Vol. 2, Chapter 4 – Capital Budgeting

Problem 1: Solution

Answers found using Excel formulas:

1. Amount invested =	$10,000	$21,589.25
Compounding period =	annually	
Number of years =	10	
Annual interest rate =	8%	
Effective interest rate =	8%	
# of periods compounded =	10	
2. Amount invested =	$5,000	$8,144.47
Compounding period =	semi-annually	
Number of years =	5	
Annual interest rate =	10%	
Effective interest rate =	5% = 10% / 2	
# of periods compounded =	10 = 5 years * 2	
3. Amount invested =	$8,000; PV of $8,000 = $7,107.90	
Compounding period =	quarterly	
Number of years =	4	$12,825.02
Annual interest rate =	12%	
Effective interest rate =	3% = 12% / 4	
# of periods compounded =	16 = 4 years * 4	

Answers found using time value of money tables:

1. Amount invested =	$10,000	=$10,000×FVF(.08,10)
Compounding period =	annually	=$10,000×2.1589
Number of years =	10	=$21,589.00
Annual interest rate =	8%	
Effective interest rate =	8%	
# of periods compounded =	10	
2. Amount invested =	$5,000	=$5,000×FVF(.05,10)
Compounding period =	semi-annually	=$5,000×1.6289
Number of years =	5	=$8,144.50
Annual interest rate =	10%	
Effective interest rate =	5% = 10% / 2	
# of periods compounded =	10 = 5 years * 2	
3. Amount invested =	$8,000	=8,000×FVF(.03,16)
Compounding period =	quarterly	=8,000×1.6047
Number of years =	4	=$12,837.60
Annual interest rate =	12%	
Effective interest rate=	3% =12% / 4	
# of periods compounded=	16 = 4 years ×4	

Problem 2: Solution

Answers found using Excel formulas:

1. Amount required = $100,000
Compounding periods = annually
Annual interest rate = 10%
Effective interest rate = 10%
Number of compounding periods = 5
Amount to invest = $62,092.13

2. Amount required = $100,000
Compounding periods = semi-annually
Annual interest rate = 10%
Effective interest rate = 5% = 10% / 2
Number of compounding periods = 10 = 5 years × 2
Amount to invest = $61,391.33

3. Amount required = $100,000
Compounding periods = quarterly
Annual interest rate = 8%
Effective interest rate = 2% = 8% / 4
Number of compounding periods = 20 = 5 years × 4
Amount to invest = $67,297.13

Answers found using time value of money tables:

1. Amount required = $100,000 =$100,000×PVF(.10,5)
Compounding periods = annually =$100,000×0.6209
Annual interest rate = 10%
Effective interest rate = 10%
Number of compounding periods =5
Amount to invest = $62,090

2. Amount required = $100,000 =$100,000×PVF(.05,10)
Compounding periods = semi-annual =$100,000×0.6139
Annual interest rate = 10%
Effective interest rate = 5% = 10% / 2
Number of compounding periods= 10 = 5 years × 2
Amount to invest = $61,390

3. Amount required = $100,000 =$100,000×PVF(.02, 20)
Compounding periods = quarterly =$100,000×0.673
Annual interest rate = 8%
Effective interest rate = 2% = 8% / 4
Number of compounding periods= 20 =5 years × 4
Amount to invest = $67,300

Problem 3: Solution

Answers found using time value of money tables:

Amount at age 29	=$10,000×FVFA(.10,10)
	=$10,000×15.9374
	=$159,374
Amount at age 65	=$159,374×(1+.10)^36
	=$4,478,797.77

Note: Exhibit 1 does not contain a line for 36 years so the formula (1+k)^n is used.

Problem 4: Solution

1. Invest $8,000 annually starting in one year for 10 and then let the investment grow.

Age	Calculation	Solution
26-35	$8,000 × 15.9374	$127,499.40
36-65	$127,499.40 × (1.1^{30})	$2,224,788.32

Note: 15.9374 is from the future value factors for an annuity table 10%, 10 years.

