

**PRAIRIE VIEW A&M UNIVERSITY
ROY G. PERRY COLLEGE OF ENGINEERING
DEPARTMENT OF CHEMICAL ENGINEERING
CHEG 2308- Economic Analysis and Technical Applications
SPRING 2022**

I. COURSE DESCRIPTION IN ABET FORMAT

II ASSESSMENT RESULTS FOR CURRENT AND PAST THREE PERIODS

Program Outcomes Assessed in Course

Assessment Summary of Class Semester Averages for Outcomes

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Original Test Questions & Master Solution/grading scheme used

(Summary of topics can be a separate page or include on the assignment itself)

Above Average (Graded original work)

Average (Graded original work)

Below Average (Graded original work)

III. HOMEWORK ASSIGNMENTS

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Original Homework Questions & Master Solution/grading scheme used

Above Average (Graded original work)

Average (Graded original work)

Below Average (Graded original work)

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Above Average (Graded original work)

Average (Graded original work)

Below Average (Graded original work)

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Above Average (Graded original work)

Average (Graded original work)

Below Average (Graded original work)

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Summary of Topics Covered by Project

Project Problem Statement and Grading Scheme

Above Average (Graded original work)

Average (Graded original work)

Below Average (Graded original work)

CHEMICAL ENGINEERING DEPARTMENT

CHEG 2308 ECONOMICS ANALYSIS AND TECHNICAL APPLICATIONS

1. **Course number and name:** CHEG 2308 ECONOMICS ANALYSIS AND TECHNICAL APPLICATIONS

2. **Credits, contact hours, categorization:** 3 credit hours; 3 contact hours; general education

3. **Instructor's or course coordinator's name:** Dr. Kazeem Olanrewaju

4. **Text book:**

Title: ENGINEERING ECONOMIC ANALYSIS

Author: Donald G. Newman, Ted G. Eschenbach, and Jerome P. Lavelle

Publisher, Year & Edition: Oxford University Press, New York, 2017, 14th Edition

a. Other Supplemental material

 1. "Basics of Engineering Economy" By Leland Blank and Anthony Tarquin. 2008. McGraw- Hill Higher Education. ISBN 978-0-07-340129-4

 2. C. S. Park, Contemporary Engineering Economics, 4th Ed. 2007, Prentice-Hall. ISBN- 0-13-187628

 3. Sullivan, W.G., Wicks and Koelling, J.A. Engineering Economy, 14th Edition, 2009, Prentice-Hall. ISBN -10-0136142974

5. **Specific course information**
 - a. Brief description of the content of the course (catalog description) CHEG 2308. Economic Analysis and Technical Applications. (3-0) Credit 3 semester hours. Fundamental concepts of economic principles. Evaluation of technical alternatives, economic significance of technical proposals; interest, description, analysis, and forecasting.

 - b. Prerequisites or Co-requisites MATH 2413 Calculus with Analytical Geometry

 - c. *Indicate whether a required, elective, or selected elective (as per definition provided) course in the program Required

6. **Specific goals for the course**

Students will be able to :

 - i. Understand and be able to apply the principles of economics and their applications in Engineering.

 - ii. Understand the crucial role project alternatives play in the

areas of production, processing, fabrication and manufacturing of all man-made products.

iii. Understand the concept of profitability or cost of the project as a necessary condition for giving the project the green light for funding and execution.

iv. Apply and understand the technical and engineering aspects of assessing different projects either in their professional career or in private life.

- b. Explicitly indicate which of the student outcomes listed in Criterion 3 and 4 or any other outcomes are addressed by the course.

This course addresses:

Chemical Engineering Department student outcome D1 (An ability to identify, formulate, and solve fundamental engineering problems by applying principles of engineering, science, and mathematics). It also evaluates students' ability to communicate effectively with a range of audiences (ABET outcome 3). Students are presented with examples that deal with management of cash inflow and outflow for projects and as such were fortified with the ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts (ABET outcome 4).

7 Brief list of topics to be covered

Making Economic Decisions	(3 hours)
Estimating Engineering Costs and Benefits	(4 hours)
Interest and Equivalence	(5 hours)
Equivalence for Repeated Cash Flows	(6 hours)
Present Worth Analysis	(5 hours)
Annual Cash Flow Analysis	(1 hours)
Rate of Return Analysis	(8 hours)
Choosing the Best Alternative	(6 hours)
Benefit/Cost Analysis and Public Sector Project	(3 hours)
Breakeven and Payback Period Analyses	(6 hours)

II ASSESSMENT RESULTS FOR CURRENT AND PAST THREE PERIODS

Program Outcomes Assessed in this course

Outcome 1:

An ability to identify, formulate, and solve complex engineering problems (CEP) by applying principles of engineering, science, and mathematics.

Outcome 3:

An ability to communicate effectively with a range of audiences

Outcome 4:

An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts

Assessment Summary of Class Semester Averages for Outcomes (Should be provided for Fall 2019 through Spring 2022 Assessment Period)

Outcomes	1	3	4
Semester	Semester Class Average (%)	Semester Class Average (%)	Semester Class Average (%)
Spring 2022	76.8	80.3	80.3
Spring 2021	76.1	87.2	87.2
Spring 2020	78.9	82.4	82.4
Fall 2019	92.6	84.4	84.4
Comments on Trend of Data (Improving or deteriorating)	Students' average performance is was observed to decrease drastically between Fall 2019 to Spring 2021 but with a slight increase in Spring 2022. The reason for the decrease may likely be due to student still recovering from the online mode of classes. Students' percent meeting expected average was significantly above the threshold limit of 70%.	Students average performance is relatively even between Fall 2019 and Spring 2020 but a significant increase in the Spring 2021 semester was observed. While in Spring 2022, a sizeable decrease in the average relative to Spring 2021 was observed. An impressive percent of students meeting expected average was observed the last three semester (Fall 2019, Spring 2020, and Spring 2021)	Students average performance is relatively even between Fall 2019 and Spring 2020 but a significant increase in the Spring 2021 semester was observed. While in Spring 2022, a sizeable decrease in the average relative to Spring 2021 was observed. An impressive percent of students meeting expected average was observed the last three semester (Fall 2019, Spring 2020, and Spring 2021)

*Expected Semester Class Average = 70% (or as defined by the program)
Ideal Semester Class Average = 75% (or as defined by the program)

End of Semester Course Assessment Reports Fall 2019 and Last Three Assessment Periods.

Each summary contains the following Information

1. Performance Statistics

- Total number of students in class
- The class average performance (**stated as %**) in each course outcome assessed in this class and the **two previous times course was assessed**.
- The acceptable class average for the class in each outcome area as set by your Department.
- Percentage of students who scored below the expected average in each outcome.

2. Implementation Summary

- Brief summary of plans implemented during the semester based on last assessment report

3. Perceived Problems

- Instructor's **critical evaluation** of perceived problems that affected students' performance. **Realistic problems should be identified throughout the semester and summarized in this section of the report.**

4. New Plans for Addressing Problems

- Instructor's plans for addressing the perceived problems the next time the class is taught. **These should be specific enough for another instructor to implement. Most of these should be things that, you, the instructor can implement to help students to improve. Be creative.**

5. Overall Trend over last three assessment periods

- Instructors summary of overall performance trend for each outcome measured over the last three periods.

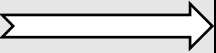
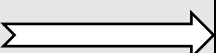
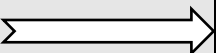
5. Were Expectations Met?

- Answer **YES** if the **class average was above the expected average** and the **stated percentage of students** scored at or above the expected average, else answer **NO**.

END OF SEMESTER COURSE OUTCOME ASSESSMENT REPORT
CHEG 2308-P01: ECONOMIC ANALYSIS WITH TECHNICAL
APPLICATION SPRING 2022 SEMESTER

Report Prepared by: Dr. Kazeem B. Olanrewaju

Report Date: May 23, 2022

Semester	Analysis Type	Number of Students	Outcome D1 An ability to identify, formulate, and solves engineering problems by applying principles of engineering, science, and mathematics.”				Outcome 3 An ability to communicate effectively with a range of audiences (Written and Oral)				Outcome 4 An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.			
			Expected Class Average	Expected Percent of students at or above average	Class Average	% Students meeting Expected Average	Expected Class Average	Expected Percent of students at or above average	Class Average	% Students meeting Expected Average	Expected Class Average	Expected Percent of students at or above average	Class Average	% Students meeting Expected Average
Spring 2022	Direct	17	75	70	76.8	83.3	75	70	80.3	66.7	75	70	80.3	66.7
Spring 2021	Direct	30	75	70	76.1	63.3	75	70	87.2	100	75	70	87.2	100
Spring 2020	Direct	29	75	70	78.9	65.5	75	70	82.4	100	75	70	82.4	100
Fall 2019	Direct	27	75	70	88.9	92.6	75	70	84.4	100	75	70	84.4	100
Implementation Summary			A considerable time was spent explaining how to develop cash flow diagram, its translation to cash flow equation. Student were constantly be engaged umpteenth times by asking them questions during lecture/class time				The instructor emphasized the need to follow technical writing structure and reference citation were emphasized during delivery of the projects				Students were assisted with skills needed to use various economic tools such as rate of return, modified internal rate of return, to make an informed decision that will have a lasting impact on humanity within the global, environmental and societal contexts			
Perceived Problems			1. Students are not proactive in solving homework and practice problems given to them for proper understanding of the concept taught in class. 2. Insufficient problem solving time 3. Students expressed challenges with understanding cash flow diagram representation and interpretation and also conversion of nominal rate of return to effective				1. Reference citation remain a challenge 2. Appropriate use of technical terms and clarity in sentence construction still remain an issue				Student still find it challenging relating the impact of this economic informed decision through the use of economic tools such as rate of return within global, environmental and societal contexts			
Plans for Addressing Problems			The following is recommended for implementation: 1 Create enough time for problem solving session 2. Attention should still be given to cash flow diagram representation and interpretation 3. Faculty should solve several example problems on converting nominal rate of return to effective rate of return				Recommendation: 1. Reference citation should be emphasize in their technical writing class and Instructor should conduct a class session on rules guiding technical writing such as reference citation 2. Emphasis on adhering to the format and structure of the report				Recommendation: Instructor should assist student skill needed to connect economic decision based on economic tools such as rate of return with its impacts on humanity within the global, environmental and societal contexts			
Overall Trend over Periods			Students’ average performance is was observed to decrease drastically between Fall 2019 to Spring 2021 but with a slight increase in Spring 2022 The reason for the decrease may likely be due to student still recovering from the online mode of classes. Students’ percent meeting expected average was significantly above the threshold limit of 70%.				Students average performance is relatively even between Fall 2019 and Spring 2020 but a significant increase in the Spring 2021 semester was observed. While in Spring 2022, a sizeable decrease in the average relative to Spring 2021 was observed. An impressive percent of students meeting expected average was observed the last three semester (Fall 2019, Spring 2020, and Spring 2021).				Students average performance is relatively even between Fall 2019 and Spring 2020 but a significant increase in the Spring 2021 semester was observed. While in Spring 2022, a sizeable decrease in the average relative to Spring 2021 was observed. An impressive percent of students meeting expected average was observed the last three semester (Fall 2019, Spring 2020, and Spring 2021)			
Were Expectations Met?	Class Average $\geq 75\%$ and $\geq 70\%$ of Students Performed at or Above Expected Average.		Yes				No				No			

ECONOMIC ANALYSIS AND TECHNICAL APPLICATIONS SPRING 2022

Title of Assignment: TEST 1

TOPICS COVERED IN TEST 1

Test 1 covered the following topics:

1. The Decision-Making Process
2. Fixed, Variable, Marginal, and Average Costs
3. Considering All costs
4. Breakeven Analysis
5. Time Value of Money

**ECONOMIC ANALYSIS AND TECHNICAL
APPLICATIONS SPRING 2022**

**SAMPLE TEST QUESTIONS, SOLUTION,
AND GRADING SCHEME FOR TEST 1**

Prairie View A & M University, CHEG 2308: Economics Analysis and Technical Applications
Spring 2022: Test 1, Tuesday, February 22, 2022, Instructor: Dr. Kazeem Olanrewaju

Name of Student: _____

Problem 1 (60 points)

MechanoBio Engineering in Nevada is making a biomedical devices for the Eurocarribean-asian market. The following costs for the product have been compiled.

Item	Cost
Selling price (r)	\$345/unit
Materials and purchased parts cost	\$30/unit
Direct labor cost	3 hrs. at \$25 per hour
Operating and maintenance (O & M) cost per unit	\$15
Advertisement cost per device	\$10
Fixed cost	\$8,750,000

Given that the variable cost per unit (v) includes direct labor cost, operating and maintenance cost, the overhead expenses (which is charged at 160 % of the direct labor cost hourly rate), advertisement cost per device and the cost of materials and purchased parts, and Q as the total number of quantity produced in a year:

- Write the total cost and total revenue relation for the year.
- Calculate the annual breakeven quantity for this product.
- Determine the total profit and profit per unit if 250% of the annual breakeven quantity are sold
- To reduce the annual breakeven quantity to 35,000 units, what should be the selling price?

Problem 2 (40 points)

BitDigitalcoin microfinance inc. lends Mr Amadion \$12000 for 8 years at 9% per year, compounded annually; then the entire proceeds generated from the lending are invested for 12 years at 10 % per annum simple interest. How much money will BitDigitalcoin microfinance inc. have at the end of the entire 20-year period?

Hints: $Profit = TR - TC$;

$$Profit = rQ - (FC + vQ)$$

$$Q = \text{Annual Quantity}$$

$$Q_{BE} = FC / (r - v)$$

$$C.I = \text{Principal}(1+i)^n - \text{Principal}$$

$$S.I = \text{Principal} * \text{Time} * \text{Rate}$$

ENGR ECON TGST 1 SPRING 2022

Problem 1

Given:

(5)

Item	Cost
Selling price (P)	\$345/unit
Materials and purchased part cost	\$30/unit
Direct Labor Cost	3 hrs at \$25 per hour
Operating and maintenance (O & M)	\$15
Cost per unit	
Advertising cost per device	\$10
Fixed cost (FC)	\$8750 000

Formula

Overhead expenses $\equiv$ 160% of the Direct labor ~~rate~~ cost hourly rate

$$VC = VC \Rightarrow \text{Variable Cost}$$

(9) To write total cost and total revenue equation for the year

$$\therefore \text{Total Cost, } TC = VC + FC$$

(10)

$$V = \frac{\$30}{\text{unit}} + \left(\frac{3 \text{ hrs} \times 25}{\text{unit}} \right) + \frac{\$15}{\text{unit}} + \frac{\$10}{\text{unit}} + \left(\frac{160}{100} \times \frac{\$25}{\text{unit}} \right)$$

$$V = \$30 + \$75 + \$15 + \$10 + \$40$$

$$V = \$170$$

$$\therefore TC = \$170Q + \$8750 000$$

(2)

Total Revenue, $TR = rQ$

$$\therefore TR = \$345Q$$

(b) To calculate the annual breakeven quantity for this product (10)

$\therefore$ Breakeven quantity, $= Q_{BE}$ i.e. $TR = TC$

$$Q_{BE} = \frac{FC}{r - v}$$

$$\therefore Q_{BE} = \frac{\$8750000}{\$345 - 170} = \frac{8750000 \text{ unit}}{345 - 170}$$

$$Q_{BE} = \frac{8750000 \text{ unit}}{175}$$

$$Q_{BE} = 50000 \text{ unit}$$

(c) To determine the total profit and profit per unit if 250% of the annual breakeven quantity are sold (20)

$$\text{Total profit} = TR - TC$$

$$\begin{aligned} \text{Total profit} &= \$345Q - [\$170Q + \$8750000] \\ &= \$345Q - \$170Q - \$8750000 \end{aligned}$$

$$\text{But } Q = 2.5 \times Q_{BE} = 2.5Q_{BE}$$

$$Q = 2.5(50000) = 125000 \text{ unit}$$

(3)

$$\begin{aligned}\text{Total profit} &= 8345(125000) - \$170(125000) - \$8750000 \\ &= \$175(125000) - \$8750000\end{aligned}$$

$$\text{Total profit} = \$13125000$$

$$\begin{aligned}\therefore \text{Profit per unit} &= \frac{\text{Total Profit}}{Q} \\ &= \frac{\$13125000}{125000}\end{aligned}$$

$$\text{Profit per unit} = \$105 \text{ unit}$$

(d) The selling price to reduce the annual breakeven quantity to 35000 units

(15)

$$\therefore Q_{BE} = 35000 \text{ units}$$

$$V = \$170/\text{units}$$

$$x = ?$$

$$\therefore Q_{BE} = \frac{FC}{x - V} = \frac{\$8750000}{(x - 170)/\text{units}}$$

$$Q_{BE} = 35000 \text{ units}$$

$$\therefore 35000 \text{ units} = \frac{\$8750000}{x - \$170/\text{units}}$$

$$x - \frac{\$170}{\text{units}} = \frac{\$8750000}{35000 \text{ units}}$$

(4)

$$x = \frac{\$170}{\text{units}} = \frac{\$250}{\text{units}}$$

$$\therefore x = (\$250 + \$170) / \text{units}$$

$$x = \$420 / \text{unit}$$

Problem 2

Given:-

Stage 1:-

Principal, $P = \$12000$

$n = 8 \text{ yrs}$

Compound Interest rate, $i = 9\%$ per year

(10)

Stage 2:-

$n = 12 \text{ yrs} \Rightarrow \text{Time}$

Simple Interest rate, $i = 10\%$ per year $\rightarrow \text{rate}$

Total Year for the Investment = 20 yrs

Formulas:-

$$C.I = \text{Principal} (1+i)^n - \text{Principal}$$

$$S.I = \text{Principal} \times \text{Time} \times \text{Rate}$$

Solve:-

Stage 1

$$C.I = 12000 (1 + 0.09)^8 - 12000$$

$$C.I = \$11910.75$$

(10)

(5)

Stage 2

The Principal for the second stage is

(15)

$$\begin{aligned}\text{Principal} &= \$11910.75 + 12000 \\ &= \$23910.75\end{aligned}$$

$$\begin{aligned}\therefore \text{S.I} &= \text{Principal} \times \text{Time} \times \text{Rate} \\ &= \$23910.75 \times 12 \text{ yrs} \times 0.1 \\ \text{S.I} &= 28692.90\end{aligned}$$

$\therefore$ The total amount accrued by Mr. Anandam after his 20 yrs investment is.

$$\begin{aligned}\text{Total Amount} &= \$23910.75 + 28692.90 \\ &= \$52603.65\end{aligned}$$

(5)

ABOVE AVERAGE

Above Average Student Original Graded Assignment

Prairie View A & M University, CHEG 2308: Economics Analysis and Technical Applications
Spring 2022: Test 1, Tuesday, February 22, 2022, Instructor: Dr. Kazeem Olanrewaju

Name of Student: Kennedy Dart

100
100

Problem 1 (60 points)

MechanoBio Engineering in Nevada is making a biomedical devices for the Eurocaribbean-asian market. The following costs for the product have been compiled.

Item	Cost
Selling price (r)	\$345/unit
Materials and purchased parts cost	\$30/unit
Direct labor cost	3 hrs. at \$25 per hour
Operating and maintenance (O & M) cost per unit	\$15
Advertisement cost per device	\$10
Fixed cost	\$8,750,000

Given that the variable cost per unit (v) includes direct labor cost, operating and maintenance cost, the overhead expenses (which is charged at 160 % of the direct labor cost hourly rate), advertisement cost per device and the cost of materials and purchased parts, and Q as the total number of quantity produced in a year:

- Write the total cost and total revenue relation for the year.
- Calculate the annual breakeven quantity for this product.
- Determine the total profit and profit per unit if 250% of the annual breakeven quantity are sold
- To reduce the annual breakeven quantity to 35,000 units, what should be the selling price?

Problem 2 (40 points)

BitDigitalcoin microfinance inc. lends Mr Amadion \$12000 for 8 years at 9% per year, compounded annually; then the entire proceeds generated from the lending are invested for 12 years at 10 % per annum simple interest. How much money will BitDigitalcoin microfinance inc. have at the end of the entire 20-year period?

Hints: $Profit = TR - TC$;

$$Profit = rQ - (FC + vQ)$$

$Q = \text{Annual Quantity}$

$$Q_{BE} = FC / (r - v)$$

$$C.I = Principal(1+i)^n - Principal$$

$$S.I = Principal * Time * Rate$$

Kennedy Part

① identify:

selling price (r) = \$345/unit
 materials = \$30/unit
 direct labour = $(3 \times \$25)$ (S)
 operating/maintenance = \$15
 Advertising = \$10
 Fixed cost (F_c) = \$8,750,000

formulate: Profit = $TR - T_c$

$$TR = r \times Q$$

$$T_c = V_c + F_c \text{ where } V_c = v \times Q$$

from statement:

$$v = (3 \times \$25) + 15 + \left(\frac{100}{100} \times 25\right) + 10 + 30$$

$$v = 170$$

$$V_c = v \times Q = 170Q$$
 (S)

$$F_c = \$8,750,000$$

$$r = \$345$$

solve:

a) $T_c = F_c + V_c$

$$= \$8,750,000 + 170Q$$
 (S)

$$TR = r \times Q$$

$$TR = \$345Q$$

b) annual break even Q

@ break even, profit = 0

$$\therefore TR = T_c$$

$$8,750,000 + 170Q = 345Q$$

$$175Q = 8,750,000$$

$$Q = \frac{8,750,000}{175}$$

$$Q = 50,000 \text{ units}$$
 (10)

c) determine total profit & profit/unit ($Q = \frac{250}{100} Q_{Be}$)
 $P = TR - T_c$

$$\text{profit} = 345Q - (8,750,000 + 170Q)$$

$$\Rightarrow Q = \frac{250}{100} (50,000)$$

$$Q = 125,000$$

$$\text{Profit} = 345(125,000) - (8,750,000 + 170(125,000))$$

$$\text{Profit} = 4.31 \times 10^7 - 8,750,000 - 21,875,000$$

$$\text{Profit} = \$13,125,000$$

$$\frac{\text{profit}}{\text{unit}} = \frac{\text{Profit}}{Q} = \frac{13,125,000}{125,000}$$

$$\text{profit/unit} = \$105/\text{unit}$$

d) reduce annual break even to 35,000 units
 what is r ?
 @ break even, Profit = 0

$$\therefore TR = T_c$$

$$r \times Q = 8,750,000 + 170Q$$

$$r(35,000) = 8,750,000 + 170(35,000)$$

$$r = \frac{14,700,000}{35,000}$$

selling price

$$r = \$420/\text{unit}$$

(2)

identify: $P = 12000$
 $n = 8 \text{ years}$

$$C.I. = 9\% = 0.09$$

$$S.I. = 10\% = 0.1$$

$$n_{S.I.} = 12 \text{ years}$$

How much
will the company
have @ 20 years

Kennedy Deet

formulate: $C.I. = P(1+i)^n$ - Principal
 $S.I. = P \times t \times r$

(10)

solve: 2 stages

stage 1: compounded

$$C.I. = 12,000 / (1 + 0.09)^8 = 12,000$$

$$C.I. = 11,910.7517$$

$$\text{total} = \frac{12,000 + 11,910.75}{2} = 23,910.75 = \text{new P!}$$

(10)

stage 2: simple

$$S.I. = P \times t \times r$$

$$= (23,910.75)(12)(0.1)$$

$$S.I. = \$28,692.9$$

$$\text{total} = 23,910.75 + 28,692.9 = \$52,603.65$$

(15)

total amount
the company
will have
@ the
end of
the year

$$\boxed{\$52,603.65}$$

(15)

AVERAGE

Average Student Original Graded Assignment

Prairie View A & M University, CHEG 2308: Economics Analysis and Technical Applications
Spring 2022: Test 1, Tuesday, February 22, 2022, Instructor: Dr. Kazeem Olanrewaju

Name of Student: Manuela Angunu Micha' Nchama

21
10

Problem 1 (60 points)

MechanoBio Engineering in Nevada is making a biomedical devices for the Eurocaribbean-asian market. The following costs for the product have been compiled.

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Fixed cost	\$8,750,000

Given that the variable cost per unit (v) includes direct labor cost, operating and maintenance cost, the overhead expenses (which is charged at 160 % of the direct labor cost hourly rate), advertisement cost per device and the cost of materials and purchased parts, and Q as the total number of quantity produced in a year:

- Write the total cost and total revenue relation for the year.
- Calculate the annual breakeven quantity for this product.
- Determine the total profit and profit per unit if 250% of the annual breakeven quantity are sold
- To reduce the annual breakeven quantity to 35,000 units, what should be the selling price?

Problem 2 (40 points)

BitDigitalcoin microfinance inc. lends Mr Amadion \$12000 for 8 years at 9% per year, compounded annually; then the entire proceeds generated from the lending are invested for 12 years at 10 % per annum simple interest. How much money will BitDigitalcoin microfinance inc. have at the end of the entire 20-year period?

Hints: $Profit = TR - TC$;

$$Profit = rQ - (FC + vQ)$$

Q = Annual Quantity

$$Q_{BE} = FC / (r - v)$$

$$C.I = Principal(1+i)^n - Principal$$

$$S.I = Principal * Time * Rate$$

①

Materials and Purchased → \$30 unit
 Direct labor → 3 hrs × \$25 = \$75
 Operating and maintenance → \$15
 Advertisement cost per device → \$10

$$V = \$30 + \$75 + \$15 + \$10 =$$

$$V = \$130$$

$$T_A = V \times Q$$

$$V_C = V \times Q$$

$$V_C = \$130Q$$

$$T_C = T_F + T_A$$

$$a) T_C = \$8,750,000 + 130Q$$

$$b) \text{Break-even} \rightarrow \text{profit} = 0$$

$$\$345 - \$130 = \$215$$

$$\text{Break-even} = \frac{\$8,750,000}{\$215} =$$

$$Q = 40,697 \text{ units}$$

c) Determine the total profit

$$(40,697 \times 160\%) \times 345 = \$22,464,744$$

$$T_C = \$8,750,000 + 130(40,697)$$

$$T_C = \$14,040,610$$

$$\text{Total Profit} = \$22,464,744 - \$14,040,610 =$$

$$\text{Total profit} = \$8,424,134$$

$$\text{Profit per unit} = \frac{\text{Total profit}}{Q(250\%)} = \frac{\$8,424,134}{40,697(2.5)} = \frac{\$8,424,134}{101,742.5}$$

$$\text{Profit per unit} = \$82.79$$

$$d) 35,000 \times 160 = \$5,600,000$$

$$\text{Fixed cost} = \$8,750,000$$

$$\$14,350,000$$

$$\frac{\$14,350,000}{35,000} =$$

$$\text{Selling price} = \$410$$

②. - $P = \$12,000$

$n = 8$

$r = 9\%$

$S.I = Prt$

$S.I = \$12,000 \times (10\%) \times 12 \text{ years}$

$S.I = \$14,400$

$A = P(1+r)^t$

$9\% = 0.09$

$A = \$14,000 (1 + 0.09)^8$

$A = \$14,000 (1.992)$

$A = \$27,888$

BELOW AVERAGE

Below Average Student Original Graded Assignment

Prairie View A & M University, CHEG 2308: Economics Analysis and Technical Applications
Spring 2022: Test 1, Tuesday, February 22, 2022, Instructor: Dr. Kazeem Olanrewaju

Name of Student: Paternsein Manana Enyanga Oboya

70
100

Problem 1 (60 points)

MechanoBio Engineering in Nevada is making a biomedical devices for the Eurocaribbean-asian market. The following costs for the product have been compiled.

Item	Cost
Selling price (r)	\$345/unit
Materials and purchased parts cost	\$30/unit
Direct labor cost	3 hrs. at \$25 per hour
Operating and maintenance (O & M) cost per unit	\$15
Advertisement cost per device	\$10
Fixed cost	\$8,750,000

Given that the variable cost per unit (v) includes direct labor cost, operating and maintenance cost, the overhead expenses (which is charged at 160 % of the direct labor cost hourly rate), advertisement cost per device and the cost of materials and purchased parts, and Q as the total number of quantity produced in a year:

- Write the total cost and total revenue relation for the year.
- Calculate the annual breakeven quantity for this product.
- Determine the total profit and profit per unit if 250% of the annual breakeven quantity are sold
- To reduce the annual breakeven quantity to 35,000 units, what should be the selling price?

Problem 2 (40 points)

BitDigitalcoin microfinance inc. lends Mr Amadion \$12000 for 8 years at 9% per year, compounded annually; then the entire proceeds generated from the lending are invested for 12 years at 10 % per annum simple interest. How much money will BitDigitalcoin microfinance inc. have at the end of the entire 20-year period?

Hints: $Profit = TR - TC$;

$$Profit = rQ - (FC + vQ)$$

Q = Annual Quantity

$$Q_{BE} = FC / (r - v)$$

$$C.I = Principal(1+i)^n - Principal$$

$$S.I = Principal * Time * Rate$$

$$a) T_c = F_c + V_c (1) + 4$$

$$V_c = 30 + 15 + 3(25) + 10$$

$$= 130Q$$

$$T_c = 8,750,000 + 130Q$$

(6)

Share to TR

$$b) \text{Break even} \Rightarrow Q = \frac{F_c}{r - v} = \frac{8,750,000}{345 - 130} = 40,000 \text{ units}$$

(8)

$$c) T_{\text{Profit}} = rQ - (F_c - vQ)$$

$$= 345(40,000) - (8,750,000 - 130(40,000))$$

$$= \$10,250,000$$

$$T_c = 8,750,000 + 130(40,000)$$

$$= \$13,950,000$$

$$T_R = \$34,500,000$$

(14)

$$T_{\text{Profit}} = T_R - T_c = 34,500,000 - 13,950,000$$

$$T_{\text{Profit}} = \$20,550,000$$

Paternocio Marana Engaña Obano

2) Investment 1

$$P = \$12000$$

$$t = 8 \text{ years}$$

$$r = 9\% = 0.09$$

Compound CI

$$CI = P(1+i)^n - P$$

$$= 12000(1+0.09)^8 - 12000$$

$$= \$14910.75$$

$$A = P + CI = \$12000 + \$14910.75$$

$$A = \$23910.75$$

Investment 2

$$P = \$20640$$

$$r = 10\% = 0.1$$

$$t = 20 \text{ years}$$

Simple Interest

$$SI = P \times r \times t$$

$$= 23910 \times 0.1 \times 20 = \$47,821.5$$

$$A = P + SI$$

$$= \$23,910.75 + \$47,821.5$$

$$= \$71,732.25$$

Answer: After the entire period, BitDigitalcoin will have \$71,732.5

Paternocio Manana Engonga Obono

ECONOMIC ANALYSIS AND TECHNICAL APPLICATIONS SPRING 2022

Title of Assignment: HOMEWORK 5

TOPICS COVERED IN HOMEWORK 5

1. Nominal and Effective Rate of Return
2. Present Worth Analysis
3. Equivalent Uniform Annual Worth
4. Gradient and Uniform Series Payment

**ECONOMIC ANALYSIS AND TECHNICAL
APPLICATIONS SPRING 2022**

**SAMPLE HOMEWORK 5 QUESTIONS, SOLUTION,
AND GRADING SCHEME FOR HOMEWORK 5**

CHEG 2308: Economics Analysis and Technical Application Assignment

Homework 5 (04/25/2022)

Instructor section

Major Evaluation Rubric	Percentage Score for Student	Assessment Aggregate Score
Identify		
Formulate		
Solve		
Total		

CHEG 2308: Economics Analysis and Technical Application Assignment

Homework 5

Due date: 04/25/2022

Name of student: _____

Problem 1

Chevron Corporation is planning operating an oil fracking project with a Canadian company. The project will run for the next 10 years with an initial investment of \$425,000 and annual operating cost of \$90,000 for the next 5 years, and \$125,000 in years 6, 7, and 8 while Chevron Corporation plan to spend 50% of the operating cost in year 3 for the last two years of the project. Another alternative project Chevron Corporation is considering is with BP Oil with an initial investment of \$1.2 M and annual operating cost of \$50,000 for the first 6 years and \$65,000 per year for the remaining four years.

