

APSC 221 - Engineering Economics- Fall 2013

Assignment 3 - Solutions

Question 1: Chapter 9 (8 marks)

A footwear company has to invest in one of two different automated cutting machines, because their existing machine can no longer be repaired. The first, Option A, has a \$10,000 first cost and annual operating costs of \$12,720. A similar one with many extra features, Option B, has a \$40,000 first cost and operating costs of \$4395 per year. Using the IRR method to compare the options and a MARR of 15% determine:

- (a) Which option, A or B, is the better choice if both machines are expected to have a service life of 5 years, with no salvage value or disposal costs?

With no revenue information provided both options would have a negative IRR. The question is not which option has the best IRR, but rather is spending the extra amount for the more expensive option justified.

Rank the options by first cost and determine the incremental cash flow. (1 mark)

Option A is least expensive and so becomes the current best, Option B is the challenger.

Incremental cash flow = Option B – Option A. Set the PW of the incremental cash flow = 0

$$PW = 0 = [-40,000 - (-10,000)] + [-4,395 - (-12,720)](P/A, i^*, 5) \quad (1 \text{ mark})$$

$$PW = 0 = -30,000 + 8,325(P/A, i^*, 5)$$

$$(P/A, i^*, 5) = 30,000/8,325 = 3.6036$$

By looking through the interest tables we can see that the i^* must be very close to 12% (1 mark)

because $(P/A, 12\%, 5) = 3.6048$

Or we can test at the MARR, $PW = -30,000 + 8,325(P/A, 15\%, 5) = -30,000 + 8,325(3.3522) = -2,092.935 < 0$

With either approach we can see that the incremental investment will **NOT** bring us the MARR and is there for not a good economic choice, so recommend Option A. (1 mark)

- (b) Would your decision change if after further research you determined that for Option A there would be no salvage value, but instead a disposal cost of \$2,340 and that with Option B you can determine the salvage value based on a declining balance approach with a depreciation rate of 35.5%? Use the Interest Table spreadsheet in the D2L -> Course Resources folder to determine i^* to two decimal places of accuracy. i.e. something like 14.57% to make your decision.

Again, we need to consider the incremental cash flow. (1 mark)

Incremental cash flow = Option B – Option A. Set the PW of the incremental cash flow = 0

To determine the estimated salvage value for Option B = $40,000(1-0.355)^5 = 4465.38$

$$PW = 0 = [-40,000 - (-10,000)] + [-4,395 - (-12,720)](P/A, i^*, 5) + [4,465 - (-2,340)](P/F, i^*, 5) \quad (1 \text{ mark})$$

$$PW = 0 = -30,000 + 8,325(P/A, i^*, 5) + 6,805(P/F, i^*, 5)$$

You were asked to use a spreadsheet to determine that $i^* = 16.65\%$ (1 mark)

We can see that the incremental investment will bring us at least the MARR and is there for a good economic choice, so recommend Option B. (1 mark)

In an examination, you could test at the MARR and determine if the $PW > 0$

$$PW = -30,000 + 8,325(P/A, 15\%, 5) + 6,805.38(P/F, 15\%, 5) = -30,000 + 8,325(3.3522) + 6,805(0.49718) = 1290.37$$

Question 2: Chapter 10 (6 marks)

George needs to evaluate the following investment options. His team has estimated the information below based on calculations and comparisons to previous projects the company has undertaken. Assuming average market returns are predicted to be about 15% per year for the time period under consideration and that risk-free investments can be found that will return 3.85% per year, use CAPM to identify which projects are viable and worthy of considering for investment. Explain your rationale and what other factors you would consider in making your final investment decision.

