M I M E 3 1 0 E N G I N E E R I N G E C O N O M Y

SAMPLE FINAL EXAM PROBLEMS

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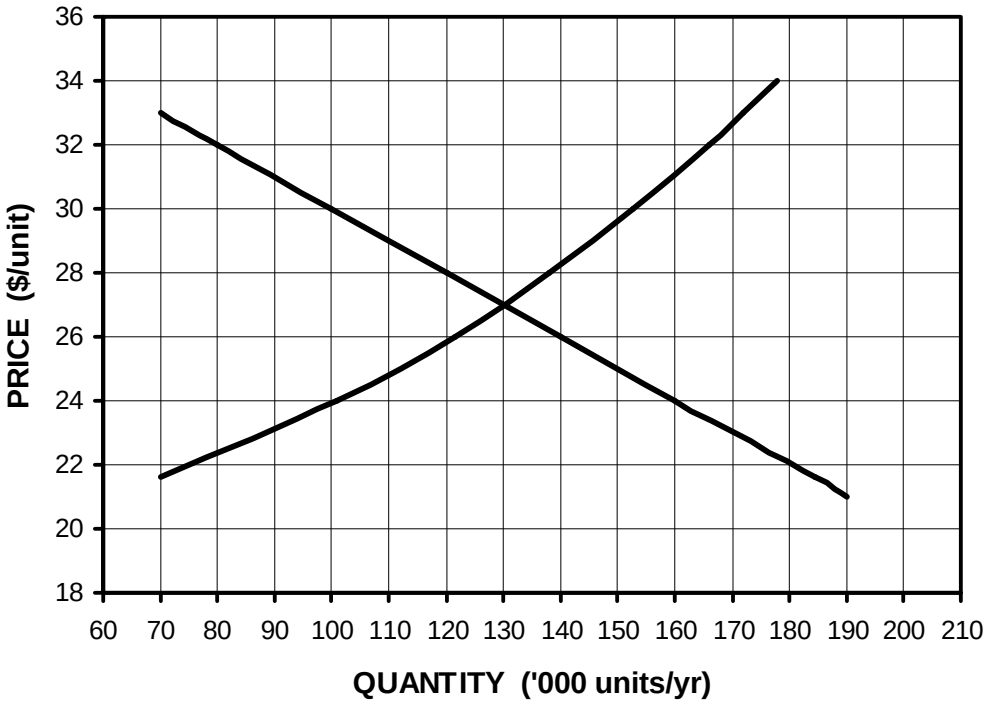
F O R E W O R D

The following are selected problems from Engineering Economy final examinations, arranged by chapters of the Engineering Economy Notes. Their purpose is to give you examples of typical problems that you should be able to solve in the course of an exam. These are supplied without solutions (answers are given for numerical problems), to maximize the benefits that you will derive from solving them on your own. If you have questions concerning any particular problem, please consult the course instructor(s) or TAs during the appropriate hours.

Prof. Bilodeau

CHAPTER 1. INTRODUCTION

1.1 The supply and demand curves for a particular product are shown in the figure below.



i) Determine the *arc elasticity of supply* between prices of $24 and $26 per unit. *[2.2]*
ii) Determine the *total consumer expenditure* under equilibrium conditions. *[$3 483 000]*
iii) Given that the introduction of new technology causes the supply curve to shift to higher levels by an amount of 20 000 units (at all prices), determine graphically the *new equilibrium price and quantity*. *[$25.90, 142 000 units/yr]*

1.2 The demand schedule for a commodity traded in the Canadian market place is as follows:

Price ($/kg)	6	8	10	12	14	16	18	20
Quantity (10^6 kg/yr)	2.60	2.15	1.80	1.50	1.25	1.05	0.90	0.76

