *(PVA, 10%, 25) * (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 million * 0.4 *(PVA, 10%, 25) * (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

6-21

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