Capital Budgeting

Learning Problems

Answer Keys

Problem: Project Evaluation Methods at Topley

1. Payback period

 $\frac{220,000}{50,000}$ = 4.4 years

1. Discounted payback period

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Year** | **Cash Flow** | **Discount Factor** | **Present Value** | **Cumulative Present Value** |
| 0 | -220,000 | (1+.16)^0 | -220,000.00 | -220,000.00 |
| 1 | 50,000 | (1+.16)^1 | 43,103.45 | -176,896.55 |
| 2 | 50,000 | (1+.16)^2 | 37,158.15 | -139,738.40 |
| 3 | 50,000 | (1+.16)^3 | 32,032.88 | -107,705.52 |
| 4 | 50,000 | (1+.16)^4 | 27,614.55 | -80,090.97 |
| 5 | 50,000 | (1+.16)^5 | 23,805.65 | -56,285.32 |
| 6 | 50,000 | (1+.16)^6 | 20,522.11 | -35,763.21 |
| 7 | 50,000 | (1+.16)^7 | 17,691.48 | -18,071.73 |
| 8 | 50,000 | (1+.16)^8 | 15,251.27 | -2,820.46 |
| 9 | 50,000 | (1+.16)^9 | 13,147.65 | 10,327.19 |
| 10 | 50,000 | (1+.16)^10 | 11,334.18 | 21,661.37 |

Discounted payback period = 8 + $\frac{2,820.46}{13,147.65}$ = 8.21 years

1. NPV

50,000 ($\frac{1-(1+.16)^{-10}}{.16}$) = 241,661.37

241,661.37 – 220,000 = 21,661.37

NPV is what remains after compensating investors for the RRR of 16%. This is the excess profit of the project in dollar terms and is equivalent to 2.60% in Part 4.

1. IRR

 220,000 = 50,000 ($\frac{1-(1+i)^{-10}}{i}$)

 i = .1860 or 18.60%

The RRR of the project is 16.00%, so the project is earning 2.60% more than required. This is the excess profit of the project in percentage terms.

Note: The IRR function in Excel can be used to solve for i.

1. Modified IRR

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Year | Cash Flow | FV Factor | FV (16%) | FV (18.6%) |
| 1 | 50,000 | (1+i)9 | 190,148.07 | 232,130.50 |
| 2 | 50,000 | (1+i)8 | 163,920.75 | 195,725.55 |
| 3 | 50,000 | (1+i)7 | 141,310.99 | 165,029.97 |
| 4 | 50,000 | (1+i)6 | 121,819.82 | 139,148.38 |
| 5 | 50,000 | (1+i)5 | 105,017.09 | 117,325.78 |
| 6 | 50,000 | (1+i)4 | 90,531.97 | 98,925.62 |
| 7 | 50,000 | (1+i)3 | 78,044.80 | 83,411.15 |
| 8 | 50,000 | (1+i)2 | 67,280.00 | 70,329.80 |
| 9 | 50,000 | (1+i)1 | 58,000.00 | 59,300.00 |
| 10 | 50,000 | (1+i)0 |   50,000.00 |   50,000.00 |
|  |  |  | 1 1,066,073.50 | 2  1,211,326.80 |



 MIRR is 17.09%

1. PI

$ \frac{241,661.37}{220,000}$ = 1.10

**Problem: Project Evaluation Methods at Cott Beverages**

1. Payback period

|  |  |
| --- | --- |
| **Year** | **Cumulative** **Cash Flows** |
| 1 | 10,000 |
| 2 | 18,000 |
| 3 | 24,000 |
| 4 | 29,000 |
| 5 | 33,000 |
| 6 | 36,000 |
| 7 | 39,000 |

3 + ($\frac{28,000-24,000}{\begin{array}{c}29,000-24,000\\\end{array}}$) (1) = 3.8 years