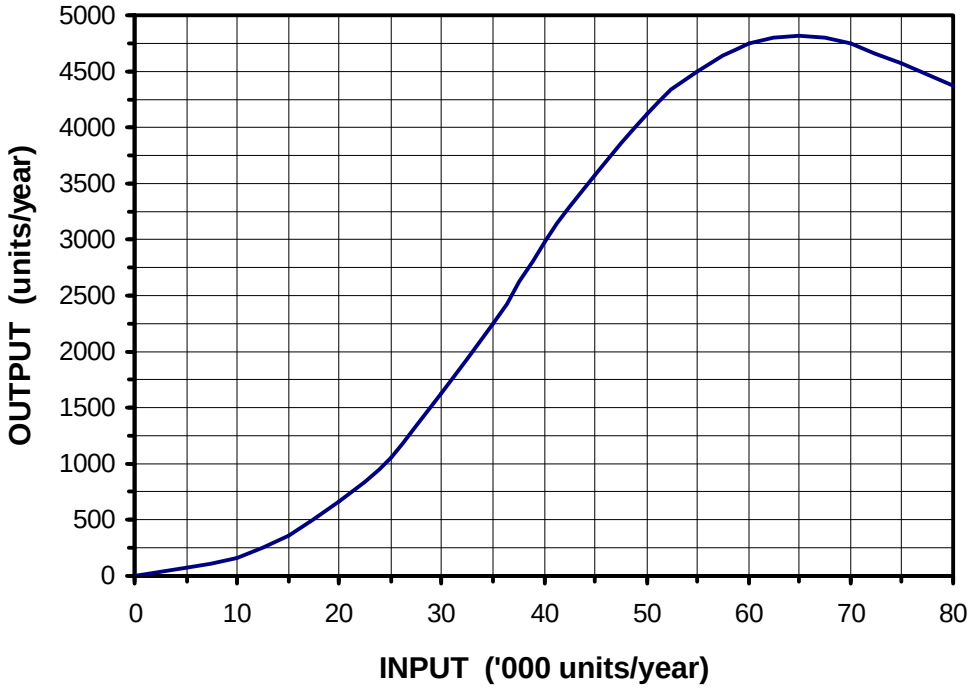
i) The market equilibrium is currently at $12/kg. What *change in total consumer expenditure* would occur if the commodity's price rose from $12/kg to $14/kg? [*$500 000 less]*
ii) Is the demand for this commodity *elastic or inelastic* in the $12-14/kg price range? Support your answer with an explanation. *[Elastic, because the total consumer expenditure decreases as the price increases]*
iii) Is the elasticity of demand unitary at a price somewhat *above, or below, the current equilibrium price* of $12/kg? Support your answer with an explanation. *[Below; as the total consumer expenditure decreases as the price increases, it should be maximized at a price below the current equilibrium price]*

1.3 Last month, twenty-eight million litres of gasoline were sold per week in the Montreal area at a price of $0.60 per unit. A recent increase in price of $0.04 per litre has caused weekly sales to decline by one million litres.

i) For the price range of concern above, determine the *arc elasticity* of demand for gasoline. *[0.56]*
ii) Determine the *total consumer expenditure* at the current market equilibrium point. *[$17.28 mil.]*

iii) Given the elasticity measure derived in part i above, *what effect (qualitative)*, if any, did the price increase have on total consumer expenditures? *[The total consumer expenditure increased because elasticity is less than 1]*

1.4 Based on the production function illustrated below, determine graphically the input levels for:



i) Maximum output; *[65 000 units]*
ii) Maximum productivity; *[52 500 units]*
iii) Maximum marginal product; *[40 000 units]*
iv) Maximum average product; *[52 500 units]*
v) Equal marginal product and average product; *[52 500 units]*
vi) The interface between Stages I and II; *[52 500 units]*
vii) The interface between Stages II and III. *[65 000 units]*

CHAPTER 2. PRINCIPLES OF ACCOUNTING

2.1 Below are selected balances from the accounts of Engec Incorporated as of 31 December, 1992, except where otherwise specified.

