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**MECH 5760 Chapter 5 Assignment #3**

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**Problem 5.1.**

Current age: 26 years

* At age 31: m = 31-26 = 5
* At age 55: m = 51-26 = 29
* At age 66: m = 66-26 = 40

Baseline Option (No Masters)

PV = 60000(P/A, 5%, m = 5, 29, 40)

* For m = 5 🡪 PV = 60000(P/A, 5%, m = 5) = 60000(4.33) 🡪 **PV = $259,800**
* For m = 29 🡪 PV = 60000(P/A, 5%, m = 29) = 60000(15.1411) 🡪 **PV = $908,466**
* For m = 40 🡪 PV = 60000(P/A, 5%, m = 40) = 60000(17.1591) 🡪 **PV = $1,029,546**

Option 1(Pay tuition, graduate in one year)

PV = -40000 + 70000(P/A, 5%, m = 5, 29, 40) – 70000(P/A, 5%, 1)

* For m = 5 🡪   
  PV = -40000 + 70000(P/A, 5%, m = 5) – 70000(P/A, 5%, 1)

PV **=** -40000 + 70000(4.33) – 70000(0.950) 🡪 **PV = $196,600**

* For m = 29 🡪   
  PV = -40000 + 70000(P/A, 5%, m = 29) – 70000(P/A, 5%, 1)

PV **=** -40000 + 70000(15.1411) – 70000(0.950) 🡪 **PV = $953,209**

* For m = 40 🡪   
  PV = -40000 + 70000(P/A, 5%, m = 40) – 70000(P/A, 5%, 1)

PV **=** -40000 + 70000(17.1591) – 70000(0.950) 🡪 **PV = $1,094,469**

Option 2 (Become a TA, no tuition, graduate in two years)

PV = 70000(P/A, 5%, m = 5, 29, 40) – 70000(P/A, 5%, 2)

* For m = 5 🡪   
  PV = 70000(P/A, 5%, m = 5) – 70000(P/A, 5%, 2)

PV **=** 70000(4.33) – 70000(1.860) 🡪 **PV = $172,900**

* For m = 29 🡪   
  PV = PV = 70000(P/A, 5%, m = 29) – 70000(P/A, 5%, 2)

PV **=** 70000(15.1411) – 70000(1.860) 🡪 **PV = $929,719**

* For m = 40 🡪   
  PV = PV = 70000(P/A, 5%, m = 40) – 70000(P/A, 5%, 2)

PV **=** 70000(17.1591) – 70000(1.860) 🡪 **PV = $1,070,979**

Option 3 (Take a loan, graduate in one year, pay loan in ten years, tuition is not in the PV equation goes directly from Bank to University)

PV = 70000(P/A, 5%, m = 5, 29, 40) – 70000(P/F, 5%, 1) - 5000(P/A, 5%, m = 11) + 5000(P/A, 5%, m = 1)

* For m = 5 🡪 PV = 70000(P/A, 5%, m = 5) – 70000(P/F, 5%, 1) - 5000(P/A, 5%, m = 11) + 5000(P/A, 5%, m = 1)

PV **=** 70000(4.33) – 70000(0.9525) – 5000(8.310) + 5000(0.950) 🡪 **PV = $199,625**

* For m = 29 🡪 PV = 70000(P/A, 5%, m = 29) – 70000(P/F, 5%, 1) - 5000(P/A, 5%, m = 11) + 5000(P/A, 5%, m = 1)

PV **=** 70000(15.1411) – 70000(0.9525) – 5000(8.310) + 5000(0.950) 🡪 **PV = $956,402**

* For m = 40 🡪 PV = 70000(P/A, 5%, m = 40) – 70000(P/F, 5%, 1) - 5000(P/A, 5%, m = 11) + 5000(P/A, 5%, m = 1)

PV **=** 70000(17.1591) – 70000(0.9525) – 5000(8.310) + 5000(0.950) 🡪 **PV = $1,097,662**

The results have been summarized in the table below:

|  |  |  |  |
| --- | --- | --- | --- |
|  | m = 5 years | m = 29 years | m = 40 years |
| Baseline | **$259,800** | **$908,466** | **$1,029,546** |
| Option 1 | **$196,600** | **$953,209** | **$1,094,469** |
| Option 2 | **$172,900** | **$929,719** | **$1,070,979** |
| Option 3 | **$199,625** | **$956,402** | **$1,097,662** |

Analysis:

It is apparent from the above matrix that the student would benefit from baseline option, that is, applying for a job immediately after getting B.S. degree and skipping masters for short term (after 5 years). However, Option 3 where the student borrows money and graduates within one year is more fruitful in both the scenarios where the student wants to retire at 55 years and 66 years.