Project Name	Beta	Project IRR % per year
A	0.96	14.8
B	1.06	15.2
C	1.90	27.5

$$R_S = R_F + \beta_S(R_M - R_F)$$

$$R_S^A = 0.0385 + 0.96(0.15 - 0.0385) = 0.14554 \text{ or } 14.6\% \text{ (}\frac{1}{2}\text{ mark)}$$

$$R_S^B = 0.0385 + 1.06(0.15 - 0.0385) = 0.15669 \text{ or } 15.7\% \text{ (}\frac{1}{2}\text{ mark)}$$

$$R_S^C = 0.0385 + 1.9(0.15 - 0.0385) = 0.25035 \text{ or } 25.0\% \text{ (}\frac{1}{2}\text{ mark)}$$

- Projects A:
 - Appears to be a viable option as it shows a minimum CAPM return on equity that is below the estimated IRR return for the project. (½ mark)
 - With a Beta of less than 1.0, Project A is a less risky investment compared to the market and will generate a return very close to the market. (½ mark)
 - This would be a good conservative investment. (½ mark)
 - (or similar reasonable justifications)
- Project B:
 - Is not a viable option as it shows a minimum CAPM return on equity that is above the estimated IRR return for the project. (½ mark)
- Project C:
 - Appears to be viable option as it shows a minimum CAPM return on equity that is below the estimated IRR return for the project. (½ mark)
 - Project C has the potential to bring in significantly more return than the market (½ mark)
 - While not a conservative investment, the risk looks acceptable. (½ mark)
 - (or similar reasonable justifications)
- The information provided does not include how much capital is required for each project (½ mark)
- Nor does it identify how much capital in total is available. (½ mark)

Question 3: Chapter 11 (10 marks)

Do question 11.19 on page 447 of the text book. Hint: Remember to use a correct PW approach.

Salvage value after 3 years for Model A: $8000(1-0.4)^3 = 1728$ (1 mark)

Salvage value after 4 years for Model B: $10\,000 - 4 \times [(10,000 - 7,500)/1] = 0$ (1 mark)

The least common multiple of the service lives is 12 years: (1 mark)

$PW(A) = -8000[1 + (P/F, 14\%, 3) + (P/F, 14\%, 6) + (P/F, 14\%, 9)]$

$-1000(P/A, 14\%, 12)$

$+ 1728[(P/F, 14\%, 3) + (P/F, 14\%, 6) + (P/F, 14\%, 9) + (P/F, 14\%, 12)]$ (3 marks – for a correct equation setup)

$PW(A) = -8000(1 + 0.67497 + 0.45559 + 0.30751) - 1000(5.6603) + 1728(0.67497 + 0.45559 + 0.30751 + 0.20756)$

$= -19\,505 - 5660 + 2844 = -22\,321$ (No marks for correct answer because it is given in the back of the book)

$PW(B) = -10\,000[1 + (P/F, 14\%, 4) + (P/F, 14\%, 8)] - 800(P/A, 14\%, 12)$ (2 marks – for a correct equation setup)

$= -10\,000(1 + 0.59208 + 0.35056) - 800(5.6603) = -23\,955$ (1 mark)

Model A is the preferred choice because the present worth of its cost is less. (1 mark)

Question 4: Chapter 11 (10 marks)

Do question 11.25 on page 449 of the text book.

Hint: You don't actually have to create the full Balance Sheet and Income Statement, however you do need to know that "Prepaid Expenses" are in fact a Current Asset and not part of the Income Statement and they are not included in the Acid Test ratio.

[See Next Page for Financial Statements]

The financial ratios for Movit Manufacturing for 2010, 2009 and 2008 are: (1 mark per correct ratio = 6 marks)

Movit's financial ratios	2013	2012	2011
Current ratio	2.40	1.90	1.60
Acid test	1.17	0.90	0.75
Equity ratio	0.33	0.40	0.55
Inventory turns	4.25	7.00	12.00
ROA	6% (5.8%)	8%	10%
ROE	17% (17.48%)	20%	18%

Simple statements, similar to examples below, are worth ½ a mark, more complex thoughts worth a 1 mark. (Maximum 4 marks for this portion)

