CHAPTER 2
Interest and Money-Time Relationship
Solved Supplementary Problems

Problem 2.1

What is the annual rate of interest if P265 is earned in four months on an investment of P15, 000?

Solution:

Let 'n' be the number of interest periods. Thus, on the basis of 1 year (12 mo.), the interest period will be,

$$n = \frac{4}{12} = \frac{1}{3}$$

Hence, the rate of interest given by the formula, $i = \frac{I}{Pn}$, is computed as

$$i = \frac{\text{P265}}{(\text{P15,000})\left(\frac{1}{3}\right)} = 0.053 \text{ or } 5.3\%$$

Thus, the annual rate of interest is 5.3%

2-2. A loan of P2, 000 is made for a period of 13 months, from January 1 to January 31 the following year, at a simple interest of 20%. What is the future amount is due at the end of the loan period?

Solution:

$$F = P(1 + ni)$$
$$F = P2{,}000\left[1 + \left(\frac{13}{12}\right)(0.2)\right]$$
$$\boldsymbol{F = P2{,}433.33}$$

Answer: *P*2,433.33

2-3. If you borrow money from your friend with simple interest of 12%, find the present worth of P20, 000, which is due at the end of nine months.

Given:

Future worth:	F = P20, 000
Number of interest period:	$n = \frac{9}{12}$
Simple interest	i = 12%

Solution:

$$F = P(1 + ni)^{-1}$$

$$P = P20{,}000[1+\left(\frac{9}{12}\right)(0.12)]^{-1}$$

$$\boldsymbol{F = P18{,}348.62}$$

Answer: $P18{,}348.62$

2-4. Determine the exact simple interest on P5, 000 for the period from Jan.15 to Nov.28, 1992, if the rate of interest is 22%.

Given:

P= P5, 000
i= 22%

Solution:

January 15= 16 (excluding Jan.15)
February = 29
March = 31
April = 30
May = 31
June = 30
July = 31
August = 31
September = 30
October = 31
November 28 = 28 (including Nov.28)
318 days

Exact simple interest = Pin
= 5000×318⁄366×0.22
= P955.74

Answer: P955.74

2-5. A man wishes his son to receive P200, 000 ten years from now. What amount should he invest if it will earn interest of 10% compounded annually during the first 5 years and 12% compounded quarterly during the next 5 years?

Given:
F= P200, 000;

For compound interest:
i= 10%; n=5
For compound interest
i= 12%⁄4= 3%; n= 5×4=20

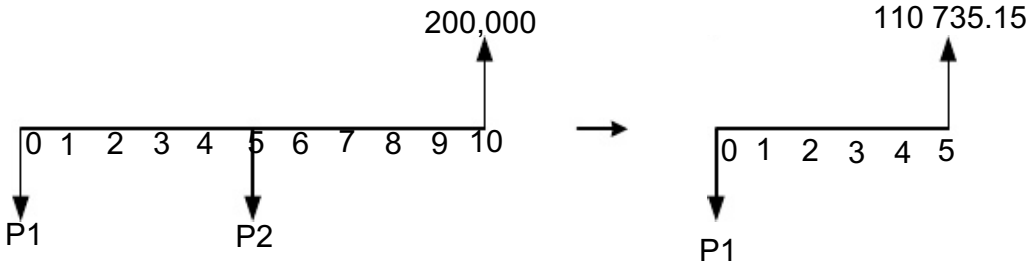
Solution:

$P_2 = F(1+i)^{-n}$
$= 200000(1+0.03)^{-20}$
$P_2 = P110,735.15$

$P_1 = P_2(1+i)^{-n}$
$= 110{,}735.15(1+0.10)^{-5}$

$P_1 = P68,757.82$

Answer: P68, 757.82



2-6. By the condition of a will the sum of P25, 000 is left to be held in trust by her guardian until it amounts to P45, 000. When will the girl receive the money if the fund is invested at 8% compounded quarterly?

Given:

P = P25, 000 i = 8%/4= 2%
F = P45, 000

Solution:

$F = P(1+i)^n$
$45000 = 25000(1+0.02)^{4n}$
$45000/25000 = (1.02)^{4n}$
$1.8 = (1.02)^{4n}$
$\ln(1.8) = 4n\ln(1.02)$
$29.682 = 4n$
$n = 7.42$ years

Answer: 7.42 years

2-7. At a certain interest rate compounded semiannually P5, 000 will amount to P20, 000 after 10 years. What is the amount at the end of 15 years?

Given:

$P = P5,000$
$n_1 = 10$
$F_1 = P20,000$
$n_2 = 15$
$F_2 = ?$

Solution:

At $n_1 = 10$, $F_1 = P20,000$

$$F_1 = P\left(1 + \frac{i}{2}\right)^{2(n_1)}$$

$$P20,000 = P5,000\left(1 + \frac{i}{2}\right)^{2(10)}$$

$$i = 14.35\%$$

At $n_2 = 15$

$$F_2 = P\left(1 + \frac{i}{2}\right)^{2(n_2)}$$

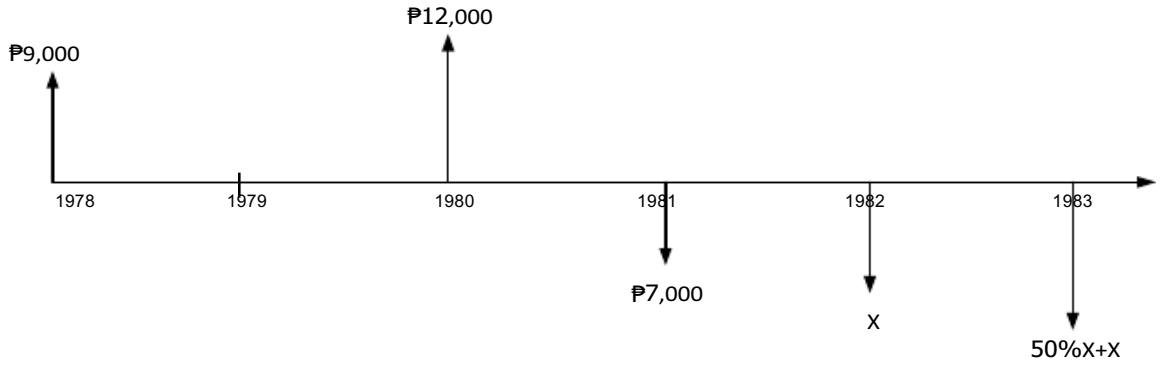
$$F_2 = P5,000\left(1 + \frac{0.1435}{2}\right)^{2(15)}$$

$$F_2 = P39,973.74$$

Answer: P39, 973.74

2-8. Jones Corporation borrowed P9, 000 from Brown Corporation on Jan. 1, 1978 and P12, 000 on Jan. 1, 1980. Jones Corporation made a partial payment of P7, 000 on Jan. 1, 1981. It was agreed that the balance of the loan would be amortizes by two payments one of Jan. 1, 1982 and the other on Jan. 1, 1983, the second being 50%larger than the first. If the interest rate is 12%. What is the amount of each payment?

Given: $i = 12\%$



Solution:

$P9,000(1+i)^5 + P12,000(1+i)^3 = P7,000(1+i)^2 + X(1+i)^2 + \frac{3}{2}X$

$P9,000(1+0.12)^5 + P12,000(1+0.12)^3 = P7,000(1+0.12)^2 + X(1+0.12)^2 + \frac{3}{2}X$

X = P9, 137.18

$\frac{3}{2}$X= P13, 705.77

Answer: P9, 137.18; P13, 705.77

2-9. A woman borrowed P3, 000 to be paid after $1\frac{1}{2}$ years with interest at 12% compounded semiannually and P5, 000 to be paid after 3 years at 12% compounded monthly. What single payment must she pay after $3\frac{1}{2}$ years at an interest rate of 16% compounded quarterly to settle the two obligations?

Given:

P_1 = P3, 000 P_2 = P5, 000

$n_1 = 1\frac{1}{2}$ $n_2 = 3$ $n_3 = 3\frac{1}{2}$

i_1 = 12% i_2 = 12% i_3 = 16%

Solution:

$F_1 = P\left(1+\frac{i_1}{2}\right)^{2(n_1)}$

$F_1 = P3,000\left(1+\frac{0.12}{2}\right)^{2\left(1\frac{1}{2}\right)}$

F_1 = P3, 573.05

$F_2 = P\left(1+\frac{i_2}{2}\right)^{2(n_2)}$

$F_2 = P5,000\left(1+\frac{0.12}{12}\right)^{12(3)}$

F_2 = P7, 153.84

$F_3 = F_1\left(1+\frac{i_3}{4}\right)^{4(n_3-n_1)} + F_2\left(1+\frac{i_3}{4}\right)^{4(n_3-n_2)}$

$F_3 = P3,573.05\left(1+\frac{0.16}{4}\right)^{4\left(3\frac{1}{2}-1\frac{1}{2}\right)} + P7,153.84\left(1+\frac{0.16}{4}\right)^{4\left(3\frac{1}{2}-3\right)}$

F_3 = P4, 889.96 + P7, 737.59

F_3 = P12, 627.55

Answer: P12, 627.55

2-10. Mr. J. de la Cruz borrowed money from a bank. He received from the bank P1, 342 and promises to repay P1, 500 at the end of 9 months. Determine the simple interest rate and the corresponding discount rate or often referred to as the "Banker's discount."

Given:

Discount = P158
Principal = P1, 500

Required:

d = rate of discount
i = rate of interest

Solution:

$$d = \frac{discount}{principal} = \frac{158}{1500} = 0.1053 \; or \; 10.53\%$$

$$i = \frac{d}{1-d} = \frac{0.1053}{1-0.1053} = 0.1177 \; or \; 11.77\%$$

Answer:
The rate of discount is equal to 10.53% and the simple interest rate is equal to 11.77%.

2-11. A man deposits P50, 000 in a bank account at 6% compounded monthly for 5 years. If the inflation rate of 6.5% per year continues for this period, will this effectively protect the purchasing power of the original principal?

Given:

P = present worth = P50, 000
r = nominal rate of interest = 6% compounded monthly
n = number of years = 5 years
f = inflation rate = 6.5%

Required:

F = future worth

Solution:

$$i = \left(1 + \frac{r}{m}\right)^m - 1$$

$$i = \left(1 + \frac{0.06}{12}\right)^{12} - 1$$

$$i = 0.061677 \; or \; 6.1677\%$$

$$F = P\left(\frac{1+i}{1+f}\right)^n$$

$$F = 50{,}000\left(\frac{1+0.061677}{1+0.065}\right)^5$$

$$F = 49{,}225$$

Answer: P49, 225.00

2-12. What is the future worth of P600 deposited at the end of every month for 4 years if the interest rate is 12% compounded quarterly?

