## **CHAPTER 6**

### Making Investment Decisions with

### The Net Present Value Rule

## **Answers to Problem Sets**

1. a, b, d, g, h.

2. Real cash flow = 100,000/1.04 = $96,154; real discount rate = 1.08/1.04 - 1 = .03846

PV = 

3. a. False

b. False

c. False

d. False

4. The longer the recovery period, the less the -present value of depreciation tax shields. This is true regardless of the discount rate. If r = .10, then 35% of the 5-year schedule’s PV is .271. The same calculation for the 7-year schedule yields .252.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | 2010 | 2011 | 2012 | 2013 | 2014 |
| Working capital | 50,000 | 230,000 | 305,000 | 250,000 | 0 |
| Cash flows | +50,000 | +180,00 | +75,000 | -55,000 | -250,000 |

5.

6. Comparing present values can be misleading when projects have different

economic lives and the projects are part of an ongoing business. For example, a machine that costs $100,000 per year to buy and lasts 5 years is not necessarily more expensive than a machine that costs $75,000 per year to buy but lasts only 3 years. Calculating the machines’ equivalent annual costs allows an unbiased comparison.

7. PV cost = 1.5 + .2 X 14.09 = $4.319 million. Equivalent annual cost = 4.319/14.09 = .306, or $306,000.

8. a. NPVA = $100,000; NPVB = $180,000

b. Equivalent cash flow of A = 100,000/1.736 5 $57,604; equivalent cash flow

of B = 180,000/2.487 = $72,376

c. Machine B.

9. Replace at end of 5 years ($80,000 > $72,376).

10. See the table below. We begin with the cash flows given in the text, Table 6.6, line 8, and utilize the following relationship from Chapter 3:

Real cash flow = nominal cash flow/(1 + inflation rate)t

Here, the nominal rate is 20%, the expected inflation rate is 10%, and the real rate is given by the following:

|  |  |
| --- | --- |
| (1 + rnominal) | = (1 + rreal) × (1 + inflation rate) |
| 1.20 | = (1 + rreal) × (1.10) |
| rreal | = 0.0909 = 9.09% |

As can be seen in the table, the NPV is unchanged (to within a rounding error).

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Year 0 | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 | Year 6 | Year 7 | |
| Net Cash Flows (Nominal) | -12,600 | -1,484 | 2,947 | 6,323 | 10,534 | 9,985 | 5,757 | 3,269 | |
| Net Cash Flows (Real) | -12,600 | -1,349 | 2,436 | 4,751 | 7,195 | 6,200 | 3,250 | 1,678 | |
| NPV of Real Cash Flows (at 9.09%) = $3,804 | | | | | | | | | |

1. The following spreadsheet calculates a NPV of -$147,510 (in nominal terms):

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Nominal Calculation |  |  |  |  |  |  |
|  | YEAR | | | | | |
|  | 0 | 1 | 2 | 3 | 4 | 5 |
| Capital Investment | 500,000 |  |  |  |  |  |
| Accumulated Depreciation |  | 100,000 | 200,000 | 300,000 | 400,000 | 500,000 |
| Year-End Book Value | 500,000 | 400,000 | 300,000 | 200,000 | 100,000 | 0 |
| Working capital | 40,000 | 44,000 | 48,400 | 53,240 | 58,564 | 0 |
| Total Book Value | 540,000 | 444,000 | 348,400 | 253,240 | 158,564 | 0 |
|  |  |  |  |  |  |  |
| Revenues |  | 200,000 | 220,000 | 242,000 | 266,200 | 292,820 |
| Costs |  | 100,000 | 110,000 | 121,000 | 133,100 | 146,410 |
| Depreciation |  | 100,000 | 100,000 | 100,000 | 100,000 | 100,000 |
| Pretax Profit |  | 0 | 10,000 | 21,000 | 33,100 | 46,410 |
| Taxes at 35% |  | 0 | 3,500 | 7,350 | 11,585 | 16,244 |
| Profit after tax |  | 0 | 6,500 | 13,650 | 21,515 | 30,167 |
|  |  |  |  |  |  |  |
| Revenues |  | 200,000 | 220,000 | 242,000 | 266,200 | 292,820 |
| Costs |  | 100,000 | 110,000 | 121,000 | 133,100 | 146,410 |
| Tax on operations |  | 0 | 3,500 | 7,350 | 11,585 | 16,244 |
| Cash Flow from Operations |  | 100,000 | 106,500 | 113,650 | 121,515 | 130,167 |
| Change in working capital | -40,000 | -4,000 | -4,400 | -4,840 | -5,324 | 58,564 |
| Capital Investment | -500,000 |  |  |  |  |  |
| Net Cash Flows | -540,000 | 96,000 | 102,100 | 108,810 | 116,191 | 188,731 |
| Discount Factor @ 15% | 1.000 | 0.870 | 0.756 | 0.658 | 0.572 | 0.497 |
| Present Value | -540,000 | 83,478 | 77,202 | 71,544 | 66,433 | 93,832 |
|  |  |  |  |  |  |  |
| NPV | -147,510 |  |  |  |  |  |

Since the nominal rate is 15% and the expected inflation rate is 10%, the real rate is given by the following:

|  |  |
| --- | --- |
| (1 + rnominal) | = (1 + rreal) × (1 + inflation rate) |
| 1.15 | = (1 + rreal) × (1.10) |
| rreal | = 0.04545 = 4.545% |
|  |  |

Adjusting the cash flows to real dollars and using this real rate gives us the same result for NPV (with a slight rounding error).

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | YEAR | | | | | |
|  | 0 | 1 | 2 | 3 | 4 | 5 |
| Net Cash Flows (Nominal) | -540,000 | 96,000 | 102,100 | 108,810 | 116,191 | 188,731 |
| Adjustment Factor for Real CF | 1 | 0.909 | 0.826 | 0.751 | 0.683 | 0.621 |
| Net Cash Flows (Real) | -540,000 | 87,273 | 84,380 | 81,751 | 79,360 | 117,187 |
| Discount Factor @ 4.545% | 1.000 | 0.957 | 0.915 | 0.875 | 0.837 | 0.801 |
| Present Value | -540,000 | 83,479 | 77,203 | 71,545 | 66,434 | 93,834 |
|  |  |  |  |  |  |  |
| NPV | -147,505 |  |  |  |  |  |

1. No, this is not the correct procedure. The opportunity cost of the land is its value in its best use, so Mr. North should consider the $45,000 value of the land as an outlay in his NPV analysis of the funeral home.
2. Investment in net working capital arises as a forecasting issue only because accrual accounting recognizes sales when made, not when cash is received (and costs when incurred, not when cash payment is made). If cash flow forecasts recognize the exact timing of the cash flows, then there is no need to also include investment in net working capital.
3. If the $50,000 is expensed at the end of year 1, the value of the tax shield is:



If the $50,000 expenditure is capitalized and then depreciated using a five-year MACRS depreciation schedule, the value of the tax shield is:



If the cost can be expensed, then the tax shield is larger, so that the after-tax cost is smaller.