- Movit appears to be solvent, with an increasing current ratio (½ mark) and acid test values now above 1.0 (½ mark)
Equity ratio is decreasing, meaning it is becoming more reliant on debt (borrowing money) to finance its operations (½ mark)
- Inventory turns are decreasing, which could be due to a drop in sales (or sales effectiveness) (½ mark)
- Return on Assets is decreasing, which could be due to managements inability to productively use assets (½ mark)
- Return on Equity is decreasing, which could be the reason behind the decreasing Equity ratio, an increased reliance on debt, because they are having a harder time attracting investors. (1 mark)
- Despite the solvency, there is some concern about the degree to which Movit relies on debt and the apparent drop in return on total assets and inventory turns. (1 mark)
- The degree to which Movit relies on debt, through increased borrowing, coupled with lower sales volumes is a concern for the health of the company. (1 mark)
- Comparative income statements and balance sheets for the period would be useful in getting to the bottom of what is going on with Movit. (1 mark)

Question 5: Chapter 12 (8 marks)

Do question 12.20 on page 497 of the text book. Print off a copy of the Schedule 8 form (the "t2sch8-11e.pdf" file found on D2L) and fill it out **by hand**. One row for each year in the question, put the year in column 1 (instead of asset class number) and you can ignore columns 4, 10, 11 by putting zeros in those columns.

Balance Sheet - Movit Manufacturing - December 31, 2013 (in \$000s)

Current Assets		Current Liabilities	
Cash	2100	Accounts Payable	7500
GICs	450	Accrued Wages	2850
Accounts Receivable	15000	Working Capital Loan	4650
Inventories	18000	Total Current Liabilities	15000
Prepaid expenses	450		
Total Current Assets	36000		
Long-term Assets		Long-term Liabilities	
Land	3000	Deferred Income Tax	2250
Plant and equipment	18450	Mortgage	9450
Less Depreciation	10950	Long-term Bonds	4350
Net	7500	Total Long-term Liabilities	16050
Total Long-term Assets	10500		
		Owner's Equity	
		Common Shares	150
		Contributed Capital	3000
		Retained Earnings	12300
		Total Owner's Equity	15450
Total Assets	46500	Total Liabilities and Equity	46500

Financial Ratios

Total Current Assets	36000
Total Current Liabilities	15000
Current Ratio	2.4
Total Current Assets	36000
Inventories	-18000
Prepaid expenses	-450
Quick Assets	17550
Total Current Liabilities	15000
Acid-test Ratio	1.17
Total Owner's Equity	15450
Total Assets	46500
Equity Ratio	0.33
Net Sales	76500
Inventories	18000
Inventory Turnover	4.25
Net Income after taxes	2700
Total Assets	46500
Return-on-Assets	5.8%
Net Income after taxes	2700
Total Owner's Equity	15450
Return-on-Equity	17.5%

Income Statement

Net Sales	76500
Cost of Goods Sold	57000
Gross Profit	19500
Operating Expenses	
Selling	4650
Depreciation	750
General	8100
Interest	1500
Total Expenses	15000
Net Income before taxes	4500
Income Taxes	1800
Net Income after taxes	2700



CAPITAL COST ALLOWANCE (CCA) (2006 and later tax years)

Name of corporation <i>Student Name and #</i>	Business Number	Tax year-end Year Month Day
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For more information, see the section called "Capital Cost Allowance" in the *T2 Corporation Income Tax Guide*.Is the corporation electing under Regulation 1101(5q)? **101** 1 Yes ☐ 2 No ☐

ONE MARK FOR EACH CORRECT AMOUNT
IN COLUMN 13 (ROUNDING TO WHOLE \$ IS
ACCEPTABLE)