1. Discounted payback period

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Year** | **Cash Flow** | **Discount Factor** | **Present Value** | **Cumulative Present Value** |
| 0 | (28,000) | (1+.16)^0 | -28,000.00 | -28,000.00 |
| 1 | 10,000 | (1+.16)^1 | 8,620.69 | -19,379.31 |
| 2 | 8,000 | (1+.16)^2 | 5,945.30 | -13,434.01 |
| 3 | 6,000 | (1+.16)^3 | 3,843.95 | -9,590.06 |
| 4 | 5,000 | (1+.16)^4 | 2,761.46 | -6,828.60 |
| 5 | 4,000 | (1+.16)^5 | 1,904.45 | -4,924.15 |
| 6 | 3,000 | (1+.16)^6 | 1,231.33 | -3,692.82 |
| 7 | 3,000 | (1+.16)^7 | 1,061.49 | -2,631.33 |

 The project does not break even on a present value basis.

1. NPV

|  |  |  |  |
| --- | --- | --- | --- |
| **Year** | **Cash Flow** | **Discount Factor** | **Present Value** |
| 1 | 10,000 | (1+.16)^1 | 8,620.69 |
| 2 | 8,000 | (1+.16)^2 | 5,945.30 |
| 3 | 6,000 | (1+.16)^3 | 3,843.95 |
| 4 | 5,000 | (1+.16)^4 | 2,761.46 |
| 5 | 4,000 | (1+.16)^5 | 1,904.45 |
| 6 | 3,000 | (1+.16)^6 | 1,231.33 |
| 7 | 3,000 | (1+.16)^7 | 1,061.49 |
| Total | 25,368.67 |

25,368.67 – 28,000.00 = <2,631.33>

The project is not earning its RRR of 16% as the NPV is negative.

1. IRR

28,000 = ($\frac{10,000}{(1+i)^{1}}$) + ($\frac{8,000}{(1+i)^{2}}$) + ($\frac{6,000}{(1+i)^{3}}$) + ($\frac{5,000}{(1+i)^{4}}$) + ($\frac{4,000}{(1+i)^{5}}$) + ($\frac{3,000}{(1+i)^{6}}$) + ($\frac{3,000}{(1+i)^{7}}$)

 i = .1186 or 11.86%

 The project is not earning the RRR of 16%.

 Note: IRR function in Excel can be used to solve for i.

1. PI

$\frac{25,368.67}{28,000.00}$ = .91

**Problem: Standalone Decision at Rogers**

1. No

|  |  |
| --- | --- |
| Initial investment  | -120,000.00 |
| Tax Shield (120,000) (.45) ($\frac{.25}{.25+.12}$) ($\frac{2+.12}{2(1+.12)}$) | 34,531.85 |
| Increase in working capital | -5,000.00 |
| 1Annual savings | 71,332.15 |
| Salvage value (10,000) / (1+.12)4 | 6,355.18 |
| Lost tax shield (100,000) (.45) ($\frac{.25}{.25+.12}$) ($\frac{2+.12}{2(1+.12)}$) / (1+.12)4 | -1,828.80 |
| Decrease in working capital (5,000) / (1+.12)4 | 3,177.59 |
| NPV | -11,432.03 |

190,000 – 22,000 – 6,000 – 3,300 – 7,000 – 9,000 = 42,700

(42,700) (1 - .45) ($\frac{1-(1+.12)^{-4}}{.12}$) = 71,332.15

1. Yes

(200) (90,000/450) – (22,000) – (200) (6,000/450) – (200) (7,000/450) – (200) (9,000/450) = 8,222.22

(8,222.22) (1 - .45) ($\frac{1-(1+.12)^{-4}}{.12}$) = 13,735.57

-11,432.03 + 13,735.57 = 2,303.54

**Problem: Replacement Decision at Ruby**

1. Yes

|  |  |
| --- | --- |
| Net investment (500,000 – 50,000) | -450,000.00 |
| Tax shield (450,000) (.35) ($\frac{.2}{.2+.10}$)($\frac{2+.10}{2(1+.10)}$) | 100,277.27 |
| Increase in net working capital | -10,000.00 |
| Annual saving(200,000) (2) (1-.35) ($\frac{1-(1+.10)^{-8}}{.10}$) + (20,000) (4 + 2) (1-.35)) ($\frac{1-(1+.10)^{-8}}{.10}$) | 1,803,205.05 |
| Salvage value (80,000-10,000) / (1+.10)8 | 32,655.52 |
| Lost tax shield (80,000-10,000) (.35) ($\frac{.2}{.2+.10}$)($\frac{2+.10}{2(1+.10)}$) / (1+.10)8 | -7,273.27 |
| Decrease in net working capital (10,000) / (1+.10)8 | 4,655.07 |
| NPV | 1,473,469.64 |