**Problem 5.2.**

Assumption:

Tax Rate = 33% and Straight-Line Depreciation for the Machine.

2-Cavity Mold

Machine Life =

200,000 parts lifetime = 5 years, profit = $10,000/year

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Year End | Before Tax Cash Flow | Depreciation | Taxable Income | Taxes | After Tax Cash Flow |
| A | B | C | D = B + C | E = -0.33\*D | F = B + E |
| 0 | -45000 |  |  |  |  |
| 1 | 10000 | -9000 | 1000 | -333 | 9667 |
| 2 | 10000 | -9000 | 1000 | -333 | 9667 |
| 3 | 10000 | -9000 | 1000 | -333 | 9667 |
| 4 | 10000 | -9000 | 1000 | -333 | 9667 |
| 5 | 10000 | -9000 | 1000 | -333 | 9667 |

PV= -45000 + 9667(P/A, i%, m = 5)

Initial guess that i% is between 2% - 3%

Use i = 2% 🡪 PV = -45000 + 9667(P/A, 2%, m = 5)

PV = -45000 + 9667(4.71) **🡪** PV = $531.57

Use i = 3% 🡪 PV = -45000 + 9667(P/A, 3%, m = 5)

PV = -45000 + 9667(4.58) 🡪 PV = $-725.14

Since the PV goes from negative (-) to positive (+), the ROI is between 2 and 3%.

Using a prorated average,

531.57 / (531.57 + 725.14) **=** 0.4229 🡪 2 + 0.4229 🡪 **ROI = 2.42% (closer to 2% = $531.57 than 3% $725.14)**

Payback Period **=** 45000 / 10000 🡪 **Payback Period = 4.5 years**

4-Cavity Mold

Machine Life =

400,000 parts lifetime = 10 years, profit = $10,000/year

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Year End | Before Tax Cash Flow | Depreciation | Taxable Income | Taxes | After Tax Cash Flow |
| A | B | C | D = B + C | E = -0.33\*D | F = B + E |
| 0 | -80000 |  |  |  |  |
| 1 | 10000 | -8000 | 2000 | -660 | 9340 |
| 2 | 10000 | -8000 | 2000 | -660 | 9340 |
| 3 | 10000 | -8000 | 2000 | -660 | 9340 |
| 4 | 10000 | -8000 | 2000 | -660 | 9340 |
| 5 | 10000 | -8000 | 2000 | -660 | 9340 |
| 6 | 10000 | -8000 | 2000 | -660 | 9340 |
| 7 | 10000 | -8000 | 2000 | -660 | 9340 |
| 8 | 10000 | -8000 | 2000 | -660 | 9340 |
| 9 | 10000 | -8000 | 2000 | -660 | 9340 |
| 10 | 10000 | -8000 | 2000 | -660 | 9340 |

PV= -80,000 + 9333(P/A, i%, m = 10)

Initial guess that i% is between 2% - 3%

Use i = 2% 🡪 PV = -80,000 + 9340(P/A, 2%, m = 10)

PV = -80,000 + 9340(8.9826) **🡪** PV = $3897.5

Use i = 3% 🡪 PV = -80,000 + 9340(P/A, 3%, m = 10)

PV = -80,000 + 9340(8.5302) 🡪 PV = $-327.94

Since the PV goes from negative (-) to positive (+), the ROI is between 2 and 3%.

Using a prorated average,

3897.5/ (3897.5 + 327.94) **=** 0.922 🡪 2 + 0.922 🡪 **ROI = 2.92% (closer to 3% = $387.64** **than 2% $3834.61)**

Payback Period **=** 80000 / 10000 🡪 **Payback Period = 8 years**

Conclusion:

Clearly, the ROI is greater for four-cavity molding machine (2.91%) than two-cavity molding machine (2.42%). Therefore, the second option can be preferred over first option of two-cavity molding machine.