Fixed assets at cost	6000
Retained earnings on 31 Dec. 1991	1200
Cash	500
Accounts payable	450
Mortgage	1600
Inventory of finished products	600
Accounts receivable	800
Accumulated depreciation on 31 Dec. 1991	900
Net income for 1992	400
Taxes payable	50

Depreciation	400
Shareholders' equity	4500
Dividend declared and paid in 1992	100

i) In the form provided below, establish Engec's *Balance Sheet* as of 31 December, 1992. Please note that all necessary entries are given in the list above. *[Total assets of $6600]*
ii) Given that there were 1000 shares outstanding on 31 December, 1992, determine Engec Inc.'s *book value per share*. [*$4.50]*
iii) Determine Engec Inc.'s *working capital*. *[$1400]*
iv) Determine Engec Inc.'s *quick ratio*. *[2.6]*
v) Determine Engec Inc.'s *equity ratio*. *[0.68]*

2.2 Below are selected entries from the adjusted trial balance of Cutler Services Inc. as of 31 December 1994.

Net sales	250 000
Dividends declared and paid	5 000
Cost of goods sold	160 000
Administrative expenses	24 000
Property taxes	1 500
Accounts payable	2 000
Depreciation	8 000
Marketing expenses	6 500
Income taxes	20 000
Accumulated depreciation	40 000

i) Using the appropriate entries from the list given above, construct the *1994 Income Statement* for Cutler Services Inc. in the space provided below. *[Net profit of $30 000]*
ii) Determine the firm's *operating ratio* and comment on its value. *[0.8]*
iii) Determine the firm's *net profit ratio* and comment on its value. *[12%]*
iv) Given that the return on equity is 8 percent and that the debt ratio of Cutler Services Inc. is currently 0.25, determine the firm's *return on total assets* and comment on its value. *[6%]*

2.3 Given the following changes in Ernie Electric's Balance Sheet accounts over a period of one year, what *change in working capital* occurred in the interim? *[Increase of $15 000]*

Increase in cash	12 000
Decrease in long-term debt	15 000
Increase in inventories	8 000
Increase in accounts payable	6 000
Decrease in taxes payable	5 000
Increase in net fixed assets	9 000
Decrease in accounts receivable	4 000

2.4 Engec Inc.'s 'Net Fixed Assets' entry on its Balance Sheet of 31 December, 1991 was $830 000. The same entry on its previous year-end Balance Sheet of 1990 was $860 000. Given that Engec claimed depreciation expenses of $15 000 and declared and paid a dividend of $20 000 in 1991, determine the 'Fixed Assets' *entry amount*, if any, listed on the firm's 1991 Statement of Changes in Financial Position, and indicate whether that entry would be listed as a source (i.e. disposal of assets) or a use (i.e. purchase of assets) of funds. *[$15 000, listed as a source of funds]*

CHAPTER 4. PRODUCTION AND COST ANALYSES

4.1 A company that produces specialized electronic components has a maximum production capacity of 1500 units per month. The monthly fixed costs amount to $12 000, and the variable costs are $30 per unit for any quantity produced up to 500 units per month, and $25 per unit for that part of the total monthly production that exceeds 500 units.

i) Determine the average production cost at a rate of 700 units per month. *[$45.71]*
ii) What is the marginal production cost at a rate of 700 units per month? *[$25]*
iii) Given a selling price of $50 per unit, determine the company's break-even production rate. *[580 units]*

4.2 Engec Incorporated manufactures and markets micro-computer components. The selling price of the product, which is stable throughout a wide range of sales volume, is $20 per unit. The total monthly production costs, in thousands of dollars, are given by:

$$TC = 15 + 12\,Q + Q^2$$

In which Q is the monthly production rate and sales volume in thousands of units.