Chevron also plans to sell some of its equipment used for the fracking at the end of the project life. The salvage value (S) for those equipment which decreases by 11% per year, is estimated by the following equation:

$$S = \text{initial investment} \times (1 - 0.11)^n ; \text{ where } n \text{ is the project life}$$

If both projects are operated at a MARR of 12%, which of the project would you advise Chevron Corporation to invest their money. Please ensure you draw the Cash flow diagram for the two Alternatives.

Problem 2

A series of quarterly cash flows began with the first cash flow on March 31, 1991 and ends with the last cash flow on Dec 31, 1999. The first quarterly cash flow is equal to \$25,000. Each successive cash flow increases \$750. The series of quarterly cash flows is equivalent to a series of equal semi-annual cash flows. The equivalent series of equal semi-annual cash flows starts with the first cash flow occurring on June 30, 1996. The last equal semi-annual cash flow in the equivalent series occurs on December 31, 2009. Use a nominal interest rate of 12% per year compounded monthly for both cash flow analysis consider equivalent. Determine the amount of each equal semi-annual cash flow in the equivalent series

(1)

ENGR ECONs Homework 5 SPRING 2022 SOLUTION

Problem 1

Given:

Canadian company Alternative

$$P = \$425000$$

$$A_{1-5} = \$90000$$

$$A_{6-8} = \$125000$$

$$A_{9-10} = 0.5 \times \$90000 = \$45000$$

$$n = 10 \text{ yrs}$$

$$\bar{i} = 12\% \text{ per year}$$

$$\text{Salvage} \Rightarrow F_{10} = 425000(1 - 0.11)^{10} = \$132522.31$$

(5)

BP oil Alternative

$$P = \$1200000$$

$$A_{1-6} = \$50000$$

$$A_{7-10} = \$65000$$

$$n = 10 \text{ yrs}$$

$$\bar{i} = 12\% \text{ per year}$$

$$\text{Salvage} \Rightarrow F_{10} = \$1200000(1 - 0.11)^{10} = \$374180.64$$

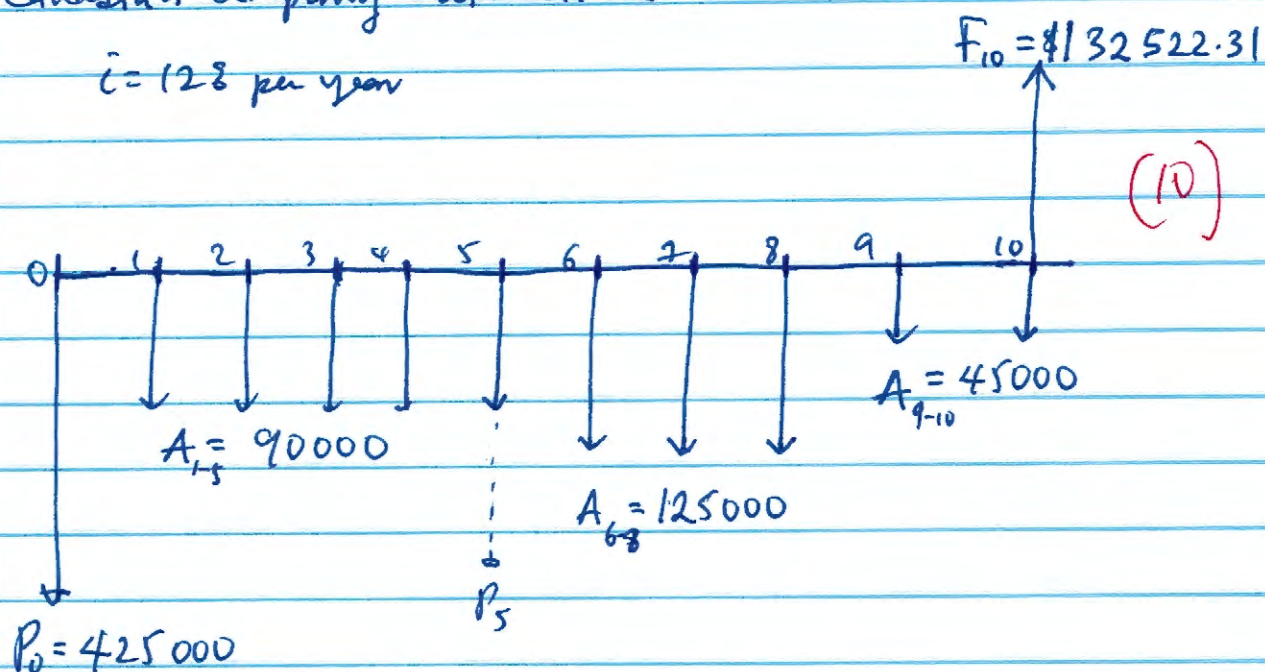
Formulate

$$P = F(P/F, \bar{i}, 10) ; \quad P = A(P/A, \bar{i}, 10)$$

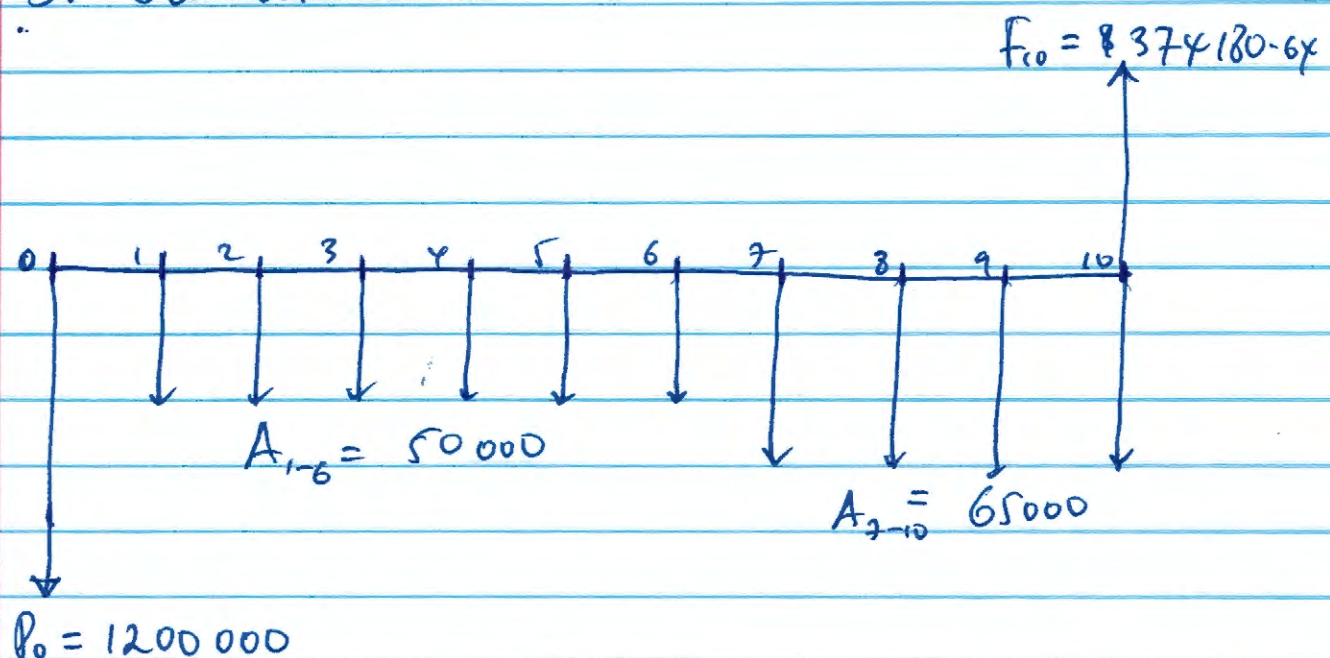
(2)

Solve
Canadian Company alternative

$\bar{i} = 12\%$ per year



BP oil alternative



(3)

$$PW_{\text{Canadian}} = -425000 + 132522.31 (P/F, 12\%, 10) - 90000 (P/A, 12\%, 5) \\ - P_5 (P/F, 12\%, 5) - 45000 (F/A, 12\%, 2) (P/F, 12\%, 10) \\ \text{But } P_5 = 125000 (P/A, 12\%, 3)$$

$$PW_{\text{Canadian}} = -425000 + 132522.31 (P/F, 12\%, 10) - 90000 (P/A, 12\%, 5) \\ - 125000 (P/A, 12\%, 3) (P/F, 12\%, 5) - 45000 (F/A, 12\%, 2) (P/F, 12\%, 10)$$

$$PW_{\text{Canadian}} = -425000 + 132522.31 (0.3220) - 90000 (3.6048) \\ - 125000 (2.4018) (0.5674) - 45000 (2.1200) (0.3220)$$

$$PW_{\text{Canadian}} = \$-907826.28$$

$$PW_{\text{BP}} = -1200000 + 50000 (P/A, 12\%, 6) + 374180.64 (P/F, 12\%, 10) \\ - 65000 (F/A, 12\%, 4) (P/F, 12\%, 10)$$

$$PW_{\text{BP}} = -1200000 - 50000 (4.1114) + 374180.64 (0.3220) \\ - 65000 (4.7793) (0.3220)$$

$$PW_{\text{BP}} = \$-1385114.58$$

I would advise Chevron Corporation to invest their money into the ~~fracker~~ oil fracking project with a Canadian company because the Present Worth for the Canadian Option is numerically larger than the BP oil option.

Problem 2Given:

$$A = \$25000$$

$$G = \$750$$

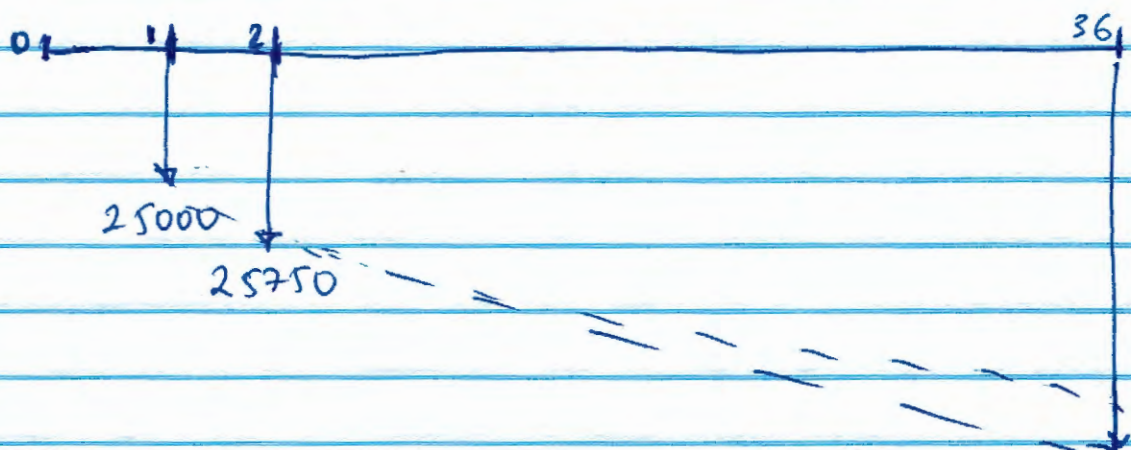
Nominal interest rate, $r = 12\%$ per year compounded monthly $N = 36$ quarter $\rightarrow$ first cash flow series $N = 28$ semi-annual $\rightarrow$ second cash flow seriesformulate

$$P = F(P/F, \bar{i}, n); \quad P = A(P/A, \bar{i}, n), \quad P = G(P/G, \bar{i}, n)$$

$$A = G(A/G, \bar{i}, n) \quad F = P(F/P, \bar{i}, n)$$

Solve

first cash flow series: gradient quarterly cash flow



$$A = \$25000$$

$$G = \$750$$

 $r = 12\%$ per year compounded monthly

(5)

$i = 1\%$ per month compounded monthly.
 nominal rate r per quarter compounded monthly = 3% .

$$\bar{i}_{\text{eff}} = \left(1 + \frac{0.03}{3}\right)^3 - 1 = 0.0303 \quad (5)$$

$$\therefore \bar{i}_{\text{eff}} = 3.03\%$$

$\therefore$ PW, for First Cash flow series $\Rightarrow$ quarterly.

$$PW_1 = 25000 (P/A, 3.03\%, 36) + 750 (P/G, 3.03\%, 36) \quad (10)$$

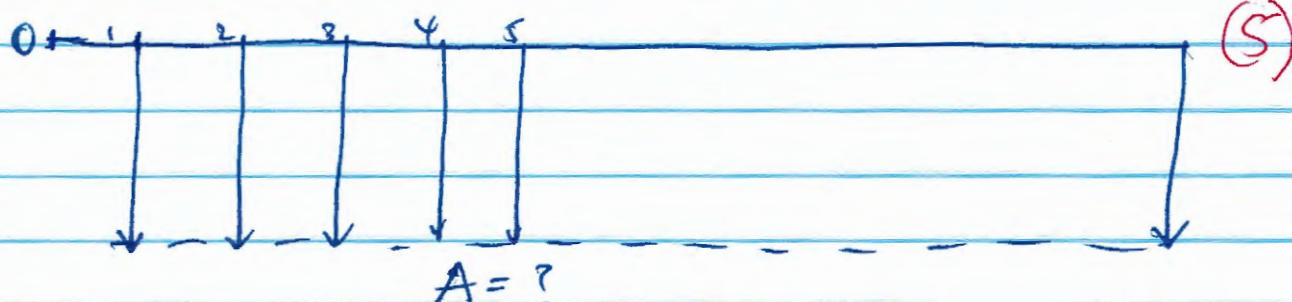
$$PW_1 = 25000 \left[\frac{(1 + 0.0303)^{36} - 1}{0.0303(1 + 0.0303)^{36}} \right] + \frac{750}{0.0303} \left[\frac{(1 + 0.0303)^{36} - 1}{0.0303(1 + 0.0303)^{36}} - \frac{36}{(1 + 0.0303)^{36}} \right]$$

$$PW_1 = 25000 [21.735] + 24752.48 [21.735 - 12.293]$$

$$PW_1 = \$543375 + \$233712.92$$

$$PW_1 = \$777087.92$$

Second Cash flow series $\div$ equal semi-annual cash flow



(6)

$\hat{i} = 1\%$ per month compounded monthly
 nominal rate r per semi-annual compounded monthly = 6%

$$\therefore \hat{i}_{eff} = \left(1 + \frac{0.06}{6}\right)^6 - 1 = 0.06152 \quad (5)$$

$$\hat{i}_{eff} = 6.152\%$$

$\therefore$ PW for Second Cash flow series $\Rightarrow$ Semi-annually.

$$PW_2 = A(P/A, 6.152, 28) \quad (10)$$

$$\text{But } PW_2 = PW_1$$

$$\therefore \boxed{PW_2 = \$777087.92}$$

$$777087.92 = A \left[\frac{(1 + 0.06152)^{28} - 1}{0.06152(1 + 0.06152)^{28}} \right]$$

$$777087.92 = A \left[\frac{4.321}{0.3273} \right]$$

$$777087.92 = A \times 13.202$$

$$\therefore A = \frac{777087.92}{13.202} = \$58861.38$$

$$\boxed{A = \$58861.38} \quad (5)$$

ABOVE AVERAGE

Above Average Student Original Graded Assignment

CHEG 2308: Economics Analysis and Technical Application Assignment

Homework 5 (04/25/2022)

Instructor section

Major Evaluation Rubric	Percentage Score for Student	Assessment Aggregate Score
Identify		
Formulate		
Solve		
Total		

CHEG 2308: Economics Analysis and Technical Application Assignment

Homework 5

Due date: 04/25/2022

Name of student: Tyler Mannings

95/100

Problem 1

Chevron Corporation is planning operating an oil fracking project with a Canadian company. The project will run for the next 10 years with an initial investment of \$425,000 and annual operating cost of \$90,000 for the next 5 years, and \$125,000 in years 6, 7, and 8 while Chevron Corporation plan to spend 50% of the operating cost in year 3 for the last two years of the project. Another alternative project Chevron Corporation is considering is with BP Oil with an initial investment of \$1.2 M and annual operating cost of \$50,000 for the first 6 years and \$65,000 per year for the remaining four years.

Chevron also plans to sell some of its equipment used for the fracking at the end of the project life. The salvage value (S) for those equipment which decreases by 11% per year, is estimated by the following equation:

$$S = \text{initial investment} \times (1 - 0.11)^n ; \text{ where } n \text{ is the project life}$$

If both projects are operated at a MARR of 12%, which of the project would you advise Chevron Corporation to invest their money. Please ensure you draw the Cash flow diagram for the two Alternatives.

Problem 2

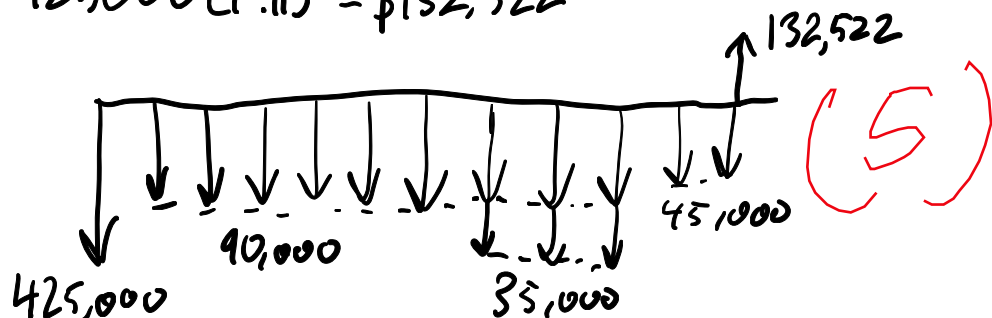
A series of quarterly cash flows began with the first cash flow on March 31, 1991 and ends with the last cash flow on Dec 31, 1999. The first quarterly cash flow is equal to \$25,000. Each successive cash flow increases \$750. The series of quarterly cash flows is equivalent to a series of equal semi-annual cash flows. The equivalent series of equal semi-annual cash flows starts with the first cash flow occurring on June 30, 1996. The last equal semi-annual cash flow in the equivalent series occurs on December 31, 2009. Use a nominal interest rate of 12% per year compounded monthly for both cash flow analysis consider equivalent. Determine the amount of each equal semi-annual cash flow in the equivalent series

Problem 1: $n = 10$ years

Alt. 1: $P_0 = \$425,000$, $A_{1-5} = \$90,000$, $A_{6-8} = \$125,000$

$$A_{9-10} = (0.5)(90,000) = \$45,000$$

$$S = 425,000(1.11)^{10} = \$132,522$$



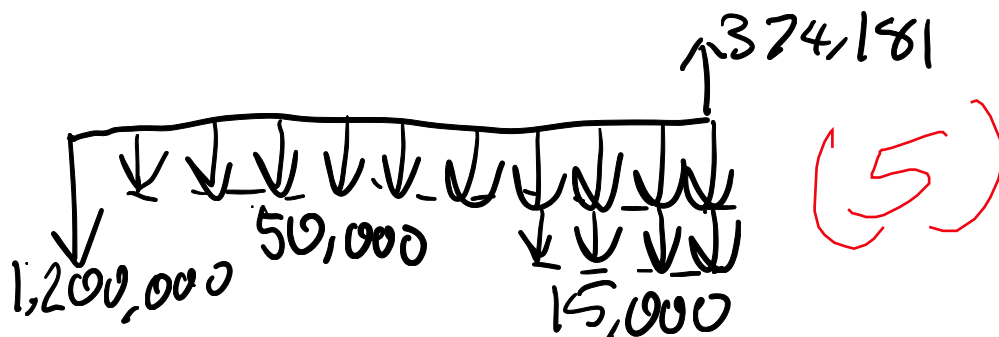
$$425,000 + 90,000(P/A, 12\%, 8) + 35,000(P/A, 12\%, 3)(P/F, 12\%, 5)$$

$$+ 45,000(P/A, 12\%, 2)(P/F, 12\%, 8) - 132,522(P/F, 12\%, 10)$$

$$= 425,000 + 90,000(4.9676) + 35,000(2.4018)(0.5674)$$

$$+ 45,000(1.6901)(0.4039) - 132,522(0.3220) = \$907,828$$

Alt 2:



$$1,200,000 + 50,000(P/A, 12\%, 10) + 15,000(F/A, 12\%, 4)(P/F, 12\%, 10)$$

$$- 374,181(P/F, 12\%, 10)$$

$$= 1,200,000 + 50,000(5.6502) + 15,000(4.7293)(0.3220)$$

$$- 374,181(0.3220) = \$1,385,107$$

Take alternative 1 as it is the cheaper option.

Problem 2:

9 yrs @ 4 payments/yr = 36 quarterly payments

(2009-1995) = 14 years

14 yrs @ 2 payments/yr = 28 bi-annual payments

$$i_{\text{eff quarterly}} = \left(1 + \frac{.12}{12}\right)^3 = 1.0303 / \text{quarter}$$

$$i_{\text{eff bi-annual}} = \left(1 + \frac{.12}{12}\right)^6 = 1.0615 / \text{semi-annum}$$

$$PW = 25,000(P/A, 0.0303, 36) + 750(P/G, 0.0303, 36)$$
$$= 25,000 \left(\frac{(1+0.0303)^{36} - 1}{0.0303 (1.0303)^{36}} \right) + 750 \left(\frac{(1.0303)^{36} - 1}{0.0303^2 (1.0303)^{36}} - \frac{36}{0.0303 (1.0303)^{36}} \right)$$

$$= 25,000(2.7349) + 750(311.658) = \$777,114$$

$$777,114(A/P, 0.0615, 28) = 777,114 \left(\frac{0.0615 (1.0615)^{28}}{(1.0615)^{28} - 1} \right)$$

$$= 777,114(0.07574) = \boxed{\$58,860}$$

AVERAGE

Average Student Original Graded Assignment

Donteneco

1. Cont

Case 2

Year	CF	PV	CF / CF
1	-120000	-1200000	$CF (1 + MARR)^1$
2	-50000	-44642.857	$CF (1 + MARR)^2$
3	-50000	-39857.694	$CF (1 + MARR)^3$
4	-50000	-35589.012	$CF (1 + MARR)^4$
5	-50000	-31775.904	$CF (1 + MARR)^5$
6	-50000	-28371.343	$CF (1 + MARR)^6$
7	-50000	-25331.556	$CF (1 + MARR)^7$
8	-65000	-29402.699	$CF (1 + MARR)^8$
9	-65000	-26252.411	$CF (1 + MARR)^9$
10	-65000	-23439.651	$CF (1 + MARR)^{10}$
11	-65000	-20928.26	$CF (1 + MARR)^{11}$
12	374181	-120470.151	$CF (1 + MARR)^{12}$

Sum - 1385117.2

Cash Flow

6000000

4000000

2000000

0

-200000

-4000000

-6000000

-8000000

-1000000

-1200000

-1400000

(3) 1 2 3 4 5 6 7 8 9 10 11 12

Point 11 & 12 are at end of 10th yr

70
150

Dante Neco

1. Case 1

MARR	12%	PV	CF
1	- 425000	- 425000	$CF / (1 + \text{MARR})^1$
2	- 90000	- 80357.143	$CF / (1 + \text{MARR})^2$
3	- 90000	- 71767.449	$CF / (1 + \text{MARR})^3$
4	- 90000	- 66060.222	$CF / (1 + \text{MARR})^4$
5	- 90000	- 57196.627	$CF / (1 + \text{MARR})^5$
6	- 90000	- 51068.417	$CF / (1 + \text{MARR})^6$
7	- 125000	- 63328.89	$CF / (1 + \text{MARR})^7$
8	- 125000	- 56543.652	$CF / (1 + \text{MARR})^8$
9	- 125000	- 50485.403	$CF / (1 + \text{MARR})^9$
10	- 45000	- 16227.451	$CF / (1 + \text{MARR})^{10}$
11	+ 132522	42668.637	$CF / (1 + \text{MARR})^{10}$

NPV: $\text{sum}(\text{All PV}) = -893346.62$

Cash Flow

200000

100000

-100000

-200000

-300000

-400000

-500000

Point 11 is end of 10th yr

I advise Case 1 for Chevron Corporation to invest their money

Dante Neco

2. Increase Amount = 750 (5)

1st Quarterly cash flow = 25,000

Nominal interest rate = 12%

first cash flow = 31 Dec 1991

cash flow = 30 June 1996

$$n = 5$$

$$\begin{aligned} \text{Present Worth} &= \left[\text{increase amount} \times \frac{(1+i)^n - 1}{i(1+i)^n - 1} \right] + \left[\text{1st cash flow} \times \frac{(1+i)^n - 1}{i(1+i)^n} \right] \\ &= 750 \times \left(\frac{(1+0.12)^5 - 1}{0.12(1+0.12)^5 - 1} \right) + 25000 \times \left(\frac{(1+0.12)^5 - 1}{0.12(1+0.12)^5} \right) \end{aligned}$$

$$= 90095.13$$

(3)

BELOW AVERAGE

Below Average Student Original Graded Assignment

CHEG 2308: Economics Analysis and Technical Application Assignment

Homework 5

Due date: 04/25/2022

Name of student: Kindrea Obeng

Problem 1

Chevron Corporation is planning operating an oil fracking project with a Canadian company. The project will run for the next 10 years with an initial investment of \$425,000 and annual operating cost of \$90,000 for the next 5 years, and \$125,000 in years 6, 7, and 8 while Chevron Corporation plan to spend 50% of the operating cost in year 3 for the last three years of the project. Another alternative project Chevron Corporation is considering is with BP Oil with an initial investment of \$1.2 M and annual operating cost of \$50,000 for the first 6 years and \$65,000 per year for the remaining four years.

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If both projects are operated at a MARR of 12%, which of the project would you advise Chevron Corporation to invest their money. Please ensure you draw the Cash flow diagram for the two Alternatives.

Problem 2

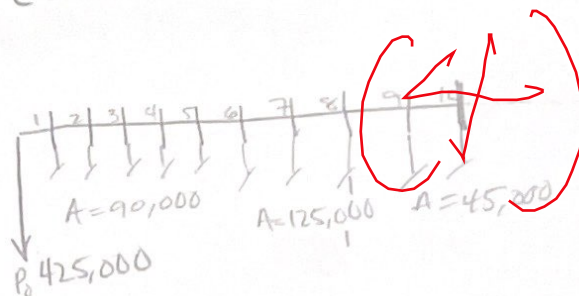
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Homework #5

Problem 1

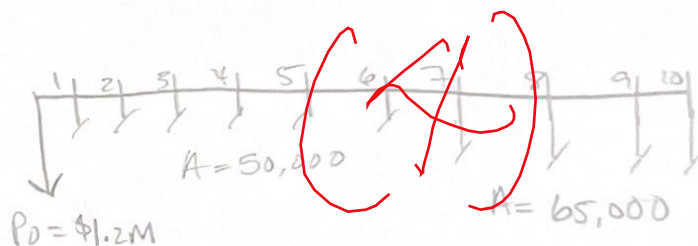
option 1 - Canadian (Chevron Corp)

yr	P	A
0	425,000	0
1		90,000
2		90,000
3		90,000
4		90,000
5		90,000
6		125,000
7		125,000
8		125,000 + 45,000
9		45,000
10		45,000
10		$425,000 \times [1 - .11]^{10}$
		$= \$132,522.31$



option 2 - BP oil

yr	P	A
0	\$1.2M	0
1		50,000
2		50,000
3		50,000
4		50,000
5		50,000
6		50,000
7		65,000
8		65,000
9		65,000
10		65,000
10		$1.2M \times [1 - 0.11]^{10}$
		$= \$374,180.64$



$$NPV_2 = -1.2M + 50,000(P/A, 12\%, 10) + 65,000(P/A, 12\%, 4)$$

Option 1

$$\begin{aligned} NPW_1 &= -425,000 - 90,000 (P/A, 12\%, 10) - 125,000 (P/F, 12\%, 3) \\ &\quad - 80,000 (P/A, 12\%, 3) (P/F, 12\%, 10) = \\ &= -893,346.62 \end{aligned}$$

Option 2

$$NPW_2 = -1.2M - 50,000 (P/A, 12\%, 10) - 15,000 (P/F, 12\%, 4)$$

$$= \$ -1,325,117.20$$

Option 2

(3)

Problem 2

$$\begin{aligned}PW_{1996} &= 750 (P/A, 12\%, 5) + 25,000 (P/F, 12\%, 5) \\&= 750 (3.6048) + 25,000 (0.5674) \\&= \$16,888.60\end{aligned}$$

$$\begin{aligned}PW_{2009} &= 750 (P/A, 12\%, 13) + 16,888.60 (P/F, 12\%, 13) \\&= 750 (6.4235) + 16,888.60 (0.2292) \\&= \$8,688.49\end{aligned}$$

The cash flow decreases from 1996 to 2009 (2)

ECONOMIC ANALYSIS AND TECHNICAL APPLICATIONS SPRING 2022

MIDTERM EXAM

TOPICS COVERED IN MIDTERM EXAM

1. The Decision-Making Process
2. Fixed, Variable, Marginal, and Average Costs
3. Considering All costs
4. The Estimating Process
5. Estimating Models: Segmenting Model
6. Equivalence
7. Cash Flow Diagram
8. Relationship Between Compound Interest Factors
9. Arithmetic Gradient
10. Present Worth Analysis
11. Rate of Return
12. Annual Cash Flow Analysis

**ECONOMIC ANALYSIS AND TECHNICAL
APPLICATIONS SPRING 2022**

MIDTERM EXAM QUESTIONS

Name of Student: _____

For each problem draw the cash flow diagram (except problem 1) even if you are not required to do so.

