ECE 472S Problem Set #5 Solutions
Spring, 2015

There are three approaches to determining the after-tax present value of a engineering project:

1 - Accounting Statement Approach - Tabular Approach
2 - Net Operating Income Approach - Tabular Approach
3 - "Elegant" Approach - Net Operating Income Using Valuation Formulas

1 (Accounting Statement Approach)

1. In-House Option	Capital	Revenue	Expenses	Before-Tax Cash Flow	Depr CCA	Taxable Income	Tax 40%	After-Tax Cash Flow	PVF 10%	PV(ATCF)
0	-600,000			-600,000						-600,000
1			190,000	-190,000	120,000	-310,000	-124,000	-66,000	0.9091	-60,001
2			90,000	-90,000	192,000	-282,000	-112,800	22,800	0.8264	18,842
3			90,000	-90,000	115,200	-205,200	-82,080	-7,920	0.7513	-5,950
4			90,000	-90,000	69,120	-159,120	-63,648	-26,352	0.6830	-17,998
5			90,000	-90,000	41,472	-131,472	-52,589	-37,411	0.6209	-23,229
5	100,000			100,000				100,000	0.6209	62,090
5						**48,160**	19,264	-19,264	0.6209	-11,961
									NPV	-638,207

CCA:	Both Machines	40%	EOY BV	Assembly Machine (for Depeciation Recapture evaluation)				
	600,000			500,000				
1	300,000	120,000	180,000	250,000	100,000	150,000	Salvage	100,000
2	480,000	192,000	288,000	400,000	160,000	240,000	BV	51,840
3	288,000	115,200	172,800	240,000	96,000	144,000	Recapture	**48,160**
4	172,800	69,120	103,680	144,000	57,600	86,400		
5	103,680	41,472	62,208	86,400	34,560	**51,840**	**Recapture required**	

2. Subcontract	Capital	Revenue	Expenses 2,000 125.00 4%	Before-Tax Cash Flow	Depr CCA	Taxable Income	Tax 40%	After-Tax Cash Flow	PVF 10%	PV(ATCF)
0				0		0	0	0	1.0000	0
1			250,000	-250,000		-250,000	-100,000	-150,000	0.9091	-136,365
2			260,000	-260,000		-260,000	-104,000	-156,000	0.8264	-128,918
3			270,400	-270,400		-270,400	-108,160	-162,240	0.7513	-121,891
4			281,216	-281,216		-281,216	-112,486	-168,730	0.6830	-115,242
5			292,465	-292,465		-292,465	-116,986	-175,479	0.6209	-108,955
									NPV	-611,371

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2 (Net Operating Income Approach)

1. In-House Option

	Capital	Revenue	Expenses	Net Operating Income	After-Tax NOI	Depreciation Tax Savings	Recapture Tax	After-Tax Cash Flow	PVF 10%	PV(ATCF)
0	-600,000									-600,000
1			190,000	-190,000	-114,000	48,000		-66,000	0.9091	-60,001
2			90,000	-90,000	-54,000	76,800		22,800	0.8264	18,842
3			90,000	-90,000	-54,000	46,080		-7,920	0.7513	-5,950
4			90,000	-90,000	-54,000	27,648		-26,352	0.6830	-17,998
5			90,000	-90,000	-54,000	16,589		-37,411	0.6209	-23,229
5	100,000							100,000	0.6209	62,090
5						**48,160**	19,264	-19,264	0.6209	-11,961
									NPV	-638,207

CCA: Both Machines 40% EOY BV — Assembly Machine (for Depeciation Recapture evaluation)

	600,000				500,000				
1	300,000	120,000	180,000		250,000	100,000	150,000	Salvage	100,000
2	480,000	192,000	288,000		400,000	160,000	240,000	BV	51,840
3	288,000	115,200	172,800		240,000	96,000	144,000	Recapture	**48,160**
4	172,800	69,120	103,680		144,000	57,600	86,400		
5	103,680	41,472	62,208		86,400	34,560	**51,840**	**Recapture required**	

2. Subcontract

	Capital	Revenue	Expenses 2,000 125.00 4%	Net Operating Income	After-Tax NOI	Depreciation Tax Savings	Recapture Tax	After-Tax Cash Flow	PVF 10%	PV(ATCF)
0									1.0000	0
1			250,000	-250,000	-150,000			-150,000	0.9091	-136,365
2			260,000	-260,000	-156,000			-156,000	0.8264	-128,918
3			270,400	-270,400	-162,240			-162,240	0.7513	-121,891
4			281,216	-281,216	-168,730			-168,730	0.6830	-115,242
5			292,465	-292,465	-175,479			-175,479	0.6209	-108,955
									NPV	-611,371

3 ("Elegant" Approach - Net Operating Income) - see next sheet

3 ("Elegant" Approach - Net Operating Income)
The following approach to determining the after-tax value of the two alternatives is generally preferred. There are fewer calculations with less chance of an error and; therefore, usually a better approach on a test.