**Problem 5.3.**

a. Fully automatic machine, 33% taxes, salvage value = 10%, 5-year life

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Year End | Before Tax Cash Flow | Depreciation | Taxable Income | Taxes | After Tax Cash Flow |
| A | B | C | D = B + C | E = -0.33\*D | F = B + E |
| 0 | -800000 |  |  |  |  |
| 1 | 200000 | -144000 | 56000 | -18480 | 181520 |
| 2 | 200000 | -144000 | 56000 | -18480 | 181520 |
| 3 | 200000 | -144000 | 56000 | -18480 | 181520 |
| 4 | 200000 | -144000 | 56000 | -18480 | 181520 |
| 5 | 200000 | -144000 | 56000 | -18480 | 181520 |
| 5 | 80000 |  |  |  |  |

PV = -800000 + 181520(P/A, i%, 5) + 80000(P/F, i%, 5)

Use i = 7% 🡪 PV = -800000 + 181520(P/A, 7%, 5) + 80000(P/F, 7%, 5)

PV = -800000 + 181520(4.10) + 80000(0.7130) 🡪 PV = $1272

Use i = 8% 🡪 PV = -800000 + 181520(P/A, 8%, 5) + 80000(P/F, 8%, 5)

PV = -800000 + 181520(3.99) + 80000(0.6806) 🡪 PV = $-21,287.2

Since the PV goes from negative (-) to positive (+), the ROI is between 7 and 8%.

Using a prorated average, closer to 7% since PV = $1272 at 7%

1272 / (1272 + 21287.2) **=** 0.056🡪 7 + 0.056 🡪 **ROI = 7.056%**

b. Fully automatic machine, NO taxes, NO salvage value, 5-year life

PV = -800000 + 200000(P/A, i%, 5)

Use i = 6% 🡪 PV = -800000 + 200000(P/A, 6%, 5)

PV = -800000 + 200000(4.21) 🡪 PV = $42,000

Use i = 7% 🡪 PV = -800000 + 200000(P/A, 7%, 5)

PV = -800000 + 200000(4.10) 🡪 PV = $20,000

Use i = 8% 🡪 PV = -800000 + 200000(P/A, 8%, 5)

PV = -800000 + 200000(3.99) 🡪 PV = -$2,000

Since the PV goes from negative (-) to positive (+), the ROI is between 7 and 8%.

Using a prorated average, closer to 8% since PV = - $2,000 at 8%

20000 / (20000 + 2000) **=** 0.909 🡪 7 + 0.909 🡪 **ROI = 7.909%**

c. Semi-automatic machine, taxes = 33%, salvage value = 10%, 5-year life (similar to a)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Year End | Before Tax Cash Flow | Depreciation | Taxable Income | Taxes | After Tax Cash Flow |
| A | B | C | D = B + C | E = -0.33\*D | F = B + E |
| 0 | -500000 |  |  |  |  |
| 1 | 120000 | -90000 | 30000 | -9900 | 110100 |
| 2 | 120000 | -90000 | 30000 | -9900 | 110100 |
| 3 | 120000 | -90000 | 30000 | -9900 | 110100 |
| 4 | 120000 | -90000 | 30000 | -9900 | 110100 |
| 5 | 120000 | -90000 | 30000 | -9900 | 110100 |
| 5 | 50000 |  |  |  |  |

PV = -500000 + 110100(P/A, i%, 5) + 50000(P/F, i%, 5)

Use i = 6% 🡪 PV = -500000 + 110100(P/A, 6%, 5) + 50000(P/F, 6%, 5)

PV = -500000 + 110100(4.21) + 50000(0.7473) 🡪 PV = $886

Use i = 7% 🡪 PV = -500000 + 110100(P/A, 7%, 5) + 50000(P/F, 7%, 5)

PV = -500000 + 110100(4.10) + 50000(0.7130) 🡪 PV = $-12,940

Since the PV goes from negative (-) to positive (+), the ROI is between 6 and 7%.

Using a prorated average, closer to 6% since PV = $886 at 6%

886 / (886 + 12940) **=** 0.064🡪 6 + 0.064 🡪 **ROI = 6.064%**

d. Semi-automatic machine, NO taxes, NO salvage value, 5-year life (similar to b)

PV = -500000 + 120000(P/A, i%, 5)

Use i = 6% 🡪 PV = -500000 + 120000(P/A, 6%, 5)

PV = -500000 + 120000(4.21) 🡪 PV = $5,200

Use i = 7% 🡪 PV = -500000 + 120000(P/A, 7%, 5)

PV = -500000 + 120000(4.10) 🡪 PV = -$8,000

Since the PV goes from negative (-) to positive (+), the ROI is between 6 and 7%.

Using a prorated average, closer to 6% since PV = $5,200 at 6%

5200/ (5200+ 8000) **=** 0.3939 🡪 6 + 0.3939 🡪 **ROI = 6.3939%**

e. Based on the ROI calculations performed in the parts above, the best option would be the highest ROI, **Option (b)**