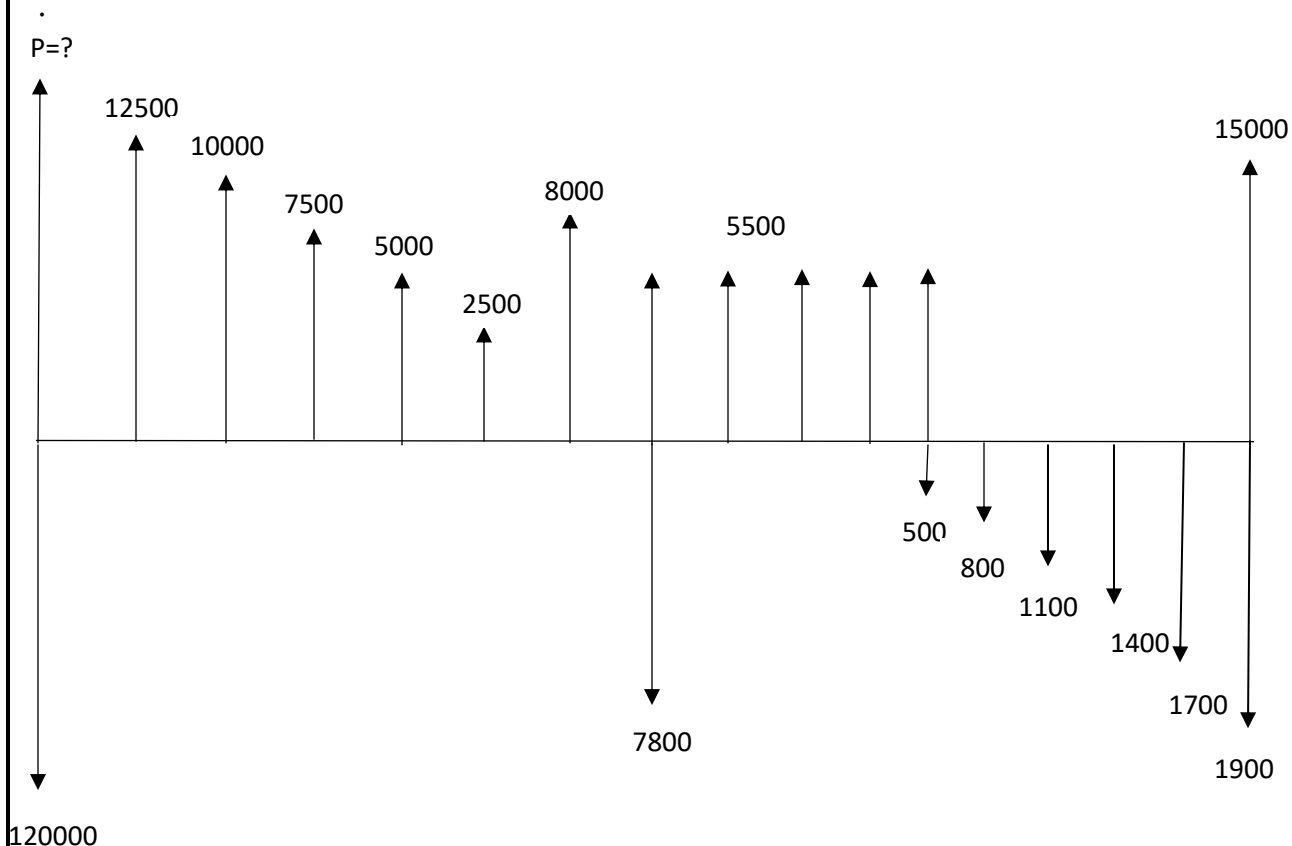
Problem 1 (30 points)

A medium sized scale company manufactures a certain product with an estimated variable costs, per unit, $v = 0.12Q - 36$ and an aggregated fixed costs of \$45000. The price–quantity demand relationship for this product is $P = -0.45Q + 945$, where P is the unit sales price of the product and Q is the annual quantity demand.

- Total cost = Fixed cost + Variable cost
 - Revenue = Quantity Demand $\times$ Price
 - Profit = Revenue – Total cost
- a) Develop the equations for total cost and total revenue.
 - b) Find the breakeven quantity.
 - c) What profit is earned if i) total cost is minimized and ii) total revenue is maximized?
 - d) Which of the strategy will be better for the company to adopt to optimize their profit, is it to minimize total cost or maximize total revenue. Give reason for your choice
 - e) What is the company's maximum possible profit?

Problem 2 (25 points)

For what value of P in the cash flow diagram will render the present worth to be equal 0 at a minimum attractive rate of return (i) of 10%?



Problem 3 (25 points)

Amelia bought a 6% \$4000 15-year bond at a discount of 5%. He received a semi-annually dividend for 7 years, and then sold it immediately after the 14th dividend for \$3875.

a) Did Amelia make the return of 7% per year compounded quarterly that he wanted? Why
Hints: draw cash flow diagram for bond investment (single project)

Matching Parts (20 points)

	Terms (A)	Concepts (B)	Answer
1	Equipment price	The future equivalent amount of a uniform series sinking fund at a compound interest, $i\%$ for n years	
2	Salvage	Sources of Possible Dilemmas in ethics is	
3	Interest	Cost estimation based on individual components is obtain by	
4	Percentage	The amount returned at end of bond's life is called	
5	Life cycle	The constant increment amount of payment series from one year to another is refer to as	
6	Compounded	This is one the alternatives in a revenue based cash flow alternatives	
7	Cost effective Alternatives	This addresses the difference in cost of a particular product at different times	
8	Net Present Worth	A unique solution to a proposed business ventures is	
9	Nominal	Time value of money depends on time	
10	Safety	Geometric gradients series payment increases by a constant	
11	Rate of return	The cost of the car you bought some couple of years ago is refer to as	
12	Effective	This is an example of a non-repetitive cost	
13	Gradient	Decision making in engineering economy is concerned with choosing the best	
14	Face value	The interest used in evaluating estimate in Cash flow equation is	
15	Equivalence	A rate statement that gives you an idea of how the actual rate will be calculated is	
16	(F/A , $i\%$, n)	Interest rate consider from the lender's perspective is term as	
17	Do-nothing	This can be categorized under single payment compound amount factor	
18	Sunk	Cost analysis of a device from the point of conceptualization to the it is phase-out	
19	Segmenting model	The annual interest rate with considering the effect of any compounding.	
20	Alternative	The value of a project at the moment based on inflow and outflow of cash for n years is	

(1)

ENGR ECONs - MULTTERM EXAM - SPRING, 2022Problem 1Given!Variable cost per unit, $V = 0.12Q - 36$ Fixed costs, $FC = \$45000$ Unit sales price, $P = -0.45Q + 945 \Rightarrow r$ Annual quantity demanded, Q

(5)

FormulateTotal cost, $TC = \text{Fixed Cost (FC)} + \text{Variable Cost (VC)}$ Revenue = Quantity Demand $\times$ Price

Profit = Revenue - Total Cost

 $\therefore \text{Total Revenue} \equiv \text{Revenue} \equiv TR = rQ =$ Solve

(a) To develop the equations for total cost and total revenue

Total cost, $TC = FC + VC$ But $VC = VQ$ $\therefore TC = \$45000 + (0.12Q - 36)Q$ $TC = \$45000 + 0.12Q^2 - 36Q$ $TR = rQ = PQ = -0.45Q^2 + 945Q$

(4)

(b) To obtain the breakeven quantity

At breakeven, $TC = TR \therefore Q = Q_{BE}$

(6)

$$\therefore 45000 + 0.12Q_{BE}^2 - 36Q_{BE} = -0.45Q_{BE}^2 + 945Q_{BE}$$

$$\therefore 45000 + 0.12Q_{BE}^2 - 36Q_{BE} = -0.45Q_{BE}^2 + 945Q_{BE}$$

(2)

$$45000 + 0.12Q_{BE}^2 + 0.45Q_{BE}^2 - 36Q_{BE} - 945Q_{BE} = 0$$

$$\therefore 0.57Q_{BE}^2 - 981Q_{BE} + 45000 = 0$$

Solve for Q_{BE} by using quadratic formula

$$\therefore Q_{BE} = \frac{-(-981) \pm \sqrt{(-981)^2 - (4 \times 0.57 \times 45000)}}{2(0.57)}$$

$$\therefore Q_{BE} = \frac{981 \pm 927.23}{1.14}$$

$$\therefore Q_{BE} = \frac{981 + 927.23}{1.14} \quad \text{or} \quad \frac{981 - 927.23}{1.14}$$

$$\therefore Q_{BE} = 1673.9 \text{ units or } 47.2 \text{ units}$$

(c) To determine the profit earned if:
(i) Total cost is minimized

$$\therefore TC = \$45000 + 0.12Q^2 - 36Q$$

$$\therefore \text{at minimum point } \frac{dTC}{dQ} = 0$$

$$\therefore \frac{dTC}{dQ} = 0.24Q - 36 = 0$$

$$\therefore 0.24Q = 36$$

$$\therefore Q = \frac{36}{0.24} = 150 \text{ unit}$$

(6)

(3)

$\therefore$ Profit at $Q = 150$

$$\therefore \text{Profit} = TR - TC$$

$$\therefore (-0.45Q^2 + 945Q) - (45000 + 0.12Q^2 - 36Q)$$

$$\therefore \text{Profit} = -0.57Q^2 + 981Q - 45000$$

$$\therefore \text{Profit} = -0.57(150)^2 + 981(150) - 45000$$

$$\text{Profit} = \$89325 \text{ at Minimum TC}$$

(ii) Total Revenue is maximized

$$\therefore TR = -0.45Q^2 + 945Q$$

at Maximum point $\frac{dTR}{dQ} = 0$

$$\therefore \frac{dTR}{dQ} = -0.90Q + 945 = 0$$

$$\therefore -0.90Q = -945$$

$$\therefore Q = \frac{945}{0.9} = 1050 \text{ unit}$$

Profit at $Q = 1050$

$$\therefore \text{Profit} = -0.57Q^2 + 981Q - 45000$$

$$\therefore \text{Profit} = -0.57(1050)^2 + 981(1050) - 45000$$

$$\therefore \text{Profit} = \$356625 \text{ at Maximum TR}$$

④ The Strategy that will better for the company ⁽⁴⁾ to adopt to optimize her profit is to maximize total revenue. The reason is because

Problem 2Given :-Minimum attractive rate of return (MARR), $\bar{i} = 10\%$

$$PW = 0$$

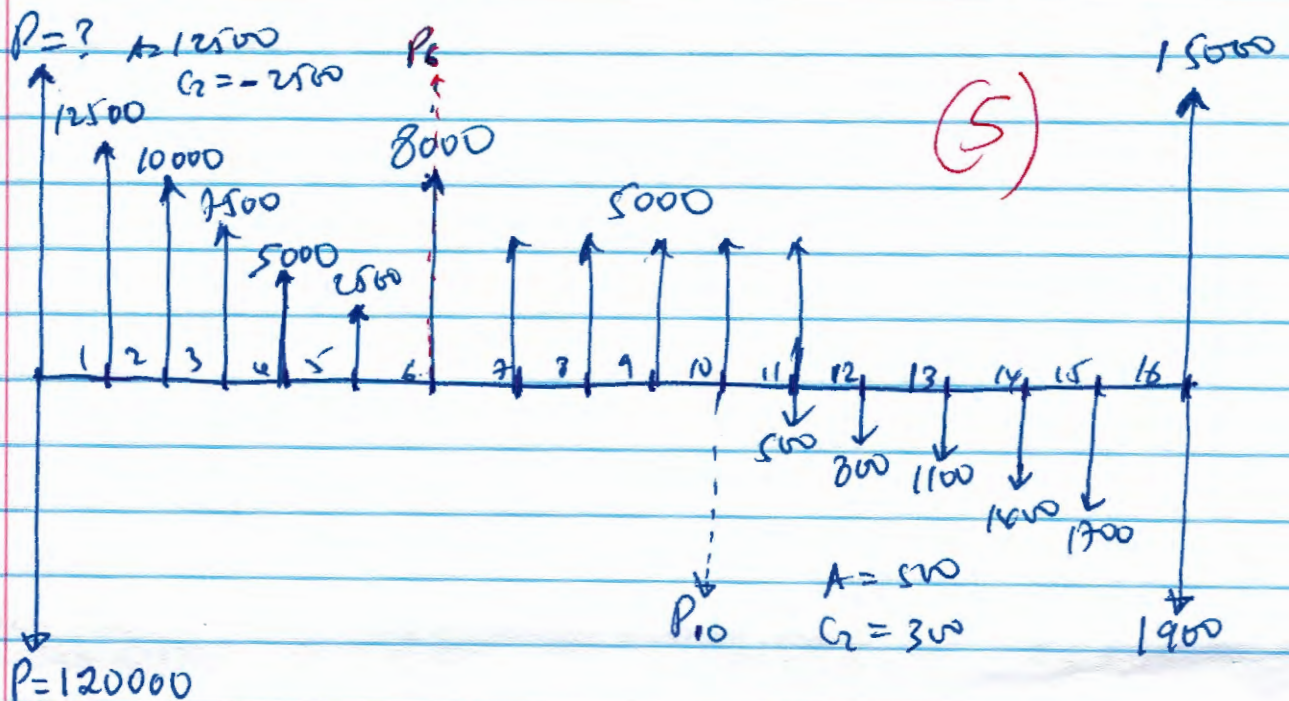
Formulate:

$$P = F(P/F, \bar{i}, n) ; P = A(P/A, \bar{i}, n)$$

$$P = G(P/G, \bar{i}, n)$$

Solve:

To determine the value of P in the cash flow diagram that will render the present worth to be equal to 0 at $\bar{i} = 10\%$



(6)

$$PW = -120000 + P - P_{10}(P/F, 10\%, 10) + P_6(P/F, 10\%, 6) \\ + 15000(P/F, 10\%, 16) - 1900(P/F, 10\%, 16) \\ + 12500(P/A, 10\%, 5) - 2500(P/G, 10\%, 5) = 0 \quad (10)$$

But $P_6 = 5000(P/A, 10\%, 5)$

$$P_{10} = 500(P/A, 10\%, 5) + 300(P/A, 10\%, 5)$$

Substitute P_6 and P_{10} in the equation above

$$\therefore PW = -120000 + P - [500(P/A, 10\%, 5) + 300(P/A, 10\%, 5)](P/F, 10\%, 10) \\ + 5000(P/A, 10\%, 5)(P/F, 10\%, 6) + 15000(P/F, 10\%, 16) \\ - 1900(P/F, 10\%, 16) + 12500(P/A, 10\%, 5) - 2500(P/G, 10\%, 5)$$

$$\therefore PW = -120000 + P - [500(3.7908) + 300(6.8618)](0.3855) \\ + 5000(3.7908)(0.5645) + 15000(0.2176) - 1900(0.2176) \\ + 12500(3.7908) - 2500(6.8618) = 0$$

$$\therefore -77743.65 + P = 0$$

(5) $\therefore P = \$77743.65$ for $PW = 0$

Problem 3

Given!

Coupon rate = 6%

Bond face Value = \$4000

Number of years for bond Maturity, $n = 15$ yr

Discount rate = 5%

$r = 7\%$ per year compounded semi-annually

Future Payment = \$3875

(5)

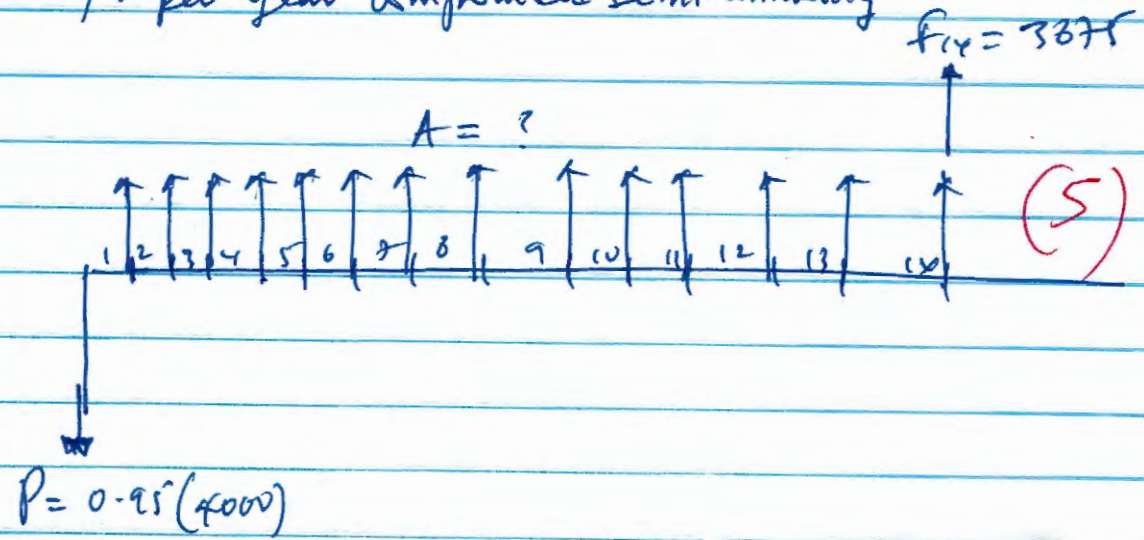
Formula:

$$\text{Annualized } I = \frac{\text{Bond face Value} \times \text{Coupon rate}}{\text{Number of Payment per year}}$$

$$PW = AN(P/A, i\%, n), \quad PW = FW(P/F, i\%, n)$$

Where:

- (a) To determine whether Amelia make the return of 7% per year compounded semi-annually



(3)

$A \equiv \text{Dividend} \Rightarrow I$

$$\therefore I = \frac{4000 \times 0.06}{2} = 120$$

(10)

$$\therefore PW = -0.95(4000) + 120(P/A, \bar{i}, 14) + 3875(P/F, \bar{i}, 14)$$

$\therefore r = 7\%$ per year Compounded Semi-annually.

$\therefore \bar{i} = \frac{7\%}{2}$ per Semi-annual/Compounded Semi-annually.

$\bar{i} = 3.5\%$ per Semi-annual/Compounded Semi-annually

$$\therefore PW = -0.95(4000) + 120(P/A, 3.5\%, 14) + 3875(P/F, 3.5\%, 14)$$

$$\therefore PW = -3800 + 120(10.92) + 3875(0.6178)$$

$$PW = -95.51$$

Amelia did not make the return of 7% per

(5) Year Compounded Semi-annually because the $PW < 0$

Amelia will not make any positive return but rather she will be losing money at the end of the bond investment.

Matching Parts (20 points)

	Terms (A)	Concepts (B)	Answer
1	Equipment price	The future equivalent amount of a uniform series sinking fund at a compound interest, $i\%$ for n years	16
2	Salvage	Sources of Possible Dilemmas in ethics is	10
3	Interest	Cost estimation based on individual components is obtain by	19
4	Percentage	The amount returned at end of bond's life is called	14
5	Life cycle	The constant increment amount of payment series from one year to another is refer to as	13
6	Compounded	This is one of the alternatives in a revenue based cash flow alternatives	17
7	Cost effective Alternatives	This addresses the difference in cost of a particular product at different times	15
8	Net Present Worth	A unique solution to a proposed business ventures is	20
9	Nominal	Time value of money depends on time	3
10	Safety	Geometric gradients series payment increases by a constant	4
11	Rate of return	The cost of the car you bought some couple of years ago is refer to as	18
12	Effective	This is an example of a non-repetitive cost	1
13	Gradient	Decision making in engineering economy is concerned with choosing the best	7
14	Face value	The interest used in evaluating estimate in Cash flow equation is	6
15	Equivalence	A rate statement that gives you an idea of how the actual rate will be calculated is	9
16	$(F/A, i\%, n)$	Interest rate consider from the lender's perspective is term as	11
17	Do-nothing	This can be categorized under single payment compound amount factor	2
18	Sunk	Cost analysis of a device from the point of conceptualization to the it is phase-out	5
19	Segmenting model	The annual interest rate with considering the effect of any compounding.	12
20	Alternative	The value of a project at the moment based on inflow and outflow of cash for n years is	8

ABOVE AVERAGE

Above Average Student Original Graded Assignment

Name of Student: Tyler Mannings

93
15

For each problem draw the cash flow diagram (except problem 1) even if you are not required to do so.

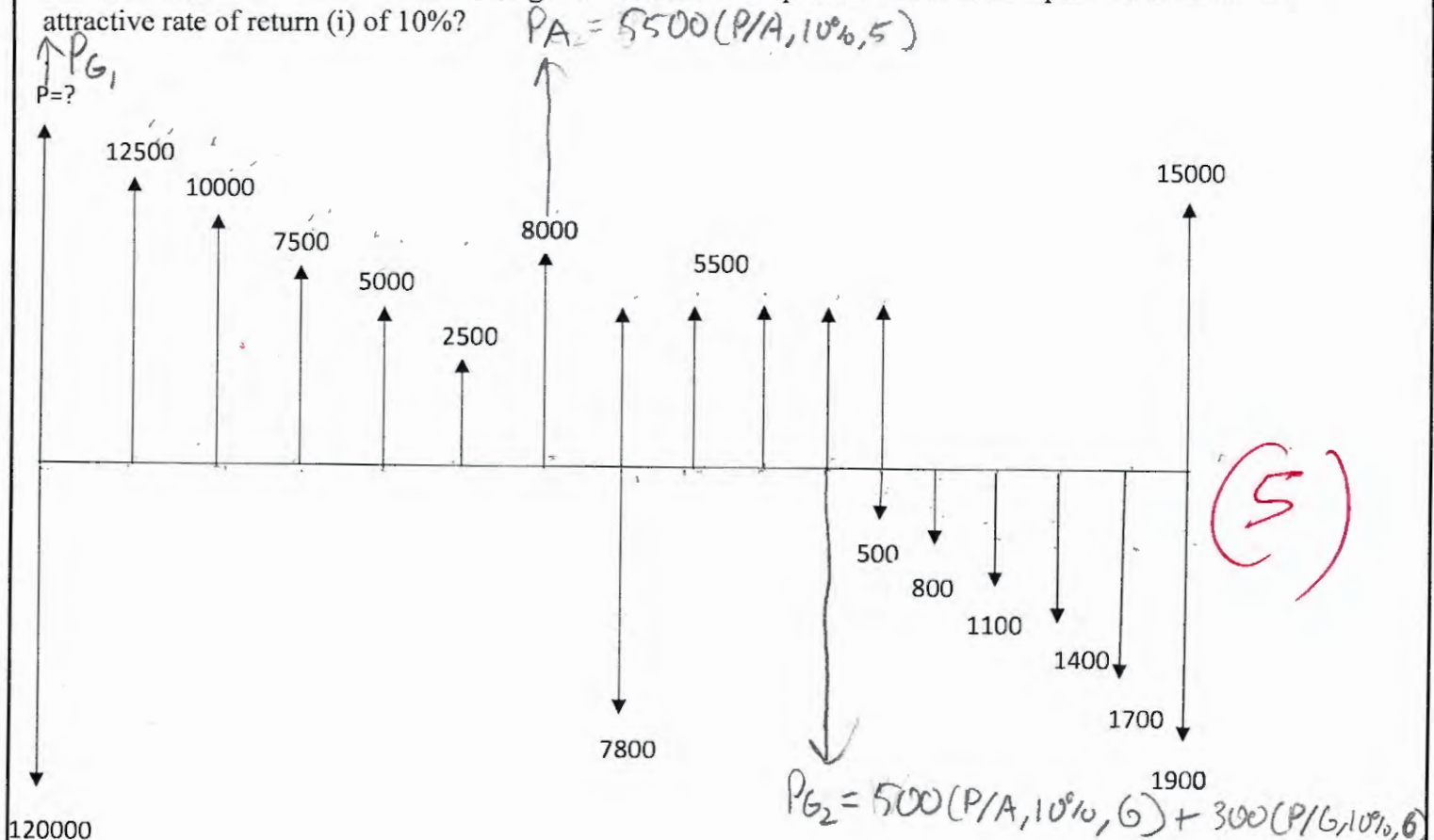
Problem 1 (30 points)

A medium sized scale company manufactures a certain product with an estimated variable costs, per unit, $v = 0.12Q - 36$ and an aggregated fixed costs of \$45000. The price-quantity demand relationship for this product is $P = -0.45Q + 945$, where P is the unit sales price of the product and Q is the annual quantity demand.

- Total cost = Fixed cost + Variable cost
- Revenue = Quantity Demand $\times$ Price
- Profit = Revenue - Total cost
- a) Develop the equations for total cost and total revenue.
- b) Find the breakeven quantity.
- c) What profit is earned if i) total cost is minimized and ii) total revenue is maximized?
- d) Which of the strategy will be better for the company to adopt to optimize their profit, is it to minimize total cost or maximize total revenue. Give reason for your choice
- e) What is the company's maximum possible profit?

Problem 2 (25 points)

For what value of P in the cash flow diagram will render the present worth to be equal 0 at a minimum attractive rate of return (i) of 10%?



Problem 3 (25 points)

Amelia bought a 6% \$4000 15-year bond at a discount of 5%. He received a semi-annually dividend for 7 years, and then sold it immediately after the 14th dividend for \$3875.

- a) Did Amelia make the return of 7% per year compounded ^{semi-annually} ~~quarterly~~ that he wanted? Why
Hints: draw cash flow diagram for bond investment (single project)

Matching Parts (20 points)

	Terms (A)	Concepts (B)	Answer
1	Equipment price \	The future equivalent amount of a uniform series sinking fund at a compound interest, $i\%$ for n years	16 ✓
2	Salvage \	Sources of Possible Dilemmas in ethics is	10 ✓
3	Interest	Cost estimation based on individual components is obtain by	19 ✓
4	Percentage \	The amount returned at end of bond's life is called	14 ✓
5	Life cycle \	The constant increment amount of payment series from one year to another is refer to as	13 ✓
6	Compounded	This is one the alternatives in a revenue based cash flow alternatives	17 ✓
7	Cost effective Alternatives	This addresses the difference in cost of a particular product at different times	15 ✓
8	Net Present Worth	A unique solution to a proposed business ventures is	20 ✓
9	Nominal	Time value of money depends on time	6 X
10	Safety	Geometric gradients series payment increases by a constant	4 ✓
11	Rate of return \	The cost of the car you bought some couple of years ago is refer to as	18 ✓
12	Effective	This is an example of a non-repetitive cost	1 ✓
13	Gradient \	Decision making in engineering economy is concerned with choosing the best	7 ✓
14	Face value \	The interest used in evaluating estimate in Cash flow equation is	9 X
15	Equivalence	A rate statement that gives you an idea of how the actual rate will be calculated is	3 X
16	(F/A, $i\%$, n) \	Interest rate consider from the lender's perspective is term as	11 ✓
17	Do-nothing \	This can be categorized under single payment compound amount factor	2 ✓
18	Sunk \	Cost analysis of a device from the point of conceptualization to the it is phase-out	5 ✓
19	Segmenting model	The annual interest rate with considering the effect of any compounding.	12 ✓
20	Alternative \	The value of a project at the moment based on inflow and outflow of cash for n years is	8 ✓

1) a) $TC = FC + VC$

$$= 45,000 + (0.12Q - 36)Q$$

$$\text{Total Cost} = 0.12Q^2 - 36Q + 45,000$$

Total Rev = (Q dem.) P

$$P = -0.45Q + 945$$

$$\text{Rev} = Q(-0.45Q + 945) = -0.45Q^2 + 945Q$$

b) Breakeven $\Rightarrow TC = TR, \text{Profit} = 0 \Rightarrow TR - TC = 0$

$$0.12Q_{BE}^2 - 36Q_{BE} + 45,000 = -0.45Q_{BE}^2 + 945Q_{BE}$$

$$0.57Q_{BE}^2 - 981Q_{BE} + 45,000 = 0$$

$$\frac{-b \pm \sqrt{b^2 - 4ac}}{2} \Rightarrow [47.164, 1673.89] = Q_{BE}$$

c) i) $C_T(\min) \Rightarrow \frac{dC_T}{dQ} = 0, 0.24Q - 36 = 0$
 $0.24Q = 36, Q_{\min} = 150$

$$C_T = 0.12Q^2 - 36Q + 45,000, C_T(\min) = 0.12(150)^2 - 36(150) + 45,000 = \$42,300$$

$$\text{Profit} = \text{Rev}_T - \text{Cost}_T = (-0.45Q^2 + 945Q) - (0.12Q^2 - 36Q + 45,000) = -0.57Q^2 + 981Q - 45,000$$

$$\text{Profit}(Q=150) = -0.57(150)^2 + 981(150) - 45,000 = \$89,325$$

ii) $\text{Rev}(\max) \Rightarrow \frac{dR_T}{dQ} = 0, -0.9Q + 945 = 0, \frac{945}{0.9} = Q, Q = 1050$

$$\text{Profit}(Q=1050) = -0.57(1050)^2 + 981(1050) - 45,000 = \$356,625$$

d) Profit is much higher at max revenue (1050) max revenue strategy should be adopted

e) $\text{Profit}(\max) \Rightarrow \frac{d\text{Profit}}{dQ} = 0, -1.14Q + 981 = 0, Q = 860.53 \approx 861$

$$\text{Profit}(Q=861) = -0.57(861)^2 + 981(861) - 45,000$$

$$\text{Profit}(\max) = \$377,086$$

$$2) P = -(\text{Total PW})$$

$$PW = 12500(P/A, 10\%, 5) - 2500(P/G, 10\%, 5) + 8,000(P/F, 10\%, 6) + (5500(P/A, 10\%, 5))(P/F, 10\%, 6) + 7800(P/F, 10\%, 7)$$

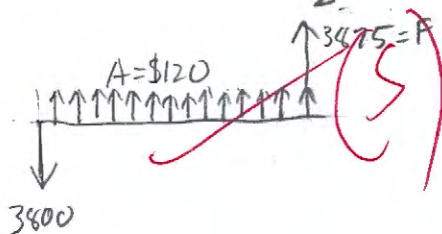
$$- (500(P/A, 10\%, 6) + 300(P/G, 10\%, 6))(P/F, 10\%, 10) + 15,000(P/F, 10\%, 16) - 120,000$$

$$PW = 12500(8.7908) - 2500(6.8618) + 8,000(0.5645) + (5500(8.7908))(0.5645) + 7800(0.5132) - (500(4.3553) + 300(9.6842))(0.3855) + 15,000(0.2176) = \$43,817.56 - \$120,000 = -\$76,182.44 = PW$$

$$PW + P = 0 \Rightarrow P = -PW = \$76,182.44 = P$$

3) 6%, \$4,000, 15 year bond @ 5% discount, $i = 7\%$ / year semi-ann. = 3.5% / semi-ann.
 Coupon Rate = 6%, Face Value = \$4,000, $n = 30$

$$Div I = \frac{(4,000)(0.06)}{2} = \$120, \text{ Purchase Price} = 4,000(0.95) = \$3800$$



$$P = -3800 + 120(P/A, 3.5\%, 14) + 3875(P/F, 3.5\%, 14) = -3800 + 120(10.921) + 3875(0.6178) = -\$95.51$$

Amelia's total Present Worth was negative when looked at from the desired interest rate. Therefore he did not make the return that he wanted.

AVERAGE

Average Student Original Graded Assignment

Name of Student: Churton murree

60
TW

For each problem draw the cash flow diagram (except problem 1) even if you are not required to do so.