1. Note: This answer assumes that the $3 million initial research costs are sunk and excludes this from the NPV calculation. It also assumes that working capital needs begin to accrue in year 0. The following spreadsheet calculates a project NPV of -$465,000.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Figures in 000's | YEAR | | | | | |
|  | 0 | 1 | 2 | 3 | 4 | 5 |
| Capital Investment | 6,000 |  |  |  |  | -500 |
| Accumulated Depreciation |  | 1,200 | 2,400 | 3,600 | 4,800 | 6,000 |
| Year-End Book Value | 6,000 | 4,800 | 3,600 | 2,400 | 1,200 | 0 |
| Working capital | 200 | 240 | 400 | 400 | 240 | 0 |
| Total Book Value | 6,200 | 5,040 | 4,000 | 2,800 | 1,440 | 0 |
|  |  |  |  |  |  |  |
| Unit Sales |  | 500 | 600 | 1,000 | 1,000 | 600 |
| Revenues |  | 2,000 | 2,400 | 4,000 | 4,000 | 2,400 |
| Costs |  | 750 | 900 | 1,500 | 1,500 | 900 |
| Depreciation |  | 1,200 | 1,200 | 1,200 | 1,200 | 1,200 |
| Pretax Profit (includes salage in yr 5) |  | 50 | 300 | 1,300 | 1,300 | 800 |
| Taxes at 35% |  | 18 | 105 | 455 | 455 | 280 |
| Profit after tax |  | 33 | 195 | 845 | 845 | 520 |
|  |  |  |  |  |  |  |
| Revenues |  | 2,000 | 2,400 | 4,000 | 4,000 | 2,400 |
| Costs |  | 750 | 900 | 1,500 | 1,500 | 900 |
| Tax on operations |  | 18 | 105 | 455 | 455 | 280 |
| Cash Flow from Operations |  | 1,233 | 1,395 | 2,045 | 2,045 | 1,220 |
| Change in working capital | -200 | -40 | -160 | 0 | 160 | 240 |
| Capital Investment | -6,000 |  |  |  |  |  |
| Net Cash Flows | -6,200 | 1,193 | 1,235 | 2,045 | 2,205 | 1,460 |
| Discount Factor @ 12% | 1.000 | 0.893 | 0.797 | 0.712 | 0.636 | 0.567 |
| Present Value | -6,200 | 1,065 | 985 | 1,456 | 1,401 | 828 |
|  |  |  |  |  |  |  |
| NPV | -465 |  |  |  |  |  |

16. a. 

NPVB = –Investment + PV(after-tax cash flow) + PV(depreciation tax shield)





NPVB = –$4,127

Another, perhaps more intuitive, way to do the Company B analysis is to first calculate the cash flows at each point in time, and then compute the present value of these cash flows:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | t = 0 | t = 1 | | | | t = 2 | | t = 3 | | | | t = 4 | | t = 5 | t = 6 | | |
| Investment | 100,000 | |  |  | | |  | | |  | | | |  |  | |
| Cash Inflow |  | 26,000 | | | 26,000 | | | | 26,000 | | 26,000 | | 26,000 | |  | |
| Depreciation | | 20,000 | | | 32,000 | | | | 19,200 | | 11,520 | | 11,520 | | 5,760 | |
| Taxable Income | | 6,000 | | | -6,000 | | | | 6,800 | | 14,480 | | 14,480 | | -5,760 | |
| Tax (at 35%) |  | 2,100 | | | -2,100 | | | | 2,380 | | 5,068 | | 5,068 | | -2,016 | |
| Cash Flow -100,000 | | 23,900 | | | 28,100 | | | | 23,620 | | 20,932 | | 20,932 | | 2,016 | |
| NPV (at 8%) = -$4,127 | | | | | | | | | | | | | | | |

b. IRRA = 9.43%

IRRB = 6.39%

Effective tax rate = 

17. a.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **TABLE 6.5 Tax payments on IM&C’s guano project ($thousands)** | | | | | | | | | |
|  |  |  |  |  |  |  |  |  |  |
|  | No. of years depreciation | 7 |  |  |  |  |  |  |  |
|  | Tax rate (percent) | 35 |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  | **Period** |  |  |  |
|  |  | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
|  | MACRS % |  | 14.29 | 24.49 | 17.49 | 12.49 | 8.93 | 8.92 | 13.38 |
|  | Tax depreciation |  | 1,429 | 2,449 | 1,749 | 1,249 | 893 | 892 | 1,338 |
|  | (MACRS% x depreciable investment) | |  |  |  |  |  |  |  |
| 1. | Sales | 0 | 523 | 12,887 | 32,610 | 48,901 | 35,834 | 19,717 | 0 |
| 2. | Cost of goods sold | 0 | 837 | 7,729 | 19,552 | 29,345 | 21,492 | 11,830 | 0 |
| 3. | Other costs | 4,000 | 2,200 | 1,210 | 1,331 | 1,464 | 1,611 | 1,772 | 0 |
| 4. | Tax depreciation | 0 | 1,429 | 2,449 | 1,749 | 1,249 | 893 | 892 | 1,338 |
| 5. | Pretax profits | -4,000 | -3,943 | 1,499 | 9,978 | 16,843 | 11,838 | 5,223 | 611 |
| 6. | Tax | -1,400 | -1,380 | 525 | 3,492 | 5,895 | 4,143 | 1,828 | 214 |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **TABLE 6.6 IM&C’s guano project – revised cash flow analysis with MACRS depreciation ($thousands)** | | | | | | | | | |
|  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  | **Period** |  |  |  |
|  |  | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
|  |  |  |  |  |  |  |  |  |  |
| 1. | Sales | 0 | 523 | 12,887 | 32,610 | 48,901 | 35,834 | 19,717 | 0 |
| 2. | Cost of goods sold | 0 | 837 | 7,729 | 19,552 | 29,345 | 21,492 | 11,830 | 0 |
| 3. | Other costs | 4,000 | 2,200 | 1,210 | 1,331 | 1,464 | 1,611 | 1,772 | 0 |
| 4. | Tax | -1,400 | -1,380 | 525 | 3,492 | 5,895 | 4,143 | 1,828 | 214 |
| 5. | Cash flow from operations | -2,600 | -1,134 | 3,423 | 8,235 | 12,197 | 8,588 | 4,287 | -214 |
| 6. | Change in working capital |  | -550 | -739 | -1,972 | -1,629 | 1,307 | 1,581 | 2,002 |
| 7. | Capital investment and disposal | -10,000 | 0 | 0 | 0 | 0 | 0 | 0 | 1,949 |
| 8. | Net cash flow (5+6+7) | -12,600 | -1,684 | 2,684 | 6,263 | 10,568 | 9,895 | 5,868 | 3,737 |
| 9. | Present value | -12,600 | -1,403 | 1,864 | 3,624 | 5,096 | 3,977 | 1,965 | 1,043 |
|  |  |  |  |  |  |  |  |  |  |
|  | Net present value = | 3,566 |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |
|  | Cost of capital (percent) | 20 |  |  |  |  |  |  |  |

