Chapter 5: Measuring Return on Investments

1. The after-tax earnings is 120000(1-0.34) = 79200. The average book value of capital invested is $250,000, since the book value is depreciated from 500,000 to zero in 10 years. Hence, the after-tax return on capital equals 79200/250000 = 19.80%

2. a.

Year	Beginning Value	Ending value	Average Book Value	After-tax earnings	After-tax ROC
1	1200	800	1000	132	0.132
2	800	400	600	132	0.22
3	400	0	200	132	0.66
4	0	0	0	132	n/a
5	0	0	0	132	n/a
Average			360	132	

The market value is not used, since it is irrelevant for the purpose of defining the book-value of the investment. For the last two years, the denominator is zero, and hence the ROC is undefined. To get around this problem, we use the average book value and after tax earnings over the 5 years.
Return on Capital = 132/360 = 36.67%

b. The geometric average cannot be defined, since the after-tax ROC for the last two years is undefined: the book value for the denominator being zero.
c. Using the return on capital of 36.67% estimated from using the averages, we would accept the project since it is high enough to exceed a cost of capital of 25%.

3. If we compute the average return on equity over the entire period, we have an average equity investment of $300,000 [$1m.x(1-0.40) = $600,000 going down to zero in 5 years]. The yearly net income equals 50,000. Hence the before-tax return on equity = 50000/300000 = 16.67%.

4. If the debt-equity ratio is 100%, the debt-to-capital ratio is 50%. Hence, we need Minimum return on capital = (0.5)(after-tax interest rate) + (0.5)(minimum return on equity). Solving, the implied minimum return on equity = 19%.

5. a.

Year	Cash Flow	Cumulated cash flow
1	250000	250000
2	500000	750000
3	750000	1500000
4	750000	2250000
5	750000	3000000
6	750000	3750000
7	750000	4500000

In year 5, the cumulated cash flow equals the initial investment of $3m. Hence, the payback period = 5 years.

b. The net present value = present value of the inflows - $3b. = 5,724,015.7 - 3 = $2.72b.

6.

Year	FCFF	PV @ 10%	PV @ 15%
0	(2,000,000.00)	2,000,000.00)	(2,000,000.00)
1	100,000.00	90,909.09	86,956.52
2	300,000.00	247,933.88	226,843.10
3	300,000.00	225,394.44	197,254.87
4	300,000.00	204,904.04	171,525.97
5	300,000.00	186,276.40	149,153.02
6	300,000.00	169,342.18	129,698.28
7	300,000.00	153,947.44	112,781.11
8	300,000.00	139,952.21	98,070.53
9	300,000.00	127,229.29	85,278.72
10	300,000.00	115,662.99	74,155.41
	NPV	(338,448.05)	(668,282.46)

The project should not be accepted at either discount rate.

7. The present value of the annual free cash flow to equity can be computed using the annuity formula: $PV = \frac{50000}{0.14}(1 - \frac{1}{(1.14)^{10}}) = \$260,805.78$. This would be the maximum initial investment.

8. The entire benefit of the NPV should accrue to the shareholders. Hence the share price should rise by $2 m./1 m. = $2 per share. However, to the extent that such projects have already been foreseen by the market and incorporated into the stock price, there will be no current impact.

9., 10. Assuming that the discount rates given only apply to the corresponding year, the present values of the flows would be 300,000/(1.1) = $272,727.27and 350,000/(1.1)(1.12) = $284,090.91. The NPV = $56818.18

11.

