

ELEC 481

Final Exam

Submitted to Prof. Jeff Carmichael

Jun 27, 2020

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Problem 1

a)

$$\text{Annual inflation rate} = \sqrt[7]{\frac{150}{115}} - 1 = 3.9\%$$

b)

$$\text{Scaling up cost: } 1.6^{0.69} * \$9,000,000 = \$12,450,000$$

$$\text{Updating the cost: } \$12,450,000 * 1.039^{12} = \$19,629,198$$

c)

$$\text{Option B cost in 2024} = \$13,000,000 * 1.039^{10} = \$19,001,639$$

Data that could come to help is the annual inflation rate between 2019 and 2024 since we previously assumed the rate stays at 3.9%.

d)

Option B (a Zap Turbine) would be recommended since it has a lower cost in the construction year.

Problem 2 (See the spreadsheet)

a)

Assume year 0 is 2023 for all of the four sections.

According to the spreadsheet, the gain on disposal is \$612,534 for option A.

b)

According to the spreadsheet, the loss on disposal is \$365,380 for option B.

c)

$$\text{NPW for option A} = \$4,159,124$$

$$\text{NPW for option B} = \$2,933,917$$

d)

Option A should be recommended since it has a higher positive NPW.

Problem 3

a)

Annual repayment = $(\$500,000 - \$50,000) (A/P, 0.06, 20) = \$39,233.05$

b)

House's value in 20 years in actual dollars = $\$500,000 (F/P, 0.03, 20) = \$903,055.62$

(Prior to paying the agent fee)

c)

If I rent:

Sum of undiscounted rent = $\$24,000 (P/A1, g=4\%, 0\%, 20) = \$714,673.89$

Undiscounted savings in 20 years = $\$50,000 (F/P, 0.02, 20) = \$74,297.37$

Sum of all undiscounted cash flows = $\$74,297.37 - \$50,000 - \$714,673.89 = -\$690,376.52$

If I buy:

Sum of undiscounted mortgage = $\$39,233.05 * 20 = \$784,661.01$

Sum of undiscounted utility payments = $\$2,500 (P/A1, g=5.5\%, 0\%, 20) = \$87,170.80$

Undiscounted revenue from the sale = $\$903,055.62 * 0.95 = \$857,902.84$

Sum of all undiscounted cash flows = $\$857,902.84 - \$50,000 - \$784,661.01 - \$87,170.80 = -\$63,928.97$

Buying the house has the lower undiscounted costs.

d)

I would usually choose my MARR to be the discount rate. Since MARR here is not explicitly given, I'd use the interest rate of the mortgage as the discounted rate (6%). It's all because I don't want the bankers/mortgage company to make any extra money from me.

e)

If I rent:

NPW of sum of rent = $\$24,000 (P/A1, g=4\%, 6\%, 20) = \$380,156.94$

NPW of savings in 20 years = $\$50,000 (F/P, 0.02, 20) * (P/F, 0.06, 20) = \$23,166.27$

NPW of sum of all cash flows = $\$23,166.27 - \$50,000 - \$380,156.94 = -\$406,990.67$

If I buy:

NPW of mortgage = $\$39,233.05 (P/A, 0.06, 20) = \$450,000$

NPW of sum of utility payments = $\$2,500 (P/A1, g=5.5\%, 6\%, 20) = \$45,114.71$

NPW of revenue from the sale = $\$903,055.62 * 0.95 (P/F, 0.06, 20) = \$267,498.16$

NPW of sum of all cash flows = $\$267,498.16 - \$50,000 - \$450,000 - \$45,114.71 = -\$277,616.55$

Again, buying the house has the lower discounted costs.

f)

Assume the borrowing rate is R, and the discount rate is to be the same (R).

An equation can be set up as (NPW1 = NPW2):

$$\begin{aligned} \$50,000 \left(\frac{F}{P}, 0.02, 20 \right) * \left(\frac{P}{F}, R, 20 \right) - \$24,000 \left(\frac{P}{A1}, g = 4\%, R, 20 \right) \\ = \$903,055.62 * 0.95 \left(\frac{P}{F}, R, 20 \right) - \$450,000 - \$2,500 \left(\frac{P}{A1}, g = 5.5\%, R, 20 \right) \end{aligned}$$

R is solved by calculator to be 2.53%.

Problem 4

a)

Class 50 has a rate of 55% according to our textbook (page 345).

Applying 50% rule:

$$\text{Depreciation in year 5} = \$500,000 * (1 - 0.55 * 0.5) * 0.45^3 * 0.55 = \$18168$$

b)

$$\text{Straight line depreciation: } \frac{\$500,000 - \$20,000}{5} = \$96,000$$

c)

$$\text{Sum-of-the-years'-digits depreciation: } \frac{5-5+1}{1+2+3+4+5} * (\$500,000 - \$20,000) = \$32,000$$

d)

$$\text{Annual depreciation rate} = 150\%/5 = 30\%$$

$$150\% \text{ declining-balance depreciation: } \$500,000 * 0.7^4 * 0.3 = \$36,015$$

Problem 5 (See the spreadsheet)

a)

$$\text{NPW for A} = -\$1,200 + \$350 (P/A, 0.08, 5) = -\$1,200 + \$350 * 3.99 = \$197$$

$$\text{NPW for B} = -\$400 + \$130 (P/A, 0.08, 5) = -\$400 + \$130 * 3.99 = \$119$$

These results are verified in spreadsheet as well.

b)

According to the spreadsheet:

$$\text{IRR for A} = 14.1\%$$

$$\text{IRR for B} = 18.7\%$$

c)

It depends (see the choice table below).

