# Chapter 17

# After-Tax Economic Analysis

**Solutions to Problems**

17.1 TI = GI – E – D
NPAT = (GI – E – D)(1 – T)

17.2 Income tax for an individual is based on the amount of money received from a salary for a job, contract for services rendered, and the like. Property tax is based on the appraised worth of things owned, such as house, car, and personal possessions like jewelry, art, etc.

17.3 (a) Net profit after taxes
(b) Taxable income
(c) Depreciation
(d) Operating expense
(e) Taxable income

17.4 (a) <u>Company 1</u>

TI = Gross income - Expenses - Depreciation
= (1,500,000 + 31,000) – 754,000 – 148,000
= $629,000

Taxes = 113,900 + 0.34(629,000 – 335,000)
= $213,860

<u>Company 2</u>

TI = (820,000 + 25,000) – 591,000 – 18,000
= $236,000

Taxes = 22,250 + 0.39(236,000 – 100,000)
= $75,290

(b) Co. 1: 213,860/1.5 million = 14.26%
Co. 2: 75,290/820,000 = 9.2%

(c) <u>Company 1</u>

Taxes = (TI)($T_e$) = 629,000(0.34) = $213,860
% error with graduated tax = 0%

Company 2

Taxes = 236,000(0.34) = $80,240

% error = $\frac{80{,}240 - 75{,}290}{75{,}290}$ (100%) = + 6.6%

17.5 Taxes using graduated rates:

Taxes on $300,000: 22,250 + 0.39(200,000)
= $100,250

(a) Average tax rate = 100,250/300,000 = 34.0%

(b) 34% from Table 17.1

(c) Taxes = 113,900 + 0.34(165,000) = $170,000
Average tax rate = 170,000/500,000 = 34.0%

(d) Marginal rate is 39% for $35,000 and 34% for $165,000. Use Eq. [17.3].
NPAT = 200,000 – 0.39(35,000) – 0.34(165,000) = $130,250

17.6 $T_e$ = 0.076 + (1 – 0.076)(0.34) = 0.390
TI = 6.5 million – 4.1 million = $2.4 million
Taxes =2,400,000(0.390) = $936,000

17.7 (a) $T_e$ = 0.06 + (1 – 0.6)(0.23) = 0.2762

(b) Reduced $T_e$ = 0.9(0.2762) = 0.2486

Set x = required state rate
0.2486 = x + (1-x)(0.23)
x = 0.0186/0.77 = 0.0242 (2.42%)

(c) Since $T_e$ = 22% is lower than the current federal rate of 23%, no state tax could be levied and an interest free grant of 1% of TI, or $70,000, would have to be made available.

17.8 (a) Federal taxes = 13,750 + 0.34(5000) = $15,450 (using Table 17-1 rates)

Average federal rate = (15,450/80,000)(100%)

= 19.3%

(b) Effective tax rate $= 0.06 + (1 – 0.06)(0.193)$
$= 0.2414$

(c) Total taxes using effective rate = 80,000(0.2414) = \$19,314

(d) State: 80,000(0.06) = \$4800

Federal: 80,000[0.193(1 – 0.06)] = 80,000(0.1814) = \$14,514

17.9 (a) GI = 98,000 + 7500 = \$105,500
TI = 105,500 – 10,500 = \$95,000

Using the rates in Table 17-2:

$$\begin{aligned} \text{Taxes} &= 0.10(7000) + 0.15(28{,}400\text{-}7000) \\ &\quad + 0.25(68{,}800 – 28{,}400) + 0.28(95{,}000 – 68{,}800) \\ &= 0.10(7000) + 0.15(21{,}400) + 0.25(40{,}400) + 0.28(26{,}200) \\ &= \$21{,}346 \end{aligned}$$

(b) 21,346/98,000 = 21.8%

(c) Reduced taxes = 0.9(21,346) = \$19,211

From part (b), taxes are determined from the relation below where x = new TI.

$$\begin{aligned} \text{Taxes} = 19{,}211 &= 0.10(7000) + 0.15(21{,}400) + 0.25(40{,}400) + 0.28(\text{TI} – 26{,}200) \\ &= 700 + 3210 + 10{,}100 + 0.28(x – 68{,}800) \\ &= 14{,}010 + 0.28(x – 68{,}800) \end{aligned}$$

$$\begin{aligned} 0.28x &= 24{,}465 \\ x &= \$87{,}375 \end{aligned}$$

From part (a),set TI = \$87,375 and let y = new total of exemptions and deductions

$$\begin{aligned} \text{TI} = 87{,}375 &= 105{,}500 – y \\ y &= \$18{,}125 \end{aligned}$$

Total would have to increase from \$10,500 to \$18,125, which is a 73% increase. This is not likely to be possible.

17.10 NPAT = GI – E – D – taxes

CFAT = GI – E – P + S – taxes

Consideration of depreciation is a fundamental difference. The NPAT expression deducts depreciation outside the TI and tax computation. The CFAT expression removes the capital investment (or adds the salvage) but does not consider depreciation, since it is a noncash flow.

17.11 D = P = S = 0. From Equation [17.9] with tax rate = T

$$\text{CFAT} = \text{GI} - \text{E} - (\text{GI} - \text{E})(\text{T})$$

$$= (\text{GI} - \text{E})(1 - \text{T})$$

17.12 Depreciation is only used to find TI. Depreciation is not a true cash flow, and as such is not a direct reduction when determining either CFBT or CFAT for an alternative.

17.13 All values are times $10,000

(a) CFAT = GI – E – P + S – taxes

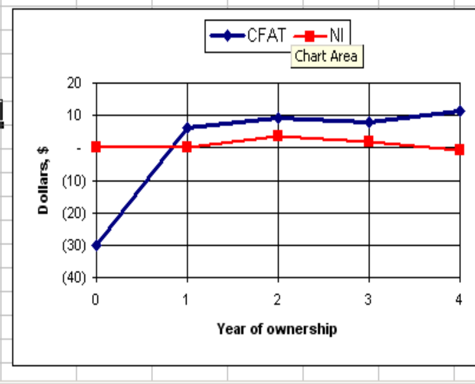
(b) NPAT = TI – taxes

| Year | GI | E | P or S | D | TI | Taxes | (a) CFAT | (b) NPAT |
|---|---|---|---|---|---|---|---|---|
| 0 | – | – | 30 | – | – | – | $-30.0 | |
| 1 | 8 | 2 | | 6 | 0 | 0.0 | 6.0 | 0.0 |
| 2 | 15 | 4 | | 6 | 5 | 1.6 | 9.4 | 3.4 |
| 3 | 12 | 3 | | 6 | 3 | 0.96 | 8.04 | 2.04 |
| 4 | 10 | 5 | 6 | 6 | -1 | -0.32 | 11.32 | -0.68 |

(c) Calculate CFAT and NI and plot them on one chart. Note the significant difference in the yearly values of CFAT and NI.

17.13 (cont)

| | A | B | C | D | E | F | G | H | I | J |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | = Interest | | | (All values are $10,000) | | | | | |
| 2 | 32% | = Tax rate | | | | | | | | |
| 3 | | Gross | | Investment | | | Taxable | | | |
| 4 | | income | Expenses | or salvage | | Depr | income | | (a) | (b) |
| 5 | Year | GI | E | P or S | CFBT | D | TI | Taxes | CFAT | NI |
| 6 | 0 | | | (30) | (30) | | | | (30.00) | - |
| 7 | 1 | 8 | (2) | | 6 | 6 | - | - | 6.00 | - |
| 8 | 2 | 15 | (4) | | 11 | 6 | 5 | 1.60 | 9.40 | 3.40 |
| 9 | 3 | 12 | (3) | | 9 | 6 | 3 | 0.96 | 8.04 | 2.04 |
| 10 | 4 | 10 | (5) | 6 | 11 | 6 | (1) | (0.32) | 11.32 | (0.68) |



17.14 MACRS rates with n = 3 are from Table 16-2. All numbers are times $10,000.

| | Year | GI | P or S | E | D | TI | Taxes | (a) CFAT | (b) CFAT |
|---|---|---|---|---|---|---|---|---|---|
| | 0 | – | -20 | – | – | – | – | -20.000 | -20.000 |
| | 1 | 8 | | 2 | 6.666 | -.666 | -.266 | 6.266 | 6.266 |
| | 2 | 15 | | 4 | 8.890 | 2.110 | .844 | 10.156 | 10.156 |
| | 3 | 12 | | 3 | 2.962 | 6.038 | 2.415 | 6.585 | 6.585 |
| (a) | 4 | 10 | 0 | 5 | 1.482 | 3.518 | 1.407 | 3.593 | – |
| (b) | 4 | 10 | 2 | 5 | 1.482 | 3.518 | 1.407 | – | 5.593 |

The S = $20,000 in year 4 is $20,000 of positive cash flow. CFAT for years 0 through 3 are the same as for S = 0.

17.15 No capital purchase (P) or salvage (S) is involved.

CFBT = CFAT + taxes
= CFAT + TI($T_e$)
= CFAT + (GI –E – D)$T_e$
= CFAT + (CFBT – D)$T_e$

CFBT = [CFAT – D($T_e$)]/(1 – $T_e$)

$T_e$ = 0.045 + 0.955(0.35) = 0.37925

CFBT = [2,000,000 – (1,000,000)(0.37925)]/(1 – 0.37925)
= 1,620,750/0.62075
= $2,610,955

17.16 (a) $T_e$ = 0.065 + (1 - 0.065)(0.35) = 0.39225

CFAT = GI – E – TI($T_e$ ) = 48 – 28 – (48-28-8.2)(0.39225)
= 20 – 11.8(0.39225)
= $15.37 million

(b) Taxes = (48 – 28 – 8.2)(0.39225) = $4.628 million

% of revenue = 4.628/48 = 9.64%

(c) NI = TI(1 - $T_e$ ) = (48-28-8.2)(1 - 0.39225)
= $7.17 million

17.17 CFBT = GI – Expenses – Investment + Salvage
TI = CFBT – Depreciation
Taxes = 0.4(TI)
CFAT = CFBT – taxes
NPAT = TI – taxes

Prob 17.17

| | A | B | C | D | E | F | G | H | I | J |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | = Interest | | | (All values are $) | | | | | |
| 2 | 40% | = Tax rate | | | | | | | | |
| 3 | | Gross | | Investment | | | Taxable | | | |
| 4 | | income | Expenses | or salvage | | Depreciation | income | | | |
| 5 | Year | GI | E | P or S | CFBT | D | TI | Taxes | NPAT | CFAT |
| 6 | 0 | | | (250,000) | (250,000) | | | | 0 | (250,000) |
| 7 | 1 | 90,000 | (20,000) | | 70,000 | 50,000 | 20,000 | 8,000 | 12,000 | 62,000 |
| 8 | 2 | 100,000 | (20,000) | | 80,000 | 80,000 | 0 | 0 | 0 | 80,000 |
| 9 | 3 | 60,000 | (22,000) | | 38,000 | 48,000 | (10,000) | (4,000) | (6,000) | 42,000 |
| 10 | 4 | 60,000 | (24,000) | | 36,000 | 28,800 | 7,200 | 2,880 | 4,320 | 33,120 |
| 11 | 5 | 60,000 | (26,000) | | 34,000 | 28,800 | 5,200 | 2,080 | 3,120 | 31,920 |
| 12 | 6 | 40,000 | (28,000) | 0 | 12,000 | 14,400 | (2,400) | (960) | (1,440) | 12,960 |
| 13 | | | | | | 250,000 | | | | |

17.18 (a) Find $BV_2$ after 2 years of MACRS depreciation.

$$BV_2 = 80{,}000 – 16{,}000 – 25{,}600 = \$38{,}400$$

(b) Sell asset for $BV_2 = S = \$38{,}400$ and use CFAT = GI – E – P + S – Taxes

| Year | (GI – E) | P or S | D | TI | Taxes | CFAT |
|---|---|---|---|---|---|---|
| 0 | - | –80,000 | - | - | - | -$80,000 |
| 1 | 50,000 | | 16,000 | 34,000 | 12,920 | 37,080 |
| 2 | 50,000 | 38,400 | 25,600 | 24,400 | 9,272 | 79,128 |

17.19 (a) For SL depreciation with n = 3 years, $D_t$ = $50,000 per year, Taxes = TI(0.35)

| Year | CFBT | Depr | TI | Taxes |
|---|---|---|---|---|
| 1-3 | $80,000 | $50,000 | $30,000 | $10,500 |

$PW_{tax}$ = 10,500(P/A,15%,3) = 10,500(2.2832) = $23,974

For MACRS depreciation, use Table 16.2 rates.

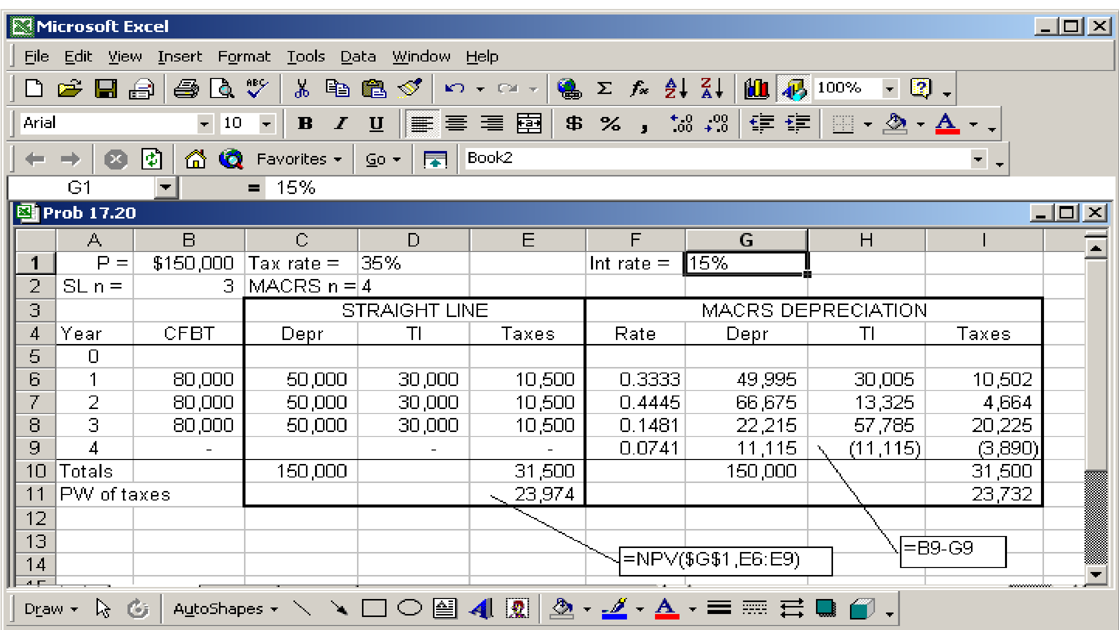
| Year | CFBT | d | Depr | TI | Taxes |
|---|---|---|---|---|---|
| 1 | $80,000 | 33.33% | $49,995 | $30,005 | $10,502 |
| 2 | 80,000 | 44.45 | 66,675 | 13,325 | 4,664 |
| 3 | 80,000 | 14.81 | 22,215 | 57,785 | 20,225 |
| 4 | 0 | 7.41 | 11,115 | -11,115 | -3,890 |

$PW_{tax}$ = 10,502(P/F,15%,1) + ... - 3890(P/F,15%,4) = $23,733

MACRS has only a slightly lower $PW_{tax}$ value.

(b) Total taxes: SL is 3(10,500) = $31,500
MACRS is 10,502 + … - 3890 = $31,501 (rounding error)

17.20 MACRS has only a slightly lower $PW_{tax}$ value.

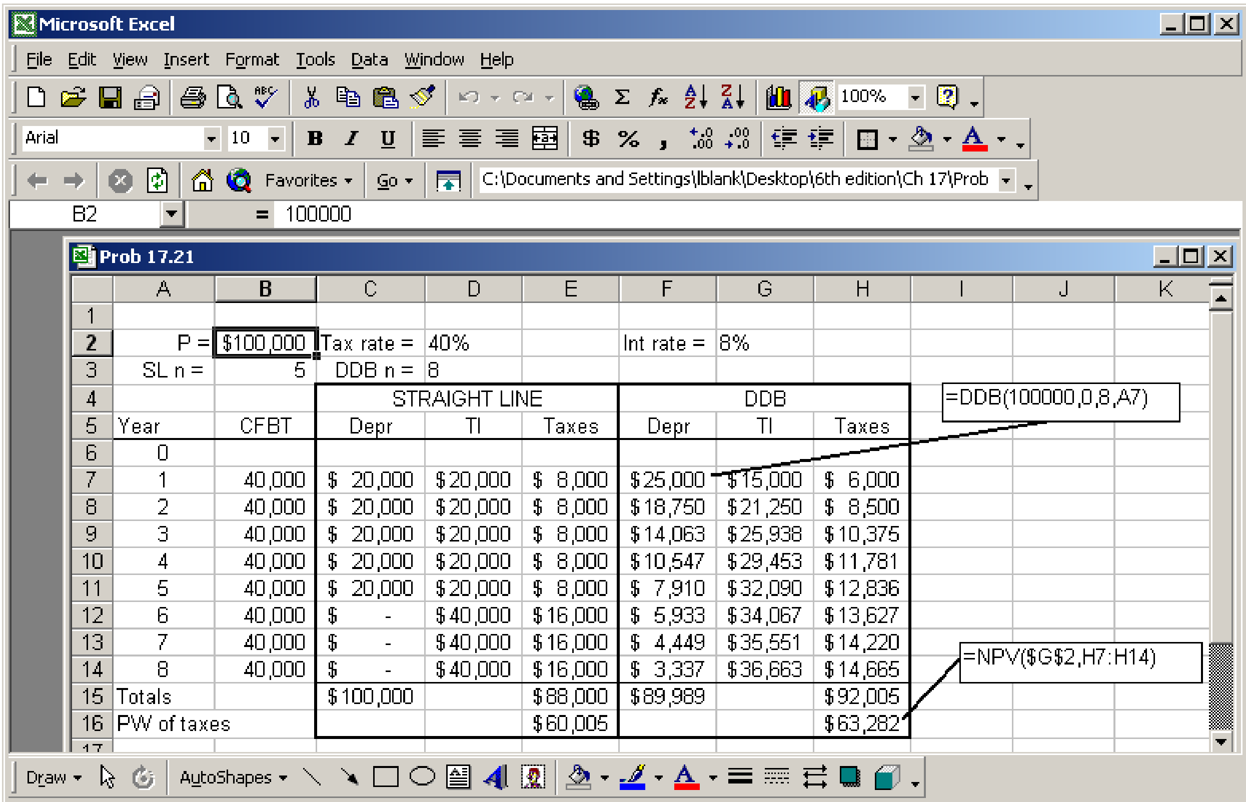

Microsoft Excel

G1 = 15%

Prob 17.20

| | A | B | C | D | E | F | G | H | I |
|---|---|---|---|---|---|---|---|---|---|
| 1 | P = | $150,000 | Tax rate = | 35% | | Int rate = | 15% | | |
| 2 | SL n = | 3 | MACRS n = | 4 | | | | | |
| 3 | | | STRAIGHT LINE | | | MACRS DEPRECIATION | | | |
| 4 | Year | CFBT | Depr | TI | Taxes | Rate | Depr | TI | Taxes |
| 5 | 0 | | | | | | | | |
| 6 | 1 | 80,000 | 50,000 | 30,000 | 10,500 | 0.3333 | 49,995 | 30,005 | 10,502 |
| 7 | 2 | 80,000 | 50,000 | 30,000 | 10,500 | 0.4445 | 66,675 | 13,325 | 4,664 |
| 8 | 3 | 80,000 | 50,000 | 30,000 | 10,500 | 0.1481 | 22,215 | 57,785 | 20,225 |
| 9 | 4 | - | | - | - | 0.0741 | 11,115 | (11,115) | (3,890) |
| 10 | Totals | | 150,000 | | 31,500 | | 150,000 | | 31,500 |
| 11 | PW of taxes | | | | 23,974 | | | | 23,732 |