2. Wait until age 36 to invest $10,000 per year for 30 years.

Age	Calculation	Solution
36-65	$10,000 × 164.4940	$1,644,940.23

Problem 5: Solution

Answer found using Excel formula: $1,060,359.92
Answer found using time value of money table:
= $100,000 × PVFA(.08,20) × (1+k)
= $100,000 × 9.8181 × (1+.08)
= $1,060,355

Problem 6: Solution

1.	$10,000 × 1 =	$10,000
	$10,000 × 5.3282 =	53,282
		$63,282
2.	$100,000 × .3220 =	$32,200
3.	$10,000 × 5.6502 =	$56,502
4.	$12,000 × 1 =	$12,000.00
	$12,000 × 3.0373 =	36,447.60
	$8,000 × 2.2908* =	18,326.40
	Total	$66,774.00

*Sum of present value factors for the end of years 5-9 (or the beginning of years 6-10) from Chapter 13, Exhibit 2.

Problem 7: Solution

1. Amount = $25,000) 14.486 = $1,725.80

2. Amount needed after 10 years = $27,000 × .9259 = $24,999.30
   Amount to be invested each year for ten years:
   Amount = $24,999.30) 14.486 = $1,725.76

3. **Note:** The investment is to be made at the end of each year for ten years. Amounts needed at the end of ten years for each year in college:

Year		Amount
1		$ 25,000.00
2	$27,000 × .9259	24,999.30
3	$29,000 × .8573	24,861.70
4	$31,000 × .7938	24,607.80
5	$33,000 × .7350	24,255.00
		$123,723.80

Amount to be invested each year = $123,723.80) 14.486
= $8,540.92

Problem 8: Solution

1. ARR = Average Annual Income ÷ Average Investment

$$= \frac{\$5,731,070}{10} \div \frac{\$5,000,000 + 0}{2}$$

= 22.92%

2. No, since computed ARR at 22.92% is less than 35%.

Problem 9: Solution

1. ARR

$$ARR = \frac{\text{Average Annual Project Income}}{\text{Average Investment}} = \frac{\$7,000}{\$7,500} = 93.33\%$$

Avg. Annual Income = Revenue - Cash Expenses - Depreciation

Avg. Annual Income = $80,000 - $70,000 - $3,000 = $7,000

$$\text{Avg. Investment} = \frac{\text{Project Cost - Salvage}}{2} = \frac{\$15,000 - 0}{2} = \$7,500$$

Problem 9: Solution (continued)

2. Payback

Yearly Cash Flow = Incremental revenues - incremental cash expenses
Yearly Cash Flow = $80,000 - $70,000
Yearly Cash Flow = $10,000

$$\text{Payback Period} = \frac{\text{Cost of Equipment}}{\text{Annual Cash Flow}}$$

$$\text{Payback Period} = \frac{\$15,000}{\$10,000} = 1.5 \text{ years}$$

3. NPV

NPV = Cost + CF × Annuity Factor
NPV = $(15,000) + $10,000 × 3.9927
NPV = $24,927

4. IRR

Annual Cash Flows		10,000
Discount Factor	×	1.5
		15,000
Cost of Equipment		(15,000)
NPV		0

Note: The discount rate of approximately 60.3% results in an NPV of $0.00. Therefore this is the IRR.

Problem 10: Solution

1. Project cost = $23,500

	Year
Cost savings = $5,000	1
5,500	2
5,000	3
4,000	4
4,000	5

Payback is 5.0 years, so Ms. Rollins should not invest in the oven.

Problem 10: Solution (continued)

2. Cost savings = $4,500 each year

   Payback = $23,500 ÷ $4,500 = 5.22 years

   Since 5.22 years is greater than the required payback period, Ms. Rollins should not invest in the oven.

Problem 11: Solution

Present value of income stream

Increase in park revenue	$ 300,000
Increase in costs	70,000
Annual profit increase	230,000
Annuity factor: 15%/10 yrs.	× 5.0188
	1,154,324
Less: Cost	1,500,000
Negative NPV	$ (345,676)

No, the equipment should not be purchased.

Problem 12: Solution

Annual pizza sales	$50,000
Less: food costs 35%	-17,500
Less: labor costs 30%	-15,000
	17,500
Annuity factor 15% / 7 years	× 4.1604
	72,807
Present value of salvage value $2,000 × .3759	752
	73,559
Less: Cost	-20,000
NPV	$53,559

The machine should be purchased.