Given:

A = annuity = P600
r = nominal rate = 12% compounded quarterly
n = 4 years

Required:

F = future worth

Solution:

$$(1+i)^{12}-1=\left(1+\frac{r}{4}\right)^{4}-1$$

$$(1+i)^{12}-1=\left(1+\frac{0.12}{4}\right)^{4}-1$$

$i = 0.0099 \; or \; 0.99\%$

$n = 4 \times 12 = 48$

$$F = A\left[\frac{(1+i)^{n}-1}{i}\right]$$

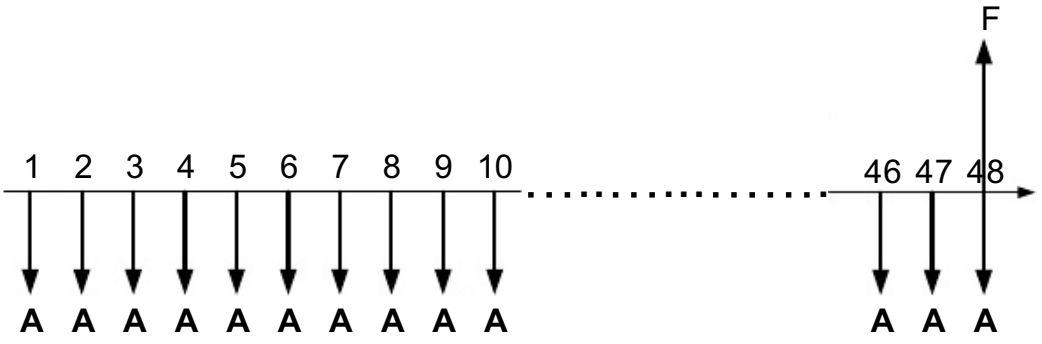
$$F = 600\left[\frac{(1+0.0099)^{48}-1}{0.0099}\right]$$

$F = 36{,}641.00$

Answer: P36, 641.00

2-13. What is the future worth of P600 deposited at the end of every month for 4 years if the interest is 12% compounded quarterly?

Given:



A = P600

n = (12) (4) = 48
i = 12% compounded quarterly
F =?

Solution:

Solving for the interest rate per quarter,

$$(1 + i)\,12 - 1 = (1 + \tfrac{0.12}{4})\,4 - 1$$
$$(1 + i) = (1.03)\,4/12$$
$$i = 0.0099$$

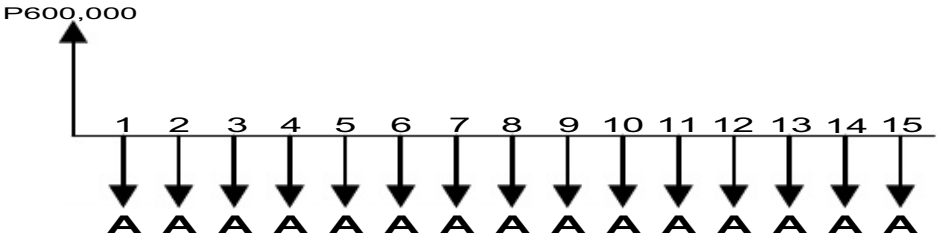
Solving for future worth; i = 0.0099, n = 48, A = 600

$$F = A(F/A, i\%, n)$$
$$F = 600\left[\frac{(1+0.0099)^{48} - 1}{0.0099}\right]$$
$$F = P36{,}641.32$$

Answer: P36, 641.32

2-14. Mr. Reyes borrows P600, 000 at 12% compounded annually, agreeing to repay the loan in 15 equal annual payments. How much of the original principal is still unpaid after he has made the 8th payment?

Given:



i = 12% annually n = 15

Solution:

Solving for A,

$$600{,}000 = A[\frac{1 - (1+i)^{-n}}{i}]$$
$$600{,}000 = A[\frac{1 - (1+0.12)^{-15}}{0.12}]$$
$$A = P88{,}094.54$$

@ n = 7

$$P = A[\frac{1 - (1+i)^{-n}}{i}]$$
$$P = 88{,}094.54[\frac{1 - (1+0.12)^{-7}}{0.12}]$$

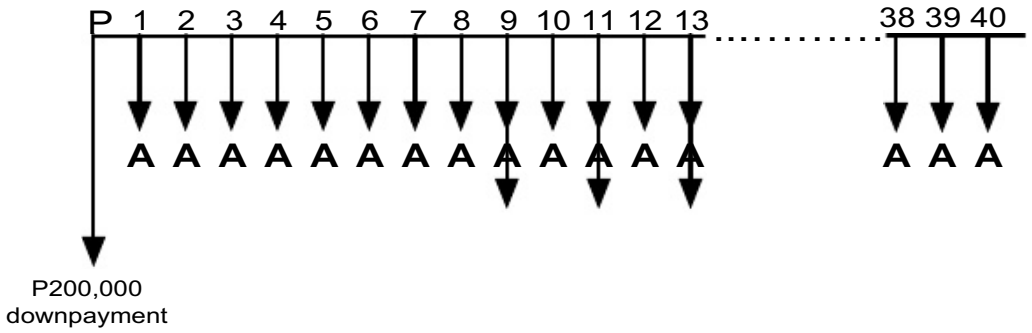
$$P = P402{,}042$$

Answer: 402,042

2-15. M purchased a small lot in a subdivision, paying P200, 000 down and promising to pay P15, 000 every 3 months for the next 10 years. The seller figured interest at 12% compounded quarterly.

(a) What was the cash price of the lot?
(b) If M missed the first 12 payments, what must he pay at the time the 13 th is due to bring him up to date?
(c) After making 8 payments, M wished to discharge his remaining indebtedness by a single payment at the time when the 9th regular payment was due, what must he pay in addition to the regular payment then due?
(d) If M missed the first 10 payments, what must he pay when the 11th payment is due to discharge his entire indebtedness?

Given:



Down payment = P200, 000
A = P15, 000
n = (4) (10) = 40
i = 12% compounded quarterly

Solution:

(a) $i = \frac{12\%}{4} = 3\%\,;\ n = 40$

$$P = 200{,}000 + A[\frac{1-(1+i)^{-n}}{i}]$$

$$P = 200{,}000 + 15{,}000[\frac{1-(1+0.03)^{-40}}{0.03}]$$

$$P = P546{,}722$$

(b) $i = 3\%\,;\ n = 13$

$$F13 = A[\frac{(1+i)^{n}-1}{i}]$$

$$F13 = 15{,}000[\frac{(1+0.03)^{13}-1}{0.03}]$$
$$F13 = P234{,}270$$

(c) $n = 40 - 9 = 31$

$$P = A[\frac{1-(1+i)^{-n}}{i}]$$
$$P = 15{,}000[\frac{1-(1+0.03)^{-31}}{0.03}]$$
$$P = P300{,}006$$

(d) $P @ n = 29$

$$P29 = A[\frac{1-(1+i)^{-n}}{i}]$$
$$P29 = 15{,}000[\frac{1-(1+0.03)^{-29}}{0.03}]$$
$$P29 = P287{,}826.82$$

$F @ n = 11$

$$F11 = A[\frac{(1+i)^{n}-1}{i}]$$
$$F11 = 15{,}000[\frac{(1+0.03)^{11}-1}{0.03}]$$
$$F11 = P192{,}116.94$$

Therefore,

$$Q = P29 + F11$$
$$Q = 287{,}826.82 + 192{,}116.94$$
$$Q = P479{,}948$$

Answer: (a) P546, 722; (b) P234, 270; (c) P300, 006; (d) P479, 948

2-16. A man approaches the ABC Loan Agency for P100, 000 to be paid in 24 monthly installments. The agency advertises an interest rate of 1.5% per month. They proceed to calculate the amount of his monthly payment in the following manner.

Amount requested	P100, 000
Credit investigation	P500
Credit risk insurance	P1000
Total	P101, 500

Interest: $(P101{,}500)(24)(0.015) = P36{,}540$
Total owed: $P101{,}500 + P36{,}540 = P138{,}040$

$Payment = \frac{P138{,}040}{24} = P5751.67$
What is the effective rate of interest of the loan?

Solution:
$\frac{P100000}{P\ 5751.67} = 17.3863$
$17.3863 = \frac{1-(1+i)^{-24}}{i}$
$i = 0.0276$

Effective Rate = $[(1+0.276)^{12} - 1] \times 100$
Effective Rate = 38.64 %

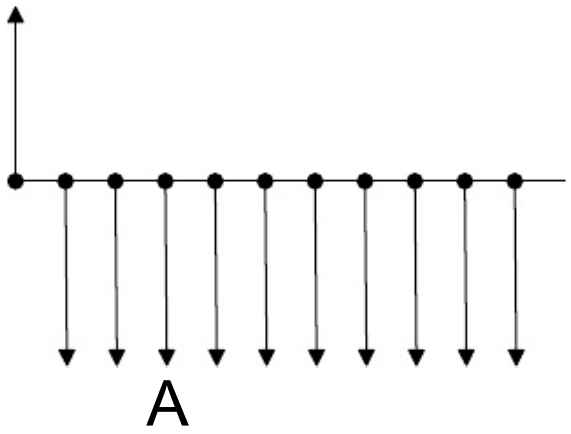
Answer: 38.64 %

2-17. A new office building was constructed 5 years ago by a consulting engineering firm. At that time the firm obtained the bank loan for P 10,000,000 with a 20% annual interest rate, compounded quarterly. The terms of the loan called for equal quarterly payments for a 10-year period with the right of prepayment any time without penalty.

Due to internal changes in the firm, it is now proposed to refinance the loan through an insurance company. The new loan is planned for a 20- year term with an interest rate of 24% per annum, compounded quarterly. The insurance company has a onetime service charge 5% of the balance. This new loan also calls for equal quarterly payments.

a.) What is the balance due on the original mortgage (principal) if all payments have been made through a full five years?
b.) What will be the difference between the equal quarterly payments in the existing arrangement and the revised proposal?

Solution:



$$A = \frac{P10{,}000{,}000}{\frac{1-(1+\frac{0.20}{4})^{-20}}{\frac{0.20}{4}}}$$

$A_1 = P582781.6117$

a.) Remaining balance = P

$$P = 582781.6117\left(\frac{1-\left(1+\frac{0.20}{4}\right)^{-20}}{\frac{.20}{4}}\right)$$

$P = P7262747.029$

b.) $Remaining\ balance\ +\ 5\%\ service\ charge\ =\ P7625884$

$$A = \frac{7625884}{\left[\frac{1-\left(1+\frac{0.24}{4}\right)^{-80}}{\frac{.24}{4}}\right]}$$

$A_2 = P461919.1922$

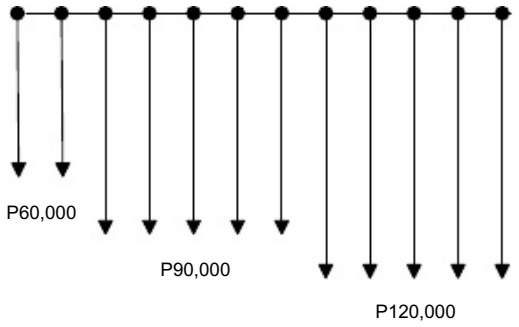
$A_1 - A_2 = P120862$

Answer: (a)P7,262.747.029; (b) P120,862

2-18. An asphalt road requires no upkeep until the end of 2 years when P60, 000 will be needed for repairs. After this P90, 000 will be needed for repairs at the end of each year for the next 5 years, then P120, 000 at the end of each year for the next 5 years.

If money is worth 14% compounded annually, what was the equivalent uniform annual cost for the 12-year period?

Solution:



$i = 14\%\ annually$

$P = 60000\ (1.14)^{-2} + 90000(\frac{1-(1.14)^{-5}}{.14})(1.14)^{-2} + 120000(\frac{1-(1.14)^{-5}}{.14})(1.14)^{-7}$

P=46168.051+237747.9895+164638.4744

P = P 448554.5149

Then find A.

$$\text{P } 448554.5149 = A\left(\frac{1-(1.14)^{-12}}{.14}\right)$$

A = P 79245.82423

Answer: P 79,245.82423

2-19. A man wishes to provide a fund for his retirement such that from his 60th to 70th birthdays he will be able to withdraw equal sums of P18, 000 for his yearly expenses. He invests equal amount for his 41st to 59th birthdays in a fund earning 10% compounded annually. How much should each of these amounts be?