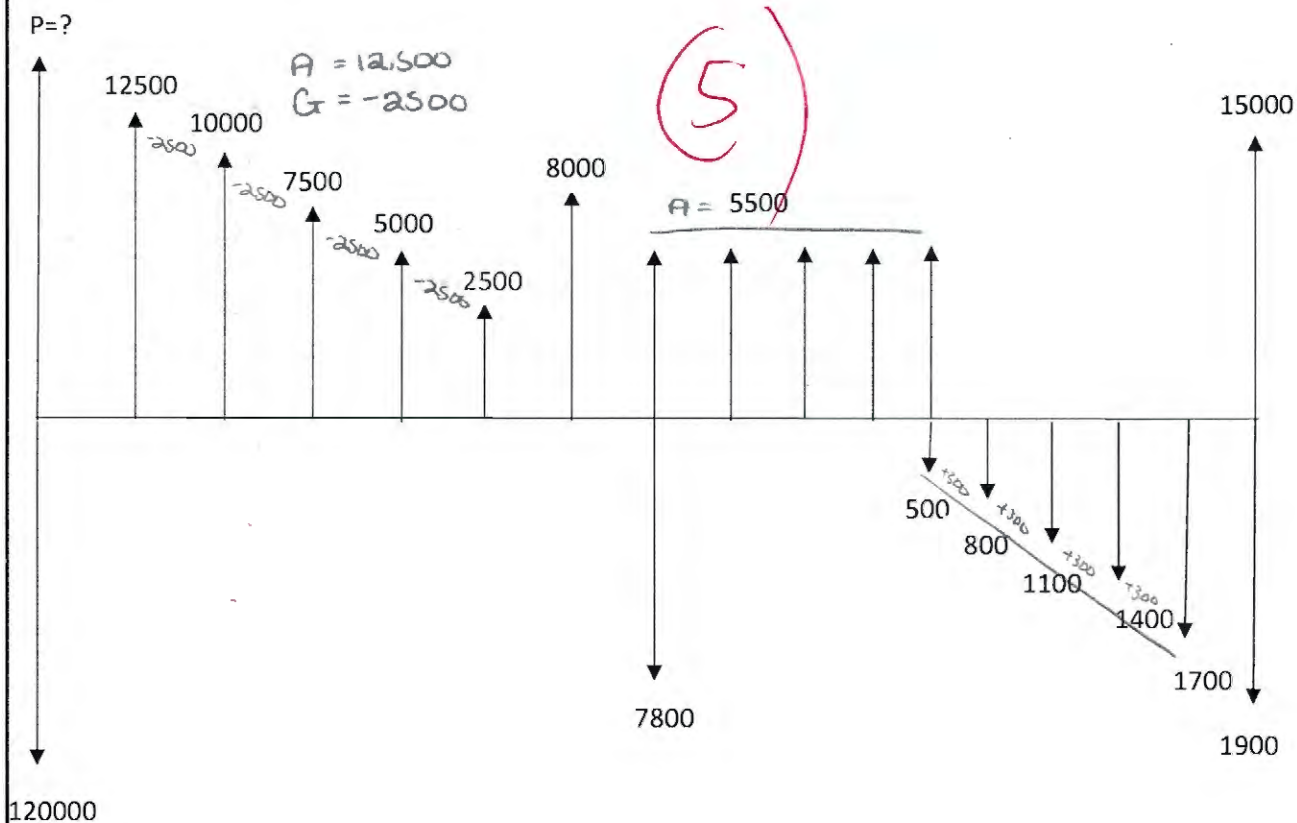
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Problem 2 (25 points)

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Problem 3 (25 points)

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Hints: draw cash flow diagram for bond investment (single project)

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19	Segmenting model	The annual interest rate with considering the effect of any compounding.	12 ✓
20	Alternative	The value of a project at the moment based on inflow and outflow of cash for n years is	8 ✓

(20)

Problem 1:

$$V = 0.12Q - 36$$

$$FC = 45,000$$

$$P = -0.45Q + 945$$

(5)

$$a) TC = FC + VC$$

$$= 45,000 + (-0.12Q - 36)$$

$$\therefore TC = -0.12Q + 44,964$$

(3)

$$R = PQ$$

$$= Q(-0.45Q + 945)$$

$$\therefore R = -0.45Q^2 + 945Q$$

$$b) \text{ Breakeven } \Rightarrow PQ = TC$$

$$PQ = TC$$

$$\Rightarrow Q(-0.45Q + 945) = -0.12Q + 44,964$$

$$\Rightarrow -0.45Q^2 + 945Q + 0.12Q - 44,964 = 0$$

$$\Rightarrow -0.45Q^2 + 945.12Q - 44,964 = 0$$

(3) + 1

→ from calculator

$$\therefore Q =$$

$$c) TC = FC + VC$$

$$= 45,000 + (+0.12Q - 36)$$

$$= 44,964 + 0.12Q$$

$$\Rightarrow \frac{d}{dQ} (44,964 + 0.12Q) = 0.12$$

$$\Rightarrow TC = (0.12)(0.12) + 44,964 \Rightarrow 44,964.01$$

$$ii) -0.45Q^2 + 945Q = -0.12Q + 44,964$$

$$\Rightarrow -0.45Q^2 + 945Q + 0.12Q - 44,964 = 0$$

$$\Rightarrow -0.45Q^2 + 945.12Q - 44,964 = 0$$

$$\Rightarrow \frac{d}{dQ} (-0.45Q^2 + 945.12Q - 44,964)$$

$$\Rightarrow -0.9Q + 945.12 = 0$$

$$\Rightarrow Q = \frac{-945.12}{-0.9} \Rightarrow 1050.13$$

$$\Rightarrow -0.45(1050.13)^2 + 945.12(1050.13) - 44,964$$

$$\Rightarrow \$451,287.01$$

d) The better option would be to maximize ~~their~~ total revenue because they would make more money

$$e) \pi = \pi_R - \pi_C$$

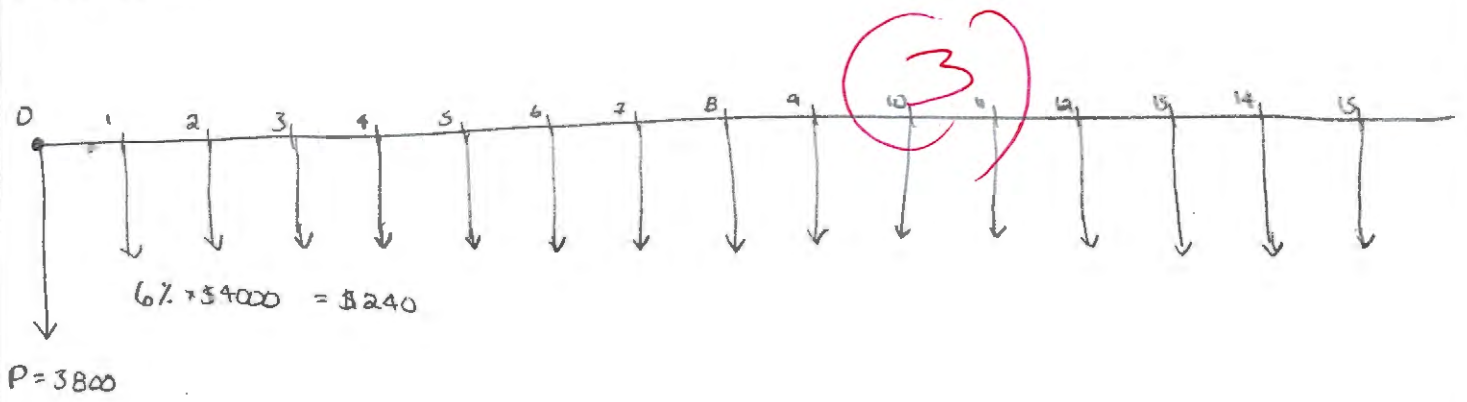
$$= \$451,287.01 - \$44,964.01$$

$$= \$406,323$$

Problem 2)

$$\begin{aligned} \Rightarrow & -120,000 + 12,500 - 2500 (A/G, 10\%, 5) + 8000 (P/F, 10\%, 6) \\ & + 5500 (P/A, 10\%, 5) - 7800 (P/F, 10\%, 7) - 500 (A/G, 10\%, 6) (P/A, 10\%, 5) \\ & - 1900 (F/P, 10\%, 1) (P/F, 10\%, 17) \end{aligned}$$

Problem 3)



BELOW AVERAGE

Below Average Student Original Graded Assignment

Name of Student: Kimdrea Oberg

For each problem draw the cash flow diagram (except problem 1) even if you are not required to do so.

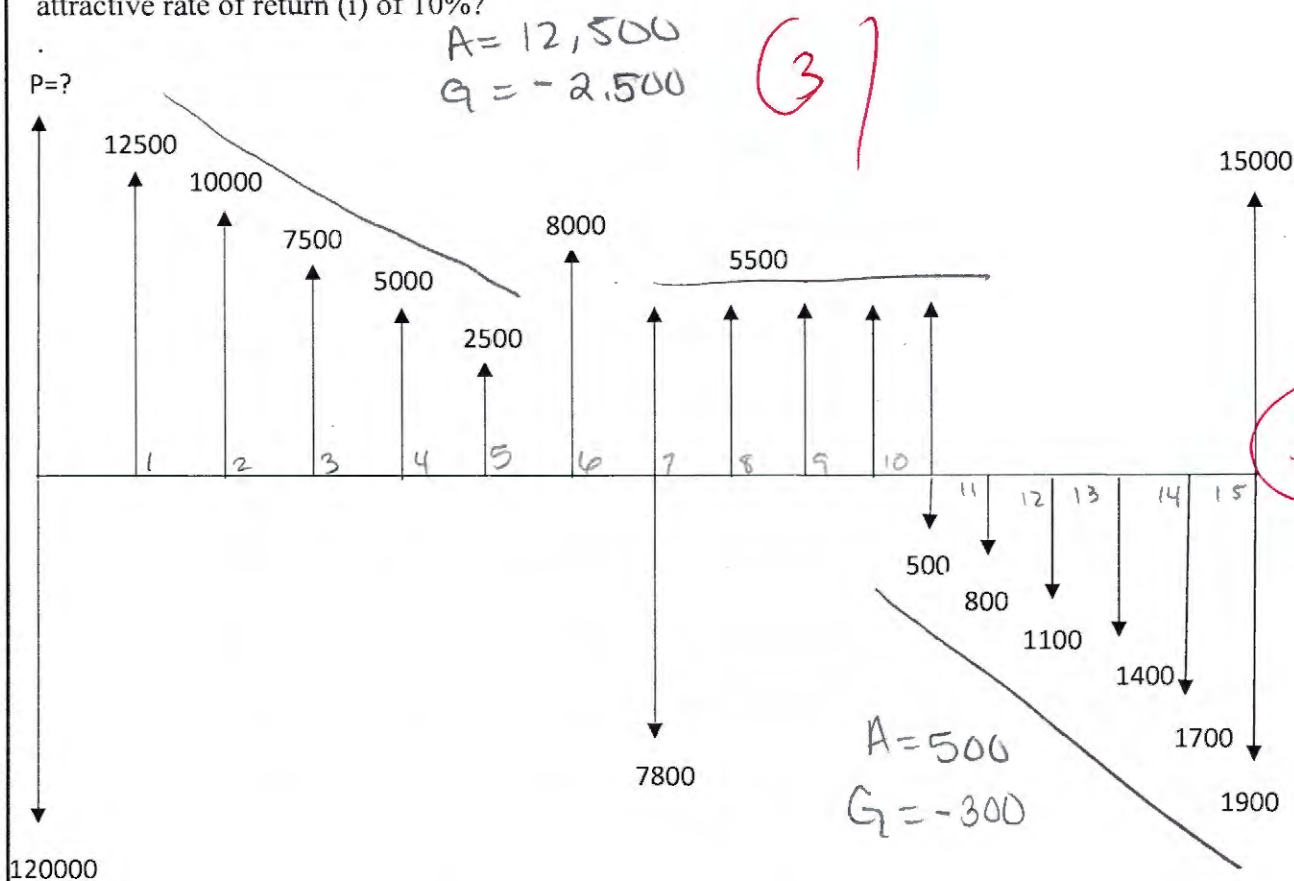
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 - e) What is the company's maximum possible profit?

Problem 2 (25 points)

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Problem 3 (25 points)

Amelia bought a 6% \$4000 15-year bond at a discount of 5%. He received a semi-annually dividend for 7 years, and then sold it immediately after the 14th dividend for \$3875.

- a) Did Amelia make the return of 7% per year compounded quarterly that he wanted? Why
Hints: draw cash flow diagram for bond investment (single project)

Matching Parts (20 points)

	Terms (A)	Concepts (B)	Answer
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3	Interest	Cost estimation based on individual components is obtain by	11 X
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6	Compounded	This is one the alternatives in a revenue based cash flow alternatives	5 X
7	Cost effective Alternatives	This addresses the difference in cost of a particular product at different times	8 X
8	Net Present Worth	A unique solution to a proposed business ventures is	2 X
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11	Rate of return	The cost of the car you bought some couple of years ago is refer to as	4 X
12	Effective	This is an example of a non-repetitive cost	12 X
13	Gradient	Decision making in engineering economy is concerned with choosing the best	10 X
14	Face value	The interest used in evaluating estimate in Cash flow equation is	16 X
15	Equivalence	A rate statement that gives you an idea of how the actual rate will be calculated is	13 X
16	(F/A, $i\%$, n)	Interest rate consider from the lender's perspective is term as	6 X
17	Do-nothing	This can be categorized under single payment compound amount factor	15 X
18	Sunk	Cost analysis of a device from the point of conceptualization to the it is phase-out	17 X
19	Segmenting model	The annual interest rate with considering the effect of any compounding.	1 X
20	Alternative	The value of a project at the moment based on inflow and outflow of cash for n years is	7 X

You did not study the Matching part at all. 12 were repeated!

Kindrea Oberg

3/22/22

①

Problem 4

Given

$$VC = 0.12Q - 36$$

$$FC = \$45,000$$

$$P = -0.45Q + 945 \Rightarrow \text{unit sale price} = 7r$$

Q = Annual quantity demand

A.) Total Cost = FC + VC

$$= \$45,000 + (0.12Q - 36)Q$$

$$= \$45,000 + 0.12Q^2 - 36Q$$

$$\boxed{= 0.12Q^2 - 36Q + \$45,000}$$

Total Revenue = Quantity demand x Price

$$= (-0.45Q + 945)Q$$

$$\boxed{= -0.45Q^2 + 945Q}$$

$$-0.27Q^2 + 270Q$$

$$36Q^2 - 14400Q + \$1,000$$

$$-0.27Q^2 + 270Q -$$

$$36Q^2 - 14400Q + \$81,000$$

B.) Break-even Quantity = TR + TC

$$= (-0.45Q^2 + 945Q) + (0.12Q^2 - 36Q + \$45,000)$$

$$-36Q^2 + 0.27Q^2 - 14,400Q$$

$$= 0.12Q^2 + 0.45Q^2 - 36Q - 945Q + \$45,000$$

$$= 0.57Q^2 - 981Q + \$45,000$$

$$ax^2 - bx + c = -b \pm \frac{\sqrt{b^2 - 4(ac)}}{2(a)}$$

$$-(-981Q) \pm \frac{\sqrt{(-981)^2 - 4(0.57 \times 45,000)}}{2(0.57)} = 981 \pm \frac{895.43}{1.14}$$

$$\frac{981 + 927.23}{1.14} = \boxed{1,674} \quad \text{or} \quad \frac{981 - 927.23}{1.14} = \boxed{47.2}$$

C.) Total cost minimized ②

$$\frac{dTC}{dQ} = 0 \quad Q = 0.24Q - 36$$

$$Q = \frac{36}{0.24} = 150$$

Profit equation

Total Revenue - Total Cost

$$(-0.45Q^2 + 945Q) - (0.12Q^2 - 36Q + \$45,000)$$

$$-0.12Q^2 + 0.45Q^2 - (-36Q - 945Q) - \$45,000$$

$$-0.57Q^2 + 981Q - \$45,000$$

$$-0.57(150)^2 + 981(150) - \$45,000 = \$89,325 \quad \leftarrow \text{Total cost minimized}$$

Total Cost maximized

$$\text{Total Revenue} = -0.45Q^2 + 945Q$$

$$\frac{dTR}{dQ} = 0$$

$$Q = -0.90Q + 945$$

$$Q = \frac{945}{0.90} = 1050$$

$$\text{Profit equation} = -0.57(1050)^2 + 981(1050) - \$45,000 = \$356,102.5$$

D.) Minimize total cost so that they are not in debt or lose money. ②

$$E.) \text{ Profit equation} = -0.57Q^2 + 981Q - \$45,000$$

$$\frac{D\text{Profit}}{dQ} = 0$$

$$Q = 1.14Q + 981$$

$$Q = \frac{981}{1.14} = 860.53 \quad (5)$$

$$-0.57(860.53)^2 + 981(860.53) - \$45,000 = \$377,088.16$$

Question 2

$$P_W = P + 12,500 + 8,000 - 7,800(P/F, 10\%, 5) + 15,000(P/F, 10\%, 16) + P_6(P/A, 10\%, 5) + P_{10}(P/G, 10\%, 6)$$

$$P_6 = 5500(P/A, 10\%, 5) = 5,500(3.7908) = 20,849.4 \quad (7)$$

$$P_{10} = 500(P/A, 10\%, 6) + 300(P/G, 10\%, 6) \\ 500(4.3553) + 300(9.6842) = 5,082.91$$

$$P_W = P + 12,500 + 8,000 - 7,800(P/F, 10\%, 5)^{0.5645} + 15,000(P/F, 10\%, 16)^{0.2176} \\ + 20,849.4(P/A, 10\%, 5)^{3.7908} + 5,082.91(P/G, 10\%, 6)^{9.6842}$$

$$\text{Rate of return} = \boxed{147,620.72} \quad (3)$$

Problem 3

$$6\% \times (5/12) = 2.5\% \text{ (2)}$$

Face value = \$4,000

$$15 \times 2 = 30 \text{ periods}$$

$$7 \times 2 = 14 \text{ periods}$$

Sold price

$$4,000 - 3875$$

$$(4,000 \times 2.5\%)$$

$$\frac{\quad}{14} = 7.14\% \times 2 = 14.28\% \text{ (3)}$$

Yes she exceeded her rate of return at 14.28%

ECONOMIC ANALYSIS AND TECHNICAL APPLICATIONS SPRING 2022

FINAL EXAM

TOPICS COVERED IN FINAL EXAM

1. The Decision-Making Process
2. Fixed, Variable, Marginal, and Average Costs
3. Considering All costs
4. Estimating Models
5. Equivalence
6. Cash Flow Diagram
7. Present Worth Analysis
8. Rate of Return Analysis
9. Annual Cash Flow Analysis.
10. Internal Rate of Return
11. Benefit-Cost Ratio Analysis
12. Breakeven Analysis
13. Payback Period

**ECONOMIC ANALYSIS AND TECHNICAL
APPLICATIONS SPRING 2022**

FINAL EXAM QUESTIONS

**Prairie View A & M University, CHEG 2308: Economics Analysis and Technical Applications
Spring 2022: Final Exam, Monday, May 10, 2022, Instructor: Dr. Kazeem Olanrewaju**

You should not reference to or have access to your textbooks, class notes, laptop, tablet, cell phone, smart phone, and any other electronic gadgets. Four problems are compulsory (1, 2, 3, 4). Problem 5 or 6 is an optional problem with extra points.

Name of Student: _____

Exam Duration: 2 hr

Problem 1 (30)

Northern Engineering is analyzing a mining project. Annual production, unit costs, and unit revenues are in the table. The first cost of the mine setup is \$7 million and the aggregate salvage value for some of the disposable equipment used in the project is 5% of the first cost.

Year	Annual Production (tons)	Cost per ton(\$)	Price per ton (\$)
1	95,000	29	45
2	125,000	30	46
3	120,000	31	47
4	110,000	33	48
5	90,000	35	49
6	65,000	37	50
7	45,000	39	51

If MARR is 11 %,

- What is the PW of the Project?
- Determine the capital recovery and the annual worth for the mining project
- Given these two guess values of 10% and 12%, estimate the internal rate of return for the project
- Is this mining project worth the investment?

Problem 2 (25 points)

The process for producing a fruit-tree pesticide has a first cost of \$200,000 (initial investment at year 0) with annual operating cost of \$45,000 and revenue of \$135,000 per year starting 5 years from now. In the 6th year, \$12000 was given to the company by Environmental Protection Agency as credit for its environmental compliance. What is the payback period at:

- 0%
- 11%

Given that the two guess values for x number of years to be between 3 yrs and 4 yrs at 11 % from the 5th year. Ensure you draw one cash flow diagram for the two interest rates.

Problem 3 (25 points)

Intel is trying to reduce supply chain risk by making more responsible make/buy decisions through improved cost estimation. A high-use component (expected usage is 5000 units per year) can be

purchased for \$25 per unit with delivery promised within a week. Alternatively, Intel can make the component inhouse and have it readily available at a cost of \$5 per unit, if equipment costing \$150,000 is purchased. Labor and other operating costs are estimated to be \$35,000 per year over the study period of 5 years. Salvage is estimated at 10% of first cost and MARR= 12% per year. Neglect the element of availability

- a) Determine the breakeven quantity,
- b) Recommend making or buying at the expected usage level.

Problem 4 (20 points)

	Terms (A)	Concepts (B)	Answer
1	Cost effective Alternative	A non-linear relationship between revenue-cost and quantity will likely two	
2	Effective	The periodic payment made to buyers of bond is refers to as	
3	MARR	Feasibility study of a new automobile plant	
4	Nominal	The future equivalent amount of a uniform series sinking fund at a compound interest, $i\%$ for n years	
5	Compounded	Decision making in engineering economy is concerned with choosing the best	
6	Fixed cost	The present worth of a project that will last for a long time is called	
7	Total cost	Paying the mortgage instead of going out for dinner	
8	(A/P, $i\%$, n)	It model relationship between task performance and repetition	
9	Usage cost	The lowest acceptable rate of return on any project is	
10	Complex problem	Interest rate consider from the lender's perspective is term as	
11	Opportunity cost	This is an example of an external rate of return	
12	Project	Costs incurred regardless of volume level to stay in business	
13	Gradient	The annual interest rate without considering the effect of any compounding	
14	Breakeven points	Finding the equivalent uniform amount for a given initial investment for n years and at a compound interest rate of $i\%$	
15	Dividend	Effective 8.3% per year compounded monthly	
16	Rate of return	Most cash flow analysis in the real world operate on an interest rate that is	
17	(F/A, $i\%$, n)	Mutually exclusive list of alternatives means the selection of a	
18	MIRR	Implied benefits in benefit/cost ratio analysis is consider under	
19	Learning curve	An example of a breakeven parameter between two alternative can be	
20	Capitalized cost	The constant increment amount of payment series from one year to another is refer to as	

Problem 5 (15 points)

Certain parts for Raytheon's reusable space exploration system can either be System X or System Y. Some of the costs for each process are shown.

	System X	System Y
First cost, \$	?	-72000
Annual operating cost, \$	-24700	?
Salvage value, \$	?	7500
Life, years	5	5

The incremental AW cash flow equation associated with (System Y – System X) is:

$$0 = -35000(A/P, \Delta i^*, 5) + 8500 + 5000(A/F, \Delta i^*, 5)$$

- a) What is the first cost for System X
- b) Determine the annual operating cost for System Y
- c) Calculate the salvage value for System X

OR

Problem 6 (15 points)

Solar and conventional alternatives are available for providing energy at a remote U.S. Army training site. The costs associated with each alternative are shown. Use the B/C method to determine which should be selected at an interest rate of 9% per year over a 10-year study period.

	Conventional	Solar
Initial cost, \$	750000	1,800,000
Annual power cost, \$/yr	180,000	35,000
Salvage value, \$	40,000	280,000

(1)

ENGR ECONs FINAL EXAM SPRING 2022 SOLUTIONS

Problem 1

Given:-

$$P_0 = \$7000000$$

$$S = F_7 = 0.05 \times \$7000000 = \$350000$$

$$MARR = 11\%$$

Given values are 10% and 12%

(5)

Year	Annual Production (tons)	Cost per ton (\$)	Price per ton (\$)
0	0	29	
1	95000	29	45
2	125000	30	46
3	120000	31	47
4	110000	33	48
5	90000	35	49
6	65000	37	50
7	45000	39	51

Formulate

$$P = F(P/F, i, n)$$

$$CR = P_0(A/P, i, n) - S(A/F, i, n)$$

$$A = P(A/P, i, n)$$

Solve

Go To calculate the PW of the Project

(2)

Firstly, we need to calculate the Annual net cash flow

Year 1

$$\text{Annual production cost} = 95000 \text{ tons} \times \frac{\$29}{\text{ton}} = \$2755000$$

$$\text{Annual revenue} = 95000 \text{ tons} \times \frac{\$45}{\text{ton}} = \$4275000$$

$$\text{Annual net cash flow} = \$4275000 - \$2755000 = \$1520000$$

Year 2

$$\text{Annual production cost} = 125000 \text{ tons} \times \frac{\$30}{\text{ton}} = \$3750000$$

$$\text{Annual revenue} = 125000 \text{ tons} \times \frac{\$46}{\text{ton}} = \$5750000$$

$$\text{Annual net cash flow} = \$5750000 - \$3750000 = \$2000000$$

Year 3

$$\text{Annual production cost} = 120000 \text{ tons} \times \frac{\$31}{\text{ton}} = \$3720000$$

$$\text{Annual revenue} = 120000 \text{ tons} \times \frac{\$47}{\text{ton}} = \$5640000$$

$$\text{Annual net cash flow} = \$5640000 - \$3720000 = \$1920000$$

Year 4

$$\text{Annual production cost} = 110000 \text{ tons} \times \frac{\$33}{\text{ton}} = \$3630000$$

$$\text{Annual revenue} = 110000 \text{ tons} \times \frac{\$48}{\text{ton}} = \$5280000$$

(3)

$$\text{Annual net cash flow} = \$5280000 - \$3630000 = \$1650000$$

Year 5

$$\text{Annual production cost} = 90000 \text{ tons} \times \frac{\$35}{\text{ton}} = \$3150000$$

$$\text{Annual revenue} = 90000 \text{ tons} \times \frac{\$49}{\text{ton}} = \$4410000$$

$$\text{Annual net cash flow} = \$4410000 - \$3150000 = \$1260000$$

Year 6

$$\text{Annual production cost} = 65000 \text{ tons} \times \frac{\$37}{\text{ton}} = \$2405000$$

$$\text{Annual revenue} = 65000 \text{ tons} \times \frac{\$50}{\text{ton}} = \$3250000$$

$$\text{Annual net cash flow} = \$3250000 - \$2405000 = \$845000$$

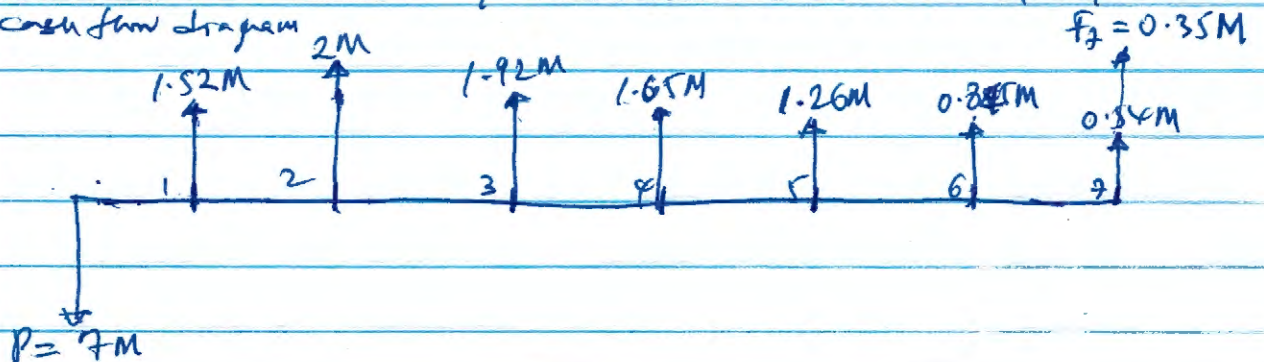
Year 7

$$\text{Annual production cost} = 45000 \text{ tons} \times \frac{\$39}{\text{ton}} = \$1755000$$

$$\text{Annual revenue} = 45000 \text{ tons} \times \frac{\$51}{\text{ton}} = \$2295000$$

$$\text{Annual net cash flow} = \$2295000 - \$1755000 = \$540000$$

cash flow diagram



(4)

$$PW = -7000000 + 1520000(P/F, 11\%, 1) + 2000000(P/F, 11\%, 2) \\ + 1920000(P/F, 11\%, 3) + 1650000(P/F, 11\%, 4) \\ + 1260000(P/F, 11\%, 5) + 845000(P/F, 11\%, 6) \\ + 390000(P/F, 11\%, 7)$$

$$\therefore PW = -7000000 + 1520000(0.9009) + 2000000(0.8116) \\ + 1920000(0.7312) + 1650000(0.6527) + 1260000(0.5935) \\ + 845000(0.5346) + 390000(0.4817)$$

$$PW = \$111587$$

(b) To determine the Capital recovery^(CCR) and the annual worth for the mining project

$$CR = 7000000(A/P, 11\%, 7) - 350000(A/F, 11\%, 7) \\ = 7000000(0.21222) - 350000(0.10222)$$

$$\therefore CR = \$1449763$$

$$AW = PW(A/P, 11\%, 7) \\ = 111587(0.21222)$$

$$AW = \$23680$$

(c) To estimate the Internal rate of return for the project given two guess values of 10% and 12%

$$\therefore \text{Internal rate of return: } i^*$$

(7)

(5)

at 10%

$$\therefore PW_{10} = -7000000 + 1520000(P/F, 10\%, 1) + 2000000(P/F, 10\%, 2) \\ + 1920000(P/F, 10\%, 3) + 1650000(P/F, 10\%, 4) \\ + 1260000(P/F, 10\%, 5) + 845000(P/F, 10\%, 6) \\ + 890000(P/F, 10\%, 7)$$

$$PW_{10} = -7000000 + 1520000(0.9091) + 2000000(0.8264) \\ + 1920000(0.7513) + 1650000(0.6830) + 1260000(0.6209) \\ + 845000(0.5645) + 890000(0.5132)$$

$$PW_{10} = \$320162.5$$

at 12%

$$\therefore PW_{12} = -7000000 + 1520000(P/F, 12\%, 1) + 2000000(P/F, 12\%, 2) \\ + 1920000(P/F, 12\%, 3) + 1650000(P/F, 12\%, 4) \\ + 1260000(P/F, 12\%, 5) + 845000(P/F, 12\%, 6) \\ + 890000(P/F, 12\%, 7)$$

$$PW_{12} = -7000000 + 1520000(0.8929) + 2000000(0.7972) \\ + 1920000(0.7118) + 1650000(0.6355) + 1260000(0.5674) \\ + 845000(0.5066) + 890000(0.4523)$$

$$PW_{12} = \$-87613$$

We can now interpolate between 10% and 12% and PW_{10} and PW_{12} respectively.