**Problem: Replacement Decision at Zebra**

1. Yes

|  |  |
| --- | --- |
| Net investment (141,000 – 10,000) | -131,000.00 |
| Tax shield (131,000) (.31) ($\frac{.2}{.2+.115}$) ($\frac{2+.115}{2(1+.115)}$) | 24,454.45 |
| Decrease in net working capital | 30,000.00 |
| 1Annual savings (191,250) (1-.31) ($\frac{1-(1+.115)^{-6}}{.115}$) | 550,322.43 |
| Salvage value (18,000) / (1 + .115)6 | 9,367.49 |
| Lost tax shield (18,000) (.31) ($\frac{.2}{.2+.115}$) ($\frac{2+.115}{2(1+.115)}$) / (1+.115)6 | -1,748.68 |
| Increase in net working capital (30,000) / (1+.115)6 | 15,612.49 |
| NPV | 465,783.20 |

1

|  |  |
| --- | --- |
| Additional units (12.00-5.75) (15,000) | 93,750 |
| Savings – VC (7.50-5.75) (50,000) | 87,500 |
| Savings – FC | 10,000 |
| Total | 191,250 |

**Problem: Standalone Decision with Inflation at Weatherly**

1. Nominal approach

|  |  |
| --- | --- |
| Investment | -3,500,000 |
| Tax shield (3,500,000) (.21) ($\frac{.3}{.3+.09}$)($\frac{2+.09}{2(1+.09)}$) | 542,043 |
| 1Annual savings | 2,776,826 |
| Salvage value (450,000) (1 + .02)5 / (1 + .09)5 | 322,910 |
| Lost tax shield (496,836) (.21) ($\frac{.3}{.3+.09}$)($\frac{2+.09}{2(1+.09)}$) / (1 + .09)5 | -50,009 |
| NPV | 91,770 |

1 (6,000) (16) (17.21 – 5.24) – (2) (115,000) – 65,000 = 854,120

(854,120) (1 - .21) = 674,755

Year 1 (674,755) (1 + .02)1 / (1 + .09)1 = 631,422

Year 2 (674,755) (1 + .02)2 / (1 + .09)2 = 590,872

Year 3 (674,755) (1 + .02)3 / (1 + .09)3 = 552,926

Year 4 (674,755) (1 + .02)4 / (1 + .09)4 = 517,417

Year 5 (674,755) (1 + .02)5 / (1 + .09)5 = 484,189

Total PV = 2,776,826

1. Real approach

(1 + .09) = (1 + .02) (1 + Real rate) - 1

Real rate = .0686

|  |  |
| --- | --- |
| Investment | -3,500,000 |
| Tax shield (3,500,000) (.21) ($\frac{.3}{.3+.0686}$)($\frac{2+.0686}{2(1+.0686)}$) | 579,008 |
| 1Annual savings | 2,777,030 |
| Salvage value (450,000) / (1 + .0686)5 | 322,951 |
| Lost tax shield (450,000) (.21) ($\frac{.3}{.3+.0686}$)($\frac{2+.0686}{2(1+.0686)}$) / (1 + .0686)5 | -64,175 |
| NPV | 114,814 |

1 (6,000) (16) (17.21 – 5.24) – (2) (115,000) – 65,000 = 854,120

(854,120) (1 - .21) = 674,755

Year 1 (674,755) / (1 + .0686)1 = 631,438

Year 2 (674,755) / (1 + .0686)2 = 590,902

Year 3 (674,755) / (1 + .0686)3 = 552,969

Year 4 (674,755) / (1 + .0686)4 = 517,470

Year 5 (674,755) / (1 + .0686)5 = 484,251

 Total PV = 2,777,030

**Why are the NPVs for the nominal and real approach not equal?** It is due to more than simply rounding errors. Under the nominal approach, it is assumed that future cash flows will increase by 2.0% each year and that the nominal discount rate of 9.0% has an allowance for this inflation plus the real rate. Under the real approach, the increase in future cash flows due to inflation is ignored and inflation is left out of the discount rate as well and all discounting is done at the real rate of 6.86% - inflation essentially cancels out in the numerator and denominator.

