The University of British Columbia

Faculty of Applied Science

APSC 540 — *Business Decisions for Engineering Ventures*

Midterm Examination 2

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Instructor: Ron Mackinnon

Duration: 80 minutes

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Instructions:

1. Please print your name and student number in the spaces provided above. At the end of the examination, submit this paper and the formula sheet(s) *immediately*.
2. This examination consists of **8 pages** with **5 questions** for a total of **50 marks**. Please check that your examination booklet is complete.
3. You are allowed to have calculators and writing instruments. You will be provided with a formula sheet. Notes, books, and other reference material are not allowed in the examination room.
4. Indicate your answers clearly and show all your work. Your numerical answers must be accurate to at least four significant figures and must include the correct units (e.g. 926.1 Kg). Your financial answers must be accurate to two decimal positions (e.g. $83,760.45).
5. The following standards apply to this examination, unless it is otherwise clearly stated:
   - Interest rates are expressed as nominal annual rates; interest rates are after-tax if taxes apply.
   - Annuity payments occur at the *end* of each payment period.
   - Bonds are purchased or sold on a coupon payment date after the coupon payment has been made.
   - Shares are purchased or sold on a dividend payment date after the dividend payment has been made.
   - The initial cash flow of an investment project occurs at time zero, and each subsequent cash flow occurs at the end of a period; cash flows are before-tax if taxes apply.
   - Taxes for an operating period are calculated and applied at the end of the operating period.
   - For Capital Cost Allowance (CCA), use the declining balance method and use the 50% rule where it is appropriate.
   - The income is sufficient to be able to deduct the full depreciation every year for tax purposes.
   - At the time of disposition of an asset, the corresponding CCA asset class has other assets remaining; the asset disposal occurs at year-end, after the CCA has been taken for the final year; and the undepreciated capital cost of the asset class at the time of disposal exceeds the salvage value of the asset.
6. You must observe the following general UBC rules governing formal examinations:
   a. You must be prepared to produce, upon the request of the invigilator or examiner, your UBCcard for identification.
   b. You are not permitted to ask questions of the examiners or invigilators, except in cases of supposed errors or ambiguities in examination questions, illegible or missing material, or the like.
   c. You will not be permitted to enter the examination room after the expiration of thirty minutes from the scheduled starting time, or to leave during the first thirty minutes of the examination. If the examination runs forty-five minutes or less, you will not be permitted to enter the examination room once the examination has begun.
   d. You must conduct yourself honestly and in accordance with established rules for a given examination, which will be articulated by the examiner or invigilator prior to the examination commencing. If dishonest behaviour is observed by the examiner(s) or invigilator(s), pleas of accident or forgetfulness shall not be received.
   e. If you are suspected of any of the following, or any other similar practices, you may be dismissed immediately from the examination by the examiner/invigilator, and may be subject to disciplinary action:
      i. speaking or communicating with other examination candidates, unless otherwise authorized;
      ii. purposely exposing written papers to the view of other examination candidates or imaging devices;
      iii. purposely viewing the written papers of other examination candidates;
      iv. using or having visible at the place of writing any books, papers or other memory aid devices other than those authorized by the examiner(s); and
      v. using or operating electronic devices including but not limited to telephones, calculators, computers, or similar devices other than those authorized by the examiner(s); electronic devices other than those authorized by the examiner(s) must be completely powered down if present at the place of writing.
   f. You must not destroy or damage any examination material, must hand in all examination papers, and must not take any examination material from the examination room without permission of the examiner or invigilator.
   g. You must follow any additional examination rules or directions communicated by the examiner(s) or invigilator(s).

Question	Maximum	Score	Question	Maximum	Score
1	12	8.5	4	11	7
2	7	2.5	5	7	6.5
3	13	12	**Total**	**50**	

36.5

1. *(12 marks)* Pearce Incorporated is considering purchasing equipment that costs $240,000 and will depreciate on a straight-line basis during its five-year planned lifetime, after which it will be salvaged for $40,250. In the first year, the equipment will produce revenue of $130,000 and fixed (indirect) costs will be $14,300. Variable costs will equal forty-five percent of revenue. Revenues, fixed costs, and variable costs will grow by two percent per year. Pearce's tax rate is twenty-six percent and its minimum acceptable rate of return is 7.36 percent.
   a. *(10 marks)* Use the net present value to recommend whether Pearce Incorporated should invest in the equipment. Provide supporting evidence and state the basis for your recommendation. *[Use space on the following page, if necessary.]*

NPV:

- equip. cost: $-240{,}000$ ✓ (1)

+ PV(salvage equipment): $\frac{40{,}250}{(1+0.0736)^5} = 28{,}219.76$ ✓ (2)