Year	Project A Cash flows	Project B Cash flows	NPV(A) @ 5%	NPV(B) @ 5%	NPV(A) @ 7.5%	NPV(B) @ 7.5%
0	-500	-2000	-500	-2000	-500	-2000
1	50	190	47.61905	180.9524	44.29679	168.3278
2	50	190	45.35147	172.3356	39.24411	149.1276
3	50	190	43.19188	164.1291	34.76776	132.1175
4	50	190	41.13512	156.3135	30.802	117.0476
5	50	190	39.17631	148.87	27.2886	103.6967
6	50	190	37.31077	141.7809	24.17594	91.86858
7	50	190	35.53407	135.0295	21.41833	81.38966
8	50	190	33.84197	128.5995	18.97527	72.10601
9	50	190	32.23045	122.4757	16.81087	63.8813
10	50	190	30.69566	116.6435	14.89335	56.59473
11	50	190	29.23396	111.0891	13.19455	50.13929
12	50	190	27.84187	105.7991	11.68952	44.42019
13	50	190	26.51607	100.7611	10.35617	39.35344
14	50	190	25.2534	95.96291	9.1749	34.86462
15	50	190	24.05085	91.39325	8.128372	30.88781
16	50	190	22.90558	87.04119	7.201215	27.36462
17	50	190	21.81483	82.89637	6.379814	24.24329
18	50	190	20.77603	78.94892	5.652106	21.478
19	50	190	19.7867	75.18945	5.007402	19.02813
20	100	340	37.68895	128.1424	8.872474	30.16641
IRR	8%	7%				
		NPV	141.955	424.3534	-141.67	-641.897

The IRR for project A is 8%
The IRR for project B is 7%.
According to the IRR rule, project A should be accepted.
The NPVs for the two projects at a cost of capital of 5% are 141.96 and 424.35 respectively. Hence, project B should be accepted.
The NPVs for the two projects at a cost of capital of 7.5% are –141.67 and –641.90 respectively. Hence, project A should be accepted.
Clearly, the IRR and the NPV rules don't always reach the same conclusions. However, the NPV rule is more consistent with the objective of maximizing shareholder wealth.

12. a. Using straight line depreciation, the depreciation each year = (15-3)/10 = $1.2 m. At a tax rate of 40%, this results in a tax saving of $0.48m. a year, for a total nominal value of $4.8 m. The present value can be computed using the annuity formula:

$$\frac{0.48}{.12}\left(1-\frac{1}{1.12^{10}}\right)=\$2.712m.$$

b., c. Using double-declining balance depreciation, the nominal value does not change. However, the depreciation is higher in earlier years, and the present value increases.

Year	Depr	Nominal Tax savings	PV	Double-declining Depreciation	Year-end book value	Nominal Tax saving	PV
0					15.000		
1	1.200	0.480	0.429	3.000	12.000	1.200	1.071
2	1.200	0.480	0.383	2.400	9.600	0.960	0.765
3	1.200	0.480	0.342	1.920	7.680	0.768	0.547
4	1.200	0.480	0.305	1.536	6.144	0.614	0.390
5	1.200	0.480	0.272	1.229	4.915	0.492	0.279
6	1.200	0.480	0.243	0.983	3.932	0.393	0.199
7	1.200	0.480	0.217	0.786	3.146	0.315	0.142
8	1.200	0.480	0.194	0.146	3.000	0.058	0.024
9	1.200	0.480	0.173	0.000	3.000	0.000	0.000
10	1.200	0.480	0.155	0.000	3.000	0.000	0.000
		4.800	2.712			4.800	3.418

The present value is $3.418 m.

13. a., b.

Year	ACRS Rate	Depreciation	Tax Benefit	PV of Tax Benefit
1	20%	0.40	0.16	0.15
2	32%	0.64	0.26	0.21
3	19.20%	0.38	0.15	0.12
4	11.50%	0.23	0.09	0.06
5	11.50%	0.23	0.09	0.06
6	5.80%	0.12	0.05	0.03
Present Value of Tax Benefits from Deprecn =				$0.62m.

c. Tax Benefits from Expensing Asset Immediately = $2.5 (0.4) = $1 million; hence the additional saving = 1-0.62 = $0.38m.