1 Class number <i>YEAR</i>	2 Undepreciated capital cost at the beginning of the year (undepreciated capital cost at the end of the year from column 13 of last year's CCA schedule)	3 Cost of acquisitions during the year (new property must be available for use) (see note 1 below)	4 Net adjustments (show negative amounts in brackets) <i>IGNORE</i>	5 Proceeds of dispositions during the year (amount not to exceed the capital cost)	6 Undepreciated capital cost (column 2 plus column 3 plus or minus column 4 minus column 5)	7 50% rule (1/2 of the amount, if any, by which the net cost of acquisitions exceeds column 5) (see note 3 below)	8 Reduced undepreciated capital cost (column 6 minus column 7)	9 CCA rate % (see note 4 below)	10 Recapture of capital cost allowance <i>IGNORE</i>	11 Terminal loss <i>IGNORE</i>	12 Capital cost allowance (for declining balance method, column 8 multiplied by column 9, or a lower amount) (see note 5 below)	13 Undepreciated capital cost at the end of the year (column 6 minus column 12)
200	201	203	205	207		211		212	213	215	217	220
1. <i>2005</i>												<i>0</i>
2. <i>2006</i>	<i>0</i>	<i>25 000</i>		<i>0</i>	<i>25 000</i>	<i>12 500</i>	<i>12 500</i>	<i>30%</i>			<i>3 750</i>	<i>21 250</i>
3. <i>2007</i>	<i>21 250</i>	<i>0</i>		<i>0</i>	<i>21 250</i>	<i>0</i>	<i>21 250</i>	<i>30%</i>			<i>6 375</i>	<i>14 875</i>
4. <i>2008</i>	<i>14 875</i>	<i>14 000</i>		<i>0</i>	<i>28 875</i>	<i>7 000</i>	<i>21 875</i>	<i>30%</i>			<i>6 562.50</i>	<i>22 312.50</i>
5. <i>2009</i>	<i>22 312.50</i>	<i>0</i>		<i>0</i>	<i>22 312.50</i>	<i>0</i>	<i>22 312.50</i>	<i>30%</i>			<i>6 693.75</i>	<i>15 618.75</i>
6. <i>2010</i>	<i>15 618.75</i>	<i>0</i>		<i>0</i>	<i>15 618.75</i>	<i>0</i>	<i>15 618.75</i>	<i>30%</i>			<i>4 685.63</i>	<i>10 933.12</i>
7. <i>2011</i>	<i>10 933.12</i>	<i>28 000</i>		<i>0</i>	<i>38 933.12</i>	<i>14 000</i>	<i>24 933.12</i>	<i>30%</i>			<i>7 479.94</i>	<i>31 453.18</i>
8. <i>2012</i>	<i>31 453.18</i>	<i>0</i>		<i>5 000</i>	<i>26 453.18</i>	<i>0</i>	<i>26 453.18</i>	<i>30%</i>			<i>7 935.95</i>	<i>18 517.23</i>
9. <i>2013</i>	<i>18 517.23</i>	<i>0</i>		<i>0</i>	<i>18 517.23</i>	<i>0</i>	<i>18 517.23</i>	<i>30%</i>			<i>5 555.17</i>	<i>12 962.06</i>
10.		<i>0</i>		<i>0</i>				<i>30%</i>				

Note 1. Include any property acquired in previous years that has now become available for use. This property would have been previously excluded from column 3. List separately any acquisitions that are not subject to the 50% rule, see Regulation 1100(2) and (2.2).

Note 2. Include amounts transferred under section 85, or on amalgamation and winding-up of a subsidiary. See the *T2 Corporation Income Tax Guide* for other examples of adjustments to include in column 4.Note 3. The net cost of acquisitions is the cost of acquisitions (column 3) **plus** or **minus** certain adjustments from column 4. For exceptions to the 50% rule, see Interpretation Bulletin IT-285, *Capital Cost Allowance – General Comments*.

Note 4. Enter a rate only if you are using the declining balance method. For any other method (for example the straight-line method, where calculations are always based on the cost of acquisitions), enter N/A. Then enter the amount you are claiming in column 12.

Note 5. If the tax year is shorter than 365 days, prorate the CCA claim. Some classes of property do not have to be prorated. See the *T2 Corporation Income Tax Guide* for more information.

Totals

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Enter the total of column 10 on line 107 of Schedule 1.
Enter the total of column 11 on line 404 of Schedule 1.
Enter the total of column 12 on line 403 of Schedule 1.

Question 6: Chapter 12 – Taxes (8 Marks)

Do question 12.31 on page 498 of the text book.

Hint: First need to figure out what the missed savings in each year is and then PW today of a cash flow that has taken place in the past, can be calculated as a FW from the original starting point.

Additional information provided via D2L News posting: Assume Class 12 is ½ - Year Rule exempt.