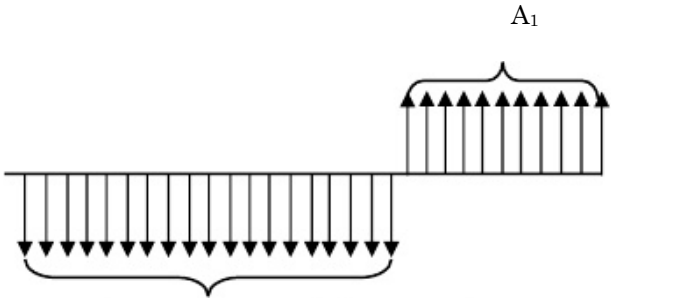
Given:

A_1 = P18, 000
n_1 = 11
n_2 = 19
i = 10% annually

Required:

A_2 = equal amount invested from 41st to 59th birthday

Solution:



Using 40 as focal date, the equation of value is:

$$A_1\left[\frac{1-(1+i)^{-n_1}}{i}\right] = A_2\left[\frac{1-(1+i)^{-n_2}}{i}\right](1+i)^{-n_1}$$

$$A_1\left[\frac{1-(1+0.10)^{-19}}{0.10}\right] = 18{,}000\left[\frac{1-(1+0.10)^{-11}}{0.10}\right](1+0.10)^{-19}$$

$$A_1 = 2{,}285.00$$

Answer: P2.285

2-21. Determine the present worth and the accumulated amount of an annuity consisting of 6 payments of P120, 000 each, the payment are made at the beginning of each year. Money is worth 15% compounded annually.

Given:

A = P120, 000
n = 6
i = 15%

Required:

P = present worth
F = future worth

Solution:

$$P = A\left\{1+\left[\frac{1-(1+i)^{-(n-1)}}{i}\right]\right\}$$

$$P=120,000\left\{1+\left[\frac{1-(1+0.15)^{-(6-1)}}{0.15}\right]\right\}$$

$$P=522,259.00$$

$$F = A\left[\frac{(1+i)^{n+1}-1}{i} - 1\right]$$

$$F=120,000\left[\frac{(1+0.15)^{6+1}-1}{0.15} - 1\right]$$

$$F=1,208,016.00$$

Answer: The present worth would be P522, 259.00 and the accumulated annuity would be P1, 208,016.00.

2-22. Calculate the capitalized cost of a project that has an initial cost of P3, 000,000 and an additional cost of P100, 000 at the end of every 10 yrs. The annual operating costs will be P100, 000 at the end of every year for the first 4 years and P160, 000 thereafter. In addition, there is expected to be recurring major rework cost of P300, 000 every 13 yrs. Assume i =15%.

Given:

Initial Cost	*(IC)*	*= P3, 000,000*	
Additional Cost (AC)		*= P1, 000,000*	*n= 10 yrs.*
Operating Cost (MC)			
P_A		*= P 100,000*	*for the first 4 yrs.*
P_F		*=P160, 000*	*thereafter*
Rework Cost	*(CR)*	*= P300, 000*	*n=13 yrs.*

Solution:

Let $FC = first\ cost$

$FC = IC + AC$

$$=3,000,000+\frac{1,000,000}{(1+0.15)^{10}-1}$$

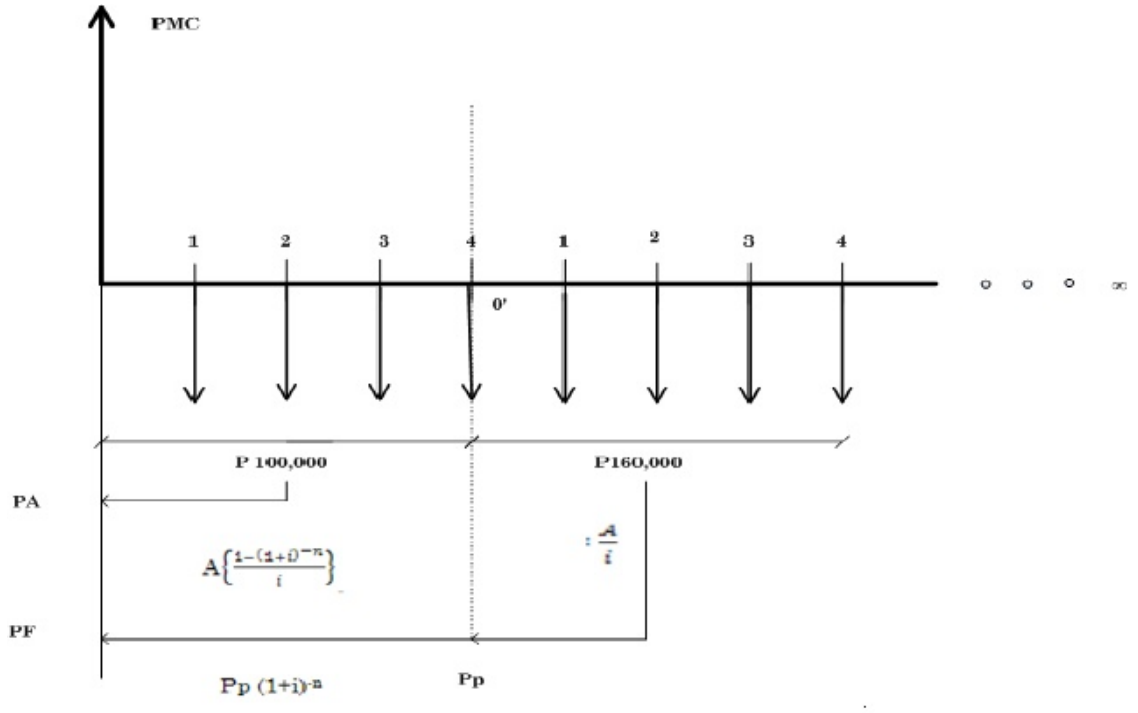
$$FC=P3,328,347.083$$

Let $PMC = Present\ Worth\ Maintenance\ Cost$

$PMC = PA + PF$

$$=100,000\left(\frac{1-(1-0.15)^{-4}}{0.15}\right)+\frac{160,000}{0.15}(1+0.15)^{-4}$$

$P_{MC} = 895{,}367$



Let $CC = Capitalized\ Cost$

$$CC = FC + \frac{MC}{i} + \frac{CR}{(1+i)^n - 1}$$

Use $P_{lc.}$ in place of $\frac{MC}{i}$

$$= 3{,}328{,}347 + 895{,}367 + \frac{300{,}000}{(1+0.15)^{13} - 1}$$

CC = P 4,281,934.994

Answer: P 4,281,934.994

2-23. the will of a wealthy philanthropist left P5, 000,000 to establish a perpetual charitable foundation. The foundation trustees decided to spend P1, 200,000 to provide facilities immediately and to provide P100, 000 of capital replacement at the end of each 5 year period. If the invested funds earned 12% per annum, what would be the year end amount available in perpetuity from the endowment for charitable purposes?

Given: P_A = *money left by the philanthropist to establish charitable foundation*
= *P5, 000,000*
P_1 = *money spend for the facilities*
= *P 1,200,000*

P_2 = *capital replacement*
= *P 100,000*

n=5 yrs.

Solution:

Using the formula for Perpetuity; $P_A = \frac{A1}{i}$

$5{,}000{,}000 = \frac{A1}{0.12}$

$A1 = P600,000$

Let $PB = total\ cost$

$PB = P1 + P2$

$= 1{,}200{,}000 + \frac{100{,}000}{(1+0.12)^5 - 1}$

$PB = 133{,}174.777$

Using the formula for Perpetuity; $P_B = \frac{A2}{i}$

$133{,}174.777 = \frac{A2}{0.12}$

$A1 = P159,741$

Let $A = year\ end\ amount$

$A = A1 - A2$

$A = P\,440{,}259$

Answer: P 440,259

2-24. the surface area of a certain plant requires painting is 8,000 sq. ft. Two kinds of paint are available whose brands are A and B. Paint A cost P 1.40 per sq. ft. but needs renewal at the end of 4 yrs., while paint B cost P 1.80 per sq. ft. If money is worth 12% effective, how often should paint B be renewed so that it will be economical as point A?

Given:

A=surface area of the plant (8,000 sq. ft.)

For paint A:

P 1.40 per sq. ft. = *4 yrs.*

For paint B

P 1.80 per sq. ft.

Solution:

Cost of renewal for paint A:

$CRpaint\ A = \frac{1.40(8000)}{(1+0.12)^4 - 1} = P19,52.55$

Let $x = (P\ 1.80\ per\ sq.ft\ x\ 8000\ sq.ft) - (P\ 1.40\ per\ sq.ft\ x\ 8000\ sq.ft)$

$x = P3200$

In order to be economical as Paint A,

$CRpaint\ A - x = CRpaintB$

$P19{,}528.55 - P3200 = \dfrac{1.80(8000)}{(1+0.12)^{n} - 1}$

$n = 5.58\,yrs.$

Answer: 5.58 years

2-25. A contract has been signed to lease a building at P20,000 per year with an annual increase of P1,500 for 8 years. Payments are to be made at the end of each year, starting one year from now. The prevailing interest rate is 7%. What lump sum paid today would be equivalent to the 8-year lease-payment plan?

Given: A= P20,000
G= P1,500
n=8years
i=7%

Solution:

$$P = A\frac{1-(1+i)^{-n}}{i} + G\frac{1}{i}\left[\frac{(1+i)^{n}-1}{i} - n\right]\left[\frac{1}{(1+i)^{n}}\right]$$

$$P = 20{,}000\left[\frac{1-(1.07)^{-8}}{0.07}\right] + 1{,}500\left\{\frac{1}{0.07}\left[\frac{(1+0.07)^{8}-1}{0.07} - 8\right]\left[\frac{1}{(1+0.07)^{8}}\right]\right\}$$

$P = 119425.9701 + 28183.40721$
$P = P147{,}609.3773$

Answer: P147,609.3773

CHAPTER 3
Depreciation
Solved Supplementary Problems

3-1. A machine shop purchased 10 years ago a milling machine for P60,000. A straight-line depreciation reserve had been provided based on a 20-year life of the machine. The owner of the machine shop desires to replace the old milling machine with a modern unit having many advantages costing P100,000. It can sell the old unit for P20, 000. How much new capital will be required for the purchase?

Solution:

Assume that no scrap value at the end of 20 years, Cn = 0.