17.21 Here Taxes = (CFBT – depr)(tax rate). Use NPV function for PW of taxes. Select the SL method with n = 5 years since it has the lower PW of tax.




| | A | B | C | D | E | F | G | H |
|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | |
| 2 | P = | $100,000 | Tax rate = | 40% | | Int rate = | 8% | |
| 3 | SL n = | 5 | DDB n = | 8 | | | | |
| 4 | | | STRAIGHT LINE | | | DDB | | |
| 5 | Year | CFBT | Depr | TI | Taxes | Depr | TI | Taxes |
| 6 | 0 | | | | | | | |
| 7 | 1 | 40,000 | $ 20,000 | $20,000 | $ 8,000 | $25,000 | $15,000 | $ 6,000 |
| 8 | 2 | 40,000 | $ 20,000 | $20,000 | $ 8,000 | $18,750 | $21,250 | $ 8,500 |
| 9 | 3 | 40,000 | $ 20,000 | $20,000 | $ 8,000 | $14,063 | $25,938 | $10,375 |
| 10 | 4 | 40,000 | $ 20,000 | $20,000 | $ 8,000 | $10,547 | $29,453 | $11,781 |
| 11 | 5 | 40,000 | $ 20,000 | $20,000 | $ 8,000 | $ 7,910 | $32,090 | $12,836 |
| 12 | 6 | 40,000 | $ - | $40,000 | $16,000 | $ 5,933 | $34,067 | $13,627 |
| 13 | 7 | 40,000 | $ - | $40,000 | $16,000 | $ 4,449 | $35,551 | $14,220 |
| 14 | 8 | 40,000 | $ - | $40,000 | $16,000 | $ 3,337 | $36,663 | $14,665 |
| 15 | Totals | | $100,000 | | $88,000 | $89,989 | | $92,005 |
| 16 | PW of taxes | | | | $60,005 | | | $63,282 |

17.22 (a) U.S. Asset - MACRS

For each year, use D for MACRS with n = 5

TI = CFBT – D = 65,000 – D

Taxes = TI(0.4)

| Year | d | Depr | TI | Taxes |
|---|---|---|---|---|
| 1 | 0.20 | $50,000 | $15,000 | $6000 |
| 2 | 0.32 | 80,000 | -15,000 | -6000 |
| 3 | 0.192 | 48,000 | 17,000 | 6800 |
| 4 | 0.1152 | 28,800 | 36,200 | 14,480 |
| 5 | 0.1152 | 28,800 | 36,200 | 14,480 |
| 6 | 0.0576 | 14,400 | 50,600 | 20,240 |
| | | | | $56,000 |

$PW_{tax}$ = 6000(P/F,12%,1) - ... + 20,240(P/F,12%,6)
= $33,086

Italian Asset - Classical SL

Calculate SL depreciation with n = 5 and find TI for all 6 years.
D = (250,000 – 25,000)/5 = $45,000
TI = 65,000 – 45,000 = $20,000

| Year | D | TI | Taxes |
|---|---|---|---|
| 1 | $45,000 | 20,000 | $8000 |
| 2 | 45,000 | 20,000 | 8000 |
| 3 | 45,000 | 20,000 | 8000 |
| 4 | 45,000 | 20,000 | 8000 |
| 5 | 45,000 | 20,000 | 8000 |
| 6 | 0 | 65,000 | 26,000 |
| | | | $66,000 |

$PW_{tax}$ = 8000(P/A,12%,5) + 26,000(P/F,12%,6) = $42,010
As expected, MACRS has a smaller $PW_{tax}$

(b) Total taxes are $56,000 for MACRS and $66,000 for classical SL. The SL depreciation has S = $25,000, so a total of (25,000)(0.4) more in taxes is paid. This generates the $10,000 difference in total taxes. (Also, there are no taxes included on the depreciation recapture of $25,000 in year 6.)

17.23 Find the difference between PW of CFBT and CFAT.

| Year | CFBT | d | Depr | TI | Taxes | CFAT |
|---|---|---|---|---|---|---|
| 1 | $10,000 | 0.20 | $1,800 | $8,200 | $3,280 | $6,720 |
| 2 | 10,000 | 0.32 | 2,880 | 7,120 | 2,848 | 7,152 |
| 3 | 10,000 | 0.192 | 1,728 | 8,272 | 3,309 | 6,691 |
| 4 | 10,000 | 0.1152 | 1,037 | 8,963 | 3,585 | 6,415 |
| 5 | 5,000 | 0.1152 | 1,037 | 3,963 | 1,585 | 3,415 |
| 6 | 5,000 | 0.0576 | 518 | 4,482 | 1,793 | 3,207 |

$PW_{CFBT}$ = 10,000(P/A,10%,4) + 5000(P/A,10%,2)(P/F,10%,4) = $37,626
$PW_{CFAT}$ = 6720(P/F,10%,1) + … + 3207(P/F,10%,6) = $25,359

Cash flow lost to taxes is $12,267 in PW dollars.

17.24 (a)

$$PW_{TS} = \sum_{t=1}^{t=n} (\text{tax savings in year t})(P/F,i,t)$$

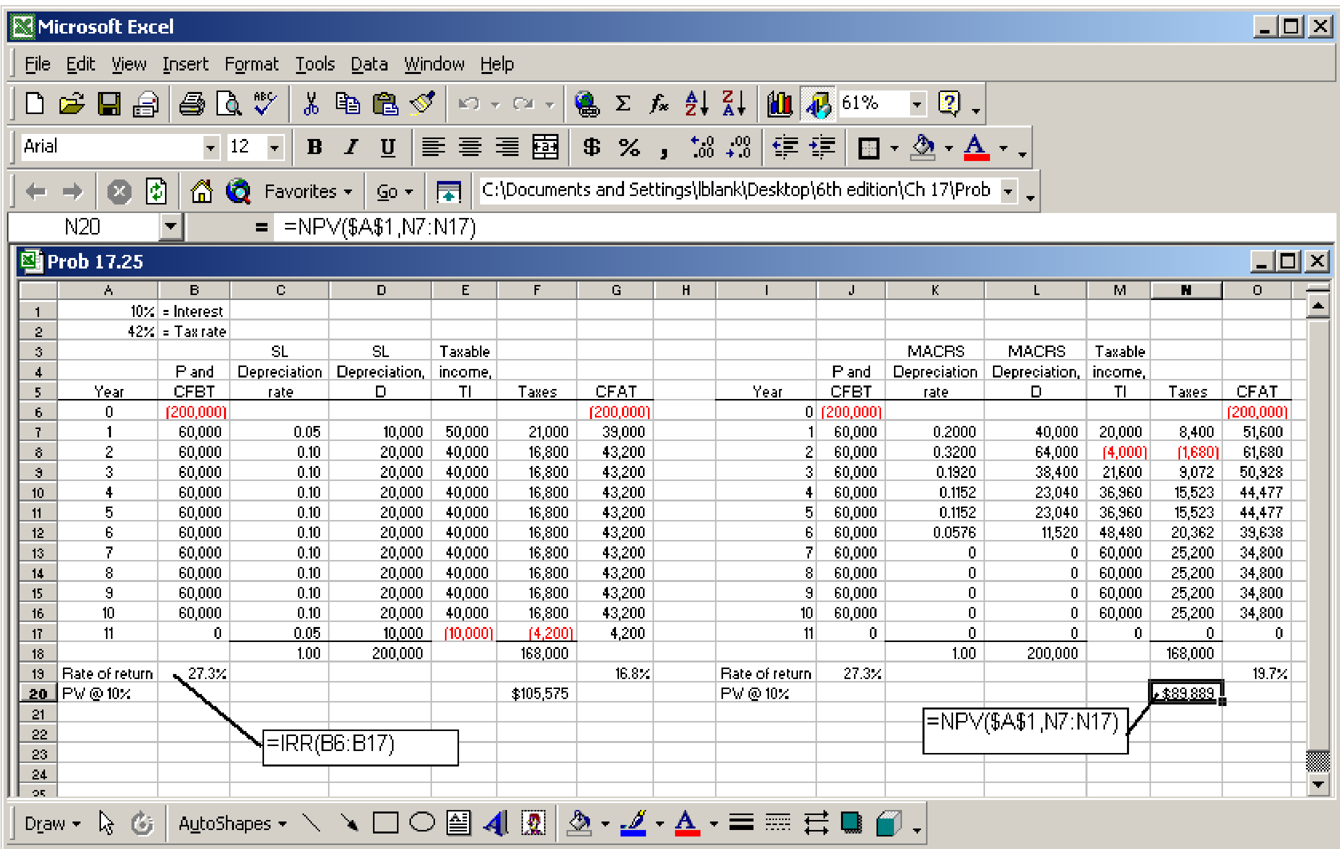
Select the method that maximizes $PW_{TS}$. This is the opposite of minimizing the $PW_{tax}$ value, but the decision will be identical.

(b) $TS_t = D_t(0.42)$

| Year,t | d | Depr | TS |
|---|---|---|---|
| 1 | 0.3333 | $26,664 | $11,199 |
| 2 | 0.4445 | 35,560 | 14,935 |
| 3 | 0.1481 | 11,848 | 4,976 |
| 4 | 0.0741 | 5,928 | 2,490 |

$PW_{TS}$ = 11,199(P/F,10%,1) + ...+ 2,490(P/F,10%,4) = $27,963

17.25



N20 = =NPV($A$1,N7:N17)

Prob 17.25

| | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|
| 1 | 10% | = Interest | | | | | |
| 2 | 42% | = Tax rate | | | | | |
| 3 | | | SL | SL | Taxable | | |
| 4 | | P and | Depreciation | Depreciation, | income, | | |
| 5 | Year | CFBT | rate | D | TI | Taxes | CFAT |
| 6 | 0 | (200,000) | | | | | (200,000) |
| 7 | 1 | 60,000 | 0.05 | 10,000 | 50,000 | 21,000 | 39,000 |
| 8 | 2 | 60,000 | 0.10 | 20,000 | 40,000 | 16,800 | 43,200 |
| 9 | 3 | 60,000 | 0.10 | 20,000 | 40,000 | 16,800 | 43,200 |
| 10 | 4 | 60,000 | 0.10 | 20,000 | 40,000 | 16,800 | 43,200 |
| 11 | 5 | 60,000 | 0.10 | 20,000 | 40,000 | 16,800 | 43,200 |
| 12 | 6 | 60,000 | 0.10 | 20,000 | 40,000 | 16,800 | 43,200 |
| 13 | 7 | 60,000 | 0.10 | 20,000 | 40,000 | 16,800 | 43,200 |
| 14 | 8 | 60,000 | 0.10 | 20,000 | 40,000 | 16,800 | 43,200 |
| 15 | 9 | 60,000 | 0.10 | 20,000 | 40,000 | 16,800 | 43,200 |
| 16 | 10 | 60,000 | 0.10 | 20,000 | 40,000 | 16,800 | 43,200 |
| 17 | 11 | 0 | 0.05 | 10,000 | (10,000) | (4,200) | 4,200 |
| 18 | | | 1.00 | 200,000 | | 168,000 | |
| 19 | Rate of return | 27.3% | | | | | 16.8% |
| 20 | PW @ 10% | | | | | $105,575 | |

| | I | J | K | L | M | N | O |
|---|---|---|---|---|---|---|---|
| 3 | | | MACRS | MACRS | Taxable | | |
| 4 | | P and | Depreciation | Depreciation, | income, | | |
| 5 | Year | CFBT | rate | D | TI | Taxes | CFAT |
| 6 | 0 | (200,000) | | | | | (200,000) |
| 7 | 1 | 60,000 | 0.2000 | 40,000 | 20,000 | 8,400 | 51,600 |
| 8 | 2 | 60,000 | 0.3200 | 64,000 | (4,000) | (1,680) | 61,680 |
| 9 | 3 | 60,000 | 0.1920 | 38,400 | 21,600 | 9,072 | 50,928 |
| 10 | 4 | 60,000 | 0.1152 | 23,040 | 36,960 | 15,523 | 44,477 |
| 11 | 5 | 60,000 | 0.1152 | 23,040 | 36,960 | 15,523 | 44,477 |
| 12 | 6 | 60,000 | 0.0576 | 11,520 | 48,480 | 20,362 | 39,638 |
| 13 | 7 | 60,000 | 0 | 0 | 60,000 | 25,200 | 34,800 |
| 14 | 8 | 60,000 | 0 | 0 | 60,000 | 25,200 | 34,800 |
| 15 | 9 | 60,000 | 0 | 0 | 60,000 | 25,200 | 34,800 |
| 16 | 10 | 60,000 | 0 | 0 | 60,000 | 25,200 | 34,800 |
| 17 | 11 | 0 | 0 | 0 | 0 | 0 | 0 |
| 18 | | | 1.00 | 200,000 | | 168,000 | |
| 19 | Rate of return | 27.3% | | | | | 19.7% |
| 20 | PW @ 10% | | | | | $89,889 | |

=IRR(B6:B17)

=NPV($A$1,N7:N17)

(a and b)

| | SL | MACRS |
|---|---|---|
| i* of CFBT | 27.3% | 27.3% |
| i* of CFAT | 16.8% | 19.7% |

MACRS raises the after tax i* because of accelerated depreciation.

(c) Select MACRS with $PW_{tax}$ = $89,889 versus $105,575 for SL.

17.26 1. Since land does not depreciate,

CG = TI = 0.15(2.6 million) = $390,000
Taxes = 390,000(0.30) = $117,000

2. SP = $10,000
$BV_5$ = 155,000(0.0576) = $8928
DR = SP – $BV_5$ = $1072
Taxes = DR($T_e$) = 1072(0.30) = $322

3. SP = 0.2(150,000) = $30,000
$BV_7$ = $0
DR = SP – $BV_7$ = $30,000
Taxes = 30,000(0.3) = $9000

17.27 1. CL = 5000 – 500 = $4500
TI = $–4500
Tax savings = 0.40(–4500) = $–1800

2. CG = $10,000
DR = 0.2(100,000) = $20,000
TI = CG + DR = $30,000
Taxes = 30,000(0.4) = $12,000

17.28 (a) The relations used in year 6 for DR and CFAT are taken from Equations [17.12] and [17.9] respectively.

DR = SP – $BV_6$ = 500 – (10,000 – sum depr. or 6 years)
CFAT = (GI-E) + SP – taxes

(b) Conclusion is that the total CFAT of $12,710 is the same for both; only the timing is different.

17.28 (cont)

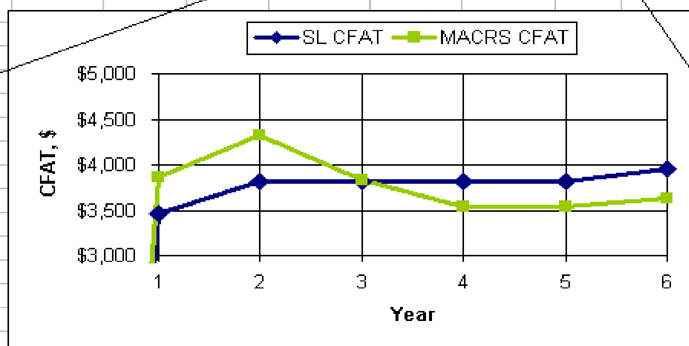
| n = 5 | | P = | $10,000 | | S = | $500 | Tax rate = | 38% | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Straight line with half-year convention | | | | | MACRS Depreciation | | | | | |
| Year | GI - E | P or S | Depr | DR | TI | Taxes | SL CFAT | Depr rate | Depr | DR | TI | Taxes | MACRS CFAT |
| 0 | $ - | $ (10,000) | | | $ - | $ - | $ (10,000) | | | | $ - | $ - | $ (10,000) |
| 1 | $5,000 | | $ 950 | | $4,050 | $1,539 | $ 3,461 | 0.2000 | $ 2,000 | | $ 3,000 | $ 1,140 | $ 3,860 |
| 2 | $5,000 | | $ 1,900 | | $3,100 | $1,178 | $ 3,822 | 0.3200 | $ 3,200 | | $ 1,800 | $ 684 | $ 4,316 |
| 3 | $5,000 | | $ 1,900 | | $3,100 | $1,178 | $ 3,822 | 0.1920 | $ 1,920 | | $ 3,080 | $ 1,170 | $ 3,830 |
| 4 | $5,000 | | $ 1,900 | | $3,100 | $1,178 | $ 3,822 | 0.1152 | $ 1,152 | | $ 3,848 | $ 1,462 | $ 3,538 |
| 5 | $5,000 | | $ 1,900 | | $3,100 | $1,178 | $ 3,822 | 0.1152 | $ 1,152 | | $ 3,848 | $ 1,462 | $ 3,538 |
| 6 | $5,000 | $ 500 | $ 950 | $ - | $4,050 | $1,539 | $ 3,961 | 0.0576 | $ 576 | $500 | $ 4,924 | $ 1,871 | $ 3,629 |
| Total | | | $ 9,500 | | | | $ 12,710 | | $10,000 | | | | $ 12,710 |

=SLN(10000,500,5)/2

=$B13+$C13-G13

=$B13-J13+K13

=$C$13 - ($D$3-SUM(J$8:J$13))



17.29 (a) Use MACRS rates for n = 5

$BV_2$ = 40,000 - 0.52(40,000) = $19,200

There is depreciation recapture (DR)
DR = 21,000 – 19,200 = $1800

TI = GI – E – D + DR
= 20,000 – 3000 – 0.32(40,000) + 1800 = $6,000

Taxes = 6,000(0.35) = $2100

(b) CFAT = GI – E + SP – taxes
= 20,000 – 3000 + 21,000 – 2100
= $35,900

17.30 Land: CG = $45,000
Building: CL = $45,000
Cleaner: DR = 18,500 – 15,500 = $3000
Circulator: DR = 10,000 - 5,000 = $5,000
CG = 10,500 - 10,000 = $500

17.31 In year 4, DR = $20,000 as additional TI.
In $10,000 units, at the time of sale in year 4:

| Year | GI | E | SP | D | TI | Taxes | CFAT |
|---|---|---|---|---|---|---|---|
| 4 | $10 | $5 | $2 | $1.482 | $5.518 | 2.2072 | $4.7928 |

CFAT = GI – E + SP – taxes
= 10 – 5 + 2 – 2.2072
= $4.7928 ($47,928)

CFAT decreased from $55,930 as calculated in Prob.17.14(b).