14. In problem 12, if salvage value is ignored, the PV of Tax Savings from Straight line Depreciation = $ 1.5 (PVA,12%,10 years) = $3.39.
The PV of the Capital Gains Taxes on Salvage = 3 (0.2)/1.12^{10} = 0.19.
Hence the PV of the tax savings from ignoring salvage = 3.39 - 0.19 = $3.20. This is 0.488m. higher than the PV with salvage considered (3.2 - 2.712)

In problem 13, if salvage value is ignored, the PV of the tax benefit is:

Year	ACRS Rate	Depreciation	Tax Benefit	PV of Tax Benefit
1	20%	0.50	0.20	0.18
2	32%	0.80	0.32	0.26
3	19.20%	0.48	0.19	0.14
4	11.50%	0.29	0.12	0.08
5	11.50%	0.29	0.12	0.07
6	5.80%	0.15	0.06	0.03

The present value of tax benefits from depreciation less capital gains taxes from salvage = 0.77 - 0.5*0.2/1.1^5 = 0.77 -0.06 = 0.71.

15.a. The Straight-line method provides the higher nominal tax savings.
b. The Double-declining method provides a higher present value of tax benefits.

Year	Depr.	Tax rate	Nominal Tax savings	PV	Double-declining Depreciation	Nominal Tax saving	PV
0.000							
1.000	2.000	0.200	0.400	0.357	4.000	0.800	0.71
2.000	2.000	0.250	0.500	0.399	2.400	0.600	0.48
3.000	2.000	0.300	0.600	0.427	1.440	0.432	0.31
4.000	2.000	0.350	0.700	0.445	1.08	0.302	0.24
5.000	2.000	0.400	0.800	0.454	1.08	0.518	0.25
			3.000	2.082		2.653	1.99

I switched to straight line depreciation in the last two years.

Problem 16

a. The after-tax operating cash flow is computed as

Revenues	$ 5.00
COGS (w/o depr.)	$ 1.50
Depreciation	$ 2.00
EBIT	$ 1.50
EBIT (1-t)	$ 0.90
+ Depreciation	$ 2.00
ATCF	$ 2.90

b. Using the annuity formula, we have $\frac{2.9}{0.11}\left(1-\frac{1}{1.11^5}\right)$= 10.72 as the present value of the operating cash-flows. Deducting the initial investment of $10m., we get an NPV of $0.72m.

c. The yearly increment to cashflow due to depreciation is the savings in taxes, which is 2(0.4) = 0.8m. The PV of this flow = $2.96m.

d.

	1	2	3	4	5
Revenues	5.00	5.00	5.00	5.00	5.00
COGS	1.50	1.50	1.50	1.50	1.50
Depreciation	2.00	2.00	2.00	2.00	2.00
EBIT	1.50	1.50	1.50	1.50	1.50
- Taxes	-	-	-	2.40	0.60
EBIT (1-t)	1.50	1.50	1.50	(0.90)	0.90
+ Deprec'n	2.00	2.00	2.00	2.00	2.00
ATCF	3.50	3.50	3.50	1.10	2.90
PV of ATCF	3.15	2.84	2.56	0.72	1.72

The sum of the PVs = $11.00. The NPV of the project = 11 - 10 = $1m.

17. a. To compute the appropriate discount rate, we need to figure out the beta. The unlevered beta for Nuk-Nuk and Gerber are computed as 1.3/(1+(1-0.4(0.5)) and 1.5/(1+(1-0.5(1.0)) respectively or 1.0 and 1.0 respectively. The discount rate therefore is .115 + 1.0(.055) = 17%.
b. The yearly after-tax operating cash flow equals:
(Revenues – Manufacturing Costs – Depreciation – Opportunity Cost of Garage)(1-tax rate) + Depreciation = 11,600.
c. To compute the NPV, we also need to factor in the outflow of $7500 in inventory setup at time zero and the inflow of $6000 in year 10. The present value of this working capital cost = $7500 - 6000/(1.17)^{10}$ = 6251.78.
The present value of the after-tax operating cash flow equals

$$\frac{11600}{.17}\left(1-\frac{1}{1.17^{10}}\right) = \$54039.80.$$

Hence the NPV = 54039.80 - 50000 - 6251.78 = $-2211.98 < 0.