(6)

i^*	PW	
10%	320162.5	
i^*	0	$\frac{10-12}{i^*-12} = \frac{320162.5 - (-87613)}{0 - (-87613)}$
12%	-87613	$\frac{-2}{i^*-12} = 4.654$

$$i^*-12 = \frac{-2}{4.654} \Rightarrow i^*-12 = -0.429$$

$$\therefore i^* = 12 - 0.429 = 11.570$$

$$\therefore \boxed{i^* = 11.570\%} \Rightarrow \text{IRR}$$

④) The mining project worth the investment because the IRR (i^*) > MARR is IRR which is equal to 11.570% is greater than MARR which is equal to 11% (5)

Problem 2

Given:

$$P = \$200000$$

$$i = 10\%$$

$$A_c = \$45000$$

$$\bar{i} = 11\%$$

$$A_r = \$135000$$

$$F_0 = \$12000$$

(5)

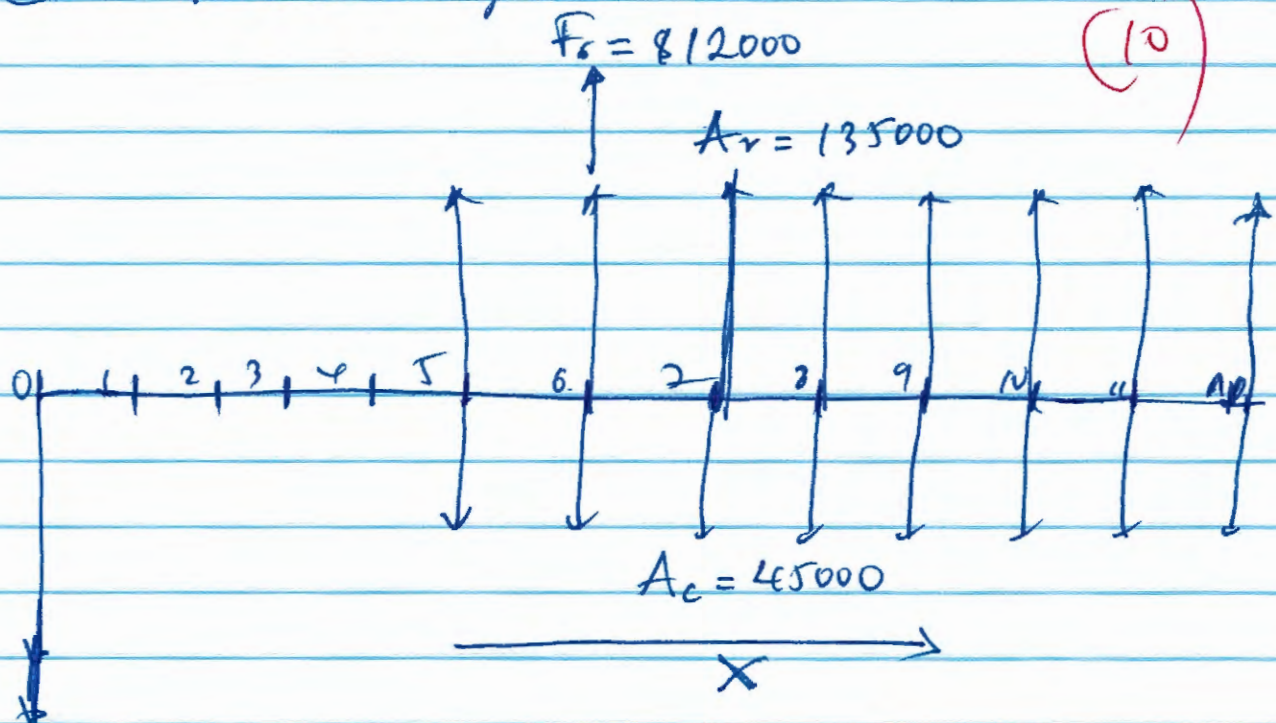
(7)

Formulae

$$P = F(P/F, \bar{i}, n); \quad P = A(P/A, \bar{i}, n)$$

Solve

Cash flow diagram



$$P = 200000$$

(g) The payback period at 08
Green first $PW = 0$

$$0 = -200000 + (135000 - 45000)X + 12000$$

$$0 = -200000 + 90000X + 12000$$

$$\therefore X = \frac{188000}{90000} = 2.09$$

(8)

$$\therefore \text{Payback Period at } 0\%, n_p = 4 + 2.09$$

$$n_p = 6.09_{\text{yrs}} \quad \text{at } i=0\%$$

(6) The payback period at 11%

Given that $PW=0$

(10)

$$0 = -200000 + 90000(P/A, 11\%, X)(P/F, 11\%, Y) + 12000(P/F, 11\%, 6)$$

$$\therefore \text{for } 3 \text{ yrs} \rightarrow X = 4$$

$$4 \text{ yrs} \rightarrow X = 5$$

We need to interpolate between $X=4$ and $X=5$

$$\therefore PW = -200000 + 90000(P/A, 11\%, X)(P/F, 11\%, Y) + 12000(P/F, 11\%, 6)$$

$$\text{at } X = 4$$

$$\therefore PW_4 = -200000 + 90000(P/A, 11\%, 4)(P/F, 11\%, 4) + 12000(P/F, 11\%, 6)$$

$$\therefore PW_4 = -200000 + 90000(3.1024)(0.6587) + 12000(0.5346)$$

$$PW_4 = \$ -9665.22$$

$$\text{at } X = 5$$

$$\therefore PW_5 = -200000 + 90000(P/A, 11\%, 5)(P/F, 11\%, 4) + 12000(P/F, 11\%, 6)$$

$$PW_5 = -200000 + 90000(3.6959)(0.6587) + 12000(0.5346)$$

$$PW_5 = \$ 25519.24$$

(9)

$$\begin{array}{rcl}
 4 & \text{---} & -9665.22 \\
 & | & \\
 X & \text{---} & 0 \\
 & | & \\
 5 & \text{---} & 25519.22
 \end{array}$$

$$\frac{4-X}{4-5} = \frac{-9665.22-0}{-9665.22-25519.22}$$

$$\frac{4-X}{-1} = 0.273$$

$$\therefore 4-X = -0.273$$

$$X = 4 + 0.273$$

$$X = 4.273$$

$$\therefore N_p = 5 + 4.273$$

$$N_p = 9.27 \text{ yrs at } i = 11\%$$

Problem 3

Green

Expected usage is 5000 units per year

Purchased price per unit = \$25 Variable Cost per unit for
day option

Variable cost per unit for inhouse make option = \$5 per unit

Equipment costing, $P_0 = \$150,000$

Annual labor and operating cost = \$35,000

$n = 5 \text{ yrs}$

Salvage = $F_5 = 0.10 \times 150,000 = 15,000$

(5)

$$i = \text{MARR} = 12\% \text{ per year}$$

Formulate

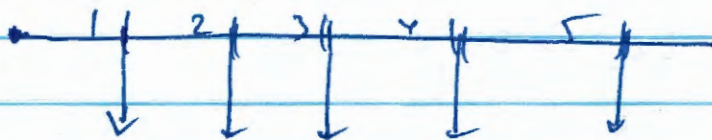
$$A = P(A/P, i, n)$$

Solve

(a) To determine the breakeven quantity
Let X represents the breakeven quantity. (15)

$\therefore$ AW for the buy option $\equiv$ Annual purchase Variable Cost

$$AW_{\text{buy}} = \frac{8-25}{\text{unit}} \times X \frac{\text{units}}{\text{yr}} = 8-25X/\text{yr}$$



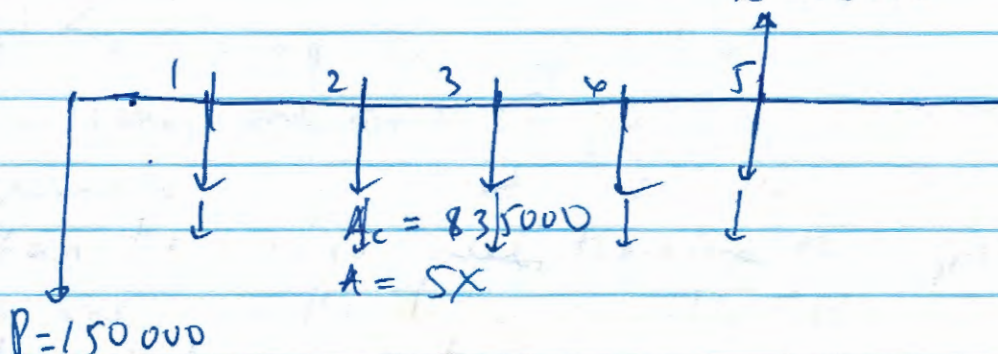
$$AW = 25X$$

$\therefore$ AW for the In-house Make option

Annual Variable Cost for In-house

$$= \frac{8-5}{\text{unit}} \times X \frac{\text{units}}{\text{yr}} = 8-5X/\text{yr}$$

$$f_5 = 15000$$



(11)

$$AW_{\text{make}} = -150000 (A/P, 12\%, 5) - 35000 + 15000 (A/F, 12\%, 5) - 5X$$

* Break-even

$$\therefore AW_{\text{buy}} = AW_{\text{make}}$$

$$-25X = -150000 (A/P, 12\%, 5) - 35000 + 15000 (A/F, 12\%, 5) - 5X$$

$$\therefore -25X = -150000 (0.21741) - 35000 + 15000 (0.15741) - 5X$$

$$-25X = -41611.5 - 35000 + 2361.15 - 5X$$

$$-25X + 5X = -74250.35$$

$$-20X = -74250.35$$

$$X = \frac{74250.35}{20} =$$

$$\therefore X = 3712.5$$

$$\therefore \boxed{X \approx 3713 \text{ units}} \quad \text{break-even quantity}$$

(5)

(5) Considering the expected usage level of 5000 units per year, and comparing it with the break-even quantity (in units) of 3713 units, which is less than the usage level, therefore the option will be the one with the lower variable cost and that will be In-house Make option.

Problem 4 (20 points)

	Terms (A)	Concepts (B)	Answer
1	Cost effective Alternative	A non-linear relationship between revenue-cost and quantity will likely two	14
2	Effective	The periodic payment made to buyers of bond is refers to as	15
3	MARR	Feasibility study of a new automobile plant	10
4	Nominal	The future equivalent amount of a uniform series sinking fund at a compound interest, $i\%$ for n years	17
5	Compounded	Decision making in engineering economy is concerned with choosing the best	1
6	Fixed cost	The present worth of a project that will last for a long time is called	20
7	Total cost	Paying the mortgage instead of going out for dinner	11
8	(A/P, $i\%$, n)	It model relationship between task performance and repetition	19
9	Usage cost	The lowest acceptable rate of return on any project is	3
10	Complex problem	Interest rate consider from the lender's perspective is term as	16
11	Opportunity cost	This is an example of an external rate of return	18
12	Project	Costs incurred regardless of volume level to stay in business	6
13	Gradient	The annual interest rate without considering the effect of any compounding	4
14	Breakeven points	Finding the equivalent uniform amount for a given initial investment for n years and at a compound interest rate of $i\%$	8
15	Dividend	Effective 8.3% per year compounded monthly	2
16	Rate of return	Most cash flow analysis in the real world operate on an interest rate that is	5
17	(F/A, $i\%$, n)	Mutually exclusive list of alternatives means the selection of a	12
18	MIRR	Implied benefits in benefit/cost ratio analysis is consider under	9
19	Learning curve	An example of a breakeven parameter between two alternative can be	7
20	Capitalized cost	The constant increment amount of payment series from one year to another is refer to as	13

Problem 5

(15)

Given:-

The incremental AW cash flow equation associated with (System Y - System X) is:

$$0 = -35000(A/P, 10\%, 5) + 8500 + 5000(A/F, 10\%, 5)$$

(a) To obtain the first cost for system X

$$\text{System Y} - \text{System X} = -35000$$

$$\therefore -72000 - \text{System X} = -35000$$

$$\therefore -\text{System X} = -35000 + 72000$$

$$\boxed{\text{System X} = \$-37000}$$

(b) To determine the annual operating cost for System Y

$$\text{System Y} - \text{System X} = 8500$$

$$\text{System Y} - (-24700) = 8500$$

$$\text{System Y} + 24700 = 8500$$

$$\text{System Y} = 8500 - 24700$$

$$\boxed{\text{System Y} = \$-16200}$$

(c) To calculate the Salvage value for System X

$$\text{System Y} - \text{System X} = 5000$$

$$7500 - \text{System X} = 5000$$

$$\text{System X} = 7500 - 5000 = \boxed{\$2500}$$

(13)

Problem 6Given:

$$\bar{i} = 9\% \text{ per year}$$

$$n = 10 \text{ yr}$$

(15)

Formulate:

$$\frac{\Delta B}{\Delta C} = \frac{\text{AW of Implied Benefits}}{\text{AW of Difference in Total Equivalent Cost}}$$

$$A = P(A/P, \bar{i}, n); \quad A = F(A/F, \bar{i}, n)$$

Solve

	Conventional	Solar
Initial cost, \$	750 000	1 800 000
Annual power cost, \$/yr	180 000	35 000
Salvage value, \$	40 000	280 000

Conventional

$$AW_{\text{initial cost}} = 750\,000 (A/P, 9\%, 10)$$

$$= 750\,000 (0.15582) = \$116\,865$$

$$AW_{\text{salvage}} = 40\,000 (A/F, 9\%, 10)$$

$$= 40\,000 (0.06582) = \$2\,632.8$$

Solar

$$AW_{\text{initial cost}} = 1\,800\,000 (A/P, 9\%, 10)$$

$$= 1\,800\,000 (0.15582) = \$280\,476$$

$$AW_{\text{salvage}} = 280\,000 (A/F, 9\%, 10)$$

(14)

$$= 280000(0.06582) = \$18278.96$$

ΔB = Increase in annual power cost savings using solar over conventional + Increase in Salvage value using solar over conventional

$$\Delta B = (180000 - 35000) + (18278.96 - 2632.8)$$

$$\Delta B = \$160646.16$$

ΔC = Difference in the annual equivalent cost between solar and the conventional

$$\Delta C = \$280746 - \$116865$$

$$\Delta C = \$163611$$

$$\therefore \Delta B/C = \frac{\Delta B}{\Delta C} = \frac{\$160646.16}{\$163611} = 0.982$$

$$\therefore \Delta B/C = 0.982$$

Since $\Delta B/C < 1$, select option with lower equivalent cost and option is conventional.

ABOVE AVERAGE

Above Average Student Original Graded Assignment

**Prairie View A & M University, CHEG 2308: Economics Analysis and Technical Applications
Spring 2021: Final Exam, Monday, May 10, 2021, Instructor: Dr. Kazeem Olanrewaju**

You should not reference to or have access to your textbooks, class notes, laptop, tablet, cell phone, smart phone, and any other electronic gadgets. Four problems are compulsory (1, 2, 3, 4). Problem 5 or 6 is an optional problem with extra points.

Name of Student: _____

Shelton Amaram

Exam Duration: 2 hr

Problem 1 (30)

Northern Engineering is analyzing a mining project. Annual production, unit costs, and unit revenues are in the table. The first cost of the mine setup is \$7 million and the aggregate salvage value for some of the disposable equipment used in the project is 5% of the first cost.

Year	Annual Production (tons)	Cost per ton(\$)	Price per ton (\$)
1	95,000	29	45
2	125,000	30	46
3	120,000	31	47
4	110,000	33	48
5	90,000	35	49
6	65,000	37	50
7	45,000	39	51

If MARR is 11 %,

- What is the PW of the Project?
- Determine the capital recovery and the annual worth for the mining project
- Given these two guess values of 10% and 12%, estimate the internal rate of return for the project
- Is this mining project worth the investment?

Problem 2 (25 points)

The process for producing a fruit-tree pesticide has a first cost of \$200,000 (initial investment at year 0) with annual operating cost of \$45,000 and revenue of \$135,000 per year starting 5 years from now. In the 6th year, \$12000 was given to the company by Environmental Protection Agency as credit for its environmental compliance. What is the payback period at:

- 0%
- 11%

Given that the two guess values for x number of years to be between 3 yrs and 4 yrs at 11 % from the 5th year. Ensure you draw one cash flow diagram for the two interest rates.

Problem 3 (25 points)

Intel is trying to reduce supply chain risk by making more responsible make/buy decisions through improved cost estimation. A high-use component (expected usage is 5000 units per year) can be

purchased for \$25 per unit with delivery promised within a week. Alternatively, Intel can make the component inhouse and have it readily available at a cost of \$5 per unit, if equipment costing \$150,000 is purchased. Labor and other operating costs are estimated to be \$35,000 per year over the study period of 5 years. Salvage is estimated at 10% of first cost and MARR= 12% per year. Neglect the element of availability

- Determine the breakeven quantity,
- Recommend making or buying at the expected usage level.

Problem 4 (20 points)

(11)

	Terms (A)	Concepts (B)	Answer
1	Cost effective Alternative	A non-linear relationship between revenue-cost and quantity will likely two	19 X
2	Effective	The periodic payment made to buyers of bond is refers to as	6 X
3	MARR	Feasibility study of a new automobile plant	12 X
4	Nominal	The future equivalent amount of a uniform series sinking fund at a compound interest, $i\%$ for n years	17 ✓
5	Compounded	Decision making in engineering economy is concerned with choosing the best	1 ✓
6	Fixed cost	The present worth of a project that will last for a long time is called	20 ✓
7	Total cost	Paying the mortgage instead of going out for dinner	11 ✓
8	(A/P, $i\%$, n)	It model relationship between task performance and repetition	10 X
9	Usage cost	The lowest acceptable rate of return on any project is	18 X
10	Complex problem	Interest rate consider from the lender's perspective is term as	16 ✓
11	Opportunity cost	This is an example of an external rate of return	3 X
12	Project	Costs incurred regardless of volume level to stay in business	7 X
13	Gradient	The annual interest rate without considering the effect of any compounding	4 ✓
14	Breakeven points	Finding the equivalent uniform amount for a given initial investment for n years and at a compound interest rate of $i\%$	8 ✓
15	Dividend	Effective 8.3% per year compounded monthly	2 ✓
16	Rate of return	Most cash flow analysis in the real world operate on an interest rate that is	5 ✓
17	(F/A, $i\%$, n)	Mutually exclusive list of alternatives means the selection of a	15 X
18	MIRR	Implied benefits in benefit/cost ratio analysis is consider under	9 ✓
19	Learning curve	An example of a breakeven parameter between two alternative can be	14 X
20	Capitalized cost	The constant increment amount of payment series from one year to another is refer to as	13 ✓

Problem 5 (15 points)

Certain parts for Raytheon's reusable space exploration system can either be System X or System Y. Some of the costs for each process are shown.

	System X	System Y
First cost, \$	?	-72000
Annual operating cost, \$	-24700	?
Salvage value, \$	?	7500
Life, years	5	5

The incremental AW cash flow equation associated with (System Y – System X) is:

$$0 = -35000(A/P, \Delta i^*, 5) + 8500 + 5000(A/F, \Delta i^*, 5)$$

- a) What is the first cost for System ~~X~~ X
- b) Determine the annual operating cost for System ~~X~~ Y
- c) Calculate the salvage value for System ~~X~~ X

OR

Problem 6 (15 points)

Solar and conventional alternatives are available for providing energy at a remote U.S. Army training site. The costs associated with each alternative are shown. Use the B/C method to determine which should be selected at an interest rate of 9% per year over a 10-year study period.

	Conventional	Solar
Initial cost, \$	750000	1,800,000
Annual power cost, \$/yr	180,000	35,000
Salvage value, \$	40,000	280,000

Problem 1

Identify

$$P = 7,000,000$$

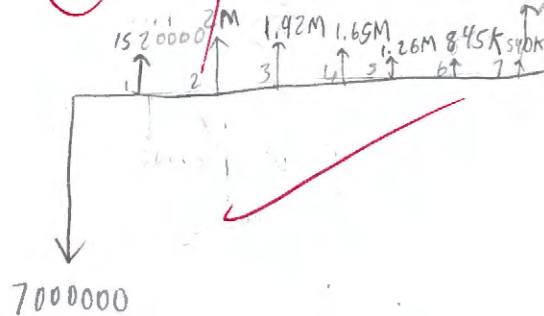
$$S = 350,000$$

$$CB = P(A/P, i\%, n) - S(A/F)$$

$$AW = PW(P/A, i\%, n)$$

$$S = F_7 = 350,000$$

Formulate



$$\text{Annual Cost 1} = 95000 \cdot 29 = \$2,755,000$$

$$\text{Annual Price 1} = 95000 \cdot 45 = \$4,275,060$$

$$\text{Annual Cost 2} = 125000 \cdot 30 = \$3,750,000$$

$$\text{Annual Price 2} = 125000 \cdot 46 = \$5,750,000$$

$$\text{Annual Cost 3} = 120000 \cdot 31 = \$3,720,000$$

$$\text{Annual Price 3} = 120000 \cdot 47 = \$5,640,000$$

$$\text{Annual Cost 4} = 110000 \cdot 33 = \$3,630,000$$

$$\text{Annual Price 4} = 110000 \cdot 48 = \$5,280,000$$

$$\text{Annual Cost 5} = 90000 \cdot 35 = \$3,150,000$$

$$\text{Annual Price 5} = 90000 \cdot 49 = \$4,410,000$$

$$\text{Annual Cost 6} = 65000 \cdot 37 = 2,405,000$$

$$\text{Annual Price 6} = 65000 \cdot 50 = 3,250,000$$

$$\text{Annual Cost 7} = 45000 \cdot 39 = 1,755,000$$

$$\text{Annual Price 7} = 45000 \cdot 51 = 2,295,000$$

Solve

a)

$$PW = -7,000,000 + 1,520,000(P/F, 11\%, 1) + 1,920,000(P/F, 11\%, 2) + 1,650,000(P/F, 11\%, 3) + 1,260,000(P/F, 11\%, 4) + 845,000(P/F, 11\%, 5) + 890,000(P/F, 11\%, 6) + 350,000(P/F, 11\%, 7)$$

$$PW = \$11,587$$

$$b) CB = P(A/P, i\%, n) - S(A/F, i\%, n)$$

$$= 7000000(A/P, 11\%, 7) - 350000(A/F, 11\%, 7)$$

$$CB = \$1,444,763$$

$$AW = PW(P/A, A/P)$$

$$(11587(P/A, 11\%, 7)) = \$525,820.30$$

$$c) PW_{10} = -7000000 + 1520000(P/F, 10\%, 1) + 2000000(P/F, 10\%, 2) + 1920000(P/F, 10\%, 3)$$

$$+ 1650000(P/F, 10\%, 4) + 1260000(P/F, 10\%, 5) + 845000(P/F, 10\%, 6)$$

$$+ 890000(P/F, 10\%, 7) = \$320,162.50$$

$$PW_{12} = -7000000 + 1520000(P/F, 12\%, 1) + 2000000(P/F, 12\%, 2) + 1920000(P/F, 12\%, 3)$$

$$+ 1650000(P/F, 12\%, 4) + 1260000(P/F, 12\%, 5) + 845000(P/F, 12\%, 6)$$

$$+ 890000(P/F, 12\%, 7) = \$-87613$$

$$\begin{array}{l|l} 10\% & 320162.5 \\ i & 0 \\ 12\% & 87613 \end{array}$$

$$\frac{320162.5 - 0}{320162.5 - 87613} = \frac{10 - i}{10 - 12}$$

$$1.377 = \frac{10 - i}{-2}$$

$$i - 2.754 = 10 - i$$

$$i = 10 + 2.754$$

$$i = 12.754\%$$

d) yes it's worth the investment

Problem 2

Identify

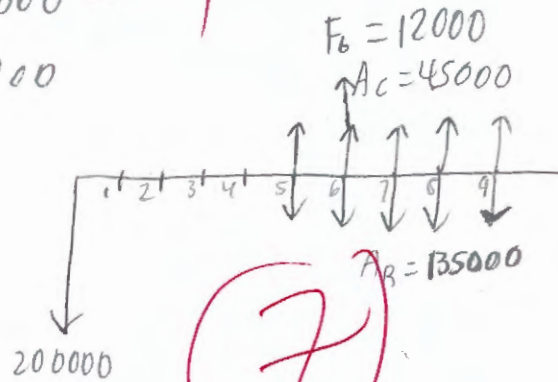
$$P_0 = 200000$$

$$A_c = 45000$$

$$A_R = 135000$$

$$F_0 = 12000$$

a) 0%



$$0 = 200000(P/F, 11\%, 7) + 45000(F/A, 11\%, 4) - 135000(F/A, 11\%, 5)$$

3.5 years

b)

5.5 years

Problem 3

Expected usage = 5000 units per year

Identify

\$25 per unit - buy

\$5 per unit - make

$$P = \$150000$$

$$A = \$35000$$

$$S = \$15000$$

Formulate

AW buy

$$-25x$$

AW make

$$AW_{make} = 150000(A/P, 12\%, 5) - 35000(A/F, 12\%, 5) + 15000 - 5x$$

$$150000(0.27741) - 35000(0.15741) + 15000 - 5x$$

Solve

a)

$$-25x = 150000(A/P, 12\%, 5) - 35000(A/F, 12\%, 5) + 15000 - 5x$$

$$-25x = 41611.5 - 5509.35 + 15000 - 5x$$

$$-20x = 51,102.15$$

20

$$x = 2555.1 \text{ units}$$

b) Recommend the ~~make~~ option

Problem 5

Identify:

	System X	System Y
First Cost \$	?	-72000
Annual Operating Cost	-24700	?
Salvage Value	?	7500
Life years	5	5

Formulate: $0 = -35000(A/P, \Delta i^*, 5) + 8500 + 5000(A/F, \Delta i^*, 5)$

Solve: a) $-72000 - x = -35000$

$$\frac{-x}{-1} = \frac{37000}{-1}$$

System X = ~~\$-37000~~

(S)

b) $Y - (-24700) = 8500$

System Y = ~~\$-16200~~

(S)

c) $\begin{matrix} 7500 \\ -7500 \end{matrix} - x = \begin{matrix} 5000 \\ -7500 \end{matrix}$

$$\frac{-x}{-1} = \frac{-2500}{-1}$$

System X = ~~\$2500~~

(S)

AVERAGE

Average Student Original Graded Assignment

**Prairie View A & M University, CHEG 2308: Economics Analysis and Technical Applications
Spring 2021: Final Exam, Monday, May 10, 2021, Instructor: Dr. Kazcem Olanrewaju**

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Name of Student: Churton Munroe

Exam Duration: 2 hr

Problem 1 (30)

Northern Engineering is analyzing a mining project. Annual production, unit costs, and unit revenues are in the table. The first cost of the mine setup is \$7 million and the aggregate salvage value for some of the disposable equipment used in the project is 5% of the first cost.

Year	Annual Production (tons)	Cost per ton(\$)	Price per ton (\$)
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6	65,000	37	50
7	45,000	39	51

If MARR is 11 %,

- What is the PW of the Project?
- Determine the capital recovery and the annual worth for the mining project
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- Is this mining project worth the investment?

Problem 2 (25 points)

The process for producing a fruit-tree pesticide has a first cost of \$200,000 (initial investment at year 0) with annual operating cost of \$45,000 and revenue of \$135,000 per year starting 5 years from now. In the 6th year, \$12000 was given to the company by Environmental Protection Agency as credit for its environmental compliance. What is the payback period at:

- 0%
- 11%

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Problem 3 (25 points)

Intel is trying to reduce supply chain risk by making more responsible make/buy decisions through improved cost estimation. A high-use component (expected usage is 5000 units per year) can be

83
100

purchased for \$25 per unit with delivery promised within a week. Alternatively, Intel can make the component inhouse and have it readily available at a cost of \$5 per unit, if equipment costing \$150,000 is purchased. Labor and other operating costs are estimated to be \$35,000 per year over the study period of 5 years. Salvage is estimated at 10% of first cost and MARR= 12% per year. Neglect the element of availability

- Determine the breakeven quantity,
- Recommend making or buying at the expected usage level.

Problem 4 (20 points)

	Terms (A)	Concepts (B)	Answer
1	Cost effective Alternative	A non-linear relationship between revenue-cost and quantity will likely two	14
2	Effective	The periodic payment made to buyers of bond is refers to as	15
3	MARR	Feasibility study of a new automobile plant	10
4	Nominal	The future equivalent amount of a uniform series sinking fund at a compound interest, $i\%$ for n years	17
5	Compounded	Decision making in engineering economy is concerned with choosing the best	1
6	Fixed cost	The present worth of a project that will last for a long time is called	20
7	Total cost	Paying the mortgage instead of going out for dinner	11
8	(A/P, $i\%$, n)	It model relationship between task performance and repetition	19
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19	Learning curve	An example of a breakeven parameter between two alternative can be	7
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(20)

Problem 5 (15 points)

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	System X	System Y
First cost, \$	?	-72000
Annual operating cost, \$	-24700	?
Salvage value, \$	?	7500
Life, years	5	5

The incremental AW cash flow equation associated with (System Y – System X) is:

$$0 = -35000(A/P, \Delta i^*, 5) + 8500 + 5000(A/F, \Delta i^*, 5)$$

- a) What is the first cost for System Y
- b) Determine the annual operating cost for System X
- c) Calculate the salvage value for System Y

OR

Problem 6 (15 points)

Solar and conventional alternatives are available for providing energy at a remote U.S. Army training site. The costs associated with each alternative are shown. Use the B/C method to determine which should be selected at an interest rate of 9% per year over a 10-year study period.