b.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **TABLE 6.1 IM&C’s guano project – projections ($thousands)**  **reflecting inflation and straight line depreciation** | | | | | | | | | |
|  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  | **Period** |  |  |  |
|  |  | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| 1. | Capital investment | 15,000 |  |  |  |  |  |  | -1,949 |
| 2. | Accumulated depn. |  | 2,417 | 4,833 | 7,250 | 9,667 | 12,083 | 14,500 | 0 |
| 3. | Year-end book value | 15,000 | 12,583 | 10,167 | 7,750 | 5,333 | 2,917 | 500 | 0 |
| 4. | Working capital |  | 550 | 1,289 | 3,261 | 4,890 | 3,583 | 2,002 | 0 |
| 5. | Total book value (3 + 4) |  | 13,133 | 11,456 | 11,011 | 10,223 | 6,500 | 2,502 | 0 |
| 6. | Sales |  | 523 | 12,887 | 32,610 | 48,901 | 35,834 | 19,717 |  |
| 7. | Cost of goods sold |  | 837 | 7,729 | 19,552 | 29,345 | 21,492 | 11,830 |  |
| 8. | Other costs | 4,000 | 2,200 | 1,210 | 1,331 | 1,464 | 1,611 | 1,772 |  |
| 9. | Depreciation |  | 2,417 | 2,417 | 2,417 | 2,417 | 2,417 | 2,417 | 0 |
| 10. | Pretax profit | -4,000 | -4,931 | 1,531 | 9,310 | 15,675 | 10,314 | 3,698 | 1,449 |
| 11. | Tax | -1,400 | -1,726 | 536 | 3,259 | 5,486 | 3,610 | 1,294 | 507 |
| 12. | Profit after tax (10 – 11) | -2,600 | -3,205 | 995 | 6,052 | 10,189 | 6,704 | 2,404 | 942 |
|  |  |  |  |  |  |  |  |  |  |
|  | Notes: |  |  |  |  |  |  |  |  |
|  | No. of years depreciation |  |  |  | 6 |  |  |  |  |
|  | Assumed salvage value in depreciation calculation |  |  |  | 500 |  |  |  |  |
|  | Tax rate (percent) |  |  |  | 35 |  |  |  |  |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **TABLE 6.2 IM&C’s guano project – initial cash flow analysis with straight-line depreciation ($thousands)** | | | | | | | | | |
|  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  | **Period** |  |  |  |
|  |  | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
|  |  |  |  |  |  |  |  |  |  |
| 1 | Sales | 0 | 523 | 12,887 | 32,610 | 48,901 | 35,834 | 19,717 | 0 |
| 2 | Cost of goods sold | 0 | 837 | 7,729 | 19,552 | 29,345 | 21,492 | 11,830 | 0 |
| 3 | Other costs | 4,000 | 2,200 | 1,210 | 1,331 | 1,464 | 1,611 | 1,772 | 0 |
| 4 | Tax | -1,400 | -1,726 | 536 | 3,259 | 5,486 | 3,610 | 1,294 | 507 |
| 5 | Cash flow from operations | -2,600 | -788 | 3,412 | 8,468 | 12,606 | 9,121 | 4,821 | -507 |
| 6 | Change in working capital |  | -550 | -739 | -1,972 | -1,629 | 1,307 | 1,581 | 2,002 |
| 7 | Capital investment and disposal | -15,000 | 0 | 0 | 0 | 0 | 0 | 0 | 1,949 |
| 8 | Net cash flow (5+6+7) | -17,600 | -1,338 | 2,673 | 6,496 | 10,977 | 10,428 | 6,402 | 3,444 |
| 9 | Present value | -17,600 | -1,206 | 2,169 | 4,750 | 7,231 | 6,189 | 3,423 | 1,659 |
|  |  |  |  |  |  |  |  |  |  |
|  | Net present value = | 6,614 |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |
|  | Cost of capital (percent) | 11 |  |  |  |  |  |  |  |

c.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **TABLE 6.1 IM&C’s guano project – projections ($thousands)**  **reflecting inflation and straight line depreciation** | | | | | | | | | |
|  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  | **Period** |  |  |  |
|  |  | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| 1. | Capital investment | 15,000 |  |  |  |  |  |  | -1,949 |
| 2. | Accumulated depn. |  | 2,417 | 4,833 | 7,250 | 9,667 | 12,083 | 14,500 | 0 |
| 3. | Year-end book value | 15,000 | 12,583 | 10,167 | 7,750 | 5,333 | 2,917 | 500 | 0 |
| 4. | Working capital |  | 605 | 1,418 | 3,587 | 5,379 | 3,941 | 2,202 | 0 |
| 5. | Total book value (3 + 4) |  | 13,188 | 11,585 | 11,337 | 10,712 | 6,858 | 2,702 | 0 |
| 6. | Sales |  | 575 | 14,176 | 35,871 | 53,791 | 39,417 | 21,689 |  |
| 7. | Cost of goods sold |  | 921 | 8,502 | 21,507 | 32,280 | 23,641 | 13,013 |  |
| 8. | Other costs | 4,000 | 2,200 | 1,210 | 1,331 | 1,464 | 1,611 | 1,772 |  |
| 9. | Depreciation |  | 2,417 | 2,417 | 2,417 | 2,417 | 2,417 | 2,417 | 0 |
| 10. | Pretax profit | -4,000 | -4,962 | 2,047 | 10,616 | 17,631 | 11,749 | 4,487 | 1,449 |
| 11. | Tax | -1,400 | -1,737 | 716 | 3,716 | 6,171 | 4,112 | 1,570 | 507 |
| 12. | Profit after tax (10 – 11) | -2,600 | -3,225 | 1,331 | 6,900 | 11,460 | 7,637 | 2,917 | 942 |
|  |  |  |  |  |  |  |  |  |  |
|  | Notes: |  |  |  |  |  |  |  |  |
|  | No. of years depreciation |  |  |  | 6 |  |  |  |  |
|  | Assumed salvage value in depreciation calculation |  |  |  | 500 |  |  |  |  |
|  | Tax rate (percent) |  |  |  | 35 |  |  |  |  |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **TABLE 6.2 IM&C’s guano project – initial cash flow analysis with straight-line depreciation ($thousands)** | | | | | | | | | |
|  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  | **Period** |  |  |  |
|  |  | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
|  |  |  |  |  |  |  |  |  |  |
| 1 | Sales | 0 | 575 | 14,176 | 35,871 | 53,791 | 39,417 | 21,689 | 0 |
| 2 | Cost of goods sold | 0 | 921 | 8,502 | 21,507 | 32,280 | 23,641 | 13,013 | 0 |
| 3 | Other costs | 4,000 | 2,200 | 1,210 | 1,331 | 1,464 | 1,611 | 1,772 | 0 |
| 4 | Tax | -1,400 | -1,737 | 716 | 3,716 | 6,171 | 4,112 | 1,570 | 507 |
| 5 | Cash flow from operations | -2,600 | -809 | 3,747 | 9,317 | 13,877 | 10,053 | 5,333 | -507 |
| 6 | Change in working capital |  | -605 | -813 | -2,169 | -1,792 | 1,438 | 1,739 | 2,202 |
| 7 | Capital investment and disposal | -15,000 | 0 | 0 | 0 | 0 | 0 | 0 | 1,949 |
| 8 | Net cash flow (5+6+7) | -17,600 | -1,414 | 2,934 | 7,148 | 12,085 | 11,491 | 7,072 | 3,644 |
| 9 | Present value | -17,600 | -1,274 | 2,382 | 5,227 | 7,961 | 6,819 | 3,781 | 1,755 |
|  |  |  |  |  |  |  |  |  |  |
|  | Net present value = | 9,051 |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |
|  | Cost of capital (percent) | 11 |  |  |  |  |  |  |  |