18. If the facility were sold, capital gains tax would have to be paid on the gain of 100,000 - 60,000 = $40,000 at 25%, i.e. a tax of $10,000. The cost of the smaller facility is $40,000. However, it would be possible to obtain a tax gain from the depreciation. This would amount to (40%)(40,000/10) = 1600 per year for 10 years. At 10%, the PV of this is $9831.30. On the other hand, depreciation from the old facility would be lost. This would amount to (40%)($60,000/10) = 2400 per year for 10 years. At 10%, this works out to $14,746.96. The net cashflow = -10,000 + 9831.30 - 14,746.96 + 100,000 - 40,000 = $45084.35

Assuming nothing else would be done with the facility if it were kept, so that there are no other hidden opportunity costs, the next opportunity cost of using the existing facility instead of selling it and buying a new facility is 45084.35.

However, in the absence of other information, the optimal course would seem to be to actually sell the facility and buy a smaller facility. On the other hand, the existing facility would allow for greater flexibility, thus arguing for keeping it. Then, we may consider the $45084.35 the cost of that additional flexibility, since by using the existing facility, we are forgoing an additional cashflow of $45084.35.

19. a., b. The annual after-tax cashflows from the project are:

Revenues	500 x 500 =	250000
Cost of instructors	24000 x 5	-120000
Rent		-48000
Depreciation	50000/10	-5000
Net Income		77,000
After-tax Income	77000(1-0.4)	46200
Depreciation		+5000
After-tax cashflow		51,200

The present value of an annuity of 51,200 for 10 years at 15% is 256960.95. The NPV = $206,960.95.
The IRR is 102%; hence the investment is worthwhile using either decision rule.

20. If the warehouse is rented out, it would bring in $100,000 per year; after-tax, this works out to (1-0.4)100000 = $60,000.
The tax advantage from depreciation would be 0.4(500000/10) = $20,000 a year. The PV of this at 15% is $100,375.37. However, this would be available irrespective of what the premises would be used for. Hence, this is not relevant for the decision. Consequently, the opportunity cost would simply be the PV of an annuity of $60,000 for 10 years = $301,126.12.

Problem 21

The annual cashflows are

Revenues	1m. bottles at $1 each	$1,000,000
Variable costs	1m. bottles at 50 cents each	$500,000
Fixed costs		$200,000
Depreciation	550,000/5	$110,000
Net Income		$190,000
After tax income	190000(1-0.50)	$95,000
Depreciation		$110,000
Total after-tax cashflow		$205,000

Assumes licensing costs can be capitalized and depreciated.

The PV of this cashflow at 10% for 5 years is $777,111. The investment tax credit adds 500,000(0.10) = $50,000 to the current cashflow. Hence the NPV = $777,111 + 50,000 - $550,000 = $277,111. This has to be compared to the present value of the salary foregone. If the $ 75,000 is pre-tax, and the tax rate on this income is also 50% (It might be lower).

Present Value of Salary foregone = $ 75,000 (1-.5) (PV of Annuity, 10%, 5 years) = $142,154

Take the project. It has a net present value greater than $ 142,154.