	Conventional	Solar
Initial cost, \$	750000	1,800,000
Annual power cost, \$/yr	180,000	35,000
Salvage value, \$	40,000	280,000

Problem 5)

→ System 4 - System X

a) $4 - X$

$$\Rightarrow -72,000 - X = -38,000$$

$$-X = -38,000 + 72,000 \Rightarrow X = -34,000$$

b) $4 - X$

$$\Rightarrow 4 - 24,700 = 8500$$

$$4 = 8500 + 24,700 \Rightarrow 4 = 33,200$$

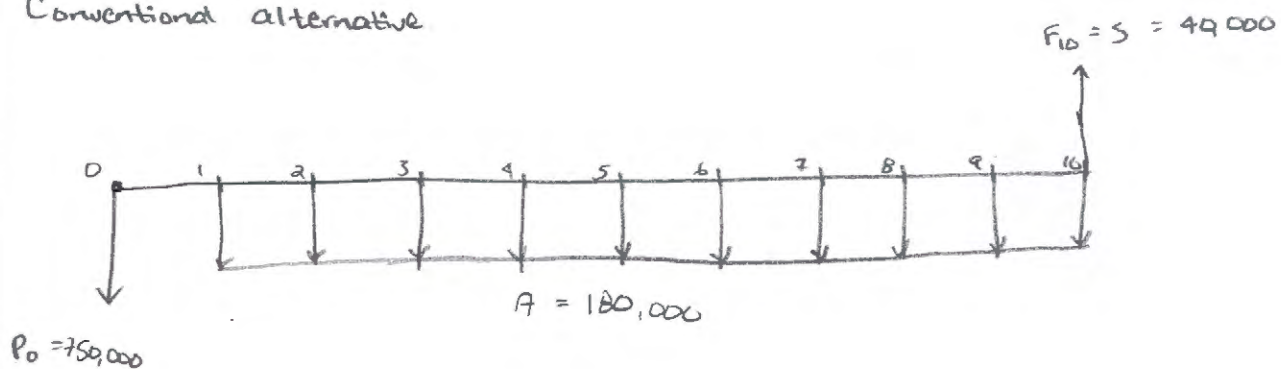
c) $4 - X$

$$\Rightarrow 7500 - X = 5000$$

$$-X = 5000 - 7500 \Rightarrow X = 2,500$$

Problem 6)

Conventional alternative

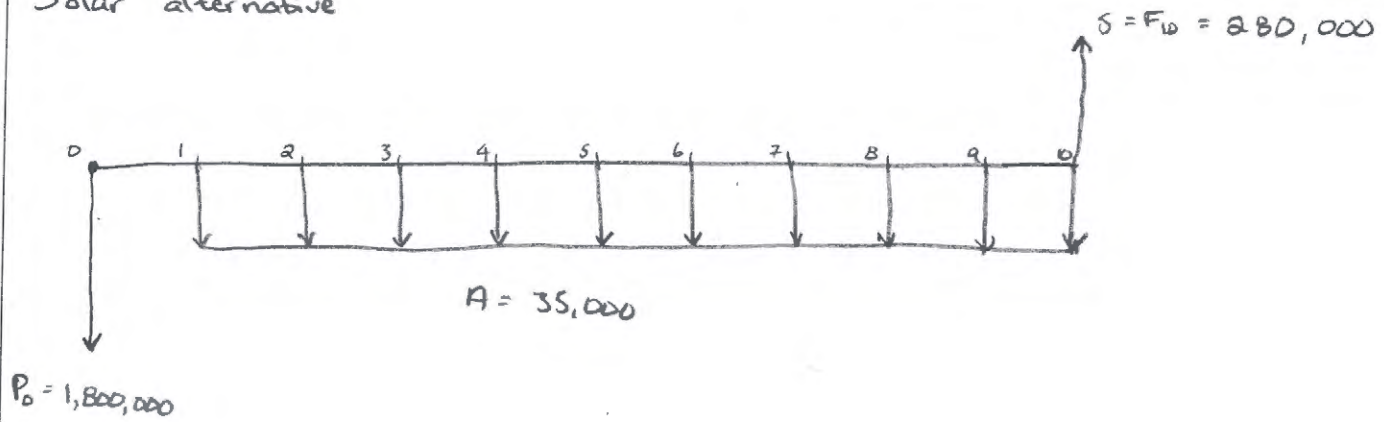


$$AW_P = 750,000 (A/P, 9\%, 10) = 750,000 (0.15582) = 116,865$$

$$A_c = 180,000$$

$$AW_F = 49,000 (A/F, 9\%, 10) = 49,000 (0.06582) = 2632.8$$

Solar alternative



$$AW_P = 1,800,000 (A/P, 9\%, 10) = 1,800,000 (0.15582) = 280,476$$

$$A_C = 35,000$$

$$AW_F = 280,000 (A/F, 9\%, 10) = 280,000 (0.06582) = 18,429.6$$

$$\Rightarrow B/C = \frac{(A_i - A_r) + (AW_{F_2} - AW_{F_3})}{(AW_{P_3} - AW_{P_F})}$$

$$= \frac{(180,000 - 35,000) + (18,429.6 - 2632.8)}{(280,476 - 116,865)}$$

$$\Rightarrow B/C = 0.983$$

$\therefore$ since $B/C = 0.983 < 1$, the alternative with the lower equivalent cost, the conventional alternative, should be selected

Problem 1)

$$P_0 = 7,000,000, S = F_7 = 5\% \text{ of } P_0 = 0.05 \times 7,000,000 = 350,000, i = 11\%$$

Annual revenue (AR), annual cost (AC), net = AR - AC

Year 1

$$AC = 95,000 \text{ ton} \times \$20/\text{ton} = 2,750,000$$

$$AR = 95,000 \text{ ton} \times \$45/\text{ton} = 4,275,000$$

$$\text{net} = 1,520,000$$

Year 2

$$AC = 125,000 \text{ ton} \times \$30/\text{ton} = 3,750,000$$

$$AR = 125,000 \text{ ton} \times \$46/\text{ton} = 5,750,000$$

$$\text{net} = 2,000,000$$

Year 3

$$AC = 120,000 \text{ ton} \times \$31/\text{ton} = 3,720,000$$

$$AR = 120,000 \text{ ton} \times \$47/\text{ton} = 5,640,000$$

$$\text{net} = 1,920,000$$

Year 4

$$AC = 110,000 \text{ ton} \times \$33/\text{ton} = 3,630,000$$

$$AR = 110,000 \text{ ton} \times \$48/\text{ton} = 5,280,000$$

$$\text{net} = 1,650,000$$

Year 5

$$AC = 90,000 \text{ ton} \times \$35/\text{ton} = 3,150,000$$

$$AR = 90,000 \text{ ton} \times \$49/\text{ton} = 4,410,000$$

$$\text{net} = 1,260,000$$

Year 6

$$AC = 65,000 \text{ ton} \times \$37/\text{ton} = 2,405,000$$

$$AR = 65,000 \text{ ton} \times \$50/\text{ton} = 3,250,000$$

$$\text{net} = 845,000$$

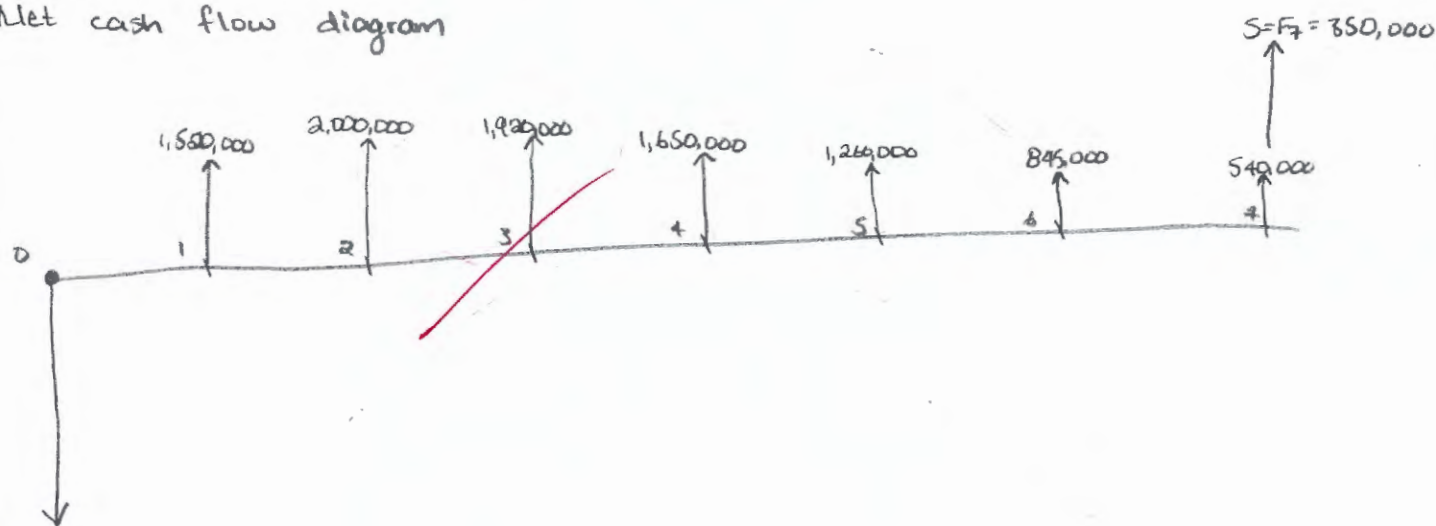
Year 7

$$AC = 45,000 \text{ ton} \times \$39/\text{ton} = 1,755,000$$

$$AR = 45,000 \text{ ton} \times \$51/\text{ton} = 2,295,000$$

$$\text{net} = 540,000$$

→ Net cash flow diagram



$$P_0 = 7,000,000$$

a) PW of project

$$\Rightarrow -7,000,000 + 1,520,000(P/F, 11\%, 1) + 2,000,000(P/F, 11\%, 2) + 1,920,000(P/F, 11\%, 3)$$

$$+ 1,650,000(P/F, 11\%, 4) + 1,260,000(P/F, 11\%, 5) + 845,000(P/F, 11\%, 6) + 890,000(P/F, 11\%, 7)$$

$$\Rightarrow -7,000,000 + 1,520,000(0.9009) + 2,000,000(0.8116) + 1,920,000(0.7312)$$

$$+ 1,650,000(0.6587) + 1,260,000(0.5935) + 845,000(0.5346) + 890,000(0.4817)$$

$$\Rightarrow \text{PW} = 114,587$$

b) capital recovery (CR) and AW

$$\Rightarrow CR = P \left(\frac{P}{F}, 11\%, 7 \right) - S \left(\frac{P}{F}, 11\%, 7 \right)$$

$$= 7,000,000 (0.4817) - 350,000 (0.4817)$$

$$\Rightarrow CR = 3,203,305$$

(3)

$$\Rightarrow AW = PW \left(\frac{P}{A}, 11\%, 7 \right)$$

$$= 111,587 (4.7122) \Rightarrow AW = 525,820.26$$

c) IRR

→ at 10%

$$\Rightarrow PW = -7,000,000 + 1,520,000 (P/F, 10\%, 1) + 2,000,000 (P/F, 10\%, 2)$$

$$+ 1,420,000 (P/F, 10\%, 3) + 1,650,000 (P/F, 10\%, 4) + 1,260,000 (P/F, 10\%, 5)$$

$$+ 845,000 (P/F, 10\%, 6) + 890,000 (P/F, 10\%, 7)$$

$$= -7,000,000 + 1,520,000 (0.9091) + 2,000,000 (0.8264) + 1,420,000 (0.7513)$$

$$+ 1,650,000 (0.6830) + 1,260,000 (0.6209) + 845,000 (0.5645) + 890,000 (0.5132)$$

$$\Rightarrow PW_{\text{at } 10\%} = 320,162.5$$

(7)

→ at 12%

$$\Rightarrow PW = -7,000,000 + 1,520,000 (P/F, 12\%, 1) + 2,000,000 (P/F, 12\%, 2) + 1,420,000 (P/F, 12\%, 3)$$

$$+ 1,650,000 (P/F, 12\%, 4) + 1,260,000 (P/F, 12\%, 5) + 845,000 (P/F, 12\%, 6)$$

$$+ 890,000 (P/F, 12\%, 7)$$

$$= -7,000,000 + 1,520,000 (0.8929) + 2,000,000 (0.7972) + 1,420,000 (0.7118)$$

$$+ 1,650,000 (0.6355) + 1,260,000 (0.5674) + 845,000 (0.5066) + 890,000 (0.4523)$$

$$\Rightarrow PW_{\text{at } 12\%} = -87,613$$

$$\Rightarrow \frac{12 - 10}{x - 10} = \frac{-87,613 - 320,162 \cdot 5}{0 - 320,162 \cdot 5}$$

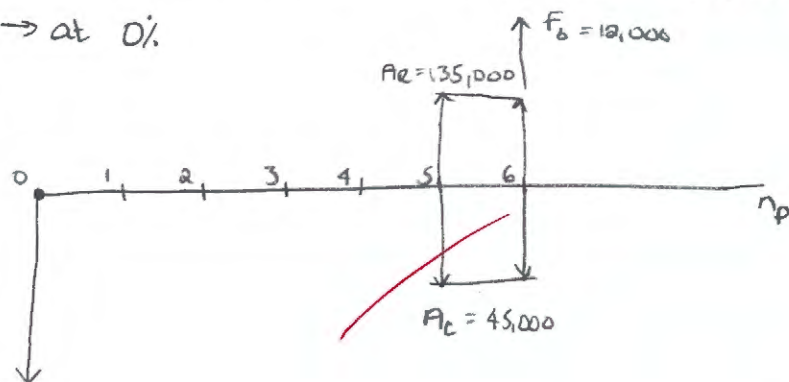
$$\Rightarrow x = 11.95 = IRR$$

d) since $IRR = 11.95 > MARR = 11\%$ the project is worth the investment

Problem 2)

$$P_0 = 200,000, AC = 45,000, AR = 135,000, F_6 = 12,000$$

→ at 0%



$$P_0 = 200,000$$

$$\Rightarrow 0 = -200,000 + (135,000 - 45,000)x + 12,000$$

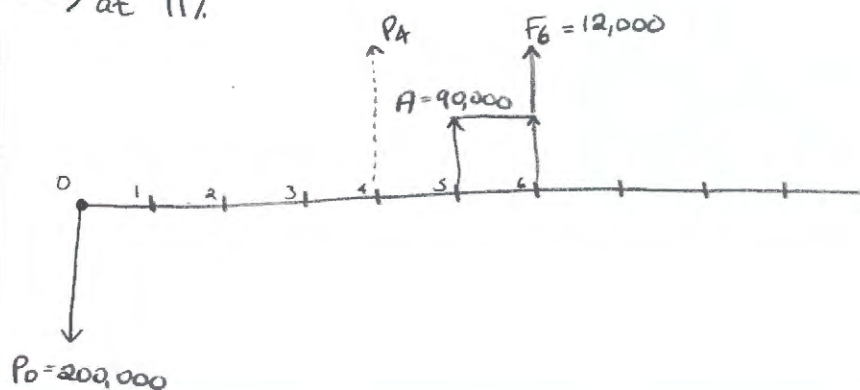
$$\Rightarrow x = \frac{200,000 - 12,000}{(135,000 - 45,000)}$$

$$\Rightarrow x = 2.01$$

$$\Rightarrow n_p = x + 4$$

$$= 2.01 + 5 \Rightarrow n_p = 7.01 \text{ years}$$

→ at 11%



$$\Rightarrow PW = -200,000 + 12,000 (P/F, 11\%, 4) + 90,000 (F/A, 11\%, x) (P/F, 11\%, 4)$$

→ for 3 years, $x = 4$

$$\begin{aligned} \Rightarrow PW &= -200,000 + 12,000 (P/F, 11\%, 4) + 90,000 (F/A, 11\%, 4) (P/F, 11\%, 4) \\ &= -200,000 + 12,000 (0.6587) + 90,000 (4.7697) (0.6587) \\ PW &= 87,109.55 \end{aligned}$$

→ for 4 years, $x = 5$

$$\begin{aligned} \Rightarrow PW &= -200,000 + 12,000 (P/F, 11\%, 4) + 90,000 (F/A, 11\%, 5) (P/F, 11\%, 4) \\ &= -200,000 + 12,000 (0.6587) + 90,000 (6.2278) (0.6587) \\ PW &= \end{aligned}$$

$$\Rightarrow \frac{4 - 3}{x - 3} = \underline{\hspace{10cm}}$$

$$\Rightarrow x =$$

$$\Rightarrow n_p = 5 + x \Rightarrow 5 + \quad \Rightarrow n_p =$$

Problem 3)

BELOW AVERAGE

Below Average Student Original Graded Assignment

**Prairie View A & M University, CHEG 2308: Economics Analysis and Technical Applications
Spring 2021: Final Exam, Monday, May 10, 2021, Instructor: Dr. Kazeem Olanrewaju**

You should not reference to or have access to your textbooks, class notes, laptop, tablet, cell phone, smart phone, and any other electronic gadgets. Four problems are compulsory (1, 2, 3, 4). Problem 5 or 6 is an optional problem with extra points.

Name of Student: Petero Cio Marana Enyong Oboro

Exam Duration: 2 hr

Problem 1 (30)

Northern Engineering is analyzing a mining project. Annual production, unit costs, and unit revenues are in the table. The first cost of the mine setup is \$7 million and the aggregate salvage value for some of the disposable equipment used in the project is 5% of the first cost.

Year	Annual Production (tons)	Cost per ton(\$)	Price per ton (\$)
1	95,000	29	45
2	125,000	30	46
3	120,000	31	47
4	110,000	33	48
5	90,000	35	49
6	65,000	37	50
7	45,000	39	51

If MARR is 11 %,

- What is the PW of the Project?
- Determine the capital recovery and the annual worth for the mining project
- Given these two guess values of 10% and 12%, estimate the internal rate of return for the project
- Is this mining project worth the investment?

Problem 2 (25 points)

The process for producing a fruit-tree pesticide has a first cost of \$200,000 (initial investment at year 0) with annual operating cost of \$45,000 and revenue of \$135,000 per year starting 5 years from now. In the 6th year, \$12000 was given to the company by Environmental Protection Agency as credit for its environmental compliance. What is the payback period at:

- 0%
- 11%

Given that the two guess values for x number of years to be between 3 yrs and 4 yrs at 11 % from the 5th year. Ensure you draw one cash flow diagram for the two interest rates.

Problem 3 (25 points)

Intel is trying to reduce supply chain risk by making more responsible make/buy decisions through improved cost estimation. A high-use component (expected usage is 5000 units per year) can be

purchased for \$25 per unit with delivery promised within a week. Alternatively, Intel can make the component inhouse and have it readily available at a cost of \$5 per unit, if equipment costing \$150,000 is purchased. Labor and other operating costs are estimated to be \$35,000 per year over the study period of 5 years. Salvage is estimated at 10% of first cost and MARR= 12% per year. Neglect the element of availability

- Determine the breakeven quantity,
- Recommend making or buying at the expected usage level.

Problem 4 (20 points)

	Terms (A)	Concepts (B)	Answer
1	Cost effective - Alternative	A non-linear relationship between revenue-cost and quantity will likely two	14 ✓
2	Effective ✓	The periodic payment made to buyers of bond is refers to as	15 ✓
3	MARR ✓	Feasibility study of a new automobile plant	10 ✓
4	Nominal ✓	The future equivalent amount of a uniform series sinking fund at a compound interest, $i\%$ for n years	17 ✓
5	Compounded	Decision making in engineering economy is concerned with choosing the best	1 ✓
6	Fixed cost ✓	The present worth of a project that will last for a long time is called	20 ✓
7	Total cost	Paying the mortgage instead of going out for dinner	11 ✓
8	(A/P, $i\%$, n)	It model relationship between task performance and repetition	12 ✗
9	Usage cost	The lowest acceptable rate of return on any project is	✗
10	Complex problem ✓	Interest rate consider from the lender's perspective is term as	16 ✓
11	Opportunity cost	This is an example of an external rate of return	✗
12	Project	Costs incurred regardless of volume level to stay in business	6 ✓
13	Gradient ✓	The annual interest rate without considering the effect of any compounding	4 ✓
14	Breakeven points	Finding the equivalent uniform amount for a given initial investment for n years and at a compound interest rate of $i\%$	8 ✓
15	Dividend	Effective 8.3% per year compounded monthly	2 ✓
16	Rate of return ✓	Most cash flow analysis in the real world operate on an interest rate that is	5 ✓
17	(F/A, $i\%$, n) ✓	Mutually exclusive list of alternatives means the selection of a	12 ✓
18	MIRR	Implied benefits in benefit/cost ratio analysis is consider under	18 ✗
19	Learning curve	An example of a breakeven parameter between two alternative can be	3 ✗
20	Capitalized cost ✓	The constant increment amount of payment series from one year to another is refer to as	13 ✓

(15)

$$\begin{aligned}
 c) P_{W(10)} &= -700000 + 152000(P/F, 10\%, 1) + 200000(P/F, 10\%, 2) + 182000(P/F, 10\%, 3) \\
 &\quad + 165000(P/F, 10\%, 4) + 126000(P/F, 10\%, 5) + 84500(P/F, 10\%, 6) \\
 &\quad + 89000(P/F, 10\%, 7) \\
 &= -700000 + 138183.2 + 165280.0 + 144249.6 + 112695.0 + 78233.4 \\
 &\quad + 477002.5 + 456748
 \end{aligned}$$

$$P_{W(10)} = -109137.5$$

$$\begin{aligned}
 P_{W(12)} &= -700000 + 152000(P/F, 12\%, 1) + 200000(P/F, 12\%, 2) + 182000(P/F, 12\%, 3) \\
 &\quad + 165000(P/F, 12\%, 4) + 126000(P/F, 12\%, 5) + 845000(P/F, 12\%, 6) \\
 &\quad + 89000(P/F, 12\%, 7) \\
 &= -700000 + 135720.8 + 159440.0 + 126656 + 104857.5 + 71492.4 \\
 &\quad + 428077 + 402947
 \end{aligned}$$

$$P_{W(12)} = -472883$$

$$\begin{array}{c|c}
 -109137.5 & 10 \\
 \hline
 0 & 0 \\
 \hline
 -472883 & -12
 \end{array}$$

$$\begin{aligned}
 \frac{-109137.5 - 0}{-109137.5 - (-472883)} &= \frac{10 - i}{10 - 12} \\
 -0.03 &= \frac{10 - i}{-2}
 \end{aligned}$$

$$\begin{aligned}
 (-0.03)(-2) &= 10 - i \\
 0.6 &= 10 - i \\
 10 - 0.6 &= i
 \end{aligned}$$

$$i = 9.4\%$$

d) $IRR < MARR$.
The project does not worth it (3)

1/ Given:

$$P_0 = \$7,000,000$$

$$S = 5\% = \$350,000$$

$$\text{Year 1: } \begin{cases} \text{An. Cost} = 95,000 \times 29 = \$2,755,000 \\ \text{An. Rev} = 95,000 \times 45 = \$4,275,000 \end{cases}$$

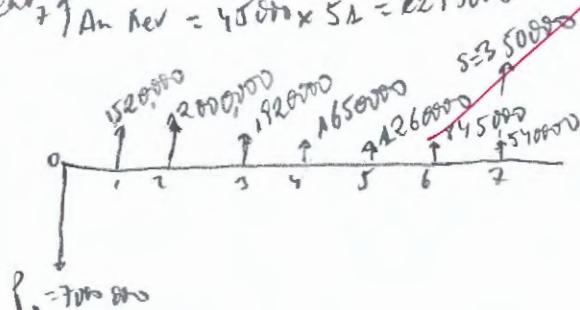
$$\text{Year 2: } \begin{cases} \text{An. Cost} = 125,000 \times 30 = 3,750,000 \\ \text{An. Rev} = 125,000 \times 46 = 5,750,000 \end{cases}$$

$$\text{Year 3: } \begin{cases} \text{An. Cost} = 120,000 \times 31 = 3,720,000 \\ \text{An. Rev} = 120,000 \times 47 = 5,640,000 \end{cases} \quad // \quad \text{Year 4: } \begin{cases} \text{An. Cost} = 110,000 \times 33 = 3,630,000 \\ \text{An. Rev} = 110,000 \times 48 = 5,280,000 \end{cases}$$

$$\text{Year 5: } \begin{cases} \text{An. Cost} = 90,000 \times 35 = 3,150,000 \\ \text{An. Rev} = 90,000 \times 49 = 4,410,000 \end{cases}$$

$$\text{Year 6: } \begin{cases} \text{An. Cost} = 65,000 \times 37 = 2,405,000 \\ \text{An. Rev} = 65,000 \times 50 = 3,250,000 \end{cases}$$

$$\text{Year 7: } \begin{cases} \text{An. Cost} = 45,000 \times 39 = 1,755,000 \\ \text{An. Rev} = 45,000 \times 51 = 2,295,000 \end{cases}$$



or 5% MARK is 11%.

$$PW = -7,000,000 + 152,000(P/F, 11\%, 1) + 2,000,000(P/F, 11\%, 2) + 192,000(P/F, 11\%, 3) \\ + 165,000(P/F, 11\%, 4) + 126,000(P/F, 11\%, 5) + 845,000(P/F, 11\%, 6) \\ + 88,000(P/F, 11\%, 7)$$

$$PW = -7,000,000 + 136,936 + 1,623,200 + 1,403,904 + 1,086,855 + 747,810 \\ + 451,737 + 428,713$$

$$PW = \$1,208,13$$

b) Capital Recovery.

$$CR = P(P/F, i, n) - S(A/F, i, n)$$

$$CR = 7,000,000(P/F, 11\%, 7) - 350,000(A/F, 11\%, 7) \\ = 7,000,000(0.4817) - 350,000(0.10222) \\ = 3,371,900 - 35,777$$

$$CR = \$3,336,123$$

$PW_{(10)} =$

Problem 3:

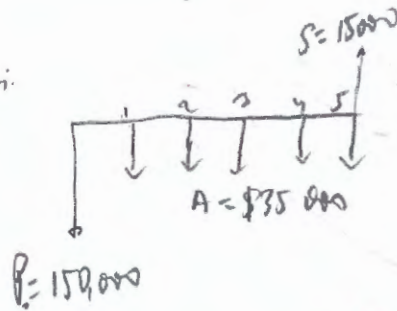
Given:

Make = \$5 per unit ; MARR = 12%

Buy = \$25 per unit ; Salvage = 150,000 ~~240 = \$15,000~~

Buy option: $-25 \frac{x}{\text{year}} \Rightarrow AW = -25X$

make option:



$$\begin{aligned}
 AW &= 150,000 (A/P, 12\%, 5) + 35,000 + 150,000 (A/F, 12\%, 5) - 5X \\
 (make) &= 41611.5 + 3500 + 4161.15 - 5X \\
 &= 49273 - 5X
 \end{aligned}$$

Break-even point

$$AW_{buy} = AW_{make}$$

$$-25X = 49273 - 5X$$

$$-20X = 49273$$

$$X = 2463 \text{ units}$$

B) I recommend make option.

Problem 5.

a) $S_Y - S_X = -35000$

$-7200 - S_X = -35000$

$-S_X = -35000 + 7200$

System X = $35000 - 7200$

$X = \$37800$

b) $S_Y - S_X = 8500$

$S_Y - (-24700) = 8500$

$S_Y + 24700 = 8500$

$S_Y = 8500 - 24700$

$S_Y = \$-16200$

c) $S_Y - S_X = 5000$

$7500 - S_X = 5000$

$-S_X = 5000 - 7500$

$S_X = 2500$

(S)

Answers:

- a) The first cost for System X is \$37800
b) Annual operating cost for System Y is \$-16200
c) Salvage value for System X = \$2500

**ECONOMIC ANALYSIS AND TECHNICAL
APPLICATIONS SPRING 2022**

PROJECT TITLE

TOPICS COVERED IN PROJRCT

1. The Decision-Making Process
2. Ethics
3. Cash Flow Diagram
4. Present Worth Analysis
5. Rate of Return
6. Annual Cash Flow Analysis.
7. Modified Internal Rate of Return

**ECONOMIC ANALYSIS AND TECHNICAL APPLICATIONS
SEMESTER PROJECT
SPRING 2022**

**DETAILED PROJECT PROBLEM STATEMENT
AND REQUIREMENTS**

**ECONOMIC ANALYSIS AND TECHNICAL
APPLICATIONS SPRING 2022**

DETAILED PROJECT GRADING SCHEME

ENGINEERING ECONOMIC PROJECT, CHEG 2308 (Prototype D)

Due Date is April 14, 2022

Direction for this project

Class Project Assignment is:

The Boeing Company has an opportunity to supply a large airplane to British Airways, a foreign airline. British Airways (BA) will pay \$19 million upfront when the contract is signed and \$19.45 million one year later. Two years after .i.e. in the third year, British Airways deposited \$9.7 million into Boeing business account. Boeing had obtained loan from Morgan Stanley (an investment bank) prior to the initial payment from BA and invest \$16.5 million from it at the beginning of the project. Subsequently, Boeing spend \$ 20 million, \$ 9.5 million, \$ 3.5 million, 26 million, and \$ 14 million as running cost for the first, second, third, fourth and fifth year respectively. British Airways will take delivery of the airplane during Year 4, and agrees to pay \$26.25 million at the end of that year and the \$15.5 million balance at the end of year 5. The outcome of the rate of return on this investment as compare with the minimum attractive rate of return (MARR) will determine if Boeing will continue to sustain their current staff strength or they will cede to the option of downsizing after the completion of the 5 year deal. Boeing management request her project management team to conduct an economic analysis on the proposed venture (project) so that they can be better informed on policy formulation in readiness for any exigency that may result from the project. These exigencies include but not limited to staff downsizing, staff retainment, salary freezing, and salary cut or closing down some of their plants since they are multinational company. The project management team is planning to approach the task as follows:

1. Generate a table depicting the cash flow estimates for the Project
2. Draw the cash flow diagram for the cash flow estimates
3. Determine the number of rates of return values this project is likely to have.
4. Obtain the values for the rate of return using Microsoft Excel (Spreadsheet). These values **should** be obtain by plotting the **Present worth** against the range of **rate of return values** (0 % to 100 %, step increase of 5 %)
5. Evaluate the Internal Rate of Return (IRR) for the zero net present worth using Microsoft Excel Spreadsheet.
6. Boeing management have set a MARR of 15% for any of their project; will you advised Boeing to embark on this project knowing the net positive cash flow received from British Airways is reinvested at 14% . The loan Boeing obtained from Morgan Stanley for the production of the Aircraft is borrowed at a rate of 10 %.
7. **You will prepare a 5-page report and a two-page appendix containing the Excel spread sheet analysis**
8. Report due on or before 04/14/2022

Format of the report:

- I. Font : 12 Times New Roman
- II. Paragraph : 1.5 spacing

Group Project

- Write a 5 page report with a two pages extra for Appendix

Structure of the report:

Introduction(Background Information on Rate of return), : 15 points

Methods(Explanation of the Graphical method of obtaining the Rate of Return Values and Method for solving External Rate of Return,) : 25 points

Results and Discussion (Answers to questions 1, 2, and 5), 30 points

Conclusion (Should Boeing embark on the project or not; how is the outcome going to affect the staff and the society as whole (effects of lack job on the society and family; give your reasons), 20 points

References : 10 points

- Due Date for the submission of report: April 14, 2022.

ENGINEERING ECONOMIC PROJECT, CHEG 2308 (Prototype E)

Due Date is April 14, 2022

Direction for this project

Class Project Assignment is:

DaimlerChrysler has an opportunity to supply Commercial Buses to Greyhound Inc, an American Private Transportation company. Greyhound Inc will pay \$4 million upfront i.e. when the contract is signed and \$1.45 million one year later. DaimlerChrysler had obtained loan from Citi Group (an investment bank) prior to the initial payment from Greyhound and invest \$1.5 million from it at the beginning of the project. Subsequently, DaimlerChrysler spend \$2 million, \$ 9.5 million, \$ 3 million, 2 million, and \$ 1.5 million as running cost for the first, second, third, fourth and fifth year respectively. Greyhound Inc will take delivery of the truck during Year 3 and 4, and agrees to pay \$9 million and \$2.25 million at the end of the two years respectively and the \$ 3 million balance at the end of year 5. The outcome of the rate of return on this investment as compare with the minimum attractive rate of return (MARR) will determine if DaimlerChrysler will continue to sustain their current staff strength or they will cede to the option of downsizing after the completion of the 5 year deal. DaimlerChrysler management request her project management team to conduct an economic analysis on the proposed venture (project) so that they can be better informed on policy formulation in readiness for any exigency that may result from the project. These exigencies include but not limited to staff downsizing, staff retainment, salary freezing, salary cut or closing down some of their plants since they are multinational company. The project management team is planning to approach the task as follows:

1. Generate a table depicting the cash flow estimates for the Project
2. Draw the cash flow diagram for the cash flow estimates
3. Determine the number of rates of return values this project is likely to have.
4. Obtain the values for the rate of return using Microsoft Excel (Spreadsheet). These values **should** be obtain by plotting the **Present worth** against the range of **rate of return values** (0 % to 100 %, step increase of 5 %)
5. Evaluate the Internal Rate of Return (IRR) for the zero net present worth using Microsoft Excel Spreadsheet.
6. DaimlerChrysler management have set a MARR of 15% for any of their project; will you advised DaimlerChrysler to embark on this project knowing the net positive cash flow received from Greyhound inc is reinvested at 30 % . The loan DaimlerChrysler obtained from Citi Group, an investment bank for the production of the commercial buses is borrowed at a rate of 10 %.
7. **You will prepare a 5-page report and a two-page appendix containing the Excel spread sheet analysis**

8. Report due on or before 04/14/2022

Format of the report:

- I. Font : 12 Times New Roman
- II. Paragraph : 1.5 spacing

Group Project

- Write a 5 page report with a two pages extra for Appendix

Structure of the report:

Introduction (Background Information on Rate of return), : 15 points

Methods(Explanation of the Graphical method of obtaining the Rate of Return Values and Method for solving External Rate of Return,) : 25 points

Results and Discussion (Answers to question 1, 2, and 5), 30 points

Conclusion (Should DaimlerChrysler embark on the project or not; how is the outcome going to affect the staff and the society as whole (effects of lack job on the society and family; give your reasons), 20 points

References : 10 points

- Due Date for the submission of report: April 14, 2022.