18. Assume the following:

1. The firm will manufacture widgets for at least 10 years.
2. There will be no inflation or technological change.
3. The 15% cost of capital is appropriate for all cash flows and is a real, after-tax rate of return.
4. All operating cash flows occur at the end of the year.
5. We cannot ignore incremental working capital costs and recovery

Note: Since purchasing the lids can be considered a one-year ‘project,’ the two projects have a common chain life of 10 years.

Compute NPV for each project as follows:

NPV(purchase) =

NPV(make) =





Thus, the widget manufacturer should make the lids.

19. a. *Capital Expenditure*

1. If the spare warehouse space will be used now or in the future, then the project should be credited with these benefits.
2. Charge opportunity cost of the land and building.
3. The salvage value at the end of the project should be included.

*Research and Development*

1. Research and development is a sunk cost.

*Working Capital*

1. Will additional inventories be required as volume increases?
2. Recovery of inventories at the end of the project should be included.
3. Is additional working capital required due to changes in receivables, payables, etc.?

*Revenue*

1. Revenue forecasts assume prices (and quantities) will be unaffected by competition, a common and critical mistake.

*Operating Costs*

1. Are percentage labor costs unaffected by increase in volume in the early years?

2. Wages generally increase faster than inflation. Does Reliable expect continuing productivity gains to offset this?

*Overhead*

1. Is “overhead” truly incremental?

*Depreciation*

1. Depreciation is not a cash flow, but the ACRS deprecation does affect tax payments.
2. ACRS depreciation is fixed in nominal terms. The real value of the depreciation tax shield is reduced by inflation.

*Interest*

1. It is bad practice to deduct interest charges (or other payments to security holders). Value the project as if it is all equity-financed.

*Tax*

1. See comments on ACRS depreciation and interest.
2. If Reliable has profits on its remaining business, the tax loss should not be carried forward.

*Net Cash Flow*

1. See comments on ACRS depreciation and interest.
2. Discount rate should reflect project characteristics; in general, it is *not* equivalent to the company’s borrowing rate.

b. 1. Potential use of warehouse.

1. Opportunity cost of building.
2. Other working capital items.
3. More realistic forecasts of revenues and costs.
4. Company’s ability to use tax shields.
5. Opportunity cost of capital.

c. The table on the next page shows a sample NPV analysis for the project. The analysis is based on the following assumptions:

1. *Inflation*: 10% per year.
2. *Capital Expenditure:* $8 million for machinery; $5 million for market value of factory; $2.4 million for warehouse extension (we assume that it is eventually needed or that electric motor project and surplus capacity cannot be used in the interim). We assume salvage value of $3 million in real terms less tax at 35%.
3. *Working Capital*: We assume inventory in year t is 9.1% of expected revenues in year (t + 1). We also assume that receivables *less* payables, in year t, is equal to 5% of revenues in year t.
4. *Depreciation Tax Shield*: Based on 35% tax rate and 5-year ACRS class. This is a simplifying and probably inaccurate assumption; i.e., not all the investment would fall in the 5-year class. Also, the factory is currently owned by the company and may already be partially depreciated. We assume the company can use tax shields as they arise.
5. *Revenues*: Sales of 2,000 motors in 2010, 4,000 motors in 2011, and 10,000 motors thereafter. The unit price is assumed to decline from $4,000 (real) to $2,850 when competition enters in 2012. The latter is the figure at which new entrants’ investment in the project would have NPV = 0.
6. *Operating Costs*: We assume direct labor costs decline progressively from $2,500 per unit in 2010, to $2,250 in 2011 and to $2,000 in real terms in 2012 and after.
7. *Other Costs*: We assume true incremental costs are 10% of revenue.
8. *Tax:* 35% of revenue less costs.
9. *Opportunity Cost of Capital*: Assumed 20%.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
| Capital Expenditure | -15,400 |  |  |  |  |  |
| Changes in Working Capital |  |  |  |  |  |  |
| Inventories | -801 | -961 | -1,690 | -345 | 380 | -418 |
| Receivables – Payables |  | -440 | -528 | -929 | -190 | -209 |
| Depreciation Tax Shield |  | 1,078 | 1,725 | 1,035 | 621 | 621 |
| Revenues |  | 8,800 | 19,360 | 37,934 | 41,727 | 45,900 |
| Operating Costs |  | -5,500 | -10,890 | -26,620 | -29,282 | -32,210 |
| Other costs |  | -880 | -1,936 | -3,793 | -4,173 | -4,590 |
| Tax |  | -847 | -2,287 | -2,632 | -2,895 | -3,185 |
| Net Cash Flow | -16,201 | 1,250 | 3,754 | 4,650 | 5,428 | 5,909 |