Problem 13: Solution

1. Payback period

Cash revenues:	$50,000
Cash expenses:	$20,000
Net cash flow:	$30,000

Payback period: Investment / Annual Cash Flow = $100,000 / $30,000 = 3.3 years

2. PV of annual cash flows: $30,000 × 3.6048 = $108,144

Cost of equipment	$100,000
NPV	$ 8,144

Problem 14: Solution

1. Payback Analysis

Years Hence	Additional Rooms	Food Service Operation
0	$ 500,000	$500,000
1	420,000	480,000
2	330,000	420,000
3	230,000	340,000
4	120,000	240,000
5	0	120,000
6	$0 / $130,000 = 0	$120,000 / $140,000 = .86
Payback Period	5.0 years	5.86 years

2. NPV

Additional Rooms

Years Hence	Cash Flow	P.V. Factor	Present Value of Cash Flow
0	$(500,000)	1.0000	$ (500,000.00)
1	80,000	0.9091	72,727.27
2	90,000	0.8264	74,380.17
3	100,000	0.7513	75,131.48
4	110,000	0.6830	75,131.48
5	120,000	0.6209	74,510.56
6	130,000	0.5645	73,381.61
7	140,000	0.5132	71,842.14
8	150,000	0.4665	69,976.11
9	160,000	0.4241	67,855.62
10	170,000	0.3855	65,542.36
		NPV	$220,478.79

Food Service Operation

Years Hence	Cash Flow	P.V. Factor	Present Value of Cash Flow
0	$(500,000)	1.0000	$(500,000.00)
1	20,000	0.9091	18,181.82
2	60,000	0.8264	49,586.78
3	80,000	0.7513	60,105.18
4	100,000	0.6830	68,301.35
5	120,000	0.6209	74,510.56
6	140,000	0.5645	79,026.35
7	160,000	0.5132	82,105.30
8	180,000	0.4665	83,971.33
9	200,000	0.4241	84,819.52
10	220,000	0.3855	84,819.52
		NPV	$185,427.71

Problem 15: Solution

1.	Increased green fees		$20,000
	Increased food sales net of related costs		2,000
	Increased miscellaneous sales	8,000	
	Increased related expenses	(4,000)	4,000
	Increased annual cash flow		26,000
	Annuity factor		1.923077
	Present value of cash flows		50,000
	Initial construction cost		50,000
	Net present value		$0.00
	Internal rate of return =		51.1654%
2.	Increased green fees		$20,000
	Increased food sales net of related costs		2,000
	Increased miscellaneous sales		8,000
	Increased related expenses	(4,000)	4,000
	Increased annual cash flow		26,000
	Annuity factor		5.6502
	Present value of cash flows		146,905
	Initial construction cost		50,000
	Net present value		$96,905.20

Problem 16: Solution

Present value of cash outflows: keeping present machine

Annual Cash Expenditures	$16,060.00
Less: Tax Savings 30%	-4,818.00
Annual Cash Outflow Net of Tax	11,242.00
Annuity Factor 12%/5 years	× 3.6048
Present Value of Cash Flows	$40,525.16

Purchasing new machine

Annual Cash Expenditures	$12,900.00
Less: Tax Savings 30%	-3,870.00
Annual Cash Flow Net of Tax	9,030.00
Annuity Factor 12%/5 years	× 3.6048
Present Value of Annual Cash Flows	32,551.34
Plus: Cost of Machine	15,000.00
Less: Salvage Value of Old Machine Less Taxes at 30%	-2,100.00
Less: Salvage Value of New Machine Less Taxes at 30% at the End of 5 Years (3,500 × .5674)	-1,985.90
Present Value	$43,465.44

No, the present value of cash flows are less at $40,525.16 with the present equipment than with the proposed purchase.

Problem 17: Solution

Part 1

Year	Pre-Depr. Income	Depr. Equip.	Depr. Build.	Pretax Income	Income Taxes	Net Income
1	($500,000)	$800,000	$300,000	($1,600,000)	$0	($1,600,000)
2	(100,000)	640,000	300,000	(1,040,000)	0	(1,040,000)
3	400,000	512,000	300,000	(412,000)	0	(412,000)
4	1,000,000	409,600	300,000	290,400	0	290,400
5	3,000,000	327,680	300,000	2,372,320	0	2,372,320
6	5,000,000	262,144	300,000	4,437,856	121,457	4,316,399
7	5,000,000	209,715	300,000	4,490,285	1,347,086	3,143,199
8	5,000,000	167,772	300,000	4,532,228	1,359,668	3,172,559
9	5,000,000	134,218	300,000	4,565,782	1,369,735	3,196,048
10	5,000,000	107,374	300,000	4,592,626	1,377,788	3,214,838