+ PV(tax shield on equipment): SL-basis: $d_t = \frac{B-S}{N}$

$$= \frac{(240{,}000 - 40{,}250)}{5} \times 0.26 \times \left[\frac{1-(1.0736)^{-5}}{0.0736}\right]$$

$$= 42{,}181.36 \quad (3) \checkmark$$

+ PV(annual cash flows(revenues, fixed costs, variable costs):

$$(130{,}000 \times (1-0.45) - 14{,}300) \times (1-0.26) \times (0.02) \times \left[\frac{1-\left(\frac{1.02}{1.0736}\right)^5}{0.0736-0.02}\right]$$

— 0.5 ✗ after 1st yr to get inflation

$$= 57{,}200 \times (1-0.26) \times 0.02 \times \left\{\frac{1-\left(\frac{1.02}{1.0736}\right)^5}{0.0736-0.02}\right\}$$

$$= 3568.12 \quad (4)$$

−2.5

PV = (1) + (2) + (3) + (4) + (5)? = $-166,030.76

NPV < 0 ⇒ I recommend not to invest

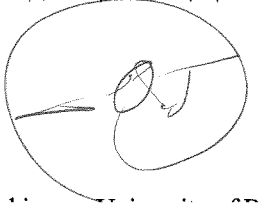
b. Continued from the preceding page. *(2 marks)* Determine the percent change in the net present value that would result from a 3.70 percent decrease in the revenue.

$$= -\frac{0.037 \times PV(\text{rev.})}{NPV}$$

4460.15

$$= -\frac{0.037 \times 130{,}000 \times (1-0.45) \times (1-0.26) \times 0.92 \times \left[\frac{1-\left(\frac{1.02}{1.0736}\right)^5}{0.0736-0.02}\right]}{166{,}030.76}$$

$$= 0.\ 9.9394 \times 10^{-4} \quad 0.099394\% \text{ decrease in NPV}$$



2. *(7 marks)* Bechamel Company is considering the purchase of a new machine to replace an old one. The new machine costs $120,000 to purchase and it will require an additional $10,000 in installation costs. The operating and maintenance (O&M) cost of the new machine will be $40,000 in the first year, then the O&M cost will grow at an annual rate of 9½ percent. Bechamel's engineers use a minimum acceptable rate of return of 8.79 percent with declining balance depreciation at an annual rate of 22½ percent to analyze investments in new machines. The company's engineers produced the table below for their financial analysis of the machine.

Year/Lifetime	Salvage Value	EAC Capital	O&M Cost	EAC O&M	EAC Total
0	$120,000.00				
1	$93,000.00	$48,427.00	$40,000.00	$40,000.00	$88,427.00
2	$72,075.00	$39,170.19	$43,800.00	$41,820.01	$80,990.20
3	$55,858.13	34,090.47	47,961	43,697.17	77,787.64
4	$43,290.05	$30,446.57	$52,517.30	$45,631.84	$76,078.41
5	$33,549.79	$27,610.68	$57,506.44	$47,624.31	$75,235.00
6	$26,001.08	$25,323.95	$62,969.55	$49,674.84	$74,998.78
7	$20,150.84	$23,443.69	$68,951.66	$51,783.58	$75,227.26

a. *(6 marks)* Find the equivalent annual cost (EAC) of capital and EAC of O&M for a lifetime of three years.

EAC O&M of year 3: O&M cost of yr 2 × 1.095

= 43,800.00 × 1.095 = $47,961

$$EAC = \frac{NPV}{\left[\frac{1-(1+r)^{-n}}{r}\right]}$$

$$\frac{130{,}000 - \frac{55{,}858.13}{1.0879^3}}{\frac{1-1.0879^{-3}}{0.0879}} = 34{,}0$$

$$\frac{110{,}958.34}{\frac{1-1.0879^{-3}}{0.0879}}$$

yr 1: EAC capital $= \frac{-120{,}000 - 10{,}000 + \frac{93{,}000}{1.0879}}{\frac{1-1.0879^{-1}}{0.0879}} = 48{,}427$

yr 2:

$$\frac{\frac{40{,}000}{1.0879} + \frac{43{,}800}{1.0879^2} + \frac{47{,}961}{1.0879^3}}{\frac{1-1.0879^{-3}}{0.0879}} = 43{,}697.17$$

b. *(1 mark)* State the economic (minimum cost) life for the machine.

EAC = $74,998.78 at year 6

3. *(13 marks)* Hurst Corporation is considering purchasing a 2014 Volvo VN 780. They conducted a feasibility study that cost $12,500 to determine the following figures. The VN 780 costs $245,000 and will earn $49,750 of net revenue each year. Thirty-six percent of one year's before-tax net revenue will be invested in working capital. The truck will be in CCA Class 10 (CCA rate = thirty percent). The VN 780 will be salvaged for $20,000 after a planned lifetime of seven years. Hurst's accountants require that $2300 of the company's annual overhead be allocated to the truck for capital budgeting purposes. Hurst's tax rate is twenty-seven percent and its minimum acceptable rate of return is 6.63 percent.

a. *(11 marks)* Use the net present value to recommend whether Hurst Corporation should purchase the 2014 Volvo VN 780. Provide supporting evidence and state the basis for your recommendation. *[Use space on the following page, if necessary.]*