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 2015 | 2016 | 2017 | | 2018 | | | 2019 | 2030 | |
| Capital Expenditure |  |  |  | |  | | | 5,058 |  | |
| Changes in Working Capital |  |  |  | |  | | |  |  | |
| Inventories | -459 | -505 | -556 | | -612 | | | 6,727 |  | |
| Receivables – Payables | -229 | -252 | -278 | | -306 | | | -336 | 3,696 | |
| Depreciation Tax Shield | 310 |  |  | |  | | |  |  | |
| Revenues | 50,489 | 55,538 | 61,092 | | 67,202 | | | 73,922 |  | |
| Operating Costs | -35,431 | -38,974 | -42,872 | | -47,159 | | | -51,875 |  | |
| Other costs | -5,049 | -5,554 | -6,109 | | -6,720 | | | -7,392 |  | |
| Tax | -3,503 | -3,854 | -4,239 | | -4,663 | | | -5,129 |  | |
| Net Cash Flow | 6,128 | 6,399 | 7,038 | | 7,742 | | | 20,975 | 3,696 | |
| NPV (at 20%) = $5,991 | | | |  | |  |  | | |  |

20. The table below shows the real cash flows. The NPV is computed using the real rate, which is computed as follows:

|  |  |
| --- | --- |
| (1 + rnominal) | = (1 + rreal) × (1 + inflation rate) |
| 1.09 | = (1 + rreal) × (1.03) |
| rreal | = 0.0583 = 5.83% |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | t = 0 | t = 1 | t = 2 | t = 3 | t = 4 | t = 5 | t = 6 | t = 7 | t = 8 |
| Investment | -35,000.0 |  |  |  |  |  |  |  | 15,000.0 |
| Savings |  | 8,580.0 | 8,580.0 | 8,580.0 | 8,580.0 | 8,580.0 | 8,580.0 | 8,580.0 | 8,580.0 |
| Insurance |  | -1,200.0 | -1,200.0 | -1,200.0 | -1,200.0 | -1,200.0 | -1,200.0 | -1,200.0 | -1,200.0 |
| Fuel |  | 1,053.0 | 1,053.0 | 1,053.0 | 1,053.0 | 1,053.0 | 1,053.0 | 1,053.0 | 1,053.0 |
| Net Cash Flow | -35,000.0 | 8,433.0 | 8,433.0 | 8,433.0 | 8,433.0 | 8,433.0 | 8,433.0 | 8,433.0 | 23,433.0 |
| NPV (at 5.83%) = $27,254.2 | | |  |  |  |  |  |  |  |

21. All numbers are in thousands:

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | t = 0 | t = 1 | t = 2 | t = 3 | t = 4 | t = 5 | t = 6 | t = 7 | t = 8 |
| Sales |  | 4,200.0 | 4,410.0 | 4,630.5 | 4,862.0 | 5,105.1 | 5,360.4 | 5,628.4 | 5,909.8 |
| Manufacturing Costs |  | 3,780.0 | 3,969.0 | 4,167.5 | 4,375.8 | 4,594.6 | 4,824.4 | 5,065.6 | 5,318.8 |
| Depreciation |  | 120.0 | 120.0 | 120.0 | 120.0 | 120.0 | 120.0 | 120.0 | 120.0 |
| Rent |  | 100.0 | 104.0 | 108.2 | 112.5 | 117.0 | 121.7 | 126.5 | 131.6 |
| Earnings Before Taxes | | 200.0 | 217.0 | 234.8 | 253.7 | 273.5 | 294.3 | 316.3 | 339.4 |
| Taxes |  | 70.0 | 76.0 | 82.2 | 88.8 | 95.7 | 103.0 | 110.7 | 118.8 |
| Cash Flow – Operations | | 250.0 | 261.1 | 272.6 | 284.9 | 297.8 | 311.3 | 325.6 | 340.6 |
|  |  |  |  |  |  |  |  |  |  |
| Working Capital | 350.0 | 420.0 | 441.0 | 463.1 | 486.2 | 510.5 | 536.0 | 562.8 | 0.0 |
| Increase in W.C. | 350.0 | 70.0 | 21.0 | 22.1 | 23.1 | 24.3 | 25.5 | 26.8 | -562.8 |
| Initial Investment | 1,200.0 |  |  |  |  |  |  |  |  |
| Sale of Plant |  |  |  |  |  |  |  |  | 400.0 |
| Tax on Sale |  |  |  |  |  |  |  |  | 56.0 |
|  |  |  |  |  |  |  |  |  |  |
| Net Cash Flow -1,550.0 | | 180.0 | 240.1 | 250.5 | 261.8 | 273.5 | 285.8 | 298.8 | 1,247.4 |
| NPV(at 12%) = | $85.8 |  |  |  |  |  |  |  |  |

22. We can use the following spreadsheet to calculate a NPV of 6.352 billion RMB for the Ambassador China project. This calculation uses the following assumptions:

1. Calculations are done on a nominal basis, converting the salvage value estimate from a real to a nominal value (638) using the 5% inflation estimate; Salvage = book value so no taxes are incurred on salvage.

2. Depreciation is calculated at 4000 – 638 (salvage) / 5 = 672.4 per year

3. Cars sales occur in year 1 (there is some ambiguity here as the problem state it takes a year for the plant to become operational but also that sales will occur in the first year).

4. The tax shield in year 0 can be used to offset profits from other operations.

5. No working capital costs (this is unrealistic, but no figures are given)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| RMB; figures in millions | YEAR | | | | | |
|  | 0 | 1 | 2 | 3 | 4 | 5 |
| Capital Investment | 4,000 |  |  |  |  | -638 |
| Accumulated Depreciation |  | 672 | 1,345 | 2,017 | 2,689 | 3,362 |
| Year-End Book Value | 4,000 | 3,328 | 2,655 | 1,983 | 1,311 | 638 |
|  |  |  |  |  |  |  |
| Unit Sales |  | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 |
| Price / unit (growing 4%) |  | 65,000 | 67,600 | 70,304 | 73,116 | 76,041 |
| Raw Material Cost / Unit (growing 3%) |  | 18,000 | 18,540 | 19,096 | 19,669 | 20,259 |
|  |  |  |  |  |  |  |
| Revenues |  | 6,500 | 6,760 | 7,030 | 7,312 | 7,604 |
| Raw Material Costs |  | 1,800 | 1,854 | 1,910 | 1,967 | 2,026 |
| Labor Costs (growing 7%) |  | 1,100 | 1,177 | 1,259 | 1,348 | 1,442 |
| Land costs (prepaid) | 300 | 300 | 300 | 300 | 300 |  |
| Depreciation |  | 672.4 | 672.4 | 672.4 | 672.4 | 672.4 |
| Pretax Profit | -300 | 2,628 | 2,757 | 2,889 | 3,025 | 3,464 |
| Taxes at 25% | -75 | 657 | 689 | 722 | 756 | 866 |
| Profit after tax | -225 | 1,971 | 2,067 | 2,167 | 2,269 | 2,598 |
|  |  |  |  |  |  |  |
| Revenues |  | 6,500 | 6,760 | 7,030 | 7,312 | 7,604 |
| Cash costs | 300 | 3,200 | 3,331 | 3,469 | 3,614 | 3,468 |
| Tax on operations |  | 657 | 689 | 722 | 756 | 866 |
| Cash Flow from Operations | -300 | 2,643 | 2,740 | 2,839 | 2,941 | 3,270 |
| Capital Investment | -4,000 |  |  |  |  | 638 |
| Net Cash Flows | -4,300 | 2,643 | 2,740 | 2,839 | 2,941 | 3,908 |
| Discount Factor @ 12% | 1.000 | 0.893 | 0.797 | 0.712 | 0.636 | 0.567 |
| Present Value | -4,300 | 2,360 | 2,184 | 2,021 | 1,869 | 2,218 |
|  |  |  |  |  |  |  |
| NPV | 6,352 |  |  |  |  |  |