ENGINEERING ECONOMIC PROJECT, CHEG 2308 (Prototype B)

Due Date is April 14, 2022

Direction for this project

Class Project Assignment is:

Medtronic Inc. has an opportunity to supply medical devices to Memorial Hermann, a private hospital in the United States. Memorial Hermann will pay \$4 million upfront i.e. when the contract is signed and \$3 million for the first year, \$1.5 million for the second year and \$7.5 million for the third year. Medtronic had obtained loan from Bank of America Merrill Lynch (an investment bank) prior to the initial payment from Hermann and invest \$2 million from it at the beginning of the project. Subsequently, Medtronic spend \$3.5 million, \$10 million, \$1.5 million, 4 million, and \$3 million as running cost for the first, second, third, fourth and fifth year respectively. Memorial Hermann will take delivery of the medical devices during year 4, and agrees to pay \$4.25 million at the end of that year and the \$ 4.5 million balance at the end of year 5. The outcome of the rate of return on this investment as compare with the minimum attractive rate of return (MARR) will determine if Medtronic will continue to sustain their current staff strength or they will cede to the option of downsizing after the completion of the 5 year deal. Medtronic management request her project management team to conduct an economic analysis on the proposed venture (project) so that they can be better informed on policy formulation in readiness for any exigency that may result from the project. These exigencies include but not limited to staff downsizing, staff retainment, salary freezing, and salary cut or closing down some of their plants since they are multinational company. The project management team is planning to approach the task as follows:

1. Generate a table depicting the cash flow estimates for the Project
2. Draw the cash flow diagram for the cash flow estimates
3. Determine the number of rates of return values this project is likely to have.
4. Obtain the values for the rate of return using Microsoft Excel (Spreadsheet). These values **should** be obtain by plotting the **Present worth** against the range of **rate of return values** (0 % to 100 %, step increase of 5 %)
5. Evaluate the Internal Rate of Return (IRR) for the zero net present worth using Microsoft Excel Spreadsheet.
6. Medtronic management have set a MARR of 15% for any of their project; will you advise Medtronic to embark on this project knowing the net positive cash flow received from Memorial Hermann is reinvested at 14% . The loan Medtronic obtained from Bank of America Merrill Lynch for the production of the medical devices is borrowed at a rate of 7 %.
7. **You will prepare a 5-page report and a two-page appendix containing the Excel spread sheet analysis**

8. Report due on or before 04/14/2022

Format of the report:

- I. Font : 12 Times New Roman
- II. Paragraph : 1.5 spacing

Group Project

- Write a 5 page report with a two pages extra for Appendix

Structure of the report:

Introduction (Background Information on Rate of return): 15 points

Methods (Explanation of the Graphical method of obtaining the Rate of Return Values and Method for solving External Rate of Return,): 25 points

Results and Discussion (Answers to questions 1, 2, 5 and 6), 30 points

Conclusion (Should Medtronic embark on the project or not; how is the outcome going to affect the staff and the society as whole (effects of lack job on the society and family; give your reasons), 20 points

References: 10 points

- Due Date for the submission of report: April 14, 2022.

**ABOVE AVERAGE
PROJECT REPORT**

**Above Average Student/Group Original Graded Assignment
Including Rubric Showing Grading**



(89/100)

Prairie View A&M University Department of Chemical Engineering

CHEG 2308 Economic Analysis and Technical Applications

Project: Engineering Economic Group Project

Group 5: Prototype D

Group Members: Kennedy Dent, Tyson Morris, and Omar Sifuentes

Date: April 14th, 2022

Introduction

Rate of return (ROR), or interest rate, can be defined as the interest rate charged on an unpaid balance. The rate of return can be referred to as a gain or loss of an investment over a specific period of time. In other words, the rate of return is the gain or loss compared to the investment and is expressed as a percentage. For a rate of return to be considered a gain, the value must be positive. In contrast a loss is represented by a negative rate of return value. The equation for ROR is $\frac{\text{Current Value} - \text{Initial Value}}{\text{Initial Value}} \times 100\%$ (Kenton, W. 2022). The rate of return can be found for a wide range of assets including student loans, mortgages, vehicles, and land. Rate of return is viewed from the Investor's perspective in which money is given by a lender. ROR also works with an asset being purchased at one point and finding its value in the future. Investors usually determine which investments are more attractive before proceeding with a project venture.

Within our problem statement, we were given information to successfully conduct an economic analysis for the Boeing Company. Boeing management requested an analysis on the proposed venture so they can enhance their understanding on policy formulation in readiness for any exigency that may result from the project. The project management team has planned to take the following approach: The Boeing Company is willing to supply a large airplane to British Airways. British Airways (BA) will pay \$19 million upfront when the contract is signed and \$19.45 million one year later. Two years later, in year three, British Airways deposited \$9.7 million into Boeing's business account. Boeing had obtained a loan from an investment bank, Morgan Stanley, prior to the initial payment from BA. Boeing used the loan to invest \$16.5 million of it at the beginning of the project. Subsequently, Boeing spent \$ 20 million, \$ 9.5 million, \$ 3.5 million, \$26 million, and \$ 14 million as running costs for the first, second, third, fourth and fifth year, respectively. British Airways will take delivery of the airplane during Year four and agrees to pay \$26.25 million at the end of that year and the \$15.5 million balance at the end of year five. Boeing management has set a MARR of 15% for any of their projects. The net positive cash flow received from British Airways is reinvested at 14% and the loan Boeing obtained from Morgan Stanley for the production of the Aircraft is borrowed at a rate of 10 %. The outcome of the rate of return on this investment as compared with the minimum attractive

$$I = 14$$

$$I = 23$$

$$ROR = 26$$

$$C = 18$$

$$R = 8$$

rate of return (MARR) will determine if Boeing will continue to sustain their current staff strength or they will cede to the option of downsizing after the completion of the 5-year deal.

Method

To successfully complete an economic analysis of the proposed project we must use the three-step methodology that consists of the following steps: Identify, formulate, and solve.

Identify: In this step we must write down our given values from the problem statement and use this data to create a cash flow diagram. The cash flow diagram is shown below in figure 1. We were also able to produce a net cash flow diagram shown in Appendix A.

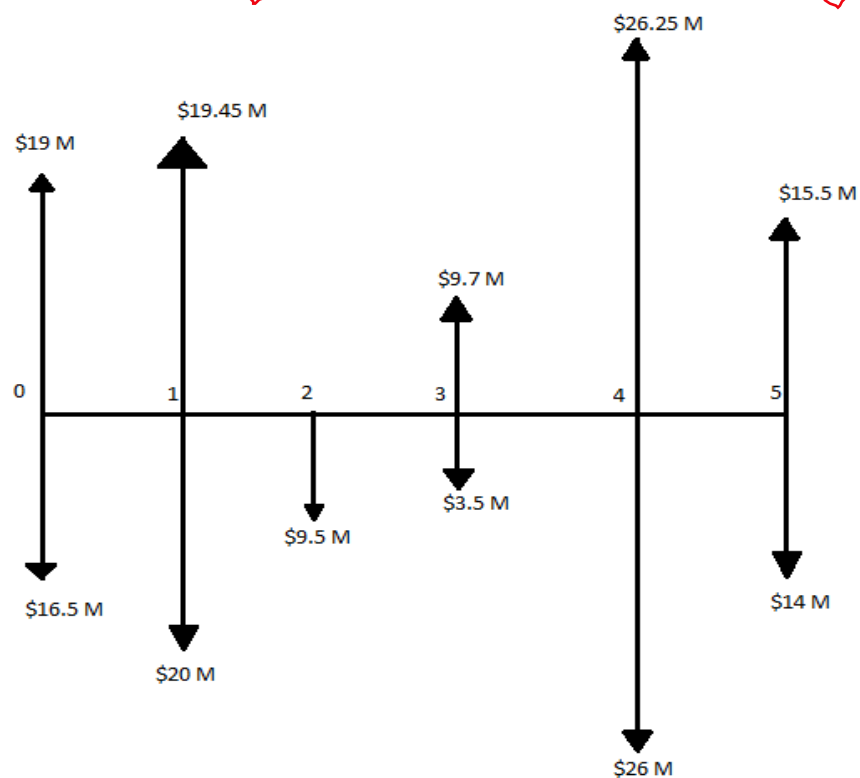


Figure 1: Cash flow diagram

To construct the cash flow diagram all costs must be represented negatively, and all cash inflow must be represented as positive values. A cash flow diagram is a graphical representation of cash inflow and outflow illustrated on a time scale. (Blank, L., & Tarquin, A. J. 2021) The diagram includes known values, annual values, and future values for each respective year. Series

over vertical lines or arrows represent the amount of money spent or acquired at the respective year. Our cash flow diagram above in figure 1 shows the inflow and outflow of cash for the Boeing Company. The arrows below the year line represent the money spent to complete the project, and the arrows above the line represent the money received from British Airways. The life of the project is shown on the cash flow diagram as five years. The initial payment of the project is shown in year zero before the project begins.

By using Net amount calculations, we can determine the number of rate of return values we will have based on the number of sign changes. Our prototype has two sign changes as shown in the table below. A plus sign represents a gain and the negative sign represents a loss. These sign changes helped us to determine the amount of rate of returns we would have. Two sign changes amount to two rates of returns.

Table 1: Net Cash flow Sign Changes

Year						Number of sign changes
0	1	2	3	4	5	
+	-	-	+	+	+	2

Formulate: In this step we must collect the necessary equations to complete the analysis. For this step we used the excel functionalities to add, find net present worth, and annual worth. The excel spreadsheet with the values of present worth are located in the Appendix.

Solve: In this step we will use excel to calculate the values for present worth and once we get this value, it will be used to calculate the internal rate of return, IRR, and the modified external rate of return. The calculations for this step are shown in the Appendix. From these calculations, we generated a present worth vs rate of return plot shown in Appendix. This plot allowed us to verify and locate our Internal rates of return, which is another name for ROR.

Results & Discussion

Boeing was the reference company for this project. The cash flow estimates shown in Appendix highlights the analysis of this proposed venture. Table 2, in the Appendix represents the inflow and outflow of cash based on the problem statement. The first column of the table entitled years, is this project life of the project from year zero to year five. The second and third column are the inputs and outputs. In Table 3, the red net amounts indicates a negative cash flow, and the black is positive. This assisted our team with creating the net cash flow diagram shown in figure 2 in the Appendix.

The estimates on the cash flow table were based on Boeing as the reference. The cash flow diagrams we created were with the cash flow of the project. We created an overall cash flow diagram with every inflow and outflow of cash and a net cash flow diagram with combined cash flow at each year. Cash flow diagrams are Figure 1 and Figure 2. The diagrams depict the amount of money Boeing received from British Airways and the Morgan Stanley investment bank. The diagrams also show the amount of money Boeing spent each year to complete the project.

Using the NPV function in Microsoft Excel, we were able to generate values for present worth with rate of return ranging from 0% to 100% in increments of 5%. The excel function used the net value of the initial payment, at year zero, and the net amounts from year one through year 5 with the adjusted rate of return values. The values we retrieved are shown in Table 3 in the Appendix.

Based on our Present Worth vs. Rate of Return graph, we observed that our curve crosses the x-axis at two points. At these two points Present Worth, PW, is equal to zero and the rate of return is equal to a return value called the Internal Rate of Return, IRR. In Table 1 above, we located two sign changes which correlates with our observation from our graph that there are two IRR values. The trend of the curve approaches negative present worth as it crosses the x-axis, and it returns to positive value after it returns over the x-axis. By looking at the graph we estimated our IRR values to be 7% and 50%. However, by using the Excel function to solve for IRR, we retrieved more exact values of 7.25% and 50.35% as shown in Figure 4 in the Appendix.

From our problem statement we were told that the loan Boeing received from the investment bank was borrowed at a 10% rate. We were also informed the net cash flow Boeing

received from British Airways is reinvested at 14%. Our minimum attractive rate of return for this project is 15%. To consider if Boeing should proceed with this project venture we must calculate the modified internal rate of return (MIRR) also known as the external rate of return (ERR). The equation and calculation for this rate of return value used in excel is shown in figures 4 and 5 in the Appendix. We were able to use the MIRR Excel function to determine our external rate of return. Hand calculations are also shown in Table 4. The value for MIRR is 11.91% or 12%.

Conclusion

In conclusion, Boeing should be advised to not proceed with this project venture. By analyzing the cash flow estimates, we were able to see a loss of money for this venture. The present worth vs. rate of return plot shows that at 7.25% and 50.35% there is a negative cash flow. This would not benefit Boeing because the rate of return would need to be incredibly high to make a positive present worth. The value calculated for the modified internal rate of return (MIRR) was 12% and the given minimum attractive rate of return (MARR) was 15%. Our MIRR is less than our MARR, therefore Boeing should not proceed. If Boeing wanted to proceed with this project, budget cuts would need to be made. These budget cuts may include employee cuts and payment cuts. These adjustments would not account for the total labor loss for the project. Cutting pay would have to amount to a large value, which is not economical. Cutting pay would directly affect the workers and their families. Workers would not make enough to provide for their families. Boeing would not only lose clientele, but they would tarnish their reputation. Supplying the airplane to British Airways would cause numerous financial problems to the society. Therefore, we believe it is best that Boeing does not proceed with this project venture.

References

1. Kenton, W. (2022, March 22). *Rate of return (ROR)*. Investopedia. Retrieved April 14, 2022, from <https://www.investopedia.com/terms/r/rateofreturn.asp>
2. Blank, L., & Tarquin, A. J. (2021). *Basics of Engineering Economy*. McGraw Hill.
3. Blank, L., & Tarquin, A. J. (2021). *Reference Materials. Basics of Engineering Economy*. McGraw Hill.

Appendix

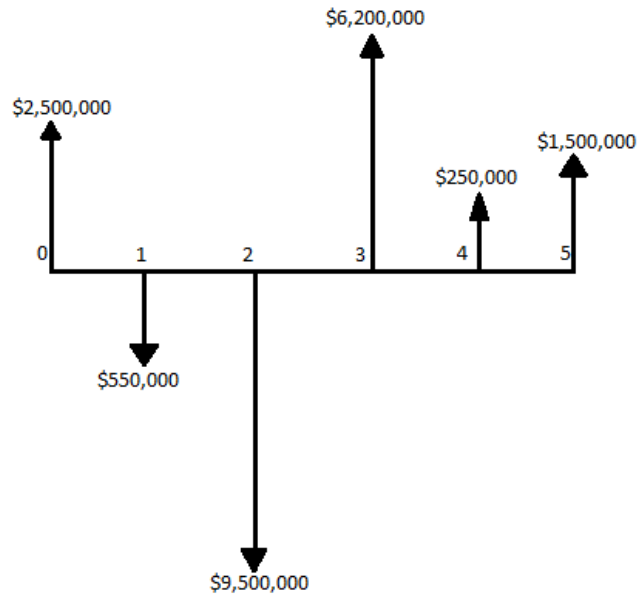


Figure 2: Net Cash Flow Diagram

Years	Input	Output
0	\$19,000,000	\$16,500,000
1	\$19,450,000	\$20,000,000
2	\$0	\$9,500,000
3	\$9,700,000	\$3,500,000
4	\$26,250,000	\$26,000,000
5	\$15,500,000	\$14,000,000

Table 2: Cash input and output of the project life

Year	NCF	Rate of Return	PW
0	\$2,500,000	0	\$400,000
1	(\$550,000)	5%	\$96,168
2	(\$9,500,000)	10%	(\$90,953)
3	\$6,200,000	15%	(\$196,322)
4	\$250,000	20%	(\$244,213)
5	\$1,500,000	25%	(\$251,680)
		30%	(\$230,823)
		35%	(\$190,299)
		40%	(\$136,342)
		45%	(\$73,463)
		50%	(\$4,938)
		55%	\$66,853
		60%	\$140,182
		65%	\$213,800
		70%	\$286,808
		75%	\$358,571
		80%	\$428,644
		85%	\$496,729
		90%	\$562,632
		95%	\$626,240
		100%	\$687,500

Table 3: Present Worth vs Rate of Return Table

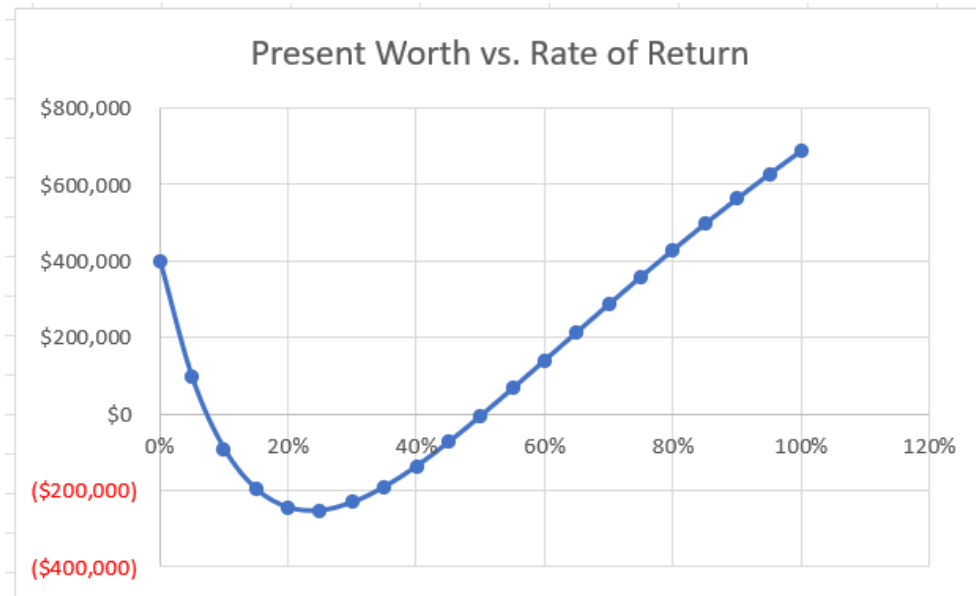


Figure 3: Present Worth vs. Rate of Return

IRR Value #1
7.25%
IRR Value #2
50.35%

Figure 4: Internal Rate of Return values (IRR)

= MIRR(values, finance_rate, reinvest_rate)

=MIRR(H6:H11, 10%,14%)

Figure 5: Excel function for calculating MIRR

MARR = 15%
Reinvested at 14%
Borrowed at Rate of 10%
Present Worth
$PW = -550,000(P/F, 10\%, 1) - 9,500,000(P/F, 10\%, 2)$
$PW = -550,000(0.9091) - 9,500,000(0.8264)$
$PW = \$-8,350,805$

Future Worth (FW)
$FW = 2,500,000(F/P, 14\%, 5) + 6,200,000(F/P, 14\%, 2) + 250,000(F/P, 14\%, 1) + 1,500,000$
$FW = 2,500,000(1.925) + 6,200,000(1.300) + 250,000(1.140) + 1,500,000$
$FW = \$14,657,500$
$FW = PW(F/P, i\%, n)$
$14,657,500 = 8,350,805(1 + i)^n$
$1.755 = (1 + i)^5$
$1.119 = 1 + i$
$0.119 = i$
MIRR = 12%

Table 4: MIRR Hand Calculations

10%		TABLE 15 Discrete Cash Flow: Compound Interest Factors						10%	
n	Single Payments		Uniform Series Payments				Arithmetic Gradients		
	F/P Compound Amount	P/F Present Worth	A/F Sinking Fund	F/A Compound Amount	A/P Capital Recovery	P/A Present Worth	P/G Gradient Present Worth	A/G Gradient Uniform Series	
1	1.1000	0.9091	1.00000	1.0000	1.10000	0.9091			
2	1.2100	0.8264	0.47619	2.1000	0.57619	1.7355	0.8264	0.4762	
3	1.3310	0.7513	0.30211	3.3100	0.40211	2.4869	2.3291	0.9366	
4	1.4641	0.6830	0.21547	4.6410	0.31547	3.1699	4.3781	1.3812	
5	1.6105	0.6209	0.16380	6.1051	0.26380	3.7908	6.8618	1.8101	
6	1.7716	0.5645	0.12961	7.7156	0.22961	4.3553	9.6842	2.2236	
7	1.9487	0.5132	0.10541	9.4872	0.20541	4.8684	12.7631	2.6216	
8	2.1436	0.4665	0.08744	11.4359	0.18744	5.3349	16.0287	3.0045	
9	2.3579	0.4241	0.07364	13.5795	0.17364	5.7590	19.4215	3.3724	
10	2.5937	0.3855	0.06275	15.9374	0.16275	6.1446	22.8913	3.7255	
11	2.8531	0.3505	0.05396	18.5312	0.15396	6.4951	26.3963	4.0641	
12	3.1384	0.3186	0.04676	21.3843	0.14676	6.8137	29.9012	4.3884	
13	3.4523	0.2897	0.04078	24.5227	0.14078	7.1034	33.3772	4.6988	
14	3.7975	0.2633	0.03575	27.9750	0.13575	7.3667	36.8005	4.9955	
15	4.1772	0.2394	0.03147	31.7725	0.13147	7.6061	40.1520	5.2789	

Appendix B: Reference Table from Textbook

14%		TABLE 18 Discrete Cash Flow: Compound Interest Factors						14%	
Single Payments			Uniform Series Payments				Arithmetic Gradients		
	F/P Compound Amount	P/F Present Worth	A/F Sinking Fund	F/A Compound Amount	A/P Capital Recovery	P/A Present Worth	P/G Gradient Present Worth	A/G Gradient Uniform Series	
n									
1	1.1400	0.8772	1.00000	1.0000	1.14000	0.8772			
2	1.2996	0.7695	0.46729	2.1400	0.60729	1.6467	0.7695	0.4673	
3	1.4815	0.6750	0.29073	3.4396	0.43073	2.3216	2.1194	0.9129	
4	1.6890	0.5921	0.20320	4.9211	0.34320	2.9137	3.8957	1.3370	
5	1.9254	0.5194	0.15128	6.6101	0.29128	3.4331	5.9731	1.7399	
6	2.1950	0.4556	0.11716	8.5355	0.25716	3.8887	8.2511	2.1218	
7	2.5023	0.3996	0.09319	10.7305	0.23319	4.2883	10.6489	2.4832	
8	2.8526	0.3506	0.07557	13.2328	0.21557	4.6389	13.1028	2.8246	
9	3.2519	0.3075	0.06217	16.0853	0.20217	4.9464	15.5629	3.1463	
10	3.7072	0.2697	0.05171	19.3373	0.19171	5.2161	17.9906	3.4490	
11	4.2262	0.2366	0.04339	23.0445	0.18339	5.4527	20.3567	3.7333	
12	4.8179	0.2076	0.03667	27.2707	0.17667	5.6603	22.6399	3.9998	
13	5.4924	0.1821	0.03116	32.0887	0.17116	5.8424	24.8247	4.2491	
14	6.2613	0.1597	0.02661	37.5811	0.16661	6.0021	26.9009	4.4819	
15	7.1379	0.1401	0.02281	43.8424	0.16281	6.1422	28.8623	4.6990	
16	8.1372	0.1229	0.01962	50.9804	0.15962	6.2651	30.7057	4.9011	
17	9.2765	0.1078	0.01692	59.1176	0.15692	6.3729	32.4305	5.0888	
18	10.5752	0.0946	0.01462	68.3941	0.15462	6.4674	34.0380	5.2630	
19	12.0557	0.0829	0.01266	78.9692	0.15266	6.5504	35.5311	5.4243	
20	13.7435	0.0728	0.01099	91.0249	0.15099	6.6231	36.9135	5.5734	

Appendix C: Reference Table from Textbook

AVERAGE
PROJECT REPORT

**Average Student/Group Original Graded Assignment
Including Rubric Showing Grading**

CHEG 2308-P01

Economic Analysis & Technical Application

82
150



Engineering Economic Project (Prototype E)

**Churton Munroe
M. Donovan Stiles
Paternocio Manana Engonga Obono**

Dr. Kazeem Olanrewaju
Economic Analysis and Technical Application Instructor
April 28, 2022

Introduction

The internal rate of return (IRR) remains the discount rate that makes the net present value (NPV) of a project equate to zero. In other words, it exists as the expected compound annual rate of return that stands earned on a project or investment. When calculating the internal rate of return (IRR), the expected cash flows for a project or investment are given and the net present value (NPV) remains equivalent to zero. Once determined, the internal rate of return (IRR) stands typically compared to a company's hurdle rate or cost of capital. If the internal rate of return (IRR) seems greater than or equal to the cost of capital, the company accepts the project as a beneficial investment. However, there remain various factors, both quantitative and qualitative that remain for consideration in an investment decision. If the internal rate of return (IRR) exists lower than the hurdle rate, then it stands denied. A rate of return (ROR) remains the net gain or loss of an investment over a specified time period, expressed as a percentage of the investment's initial cost. A rate of return (ROR) considered for application to any investment, from real estate to stocks or in this case, an opportunity to supply commercial buses to Greyhound Inc.

The rate of return (ROR) works with any purchased asset and produces cash flow at some point in the future. Often referred to as rate of investment (ROI), internal rate of return (IRR), and profitability index (PI). There remain two forms of rate of return (ROR), minimum attractive rate of return (MARR) which stands calculated independent from the given rate of return (ROR). In comparison, modified internal rate of return (MIRR) stands utilized for helping to arrive at one value for IRR or incremental rate of return.

Methods

To obtain the rate of return values, the initial step stood to construct the cash flow diagram and the net cash flow table. Using the problem statement, these remained easily built as revenue and costs were subtracted and added in each year to come up with the net cost for the specified year. The methodology in which the internal rate of return (IRR) stood calculated, as presented below, for this project remained where the cash flow at the time period stands divided

$I = 13$

$M = 23$

$R \times D = 22$

$C = 18$

$R = 6$

Information is presented in the report but no indication of their source because there is no citations

by one plus the internal rate of return (IRR) as well as the total number of time periods stand significant in the calculation that equates to the net present value. So, as the DaimlerChrysler company requires an economic analysis on the proposed venture to supply Commercial Buses to Greyhound Inc, an American Private Transportation company, paring down each term after-tax cash flow remains discounted by a specific rate. For instance, the length of time of the DaimlerChrysler project, which stand as five (5) years, vividly there exists a significant change between year zero (0) to year one (1) and year two (2) to year three (3). This indicates the two varied rate of returns for the entire project, according to the Decartes' rule that states the real i^* values remain equal to the number of sign changes. As shown below, the NCF table, created in Excel, stands now possible to obtain the values for the internal rate of return by creating a graph through plotting the present worth (PW) against the range of rate or returns. Using the graph, the internal rate of returns remains estimated and decided to be 4.8 percent and 54 percent. The interest rates found depicts the specific interest rates the present worth and future worth of the DaimlerChrysler Project equivalent to zero. This mirrors with the definition of a project's internal rate of return IRR.

The value of all these economic investment flows stands offset by the original transaction which equals the current net present value (NPV). Whereas modified rate of return (MARR) equals project value plus rate of interest for the specific loans, then add anticipated rate of inflation plus rate of inflation change, as well as add in the loan default risk plus any associated project risk. Remarkably, as it relates to the DaimlerChrysler management project, the internal rate of return (IRR) exists to counter architect the essential values so that the net present value (NPV) stands equivalent to zero. In addition, the allowance estimate exists solely for the purpose of analysis and a budget standpoint for this project in order to make sense of the net present value (NPV) of future cash flows. In calculating the external rate of return, the present and future value must remain found and equated to each other, to do this, we take the positive values to form the future worth (FW) by using the reinvestment rate which remains given at thirty percent, since the establishment of the additional money provided to DaimlerChrysler from GreyHound Inc. So, by doing this, the net values, once again, for each year stand determined by the particular ones that exist as positive and negative. In this case, the present year as well as years three (3), four (4), and five (5) all possess positive cash flows. Using the compound interest

table, calculation of the future worth (FW) value located in the fifth year remains stagnant with no multiplying factor. Then, in finding the required value, we take years two (2) and three (3) and bring them to the present using the borrowing rate of ten percent to reflect the interest rate on the loan DaimlerChrysler took from Citi Group. Following the previous mentioned steps, with the exception of converting to present worth with their corresponding factors, we set the values equal to each other with the present worth found being multiplied by $(1+i)^n$, thus the MIRR remains solved and found. The last procedure stands to compare the MIRR to the MARR.

Results and Discussions

Year	Cash Flow Estimate
0	\$ 2,500,000.00
1	\$ (550,000.00)
2	\$ (9,500,000.00)
3	\$ 6,000,000.00
4	\$ 250,000.00
5	\$ 1,500,000.00

Figure 1: Net Cash Flow (NCF) Table of the Project

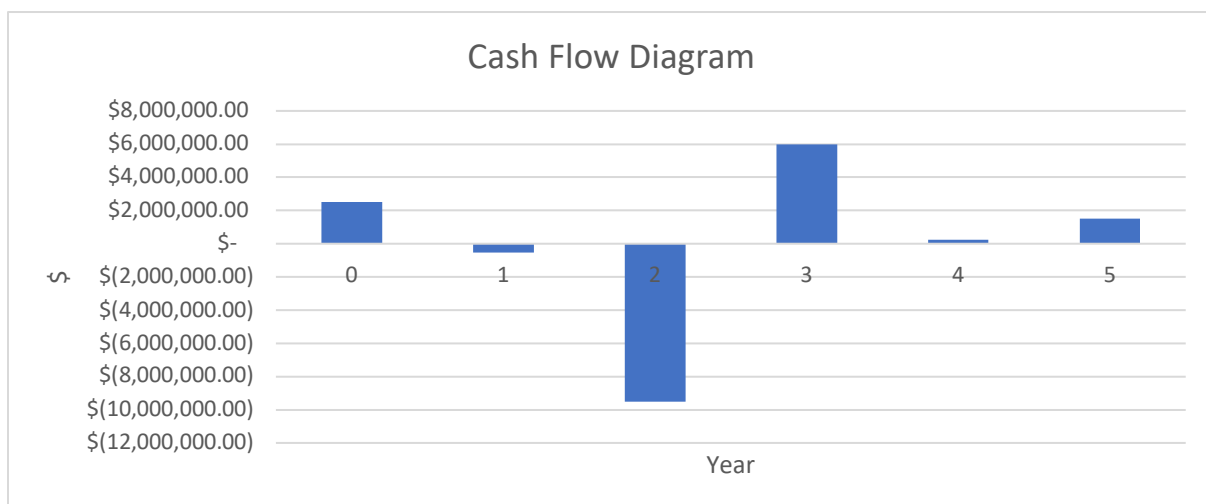


Figure 2: Cash Flow diagram for the Project

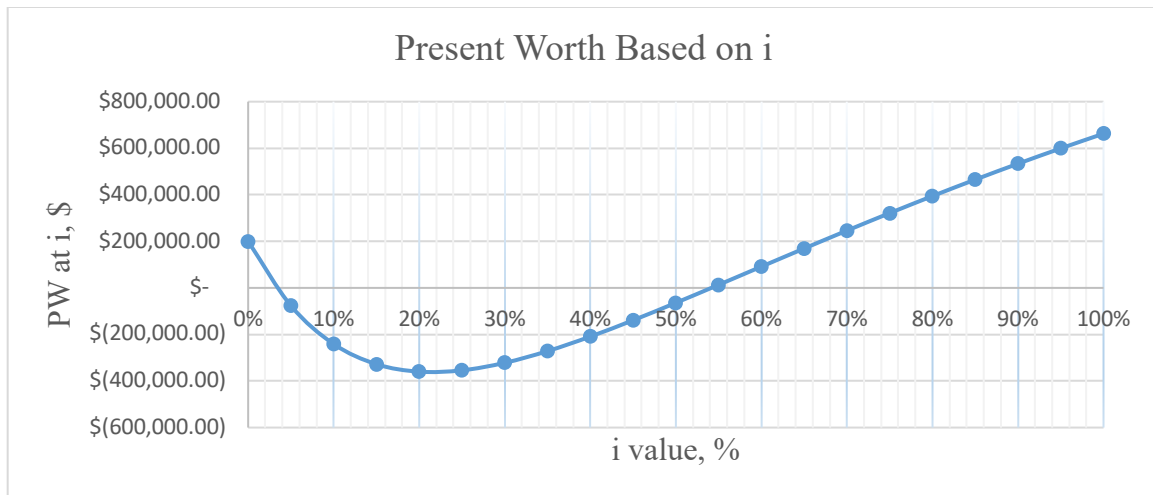


Figure 3: Graph of Present Worth at i vs range of Rate of Returns

Note: The first internal rate of return is going to be approximately when $i=4.8\%$ and the second internal rate of return is going to take place at $i=54\%$ as shown above in Figure 3.