When the CAD 3,000,000 is put in a CCA pool, the government does not allow these amounts to be increased each year to compensate for inflation. The government has considered indexing the contents of CCA pools but has decided against it because of the magnitude of lost tax revenues. As a result, the RRR used in the present value of the CCA tax shield calculation must be 9.0% and not 6.86% since the value of the pool does not rise by the inflation rate each year. There is no inflation in the numerator to cancel out with the denominator.

The correct calculation of the NPV under the real approach is:

|  |  |
| --- | --- |
| Investment | -3,500,000 |
| Tax shield (3,500,000) (.21) ($\frac{.3}{.3+.09}$)($\frac{2+.09}{2(1+.09)}$) | 542,043 |
| 1Annual savings | 2,777,030 |
| Salvage value (450,000) / (1 + .0686)5  | 322,951 |
| Lost tax shield (450,000) (.21) ($\frac{.3}{.3+.09}$)($\frac{2+.09}{2(1+.09)}$) / (1 + .0686)5 | -50,015 |
| NPV | 92,009 |

1 (6,000) (16) (17.21 – 5.24) – (2) (115,000) – 65,000 = 854,120

(854,120) (1 - .21) = 674,755

Year 1 (674,755) / (1 + .0686)1 = 631,438

Year 2 (674,755) / (1 + .0686)2 = 590,902

Year 3 (674,755) / (1 + .0686)3 = 552,969

Year 4 (674,755) / (1 + .0686)4 = 517,470

Year 5 (674,755) / (1 + .0686)5 = 484,251

Total PV = 2,776,826

1. The general inflation estimate of 2.0% is reasonable for operating costs, but not for metal prices. The price of most metals is unstable. A more thorough analysis of the metal price over the next five years is needed before a decision can be made. Even with this, the price of most metals is difficult to forecast meaning project risk is high.

**Problem: Standalone Decision with Inflation at Quaker**

1. No

.05 + .03 = .08

(1 + .08) = (1 + .0250) (1 + X)

X = .0537

|  |  |  |
| --- | --- | --- |
| Net investment | (2,500,000) (.95) | -2,375,000 |
| Tax Shield | (2,375,000) (.3) ($\frac{.20}{.20+.08}$)($\frac{2+.08}{2(1+.08)}$) | 490,079.31 |
| Change in NWC | (2,900,000) (.3) | -870,000 |
| 1Annual Savings |  | 2,241,556.23 |
| Change in NWC | ((3,500,000) (.3) – (2,900,000) (.3)) / (1 + .0537)6 | 131,513.59 |
| Overhaul | (850,000) (.95) / (1 + .0537)6 | -589,984.57 |
| **Tax Shield**  | (850,000) (.95) (.3) ($\frac{.20}{.20+.08}$) ($\frac{2+.08}{2(1+.08)}$) / (1 + .0537)6 | 121,742.85 |
| Salvage value  | 350,000 / (1 + .0537)12 | 186,837.60 |
| **Lost Tax Shield** | (350,000) (.3) ($\frac{.20}{.20+.08}$) ($\frac{2+.08}{2(1+.08)}$) / (1 + .0537)12 | -38,553.79 |
| Change in NWC | (3,500,000) (.3) / (1 + .0537)12 | 560,512.80 |
|  | NPV | -141,295.98 |

**1Years 1–6**

(2,900,000 - 1,900,000 - 800,000) = 200,000

(200,000) (1 - .3) ($\frac{1-(1+.0537)^{-6}}{.0537}$) = 702,265.44

**Years 7–12**

(3,500,000 - 2,100,000 - 800,000) = 600,000

(600,000) (1 - .3) ($\frac{1-(1+.0537)^{-6}}{.0537}$) / (1 + .0537)6 = 1,539,290.79