Problem 22:

The annual cashflows are

	1	2	3	4	5
Revenues	600000.00	679800.00	770213.40	872651.78	988714.47
Software specialists	250000.00	257500.00	265225.00	273181.75	281377.20
Rent	50000.00	51500.00	53045.00	54636.35	56275.44
Depreciation	20000.00	20000.00	20000.00	20000.00	20000.00
Marketing and selling costs	100000.00	103000.00	106090.00	109272.70	112550.88
Cost of materials	120000.00	135960.00	154042.68	174530.36	197742.89
Pre tax Income	60000.00	111840.00	171810.72	241030.63	320768.05
After tax income	36000.00	67104.00	103086.43	144618.38	192460.83
+ Depreciation	20000.00	20000.00	20000.00	20000.00	20000.00
Change in WC	-7980.00	-9041.34	-10243.84	-11606.27	98,871.45
ATCF	48020.00	78062.66	112842.59	153012.11	311,332.28

Working Capital	60000.00	67980.00	77021.34	87265.18	98871.45

Working capital is fully salvaged in the last year.
There is an initial investment of 100,000 plus an initial outlay of $60,000 for working capital. Taking these into account, the NPV = $ 299,325
The project has a positive NPV and should be accepted.

Problem 23

Year	Excess Capacity	Encroachment	Cash flow from racquets
1	22500.00	0.00	0
2	19750.00	250.00	9000
3	16725.00	3275.00	117900
4	13397.50	6602.50	237690
5	9737.25	10262.75	369459
6	5710.97	14289.03	514404.9
7	1282.07	18717.93	673845.39
8	0	20000.00	720000
9	0	20000.00	720000
10	0	20000.00	720000
		NPV	$2,042,752.63

The opportunity cost is $2,042,752.63.

Problem 24.

a. There is no opportunity cost to using the employees for the first three years, since they must be paid their salaries whether or not they are used on the project. However, their salaries for the last years is an opportunity cost. This equals $80,000(1-0.4)/1.1^4 + 80000(1-0.4)/1.1^5$ = $62,589.

b. The opportunity cost of the packaging plant = $(250,000)/1.1^4 - (250,000)/1.1^8$ = $54,126.52.

c. The depreciation tax advantage can be reaped whether or not the van is used for the current project. The opportunity cost is simply the present value of the after-tax rental income, which is equal to $(3000/.1)(1-(1.1)^{-5})(1-0.4)$ = $6,823.42.

d. The annual cash flows equal (Revenues – Cost of Goods Sold – Depreciation)(1-0.4) + Depreciation = (400000 – 160000 – 100000)(1-0.4) + 100000 = 184000.

The PV of the after-tax operating cash flow = $\frac{184000}{.10}\left(1-\frac{1}{1.10^5}\right) = \$697504.77$

The NPV of the project = 697505 - 500000 - 54127 - 6823 - 62,589 = $73966.

Problem 25.
a. The initial investment is $10 m. + additional working capital at the beginning of 0.10(10,000,000) = $1m; hence total initial investment = $11m.
b.

		Current level	New level	Increment
Revenue	$100m.(.10)	10,000,000	20,000,000	$10,000,000
Fixed Costs		2,000,000	2,000,000	0
Variable Costs		4,000,000	8,000,000	4,000,000
Advertising			1,000,000	1,000,000
Depreciation			1,000,000	1,000,000
Before-tax income				4,000,000
After-tax income				2,400,000
Depreciation				1,000,000
After-tax Operating Cashflow				3,400,000

The present value of the after-tax operating cash flow =

$$\frac{3400000}{.08}\left(1-\frac{1}{1.08^{10}}\right) = \$22,814,277.00$$

Additional working capital at the beginning equals 0.10(10,000,000) = $1m, which will be recouped at the end. The present value consequence of this is $\$1m(1-1.08^{10}) = \$536,806.50$. The NPV of the project = 22,814,277 - 10,000,000 - 536,806.50 = $12,277,470.

Problem 26.