The depreciation d of a milling machine with an original cost C_o of P60, 000 10 years ago having a machine life of 20 years is

$$d = \frac{C_o - C_n}{n},\ d = \frac{60{,}000}{20} = P3{,}000.00$$

After 10 years, the depreciation D_{10} would be

$$D_{10} = 10d = 10\ (P3{,}000.00) = P30{,}000.00$$

and the total amount available would be

$$\text{Total Amount Available} = P30,\ 000.00 + P20,\ 000 = P50,\ 000$$

Therefore the new capital required would be the difference of the cost of the modern unit and the total amount available for the purchase of the milling machine

$$\text{New Capital Required} = P100,\ 000 - P50,\ 000$$
$$\text{New Capital Required} = P50,\ 000$$

3-2. A tax and duty free importation of a 30-horsepower sand mill for paint manufacturing costs P360,000, CIF Manila. Bank charges, arrester and brokerage cost P5,000. Foundation and installation costs were P25,000. Other incidental expenses amount to P20,000. Salvage value of the mill is estimated to be P60,000 after 20 years. Find the appraisal value of the mill using straight-line depreciation at the end of

a.) 10 years,
b.) 15 years

Solution:

Using straight-line formula,

a.) For 10 years

The original cost C_o would be the summation of the manufacturing costs, bank charges, arrester, brokerage cost, foundation and installation costs and other incidental expenses

$$C_o = P360{,}000 + P5{,}000 + P25{,}000 + P20{,}000 = P410{,}000$$

The depreciation having a salvage value $C_n = P60{,}000$ for a 20 year life span would be

$$\text{d} = \frac{C_o - C_n}{n} = \frac{P410{,}000 - P60{,}000}{20} = P17{,}500$$

After a 10 year depreciation period

$$D_{10} = 10\text{d} = 10(P17{,}500) = 175{,}000$$

Therefore, the appraisal value of the mill

$$C_{10} = C_o - D_{10} = P410{,}000 - P175{,}000$$
$$C_{10} = \text{P}235{,}000$$

b.) For 15 years

The original cost C_o would be the summation of the manufacturing costs, bank charges, arrester, brokerage cost, foundation and installation costs and other incidental expenses

$$C_o = P360{,}000 + P5{,}000 + P25{,}000 + P20{,}000 = P410{,}000$$

The depreciation having a salvage value $C_n = P60{,}000$ for a 20 year life span would be

$$\text{d} = \frac{C_o - C_n}{n} = \frac{P410{,}000 - P60{,}000}{20} = \text{P}17{,}500$$

After a 15 year depreciation period

$$D_{15} = 15\text{d} = 15(P17{,}500) = \text{P}262{,}500$$

Therefore, the appraisal value of the mill

$$C_{15} = C_o - D_{15} = P410{,}000 - P262{,}500$$
$$C_{15} = \text{P}147{,}500$$

3-3. On January 1, 1978, the purchasing engineer of a Cement Co. purchased a new machine at a cost of 140,000. Depreciation has been computed by the straight-line method based on an estimated useful life of five years and residual scrap value of 12,800. On January 2, 1981, extraordinary repairs (which were almost equivalent to a rebuilding of machinery) were performed at a cost of 30,400. Because of

the thorough going nature of these repairs, the normal life of the machinery was extended materially. The revised estimate of useful life was four years from January 1, 1981.

Determine the annual provision for depreciation for the years 1978 to 1980 and the adjusted provision for depreciation on December 31, 1981. Assume payment in cash for the machine and extraordinary repairs.

Solution:

For the depreciation of the new machine costing P140,000 and having a scrap value of P12,800 from 1978-1980 with a useful life of 5 years

$$d = \frac{P\ 140{,}000 - P12{,}800}{5} = P25{,}440$$

On December 31, 1981, a total cost of

$$C_o = P140{,}000 + P30{,}400 = P170{,}400$$

and the total book value after the useful life would be three times the annual depreciation cost from 1978 – 1981 which is three years, plus the depreciation of the new machine with a useful life of 5 years.

$$C_L = P25{,}440(3) + 12{,}800 = P89{,}120$$

Therefore the new machine with 4 years of useful life has an adjusted depreciation of

$$d = \frac{P170{,}400 - P89{,}120}{4} = P\ 20{,}320$$

3-4. Power to a remote transmitting station is provided by a Diesel-generator unit. The original cost of the unit is P65,000. It costs P2,000 to ship the unit to the job site. An additional cost of P3,000 was incurred for installation.

(a) Determine the annual depreciation cost by the sinking fund method, if the unit has an expected life of 10 years. The salvage value of the unit at the end of its life was estimated at P5000.
(b) Determine the annual depreciation cost by the sinking fund method. Assume that the annual charge for depreciation was deposited in a fund drawing compound interest at the rate of 5%.

Solution:

(a) The total original cost of the Diesel – generator unit is P65,000 plus the shipment of the unit to the job site and cost for installation.

$$C_o = 65{,}000 + P\ 2{,}000 + P\ 3{,}000 = P70{,}000$$

The annual depreciation cost with an expected unit life of 10 years and a salvage value of P5,000 would be

$$d = \frac{P\ 70{,}000 - P\ 5{,}000}{10} = P6{,}500.00$$

(b) The annual depreciation cost at an interest rate of 5% would be

$$d = \frac{P\ 65{,}000 + P\ 2{,}000 + P\ 3{,}000 - P\ 5{,}000}{\frac{(1+0.05)^{10} - 1}{0.05}} = P\ 5{,}167.80$$

3-5. An industrial plant bought a generator set for 90,000. Other expenses including installation amounted to 10,000. The generator set is to have a life of 17 years with a salvage value at the end of life of 5,000. Determine the depreciation charge during the 13th year and the book value at the end of 13 years by the (a) declining balance method, (b) double declining balance method, (c) sinking fund method at 12% and (d) SYD method.

Solution:

a.) Declining Balance Method

The book value of the at the end of 13 years with an original cost of C_o =P90,000+P10,000= P100,000, salvage value of P5,000 and a useful life of 17 years at an interest of 12% would be

$$C_n = C_O \left(\frac{C_L}{C_O}\right)^{\frac{n}{L}}$$

$$C_{13} = P100{,}000\left(\frac{P5{,}000}{P100{,}000}\right)^{\frac{13}{17}}$$

$$C_{13} = 10{,}118.00$$

The annual depreciation cost of the generator set would be

$$d_n = C_O(1-k)^{n-1}(k)$$

$$k = 1 - \sqrt[L]{\frac{C_L}{C_O}}$$

$$k = 1 - \sqrt[17]{\frac{5{,}000}{100{,}000}}$$

$$k = 0.1616$$

At the 13th year, the annual depreciation cost would be

$$d_{13} = 100{,}000(1-0.1616)^{13-1}(0.1616)$$

$$d_{13} = P1{,}949.20$$

Using the declining balance method, the depreciation charge during the 13th year is 1,949.20 and the book value at the end of 13 years is 10,118.00.

b.) Double Declining Balance Method

$$C_n = C_O\left(1-\frac{2}{L}\right)^n$$

$$C_{13} = 100{,}000\left(1-\frac{2}{17}\right)^{13}$$

$$C_{13} = P19{,}649.45$$

$$d_n = C_O\left(1-\frac{2}{L}\right)^{n-1}\frac{2}{L}$$

$$d_{13} = 100{,}000\left(1-\frac{2}{17}\right)^{13-1}\frac{2}{17}$$

$$d_{13} = P2{,}619.93$$

Using the double declining balance method, the depreciation charge during the 13th year is 2,619.93 and the book value at the end of 13 years is 19,649.45.

c.) Sinking Fund Method

$$d = \frac{C_O - C_L}{\left[\frac{(1+i)^L - 1}{i}\right]}$$

$$d = \frac{100{,}000-5{,}000}{\left[\frac{(1+0.12)^{17}-1}{0.12}\right]}$$

$$d = P1{,}943.39$$

$$D_n = d\left[\frac{(1+i)^n - 1}{i}\right]$$

$$D_{13} = 1{,}943.39\left[\frac{(1+0.12)^{13}-1}{0.12}\right]$$

$$D_{13} = 54{,}471.00$$

$C_n = C_O - D_n$

$C_{13} = 100{,}000 - 54{,}471.00$

$C_{13} = P45{,}529.00$

Using the sinking fund method, the depreciation charge during the 13th year is 1,943.39 and the book value at the end of 13 years is 45,529.00.

c.) Sum of the Year's Digit (SYD) Method

$d_n = \frac{reverse\ digit}{sum\ of\ the\ digits}\ (C_o - C_L)$
$d_{13} = \frac{5}{153}\ (100{,}000 - 5{,}000)$
$d_{13} = 3{,}104.58$ or $3{,}105.00$

$D_n = \frac{n(2L-n+1)}{L(L+1)}\ (C_o - C_L)$
$D_{13} = \frac{13(34-13+1)}{17(17+1)}\ (100{,}000 - 5{,}000)$
$D_{13} = 88{,}790.85$

$C_n = C_o - D_n$
$C_{13} = 100{,}000 - 88{,}790.84967$
$C_{13} = 11{,}209.15$ or $11{,}209.00$

Using the SYD method, the depreciation charge during the 13th year is 3,105.00 and the book value at the end of 13 years is 11,209.00.

3-6. A telephone company purchased a microwave radio equipment for P6,000,000.00. Freight and installation charges amounted to 3% of the purchased price. If the equipment shall be depreciated over a period of 8 years with a salvage value of 5%, determine the following:

a.) Annual depreciation charge using the straight line method.
b.) Depreciation charge during the 5th year using the sum-of-the year's digits method.

Solution:

a.) Straight Line Method

The original cost of microwave radio equipment having a life span of 8 year is $C_O = P6{,}000{,}000 + (0.03)\ 6{,}000{,}000 = P6{,}180{,}000$ and a salvage value of $C_L = (0.05)\ 6{,}180{,}000$

$$d = \frac{Co - CL}{L}$$

$$d = \frac{P6{,}180{,}000 - P6{,}180{,}000\ (0.05)}{8}$$

$$d = 733{,}875.00$$

b.) SYD method:

Depreciation charge during the 5th year

Solution:

$$d_5 = \frac{reverse\ digit}{sum\ of\ the\ digits}\ (C_o - C_L)$$

$$d_5 = \frac{4}{36}\ (6{,}180{,}000 - 6{,}180{,}000\ (0.05))$$

$$d_5 = 652{,}333.32 \text{ or } 652{,}333.00$$

Answer: (a) 733,875.00; (b) 652,333.00

CHAPTER 4
Capital Financing
Solved Supplementary Problems

4-1. A Corporation sold an issue of 20-year bonds, having a total face value of 10,000,000 for 9,500,000. The bonds bear interest at 16%, payable semiannually. The company wishes to establish a sinking fund for retiring the bond issue and will make semiannual deposit that will earn 12%, compounded semiannually. Compute the annual cost for interest and redemption of these bonds.

Solution:

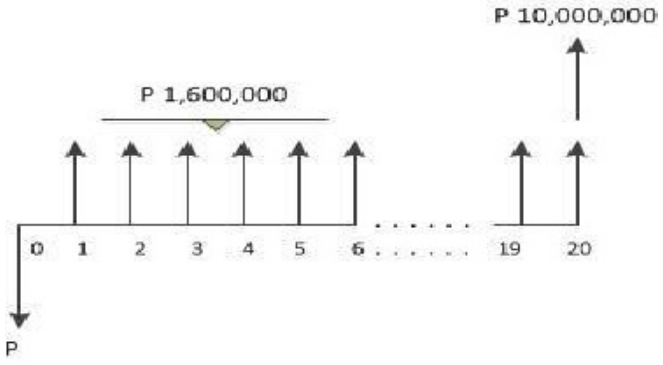
F= 10,000,000

$\mathbf{r} = \frac{16\%}{2} = 8\%$

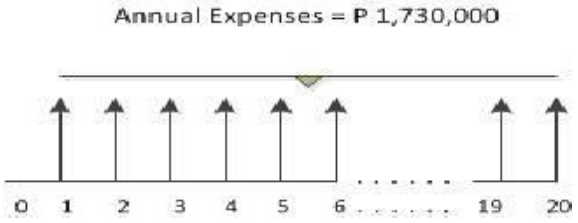
$\mathbf{i} = \frac{12\%}{2} = 6\%$

Interest on the bond per period = **Fr** = (10,000,000)(0.16)= 1,600,000

Here the rate used is 16% since the Interest calculated in on annual basis



Periodic Deposit on the sinking Fund = **A** = $\frac{10,000,000}{\frac{1.06^{40}-1}{0.06}}$ = 64,615.36



Therefore the Total annual expenses = 2A + **Fr**

Total Annual Expenses = 2(64,615.36) + 1,600,000

= 1,729,230.718≈ 1,730,000.00

Answer: 1,730,000.00

4-2. A company has issued 10-year bonds, with face value of 1,000,000 in 1,000 units. Interest at 16% is aid quarterly. If an investor desires to earn 20% nominal interest on 100,000 worth of these bonds, what would the selling rice have to be?