i) What are the monthly *fixed production costs*? *[$15 000]*
ii) Determine the *average production cost* at a monthly rate of 3000 units. *[$20]*
iii) Determine the *marginal production cost* at a monthly rate of 4000 units. *[$20]*
iv) Determine the monthly *production rate* at which average production cost is minimized. *[3873 units]*
v) Determine the *break-even production rate*. *[3000 units]*
vi) Determine the *production rate* that maximizes total monthly profits. (4000 units)

4.3 A chemical manufacturing company is considering three different methods of shipping waste material to a disposal area. The study period is 10 years and the company's cost of capital is 15 percent. All methods could easily handle the expected volume of waste material. The following cost estimates have been generated for the three methods:

Method	A	B	C
Initial investment ($)	26 600	20 100	12 000
Fixed annual maintenance costs ($)	4 500	5 500	8 000
Variable costs, including labour ($/tonne)	0.010	0.012	0.008

i) Determine the *break-even volume of waste* (tonnes/yr of material) between methods A and B. *[147 725 t/yr]*
ii) Determine the volume of waste (tonnes/yr of material) at which methods B and C are *economically equivalent*. *[221 418 t/yr]*
iii) For what *ranges of annual volume of waste* is each method preferred? *[B is preferred below 147 725 t/yr; C is preferred above 295 110 t/yr; A is preferred in between]*

CHAPTER 5. SOURCES OF FUNDS AND THE COST OF CAPITAL

5.1 A business firm with an overall corporate income tax rate of 55 percent must raise funds for a new project. The following sources are available:

- Bonds: Face value of $1000 with coupon rate of 12 percent paid quarterly, maturing in 16 years; issuing expenses of $40; no discount will be offered.
- Common Shares: Current market price of $75; dividend of $6 expected at year-end, with anticipated growth rate of 5.2 percent; issuing expenses of $4.
- Retained Earnings

i) Determine the *after-tax cost of raising funds through debt*. *[5.7%]*
ii) Determine the *after-tax cost of raising funds through common shares*. *[13.4%]*
iii) Given that the company's policy is to maintain a debt to equity ratio of 0.43 and that 30 percent of the equity requirement can be satisfied from its current retained earnings, determine the *weighted-average after-tax cost of capital* associated with the financing. *[11.0%]*

5.2 A medium-size business firm with an overall corporate income tax rate of 45 percent financed a particular project using the following mixture of funds:

- 30% Bonds: Face value of $500; annual coupon rate of 10 percent paid quarterly; maturing in 15 years; issuing expenses of $25; no discounts.
- 10% Preferred Shares: Face value of $100 with annual dividend of 11 percent; issuing expenses of $8.
- 40% Common Shares: Current market price of $60; current annual dividend of $6, with expected growth rate of 8 percent per year; issuing expenses of $5.
- 20% Retained Earnings

i) If kept to maturity, what *before-tax return on investment* will the bonds yield to the bondholder? *[10.4%]*
ii) Determine the *after-tax cost of raising funds through debt*. *[5.9%]*
iii) Determine the *after-tax cost of raising funds through common equity*. *[19.2%]*
iv) Using the information given for common equity, determine the firm's *after-tax cost of retained earnings*. *[18.8%]*

CHAPTER 6. PROJECT EVALUATION CRITERIA

6.1 A new water line must be constructed from an existing pumping station to a reservoir located at a distance of 600 metres from the station. Cost estimates for three pipe sizes have been made as follows:

Pipe Size (cm)	Pumping Cost ($/ '000 m^3)	Construction Cost ($)
20	2.00	19 000
25	1.50	37 000
30	0.75	62 000