Year	Net Income	Add Depr.	Cash Flow
1	($1,600,000)	$1,100,000	($500,000)
2	(1,040,000)	940,000	(100,000)
3	(412,000)	812,000	400,000
4	290,400	709,600	1,000,000
5	2,372,320	627,680	3,000,000
6	4,316,399	562,144	4,878,543
7	3,143,199	509,715	3,652,915
8	3,172,559	467,772	3,640,332
9	3,196,048	434,218	3,630,265
10	3,214,838	407,374	3,622,212

Interest Rate 0.12

Present value of cash flows $10,166,012

Sale of Hotel:

Cost	$20,000,000	
Accumulated Depr.	6,570,503	
Net book	13,429,497	
Proceeds	15,000,000	
Gain on sale	1,570,503	
Taxes	471,151	
Cash flow	$14,528,849	
Present value of cash flow from sale		4,677,901
Original cost		(20,000,000)
Net present value		($ 5,156,088)

Problem 17: Solution (continued)

Part 2

Internal Rate of Return:

		Cash Flows	Present Value
Cost		$20,000,000	($20,000,000)
Cash flows year	1	(500,000)	(479,079)
	2	(100,000)	(91,807)
	3	400,000	351,860
	4	1,000,000	842,844
	5	3,000,000	2,422,731
	6	4,878,543	3,774,948
	7	3,652,915	2,708,302
	8	3,640,332	2,586,041
	9	3,630,265	2,470,982
	10	8,300,113	5,413,174
Net present value		-3	

IRR = 0.043670

Note: Determining an IRR to this degree of accuracy is only practical when using a computer.

Part 3

The Fairview Hotel should not be purchased if the desired return is 12% since the NPV is negative and the IRR is only 4.367%.

Problem 18: Solution

Keep:

	20X1	20X2	20X3	20X4	20X5
EBDIPIT	$121,000	$125,000	$131,000	$133,000	$135,000
Depreciation	10,000	8,000	6,000	4,000	2,000
Interest	1,000	800	600	400	200
Prop. taxes	3,000	3,200	3,400	3,600	3,800
Insurance	3,000	3,000	3,000	3,000	3,000
Pretax Income	104,000	110,000	118,000	122,000	126,000
Taxes	34,320	36,300	38,940	40,260	41,580
Net Income	$ 69,680	$ 73,700	$ 79,060	$ 81,740	$ 84,420

Cash Flow:

Net Income	$ 69,680	$ 73,700	$ 79,060	$ 81,740	$ 84,420
Add: Depr.	10,000	8,000	6,000	4,000	2,000
Less: Debt Red.	2,000	2,000	2,000	2,000	2,000
Cash Flow	$ 77,680	$ 79,700	$ 83,060	$ 83,740	$ 84,420
Present Value	$ 69,357	$ 63,536	$ 59,120	$ 53,218	$ 47,902

Total of present value of above cash flows		$293,134	
Sales price of building	$20,000		
Net book value	0		
Gain on sale	20,000		
Taxes	5,000		
Net cash flow from sale	$15,000		
Present value of cash flow from sale of building			8,511
Total			$301,646

Problem 18: Solution (continued)

Sale and Leaseback:

	20X1	20X2	20X3	20X4	20X5
EBDIPIT	$121,000	$125,000	$131,000	$133,000	$135,000
Lease expense	12,000	12,000	12,000	12,000	12,000
Pretax income	109,000	113,000	119,000	121,000	123,000
Income tax	35,970	37,290	39,270	39,930	40,590
Net income	$ 73,030	$ 75,710	$ 79,730	$ 81,070	$ 82,410
Present value	$ 65,205	$ 60,356	$ 56,750	$ 51,521	$ 46,762
Total present value					$280,594

Sale of Restaurant:

	Income	Cash Flow	
Selling price	$ 50,000	$ 50,000	
Net book	30,000		
Gain	$20,000		
Taxes		5,000	
Payment of mortgage		(10,000)	
Cash flow from sale		$ 35,000	35,000
Total present value of this option			$315,594

Since the present value of the cash flows is greater with the sale and leaseback option, the Holt Company should pursue this alternative.