23. [Note: Section 6.2 provides several different calculations of pre-tax profit and taxes, based on different assumptions; the solution below is based on Table 6.6 in the text.]

See the table below. With full usage of the tax losses, the NPV of the tax payments is $4,779. With tax losses carried forward, the NPV of the tax payments is $5,741. Thus, with tax losses carried forward, the project’s NPV decreases by $962, so that the value to the company of using the deductions immediately is $962.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | t = 0 | t = 1 | t = 2 | t = 3 | t = 4 | t = 5 | t = 6 | t = 7 |
| Pretax Profit | -4,000 | -4,514 | 748 | 9,807 | 16,940 | 11,579 | 5,539 | 1,949 |
| Full usage of tax losses immediately | | |  |  |  |  |  |  |
| (Table 7.6) | -1,400 | -1,580 | 262 | 3,432 | 5,929 | 4,053 | 1,939 | 682 |
| NPV (at 20%) = $4,779 | |  |  |  |  |  |  |  |
| Tax loss carry-forward | 0 | 0 | 0 | 714 | 5,929 | 4,053 | 1,939 | 682 |
| NPV (at 20%) = $5,741 | |  |  |  |  |  |  |  |

24. In order to solve this problem, we calculate the equivalent annual cost for each of the two alternatives. (All cash flows are in thousands.)

*Alternative 1 – Sell the new machine*: If we sell the new machine, we receive the cash flow from the sale, pay taxes on the gain, and pay the costs associated with keeping the old machine. The present value of this alternative is:

**



The equivalent annual cost for the five-year period is computed as follows:

PV1 = EAC1 × [annuity factor, 5 time periods, 12%]

–93.80 = EAC1 × [3.605]

EAC1 = –26.02, or an equivalent annual cost of $26,020

*Alternative 2 – Sell the old machine*: If we sell the old machine, we receive the cash flow from the sale, pay taxes on the gain, and pay the costs associated with keeping the new machine. The present value of this alternative is:

**

**

**

The equivalent annual cost for the ten-year period is computed as follows:

PV2 = EAC2 × [annuity factor, 10 time periods, 12%]

–127.51 = EAC2 × [5.650]

EAC2 = –22.57, or an equivalent annual cost of $22,570

Thus, the least expensive alternative is to sell the old machine because this alternative has the lowest equivalent annual cost.

One key assumption underlying this result is that, whenever the machines have to be replaced, the replacement will be a machine that is as efficient to operate as the new machine being replaced.

25. Assuming that the light bulb purchases occur at year 0 (for use during the following year or years), the cost structure and PV of each option is

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | YEAR | | | | | | | | | |  |
|  | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | PV @ 5% |
| Low Energy | 3.50 | 1.60 | 1.60 | 1.60 | 1.60 | 1.60 | 1.60 | 1.60 | 1.60 | 1.60 | 14.87 |
| Conventional | 0.50 | 6.60 |  |  |  |  |  |  |  |  | 6.79 |

The equivalent annual cost for the low energy bulb is computed as follows:

PVLE = EACLE × [annuity factor, 9 time periods, 5%]

14.87 = EACLE × [7.108]

EACLE = $2.09, which is much cheaper than the $6.79 cost of using a conventional light bulb for the year.

26. The current copiers have net cost cash flows as follows:

|  |  |  |  |
| --- | --- | --- | --- |
| Year | Before-Tax  Cash Flow | After-Tax Cash Flow | Net Cash Flow |
| 1 | -2,000 | (-2,000 × .65) + (.35 × .0893 × 20,000) | -674.9 |
| 2 | -2,000 | (-2,000 × .65) + (.35 × .0892 × 20,000) | -675.6 |
| 3 | -8,000 | (-8,000 × .65) + (.35 × .0893 × 20,000) | -4,574.9 |
| 4 | -8,000 | (-8,000 × .65) + (.35 × .0445 × 20,000) | -4,888.5 |
| 5 | -8,000 | (-8,000 × .65) | -5,200.0 |
| 6 | -8,000 | (-8,000 × .65) | -5,200.0 |

These cash flows have a present value, discounted at 7%, of –$15,857. Using the annuity factor for 6 time periods at 7% (4.767), we find an equivalent annual cost of $3,326. Therefore, the copiers should be replaced only when the equivalent annual cost of the replacements is less than $3,326.

When purchased, the new copiers will have net cost cash flows as follows:

|  |  |  |  |
| --- | --- | --- | --- |
| Year | Before-Tax  Cash Flow | After-Tax Cash Flow | Net Cash Flow |
| 0 | -25,000 | -25,000 | -25,000.0 |
| 1 | -1,000 | (-1,000 × .65) + (.35 × .1429 × 25,000) | 600.4 |
| 2 | -1,000 | (-1,000 × .65) + (.35 × .2449 × 25,000) | 1,492.9 |
| 3 | -1,000 | (-1,000 × .65) + (.35 × .1749 × 25,000) | 880.4 |
| 4 | -1,000 | (-1,000 × .65) + (.35 × .1249 × 25,000) | 442.9 |
| 5 | -1,000 | (-1,000 × .65) + (.35 × .0893 × 25,000) | 131.4 |
| 6 | -1,000 | (-1,000 × .65) + (.35 × .0892 × 25,000) | 130.5 |
| 7 | -1,000 | (-1,000 × .65) + (.35 × .0893 × 25,000) | 131.4 |
| 8 | -1,000 | (-1,000 × .65) + (.35 × .0445 × 25,000) | -260.6 |

These cash flows have a present value, discounted at 7%, of –$21,967. The decision to replace must also take into account the resale value of the machine, as well as the associated tax on the resulting gain (or loss).