17.32 Straight line depreciation

$D_t = \frac{45{,}000 - 3000}{5} = \$8400$

TI = 15,000 – 8400 = $6600
Taxes = 6600(0.5) = $3300
No depreciation recapture is involved.

$PW_{tax} = 3300(P/A,18\%,5) = \$10,320$

<u>DDB-to-SL switch</u>

$TI = 15,000 – D_t$
Taxes = TI(0.50)

The depreciation schedule was determined in Problem 16A.4.

| t | CFBT | Depr | Method | TI | Taxes |
|---|---|---|---|---|---|
| 1 | $15,000 | 18,000 | DDB | $–3000 | $–1500 |
| 2 | 15,000 | 10,800 | DDB | 4200 | 2100 |
| 3 | 15,000 | 6480 | DDB | 8520 | 4260 |
| 4 | 15,000 | 3888 | DDB | 11,112 | 5556 |
| 5 | 15,000 | 2832 | SL | 12,168 | 6084 |

$$PW_{tax} = –1500(P/F,18\%,1) + ... + 6084(P/F,18\%,5) = \$8355$$

Switching gives a $1965 lower $PW_{tax}$ value.

17.33 Chapter 4 includes a description of the method used to determine each of the following:

Net short-term capital gain or loss
Net long-term capital gain or loss
Net gain
Net loss

In brief, net all short term, then all long term gains and losses. Finally, net the gains and losses to determine what is reported on the return and how it is taxed.

17.34 Effective tax rate = 0.06 + (1 – 0.06) (0.35)
= 0.389

$$\text{Before-tax ROR} = \frac{0.09}{1 - 0.389} = 0.147$$

A 14.7 % before-tax rate is equivalent to 9% after taxes.

17.35 Calculate taxes using Table 17-1 rates, use Equations [17.4] for the average tax rate and [17.5] for $T_{e,}$ followed by Equation [17.17] solved for after-tax ROR.

Income taxes = 113,900 + 0.34(8,950.000-335,000)
= 113,900 + 2,929,100
= $3,043,000

Average tax rate = taxes /TI = 3,043,000/8,950,000
= 0.34

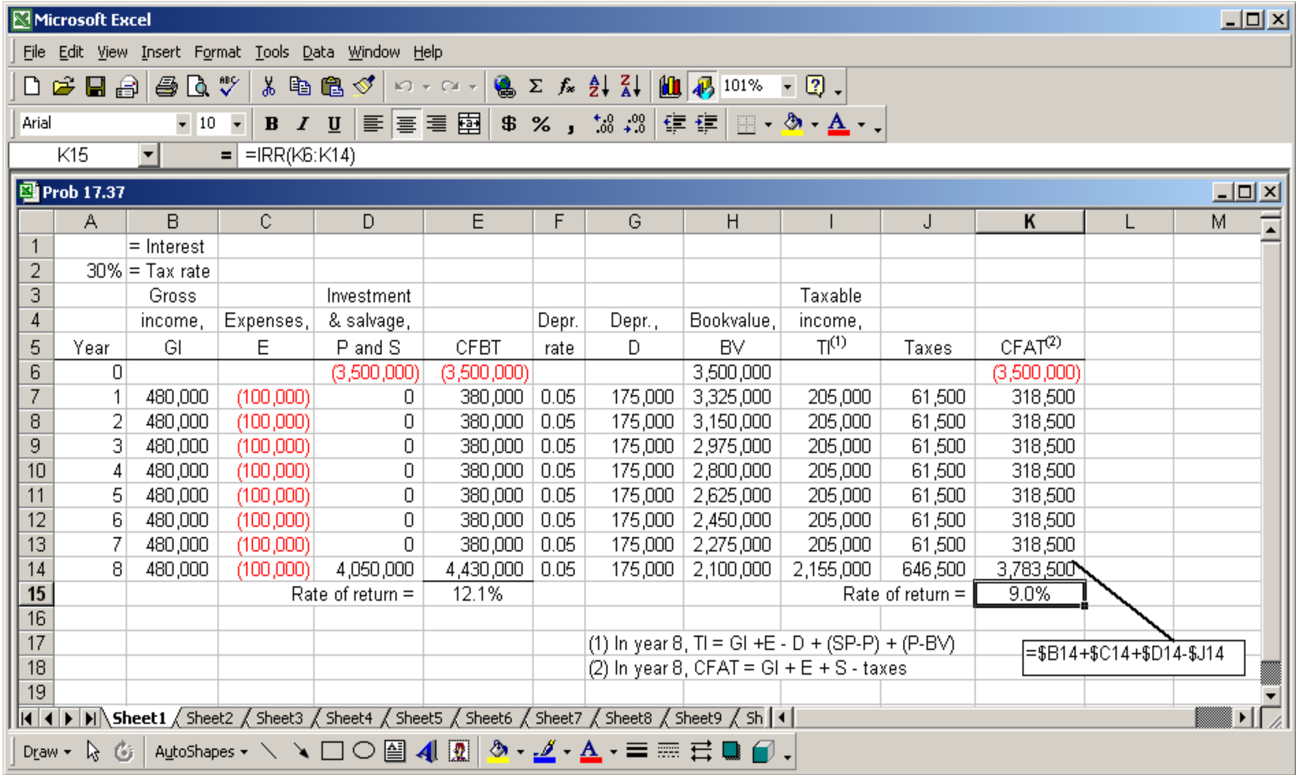
$$T_e = 0.05 + (1-0.05)(0.34) = 0.373$$

After-tax ROR = (before-tax ROR)(1-$T_e$)
= 0.22(1 – 0.373)
= 0.138

A before-tax ROR of 22% is equivalent to an after-tax ROR of 13.8%

17.36 0.08 = 0.12 (1-tax rate)
1-tax rate = 0.667
Tax rate = 0.333 (33.3%)

17.37




| | A | B | C | D | E | F | G | H | I | J | K | L | M |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | = Interest | | | | | | | | | | | |
| 2 | 30% | = Tax rate | | | | | | | | | | | |
| 3 | | Gross | | Investment | | | | | Taxable | | | | |
| 4 | | income, | Expenses, | & salvage, | | Depr. | Depr., | Bookvalue, | income, | | | | |
| 5 | Year | GI | E | P and S | CFBT | rate | D | BV | TI(1) | Taxes | CFAT(2) | | |
| 6 | 0 | | | (3,500,000) | (3,500,000) | | | 3,500,000 | | | (3,500,000) | | |
| 7 | 1 | 480,000 | (100,000) | 0 | 380,000 | 0.05 | 175,000 | 3,325,000 | 205,000 | 61,500 | 318,500 | | |
| 8 | 2 | 480,000 | (100,000) | 0 | 380,000 | 0.05 | 175,000 | 3,150,000 | 205,000 | 61,500 | 318,500 | | |
| 9 | 3 | 480,000 | (100,000) | 0 | 380,000 | 0.05 | 175,000 | 2,975,000 | 205,000 | 61,500 | 318,500 | | |
| 10 | 4 | 480,000 | (100,000) | 0 | 380,000 | 0.05 | 175,000 | 2,800,000 | 205,000 | 61,500 | 318,500 | | |
| 11 | 5 | 480,000 | (100,000) | 0 | 380,000 | 0.05 | 175,000 | 2,625,000 | 205,000 | 61,500 | 318,500 | | |
| 12 | 6 | 480,000 | (100,000) | 0 | 380,000 | 0.05 | 175,000 | 2,450,000 | 205,000 | 61,500 | 318,500 | | |
| 13 | 7 | 480,000 | (100,000) | 0 | 380,000 | 0.05 | 175,000 | 2,275,000 | 205,000 | 61,500 | 318,500 | | |
| 14 | 8 | 480,000 | (100,000) | 4,050,000 | 4,430,000 | 0.05 | 175,000 | 2,100,000 | 2,155,000 | 646,500 | 3,783,500 | | |
| 15 | | | | Rate of return = | 12.1% | | | | | Rate of return = | 9.0% | | |
| 16 | | | | | | | | | | | | | |
| 17 | | | | | | | (1) In year 8, TI = GI +E - D + (SP-P) + (P-BV) | | | | | | |
| 18 | | | | | | | (2) In year 8, CFAT = GI + E + S - taxes | | | | | | |
| 19 | | | | | | | | | | | | | |

(a) CFAT is in column K.

(b) Before-tax ROR = 12.1% (cell E15)
After-tax ROR = 9.0% (cell K15)

17.38

| | Cell | Before-tax | Cell | After-tax |
|---|---|---|---|---|
| PW: | B12 | =-PV(14%,5,75000,15000)-200000 | C12 | =NPV(9%,C6:C10)+C5 |
| AW: | B13 | =PMT(14%,5,-B12) | C13 | =PMT(9%,5,-C12) |
| ROR: | B14 | =IRR(B5:B10) | C14 | =IRR(C5:C10) |

17.39 NE has an investment requirement now, so the incremental ROR is based on (NE-TSE) analysis. The original purchase prices four years ago do not enter into this after-tax analysis. The last 4 years of the MACRS rates are used to determine annual depreciation. Also, income taxes must be zero if the tax amount is negative. Solution uses the Excel IF statement for this logic.

Since MARR = 25% exceeds delta i* = 17.26%, the incremental investment is not justified. So, sell NE now, retain TSE for the 4 years and then dispose of it. The NPV function at varying i values verifies this. For example, at MARR = 25%, TSE has a larger PW value.

Tax rate = 35%

**North Enterprises (NE)**

Capital cost $ 10,000

| Year | Investment | Revenue | Expenses | MACRS rate | Depr | TI | Taxes | CFAT |
|---|---|---|---|---|---|---|---|---|
| now | -500 | 0 | 0 | | | 0 | 0 | -500 |
| 1 | | 2000 | 500 | 0.0893 | 893 | 607 | 212 | 1288 |
| 2 | | 2500 | 800 | 0.0892 | 892 | 808 | 283 | 1417 |
| 3 | | 3000 | 1100 | 0.0893 | 893 | 1007 | 352 | 1548 |
| 4 | | 3500 | 1400 | 0.0446 | 446 | 1654 | 579 | 1521 |

**The Southern Exchange (TSE)**

Capital cost $ 20,000

| Year | Investment | Revenue | Expenses | MACRS rate | Depr | TI | Taxes | CFAT | Incr CFAT (NE-TSE) |
|---|---|---|---|---|---|---|---|---|---|
| now | 0 | 0 | 0 | | | 0 | 0 | 0 | -500 |
| 1 | | 4000 | 800 | 0.0893 | 1786 | 1414 | 495 | 2705 | -1418 |
| 2 | | 3000 | 1200 | 0.0892 | 1784 | 16 | 6 | 1794 | -377 |
| 3 | | 2000 | 1500 | 0.0893 | 1786 | -1286 | 0 | 500 | 1048 |
| 4 | | 1000 | 2000 | 0.0446 | 892 | -1892 | 0 | -1000 | 2521 |
| Breakeven IRR | | | | | | | | | **17.26%** |

PW values

| i | NE | TSE |
|---|---|---|
| 10% | $4,043 | $3,635 |
| 15% | $3,578 | $3,466 |
| 17.26% | $3,393 | $3,393 |
| 20% | $3,186 | $3,307 |
| 25% | $2,852 | $3,159 |
| 30% | $2,566 | $3,020 |
| 35% | $2,318 | $2,891 |

=$I9-$I19

=IF(($G19*$J$1)>0,$G19*$J$1,0)

=IRR(J15:J19)

17.40 (a) Solution by Computer -- Use the spreadsheet format of Figure 17-3b plus a column for BV.

Conclusion: $PW_A$ = \$3345 and $PW_B$ = \$9221. Select machine B.

(b) Solution by hand – Develop two tables similar to the spreadsheet.

Microsoft Excel – Prob 17.40

40% = Tax rate | 8% = Interest

**Machine A**

| Year | CFBT | Investment & salvage, P and S | Depreciation rate | Depreciation, D | Book value, BV | Taxable income, TI | Taxes | CFAT |
|---|---|---|---|---|---|---|---|---|
| 0 | | (35,500) | | | 35,500 | | | (35,500) |
| 1 | 8,000 | | 0.2000 | 7,100 | 28,400 | 900 | 360 | 7,640 |
| 2 | 8,000 | | 0.3200 | 11,360 | 17,040 | (3,360) | (1,344) | 9,344 |
| 3 | 8,000 | | 0.1920 | 6,816 | 10,224 | 1,184 | 474 | 7,526 |
| 4 | 8,000 | | 0.1152 | 4,090 | 6,134 | 3,910 | 1,564 | 6,436 |
| 5 | 8,000 | | 0.1152 | 4,090 | 2,045 | 3,910 | 1,564 | 6,436 |
| 6 | 8,000 | | 0.0576 | 2,045 | 0 | 5,955 | 2,382 | 5,618 |
| 7 | 8,000 | 4,000 | 0 | 0 | 0 | 8,000 | 3,200 | 8,800 |
| | | | 1 | 35,500 | | | | |
| | | | | | | | PW(A) = | \$3,345 |

**Machine B**

| Year | CFBT | Investment & salvage, P and S | Depreciation rate | Depreciation, D | Book value, BV | Taxable income, TI | Taxes | CFAT |
|---|---|---|---|---|---|---|---|---|
| 0 | | (19,000) | | | 19,000 | | | (19,000) |
| 1 | 6,500 | | 0.2000 | 3,800 | 15,200 | 2,700 | 1,080 | 5,420 |
| 2 | 6,500 | | 0.3200 | 6,080 | 9,120 | 420 | 168 | 6,332 |
| 3 | 6,500 | | 0.1920 | 3,648 | 5,472 | 2,852 | 1,141 | 5,359 |
| 4 | 6,500 | | 0.1152 | 2,189 | 3,283 | 4,311 | 1,724 | 4,776 |
| 5 | 6,500 | | 0.1152 | 2,189 | 1,094 | 4,311 | 1,724 | 4,776 |
| 6 | 6,500 | | 0.0576 | 1,094 | 0 | 5,406 | 2,162 | 4,338 |
| 7 | 6,500 | 3,000 | 0 | 0 | 0 | 6,500 | 2,600 | 6,900 |
| | | | 1 | 19,000 | | | | |
| | | | | | | | PW(B) = | \$ 9,221 |

17.41 Both solutions are on the spreadsheet below.

Prob 17.41

| | D | E | F | G | H |
|---|---|---|---|---|---|
| 1 | (a) | | | Before taxes | |
| 2 | | Year | X | Y | Y - X |
| 3 | | 0 | -12000 | -25000 | -13000 |
| 4 | | 1 | -3000 | -1500 | 1500 |
| 5 | | 2 | -3000 | -1500 | 1500 |
| 6 | | 3 | -3000 | -1500 | 1500 |
| 7 | | 4 | -3000 | -1500 | 1500 |
| 8 | | 5 | -3000 | -1500 | 1500 |
| 9 | | 6 | -3000 | -1500 | 1500 |
| 10 | | 7 | -3000 | -1500 | 1500 |
| 11 | | 8 | -3000 | -1500 | 1500 |
| 12 | | 9 | -3000 | -1500 | 1500 |
| 13 | | 10 | 0 | 3500 | 3500 |
| 14 | | Incr IRR | | | 4.72% |
| 15 | | PW | $ (26,839) | $ (31,475) | ($0.00) |

=NPV($H$14,H4:H13)+H3

| | A | B | C | D | E | F | G | H | I | J | K | L |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 16 | (b) | After taxes | | | | | | | | | | |
| 17 | | Alternative X | | | | | Alternative Y | | | | | Incr CFAT |
| 18 | Year | CFBT | Depr | TI | Taxes | CFAT | CFBT | Depr | TI | Taxes | CFAT | (Y - X) |
| 19 | 0 | -12000 | | | | -12000 | -25000 | | | | -25000 | -13000 |
| 20 | 1 | -3000 | 900 | -3900 | -1950 | -1050 | -1500 | 2,000 | -3500 | -1750 | 250 | 1300 |
| 21 | 2 | -3000 | 900 | -3900 | -1950 | -1050 | -1500 | 2,000 | -3500 | -1750 | 250 | 1300 |
| 22 | 3 | -3000 | 900 | -3900 | -1950 | -1050 | -1500 | 2,000 | -3500 | -1750 | 250 | 1300 |
| 23 | 4 | -3000 | 900 | -3900 | -1950 | -1050 | -1500 | 2,000 | -3500 | -1750 | 250 | 1300 |
| 24 | 5 | -3000 | 900 | -3900 | -1950 | -1050 | -1500 | 2,000 | -3500 | -1750 | 250 | 1300 |
| 25 | 6 | -3000 | 900 | -3900 | -1950 | -1050 | -1500 | 2,000 | -3500 | -1750 | 250 | 1300 |
| 26 | 7 | -3000 | 900 | -3900 | -1950 | -1050 | -1500 | 2,000 | -3500 | -1750 | 250 | 1300 |
| 27 | 8 | -3000 | 900 | -3900 | -1950 | -1050 | -1500 | 2,000 | -3500 | -1750 | 250 | 1300 |
| 28 | 9 | -3000 | 900 | -3900 | -1950 | -1050 | -1500 | 2,000 | -3500 | -1750 | 250 | 1300 |
| 29 | 10 | 0 | 900 | -900 | -450 | 450 | 3500 | 2,000 | 1500 | 750 | 2750 | 2300 |
| 30 | Incr IRR | | | | | | | | | | | 1.29% |
| 31 | PW @ 7% | | | | | $ (18,612) | | | | | $ (21,973) | |

=NPV(7%,K20:K29)+K19

(a) The before-tax MARR equivalent is 7%/(1- 0.50) = 14% per year. The incremental ROR analysis uses (Y – X) since Y has a larger first cost.