Calculations to Answer #6:

$$\begin{aligned}
 PW_0 &= -\$550,000 \times (P/F, 10\%, 1) - \$9,500,000 \times (P/F, 10\%, 2) \\
 &= -\$550,000 \times (0.9091) - \$9,500,000 \times (0.8264) \\
 &= -\$8,350,805
 \end{aligned}$$

$$\begin{aligned}
 FW_5 &= \$2,500,000 \times (F/P, 30\%, 5) + \$6,000,000 \times (F/P, 30\%, 2) \\
 &\quad + \$250,000 \times (F/P, 30\%, 1) + \$1,500,000 \\
 &= \$2,500,000 \times (3.7129) + \$6,000,000 \times (1.6900) + \$250,000 \times (1.3000) \\
 &\quad + \$1,500,000 \\
 &= \$21,247,250
 \end{aligned}$$

$$FW_5 = PW_0$$

$$\rightarrow \$21,247,250 = \$8,350,805 \times (F/P, i^n, 5)$$

$$\rightarrow \frac{\$21,247,250}{\$8,350,805} = (1 + i^n)^5 \rightarrow 1 + i^n = \sqrt[5]{\frac{\$21,247,250}{\$8,350,805}} \rightarrow i^n = 1.205 - 1$$

$$\rightarrow i^n = 0.205 = 20.5\%$$

$\therefore$ Since MIRR = 20.5% is greater than the MARR = 15%, the project is profitable.

Conclusion

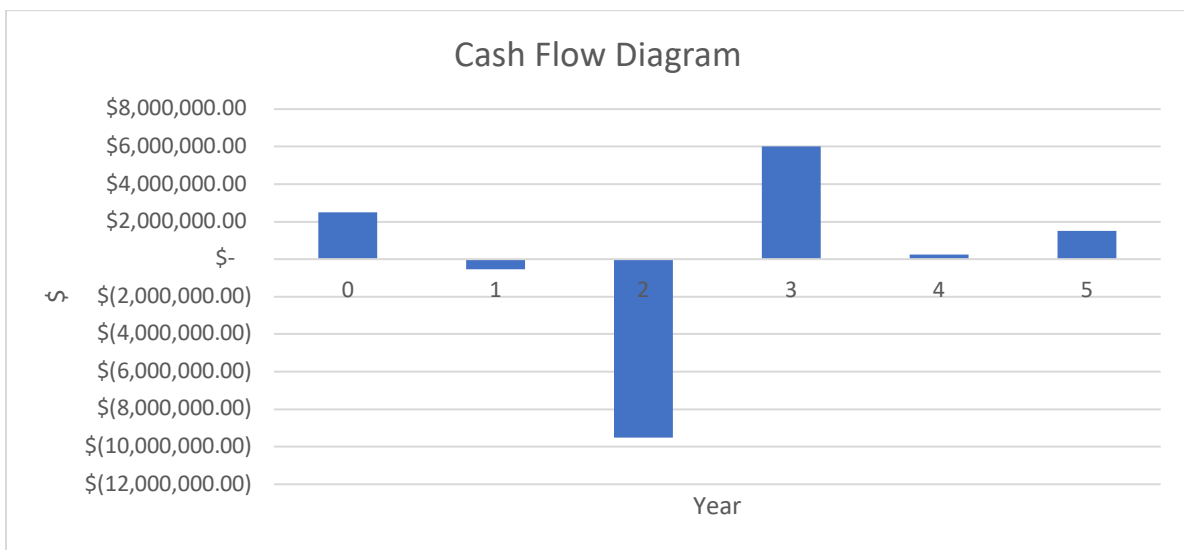
In conclusion, most businesses incorporate the use of ROR in order to determine how viable a certain project stands, the beneficial factors and of how much they will profit. In this group project, it remained our goal to determine if DaimlerChrysler continues to sustain their current staff or will they cede to the option of downsizing after the end of the five-year deal. As we analyzed background information such as the MARR value that DaimlerChrysler utilizes for any of their projects, we determined various interesting facts. By conducting an overall economic analysis on their business venture, this facilitated in the process being relatively straightforward. The route taken stood to study the yearly numerical cash flow estimates, determine the number of ROR values, obtain the ROR values and evaluate our IRR, which assisted our team in determining our final decision.

After developing a cash flow table, net cash flow diagram, determining the ROR values the project possesses, graphing the present worth against the range of the rate of returns, calculating for internal rate of return based on the project scope given to the team in the problem statement, we came to the conclusion that because i^* (MIRR) value remains greater than the given MARR, this project stands in fact viable. The team's recommendation remains that DaimlerChrysler move forward with this business venture, based on the justification that the business venture exists as viable. In addition, the team recommends that DaimlerChrysler maintains the current staff strength and there seems no need to implement any exigencies such as budget reductions including staff downsizing or cutting salaries.

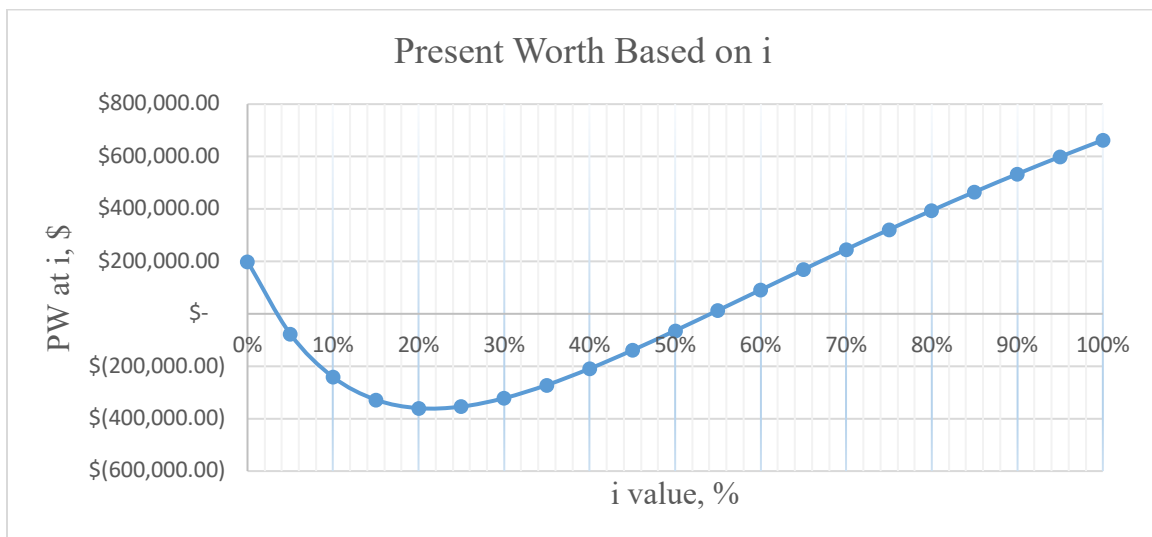
APPENDIX

Year	Cash Inflow	Cash Outflow	Net Cash Flow (NCF)
0	\$ 4,000,000.00	\$ (1,500,000.00)	\$ 2,500,000.00
1	\$ 1,450,000.00	\$ (2,000,000.00)	\$ (550,000.00)
2	\$ -	\$ (9,500,000.00)	\$ (9,500,000.00)
3	\$ 9,000,000.00	\$ (3,000,000.00)	\$ 6,000,000.00
4	\$ 2,250,000.00	\$ (2,000,000.00)	\$ 250,000.00
5	\$ 3,000,000.00	\$ (1,500,000.00)	\$ 1,500,000.00

Cash In, Out and Net Flow of the project.



Cash Flow diagram for the Project



Present worth estimation based on i

Year	Cash Flow, \$	i value, %	PW at i, \$
0	\$ 2,500,000.00	0%	\$ 200,000.00
1	\$ (550,000.00)	5%	\$ (76,599.11)
2	\$ (9,500,000.00)	10%	\$ (241,215.52)
3	\$ 6,000,000.00	15%	\$ (327,824.90)
4	\$ 250,000.00	20%	\$ (359,953.70)
5	\$ 1,500,000.00	25%	\$ (354,080.00)
		30%	\$ (321,856.32)
		35%	\$ (271,587.48)
		40%	\$ (209,228.30)
		45%	\$ (139,066.73)
		50%	\$ (64,197.53)
		55%	\$ 13,145.57
		60%	\$ 91,354.37
		65%	\$ 169,277.76
		70%	\$ 246,100.14
		75%	\$ 321,253.05
		80%	\$ 394,350.45
		85%	\$ 465,141.06
		90%	\$ 533,473.02
		95%	\$ 599,267.68
		100%	\$ 662,500.00

Table showing the PW of the project at different interest values utilized to determine the IRR

30% TABLE 26 Discrete Cash Flow: Compound Interest Factors 30%								
n	Single Payments		Uniform Series Payments				Arithmetic Gradients	
	F/P Compound Amount	P/F Present Worth	A/F Sinking Fund	F/A Compound Amount	A/P Capital Recovery	P/A Present Worth	P/G Gradient Present Worth	A/G Gradient Uniform Series
1	1.3000	0.7692	1.00000	1.0000	1.30000	0.7692		
2	1.6900	0.5917	0.43478	2.3000	0.73478	1.3609	0.5917	0.4348
3	2.1970	0.4552	0.25063	3.9900	0.55063	1.8161	1.5020	0.8271
4	2.8561	0.3501	0.16163	6.1870	0.46163	2.1662	2.5524	1.1783
5	3.7129	0.2693	0.11058	9.0431	0.41058	2.4356	3.6297	1.4903
6	4.8268	0.2072	0.07839	12.7560	0.37839	2.6427	4.6656	1.7654
7	6.2749	0.1594	0.05687	17.5828	0.35687	2.8021	5.6218	2.0063
8	8.1573	0.1226	0.04192	23.8577	0.34192	2.9247	6.4800	2.2156
9	10.6045	0.0943	0.03124	32.0150	0.33124	3.0190	7.2343	2.3963
10	13.7858	0.0725	0.02346	42.6195	0.32346	3.0915	7.8872	2.5512
11	17.9216	0.0558	0.01773	56.4053	0.31773	3.1473	8.4452	2.6833
12	23.2981	0.0429	0.01345	74.3270	0.31345	3.1903	8.9173	2.7952
13	30.2875	0.0330	0.01024	97.6250	0.31024	3.2233	9.3135	2.8895
14	39.3738	0.0254	0.00782	127.9125	0.30782	3.2487	9.6437	2.9685
15	51.1859	0.0195	0.00598	167.2863	0.30598	3.2682	9.9172	3.0344
16	66.5417	0.0150	0.00458	218.4722	0.30458	3.2832	10.1426	3.0892
17	86.5042	0.0116	0.00351	285.0139	0.30351	3.2948	10.3276	3.1345
18	112.4554	0.0089	0.00269	371.5180	0.30269	3.3037	10.4788	3.1718
19	146.1920	0.0068	0.00207	483.9734	0.30207	3.3105	10.6019	3.2025
20	190.0496	0.0053	0.00159	630.1655	0.30159	3.3158	10.7019	3.2275
22	321.1839	0.0031	0.00094	1067.28	0.30094	3.3230	10.8482	3.2646
24	542.8008	0.0018	0.00055	1806.00	0.30055	3.3272	10.9433	3.2890
25	705.6410	0.0014	0.00043	2348.80	0.30043	3.3286	10.9773	3.2979
26	917.3333	0.0011	0.00033	3054.44	0.30033	3.3297	11.0045	3.3050
28	1550.29	0.0006	0.00019	5164.31	0.30019	3.3312	11.0437	3.3153
30	2620.00	0.0004	0.00011	8729.99	0.30011	3.3321	11.0687	3.3219
32	4427.79	0.0002	0.00007	14756	0.30007	3.3326	11.0845	3.3261
34	7482.97	0.0001	0.00004	24940	0.30004	3.3329	11.0945	3.3288
35	9727.86	0.0001	0.00003	32423	0.30003	3.3330	11.0980	3.3297

10%		TABLE 15 Discrete Cash Flow: Compound Interest Factors					10%	
n	Single Payments		Uniform Series Payments				Arithmetic Gradients	
	F/P Compound Amount	P/F Present Worth	A/F Sinking Fund	F/A Compound Amount	A/P Capital Recovery	P/A Present Worth	P/G Gradient Present Worth	A/G Gradient Uniform Series
1	1.1000	0.9091	1.00000	1.0000	1.10000	0.9091		
2	1.2100	0.8264	0.47619	2.1000	0.57619	1.7355	0.8264	0.4762
3	1.3310	0.7513	0.30211	3.3100	0.40211	2.4869	2.3291	0.9366
4	1.4641	0.6830	0.21547	4.6410	0.31547	3.1699	4.3781	1.3812
5	1.6105	0.6209	0.16380	6.1051	0.26380	3.7908	6.8618	1.8101
6	1.7716	0.5645	0.12961	7.7156	0.22961	4.3553	9.6842	2.2236
7	1.9487	0.5132	0.10541	9.4872	0.20541	4.8684	12.7631	2.6216
8	2.1436	0.4665	0.08744	11.4359	0.18744	5.3349	16.0287	3.0045
9	2.3579	0.4241	0.07364	13.5795	0.17364	5.7590	19.4215	3.3724
10	2.5937	0.3855	0.06275	15.9374	0.16275	6.1446	22.8913	3.7255
11	2.8531	0.3505	0.05396	18.5312	0.15396	6.4951	26.3963	4.0641
12	3.1384	0.3186	0.04676	21.3843	0.14676	6.8137	29.9012	4.3884
13	3.4523	0.2897	0.04078	24.5227	0.14078	7.1034	33.3772	4.6988
14	3.7975	0.2633	0.03575	27.9750	0.13575	7.3667	36.8005	4.9955
15	4.1772	0.2394	0.03147	31.7725	0.13147	7.6061	40.1520	5.2789
16	4.5950	0.2176	0.02782	35.9497	0.12782	7.8237	43.4164	5.5493
17	5.0545	0.1978	0.02466	40.5447	0.12466	8.0216	46.5819	5.8071
18	5.5599	0.1799	0.02193	45.5992	0.12193	8.2014	49.6395	6.0526
19	6.1159	0.1635	0.01955	51.1591	0.11955	8.3649	52.5827	6.2861
20	6.7275	0.1486	0.01746	57.2750	0.11746	8.5136	55.4069	6.5081
21	7.4002	0.1351	0.01562	64.0025	0.11562	8.6487	58.1095	6.7189
22	8.1403	0.1228	0.01401	71.4027	0.11401	8.7715	60.6893	6.9189
23	8.9543	0.1117	0.01257	79.5430	0.11257	8.8832	63.1462	7.1085
24	9.8497	0.1015	0.01130	88.4973	0.11130	8.9847	65.4813	7.2881
25	10.8347	0.0923	0.01017	98.3471	0.11017	9.0770	67.6964	7.4580
26	11.9182	0.0839	0.00916	109.1818	0.10916	9.1609	69.7940	7.6186
27	13.1100	0.0763	0.00826	121.0999	0.10826	9.2372	71.7773	7.7704
28	14.4210	0.0693	0.00745	134.2099	0.10745	9.3066	73.6495	7.9137
29	15.8631	0.0630	0.00673	148.6309	0.10673	9.3696	75.4146	8.0489
30	17.4494	0.0573	0.00608	164.4940	0.10608	9.4269	77.0766	8.1762
31	19.1943	0.0521	0.00550	181.9434	0.10550	9.4790	78.6395	8.2962
32	21.1138	0.0474	0.00497	201.1378	0.10497	9.5264	80.1078	8.4091
33	23.2252	0.0431	0.00450	222.2515	0.10450	9.5694	81.4856	8.5152
34	25.5477	0.0391	0.00407	245.4767	0.10407	9.6086	82.7773	8.6149
35	28.1024	0.0356	0.00369	271.0244	0.10369	9.6442	83.9872	8.7086
40	45.2593	0.0221	0.00226	442.5926	0.10226	9.7791	88.9525	9.0962
45	72.8905	0.0137	0.00139	718.9048	0.10139	9.8628	92.4544	9.3740
50	117.3909	0.0085	0.00086	1163.91	0.10086	9.9148	94.8889	9.5704
55	189.0591	0.0053	0.00053	1880.59	0.10053	9.9471	96.5619	9.7075
60	304.4816	0.0033	0.00033	3034.82	0.10033	9.9672	97.7010	9.8023
65	490.3707	0.0020	0.00020	4893.71	0.10020	9.9796	98.4705	9.8672
70	789.7470	0.0013	0.00013	7887.47	0.10013	9.9873	98.9870	9.9113
75	1271.90	0.0008	0.00008	12709	0.10008	9.9921	99.3317	9.9410
80	2048.40	0.0005	0.00005	20474	0.10005	9.9951	99.5606	9.9609
85	3298.97	0.0003	0.00003	32980	0.10003	9.9970	99.7120	9.9742
90	5313.02	0.0002	0.00002	53120	0.10002	9.9981	99.8118	9.9831
95	8556.68	0.0001	0.00001	85557	0.10001	9.9988	99.8773	9.9889
96	9412.34	0.0001	0.00001	94113	0.10001	9.9989	99.8874	9.9898
98	11389	0.0001	0.00001		0.10001	9.9991	99.9052	9.9914
100	13781	0.0001	0.00001		0.10001	9.9993	99.9202	9.9927

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BELOW AVERAGE
PROJECT REPORT

**Below Average Student/Group Original Graded Assignment
Including Rubric Showing Grading**

Shelton Amaram

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CHEG 2308-P81

4/28/22

Dr. Kazeem Olanrewaju

Engineering Economics Project Report

Introduction:

The rate of return is expressed as the net profit or loss for an investment over a specific period of time. It is usually shown as a percentage of the investment's initial cost. Rate of return is usually used when looking at investments, bonds, stocks, and real estate. As long as an asset is bought at a certain time and produces benefits leading to more cash flow than the rate of return can be found. Most of the time investors want to assign a required rate of return before they decide to start a project. In this project VSEL decides to supply a ship to Royal Caribbean International and wants to find out if this is a good decision to make due to economical and societal reasons.

Methods:

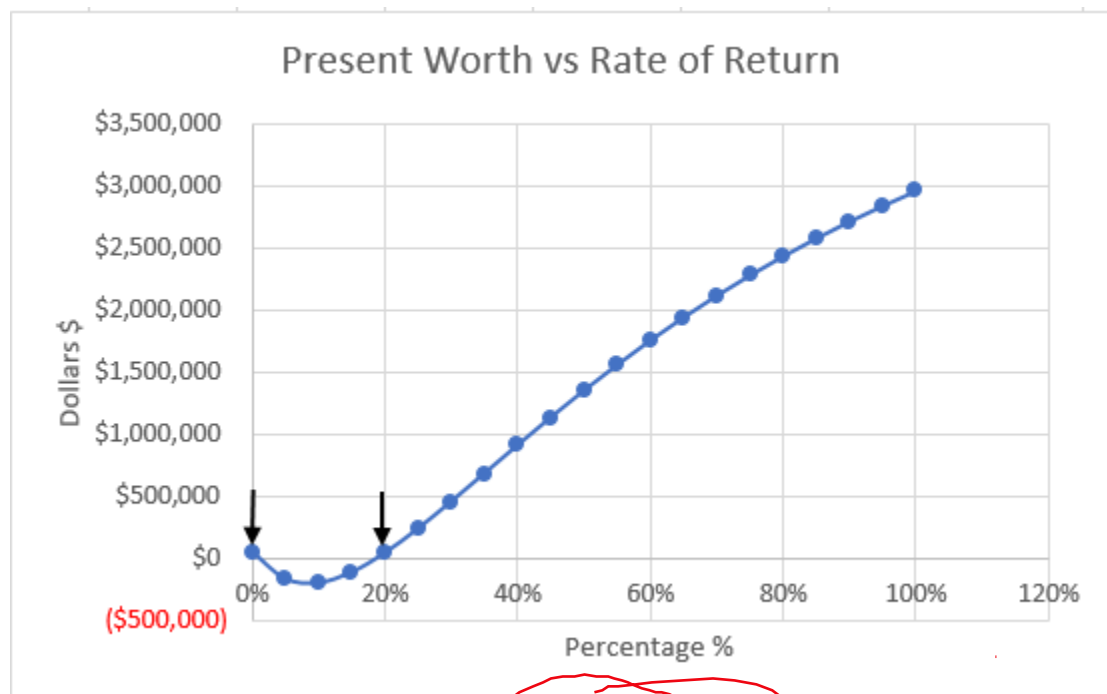


Figure 1

$$\frac{175}{10}$$

$$I = 10$$
$$M = 19$$

$$R_{\Delta} = 23$$

$$C = 18$$

$$R = 5$$

As shown in figures 1, 2, and 3, it is clearly shown that there are two rate of return values due to the two sign changes in our cash flow diagram. Figure one shows the depiction where the curved line passes the x axis twice. The External Rate of Return was calculated on excel using a very simple algorithm. The first thing to type was =IRR and then to highlight the net value obtained from our cash flow estimates table. Next we input the rate that VSEL borrowed money at and then we put the rate that the reinvestment was made at. After all of those were put into excel we pressed enter and our value was obtained. For a better picture on how the calculation looked, it is shown in the Appendix below.

Results and Discussion:

Cash Flow Estimates

(\$ mn)	Investment by VSEL	Royal Caribbean	Net Cash Flow
Year 0	-13.5	+19	5.5
Year 1	-6	+5.1	-0.9
Year 2	-6.5	N/A	-6.5
Year 3	-5.7	N/A	-5.7
Year 4	-6.65	+7	0.35
Year 5	-4.7	+12	7.3

Table 1

Royal Caribbean International, a cruise line based in the United States, has approached VSEL about supplying a big cruise ship. Royal Caribbean International will pay \$19 million in advance when the deal is signed, followed by \$5.1 million a year thereafter. Prior to receiving the initial deposit from Royal Caribbean International, VSEL received a loan from HSBC and invested \$13.5 million from this prior to the process. Following that, for the first, second, third, fourth, and fifth years, VSEL spent \$6 million, \$6.5 million, \$5.7 million, \$6.65 million, and \$4.7 million in operating costs, consecutively. Royal Caribbean International will take delivery of the plane in the fourth year and committed to pay \$7 million at the end of the same year, with

the remaining \$12 million due at the end of Year 5. The rate of return on this investment in comparison to the MARR will determine whether VSEL will maintain their existing workforce strength or opt for reconstructing at the end of the 5-year arrangement. VSEL management has asked their management contractor to undertake an epidemiological study on the planned project so that they would better influence policy development and be prepared for any unforeseen circumstances that may arise as a consequence of the project. Because they are a worldwide corporation, these requirements may include, but aren't restricted to, personnel reduction, employee retention, wage holding, pay cuts, or even the closure of several of its factories.

2. Cash Flow Diagrams

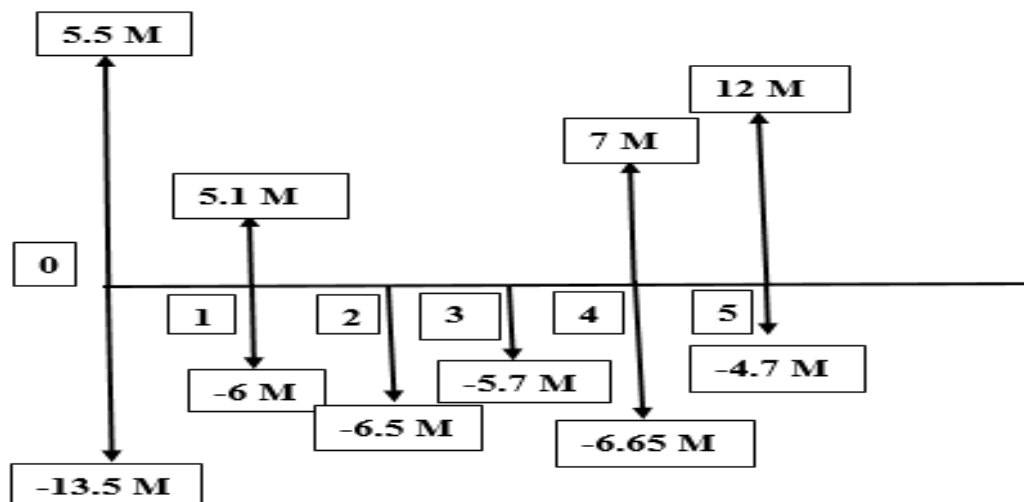


Figure 2

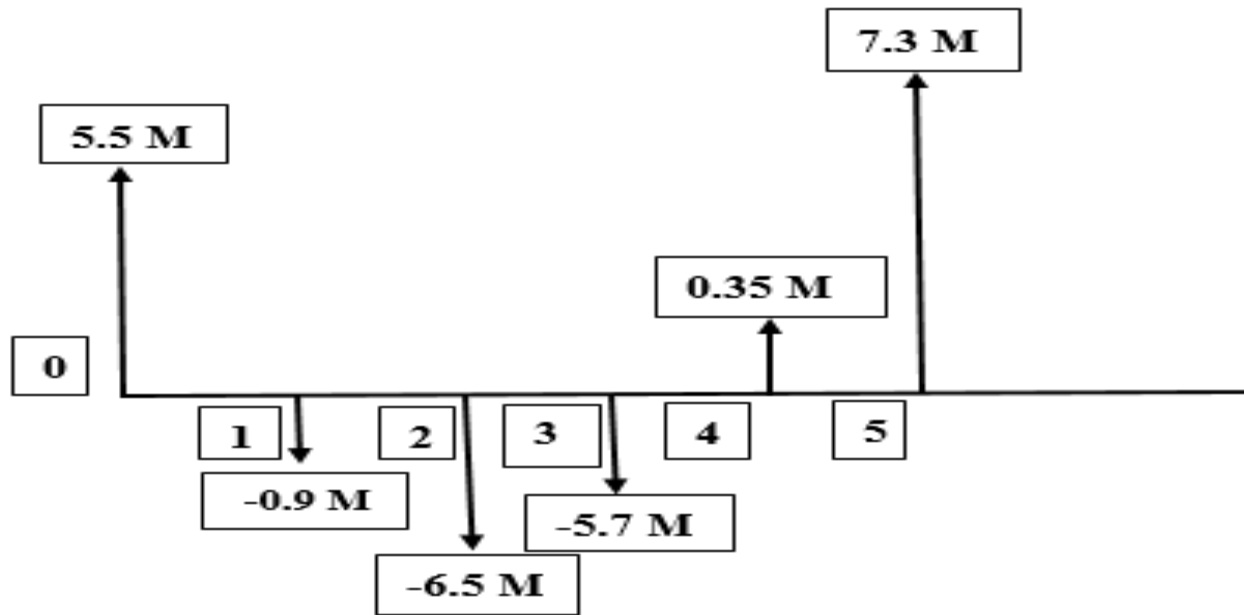


Figure 3

For the two cash flow diagrams shown above it is found that the money flow throughout the whole project changed from negative values to positive values during the whole project. In figure 2 there are 4 different payments made towards VSEL which is why there are 4 arrows pointing up. After the initial payment made by VSEL they also spent money 5 different times as the running cost for each year.

In Figure 3 under years 0, 4, and 5, the net cash flow calculated turned out to be positive meaning that the money made from the payments from Royal Caribbean International outweighed the cost of participating in the project for that time. Under years 1, 2, and 3, the payments made by VSEL turned out to be higher than the money obtained from the Royal Caribbean International.

5. Internal Rate of Return Values

External ROR #1	External ROR #2
0.77%	19%

Figure 4

The two rates of return values obtained from our excel calculations were shown in Figure 4. Our first rate of return value was close to 1% and our second was close to 20%. When actually clicking the point at which our curved line touched the x- axis, it was found that our actual rate of return values when the present worth equaled 0 were 0.77% and 19%.

Conclusion:

By doing our calculation on excel and forming our cash flow diagram it was realized that the Internal Rate of Return for this project is 12%. This does not meet the expectations of VSEL's minimum attractive rate of return. The MARR that was set for them was 15% which means that is the minimum amount of money the company wanted to make back from the investment as profit. Taking part in this project would cause the company to lose money from their investment over time. Even though they might make money at certain points of the project's timeline, at the end when all of the costs and money made are calculated it would show a net loss.

The consequences of doing this experiment lie with the staff and the people around them. They wouldn't be able to get paid the amount of money agreed to when they signed their contract. Also working on the ship would put them at risk of getting laid off at a certain point in the future due to the lack of profit being made by VSEL. As far as society is concerned, people that have waited until a certain point to sign up for Royal Caribbean International as their cruise ship might be at risk of the ship not having enough room for them to be on the ship. The lack of rooms would be of concern because of the lack of money coming in. Therefore due to all of these reasons, it's best if VSEL takes a different approach in regards to who they want to supply a ship to for their project going forward.

Reference:

[https://www.investopedia.com/terms/r/rateofreturn.asp#:~:text=A%20rate%20of%20return%20\(RoR\)%20is%20the%20net%20gain%20or,the%20period%20until%20the%20end](https://www.investopedia.com/terms/r/rateofreturn.asp#:~:text=A%20rate%20of%20return%20(RoR)%20is%20the%20net%20gain%20or,the%20period%20until%20the%20end)
<https://www.ig.com/en/glossary-trading-terms/rate-of-return-definition>

Appendix

Cash Flow Estimates Table:

Year	PW	Net Value	Rate
0	\$50,000	\$5,500,000	0%
1	(\$169,022)	(\$900,000)	5%
2	(\$200,797)	(\$6,500,000)	10%
3	(\$115,881)	(\$5,700,000)	15%
4	\$39,995	\$350,000	20%
5	\$237,024	\$7,300,000	25%
	\$455,738		30%
	\$683,456		35%
	\$911,986		40%
	\$1,136,127		45%
	\$1,352,675		50%
	\$1,559,765		55%
	\$1,756,424		60%
	\$1,942,270		65%
	\$2,117,308		70%
	\$2,281,793		75%
	\$2,436,134		80%
	\$2,580,826		85%
	\$2,716,412		90%
	\$2,843,452		95%
	\$2,962,500		100%

Minimum Attractive Rate of Return Calculation:

=MIRR(K5:K10,10%,14%)		
D	E	F

Internal Rate of Return
12%