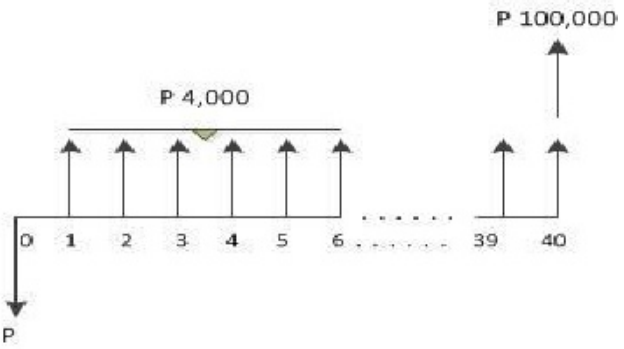
Solution:

C = 100,000

$\mathbf{r} = \frac{16\%}{4} = 4\%$

$\mathbf{i} = \frac{20\%}{4} = 5\%$

Interest on the bond per period = **Fr** = (100,000)(0.04)= 1,600,000 = 4,000



$= 4{,}000(\frac{1-1.05^{-40}}{0.05}) + 100{,}000\ (1.05^{-40}) = 82{,}840.91$

Answer: 82,840.91

4-3. A 1,500-bond which will mature in 10 years and with a bond rate of 15% payable annually is to be redeemed at par at the end of this period. If it is sold now for 1,390, determine the yield at this price.

Given:

F = 1,500
N = 10
r = 15%
P = 1,390

Solution:

$P = Fr\left(\frac{1-(1+i)^{-n}}{i}\right) + C\,(1+i)$

$1{,}390 = (1{,}500)(0.15)\left(\frac{1-(1+i)^{-10}}{i}\right) + C\,(1+i)$

$i = 0.1655\ or\ 16.55\%$

Answer: 16.55%

CHATER 5
Selections in resent Economy
Solved Supplementary Problems

5-1. An industrial engineer has designed two alternative methods for accomplishing a production job. Both methods involve the acquisition of the same working place and other capital equipment to be used for this job only.

Method A calls for a crew consisting of three men each costing P30.00 per hour. This method will result in the production of 10 units per hour of which two will be reject.

Method B calls for a crew of two men each costing P35.00 per hour and should result in the production of eight units per hour of which one will be reject.

The cost of the direct material lost in each reject is P20.00. If a certain total number of units is to be produced, find which method is economical.

Solution:

Method A:

$$\frac{(30)(3)+(2)(20)}{10-2} = \boldsymbol{P16.25}$$

Method B:

$$\frac{(35)(2)+20}{8-1} = \boldsymbol{P12.86}$$

Answer: Method B is economical.

5-2. An executive receives an annual salary of P600,000 and his secretary a salary of P180,000. A certain task can be performed by the executive working alone in 4 hours. If he delegates the task to his secretary it will require him 30 minutes to explain the work and another 45 minutes to check the finished work. Due to the unfamiliarity of the secretary to the task, it takes her an additional time of 6 hours after being instructed. Considering salary costs only, determine the cost of performing the task by each method, if the secretary works 2,400 hours a year and the executive 3,000 hours a year.

Solution:

If the executive works alone:

$Annual\ salary = P600{,}000.00$

$Time\ to\ finish\ the\ work = 4\ hours$

$Annual\ working\ hours = 3000\ hrs/yr$

$Rate\ per\ hour = \frac{P600{,}000/yr}{3000\ hrs/yr} = P200.00\ /\ hr$

$Cost\ of\ performing\ the\ task = P200.00\ /hr\ x\ 4000\ hrs = \boldsymbol{P800.00}$

Answer: P800.00

If the executive delegates the work to his secretary:

$Annual\ salary\ of\ the\ executive = P600{,}000.00$

$Annual\ salary\ of\ the\ secretary = P180{,}000.00$

$Annual\ working\ hours\ of\ the\ executive = 3000\ hrs/yr$

$Annual\ working\ hours\ of\ the\ secretary = 2400\ hrs/yr$

$Rate\ per\ hour\ of\ the\ executive = \frac{P\ 600{,}000.00/\ yr}{3000\ hrs/\ yr} = P200.00$

$Rate\ per\ hour\ of\ the\ secretary = \frac{P\ 180{,}000.00/\ yr}{2400\ hrs/\ yr} = P75.00$

Note: the executive works 30 mins. to explain the work and another 45 mins. to check the finished work for a total of 1.25 hrs. and the secretary works 30 mins. for explanation of the work and additional 6 hrs. to finish the work for a total of 6.5 hrs.

Cost for performing the work= (200.00/hr x1.25 hrs) + (75.00/hr x6.5 hrs) = **P737.50**

Answer: P737.50

5-3. A cement grinding mill "A" with a capacity of 50 tons per hour utilizes forged steel grinding balls costing P12,000 per ton, which have a wear rate of 100 grams per ton cement milled. Another cement mill "B" of the same capacity uses high chrome steel grinding balls costing P50,000 per ton with a wear rate of 20 grams per ton cement milled. Determine the more economical grinding mill, considering other factors to be the same.

Solution:

For cement grinding mill "A":

$$Wear\ rate = 100\ grams\ x \frac{1\ kg}{1000\ grams} x \frac{1 ton}{1000\ kg} = 0.0001\ ton\ /\ cement\ milled$$

$$Capacity = 50\ tons/hr$$

$$Cost = P12{,}000/ton$$

$$Total\ cost\ of\ grinding\ er\ hour = wear\ rate\ x\ caacity\ x\ cost$$

$$= 0.0001\ ton\ x\ 50 tons/hr\ x\ P12{,}000/ton = \boldsymbol{P60.00/hr}$$

For cement grinding mill "B":

$$Wear\ rate = 20\ grams\ x \frac{1\ kg}{1000\ grams} x \frac{1 ton}{1000\ kg} = 0.00002\ ton\ /\ cement\ milled$$

$$Capacity = 50\ tons/hr$$

$$Cost = P50{,}000/ton$$

$$Total\ cost\ of\ grinding\ per\ hour = wear\ rate\ x\ capacity\ x\ cost$$

$$= 0.00002\ ton\ x\ 50 tons/hr\ x\ P50{,}000/ton = \boldsymbol{P50.00/hr}$$

Answer: Since mill "B" has lower production cost per hour than mill "A", mill "B" is more economical.

5-4. A cement kiln with production capacity of 130 tons per day (24 hours) of clinker has at its burning zone about 45 tons of magnetite chrome bricks being replaced periodically, depending on some operational factors and the life of the bricks.
If locally produced bricks costs P25,000 per ton and have a life of 4 months, while certain imported bricks costing P30,000 per ton and have a life of 6 months, determine the more economical bricks and by how much.

Solution:

$Magnesite\ bricks\ being\ replaced\ periodically = 45\ tons$
$Cost\ of\ local\ bricks = \ P25{,}000/\ tons$
$Life\ of\ local\ bricks = \ 4\ months$
$Cost\ of\ imported\ bricks = \ P30{,}000/\ ton$
$Life\ of\ imported\ bricks = \ 6\ months$
$Assume\ the\ magnesite\ chrome\ bricks\ are\ being\ replaced\ \ every\ month$

$$Cost\ of\ \ local\ bricks\ per\ month = \frac{\frac{P\ 25000}{ton}\ x45\ tons}{4\ months} = \ P281{,}250.00/month$$

$$Cost\ of\ imported\ bricks\ per\ month = \frac{\frac{P30000}{ton}\ x45\ tons}{6\ months} = \ P225{,}000/month$$

$Savings\ by\ using\ imported\ bricks\ every\ month = P281{,}250 - P225000 = P56{,}250/month$

Answer: Imported bricks are more economical by P56,250/ month

5-5. A manufacturer has been shipping his product (moderately heavy machines), mounted only on skids without comlete crating. To avoid crating he must ship in freight cars which contain only his machines. To do this he must pay freight on a car capacity load of 42 tons regardless of whether or not the car is completely full. In the past he actually has shied only 30 tons in each car. The car load freight rate is P4.10 per hundred pounds. If the machines are crated so that they can be shied in mixed car lots, along with other merchandise, they can be shied at a rate of P4.20 per hundred pounds with the freight bill computed only on the actual weight shied. The cost of crating would be P25.00 per machine and would increase the shipping weight from 1,200- 1220 pounds per machine.
Which procedure should be followed? (1 ton= 2,200 lbs.)

Solution:

Without crating:

Total cost of shipping without crating= $\frac{P\ 4.10}{100\ lbs}$x42 tons x$\frac{2200\ lbs}{1\ ton}$= P3,788.40

With crating:

$$Number\ of\ machines\ to\ be\ shied = \frac{30\ tons\ x\frac{2200lbs}{1ton}}{1200\ lbs} = 55\ machines$$

$Increase\ in\ weight = \ 55\ machines\ x\ (1220\ lbs/machine - \ 1200\ lbs/machine) \ = \ 1100\ lbs$
$Total\ cost\ of\ shipment\ with\ crating = \ cost\ of\ shipment \ + \ cost\ of\ crating$

$$Cost\ of\ shipment = \frac{P\ 4.20}{100\ lbs}\ x(30\ tonsx\frac{2200lbs}{1\ ton} + \ 1100\ lbs) = \ P2818.20$$

$$Cost\ of\ crating = \frac{P\ 25.00}{machine}\ x\ 55\ machines = \ P1375.00$$

$Total\ cost\ of\ shipment\ with\ crating = P2818.20 + P1375.20 = P4193.20$
$Savings\ by\ shipping\ without\ crate = P4193.20 - P3{,}788.40 = P404.80$

***Answer*: *Shipping without crane is cheaper by* 404.80**

5-6. A machine used for cutting materials in a factory has the following outputs per hour at various seeds and required periodic tool regrinding at the intervals cited.

Seed	Outputs per hour	Tool regrinding
A	200 pieces	Every 8 hours
B	280 pieces	Every 5 hours

A set of tools cost 1260 and can be ground twenty times. Each regrinding costs 54.00 and the time needed to regrind and change tools is 1 hour. The machine operator is aid 35.00 per hour including the time the tool is changed. The tool grinder who also sets the tools to the machine is aid 40.00 per hour. The hourly rate chargeable against the machine is 38.00 regardless of machine seed. Which seed is the most economical?

Solution:

Machine A:
Outputs per cycle: 200(8) = 1600
Cycle time: 8+1 = 9hours
Operator: P35(9) = P315
Sets tool: P40(1) = P40
Tools costs: P1260/20 = P63
Regrinding cost: P54
Rate of machine: P38(8) =P304

Total cost: P776

Machine B:
Outputs per cycle: P280(5) = P1400
Cycle time: 5 + 1 = 6 hours
Operator: P35(6) = P210
Sets Tool: P40(1) = P40
Tools costs: P1260/20 =P63
Regrinding cost: P54
Rate of machine: 38(5) =P190

Total cost: P557

Cost per piece: 776/ (1600) = P0.485

Cost per piece: 557/(1400) = P0.397857

Comparing the cost per piece of each machine,
P0.485 – P0.397857 = P**0.087143**

Answer: We can conclude that the machine B is more economical than machine A by P**0.087 per piece**.

CHAPTER 6
Basic Methods for Making Economy Studies
Solved Supplementary Problems

6-1 A young mechanical engineer is considering establishing his own small company. An investment of P400,000 will be required which will be recovered in 15 years.
It is estimated that sales will be P800,000 per year and that operating expenses will be as follows.