The present worth of a year's savings due to CCA for the assets if they were correctly recognised as Class 8 can be calculated using the CTF. CCA rate for Class 8 = 20%, Tax rate = 50%, MARR=9%

$$CTF = 1 - [(0.5)(0.2)(1 + 0.09/2)] / [(0.09 + 0.2)(1 + 0.09)] = 0.6694 \quad (1 \text{ mark})$$

PW of cost would be = $-10,000(CTF)$ so one year's savings = $10,000 - 10,000(CTF)$

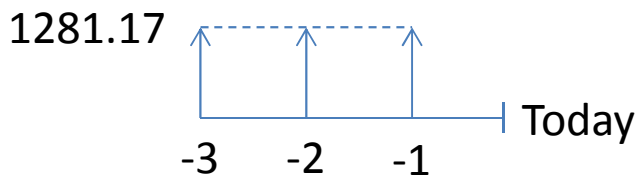
$$PW_{\text{Savings-Class 8}} = 10,000 - 10,000(CTF) = 10,000 - 10,000(0.6694) = 3,306 \quad (2 \text{ marks})$$

The present worth of a year's savings due to CCA for the items recognised as Class 12 can be calculated directly from the tax rate because the CCA rate for class 12 is 100%, i.e. complete write-off of expenses every year. This will occur at the end of the time period, so we need to bring it back one year to get the PW.

$$PW_{\text{Savings-Class 12}} = (1-t)(10,000)(P/F, 9\%, 1) = 0.5(10,000)(0.91743) = 4,587.17 \quad (2 \text{ marks})$$

$$\text{Then the mistake per year is} = 4,587.17 - 3,306 = 1,281.17 \text{ /yr} \quad (1 \text{ mark})$$

The present worth today of such losses over the past three years is then:



$$FW = 1,281.17(F/A, 9\%, 3)(F/P, 9\%, 1) \quad (1 \text{ mark})$$

$$FW = 1,281(3.2781)(1.09) = 4,577.79$$

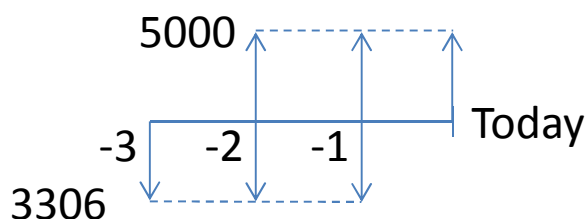
The mistake has cost us about \$4,578. (1 mark)

Alternate Approaches:

$$CTF = 1 - [(0.5)(0.2)(1 + 0.09/2)] / [(0.09 + 0.2)(1 + 0.09)] = 0.6694 \quad (1 \text{ mark})$$

$$AW_{\text{Savings-Class 8}} = 10,000 - 10,000(CTF) = 3,306 \quad (2 \text{ marks})$$

$$\text{and } AW_{\text{Savings-Class 12}} = (1-t)(10,000) = 0.5(10,000) = 5,000 \quad (2 \text{ mark})$$



FW:

$$= 5000(F/A, 9\%, 3) - 3306(F/A, 9\%, 3)(F/P, 9\%, 1) \text{ (2 marks)}$$

$$= [5000 - 3306(1.09)](3.2781) = 4577.74$$

The mistake has cost us about \$4,578. (1 mark)

Or

PW:

$$= [5000(P/A, 9\%, 3) - 3306(P/A, 9\%, 3)(F/P, 9\%, 1)](F/P, 9\%, 3) \text{ (2 marks)}$$

$$= \{[5000 - 3306(1.09)](2.5313)\}(1.2950) = 4577.64$$

The mistake has cost us about \$4,578. (1 mark)

Or

$$= [5000(P/A, 9\%, 3)(P/F, 9\%, 1) - 3306(P/A, 9\%, 3)](F/P, 9\%, 4) \text{ (2 marks)}$$

$$= \{[5000(0.91743) - 3306](2.5313)(1.4116)\} = 4577.78$$

The mistake has cost us about \$4,578. (1 mark)

The problem with doing a UCC balance approach, similar to Question 5, is that unless we use a spread sheet for many more years than the 3 years it doesn't take into account the long term Class 8 benefits