1. "Elegant" Net Operating Income Approach

In-House Option

1. Capital Cash Flows $PV_1 = -500 - 100 + (P|F\ 10\%, 5)\ 100$ (0.6209)
$= -537.9$

2. After-Tax NOI $PV_2 = (1-0.4)\left[-100\,(P|F\ 10\%, 1) - 90\,(P|A\ 10\%, 5)\right]$ (0.9091, 3.7908)
$= -259.2$

3. Depreciation Tax Savings $PV_3 = (P|F\ 10\%, 1)\,DTS_1 + \sum_{j=2}^{5} (P|F\ 10\%, j)\,DTS_j$

Two machines:

$D_1 = \frac{600}{2}(0.4) = 120 \therefore DTS_1 = (0.4)D_1 = 48$

$D_2 = (600-120)(0.4) = 192 \therefore DTS_2 = (0.4)D_2 = 76.8$

$\therefore PV_3 = (P|F\ 10\%, 1)(48) + (P|F\ 10\%, 1)(P|A, 10\%, -40\%, 4)(76.8)$ (0.9091, 0.9091, 1.8280)
$= 170.9$

4. Tax Effects of Assembly Machine Salvage at EOY5 $PV_4 = -(P|F\ 10\%, 5)(0.4)(SV - BV_5)$ (if recapture applies)

$BV_m = \frac{FC}{2}(1-p)^m + \frac{FC}{2}(1-p)^{m-1}$

$\therefore BV_5 = 250\,(0.6)^5 + 250\,(0.6)^4$
$=$

$\therefore PV_4 = -(P|F\ 10\%, 5)(0.4)(100 - 51.8)$ (0.6209)
$= -12.0$

$\therefore NPV_{INHOUSE} = PV_1 + PV_2 + PV_3 + PV_4 = -638.2$ $\therefore NPV = -638.200$

Sub-Contract Option

No equipment owned by Netronics in this option.

$NPV = -(125.00)(2000)(1-t)^{(0.6)}(P|A, 10\%, 4\%, 5)$ (4.0759)
$= -611\,385$

2

USA:

MACRS Method - 5 Year Property Class

Annual depreciation = (First Cost) * Allowable Percentage

MARR 12%

Year	Rate
1	20.00%
2	32.00%
3	19.20%
4	11.52%
5	11.52%

EOY	Book Value	Depreciation Charge	Accumulated Depreciation	PVF	Tax Savings	PV - Tax Savings
0	4,000,000			1.0000		
1	3,200,000	800,000	800,000	0.8929	320,000	285,714
2	1,920,000	1,280,000	2,080,000	0.7972	512,000	408,163
3	1,152,000	768,000	2,848,000	0.7118	307,200	218,659
4	691,200	460,800	3,308,800	0.6355	184,320	117,139
5	230,400	460,800	**3,769,600**	0.5674	184,320	104,588

Difference in Book Value at the EOY 5 585,940

Total - PV Tax Savings **1,134,263**

Canada:

CCA Declining Balance Depreciation

Year 1: 15% ("half-year" rule)
Years 2-5 30%

EOY	Book Value	Depreciation Charge	Accumulated Depreciation	PVF	Tax Savings	PV - Tax Savings
0	4,000,000			1.0000		
1	3,400,000	600,000	600,000	0.8929	240,000	214,286
2	2,380,000	1,020,000	1,620,000	0.7972	408,000	325,255
3	1,666,000	714,000	2,334,000	0.7118	285,600	203,284
4	1,166,200	499,800	2,833,800	0.6355	199,920	127,053
5	816,340	349,860	**3,183,660**	0.5674	139,944	79,408

Total - PV Tax Savings **949,286**

Therefore, choose the Modified Accelerated Cost Recovery depreciation because the present value of the tax savings is higher.

Present Value of tax savings in the US are greater by 184,977

If all other factors are equal, locate the facility in the US.

3

t =	40%	Income tax rate
i =	15%	MARR
p =	5%	CCA depreciation rate

Depreciation can only be taken if a company is profitable. Depreciation reduces taxes that would otherwise have been paid. That is why it is referred to as Depreciation Tax Savings. If a company is unprofitable, it does not pay any income tax. Therefore, depreciation cannot be taken and has no value. However, nothing is lost. Since there is no depreciation charge, the book value remains the same. When the company beomes profitable, it can start to receive the tax savings association with depreciation.

Note that the Half Year Rule only applies in the first year. Since there is no depreciation in the first year, the HYR does not apply and the standard CCTF formula (no HYR) can be used if the first depreciation tax saving starts at end-of-year 2 or later.

CCTF = 0.9000

Therefore, the present value of the depreciation tax savings factor is:

PVTS = 1 - CCTF = 0.1000

The value of the tax savings one year before the first tax saving occurs:

PV = 4,000,000 * CCTF = 400,000

Because the company is unproftable for the first three years, it cannot claim depreciation until the end-of-year 4. Therefore, the $400,000 calculated above is the value of the depreciation one year before, that is, end-of-year 3.

$$PVTS\ (EOY\ 0) = 400{,}000 * (P|F15\%, 3)^{0.6575162} = 263{,}006$$

And the total after-tax present value is the sum of the first cost less the tax savings:

PV (EOY 0) = -4,000,000 + 263,006
= -3,736,994

Therefore, the **present value after-tax cost** is: **$ 3,736,994**

Note that if the company is not profitable it cannot claim depreciation; it cannot reduce taxes that it is not paying. The Undepreciated Capital Cost remains the same during years 1 through 3 because no depreciation is being taken. The company is not allowed to "catch-up" on the missed depreciation when it becomes profitable. It is only allowed the 5% of the Undepreciated Capital Cost per year in years that it is profitable.

Compare this cost with the cost had the company been profitable the entire time. In this case, the CCTF(HYR) can be used directly.

$$PV = 4{,}000{,}000 * CCTF^{0.9065217} = 3{,}626{,}087$$

Note that being unprofitable has increased the present value cost of the warehousing facility by $ 110,907 .