Materials	P160,000 per year
Labor	P280,000 per year
Overhead	P40,000 +10% of sales per year
Selling expense	P60,000

The man will give u his regular job paying P216,000 per year and devote full time to the operation of the business; this will result in decreasing labor cost by P40,000 per year, material cost by P28,000 per year and overhead cost by P32,000 per year. If the man expects to earn at least 20% of his capital, should he invest?

Solution:

Compute for the depreciation value,

$\frac{(P800{,}000)}{\frac{(1+0.2)^{15}-1}{0.2}}$ = P11,105.69587

Materials	P160,000 – P28,000 = P132,000
Labor	P280,000 – P40,000 = P240,000
Overhead	P120,000 – P32,000 = P88,000
Selling expense	= P60,000
Salary that he will give u	=P216,000
Depreciation Value	= P11,105.69587
Total Annual Cost	= 747,105.69587

Getting the Annual profit: 800,000 – 747,105.69587 = 52,894.30413
Computing the Rate of Return: (52,894.30413/800,000)(100) = 6.6118%

Answer: Therefore, the man *should not* invest in the business.

6-2 The ABC company is considering constructing a plant to manufacture a proposed new product. The land costs P15,000,000, the building costs P30,000,000, the equipment costs P12,500,000, and P5,000,000 working capital is required. At the end of 12 years, the land can be sold for P25,000,000, the building for P12,000,000, the equipment for P250,000 and all of the working capital recovered. The annual disbursements for labor, materials, and all other expenses are estimated to cost P23,750,000. If the company requires a minimum return of 25%, what should be the minimum annual sales for 12 years to justify the investment?

Find: Minimum annual sales for 12 years to justify the investment
Given:

		At the end of 12 years
Land	P15,000,000.00	P25,000,000.00

Building	P30,000,000.00	P12,000,000.00
Equipment	P12,500,000.00	P250,000.00

Solution:

$Let\ X\ be\ the\ minimum\ annual\ sales\ for\ 12\ years.$

$Annual\ Cost$:

$Annual\ Cost\ =\ Appreciated\ Value\ on\ land\ +\ X$

$$Land = \frac{P30{,}000{,}000.00 - P15{,}000{,}000.00}{\frac{1.25^{12}-1}{.25}} = P184{,}475.77$$

$Total\ Annual\ Income$:

$P184{,}475.77\ +\ X$

$Annual\ Cost$:

$Annual\ Cost\ =\ Depreciated\ Values\ +\ Annual\ Expenses$

$$= \left(\frac{P30{,}000{,}000.00 - P12{,}000{,}000.00}{\frac{1.25^{12}-1}{.25}}\right)\left(\frac{P12{,}500{,}000.00 - P250{,}000.00}{\frac{1.25^{12}-1}{.25}}\right) + P23{,}750{,}000.00$$

$Annual\ Cost\ =\ 24{,}308{,}039.21$

$Net\ Annual\ profit\ =\ Annual\ Cost\ (Appreciated)\ -\ Annual\ Cost\ (Depreciated)$

$Net\ Annual\ profit\ =\ P184{,}475.77\ +\ X\ -\ P24{,}308{,}039.21$

$Rate\ of\ Return$:

$$Rate\ of\ Return = \frac{Net\ Annual\ Profit}{Capital\ Invested}$$

$$25\% = \frac{P184{,}475.77 + X\ - P24{,}308{,}039.21}{P57{,}500{,}000.00 + P5{,}000{,}000.00}$$

$Solving\ for\ X: We\ get,$

$\boldsymbol{X\ = P\ 39{,}748{,}563.43\ (the\ minimum\ annual\ sales\ for\ 12\ years)}$

$\boldsymbol{Answer: P39{,}748{,}563.43}$

6-3 A man formerly employed as chief mechanic of an automobile repair shop has saved P1,000,000.00 which are now invested in certain securities giving him an annual dividend of 15%. He now plans to invest this amount in his own repair shop. In his resent job, he is earning P25,000.00 a month, but he has to resign to run his own business. He will need the services of the following: 2 mechanics each earning P400.00 a day, and 8 helpers each earning P200.00 a day. These men will work on the average 300 days per year. His other expenses are the following:

Rental	P30,000.00 a month
Miscellaneous	P25,000.00 a month
Sales tax	3% of gross income
Insurance	2%

The length of his lease is 5 years. If the average charge for each car repaired by his shop is P1,000.00. Determine the number of cars he must service in one year so that he will obtain a profit of at least 20% on his investment?

Find: Number of cars he must service in one year

Given:

N = 5 years	I = 20%	
Rental		P30,000.00 a month
Miscellaneous		P25,000.00 a month
Sales tax		3% of gross income
Insurance		2%
2 mechanics	P400/day	
8 helpers	P200/day	

Solution:

First, compute for the annual cost;

Annual Cost=12(P30,000)+ 12(P25,000)+0.03(Gross)+0.02(P1,000,000)+2(400)(300days)
+8(200)(300days)+1,000,000/((F/A, 15%, 5))+12(25,000)

Annual Cost=P2048315.552+0.03(Gross)

Then, for the Net Annual profit and the Gross Income is;

Net Annual profit=P1,000,000.00(20%)
=P200,000.00

Gross Income= P2,048,315.552/(1-0.03)
=P2,111,655.518

To compute for the number of cars, simply divide the Gross Income to the average charge of each repaired car. Thus,

Number of Cars=P2,111,655.518/1,000.00
=2111.65 or **2112 cars**

Answer: **2112 cars**

6-5 A firm is charged P150 per ton for hauling its raw materials by a trucking company. Forty tons per day are hauled for 300 days a year. It is desired to install a railway system which would bring down the cost of hauling to P6.60 per ton. Maintenance cost of this is P12,000 per month. Tax is 1%. Average rate if earning is 20%.

a. If the company has the cash necessary for the installation, would you recommend the change?
b. If the company has to float P5,000,000 worth of noncallable bonds at 15% that will mature in 10 years to have the capital for the project, would you recommend the change?

Solution:

a. $Case\ 1$:

$PhP\ 150/ton, \quad 40tons/day, 300days/year$

$Total\ Cost = PhP(\ 150 \times 40 \times 300\ )\ a\ year = P1{,}800{,}000\ a\ year$

$Case\ 2$:

$Hauling = (40 \times 300 \times PhP6.60) = P79{,}200.00\ a\ year$

$Maintaenance = (PhP12{,}000 \times 12) = P144{,}000.00\ a\ year$

$Tax = (0.01 \times PhP\ 5{,}000{,}000) = P50{,}000.00\ a\ year$

$$Depreciation\ Cost = \frac{PhP\ 5{,}000{,}000}{\frac{1.15^{10}-1}{0.15}} = P246{,}260.31\ a\ year$$

$Total\ Cost = P519{,}460.31\ a\ year$

$Annual\ Net\ Savings = Total\ Cost\ (Case1) - Total\ Cost\ (Case2)$

$Annual\ Net\ Savings = P\ 1{,}800{,}000 - P519{,}460.31 = P1{,}280{,}539.69$

$$Rate\ of\ Return = \frac{Annual\ Net\ Savings}{Capital} = \frac{PhP\ 1{,}280{,}539.69}{PhP\ 5{,}000{,}000} = \mathbf{25.61\%}$$

Answer*: *Since Case1 > Case2, the investment is justified at* 25. 61% *ROR.

b. Since we're dealing with a resent value given (Case3),

$$A = \frac{PhP5{,}000{,}000.00}{\frac{1-1.15^{-10}}{0.15}} = P996{,}160.31$$

$Hauling = (40 \times 300 \times P6.60) = P79{,}200{,}000$

$Maintaenance = (P12{,}000 \times 12) = P144{,}000.00\ a\ year$

$Tax = (0.01 \times P5{,}000{,}000) = P50{,}000.00\ a\ year$

$Total\ Cost = P1{,}369{,}360.31$

$Annual\ Net\ Savings = Total\ Cost\ (Case1) - Total\ Cost\ (Case3)$

$Annual\ Net\ Savings = P1{,}800{,}000 - P1{,}369{,}360.31 = P530{,}639.687$

$$Rate\ of\ Return = \frac{Annual\ Net\ Savings}{Capital} = \frac{P530{,}639.687}{P5{,}000{,}000} = \mathbf{10.61\%}$$

Answer:Since 10.61% < 15% ROR, the investment is not justified.

6-5 A food processing plant consumed 600,000 kW of electric energy annually and pays an average of P2.00 per kWh. A study is being made to generate its own power to supply the plant the energy required, and that the power plant installed would cost P2,000,000. Annual operation and maintenance,P800,000. Other expenses P100,000 per year. Life of power plant is 15 years; salvage value at the end of life is P200,000; annual taxes and insurances, 6% of first cost; and rate of interest is 15%. Using the sinking fund method for depreciation, determine if the power plant is justifiable.

Solution

Annual Savings:

Annual cost for electric energy

$$= 600{,}000\ kWh\left(\frac{P\ 2.00}{kWh}\right) = P1{,}200{,}000.00$$

Annual cost for power plant

a. Maintenance $=P800{,}000$
b. Other expenses $=P100{,}000$
c. Tax and insurances $=P2{,}000{,}000 \times 6\% = P120{,}000$
d. Depreciation $= \frac{C_O - C_L}{\frac{(1+i)^n - 1}{i}} = \frac{P2{,}000{,}000 - P200{,}000}{\frac{(1+0.15)^{15} - 1}{0.15}}$
$=P37{,}380.69476$

Annual Net Savings = Annual cost for electric energy – Annual cost for power plant
Annual Net Savings $=P1{,}200{,}000.00 - P1{,}057{,}830.695 = P142{,}169.3052$

$$Rate\ of\ Return = \frac{Annual\ Net\ Savings}{Capital}$$
$$= \frac{P142{,}169.3052}{P2{,}000{,}000} = 0.0710 = \mathbf{7.1085}\%$$

Answer: Rate of return is approximately 7.11%; the power plant is not a good investment.

6.6 A fixed capital investment of P10, 000,000.00 is required for a proposed manufacturing plant and an estimated working capital of P2,000,000.00. Annual depreciation is estimated to be 10% of the fixed capital investment. Determine the rate of return on the total investment and the payout period is the annual profit is P2,500,000.00.

Given:

Fixed Capital = P10,000,000.00
Work Capital = P2,500,000.00
Annual Depreciation = P1,000,000.00
Annual profit = P2,500,000.00

Solution:

Rate of Return= (Annual Profit-Annual Depreciation)/(Fixed Capita+ Work capital)
= (P2,500,00000-P1,000,000.00)/(P10,000,000.00+P2,000,000.00)
=12.5 %

Payout period= 12,000,000.00/2,500,000.00
= 4.8 years

Answer: 12.5 % and 4.8 years

6.7 A small business purchased now for P50, 000 will lose P9, 600 each year for first 4 years. An additional investment of P30,000 in the business will required at the end of the fourth year. After 15 years the business can sold for P70, 000. What should be the profit each year from the fifth through the fifteenth year to obtain a rate return of 25%?

CHAPTER 7
Comparing Alternatives
Solved Supplementary Problems

7-1. An oil company is being offered a special coating for the gasoline underground tank installation in its service stations which will increase the life of the tank from the usual 10 years to 15 years. The cost of the special coating will increase the cost of the 40,000-tank to 58,000. Cost of installation for either of the tanks is P24,000. If the salvage value for both is zero, and interest rate is 26%, would you recommend the use of the special coating?