Personally, I would recommend option A since it has a significantly higher NPW, even though it needs a higher amount of initial investment. (My MARR is around 8%.)

d)

Choice table:

$0 < MARR \leq 14.1\%$	A should be selected
$14.1\% < MARR \leq 18.7\%$	B should be selected
$18.7\% < MARR \leq 100\%$	DO NOTHING!

Problem 6

a)

Federal tax w/out exemption = $\$47,630 \times 0.15 + (\$95,259 - \$47,630) \times 0.205 + (\$147,667 - \$95,259) \times 0.26 + (\$210,371 - \$147,667) \times 0.29 + (\$230,000 - \$210,371) \times 0.33 = \$55,196.255$

Federal tax credits = $\$12,069 \times 0.15 = \$1,810.35$

Federal tax paid = $\$55,196.255 - \$1,810.35 = \mathbf{\$53,385.91}$

Provincial tax w/out exemption = $\$43,906 \times 0.0505 + (\$87,813 - \$43,906) \times 0.0915 + (\$150,000 - \$87,813) \times 0.1116 + (\$220,000 - \$150,000) \times 0.1216 + (\$230,000 - \$220,000) \times 0.1316 = \$23,002.8127$

Provincial tax credits = $\$10,582 \times 0.0505 = \534.391

Provincial tax paid = $\mathbf{\$22,468.42}$

b)

Federal personal tax = $\$47,630 \times 0.15 + (\$80,000 - \$47,630) \times 0.205 = \$13,780.35$

Federal corporate tax = $\$150,000 \times 0.15 = \$22,500$

Federal tax paid = $\$13,780.35 + \$22,500 - \$1,810.35 = \mathbf{\$34,470}$

Provincial personal tax = $\$43,906 \times 0.0505 + (\$80,000 - \$43,906) \times 0.0915 = \$5,519.854$

Provincial corporate tax = $\$150,000 \times 0.115 = \$17,250$

Provincial tax paid = $\mathbf{\$22,235.463}$

Total tax paid = $\mathbf{\$56,705.46}$

c)

Yes, he should incorporate since option b gets him a lower amount of taxes.

Problem 7

a)

Plan 1:

PW of cost = $\$2,000 + \$1,200 (P/A, 0.075, 20) + \$50 (P/G, 0.075, 20)$

= $\$2,000 + \$1,200 \times 10.19 + \$50 \times 73.15$

= $\mathbf{\$17,890.88}$

PW of benefit = $\$650 (P/A, 0.075, 20) + \$350 (P/G, 0.075, 20)$

= $\$650 \times 10.19 + \350×73.15

= $\mathbf{\$32,228.82}$

B/C ratio = 1.80

Plan 2:

PW of cost = $\$3,800 + \$1,400 (P/A, 0.075, 20) + \$70 (P/G, 0.075, 20)$

= $\$3,800 + \$1,400 \times 10.19 + \$70 \times 73.15$

= $\mathbf{\$23,192.77}$

$$\begin{aligned}
 \text{PW of benefit} &= \$1,000 (P/A, 0.075, 20) + \$500 (P/G, 0.075, 20) \\
 &= \$1,000 * 10.19 + \$500 * 73.15 \\
 &= \$46,769.35
 \end{aligned}$$

$$\text{B/C ratio} = 2.02$$

b)

According to the benefit-cost ratios, plan 2 is better.

Problem 8

Generally, a company's or person's MARR would be no less than the borrowing interest rate in the market. When the interest rate shows an upward trend, corresponding MARR goes up as well. Thus, the investor would be willing to take a higher risk or obtain a lower net benefit as long as the rate of return of the invested project can be above the MARR. Using the choice table, it is also intuitively shown that--when MARR is larger than all rate of returns, no investment is likely to be made.

Problem 9

Since it is obvious that both of the options given are likely to cost me money at the end of year (B/C ratio is less than 1), the incremental B/C ratio method can be introduced to the problem. In this specific case, such method would help me pick the least-bad of the alternatives. Comparing option to A, option B comes with \$150 instant benefit, 2% borrowing interest rate, and 2% rebate on gasoline and grocery.

Other information needed: the amount borrowed from the credit card annually, the amount of money spent on all gasoline and grocery purchases annually, possibly the time length of our analysis.

Problem 10

a)

Cash flow analysis:

$$\begin{aligned}
 \text{EUAC} &= \$55,000 (A/P, 0.065, 12) - \$8,000 (A/F, 0.065, 12) + \$3,500 \\
 &= \$55,000 * 0.1226 - \$8,000 * 0.05757 + \$3,500 \\
 &= \$9780.70
 \end{aligned}$$

b)

$$\text{Annual cost of option B} = \$0.6 * 20,000 = \$12,000$$

c)

Comparing the annual costs of the two option above, option A should be chosen.

Problem 11 (See the spreadsheet)

11 Errors (Most are marked in red in spreadsheet):

Option A:

- M11:Q11 Operating cost of doesn't go up by 2%.
- M12:Q12 Annual principal repayment is supposed to increase due to the 4% of loan interest.
- L12 Initial amount of the load is not listed.
- Q15/Q17 Loss on disposal (positive) should decrease the taxable income.
- Q25 Loss on disposal should be added back in as a positive value. (Similar to Q15)
- N17 Taxable income can't be negative.
- L35 IRR formula applies to the values before getting discounted.
- Loan interest should be taken into consideration as tax-free credits (like CCA) when calculating tax.
- Loan repayment should be taken into account **at the end** since it doesn't give us tax exemption as a typical type of cost would do by cutting down taxable income.

Option B:

- H42 First year CCA depreciation doesn't get halved.
- M58:V58 CCA and recaptured CCA need to be added back in for ATCF.
- V64/V65 Salvage value should be considered in 'discounted benefits' not 'discounted cost'.