Year	Current use; old prod	current use; new prod	total need	restriction of old product	cost of restricting old product
1	50.00%	30.00%	80.00%	0.00%	0.00
2	52.50%	33.00%	85.50%	0.00%	0.00
3	55.13%	36.30%	91.43%	0.00%	0.00
4	57.88%	39.93%	97.81%	0.00%	0.00
5	60.78%	43.92%	104.70%	4.70%	2818987.50
6	63.81%	48.32%	112.13%	12.13%	7277626.88
7	67.00%	53.15%	120.15%	20.15%	12090967.22
8	70.36%	58.46%	128.82%	28.82%	17289920.48
9	73.87%	64.31%	138.18%	38.18%	22908261.89
10	77.57%	70.74%	148.30%	48.30%	28982904.92
				NPV	$41,018,357.39

a. The projects will run out of capacity in year 5.

b. Assuming that the old product can be continued to be produced after the end of the new product's life, we simply compare the relative flows of the old product versus the new product at the margin. The marginal after-tax operating profit for the old product currently is \$50(1-0.4)/50m = \$0.6m, while it is \$36(1-0.4)/30m. = \$21.6/30 = 0.72m. for the new product per % unit of capacity. This does not change over time. Hence, it would be appropriate to go with the new product in year 5 to the extent of 44% of capacity, and restrict the old product to 56% of capacity. Similarly, in future years, we would restrict the old product further to allow the new product to expand. The extent of the restriction is shown in column 5 in the table above. The NPV of restricting the capacity usage of the old product in years 5 through 10 is equal to \$41.018m.

c. The old product itself is growing at the rate of 5% per year. Hence, the existing facility would be insufficient even for the old product in *n* years, where *n* is the highest integer that satisfies $50(1.05)^n \leq 100$, or $n = 14$. Hence a new facility would have to be built even without the new product line, in 14 years. If we assume that the cost of a new facility is still \$50m. (as given), then the opportunity cost assigned to the new facility if we decided to build it in year 5 is simply the difference in present values of building it in year 5 instead of year 14, which can be computed as $50/1.1^5 - 50/1.1^{14}$ = \$17.88m. However, in this case, we also postpone the depreciation tax advantages from year 5 to year 14. The difference in present values of this advantage are \$2m.(0.40)$[1-(1.1)^{-25}]/0.1 \times (1/1.1^5 - 1/1.1^{14})$ = \$2.60m. The net opportunity cost, therefore, is 17.88 - 2.60 = 15.28m.

Problem 27.

a. Cash flow at time zero is the sum of the installation cost of \$10m. and the change in working capital. Existing working capital = \$5m. (0.50) = \$2.5m. New working capital requirements are \$8m. (0.25) = \$2m. Hence there will be a reduction of \$0.5m., and the net cash flow at time zero = \$9.5m.

b.

Annual flow	Existing system	New system
Operating cost after-tax	-0.9	-0.3
Reduction in taxes due to Depreciation (Annual Depr. 0f \$1m. x Tax rate)		0.4
Profits after tax [Profit margin x (1-Tax rate)]	1.5	2.4
	0.6	2.5

c. The NPV of this project = $\frac{2.5-0.6}{.08}\left(1-\frac{1}{1.08^{10}}\right) - 9.5 = 3.249$m.

{Since this project requires an investment in working capital at the beginning, a reasonable argument can be made that that cash inflow should be reversed in year 5 – working capital increased by \$ 0.5 million . If this is done, the net present value of this project will be only \$ 3.017 million.]

Problem 28.

Country	Cash flow before taxes	Marginal tax rate	After tax flow
A	20	0.6	8
B	15	0.5	7.5
C	10	0.4	6
D	5	0.4	3
E	3	0.35	1.95
Total	53		26.45

The marginal tax rate is the weighted average of the tax rates in column 3 weighted by the relative weights of the cash flows in column 2, which works out to 0.500943. Alternatively, solve for t in 26.45 = 53(1-t).

Problem 29.

Year	Cash flow before taxes	Marginal tax rate	After tax flow
1	10	0.25	7.5
2	20	0.3	14
3	50	0.3	35
4	50	0.3	35
5	100	0.4	60

The present value of these flows at 12% = $99.06m. The NPV = -20.94m.