Given:

	Machine w/o coating	**Machine w/ special coating**
First Cost	40,000	58,000
Installation	24,000	24,000
Salvage Value	0	0
Estimated Life	10 years	15 years

Interest rate = 26%

Solution:

Machine w/o coating:
Depreciation = $\frac{P40{,}000 + P24{,}000}{\frac{(1+0.26)^{10}-1}{0.26}}$ = P1831.45

Machine w/ special coating
Depreciation = $\frac{P58{,}000 + P24{,}000}{\frac{(1+0.26)^{15}-1}{0.26}}$ = P687.08

Compare machine w/o coating to machine w/ special coating.

ROR on Additional Investment on machine w/ special coating = $\frac{P1831.45 - P687.08}{P58{,}000 - P40{,}000}$
= 6.36% < 26%

ROR is less than the interest rate.
Therefore,

Answer: Special Coating should not be used.

7-2. An electric cooperative is considering the use of a concrete electric pole in the expansion of its power distribution lines. A concrete pole costs 18,000 each and will last 20 years. The company is presently using creosoted wooden poles which cost 12,000 per pole and will last 10 years. If money is worth 12 percent, which ole should be used? Assume annual taxes amount to 1 percent of first cost and zero salvage value in both cases.

Given:

	Creosoted Wood pole	**Concrete pole**
First Cost	12,000	18,000
Salvage Value	0	0
Annual Tax	1%	1%
Estimated Life	10 years	20 years

i = 12%

Solution:

Creosoted Wood pole:

Depreciation = $\frac{P12{,}000}{\frac{(1+0.12)^{10}-1}{0.12}}$ = P684

Annual Tax = P2,000 (0.01) = P120

Total Annual Cost = P804

Concrete pole:

Depreciation = $\frac{P18{,}000}{\frac{(1+0.12)^{20}-1}{0.12}}$ = P250

Annual Tax = P18,000 (0.01) = P180

Total Annual Cost = P430

Compare creosoted wood pole to concrete pole.

ROR on Additional Investment on Concrete pole $= \frac{P804 - P430}{P18000 - P12{,}000}$

$= 6.23\% < 12\%$

ROR is less than the interest rate.

Answer: Creosoted Wood pole should be used

7-3. It is proposed to place a cable on existing pole line along the shore of a lake to connect two points on opposite sides.

Land Route **Submarine Route**

Length, miles	10	5
First cost of cable per mile	P40, 000	P68, 000
Annual maintenance per mile	P950	P3, 500
Interest on investment	18%	18%
Taxes	3%	3%
Net Salvage value per mile	P12, 000	P22, 000
Life, years	15	15

Which is more economical?

Solution:

@Land route

Depreciation = $\frac{(40000)(10)-(12000)(10)}{\frac{(1+.18)^{15}-1}{.18}}$ = P4592.779

Maintenance = 950(10) = P9500

Taxes = 40000(10)(.03) = P12000.00

Total Income = P26092.779

@Submarine route

Depreciation = $\frac{(68000)(5)-(22000)(5)}{\frac{(1+.18)^{15}-1}{.18}}$ = 3772.63998

Maintenance = 3500(5) = 17500

Taxes = 68000(5)(.03) = 1020.00

Total Income = 31472.63998

$\frac{31472.63998-26092.779}{(40000)(10)-(68000)(5)}$ = 0.08967601633 = **8.97%**

Answer: Submarine route is more *economical.*

7-4. In a cold storage plant, it is desired to determine whether to use insulation two inches thick or three inches in insulating the walls of the cold storage warehouse. Heat absorbed through the walls without insulation would cost P96.00 per year per square meter. A two-inch insulation will cost P30.40 per square meter and will cut out 89% of the loss. A three-inch insulation will cut out 92% of the loss and will cost P65.00 per square meter. Using a life of 15 years for the insulation

with no salvage value and a minimum attractive return of 8%, what thickness of insulation should be used?

Given:

Wall Thickness	**Two-inches**	**Three-inches**
Without insulation	96.00	96.00
Without insulation, per m^2	30.40	65.00
Heat Loss	89%	92%
Interest on investment	8%	8%
Net Salvage value	0	0
Life, years	15	15

7-5. In building their plant, the officers of the International Leather Company had the choice between alternatives:

One alternative is to build in Metro Manila where the plant would cost P200,000,000. Labor would cost annually P120,000 and annual overhead would be 40,000. Taxes and insurance would total 5% of the first cost of the plant.

The second alternative would be to build in Bulacan a plant costing P2,250,000. Labor would cost annually P100,000 and overhead would be P55,000. Taxes and insurance would be 3% of the first cost. The cost of raw materials would be the same in neither plant. If capital must be recovered within 10 years and money is worth at least 20%, which site should the officers of the company choose?

Solution:

By the rate of return on an additional investment method

Metro Manila plant

Annual costs:

$$Depreciation = P2{,}000{,}000\left[\frac{(1+0.20)^{10}-1}{0.20}\right] = \frac{P2{,}000{,}000}{25.9587} = P77{,}045.5138$$

$Labor = P120{,}000$

$Overhead = P40{,}000$

$Taxes\ and\ Insurance (P2{,}000{,}000)(0.05) = P100{,}000$

$Total\ Annual\ Cost = P337{,}045.51$

Bulacan plant

Annual cost:

$$Depreciation = P2{,}250{,}000\left[\frac{(1+0.20)^{10}-1}{0.20}\right] = \frac{P\,2{,}250{,}000}{25.9587} = P86{,}676.2029$$

$Labor = P100{,}000$
$Overhead = P55{,}000$
$Taxes\ and\ Insurance (P2{,}250{,}000)(0.03) = P67{,}500$

$Total\ Annual\ Cost = P309{,}176.2029$

$Annual\ Savings = P337{,}045.5138 - P309{,}176.2029 = P27{,}869.3108$
$Additional\ Investment = P2{,}250{,}000 - P2{,}000{,}000 = P250{,}000$

$Rate\ of\ return\ on\ additional\ investment = P27{,}869.3108/P250{,}000 = 11.1477\%$

$Since\ 11.1477\% < 20\%, the\ officers\ should\ build\ their\ plant\ in\ Metro\ Manila$

By resent worth cost method

$Let\ WCMM\ be\ the\ resent\ worth\ cost\ for\ Metro\ Manila\ and\ WCB\ be\ the\ resent\ worth\ cost\ for\ Bulacan$

Metro Manila

$Annual\ cost\ (excluding\ depreciation) = P120{,}000 + P40{,}000 + P100{,}000 = P260{,}000$

$$WCMM = P200{,}000{,}000 + P260{,}000\left[\frac{1-(1+0.20)}{0.20}\right]$$
$$= P200{,}000{,}000 + P260{,}000(4.1925)$$
$$= P3{,}090{,}050$$

Bulacan
$Annual\ cost\ (excluding\ depreciation) = P100{,}000 + P55{,}000 + P67{,}500 = P222{,}500$

$$WCB = P2{,}250{,}000 + P222{,}500\left[\frac{1-(1+0.20)^{-10}}{0.20}\right]$$

$= P2{,}250{,}000 + P222{,}250(4.1925)$
$= P3{,}182{,}831.25$

Answer*: *Since WCMM < WCB, the plant in Metro Manila should be chosen.

By equivalent uniform annual cost method

Let EUACMM be the equivalent uniform annual cost method for Metro Manila and EUACB for Bulacan

$EUACMM = 2{,}000{,}000(A/,20\%,10) + 260{,}000$
$= 2{,}000{,}000(0.2385) + 260{,}000$
$= 737{,}000$
$EUACB = 2{,}250{,}000(A/,20\%,10) + 222{,}500$
$= 2{,}250{,}000(0.2385) + 260{,}000$
$= 759{,}125$

Answer: Since $EUAC_{MM} < EUAC_{B}$, the plant in Metro Manila should be chosen.

7-6. A utility company is considering the following plans to provide a certain service required by resent demand and the respective growth of demand for the coming 18 years.

Plan R requires an immediate investment of 500,000 in property that has an estimated life of 18 years and with 20% terminal salvage value. Annual disbursements for operation and maintenance will be 50,000. Annual property taxes will be 2% of the first cost.

Plan S requires an immediate investment of 300,000 in property that has an estimated life of 18 years with 20% terminal salvage value. Annual disbursements for its operation and maintenance during the first 6 years will be 40,000. After 6 years, an additional investment of 400,000 will be required having an estimated life of 12 years with 40% terminal salvage value. After this additional property is installed, annual disbursements for operation and maintenance of the combined property will be 60,000. Annual property taxes will be 2% of the first cost of property in service at any time. Money is worth 12%. What would you recommend?

Solution:

By resent worth cost method

Let WC_R be the resent worth cost of Plan R and WC_S be the resent cost of Plan S

Plan R
Annual cost = P50,000 + P500,000(0.02) = P60,000
Salvage Value = P500,000(0.2) =P100,000

WC_R = P500,000 + P60,000$\left[\frac{1-(1+0.12^{-18})}{0.12}\right]$ – 100,000$(1+0.12)^{-18}$
= P500,000 +P60,000(7.2497) – P100,000(0.13)
= P921,982

Plan S
Annual cost = P40,000
Additional annual cost after 6 years = P60,000 + P300,000(0.02) = P66,000

Salvage value = P300,000(0.2) + P400,000(0.4) = P220,000

WC_S = P300,000 + P40,000$\left[\frac{1-(1+0.12)^{-6}}{0.12}\right]$+ 400,000$(1+0.12)^{-6}$
+ 66,000$\left[\frac{1-(1+0.12)^{-12}}{0.12}\right]$– 300,000(/F, 12%, 18)
- 400,000(/F, 12%, 12)

= 300,000 + 40,000(4.1114) + 400,000(0.5066)
+ 66,000(6.1944)(0.5066) – 60,000(0.13) – 160,000(0.2567)
= 825,337.4806

Answer: Since $WC_S < WC_R$, Plan S should be chosen to provide the certain service.

By equivalent uniform annual cost method

Let $EUAC_R$ be the equivalent annual cost for Plan R and $EUAC_S$ for Plan S

$EUAC_R$ = 500,000(A/, 12%, 18) + 60,000 – 100,000(A/F, 12%, 18)
= 500,000(0.1379) + 60,000 – 100,000(0.0179)
= 127,160

$EUAC_S$ = 300,000(A/, 12%, 18) + 40,000 + 400,000(/F, 12%, 6)
(A/, 12%, 18) + 66,000(F/A, 12%, 12)(A/F, 12%, 18)
– 60,000 (A/F, 12%, 6) – 160,000(A/F, 12%, 18)

= 300,000(0.1379) + 40,000 + 400,000(0.5066) (0.1379) +66,000(24.1331)(0.0179)
– 60,000(0.0179) – 160,000(0.0179)
= 133,886.9003

CHATER 8
Fixed, Increment, Sunk Cost
Solved Supplementary Problems

8-1. The XYZ company has two plants producing "K Specials". It has the following expected data for the next month's operations. Variable (incremental) costs vary linearly from zero production to maximum capacity production.

	plant A	plant B
Max. Capacity, units	1,000	800
Total fixed cost	750,000	480,000
Variable (incremental) Costs Max. Capacity	900,000	800,000

a. performance has not been good, so the company expects to receive domestic orders for only 1,200 units next month at a rice of 1,400 per unit. How should the production be distributed between the plants for optimum economic oration?

b. If the friendly foreign power offers to buy 350 additional units at 1,100 per unit, should the company accept the offer? Show the increment gain or loss.