Consider three cases:

1. The book (depreciated) value of the existing copiers is now $6,248. If the existing copiers are replaced now, then the present value of the cash flows is:

–21,967 + 8,000 – [0.35 × (8,000 – 6,248)] = –$14,580

Using the annuity factor for 8 time periods at 7% (5.971), we find that the equivalent annual cost is $2,442.

1. Two years from now, the book (depreciated) value of the existing copiers will be $2,678. If the existing copiers are replaced two years from now, then the present value of the cash flows is:

(–674.9/1.071) + (–675.6/1.072) + (–21,967/1.072) +

{3,500 – [0.35 × (3,500 – 2,678)]}/1.072 = –$17,602

Using the annuity factor for 10 time periods at 7% (7.024), we find that the equivalent annual cost is $2,506.

1. Six years from now, both the book value and the resale value of the existing copiers will be zero. If the existing copiers are replaced six years from now, then the present value of the cash flows is:

–15,857+ (–21,967/1.076) = –$30,495

Using the annuity factor for 14 time periods at 7% (8.745), we find that the equivalent annual cost is $3,487.

The copiers should be replaced immediately.

27. a.

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Year 1 | Year 2 | Year 3 | Year 4 | | Year 5 | Year 6 | Year 7 | Year 8 | Year 9 | Year 10 | Year 11 |
| MACRS  Percent | 10.00% | 18.00% | 14.40% | 11.52% | | 9.22% | 7.37% | 6.55% | 6.55% | 6.56% | 6.55% | 3.29% |
| MACRS Depr. | 40.00 | 72.00 | 57.60 | 46.08 | | 36.88 | 29.48 | 26.20 | 26.20 | 26.24 | 26.20 | 13.16 |
| Tax Shield | 15.60 | 28.08 | 22.46 | 17.97 | | 14.38 | 11.50 | 10.22 | 10.22 | 10.23 | 10.22 | 5.13 |
| Present Value (at 7%) = $114.57 million | | | | |  | | | | | | | |

The equivalent annual cost of the depreciation tax shield is computed by dividing the present value of the tax shield by the annuity factor for 25 years at 7%:

Equivalent annual cost = $114.57 million/11.654 = $9.83 million

The equivalent annual cost of the capital investment is:

$34.3 million – $9.83 million = $24.47 million

1. The extra cost per gallon (after tax) is:

$24.47 million/900 million gallons = $0.0272 per gallon

The pre-tax charge = $0.0272/0.65 = $0.0418 per gallon

28. a. 

PVA = $66,730 (Note that this is a cost.)



PVB = $77,721 (Note that this is a cost.)

Equivalent annual cost (EAC) is found by:

|  |  |
| --- | --- |
| PVA = | EACA × [annuity factor, 6%, 3 time periods] |
|  |  |
| 66,730 = | EACA × 2.673 |
|  |  |
| EACA = | $24,964 per year rental |
|  |  |
| PVB = | EACB × [annuity factor, 6%, 4 time periods] |
|  |  |
| 77,721 = | EACB × 3.465 |
|  |  |
| EACB = | $22,430 per year rental |

b. Annual rental is $24,964 for Machine A and $22,430 for Machine B. Borstal should buy Machine B.

1. The payments would increase by 8% per year. For example, for Machine A, rent for the first year would be $24,964; rent for the second year would be ($24,964 × 1.08) = $26,961; etc.

29. Because the cost of a new machine now decreases by 10% per year, the rent on such a machine also decreases by 10% per year. Therefore:



PVA = $61,820 (Note that this is a cost.)



PVB = $71,614 (Note that this is a cost.)

Equivalent annual cost (EAC) is found as follows:

|  |  |
| --- | --- |
| PVA = | EACA × [annuity factor, 6%, 3 time periods] |
|  |  |
| 61,820 = | EACA × 2.673 |
|  |  |
| EACA = | $23,128, a reduction of 7.35% |
|  |  |
| PVB = | EACB × [annuity factor, 6%, 4 time periods] |
|  |  |
| 71,614 = | EACB × 3.465 |
|  |  |
| EACB = | $20,668, a reduction of 7.86% |

30. With a 6-year life, the equivalent annual cost (at 8%) of a new jet is:

$1,100,000/4.623 = $237,941

If the jet is replaced at the end of year 3 rather than year 4, the company will incur an incremental cost of $237,941 in year 4. The present value of this cost is:

$237,941/1.084 = $174,894



The present value of the savings is:

The president should allow wider use of the present jet because the present value of the savings is greater than the present value of the cost.

31. a.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Year 0 | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 | Year 6 | Year 7 |
| Pre-Tax Flows | -14,000 | -3,064 | 3,209 | 9,755 | 16,463 | 14,038 | 7,696 | 3,951 |
| IRR = 33.5% |  |  |  |  |  |  |  |  |
| Post-Tax Flows | -12,600 | -1,630 | 2,381 | 6,205 | 10,685 | 10,136 | 6,110 | 3,444 |
| IRR = 26.8% |  |  |  |  |  |  |  |  |
| Effective Tax Rate = 20.0% | | | | | | | | |

b. If the depreciation rate is accelerated, this has no effect on the pretax IRR, but it increases the after-tax IRR. Therefore, the numerator decreases and the effective tax rate decreases.

If the inflation rate increases, we would expect pretax cash flows to increase at the inflation rate, while after-tax cash flows increase at a slower rate. After-tax cash flows increase at a slower rate than the inflation rate because depreciation expense does not increase with inflation. Therefore, the numerator of TE becomes proportionately larger than the denominator and the effective tax rate increases.

c. 

Hence, if the up-front investment is deductible for tax purposes, then the effective tax rate is equal to the statutory tax rate.

32. a. With a real rate of 6% and an inflation rate of 5%, the nominal rate, r, is determined as follows:

|  |  |
| --- | --- |
| (1 + r) = | (1 + 0.06) × (1 + 0.05) |
|  |  |
| r = | 0.113 = 11.3% |
|  |  |

For a three-year annuity at 11.3%, the annuity factor is: 2.4310

For a two-year annuity, the annuity factor is: 1.7057

For a three-year annuity with a present value of $28.37, the nominal annuity is: ($28.37/2.4310) = $11.67

For a two-year annuity with a present value of $21.00, the nominal annuity is: ($21.00/1.7057) = $12.31

These nominal annuities are not realistic estimates of equivalent annual costs because the appropriate rental cost (i.e., the equivalent annual cost) must take into account the effects of inflation.

b. With a real rate of 6% and an inflation rate of 25%, the nominal rate, r, is determined as follows:

|  |  |
| --- | --- |
| (1 + r) = | (1 + 0.06) × (1 + 0.25) |
|  |  |
| r = | 0.325 = 32.5% |
|  |  |

For a three-year annuity at 32.5%, the annuity factor is: 1.7542

For a two-year annuity, the annuity factor is: 1.3243

For a three-year annuity with a present value of $28.37, the nominal annuity is: ($28.37/1.7542) = $16.17

For a two-year annuity with a present value of $21.00, the nominal annuity is: ($21.00/1.3243) = $15.86

With an inflation rate of 5%, Machine A has the lower nominal annual cost ($11.67 compared to $12.31). With inflation at 25%, Machine B has the lower nominal annual cost ($15.86 compared to $16.17). Thus it is clear that inflation has a significant impact on the calculation of equivalent annual cost, and hence, the warning in the text to do these calculations in real terms. The rankings change because, at the higher inflation rate, the machine with the longer life (here, Machine A) is affected more.