Conclusion: Select X. Increment for Y not justified at MARR = 14% since incremental i* = 4.72%

(b) SL depreciation is

$$SL_X = (12,000 - 3,000)/10 = \$\ 900 \text{ per year}$$
$$SL_Y = (25,000 - 5,000)/10 = \$2000 \text{ per year}$$

Conclusion: Select X. Increment for Y not justified at after-tax MARR = 7%
Since incremental i* = 1.29%.

17.42 (a) $PW_A$ = -15,000 – 3000(P/A,14%,10) + 3000(P/F,14%,10)
= -15,000 – 3000(5.2161) + 3000(0.2697)
= $-29,839

$PW_B$ = -22,000 – 1500(P/A,14%,10) + 5000(P/F,14%,10)
= -22,000 – 1500(5.2161) + 5000(0.2697)
= $-28,476

Select B with a slightly smaller PW value.

(b) All costs generate tax savings.

Machine A

Annual depreciation = (15,000 – 3,000)/10 = $1200
Tax savings = (AOC + D)0.5 = 4200(0.5) = $2100
CFAT = –3000 + 2100 = $–900

$PW_A$ = –15,000 – 900(P/A,7%,10) + 3000(P/F,7%,10)
= –15,000 – 900(7.0236) + 3000(0.5083)
= $–19,796

Machine B

Annual depreciation = $\frac{22{,}000 - 5000}{10}$ = $1700
Tax savings = (1500 + 1700) (0.50) = $1600
CFAT = –1500 + 1600 = $100

$PW_B$ = –22,000 + 100(P/A,7%,10) + 5000(P/F,7%,10)
= –22,000 + 100(7.0236) + 5000(0.5083)
= $–18,756

Select machine B.

(c) MACRS with n = 5 and a DR in year 10, which is a tax, not a tax savings.
Tax savings = (AOC + D)(0.5), years 1-6
CFAT = -AOC + tax savings, years 1-10.

17.42 (cont)

Machine A

Year 10 has a DR tax of 3,000(0.5) = $1500

| Year | P or S | AOC | Depr | Tax savings | CFAT |
|---|---|---|---|---|---|
| 0 | $–15,000 | - | - | - | $–15,000 |
| 1 | | $3000 | $3000 | $3000 | 0 |
| 2 | | 3000 | 4800 | 3900 | 900 |
| 3 | | 3000 | 2880 | 2940 | -60 |
| 4 | | 3000 | 1728 | 2364 | -636 |
| 5 | | 3000 | 1728 | 2364 | -636 |
| 6 | | 3000 | 864 | 1932 | -1068 |
| 7 | | 3000 | 0 | 1500 | -1500 |
| 8 | | 3000 | 0 | 1500 | -1500 |
| 9 | | 3000 | 0 | 1500 | -1500 |
| 10 | | 3000 | 0 | 1500 | -1500 |
| 10 | 3000 | - | - | –1500 | 1500 |

$PW_A$ = –15,000 + 0 + 900(P/F,7%,2) + ... – 1,500(P/F,7%,9)
= $–18,536

Machine B

Year 10 has a DR tax of 5,000(0.5) = $2,500

| Year | P or S | AOC | Depr | Tax savings | CFAT |
|---|---|---|---|---|---|
| 0 | $–22,000 | - | - | - | $–22,000 |
| 1 | | $1500 | $4400 | $2950 | 1450 |
| 2 | | 1500 | 7040 | 4270 | 2770 |
| 3 | | 1500 | 4224 | 2862 | 1362 |
| 4 | | 1500 | 2534 | 2017 | 517 |
| 5 | | 1500 | 2534 | 2017 | 517 |
| 6 | | 1500 | 1268 | 1384 | –116 |
| 7 | | 1500 | 0 | 750 | –750 |
| 8 | | 1500 | 0 | 750 | –750 |
| 9 | | 1500 | 0 | 750 | –750 |
| 10 | | 1500 | 0 | 750 | –750 |
| 10 | 5000 | - | - | –2500 | 2500 |

$PW_B$ = –22,000 + 1450(P/F,7%,1) + ... + 2500(P/F,7%,10)
= $–16,850

Select machine B, as above.

17.43 (a) incremental i = 3.6% (b) P = $12,689

40% = Tax rate

**Alternative A**

| Year | GI - E | Investment & salvage P and S | Depreciation rate | Depreciation D | Book value BV | Taxable income TI | Taxes | CFAT |
|---|---|---|---|---|---|---|---|---|
| 0 | | (10,000) | | | 10,000 | | | (10,000) |
| 1 | 4,500 | | 0.3333 | 3,333 | 6,667 | 1,167 | 467 | 4,033 |
| 2 | 4,500 | | 0.4445 | 4,445 | 2,222 | 55 | 22 | 4,478 |
| 3 | 4,500 | | 0.1481 | 1,481 | 741 | 3,019 | 1,208 | 3,292 |
| 4 | 0 | 0 | 0.0741 | 741 | 0 | (741) | (296) | 296 |
| | | | 1.0000 | 10,000 | | | PW = | $ 405 |

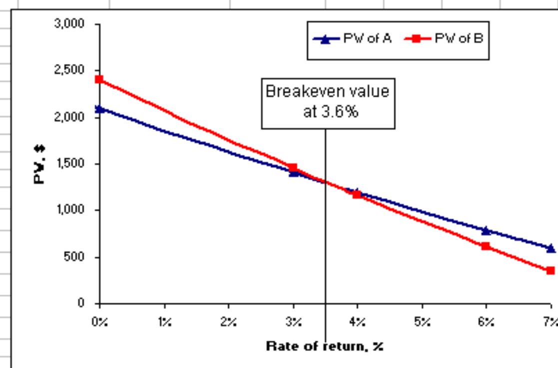
| Year | Incr CFAT |
|---|---|
| 0 | (3,000) |
| 1 | 700 |
| 2 | 833 |
| 3 | 478 |
| 4 | 1,289 |
| 8% PW on incr | (310.76) |
| **IRR on incr** | **3.6%** |

**Alternative B**

| Year | GI - E | Investment & salvage P and S | Depreciation rate | Depreciation D | Book value BV | Taxable income TI | Taxes | CFAT |
|---|---|---|---|---|---|---|---|---|
| 0 | | (13,000) | | | 13,000 | | | (13,000) |
| 1 | 5,000 | | 0.3333 | 4,333 | 8,667 | 667 | 267 | 4,733 |
| 2 | 5,000 | | 0.4445 | 5,779 | 2,889 | (779) | (311) | 5,311 |
| 3 | 5,000 | | 0.1481 | 1,925 | 963 | 3,075 | 1,230 | 3,770 |
| 4 | 0 | 2,000 | 0.0741 | 963 | 0 | 1,037 | 415 | 1,585 |
| | | | 1.0000 | 13,000 | | | PW = | $ 94 |

**(a) PW vs. i plot**

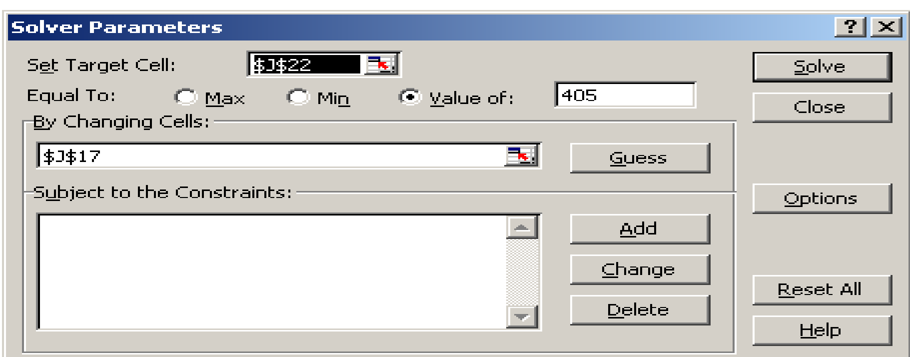
| i | PW of A | PW of B |
|---|---|---|
| -5% | 3,411 | 4,211 |
| 0% | 2,100 | 2,400 |
| 3% | 1,413 | 1,461 |
| 4% | 1,199 | 1,169 |
| 6% | 789 | 614 |
| 7% | 594 | 350 |




**(b) Breakeven for first cost using SOLVER**

Target cell is J22 to equal $405; changing cell is J17.

**Result is P = $12,689**



17.44 System A

Depreciation = 150,000/3 = $50,000

For years 1 to 3:

TI = 60,000 – 50,000 = $10,000
Taxes = 10,000(0.35) = $3500
CFAT = 60,000 – 3500 = $56,500

$AW_A$ = –150,000(A/P,6%,3) + 56,500
= –150,000(0.37411) + 56,500
= $384

System B

Depreciation = 85,000/5 = $17,000

For years 1 to 5:

TI = 20,000 – 17,000 = $3,000
Taxes = 3,000(0.35) = $1050
CFAT = 20,000 – 1050 = $18,950

For year 5 only, when B is sold for 10% of first cost:

DR = 85,000(0.10) = $8500
DR taxes = 8500(0.35) = $2975

$AW_B$ = –85,000(A/P,6%,5) + 18,950 + (8500–2975)(A/F,6%,5)
= –85,000(0.23740) + 18,950 + 5525(0.17740)
= -$249

Select system A

17.45 (a - 1) Classical SL with n = 5 year recovery period.

Annual depreciation = (2,500 – 0)/5 = $500

Year 1

Taxes = (1,500 - 500) (0.30) = $300
CFAT = 1,500 - 300
= $1,200

Years 2-5

Taxes = (300 - 500) (0.30) = $–60

17.45 (cont) CFAT = 300 - (-60)
= $360

The rate of return relation over 5 years is

$$0 = –2,500 + 1,200(P/F,i^*,1) + 360 (P/A,i^*,4)(P/F,i^*,1)$$

$i^* = 2.36$ % (trail and error between 2% and 3%)

(b - 1) Use MACRS with n = 5 year recovery period.

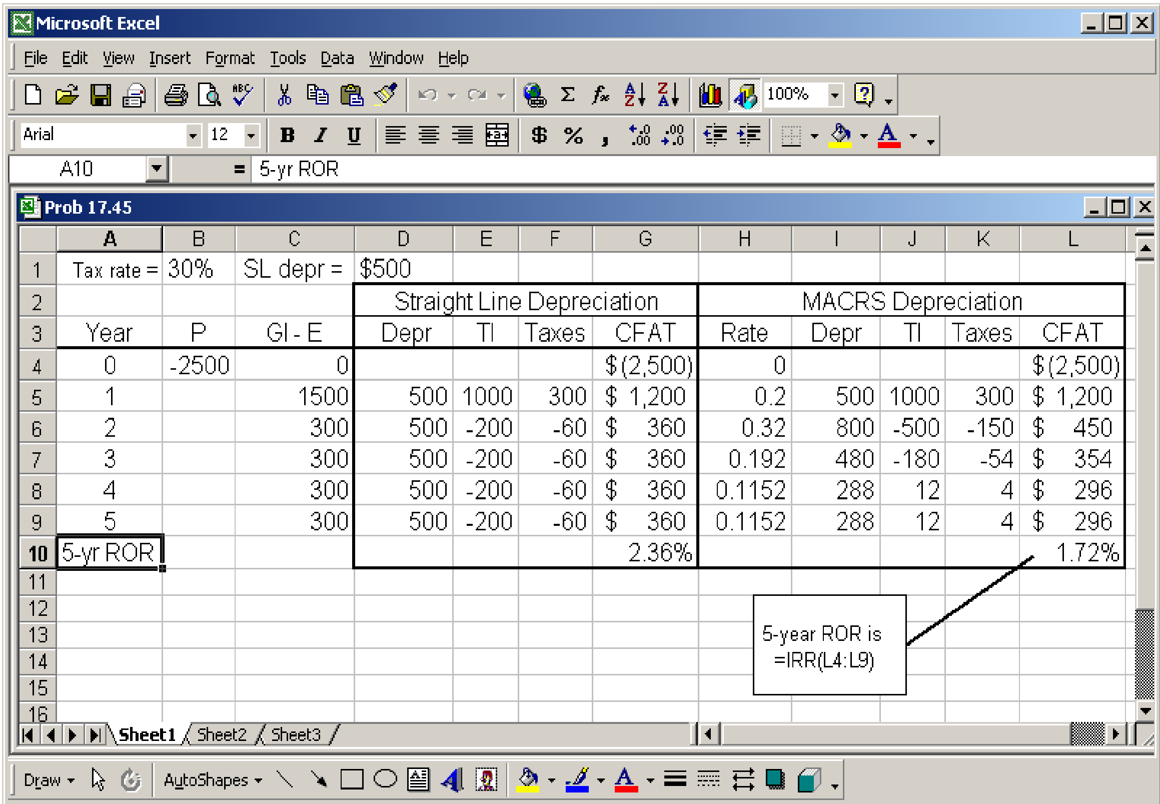
| Year | P | GI - E | Depr | TI | Taxes | CFAT |
|---|---|---|---|---|---|---|
| 0 | $–2,500 | - | - | - | - | -$2,500 |
| 1 | | $1,500 | $500 | $1,000 | $300 | 1,200 |
| 2 | | 300 | 800 | -500 | -150 | 450 |
| 3 | | 300 | 480 | -180 | -54 | 354 |
| 4 | | 300 | 288 | 12 | 4 | 296 |
| 5 | | 300 | 288 | 12 | 4 | 296 |

The ROR relation over 6 years is

$$0 = –2500 + 1200(P/F,i^*,1) + ... + 296(P/F,i^*,5)$$
$i^* = 1.71\%$ (trial and error between 1% and 2%)

Note that the 5-year after-tax ROR for MACRS is less than that for SL depreciation, since not all of the first cost is written off in 5 years using MACRS.

(b – 1 and 2) Spreadsheet solutions



| | A | B | C | D | E | F | G | H | I | J | K | L |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Tax rate = | 30% | SL depr = | $500 | | | | | | | | |
| 2 | | | | Straight Line Depreciation | | | | MACRS Depreciation | | | | |
| 3 | Year | P | GI - E | Depr | TI | Taxes | CFAT | Rate | Depr | TI | Taxes | CFAT |
| 4 | 0 | -2500 | 0 | | | | $(2,500) | 0 | | | | $(2,500) |
| 5 | 1 | | 1500 | 500 | 1000 | 300 | $ 1,200 | 0.2 | 500 | 1000 | 300 | $ 1,200 |
| 6 | 2 | | 300 | 500 | -200 | -60 | $ 360 | 0.32 | 800 | -500 | -150 | $ 450 |
| 7 | 3 | | 300 | 500 | -200 | -60 | $ 360 | 0.192 | 480 | -180 | -54 | $ 354 |
| 8 | 4 | | 300 | 500 | -200 | -60 | $ 360 | 0.1152 | 288 | 12 | 4 | $ 296 |
| 9 | 5 | | 300 | 500 | -200 | -60 | $ 360 | 0.1152 | 288 | 12 | 4 | $ 296 |
| 10 | 5-yr ROR | | | | | | 2.36% | | | | | 1.72% |



17.46 For a 12% after-tax return, find n by trial and error in a PW relation.

$$-78{,}000 + 18{,}000(P/A,12\%,n) - 1000(P/G,12\%,n) = 0$$

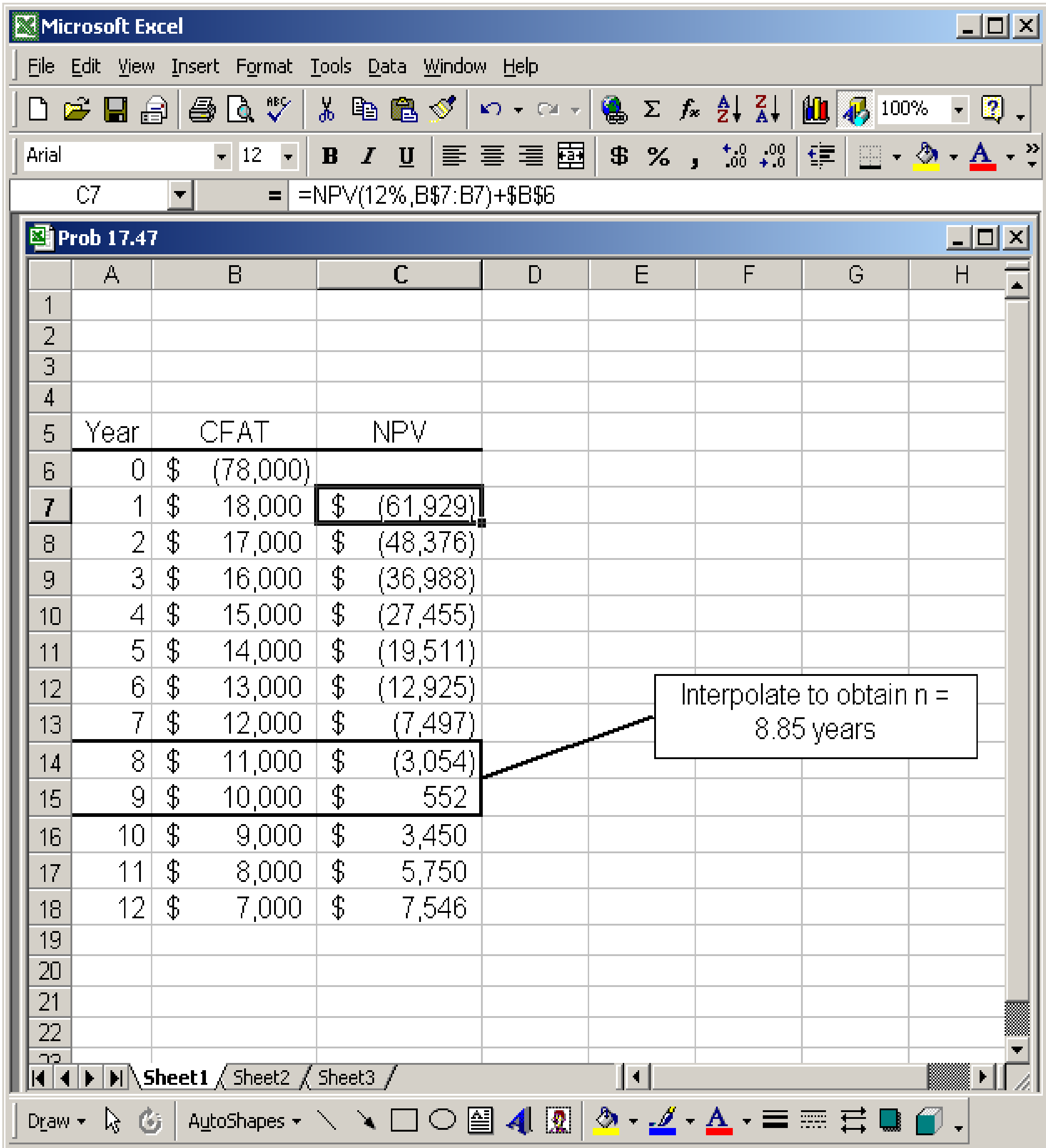
For n = 8 years: $-78{,}000 + 18{,}000(4.9676) - 1000(14.4714) = -\$3055$

For n = 9 years: $-78{,}000 + 18{,}000(5.3282) - 1000(17.3563) = \$551$

n = 8.85 years

Keep the equipment for 3.85 (or 4 rounded off) more years.