Assume that construction costs are incurred at time 0 and that the pipe has a life of 16 years at the end of which there is no salvage value. Using a cost of capital of 15 percent,

i) What annual volume of water is required to render the 20 cm and 25 cm pipes economically equivalent? [6044.4 '000 m^3]
ii) What annual volume of water is required to render the 25 cm and 30 cm pipes economically equivalent? [5596.6 '000 m^3]
iii) For what ranges of annual water requirements is each pipe size most economical? [The 20 and 30 cm pipes are economically equivalent at an annual volume of 5783.8 '000 m^3; therefore, the 20 cm pipe is preferred below 5783.8 '000 m^3 and the 30 cm pipe is preferred above 5783.8 '000 m^3]

6.2 The following mutually exclusive investment alternatives are being considered:

Alternative	A	B	C	D
Immediate investment ('000 $)	75	100	160	200
Uniform annual benefits ('000 $)	10	20	30	50

All four alternatives have 10-year lives and negligible salvage values. The minimum acceptable return on investment is 12 percent and there are no budgetary restrictions.

i) Determine alternative A's rate of return. *[5.6%]*
ii) Determine alternative B's present value ratio. *[0.13]*
iii) Determine alternative C's benefit-cost ratio. *[1.06]*
iv) Determine alternative D's equivalent annual value (return or cost). *[$14.6 thousand]*
v) Which alternative should be selected? *[Select D with the highest NPV]*

6.3 Newspaper vending machines cost $1399, have a negligible salvage value, and generate annual cash flows of $500. The owner of these vending machines has a cost of capital of 12 percent.

i) *For how many years must a machine be operative* to yield a before-tax rate of return of 16 percent? *[4 yrs]*
ii) If a machine were used indefinitely, what *before-tax rate of return* would it yield? *[35.7%]*

6.4 New equipment must be purchased for use in a warehouse to handle an additional workload. The equipment is to handle 8000 tonnes of goods per year, for which the estimated revenue is $6 per tonne. The equipment has an initial cost of $50 000. Its service life is five years and annual operating expenses consist of a fixed cost component of $10 000 and a variable component of $2 per tonne. The salvage value of the equipment is negligible. The equipment is to be depreciated by the straight-line method over its service life (do not apply any Canadian corporate income tax system particularities here). The corporate income tax rate is 40 percent and the cost of capital is 12 percent.

i) Determine the *distribution of after-tax cash flows* associated with this project; *[-$50 000 at time 0 and $17 200 from time 1 to 5]*
ii) Determine the *after-tax net present value* of the project; *[$12 003]*
iii) Determine the *absolute sensitivity* of the after-tax net present value to a 20 percent increase in unit variable costs. *[The net present value decreases by $6922]*
iii) Determine the absolute *sensitivity* of the after-tax net present value to a 20 percent decrease in revenue per tonne; *[The net present value decreases by $20 764]*
iv) *To which variable is the net present value more sensitive*, unit variable costs or revenue per tonne? *[Revenue per tonne]*

CHAPTER 7. INCOME TAX CONSIDERATIONS

7.1 A machine that costs $75 000 has a useful life of 5 years and an estimated salvage value of $20 000. The machine is to be depreciated by the declining-balance method at an annual rate of 30 percent (neglect the half-year rule). The corporate income tax rate is 40 percent and the cost of capital is 15 percent.

i) Given an annual cost saving of $25 000, determine the *after-tax net present value* of the investment proposal. *[$2577]*
ii) Determine the *minimum annual cost saving* required to justify the purchase of the machine. *[$23 718]*

7.2 Two machines are available for performing the same task in a plant. Machine A costs $75 000 and can be operated for $12 000 per year. It has a salvage value of $15 000 at the end of a useful life of 4 years. Machine B costs $105 000 and can be operated for $9000 per year. It has a salvage value of $20 000 after a useful life of 6 years.