33. a. The spreadsheet on the next two pages indicates that the NPV for the Mid-American wind farm investment is: -$87,271,675

By eliminating the tax in the spreadsheet, we find that the NPV is still negative: -$7,692,376

NPV becomes positive with a tax subsidy of approximately 3.5%.

b. Using the same spreadsheet, we can show that a capacity factor of 30% reduces NPV to: -$138,249,182

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **ESTIMATED NPV OF MIDAMERICAN ENERGY'S WINDFARM PROJECT IN THE ABSENCE OF ANY TAX BREAKS** | | | | | | | | |
| **PROJECT DATA** | |  |  |  |  |  |  |  |
| Capacity (megawatts) | | 360.5 |  |  |  |  |  |  |
| Load factor | | 35% |  |  |  |  |  |  |
| Year 1 electricity price $/mWh | | 55.00 |  |  |  |  |  |  |
| Year 1 maintenance & other costs ($) | | 18,900,000 |  |  |  |  |  |  |
| Inflation | | 3.00% |  |  |  |  |  |  |
| Total capital cost ($) | | 386,000,000 |  |  |  |  |  |  |
| MACRS years | | 20 |  |  |  |  |  |  |
| Cost of capital | | 12.0% |  |  |  |  |  |  |
|  | |  |  |  |  |  |  |  |
| **Year** | **0** | | **1** | **2** | **3** | **4** | **5** | **6** |
| Capital cost | **386,000,000** | |  |  |  |  |  |  |
| Revenues |  | | 60,791,115 | 62,614,848 | 64,493,294 | 66,428,093 | 68,420,936 | 70,473,564 |
| Maintenance & other costs |  | | 18,900,000 | 19,467,000 | 20,051,010 | 20,652,540 | 21,272,117 | 21,910,280 |
| MACRS depreciation |  | | 14,475,000 | 27,869,200 | 25,784,800 | 23,854,800 | 22,040,600 | 20,380,800 |
| Pretax profit |  | | 27,416,115 | 15,278,648 | 18,657,484 | 21,920,752 | 25,108,219 | 28,182,484 |
| Tax |  | | 9,595,640 | 5,347,527 | 6,530,119 | 7,672,263 | 8,787,877 | 9,863,869 |
| Cash flow | -386,000,000 | | 32,295,475 | 37,800,321 | 37,912,165 | 38,103,289 | 38,360,942 | 38,699,414 |
| PV | -386,000,000 | | 28,835,245 | 30,134,185 | 26,985,130 | 24,215,329 | 21,767,029 | 19,606,328 |
| NPV | **-87,271,675** | |  |  |  |  |  |  |
| MACRS depreciation (%) |  | | 3.75 | 7.22 | 6.68 | 6.18 | 5.71 | 5.28 |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |  |  |
| Year | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** |
| Capital cost |  |  |  |  |  |  |  |  |
| Revenues | 72,587,770 | 74,765,404 | 77,008,366 | 79,318,617 | 81,698,175 | 84,149,120 | 86,673,594 | 89,273,802 |
| Maintenance & other costs | 22,567,588 | 23,244,616 | 23,941,955 | 24,660,213 | 25,400,020 | 26,162,020 | 26,946,881 | 27,755,287 |
| MACRS depreciation | 18,875,400 | 17,447,200 | 17,215,600 | 17,215,600 | 17,215,600 | 17,215,600 | 17,215,600 | 17,215,600 |
| Pretax profit | 31,144,782 | 34,073,588 | 35,850,811 | 37,442,803 | 39,082,556 | 40,771,500 | 42,511,113 | 44,302,915 |
| Tax | 10,900,674 | 11,925,756 | 12,547,784 | 13,104,981 | 13,678,894 | 14,270,025 | 14,878,890 | 15,506,020 |
| Cash flow | 39,119,508 | 39,595,032 | 40,518,627 | 41,553,422 | 42,619,261 | 43,717,075 | 44,847,824 | 46,012,495 |
| PV | 17,695,679 | 15,991,769 | 14,611,423 | 13,379,090 | 12,252,019 | 11,221,084 | 10,277,964 | 9,415,068 |
| NPV |  |  |  |  |  |  |  |  |
| MACRS depreciation (%) | 4.89 | 4.52 | 4.46 | 4.46 | 4.46 | 4.46 | 4.46 | 4.46 |
|  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| Year | **15** | **16** | **17** | **18** | **19** | **20** | **21** |  |
| Capital cost |  |  |  |  |  |  |  |  |
| Revenues | 91,952,016 | 94,710,576 | 97,551,894 | 100,478,450 | 103,492,804 | 106,597,588 | 0 |  |
| Maintenance & other costs | 28,587,946 | 29,445,584 | 30,328,952 | 31,238,820 | 32,175,985 | 33,141,264 | 0 |  |
| MACRS depreciation | 17,215,600 | 17,215,600 | 17,215,600 | 17,215,600 | 17,215,600 | 17,215,600 | 8,607,800 |  |
| Pretax profit | 46,148,470 | 48,049,392 | 50,007,342 | 52,024,030 | 54,101,219 | 56,240,724 | -8,607,800 |  |
| Tax | 16,151,965 | 16,817,287 | 17,502,570 | 18,208,411 | 18,935,427 | 19,684,253 | -3,012,730 |  |
| Cash flow | 47,212,106 | 48,447,705 | 49,720,372 | 51,031,220 | 52,381,392 | 53,772,070 | 3,012,730 |  |
| PV | 8,625,475 | 7,902,870 | 7,241,491 | 6,636,079 | 6,081,835 | 5,574,377 | 278,857 |  |
| NPV |  |  |  |  |  |  |  |  |
| MACRS depreciation (%) | 4.46 | 4.46 | 4.46 | 4.46 | 4.46 | 4.46 | 2.23 |  |