17.47 Repeatedly set up the NPV relation until the PW value becomes positive, then interpolate to estimate n.



Microsoft Excel — Prob 17.47

C7 = =NPV(12%,B$7:B7)+$B$6

| Year | CFAT | NPV |
|---|---|---|
| 0 | $ (78,000) | |
| 1 | $ 18,000 | $ (61,929) |
| 2 | $ 17,000 | $ (48,376) |
| 3 | $ 16,000 | $ (36,988) |
| 4 | $ 15,000 | $ (27,455) |
| 5 | $ 14,000 | $ (19,511) |
| 6 | $ 13,000 | $ (12,925) |
| 7 | $ 12,000 | $ (7,497) |
| 8 | $ 11,000 | $ (3,054) |
| 9 | $ 10,000 | $ 552 |
| 10 | $ 9,000 | $ 3,450 |
| 11 | $ 8,000 | $ 5,750 |
| 12 | $ 7,000 | $ 7,546 |

Interpolate to obtain n = 8.85 years

Keep the equipment for 8.85 – 5 = 3.85 more years.

17.48 (a) Get the CFAT values from Problem 17.42(b) for years 1 through 10.

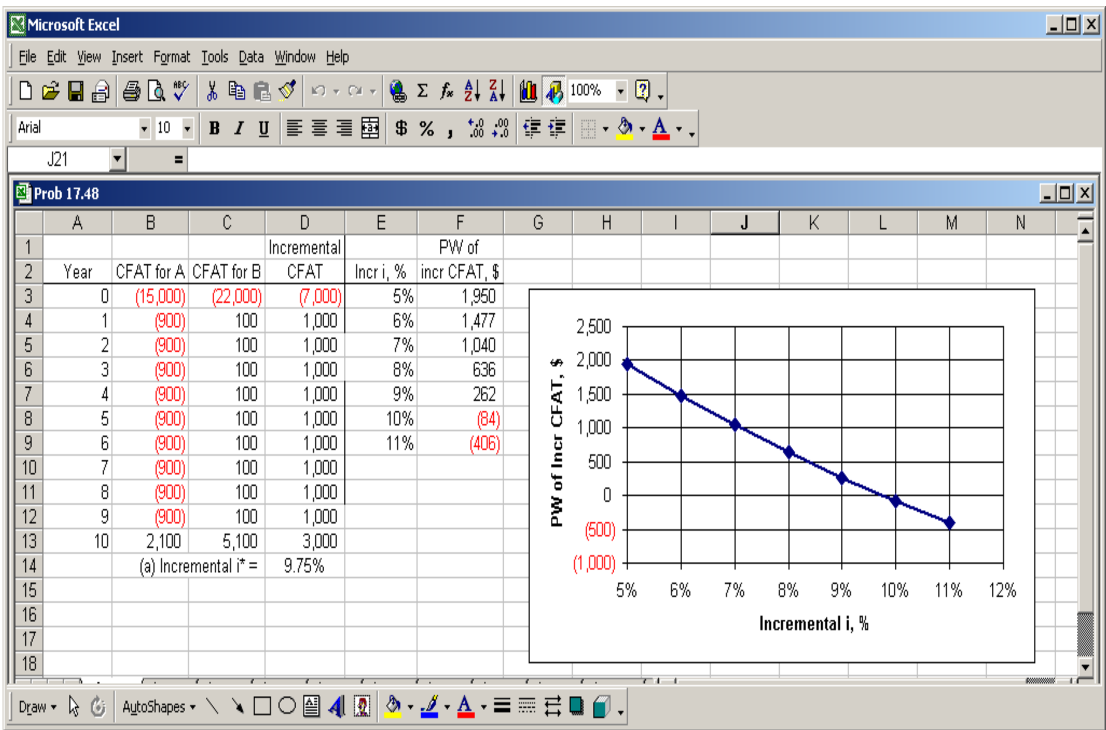
$CFAT_A = \$–900 \qquad\qquad CFAT_B = \$+100$

Use a spreadsheet to find the incremental ROR (column D) and to determine the PW of incremental CFAT versus incremental i values (columns E and F) for the chart.

The incremental i* = 9.75% can also be found using the PW relation:

$$0 = –7000 + 1000(P/A,i^*,9) + 3000(P/F,i^*,10)$$

If MARR < 9.75%, select B, otherwise select A.



| Year | CFAT for A | CFAT for B | Incremental CFAT | Incr i, % | PW of incr CFAT, $ |
|---|---|---|---|---|---|
| 0 | (15,000) | (22,000) | (7,000) | 5% | 1,950 |
| 1 | (900) | 100 | 1,000 | 6% | 1,477 |
| 2 | (900) | 100 | 1,000 | 7% | 1,040 |
| 3 | (900) | 100 | 1,000 | 8% | 636 |
| 4 | (900) | 100 | 1,000 | 9% | 262 |
| 5 | (900) | 100 | 1,000 | 10% | (84) |
| 6 | (900) | 100 | 1,000 | 11% | (406) |
| 7 | (900) | 100 | 1,000 | | |
| 8 | (900) | 100 | 1,000 | | |
| 9 | (900) | 100 | 1,000 | | |
| 10 | 2,100 | 5,100 | 3,000 | | |
| | (a) Incremental i* = | | 9.75% | | |



(b) Use the PW vs. incremental i plot to select between A and B at each MARR value.

| MARR | Select |
|---|---|
| 5% | B |
| 9 | B |
| 10 | A |
| 12 | A |

17.49 (a) The equation to determine the required first cost P is

$$
\begin{aligned}
0 &= -P + (CFBT - taxes)(P/A,20\%,5) \\
&= -P + [20{,}000 - (20{,}000 - P/5)(0.40)](P/A,20,\%5) \\
&= -P + [12{,}000 + 0.08P](2.9906) \\
&= -P + 35{,}887 + 0.23925P
\end{aligned}
$$

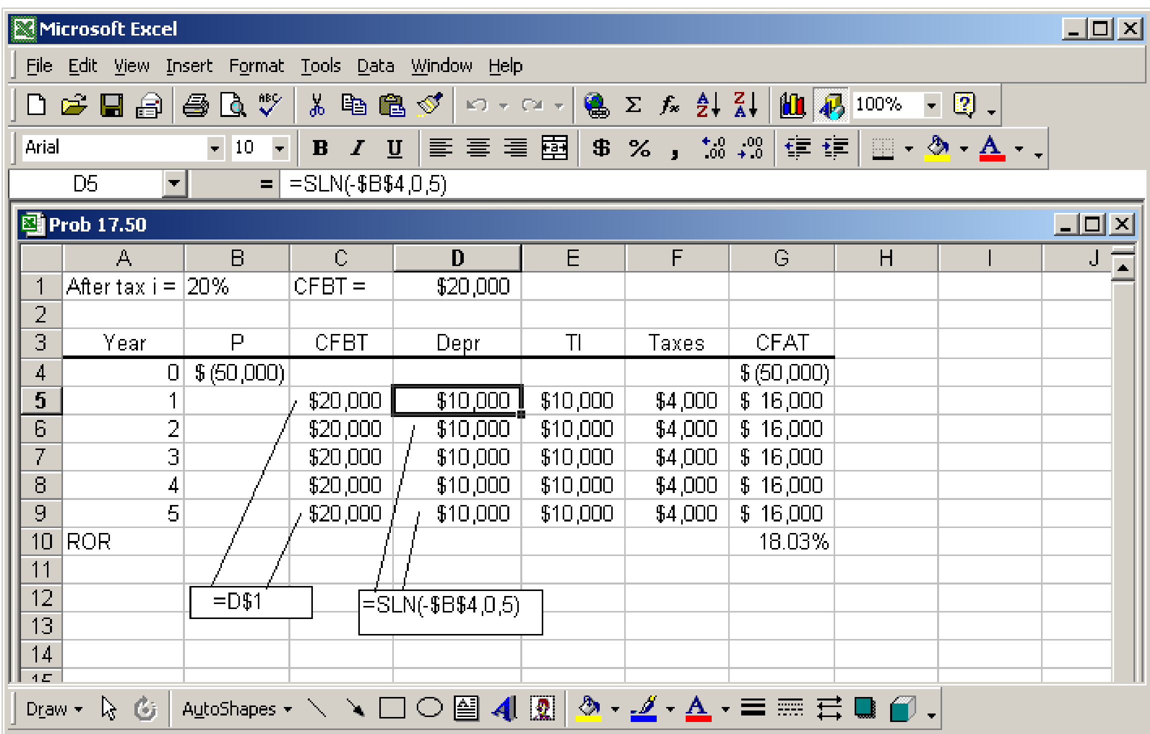
$$P = \$47{,}173$$

(b) Let CFBT = C. The equation to find the required CFBT is

$$
\begin{aligned}
0 &= -50{,}000 + \{C - [C - 10{,}000](0.40)\}(P/A,20\%,5) \\
&= -50{,}000 + \{0.6C(2.9906) \ + 4{,}000(2.9906) \\
&= -50{,}000 + 1.79436C + 11{,}962 \\
&= -\ 38{,}038 + 1.79436C
\end{aligned}
$$

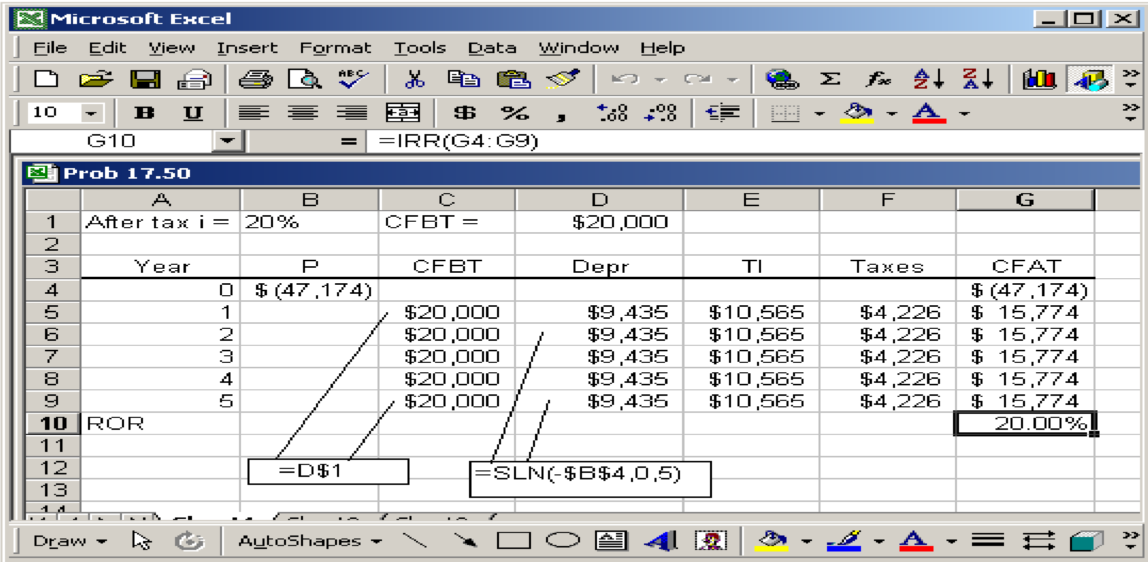
$$CFBT = \$21{,}198$$

17.50 (a) Set up spreadsheet and find ROR = 18.03%.




| | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|
| 1 | After tax i = | 20% | CFBT = | $20,000 | | | |
| 2 | | | | | | | |
| 3 | Year | P | CFBT | Depr | TI | Taxes | CFAT |
| 4 | 0 | $ (50,000) | | | | | $ (50,000) |
| 5 | 1 | | $20,000 | $10,000 | $10,000 | $4,000 | $ 16,000 |
| 6 | 2 | | $20,000 | $10,000 | $10,000 | $4,000 | $ 16,000 |
| 7 | 3 | | $20,000 | $10,000 | $10,000 | $4,000 | $ 16,000 |
| 8 | 4 | | $20,000 | $10,000 | $10,000 | $4,000 | $ 16,000 |
| 9 | 5 | | $20,000 | $10,000 | $10,000 | $4,000 | $ 16,000 |
| 10 | ROR | | | | | | 18.03% |

17.50 (cont) For a 20% return, use SOLVER with B4 (first cost, P) as the changing cell and G10 as the target cell to obtain a new P = $47,174. Many of the other values change accordingly, as shown here on the resulting spreadsheet once SOLVER is complete.


Microsoft Excel
G10 = =IRR(G4:G9)
Prob 17.50

| | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|
| 1 | After tax i = | 20% | CFBT = | $20,000 | | | |
| 2 | | | | | | | |
| 3 | Year | P | CFBT | Depr | TI | Taxes | CFAT |
| 4 | 0 | $ (47,174) | | | | | $ (47,174) |
| 5 | 1 | | $20,000 | $9,435 | $10,565 | $4,226 | $ 15,774 |
| 6 | 2 | | $20,000 | $9,435 | $10,565 | $4,226 | $ 15,774 |
| 7 | 3 | | $20,000 | $9,435 | $10,565 | $4,226 | $ 15,774 |
| 8 | 4 | | $20,000 | $9,435 | $10,565 | $4,226 | $ 15,774 |
| 9 | 5 | | $20,000 | $9,435 | $10,565 | $4,226 | $ 15,774 |
| 10 | ROR | | | | | | 20.00% |
| 11 | | | | | | | |
| 12 | | =D$1 | | =SLN(-$B$4,0,5) | | | |
| 13 | | | | | | | |

To use SOLVER to find CFBT, make D1 the changing cell. The following answers are obtained for P and CFBT at 20% and 10%:

| After-tax Return | First cost | CFBT |
|---|---|---|
| (a) 20% | $47,174(display above) | $21,198 |
| (b) 10% | $65,289 | $15,316 (display below) |

D1 = 15316.447695396

Prob 17.50

| | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|
| 1 | After tax i = | 20% | CFBT = | $15,316 | | | |
| 2 | | | | | | | |
| 3 | Year | P | CFBT | Depr | TI | Taxes | CFAT |
| 4 | 0 | $ (50,000) | | | | | $ (50,000) |
| 5 | 1 | | $15,316 | $10,000 | $5,316 | $2,127 | $ 13,190 |
| 6 | 2 | | $15,316 | $10,000 | $5,316 | $2,127 | $ 13,190 |
| 7 | 3 | | $15,316 | $10,000 | $5,316 | $2,127 | $ 13,190 |
| 8 | 4 | | $15,316 | $10,000 | $5,316 | $2,127 | $ 13,190 |
| 9 | 5 | | $15,316 | $10,000 | $5,316 | $2,127 | $ 13,190 |
| 10 | ROR | | | | | | 10.00% |

Since 20% >18.03%, either a lower first cost is required or a larger CFBT is required to make the 20%. Similarly, since 10% < 18.03%, the first cost investment can be higher or less CFBT is required to make the 10%.

17.51 Defender

Original life estimate was 12 years.

Annual SL depreciation = 450,000 /12 = $37,500

Annual tax savings = (37,500 + 160,000)(0.32) = $63,200

$AW_D$ = -50,000(A/P,10%,5) – 160,000 + 63,200
= -50,000(0.2638) – 96,800
= $–109,990

Challenger

Book value of D = 450,000 – 7(37,500) = $187,500

CL from sale of D = $BV_7$ – Market value
= 187,500 – 50,000 = $137,500

Tax savings from CL, year 0 = 137,500(0.32) = $44,000

Challenger annual SL depreciation = $\frac{700,000 - 50,000}{10}$ = \$65,000

Annual tax saving = (65,000 +150,000)(0.32) = \$68,800

Challenger DR when sold in year 8 = \$0

$AW_C$ =(–700,000 + 44,000)(A/P,10%,10) + 50,000(A/F,10%,10) – 150,000 + 68,800
= –656,000(0.16275) + 50,000(0.06275) – 81,200
= \$-184,827

Select the defender. Decision was incorrect since D has a lower AW value of costs.

17.52 (a) Lives are set at 5 (remaining) for the defender and 8 years for the challenger.

Defender

Annual depreciation = $\frac{28,000 - 2000}{10}$ = \$2600

Annual tax savings = (2600 + 1200)(0.06) = \$228

$AW_D$ = -15,000(A/P,6%,5) + 2000(A/F,6%,5) – 1200 + 228
= -15,000(0.2374) + 2000(0.1774) – 1200 + 228
= \$– 4178

Challenger

DR from sale of D = Market value – $BV_5$
= 15,000 – [28,000 – 5(2600)] = 0

Challenger annual depreciation = $\frac{15,000 - 3000}{8}$ = \$1500

Annual tax saving = (1,500 + 1,500)(0.06) = \$180

Challenger DR, year 8 = 3000 – 3000 = 0

$AW_C$ = –15,000(A/P,6%,8) + 3000(A/F,6%,8) – 1500 + 180
= –15,000(0.16104) + 3000(0.10104) – 1320
= \$–3432

Select the challenger

(b) $AW_D$ = –15,000(A/P,12%,5) + 2000(A/F,12%,5) – 1200
= –15,000(0.27741) + 2000(0.15741) – 1200
= \$–5046

$$AW_C = –15{,}000(A/P,12\%,8) + 3000(A/F,12\%,8) – 1500$$
$$= –15{,}000(0.2013) + 3000(0.0813) – 1500$$
$$= \$–4276$$

Select the challenger. The before-tax and after-tax decisions are the same.