- capital cost: $-245{,}000$ (1) ✓

$+PV(\text{salvage}) = \dfrac{20{,}000}{(1.0663)^7} = 12{,}760.69$ (2) ✓

$+PV(\text{tax shield gained}): \dfrac{BdT_c}{i+d}\left[\dfrac{1+i/2}{1+i}\right]$

$= \dfrac{245{,}000 \times 0.3 \times 0.27}{0.0663+0.3} \times \left[\dfrac{1+0.0663/2}{1+0.0663}\right]$ ✓

$= 52{,}492.61$ (3)

$-PV(\text{tax shield lost}): \dfrac{SdT_c}{i+d}\cdot\left[\dfrac{1}{(1+i)^N}\right]$ ✓

$= \dfrac{-20{,}000 \times 0.30 \times 0.27}{0.0663+0.3} \times \dfrac{1}{1.0663^7} = -2821.77$ (4)

Assume 49750 of net revenue is before tax

$+PV(\text{annual revenue after taxes})$: (-0.5) ✓

$49{,}750 \times (1-0.27) \times \left[\dfrac{1-1.0663^{-5}}{0.0663}\right] = 150{,}395.84$ (5)

- Working capital: $49{,}750 \times 0.36 = -17910$ (6) ✓

+ PV(recovered working capital):

$$\frac{17,910}{1.0663^7} = 11,427.20 \quad (7)\checkmark$$

NPV: (1) + (2) + (3) + (4) + (5) + (6) + (7)

$-245,000 + 12760.69 + 52,492.61 - 2821.77$

$+150,395.84 - 17910 + 11,427.20$

NPV $= \$-38,655.43$

Since NPV < 0, I recommend not to invest

b. Continued from the preceding page. *(2 marks)* Determine the percent change in the annual net revenue that would produce a break-even condition in terms of the net present value.

$$\left(\frac{(5)+(6)+(7)}{NPV}\right) = \left(\frac{150,395.84 + -17,910 + 11,427.20}{-38,655.43}\right) = 3.72247$$

$= 372.247\%$ increase is needed

(0.5)

4. *(11 marks)* Herald Limited needs to purchase a machine for a planned operating period of nine years and they are considering two models. Model V has an initial cost of $27,800 and its annual operating profit is expected to be $6935. Model V has a useful lifetime of five years during which its value declines by thirty percent per year. Model H has an initial cost of $31,100 and its annual operating profit is expected to be $7100. Model H has a useful lifetime of six years during which its value declines by twenty-six percent per year. Herald requires an 8.27 percent rate of return on machine investments and they round all salvage values to the nearest $50. Use an appropriate technique to recommend one of the models to Herald Limited; provide supporting evidence and state the basis for your recommendation.

Model V:

use declining balance to find salvage (BV) at end of lifetime!

$BV_n = B(1-D)^n$

$BV_5 = 27,800 \times (1-0.3)^5 = 4672.35 \simeq 4650 =$ salvage value

use EACF:

$$EACF_V = 6935 + \frac{-27,800 + \frac{4650}{1.0827^5}}{\frac{1-1.0827^{-5}}{0.0827}} = \$711.06$$

-2

Model H:

$BV_6 = 31,100 \times (1-0.26)^6 = 5106.82 \simeq 5100 =$ salvage

$$EACF_H = 7100 + \frac{-31,100 + \frac{5100}{1.0827^6}}{\frac{1-1.0827^{-6}}{0.0827}} = \$1007.88$$

-2

$EACF_H > EACF_V \Rightarrow$ so I recommend Model H

5. *(7 marks)* Global Pillage Corporation is considering a resource extraction project that requires an outlay of $160,000 today. In one year, the company will realize a profit of $500,000. During the year following that, the company must perform an environmental cleanup that is expected to cost $360,000. Global Pillage requires a rate of return of 16.85 percent on resource extraction projects.

a. *(3 marks)* Calculate the internal rate(s) of return of the proposed project.

$-160,000 \qquad 500,000 \qquad -360,000$

$$0 = -160,000 + \frac{500,000}{(1+i)} - \frac{360,000}{(1+i)^2}$$

Using TI-83 Plus enter: irr(-160,000, {500,000, -360,000},

& I get $i = 12.5\%$ ✓ 0.5

b. *(3 marks)* Calculate the benefit cost ratio(s) of the proposed project.

$$BCR = \frac{PV(\text{positive cash flows})}{PV(\text{negative cash flows})}$$

$$= \frac{\frac{500,000}{1.1685}}{160,000 + \frac{360,000}{1.1685^2}} = 1.0100$$ ✓

$BCR = 1.0100$

c. *(1 mark)* Make a recommendation to Global Pillage Corporation regarding the resource extraction project and state the basis for your recommendation.

Since $BCR > 1$, I recommend investing in the project ✓

Also, $IRR > MARR$

$12.5\% > 16.85\%$