Both machines are to be depreciated by the declining-balance method at an annual rate of 20 percent (ignore the half-year rule, but assume the Canadian CCA pool system). The company's overall corporate income tax rate is 45 percent and its after-tax cost of capital is 10 percent.

i) Determine the *present worth after-tax cost equivalents* of the machines over their respective lives. *[A: $66 249; B: $87 156]*

ii) Based on present value analysis, *which machine should be chosen? Why? [Machine B is preferred because it has the lowest present worth cost equivalent over a common analysis period of 12 years]*

7.3 A project has the following specifications:

Preproduction period (yrs):	2
Production period (yrs):	5
Preproduction investment (mil. $):	
Capital expenditures incurred over year 1	4
Capital expenditures incurred over year 2	6
Working capital	1
Projected annual revenues (mil. $):	10
Projected annual operating expenses (mil. $):	4
Salvage value (mil. $):	2

For tax purposes, capital expenditures can be depreciated by the straight-line method at a rate of 25 percent per year. Depreciation allowances cannot be used to create losses. Any gain or loss on the disposal of assets is taxable in the year of disposal. The corporate tax rate is 40 percent.

i) Determine the *before-tax cash flow distribution* associated with the project. *[From years 1 to 7: -4, -7, 6, 6, 6, 6, 9]*
ii) Given that a non-integrated tax position is applicable, determine the *after-tax cash flow distribution* associated with the project. *[From years 1 to 7: -4, -7, 4.6, 4.6, 4.6, 4.6, 5.8]*
iii) Given that an integrated tax position is applicable, determine the *after-tax cash flow distribution* associated with the project. *[From years 1 to 7: -3.6, -6, 4.6, 4.6, 4.2, 3.6, 5.8]*

7.4 Real estate was purchased 4 years ago for $350 000. The property consisted of a small apartment building worth $250 000, and land valued at $100 000. The property has just been sold for $410 000, of which $150 000 represents the land value. The building, the only asset in its class, was depreciated by the declining-balance method at a rate of 10 percent per year over the period of ownership. If the overall income tax rate is 45 percent, 75 percent of any capital gain is taxable, and no capital losses are available to offset a capital gain, determine:

i) The *capital gain* associated with the sale of the property; *[$60 000]*
ii) The *capital gains tax*; *[$20 250]*
iii) The *after-tax proceeds* from the sale of the property. *[$351 061.25]*

CHAPTER 8. INFLATION

8.1 The table below lists the current-dollar gold price for the 1980-90 time period as well as the U.S. Consumer Price Index (CPI) series for the same period.

Year	Price (U.S. $/oz)	CPI (1985=100)
1980	613	77
1981	460	84
1982	376	90
1983	424	93
1984	360	97
1985	317	100
1986	368	102

1987	446	106
1988	437	110
1989	381	115
1990	384	121

i) What is the *1985 gold price expressed in constant 1990 dollars*? *[$384]*
ii) If the base year of the price index series is changed from 1985 to 1990, determine the *revised price index for 1980*. *[64]*
iii) Has the constant dollar price of gold *remained relatively stable* during the 1980-90 period? If not, briefly *describe its behaviour*? *[No; constant 1990$ prices: 963, 663, 506, 552, 449, 384, 437, 509, 481, 401, 384; long-term decrease with short-term cycling]*

8.2 The current $ cash flow distribution associated with a five-year project is shown below.

Time	0	1	2	3	4	5
CF ('000 $)	-10 000	4 000	4 500	5 000	5 500	6 500

Assuming that an inflation rate of 6 percent per annum is expected over the next eight years, and using a constant-dollar cost of capital of 15 percent when appropriate, determine the following:

i) The project's *Payback period*. *[2.5 yrs]*
ii) The project's *Present value ratio*. *[0.398]*

Instead of assuming a constant annual inflation rate of 6 percent as described above, suppose that the inflation rate is expected to vary as indicated below.