17.53 Challenger (in $1,000 units)

Challenger annual depreciation = (15,000 – 300)/8 = $1500

Challenger DR from sale = Market value – $BV_5$
= 10,000 – [15,000 – 5(1500)] = $2500

Taxes from DR, year 5 = 2500(0.06) = $150

Annual tax saving = (1,500 + 1,500)(0.06) = $180

Now, calculate $AW_C$ over the 5 years that C was actually in service.

$$AW_C = –15{,}000(A/P,6\%,5) + 10{,}000(A/F,6\%,5) – 1500 + 180 – 150(A/F,6\%,5)$$
$$= –15{,}000(0.2374) + 10{,}000(0.1774) – 1320 – 150(0.1774)$$
$$= \$–3134$$

From Problem 17.52(a), $AW_D$ = $–4178
Challenger was the correct decision 5 years ago.

17.54 Study period is fixed at 3 years. Follow the analysis logic in Section 11.5.

1. Succession options

| Option | Defender | Challenger |
|---|---|---|
| 1 | 2 years | 1 year |
| 2 | 1 | 2 |
| 3 | 0 | 3 |

2. Find AW for defender and challenger for 1, 2 and 3 years of retention.

Defender

$AW_{D1}$ = $300,000 $AW_{D2}$ = $240,000

17.54 (cont)

Challenger

No tax effect if (defender) contract is cancelled. Calculate CFAT for 1, 2, and 3 years of ownership. Tax rate is 35%.

| Yr | Exp | d | Depr | BV | SP | DR or CL | TI | Tax savings | CFAT |
|---|---|---|---|---|---|---|---|---|---|
| 0 | - | - | - | $800,000 | - | - | - | - | $–800,000 |
| 1 | $120,000 | 0.3333 | $266,640 | 533,360 | $600,000 | $ 66,640$^{DR}$ | $–320,000 | $–112,000 | 592,000 |
| 2 | 120,000 | 0.4445 | 355,600 | 177,760 | 400,000 | 222,240$^{DR}$ | –253,360 | – 88,676 | 368,676 |
| 3 | 120,000 | 0.1481 | 118,480 | 59,280 | 200,000 | 140,720$^{DR}$ | – 97,760 | – 34,216 | 114,216 |

TI = –Exp – Depr + DR – CL

Year 1: TI = –120,000 – 266,640 + 66,640 = $–320,000
Year 2: TI = –120,000 – 355,600 + 222,240 = $–253,360
Year 3: TI = –120,000 – 118,480 + 140,720 = $–97,760

CFAT = –E + SP – taxes where negative taxes are a tax savings

Year 1: –120,000 + 600,000 – (–112,000) = $592,000
Year 2: -120,000 + 400,000 – (-88,676) = $368,676
Year 3: -120,000 + 200,000 – (-34,216) = $114,216

$AW_{C1}$ = –800,000(A/P,10%,1) + 592,000
= –800,000 (1.10) + 592,000
= $– 288,000

$AW_{C2}$ = –800,000(A/P,10%,2)+[592,000(P/F,10%,1) + 368,676(P/F,10%,2)](A/P,10%,2)
= –800,000(0.57619) + [592,000(0.9091) + 368,676(0.8264)](0.57619)
= $+24,696

$AW_{C3}$ = –800,000(A/P,10%,3) + [592,000(P/F,10%,1) + 368,676(P/F,10%,2)
+ 114,216(P/F,10%,3)](A/P,10%,3)
= –800,000(0.40211) + [592,000(0.9091) + 368,676(0.8264)
+ 114,216(0.7513)](0.40211)
= $+51,740

Selection of best option – Determine AW for each option first.

Summary of cost/year and project AW

| Option | Year 1 | Year 2 | Year 3 | AW |
|---|---|---|---|---|
| 1 | $–240,000 | $–240,000 | $–288,000 | $–254,493 |
| 2 | –300,000 | 24,696 | 24,696 | – 94,000 |
| 3 | 51,740 | 51,740 | 51,740 | + 51,740 |

Conclusion: Replace now with the challenger. Engineering VP has the better economic strategy.

17.55 (a) Study period is set at 5 years. The only option is the defender for 5 years and the challenger for 5 years.

Defender

First cost = Sale + Upgrade
= 15,000 + 9000
= $24,000

Upgrade SL depreciation = $3000 year (years 1-3 only)
AOC, years 1-5: = $6000
Tax saving, years 1-3: = (6000 + 3000)(0.4)
= $3600
Tax savings, year 4-5: = 6000(0.4) = $2,400
Actual cost, years 1-3: = 6000 – 3600 = $2400
Actual cost, years 4-5: = 6000 – 2400 = $3600

$AW_D$ = –24,000(A/P,12%,5) – 2400 – 1200(F/A,12%,2)(A/F,12%,5)
= –24,000(0.27741) – 2400 – 1200(2.12)(0.15741)
= $–9458

Challenger

DR on defender = $15,000
DR tax = $6000
First cost + DR tax = $46,000
Depreciation = 40,000/5 = $8,000
Expenses = $7,000 (years 1-5)
Tax saving = (8000 + 7000)(0.4) = $6,000
Actual AOC = 7000 – 6000 = $1000 (years 1-5)

17.55 (cont)

$AW_C$ = –46,000(A/P,12%,5) – 1000
= –46,000(0.27741) – 1000
= $–13,761

Retain the defender since the AW of cost is smaller.

(b) $AW_C$ will become less costly, but the revenue from the challenger's sale between $2000 to $4000 will be reduced by the 40% tax on DR in year.

17.56

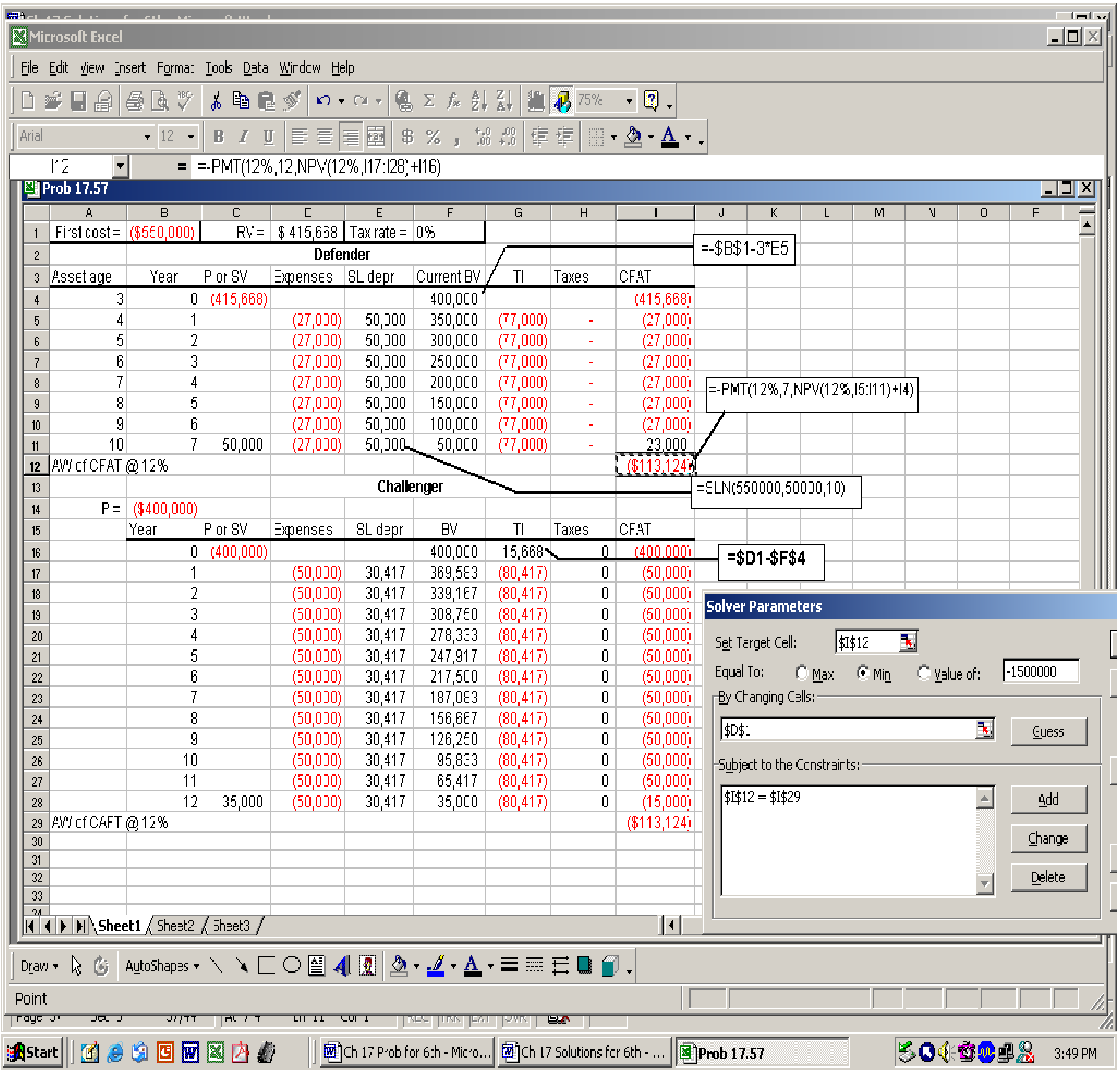
Microsoft Excel — Prob 17.56

I12 = =-PMT($B$1,5,NPV($B$1,I6:I10)+I5)

| | A | B | C | D | E | F | G | H | I |
|---|---|---|---|---|---|---|---|---|---|
| 1 | MARR | 7% | | | | | | | |
| 2 | Purchase | $ 600,000 | | **Defender after-tax MACRS analysis** | | | | | |
| 3 | Asset | | First cost & | (Expenses) | MACRS | | | Tax savings | |
| 4 | age | Year | salvage value(1) | CFBT | rates | Depr | TI | 34% of TI | CFAT |
| 5 | 3 | 0 | ($275,000) | | | | | | ($275,000) |
| 6 | 4 | 1 | | ($100,000) | 0.1249 | $74,940 | ($174,940) | ($59,480) | ($40,520) |
| 7 | 5 | 2 | | ($100,000) | 0.0893 | $53,580 | ($153,580) | ($52,217) | ($47,783) |
| 8 | 6 | 3 | | ($100,000) | 0.0892 | $53,520 | ($153,520) | ($52,197) | ($47,803) |
| 9 | 7 | 4 | | ($100,000) | 0.0893 | $53,580 | ($153,580) | ($52,217) | ($47,783) |
| 10 | 8 | 5 | $0 | ($100,000) | 0.0446 | $26,760 | ($126,760) | ($43,098) | ($56,902) |
| 11 | | | | | | $262,380 | | | |
| 12 | (1)Defender assumed to be sold in year 5 (year 8 of its life) for exactly BV = 0. | | | | | | | AW at 7% | ($114,787) |
| 13 | All of original P=$600,000 depreciated over the 8 years. No tax effect. | | | | | | | | |
| 14 | | | | | | | | | |
| 15 | Purchase | $ 1,000,000 | | **Challenger after-tax MACRS analysis** | | | | | |
| 16 | Asset | | First cost & | (Expenses) | MACRS | | | Tax savings | |
| 17 | age | Year | salvage value(1) | CFBT | rates | Depr | TI (2) | 34% of TI | CFAT |
| 18 | 0 | 0 | ($1,000,000) | | | | $12,620 | $4,291 | ($1,004,291) |
| 19 | 1 | 1 | | ($15,000) | 0.2000 | $200,000 | ($215,000) | ($73,100) | $58,100 |
| 20 | 2 | 2 | | ($15,000) | 0.3200 | $320,000 | ($335,000) | ($113,900) | $98,900 |
| 21 | 3 | 3 | | ($15,000) | 0.1920 | $192,000 | ($207,000) | ($70,380) | $55,380 |
| 22 | 4 | 4 | | ($15,000) | 0.1152 | $115,200 | ($130,200) | ($44,268) | $29,268 |
| 23 | 5 | 5 | $100,000 | ($15,000) | 0.1152 | $115,200 | ($87,800) | ($29,852) | $114,852 |
| 24 | | | | | | $942,400 | | | |
| 25 | (1)Challenger sold in year 5 for $100,000. The DR is: | | | | | | | AW at 7% | ($174,183) |
| 26 | DR = SP-BV = 100,000-(1,000,000-942,400) = $42,400. | | | | | | | | |
| 27 | DR has a tax effect on TI in year 5. | | | | | | | | |
| 28 | (2) TI of $12,620 in year 0 is DR from trade of defender. DR = P - current BV = 275,000 - 262,380. | | | | | | | | |

Still select the defender but with a larger AW advantage.

17.57 (a) Before taxes: Spreadsheet is similar to Figure 17-8 with RV a separate cell (D1) from defender first cost. Let RV = 0 to start and establish CFAT column and AW of CFAT series. If tax rate (F1) is set to 0%, and SOLVER is used, RV = $415,668 is determined. Spreadsheet is below with SOLVER parameters. Note that the equality between AW of CFAT values is guaranteed by using the constraint I12 = I 29 and establishing a minimum (or maximum) value so a solution can be found by SOLVER.



| | A | B | C | D | E | F | G | H | I |
|---|---|---|---|---|---|---|---|---|---|
| 1 | First cost = | ($550,000) | RV = | $ 415,668 | Tax rate = | 0% | | | |
| 2 | | | | Defender | | | | | |
| 3 | Asset age | Year | P or SV | Expenses | SL depr | Current BV | TI | Taxes | CFAT |
| 4 | 3 | 0 | (415,668) | | | 400,000 | | | (415,668) |
| 5 | 4 | 1 | | (27,000) | 50,000 | 350,000 | (77,000) | - | (27,000) |
| 6 | 5 | 2 | | (27,000) | 50,000 | 300,000 | (77,000) | - | (27,000) |
| 7 | 6 | 3 | | (27,000) | 50,000 | 250,000 | (77,000) | - | (27,000) |
| 8 | 7 | 4 | | (27,000) | 50,000 | 200,000 | (77,000) | - | (27,000) |
| 9 | 8 | 5 | | (27,000) | 50,000 | 150,000 | (77,000) | - | (27,000) |
| 10 | 9 | 6 | | (27,000) | 50,000 | 100,000 | (77,000) | - | (27,000) |
| 11 | 10 | 7 | 50,000 | (27,000) | 50,000 | 50,000 | (77,000) | - | 23,000 |
| 12 | AW of CFAT @ 12% | | | | | | | | ($113,124) |
| 13 | | | | | Challenger | | | | |
| 14 | P = | ($400,000) | | | | | | | |
| 15 | | Year | P or SV | Expenses | SL depr | BV | TI | Taxes | CFAT |
| 16 | | 0 | (400,000) | | | 400,000 | 15,668 | 0 | (400,000) |
| 17 | | 1 | | (50,000) | 30,417 | 369,583 | (80,417) | 0 | (50,000) |
| 18 | | 2 | | (50,000) | 30,417 | 339,167 | (80,417) | 0 | (50,000) |
| 19 | | 3 | | (50,000) | 30,417 | 308,750 | (80,417) | 0 | (50,000) |
| 20 | | 4 | | (50,000) | 30,417 | 278,333 | (80,417) | 0 | (50,000) |
| 21 | | 5 | | (50,000) | 30,417 | 247,917 | (80,417) | 0 | (50,000) |
| 22 | | 6 | | (50,000) | 30,417 | 217,500 | (80,417) | 0 | (50,000) |
| 23 | | 7 | | (50,000) | 30,417 | 187,083 | (80,417) | 0 | (50,000) |
| 24 | | 8 | | (50,000) | 30,417 | 156,667 | (80,417) | 0 | (50,000) |
| 25 | | 9 | | (50,000) | 30,417 | 126,250 | (80,417) | 0 | (50,000) |
| 26 | | 10 | | (50,000) | 30,417 | 95,833 | (80,417) | 0 | (50,000) |
| 27 | | 11 | | (50,000) | 30,417 | 65,417 | (80,417) | 0 | (50,000) |
| 28 | | 12 | 35,000 | (50,000) | 30,417 | 35,000 | (80,417) | 0 | (15,000) |
| 29 | AW of CAFT @ 12% | | | | | | | | ($113,124) |

17.57 (b) After taxes: If the tax rate of 30% is set (cell F1 in the spreadsheet below), RV = $414,109 is obtained in D1. So, after-tax consideration has, in the end, made a very small impact on the required RV value; only a $1559 reduction.