Problem 19: Solution

Year	1	2	3	4	5
Cash Savings/Expenses:					
Labor Cost Savings	$ 30,000	$30,000	$30,000	$ 30,000	$30,000
Annual cash expenses	(10,000)	(10,000)	(10,000)	(10,000)	(10,000)
Net cost reduction	20,000	20,000	20,000	20,000	20,000
Tax savings (costs)	9,800	3,080	(952)	(4,928)	(7,000)
Total Annual Cash Flow	29,800	23,080	19,048	15,072	13,000
PV Factors	0.9091	0.8264	0.7513	0.6830	0.6209
PV of Cash Flows	27,091	19,073	14,311	10,294	8,072

Total PV of Cash Flows				78,841
PV of Salvage Value		20,000 ×	.6209 =	12,418
Total				91,259
Less: Cost of Copier				120,000
NPV				$ (28,741)

Recommendation: No the copier should **not** be purchased!

Year	1	2	3	4	5
Tax Savings (Costs) Calculations:					
Net cash cost reductions	$20,000	$20,000	$20,000	$20,000	$20,000
Less: Depreciation*	48,000	28,800	17,280	5,920	-
Reduction in Taxable Income	28,000	8,800	(2,720)	(14,080)	(20,000)
Marginal tax rate	0.35	0.35	0.35	0.35	0.35
Tax Savings (Costs)	9,800	3,080	(952)	(4,928)	(7,000)

* Double Declining Balance = Undepreciated Cost * (2/n)

Annual Depreciation

Year 1	$120,000 * (0.4) = $48,000
Year 2	$72,000 * (0.4) = $28,800
Year 3	$43,200 * (0.4) = $17,280
Year 4	$25,920 - $20,000 = $5,920
Year 5	0

Note: Depreciation was limited to the cost - salvage value of $100,000.

Problem 20: Solution

Part 1

Investment Project #1:

Cash flows: years 1 - 20	$200,000
Present value factor	7.4694
	1,493,880
Cost	1,000,000
Net present value	$ 493,880

Investment Project #2:

Year	Cash Flow
1	(200,000)
2	(50,000)
3	200,000
4	600,000
5	1,100,000
6	1,100,000
7	1,100,000
8	1,100,000
9	1,100,000
10	1,100,000
11	1,100,000
12	1,100,000
13	1,100,000
14	1,100,000
15	1,100,000
16	1,100,000
17	1,100,000
18	1,100,000
19	1,100,000
20	1,100,000

Present value of above cash flows		5,180,539
Discount rate	0.12	
Purchase cost		4,000,000
Net present value		$1,180,539

Based on the NPV model, select Investment Project #2.

Problem 20: Solution (continued)

Part 2

Investment Project #1: IRR = 0.194258

Year	Cash Flow	Present Value
1	$200,000	$167,468
2	200,000	140,228
3	200,000	117,418
4	200,000	98,319
5	200,000	82,326
6	200,000	68,935
7	200,000	57,722
8	200,000	48,333
9	200,000	40,471
10	200,000	33,888
11	200,000	28,376
12	200,000	23,760
13	200,000	19,895
14	200,000	16,659
15	200,000	13,949
16	200,000	11,680
17	200,000	9,781
18	200,000	8,190
19	200,000	6,857
20	200,000	5,742
	Total	1,000,000
Cost		1,000,000
Net present value		(0)

Investment Project #2: IRR = 0.1502307500

Year	Cash Flow	Present Value
1	(200,000)	(173,878)
2	(50,000)	(37,792)
3	200,000	131,424
4	600,000	342,777
5	1,100,000	546,346
6	1,100,000	474,988
7	1,100,000	412,950
8	1,100,000	359,015
9	1,100,000	312,125
10	1,100,000	271,359
11	1,100,000	235,916
12	1,100,000	205,103
13	1,100,000	178,315
14	1,100,000	155,025
15	1,100,000	134,778
16	1,100,000	117,174
17	1,100,000	101,870
18	1,100,000	88,565
19	1,100,000	76,998
20	1,100,000	66,941

Problem 20: Solution (continued)

	Total	4,000,000
Cost		4,000,000
Net present value		(0)

Based on the IRR model, select Investment Project #1.

Note that this example shows clearly why it is preferable to follow the NPV model when the NPV and IRR models disagree. Although the IRR is higher for Project #1, Project #2 provides much more money.