Year	1	2	3	4	5	6	7	8
Rate (%)	2	2	4	4	6	6	8	8

iii) Determine the project's *Net present value* under these conditions. *[$5222 thousands]*

8.3 A project has the following cash flow distribution, in which the monetary values are expressed in constant dollars:

Time	0	1	2	3	4	5	6	7	8
Cash Flow (mil. $)	-5	-10	-15	10	10	10	15	15	16

Using a constant-dollar cost of capital of 12 percent where appropriate, determine the following:

i) The project's constant-dollar *Payback period*. *[3 yrs]*
ii) The project's constant-dollar *discounted Payback period*. *[3.9 yrs]*
iii) The project's *Net present value*. *[$14.11 mil.]*
iv) The project's *Present value ratio*. *[0.55]*
v) The project's constant-dollar *Rate of return*. *[24.5%]*

Assuming that the cash flows given above are expressed in current dollars and that the general monetary inflation rate is expected to be 8 percent per annum over the next 10 years, determine the following:

vi) The project's *Net present value*. *[$2.94 mil.]*
vii) The project's constant-dollar *Rate of return*. *[15.3%]*

8.4 A project has the following specifications:

Preproduction period (yrs):	2
Production period (yrs):	6
Preproduction investment (mil. constant $):	
Capital expenditures incurred over year 1	10
Capital expenditures incurred over year 2	15
Working capital	2

For tax purposes, capital expenditures can be depreciated by the straight-line method at a rate of 20 percent per year (do not apply any Canadian corporate income tax system particularities here). An annual inflation rate of 10 percent is expected over the project's life.

i) Assuming that there is enough income to absorb all depreciation allowances in any particular production year of the project, that a non-integrated tax position is applicable, and that losses cannot be created with depreciation allowances, determine the *depreciation allowance schedule* used for the purpose of deriving taxable income over the life of the project. *[From years 1 to 8: 0, 0, 5.83, 5.83, 5.83, 5.83, 5.83, 0]*

ii) Assuming that there is enough corporate income to absorb all depreciation allowances in any particular year and that an integrated tax position is applicable, determine the *depreciation allowance schedule* used for the purpose of deriving taxable income over the life of the project. *[From years 1 to 8: 2.2, 5.83, 5.83, 5.83, 5.83, 3.63, 0, 0]*

CHAPTER 9. SENSITIVITY AND RISK ANALYSES

9.1 An investment proposal has the following specifications:

Initial Investment (mil. $)	Prob.
1.5	0.8
1.8	0.2

Annual Cash Flow ($)	Prob.
300 000	0.3
400 000	0.5
500 000	0.2

Project Life (yrs)	Prob.
4	0.3
5	0.6
6	0.1

Assume that the salvage value is negligible, that all three variables are independent, and that the minimum acceptable return on investment is 10 percent. Ignore the effect of income taxes.

i) Determine the *most probable rate of return* of this investment proposal. *[10.4%]*
ii) If implemented, determine the *probability of financial success* of the project. *[46.8%]*

9.2 A manufacturing firm is considering the production of a new electronic device. This project has an estimated life of 7 years and requires an initial capital outlay of $5.2 million. The salvage value is negligible. The fixed production costs will amount to $1 million per year. However, the demand and the unit variable production costs (assumed constant within the plant's range of operating capacities) for such a new device are uncertain. A market survey and a detailed cost analysis has yielded the following information concerning these parameters:

Annual Demand (units)	Prob.
40 000	0.2
50 000	0.5
60 000	0.3

Unit Variable Costs ($)	Prob.
40	0.1
45	0.2
50	0.6
55	0.1

The firm's cost of capital is 15 percent and the selling price of the new device is $100 per unit. Assume that annual demand and unit variable production costs are independent.

i) Determine the *expected total annual operating costs*. *[$3 473 500]*
ii) Determine the *most-likely net present value*. *[$1 040 600]*
iii) What is the project's *probability of financial failure*? *[18%]*

CHAPTER 10. EQUIPMENT REPLACEMENT

10.1 Modern Inc. is using an old piece of equipment to manufacture engine components. Serious maintenance problems have been occurring recently and Modern must either replace the equipment or perform a complete overhaul. The used equipment has a scrap value of $5000. The complete overhaul costs $27 000 and is expected to prolong the useful life of the equipment by five years. End-of-year salvage values and annual operating costs following the overhaul are estimated as shown below:

Year	Salvage Value ($)	Operating Costs ($)
1	21 000	12 000
2	16 800	13 700
3	13 400	15 800
4	10 800	18 400
5	8 600	20 900

Modern has a cost of capital of 12 percent and is subjected to a corporate income tax rate of 40 percent. The equipment is to be depreciated at a declining-balance rate of 20 percent per year (assume the Canadian corporate income tax pool system, but ignore the half-year rule). Modern favours the trade-in approach in its equipment replacement decisions.

i) Determine the *net present equivalent after-tax capital expenditure* (i.e. net of the salvage value) associated with the overhauled equipment given that it is kept for a period of five years. *[$16 590]*
ii) Determine the *equivalent annual after-tax operating costs* associated with the overhauled equipment over its useful life of five years. *[$9393]*
iii) Using a cost of capital of 0 percent rather than a value of 12 percent as specified above, determine the *economic life* of the overhauled equipment. *[2 yrs]*
iv) What would be the effect of using a cost of capital of 12 percent in iii above? Provide a qualitative response only, and justify your answer. *[The economic life would be longer because increasing operating expense effect would be dampened]*

10.2 At the end of half of its economic life, a 4-year-old machine with an original cost of $9200 has a book value of $5888. Estimated operating costs over the coming year will amount to $6000. The machine has a current salvage value of $3600 which is expected to decrease by $800 if kept one more year. An equipment dealer proposes a new machine to perform the same function over the remaining 4 years of the project. Its purchase price of $12 500 includes installation. It is estimated that the new machine

will have relatively stable annual operating costs of $4500, and can be resold for $3000 after 4 years of use.

Both machines are depreciated by the declining-balance method at an annual rate of 20 percent (ignore the half-year rule) and the corporate income tax rate is 40 percent. The company's minimum acceptable return on investment is 15 percent.

i) Using the opportunity cost approach, determine the *after-tax cost associated with keeping the used machine for one more year*. *[$4636]*
ii) If the trade-in approach is used in the question above, what would be the *after-tax cost of keeping the used machine for one more year*? *[$1440]*
iii) Using the opportunity cost approach, determine the *equivalent annual after-tax cost associated with the new machine* for the 4-year period over which it is required. *[$5614]*
iv) Based on the opportunity cost approach, what is your *recommendation* concerning this replacement proposal? *[Keep old machine for now and reassess later]*

10.3 Granite Construction Co. is assessing whether it should replace or overhaul its four-year-old earth moving equipment. The overhaul costs $8000 and would extend the life of the existing equipment by 4 years. Annual operating costs would then amount to $2500. The current market value of the existing equipment is $2000 but, if overhauled and retained for another 4 years, it would have no recoverable value. New equipment costs $20 000, has a useful life of 6 years, relatively constant annual operating costs of $1500, and a salvage value of $3300.

Assume that the firm requires a 15 percent return on investment and uses the opportunity cost approach to assess equipment replacement proposals. Earth moving equipment is a class 10 asset, depreciated by the declining-balance method at an annual rate of 30 percent (ignore the half-year rule). The firm is subject to a 40 percent corporate income tax rate.

i) Determine the *equivalent annual after-tax cost* of the new equipment over its useful life of 6 years. *[$4498]*
ii) Based on the cost characteristics of the new equipment given above, what should be its *economic life*? *Justify your answer*. *[The economic life is the useful life, i.e. 6 years, because the annual operating costs remain relatively constant]*
iii) Determine the *equivalent annual after-tax cost* of the overhauled equipment over its life of 4 years. *[$4069]*
iv) *Which alternative is preferred? Justify your answer. [The overhaul alternative is preferred because of its lower equivalent annual cost]*