Microsoft Excel — Prob 17.57

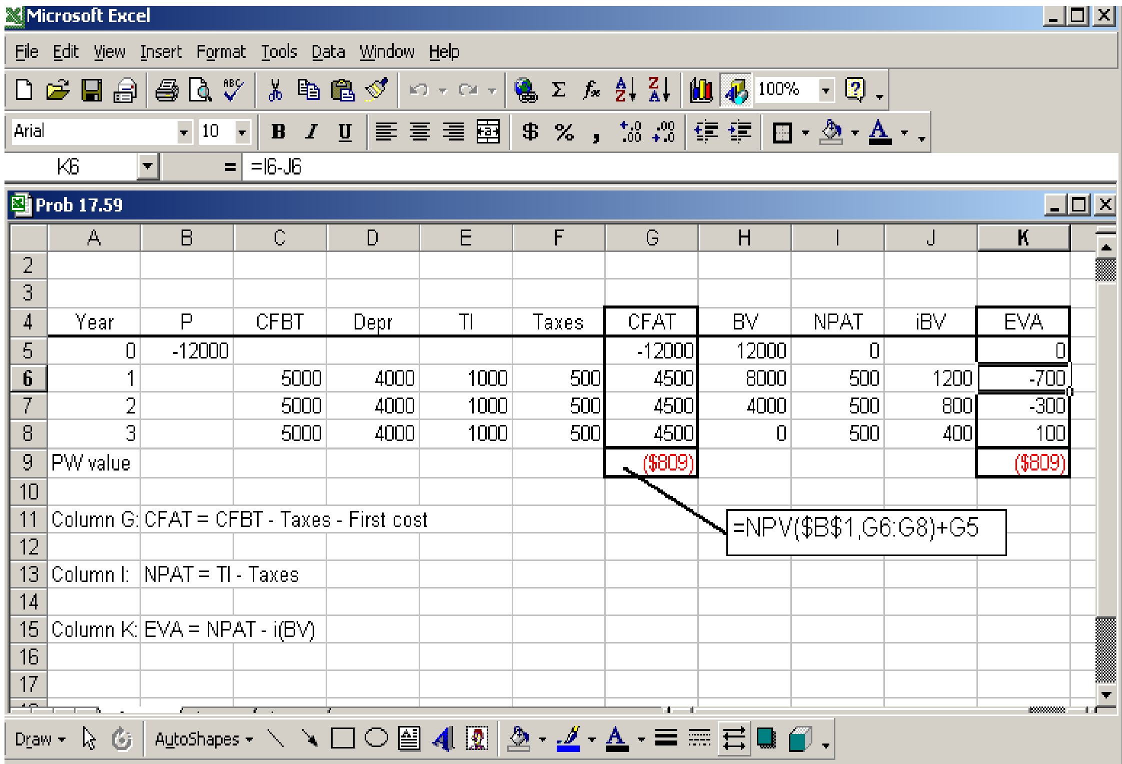
G16 = =$D1-$F$4

| | A | B | C | D | E | F | G | H | I |
|---|---|---|---|---|---|---|---|---|---|
| 1 | First cost = | ($550,000) | RV = | $ 414,109 | Tax rate = | 30% | | | |
| 2 | | | | Defender | | | | | |
| 3 | Asset age | Year | P or SV | Expenses | SL depr | Current BV | TI | Taxes | CFAT |
| 4 | 3 | 0 | (414,109) | | | 400,000 | | | (414,109) |
| 5 | 4 | 1 | | (27,000) | 50,000 | 350,000 | (77,000) | (23,100) | (3,900) |
| 6 | 5 | 2 | | (27,000) | 50,000 | 300,000 | (77,000) | (23,100) | (3,900) |
| 7 | 6 | 3 | | (27,000) | 50,000 | 250,000 | (77,000) | (23,100) | (3,900) |
| 8 | 7 | 4 | | (27,000) | 50,000 | 200,000 | (77,000) | (23,100) | (3,900) |
| 9 | 8 | 5 | | (27,000) | 50,000 | 150,000 | (77,000) | (23,100) | (3,900) |
| 10 | 9 | 6 | | (27,000) | 50,000 | 100,000 | (77,000) | (23,100) | (3,900) |
| 11 | 10 | 7 | 50,000 | (27,000) | 50,000 | 50,000 | (77,000) | (23,100) | 46,100 |
| 12 | AW of CFAT @ 12% | | | | | | | | ($89,683) |
| 13 | | | | | Challenger | | | | |
| 14 | P = | ($400,000) | | | | | | | |
| 15 | | Year | P or SV | Expenses | SL depr | BV | TI | Taxes | CFAT |
| 16 | | 0 | (400,000) | | | 400,000 | 14,109 | 4,233 | (404,233) |
| 17 | | 1 | | (50,000) | 30,417 | 369,583 | (80,417) | (24,125) | (25,875) |
| 18 | | 2 | | (50,000) | 30,417 | 339,167 | (80,417) | (24,125) | (25,875) |
| 19 | | 3 | | (50,000) | 30,417 | 308,750 | (80,417) | (24,125) | (25,875) |
| 20 | | 4 | | (50,000) | 30,417 | 278,333 | (80,417) | (24,125) | (25,875) |
| 21 | | 5 | | (50,000) | 30,417 | 247,917 | (80,417) | (24,125) | (25,875) |
| 22 | | 6 | | (50,000) | 30,417 | 217,500 | (80,417) | (24,125) | (25,875) |
| 23 | | 7 | | (50,000) | 30,417 | 187,083 | (80,417) | (24,125) | (25,875) |
| 24 | | 8 | | (50,000) | 30,417 | 156,667 | (80,417) | (24,125) | (25,875) |
| 25 | | 9 | | (50,000) | 30,417 | 126,250 | (80,417) | (24,125) | (25,875) |
| 26 | | 10 | | (50,000) | 30,417 | 95,833 | (80,417) | (24,125) | (25,875) |
| 27 | | 11 | | (50,000) | 30,417 | 65,417 | (80,417) | (24,125) | (25,875) |
| 28 | | 12 | 35,000 | (50,000) | 30,417 | 35,000 | (80,417) | (24,125) | 9,125 |
| 29 | AW of CAFT @ 12% | | | | | | | | ($89,683) |

17.58 (a) The EVA shows the monetary worth added to a corporation by an alternative.

(b) The EVA estimates can be used directly in public reports (e.g., to stockholders). EVA shows worth contribution, not just CFAT.

17.59 (a) This solution uses a spreadsheet. Both PW values are the same (cells G9 and K9 ).




| Year | P | CFBT | Depr | TI | Taxes | CFAT | BV | NPAT | iBV | EVA |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | -12000 | | | | | -12000 | 12000 | 0 | | 0 |
| 1 | | 5000 | 4000 | 1000 | 500 | 4500 | 8000 | 500 | 1200 | -700 |
| 2 | | 5000 | 4000 | 1000 | 500 | 4500 | 4000 | 500 | 800 | -300 |
| 3 | | 5000 | 4000 | 1000 | 500 | 4500 | 0 | 500 | 400 | 100 |
| PW value | | | | | | ($809) | | | | ($809) |

Column G: CFAT = CFBT - Taxes - First cost

Column I: NPAT = TI - Taxes

Column K: EVA = NPAT - i(BV)

(b) Calculate the equivalent AW of P = -12,000 over 3 years that is charged against the annual CFAT = $4500, then find the PW value of the difference.

-12,000(A/P,10%,3) = -12,000(0.40211) = $-4825

CFAT – 325 = 4500 – 4825 = $-325

PW = -325(P/A,10%,3) = -325(2.4869) = $-809 = PW of EVA

17.60 (a) Take TI, taxes and D from Example 17.3. Use i = 0.10 and $T_e$ = 0.35.

| | A | B | C | D | E | F | G | H | I | J | K | L | M |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 10% | = Interest | # years = | 6 | | | | | | | | | |
| 2 | 35% | = Tax rate | | | | | | | | | | | |
| 3 | | Gross | | Investment | | | | Taxable | | | Interest on | | |
| 4 | | income | Expenses | & salvage | Depr. | Depr. | Book value | income | | | invested | | |
| 5 | Year | GI | E | P and S | rate | D | BV | TI | Taxes | NPAT | capital | EVA | CFAT |
| 6 | 0 | | | (550,000) | | | 550,000 | | | | | | (550,000) |
| 7 | 1 | 200,000 | (90,000) | | | 110,000 | 440,000 | 0 | 0 | 0 | 55,000 | (55,000) | 110,000 |
| 8 | 2 | 200,000 | (90,000) | | | 176,000 | 264,000 | (66,000) | (23,100) | (42,900) | 44,000 | (86,900) | 133,100 |
| 9 | 3 | 200,000 | (90,000) | | | 105,600 | 158,400 | 4,400 | 1,540 | 2,860 | 26,400 | (23,540) | 108,460 |
| 10 | 4 | 200,000 | (90,000) | | | 63,360 | 95,040 | 46,640 | 16,324 | 30,316 | 15,840 | 14,476 | 93,676 |
| 11 | 5 | 200,000 | (90,000) | | | 63,360 | 31,680 | 46,640 | 16,324 | 30,316 | 9,504 | 20,812 | 93,676 |
| 12 | 6 | 200,000 | (90,000) | 0 | | 31,680 | 0 | 78,320 | 27,412 | 50,908 | 3,168 | 47,740 | 82,588 |
| 13 | 7 | | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 14 | 8 | | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 15 | 9 | | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 16 | 10 | | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 17 | | | | | | | | | | | | | |
| 18 | | | | | | | | | | | PW at i | ($89,746) | ($89,746) |
| 19 | | | | | | | | | | | AW at i | ($20,606) | ($20,606) |
| 20 | | | | | | | | | | | | | |

NPAT = TI(1 – 0.35)

EVA = NPAT – interest of invested capital

(b) The spreadsheet shows that the two AW values are equal. Solution by hand is as follows:

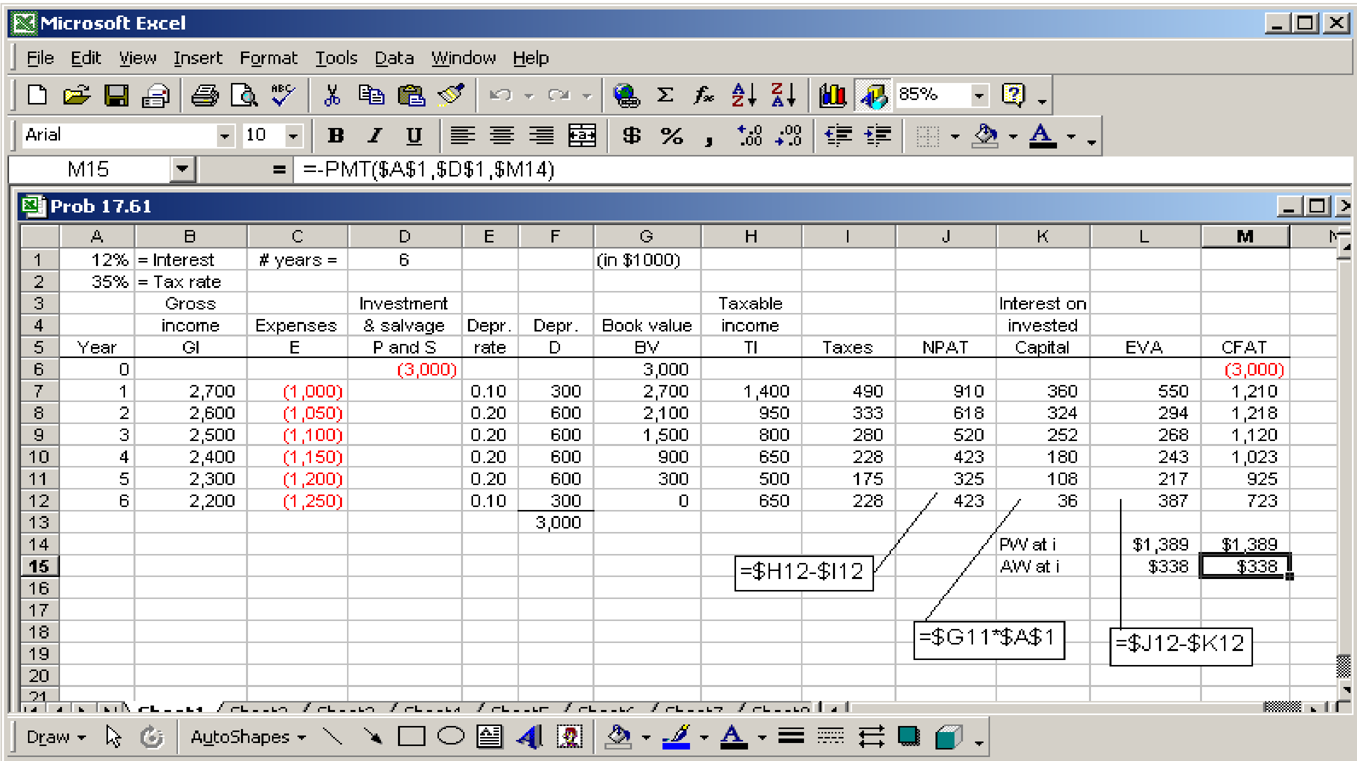
$$
\begin{aligned}
AW_{EVA} &= [-55{,}000(P/F,10\%,1) + \ldots + 47{,}740(P/F,10\%,6)](A/P,10\%,6) \\
&= [-55{,}000(0.9091) + \ldots + 47{,}740(0.5645)](0.22961) \\
&= -89{,}746(0.22961) \\
&= \$-20{,}606
\end{aligned}
$$

$$
\begin{aligned}
AW_{CFAT} &= [-550{,}000 + 110{,}000(P/F,10\%,1) + \ldots + 82{,}588(P/F,10\%,6)](A/P,10\%,6) \\
&= [-550{,}000 + 110{,}000(0.9091) + \ldots + 82{,}588(0.5645)](0.22961) \\
&= -89{,}746(0.22961) \\
&= \$-20{,}606
\end{aligned}
$$

17.61 (a) Column L shows the EVA each year. Use Eq. [17.18} to calculate EVA.

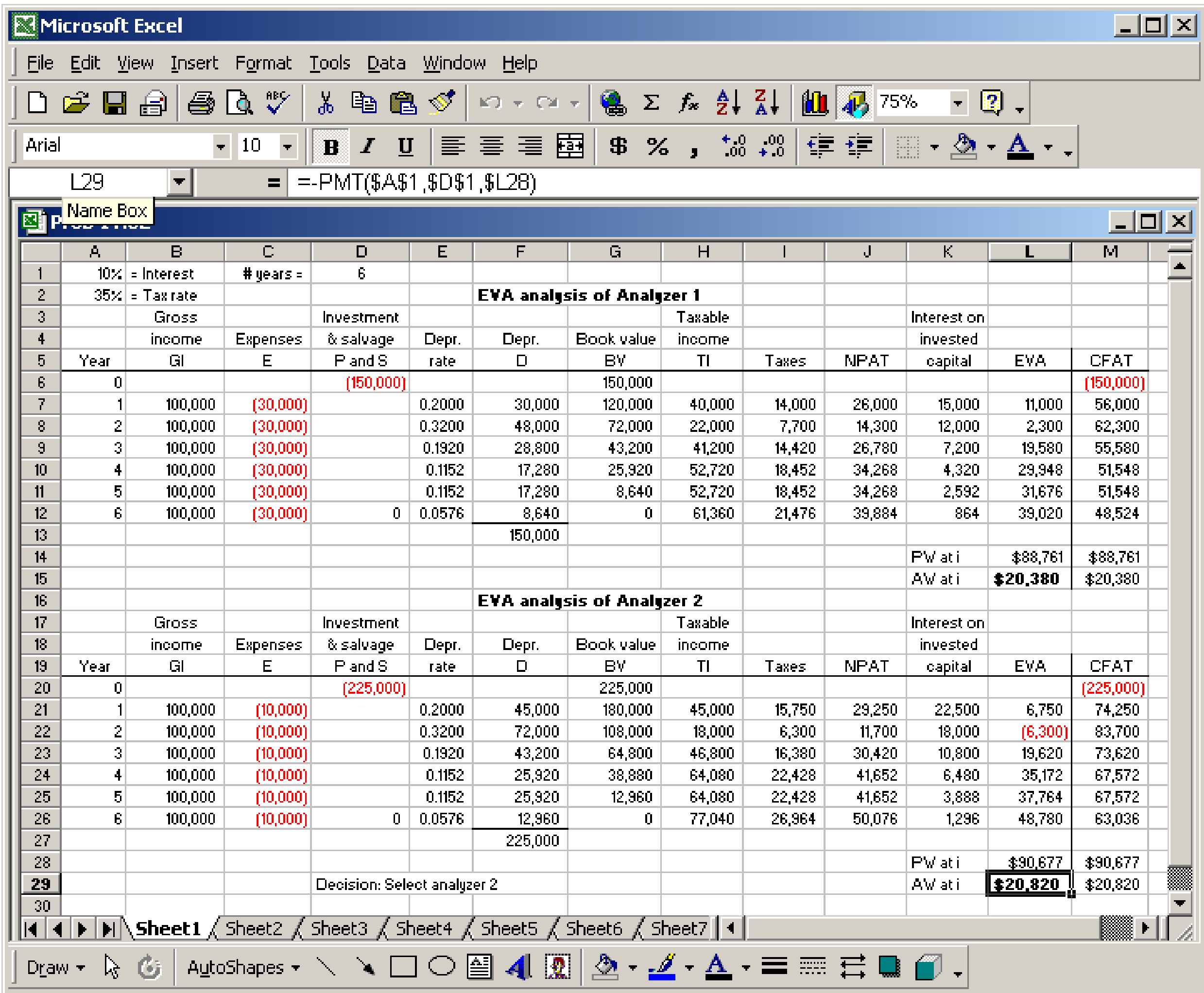
(b) The $AW_{EVA}$ = $338,000 is calculated on the spreadsheet.

Note: The CFAT and $AW_{CFAT}$ values are also shown on the spreadsheet.




| | A | B | C | D | E | F | G | H | I | J | K | L | M |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 12% | = Interest | # years = | 6 | | | (in $1000) | | | | | | |
| 2 | 35% | = Tax rate | | | | | | | | | | | |
| 3 | | Gross | | Investment | | | | Taxable | | | Interest on | | |
| 4 | | income | Expenses | & salvage | Depr. | Depr. | Book value | income | | | invested | | |
| 5 | Year | GI | E | P and S | rate | D | BV | TI | Taxes | NPAT | Capital | EVA | CFAT |
| 6 | 0 | | | (3,000) | | | 3,000 | | | | | | (3,000) |
| 7 | 1 | 2,700 | (1,000) | | 0.10 | 300 | 2,700 | 1,400 | 490 | 910 | 360 | 550 | 1,210 |
| 8 | 2 | 2,600 | (1,050) | | 0.20 | 600 | 2,100 | 950 | 333 | 618 | 324 | 294 | 1,218 |
| 9 | 3 | 2,500 | (1,100) | | 0.20 | 600 | 1,500 | 800 | 280 | 520 | 252 | 268 | 1,120 |
| 10 | 4 | 2,400 | (1,150) | | 0.20 | 600 | 900 | 650 | 228 | 423 | 180 | 243 | 1,023 |
| 11 | 5 | 2,300 | (1,200) | | 0.20 | 600 | 300 | 500 | 175 | 325 | 108 | 217 | 925 |
| 12 | 6 | 2,200 | (1,250) | | 0.10 | 300 | 0 | 650 | 228 | 423 | 36 | 387 | 723 |
| 13 | | | | | | 3,000 | | | | | | | |
| 14 | | | | | | | | | | | PW at i | $1,389 | $1,389 |
| 15 | | | | | | | | | | | AW at i | $338 | $338 |

17.62 The spreadsheet shows EVA for both analyzers. Select analyzer 2 with the larger AW of EVA. This is the same decision reached using AW of CFAT in Example 17.11 when the time value of money was considered. (Note: Be sure to read both Examples 17.6 and 17.11 before working this problem.)




| | A | B | C | D | E | F | G | H | I | J | K | L | M |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 10% | = Interest | # years = | 6 | | | | | | | | | |
| 2 | 35% | = Tax rate | | | | EVA analysis of Analyzer 1 | | | | | | | |
| 3 | | Gross | | Investment | | | | Taxable | | | Interest on | | |
| 4 | | income | Expenses | & salvage | Depr. | Depr. | Book value | income | | | invested | | |
| 5 | Year | GI | E | P and S | rate | D | BV | TI | Taxes | NPAT | capital | EVA | CFAT |
| 6 | 0 | | | (150,000) | | | 150,000 | | | | | | (150,000) |
| 7 | 1 | 100,000 | (30,000) | | 0.2000 | 30,000 | 120,000 | 40,000 | 14,000 | 26,000 | 15,000 | 11,000 | 56,000 |
| 8 | 2 | 100,000 | (30,000) | | 0.3200 | 48,000 | 72,000 | 22,000 | 7,700 | 14,300 | 12,000 | 2,300 | 62,300 |
| 9 | 3 | 100,000 | (30,000) | | 0.1920 | 28,800 | 43,200 | 41,200 | 14,420 | 26,780 | 7,200 | 19,580 | 55,580 |
| 10 | 4 | 100,000 | (30,000) | | 0.1152 | 17,280 | 25,920 | 52,720 | 18,452 | 34,268 | 4,320 | 29,948 | 51,548 |
| 11 | 5 | 100,000 | (30,000) | | 0.1152 | 17,280 | 8,640 | 52,720 | 18,452 | 34,268 | 2,592 | 31,676 | 51,548 |
| 12 | 6 | 100,000 | (30,000) | 0 | 0.0576 | 8,640 | 0 | 61,360 | 21,476 | 39,884 | 864 | 39,020 | 48,524 |
| 13 | | | | | | 150,000 | | | | | | | |
| 14 | | | | | | | | | | | PW at i | $88,761 | $88,761 |
| 15 | | | | | | | | | | | AW at i | **$20,380** | $20,380 |
| 16 | | | | | | EVA analysis of Analyzer 2 | | | | | | | |
| 17 | | Gross | | Investment | | | | Taxable | | | Interest on | | |
| 18 | | income | Expenses | & salvage | Depr. | Depr. | Book value | income | | | invested | | |
| 19 | Year | GI | E | P and S | rate | D | BV | TI | Taxes | NPAT | capital | EVA | CFAT |
| 20 | 0 | | | (225,000) | | | 225,000 | | | | | | (225,000) |
| 21 | 1 | 100,000 | (10,000) | | 0.2000 | 45,000 | 180,000 | 45,000 | 15,750 | 29,250 | 22,500 | 6,750 | 74,250 |
| 22 | 2 | 100,000 | (10,000) | | 0.3200 | 72,000 | 108,000 | 18,000 | 6,300 | 11,700 | 18,000 | (6,300) | 83,700 |
| 23 | 3 | 100,000 | (10,000) | | 0.1920 | 43,200 | 64,800 | 46,800 | 16,380 | 30,420 | 10,800 | 19,620 | 73,620 |
| 24 | 4 | 100,000 | (10,000) | | 0.1152 | 25,920 | 38,880 | 64,080 | 22,428 | 41,652 | 6,480 | 35,172 | 67,572 |
| 25 | 5 | 100,000 | (10,000) | | 0.1152 | 25,920 | 12,960 | 64,080 | 22,428 | 41,652 | 3,888 | 37,764 | 67,572 |
| 26 | 6 | 100,000 | (10,000) | 0 | 0.0576 | 12,960 | 0 | 77,040 | 26,964 | 50,076 | 1,296 | 48,780 | 63,036 |
| 27 | | | | | | 225,000 | | | | | | | |
| 28 | | | | | | | | | | | PW at i | $90,677 | $90,677 |
| 29 | | | | Decision: Select analyzer 2 | | | | | | | AW at i | **$20,820** | $20,820 |
| 30 | | | | | | | | | | | | | |

## Case Study Solution

1. Set up on the next two spreadsheets. The 90% debt option has the largest PW at 10%. As mentioned in the chapter, the largest D-E financing option will always offer the largest return on the invested equity capital. But, too high D-E mixes are risky.

Microsoft Excel - C17 - Case Study soln

**0% debt and 100% equity financing** — Capital = $ 1,500,000

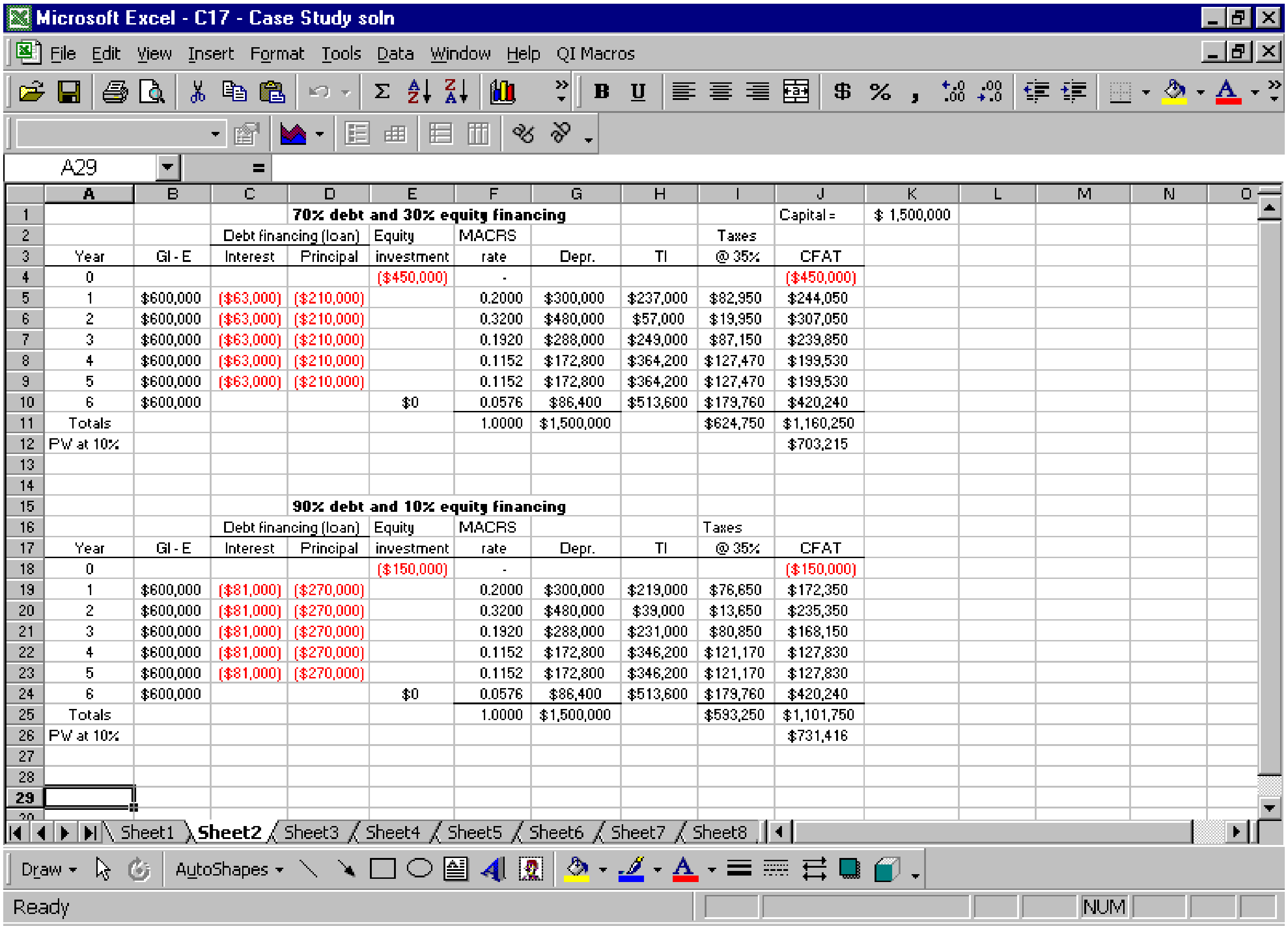
| Year | GI - E | Debt financing (loan) Interest[1] | Principal | Equity investment | MACRS rate | Depr. | TI | Taxes @ 35% | CFAT |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | ($1,500,000) | - | | | | ($1,500,000) |
| 1 | $600,000 | $0 | $0 | | 0.2000 | $300,000 | $300,000 | $105,000 | $495,000 |
| 2 | $600,000 | $0 | $0 | | 0.3200 | $480,000 | $120,000 | $42,000 | $558,000 |
| 3 | $600,000 | $0 | $0 | | 0.1920 | $288,000 | $312,000 | $109,200 | $490,800 |
| 4 | $600,000 | $0 | $0 | | 0.1152 | $172,800 | $427,200 | $149,520 | $450,480 |
| 5 | $600,000 | $0 | $0 | | 0.1152 | $172,800 | $427,200 | $149,520 | $450,480 |
| 6 | $600,000 | | | $0 | 0.0576 | $86,400 | $513,600 | $179,760 | $420,240 |
| Totals | | | | | 1.0000 | $1,500,000 | | $735,000 | $1,365,000 |
| PW at 10% | | | | | | | | | $604,513 |

(1) Interest plus principal = $ debt/5 + ($ debt)(0.06)

**50% debt and 50% equity financing**

| Year | GI - E | Debt financing (loan) Interest[1] | Principal | Equity investment | MACRS rate | Depr. | TI | Taxes @ 35% | CFAT |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | ($750,000) | - | | | | ($750,000) |
| 1 | $600,000 | ($45,000) | ($150,000) | | 0.2000 | $300,000 | $255,000 | $89,250 | $315,750 |
| 2 | $600,000 | ($45,000) | ($150,000) | | 0.3200 | $480,000 | $75,000 | $26,250 | $378,750 |
| 3 | $600,000 | ($45,000) | ($150,000) | | 0.1920 | $288,000 | $267,000 | $93,450 | $311,550 |
| 4 | $600,000 | ($45,000) | ($150,000) | | 0.1152 | $172,800 | $382,200 | $133,770 | $271,230 |
| 5 | $600,000 | ($45,000) | ($150,000) | | 0.1152 | $172,800 | $382,200 | $133,770 | $271,230 |
| 6 | $600,000 | | | $0 | 0.0576 | $86,400 | $513,600 | $179,760 | $420,240 |
| Totals | | | | | 1.0000 | $1,500,000 | | $656,250 | $1,218,750 |
| PW at 10% | | | | | | | | | $675,015 |

**There are three worksheets for this case study solution**



| | A | B | C | D | E | F | G | H | I | J | K |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | 70% debt and 30% equity financing | | | | | | | Capital = | $ 1,500,000 |
| 2 | | | Debt financing (loan) | | Equity | MACRS | | | Taxes | | |
| 3 | Year | GI - E | Interest | Principal | investment | rate | Depr. | TI | @ 35% | CFAT | |
| 4 | 0 | | | | ($450,000) | - | | | | ($450,000) | |
| 5 | 1 | $600,000 | ($63,000) | ($210,000) | | 0.2000 | $300,000 | $237,000 | $82,950 | $244,050 | |
| 6 | 2 | $600,000 | ($63,000) | ($210,000) | | 0.3200 | $480,000 | $57,000 | $19,950 | $307,050 | |
| 7 | 3 | $600,000 | ($63,000) | ($210,000) | | 0.1920 | $288,000 | $249,000 | $87,150 | $239,850 | |
| 8 | 4 | $600,000 | ($63,000) | ($210,000) | | 0.1152 | $172,800 | $364,200 | $127,470 | $199,530 | |
| 9 | 5 | $600,000 | ($63,000) | ($210,000) | | 0.1152 | $172,800 | $364,200 | $127,470 | $199,530 | |
| 10 | 6 | $600,000 | | | $0 | 0.0576 | $86,400 | $513,600 | $179,760 | $420,240 | |
| 11 | Totals | | | | | 1.0000 | $1,500,000 | | $624,750 | $1,160,250 | |
| 12 | PW at 10% | | | | | | | | | $703,215 | |
| 13 | | | | | | | | | | | |
| 14 | | | | | | | | | | | |
| 15 | | | 90% debt and 10% equity financing | | | | | | | | |
| 16 | | | Debt financing (loan) | | Equity | MACRS | | | Taxes | | |
| 17 | Year | GI - E | Interest | Principal | investment | rate | Depr. | TI | @ 35% | CFAT | |
| 18 | 0 | | | | ($150,000) | - | | | | ($150,000) | |
| 19 | 1 | $600,000 | ($81,000) | ($270,000) | | 0.2000 | $300,000 | $219,000 | $76,650 | $172,350 | |
| 20 | 2 | $600,000 | ($81,000) | ($270,000) | | 0.3200 | $480,000 | $39,000 | $13,650 | $235,350 | |
| 21 | 3 | $600,000 | ($81,000) | ($270,000) | | 0.1920 | $288,000 | $231,000 | $80,850 | $168,150 | |
| 22 | 4 | $600,000 | ($81,000) | ($270,000) | | 0.1152 | $172,800 | $346,200 | $121,170 | $127,830 | |
| 23 | 5 | $600,000 | ($81,000) | ($270,000) | | 0.1152 | $172,800 | $346,200 | $121,170 | $127,830 | |
| 24 | 6 | $600,000 | | | $0 | 0.0576 | $86,400 | $513,600 | $179,760 | $420,240 | |
| 25 | Totals | | | | | 1.0000 | $1,500,000 | | $593,250 | $1,101,750 | |
| 26 | PW at 10% | | | | | | | | | $731,416 | |

2. Subtract 2 different equity CFAT totals.

For 30% and 10%:

(1,160,250 – 1,101,750) = $58,500

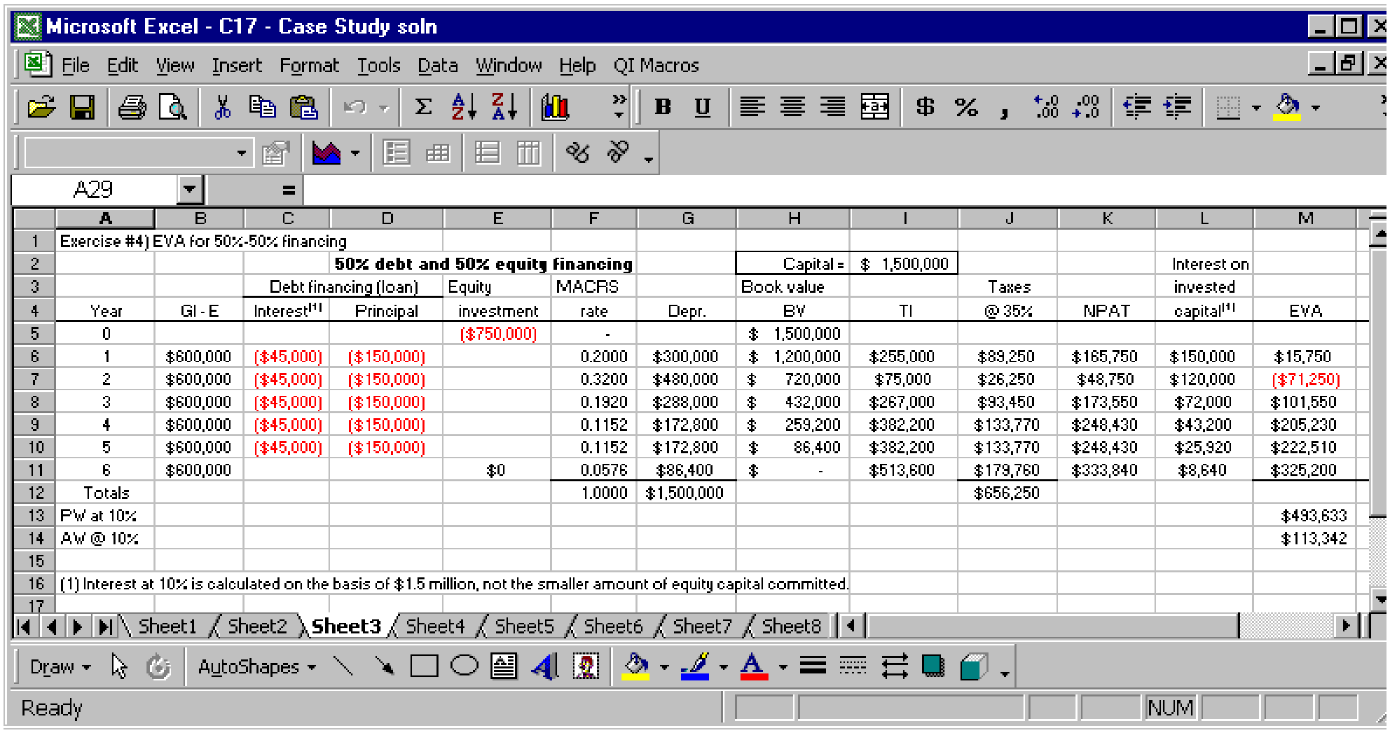
Divide by 2 to get the change per 10% equity.

58,500/2 = $29,250

Conclusion: Total CFAT increases by $29,250 for each 10% increase in equity financing.

3. This happens because less of the Young Brothers own funds are committed to the Portland branch the larger the loan principal.

4. The best estimates of annual EVA are shown in column M.
The equivalent AW = $113,342.



Exercise #4) EVA for 50%-50% financing

| Year | GI - E | Interest[1] | Principal | Equity investment | MACRS rate | Depr. | Book value BV | TI | Taxes @ 35% | NPAT | Interest on invested capital[1] | EVA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 50% debt and 50% equity financing | | | | | Capital = | $ 1,500,000 | | | | |
| | | Debt financing (loan) | | Equity | | | | | | | | |
| 0 | | | | ($750,000) | - | | $ 1,500,000 | | | | | |
| 1 | $600,000 | ($45,000) | ($150,000) | | 0.2000 | $300,000 | $ 1,200,000 | $255,000 | $89,250 | $165,750 | $150,000 | $15,750 |
| 2 | $600,000 | ($45,000) | ($150,000) | | 0.3200 | $480,000 | $ 720,000 | $75,000 | $26,250 | $48,750 | $120,000 | ($71,250) |
| 3 | $600,000 | ($45,000) | ($150,000) | | 0.1920 | $288,000 | $ 432,000 | $267,000 | $93,450 | $173,550 | $72,000 | $101,550 |
| 4 | $600,000 | ($45,000) | ($150,000) | | 0.1152 | $172,800 | $ 259,200 | $382,200 | $133,770 | $248,430 | $43,200 | $205,230 |
| 5 | $600,000 | ($45,000) | ($150,000) | | 0.1152 | $172,800 | $ 86,400 | $382,200 | $133,770 | $248,430 | $25,920 | $222,510 |
| 6 | $600,000 | | | $0 | 0.0576 | $86,400 | $ - | $513,600 | $179,760 | $333,840 | $8,640 | $325,200 |
| Totals | | | | | 1.0000 | $1,500,000 | | | $656,250 | | | |
| PW at 10% | | | | | | | | | | | | $493,633 |
| AW @ 10% | | | | | | | | | | | | $113,342 |

(1) Interest at 10% is calculated on the basis of $1.5 million, not the smaller amount of equity capital committed.

Equations used to determine the EVA:

EVA = NPAT – interest on invested capital

NPAT = TI – taxes

$$(\text{Interest on invested capital})_t = i(\text{BV in the previous year})$$
$$= 0.10(BV_{t-1})$$

Note: BV on the entire $1.5 million in depreciable assets is used to determine the interest on invested capital.