Solution:

a. Expected orders= 1,200 units

Plant A
1000X=900,000
X= 900 per unit

Plant B
800Y=800,000
Y= 1000 per unit

Unit per month		Variable Costs		Total variable Cost
Plant A	Plant B	Plant A	Plant B	
400	800	360,000	800,000	1,160,000
500	700	450, 000	700,000	1,150,000
600	600	540, 000	600,000	1,140,000
700	500	630,000	500, 000	1,130,000
800	400	720,000	400,000	1,120,000
900	300	810, 000	300,000	1,110,000
1000	200	900,000	200,000	1,100,000

Therefore Plant A should produce 1,000 units and 200 units for Plant B.

b. Increment Revenue for 350 units:

(350)(1,100) = 385,000

Increment cost:
Plant B 350(1000) = 350,000

Therefore, with gain 35,000, the company should accept the offer

8-2. A company has a new plant A and an old plant B in the same metropolitan area, each with a capacity of 12 units of product per month. Fixed expense at A is 40,000 per month and at B are 20,000 per month. Variable expense per month at A is $1{,}000xN^2$, where N = the number of units produced. At resent the sales have been established at 14 units per month with each plant producing 7 units. Should the interplant load be redistributed? Why? How?

NOTE:
Plant A should produce 9 units per month and plant B should produce 5 units because it's more profitable when you have the lowest Total Variable Cost.

Unit per month		**Variable Cost**		**Total Variable Cost**
plant A	plant B	plant A	plant B	
3	11	9000	242000	251000
4	10	16000	200000	216000
5	9	25000	162000	187000
6	8	36000	128000	164000
7	7	49000	98000	147000
8	6	64000	72000	136000
9	5	81000	50000	131000
10	4	100000	32000	132000
11	3	121000	18000	139000

8-3. An asset was purchased six years ago at a cost of 7,000. It was estimated to have a useful life of ten years with a salvage value of 300 at the end of the time. It is now of no future use and can be sold for only 800. Determine the sunk cost if the depreciation has been computed by:

(a) The straight-line method
(b) The sum-of-the-year's digits method

Solution:

$C_O = 7{,}000$ $C_L = 300$ $L = 6$ $n = 10$

(a) Straight line method

$D_6 = \frac{(7{,}000-300)(6)}{10} = 4{,}020$

$C_6 = C_O - D_6 = 7{,}000 - 4{,}020 = 2{,}980$

Sunk cost = book value – resale value

= 2,980 – 800

= **2,180.00**

(b) Sum-of-the-year's digits method

Sum of digits = 1+2+3+ … 9+10 = 55

$D_6 = \frac{(10+9+\cdots 5+6)}{55}(7{,}000 - 300) = 5{,}481.82$

$C_6 = 7{,}000 - 5{,}481.82 = 1{,}518.18$

Sunk cost = 1,518.18 – 800 = **718.18**

CHATER 9
Replacement Studies
Solved Supplementary Problems

9-1. A recapping plant is planning to acquire a new Diesel generating set to replace its resent unit which they run during brownouts. The new set would cost 135,000 with a five (5) year-life, and no estimated salvage value. Variable cost would be 150,000 a year.

The resent generating set has a book value of 75,000 and a remaining life of 5 years. Its disposal value now is 7,500 but it would be zero after 5 years. Variable operating cost would be 187,500 a year. Money is worth 10%.

Which is profitable, to buy the new generator set or retain the resent set? Support your answer by showing your computation.

Solution:

Retaining the resent generator

Annual costs:

$$\text{Depreciation} = \frac{75{,}000-0}{\left[\frac{(1+0.10)^5-1}{0.10}\right]} \quad = \quad 12{,}284.81$$

Variable operation cost = 187,500.00

Total annual cost 199,784.81

Replacement

Annual costs:

New generator set

$$\text{Depreciation} = \frac{135{,}000-0}{\left[\frac{(1+0.10)^5-1}{0.10}\right]} \quad = \quad 22{,}112.66$$

Variable operation cost = 150,000.00

Total annual cost 172,112.66

Annual savings = 199,784.81 – 172,112.66 = 27,672.15

Additional investment = 135,000 + 150,000 – 187,000 = 98,000.00

Rate of return on additional investment = $\frac{27{,}672.15}{98{,}000.00}$ X 100 = **28.24%**

Since the rate of return on additional investment is greater than the worth of money at 10%

rate of return on additional investment > worth of money

28.24% > 10%

Therefore it is advisable to buy the new generating set.

9-2. A company that sells has proposed to a small public utility company that it purchase a small electronics computer for 1, 000,000 to replace ten calculating machines and their operators. An annual service maintenance contract for the computer will be provided at accost of 100, 000 per year. One operator will be required at a salary of 96, 000 per year and one programmer at a salary of 144, 000. The estimated economical life of the computer is 10 years.

The calculating machines costs 7, 000 each when new, 5 years ago, and presently can be sold for 2, 000 each. They have an estimated life of 8 years and an expected ultimate trade in value of 1, 000 each. Each calculating machine operator receives 84, 000 per year. Fringe Benefits for all labour cost 8% of annual salary. Annual maintenance cost on the calculating machine has been 500 each. Taxes and insurance on all equipment is 2% of the first cost per year.

If capital costs the company about 25%, would you recommend the computer installation?

Solution:

For the electronic computer:

An investment of P1,000,000 to purchase a small electronic computer to replace 10 calculating machines and their operators.

Other expenses for the computer are:

Service Maintenance = P100,000

Salary of the Operator = P96,000

Salary of the Programmer = P144, 000

Estimated economical Life of the computer = 10 years

Annual cost = $\frac{P1{,}000{,}000}{\frac{(1+0.25)^{10}-1}{0.25}}$ = P30,072.56

Total Annual Cost = P100,000 +P96,000+P144,000+ P30,072.56= P370,072.56

For the 10 calculating machine:

Cost of each calculating machine = P7,000

Annual maintenance of each calculating machine = P500

Annual taxes and insurance = 2%

Salary of each operator = P84, 000

Fringe benefit = 8%

Salvage value = P1,000

After 5 years, the cost of the calculating machines are P2,000 each so the total annual depreciation would be

Total Annual Depreciation = (P7,000 – P2,000) (10) = (P50,000)

Total Annual Cost = $\frac{(P7{,}000-P1{,}000)(10)}{\frac{(1+0.25)^{8}-1}{0.25}}$ + P50,000+ P70,000(1 – 0.02) + P84,000(1 – 0.08)(10)

Total Annual Cost = P894,423.91

Since the total annual cost of the calculating machine is greater than the annual cost of the computer, therefore, it is advisable to replace the calculating machines.

9-3. It is desired to determine the resent economic Value of an old machine by considering of how it compares with the best modern machine that could replace it. The old machine is expected to require out of pocket cost of 85, 000 each year for 4 years and then be scared for 5, 000 residual value. The new machine requires an investment of 40, 000 and would have out of the pocket costs of 79, 000 a year for 8 years and the zero salvage value. Invested capital should earn a minimum return of 15% before taxes. Determine the resent value of an old machine

Solution:

For the old machine with original cost of P85,000 for 4 years at 15% and scraped value of P5,000 has a depreciation value of

D = $\frac{P85{,}000-P5{,}000}{\frac{(1+0.15)^{4}-1}{0.15}}$ = P16,021.22813

For the new machine with original cost of P40,000 for 4 years and investment of P79,000 would have cost of

$$P = P79{,}000(1+0.15)^{-4} = P45{,}168.5$$

Therefore the total cost of the new machine would be

Total Cost = P45,168.9+P40,000+16,021.22813 = P101,190.1281

Therefore, the resent value of the of an old machine is P16,021.22813

CHATER 10
Break Even Analysis
Solved Supplementary problems

10-1. A company is considering two alternatives with regards to equipment which it needs. The alternatives are as follows:

Alternative A:

Purchase	
Cost of Equipment	700,000
Salvage Value	100,000
Daily operating cost	500
Economic life, years	10

Alternative B: Rental at 1,500 per day.

At 18% interest, how many days per year must the equipment be in use if Alternative A is to be chosen.

Solution:

Let x = number of days per year the equipment must be in use

Annual cost of Alternative A

$$Depreciation = \frac{P700{,}000 - P100{,}000}{\frac{(1+0.18)^{10}-1}{0.18}}$$

$$= P25{,}508.95$$

$$Interest\ on\ Capital = 0.18(P700{,}000)$$

$$= P126{,}000$$

$$Daily\ Operation\ Cost = \frac{P500X}{P151{,}508.785 + P500X}$$

Annual Cost of Alternative B

$$B = 1500X$$

Break-even point

Annual cost of Alternative A = Alternative cost of B

$$P151{,}508.785+500X=1500X$$

$$P1{,}000X=P151500.785$$

Find X;

Answer: X = 152 days

10-2. Data for two 50-h motors are follows:

	Alpha Motor	Beta Motor
Original Cost	37,500	48,000
Annual Maintenance	1,500	750
Life, years	10	10
Efficiency	87%	87%
Taxes and Insurance	3%	3%

Power cost is 2.00 per kWh. If money is worth 20%, how many hours per year would the motors have to be operated at full load for them to be equally economical? If the expected number of hours of operation per year exceeds the break-even point, which motor is more economical?

Solution:

Let N = number of hours per year the motors have to be operated

Annual Cost of Alpha Motor

$$Depreciation=\frac{P37{,}500}{\frac{(1+0.2)^{10}-1}{0.2}}$$

$$=P1444.6034$$

Annual Maintenance = 1,500

$$Power\ Consumption=\frac{\frac{P2.00}{kWh}x\ 50hp\ x\frac{0.746kWh}{1hp}}{0.87}\ x\ N$$

$$=85.7471N$$

$$Taxes\ and\ Insurance = P37{,}500\ x\ 0.03$$

$$=P1{,}125$$

$$Intereston\ Capital = P37{,}500\ x\ 0.20$$

$$=P7{,}500$$

Annual Cost Alpha: 11569.6034 + 85.7471N

Annual Cost of Beta Motor

$$Depreciation=\frac{P48{,}000}{\frac{(1+0.20)^{10}-1}{0.20}}$$

$$= P1849.0923$$

Annual Maintenance = 750

$$Power\ Consumption = \frac{\frac{P2.00}{kWh} x\ 50hp\ x \frac{0.746kWh}{1hp}}{0.92} x\ N$$

$$= P81.087N$$

$$Taxes\ and\ Insurance = P48{,}000\ x\ 0.03$$

$$= P1440$$

$$Interest\ on\ Capital = P48{,}000\ x\ 0.20$$

$$= P9{,}600$$

Annual Cost Beta: 13,639.092 + 81.087N

Break-even point

Annual Cost of Alpha Motor = Annual Cost of Beta Motor

11569.6034 + 85.7471N = 13,639.092 + 81.087N

4.6601N = 2,069.489

N = 444 hours

Answer: 444 hours

If the expected number of hours of operation per year exceeds the break-even point, Beta Motor is more economical since it has a lower fix cost.

10-3. A small shop in bulacan fabricates portable threshers for palay producers in the locality. The shop can produce each thresher at labor cost of P1800. The cost of materials for each unit is P2, 500. The variable costs amount to P650 per unit, while fixed charges incurred per annum totals P69, 000. If the portable threshers are sold at P7, 800 per unit, how many units must be produced and sold per annum to break-even?

Solution:

Let N= number of units must be produced and sold per annum to break-even.

Total Income = Total Cost

P 7,800N = P 69,000 + (P 650 + P 2,500 + P 1,800) N

Solving for N;

N = 25 units

Answer: 25 units

10-4. Compute for the number of blocks that an ice plant must be able to sell per month to break-even based on the following data:

Cost of electricity per block		P20
Tax to be aid per block	P2	
Real estate tax		P3, 500/month
Salaries and wages		P25, 000/month
Others		P12, 000/month
Selling rice of ice		P55/block

Solution:

Let N = number of blocks that an ice plant must be able to sell per month to break-even

Total Income = Total Cost

P 55N = (P 3,500 + P 25,000 + P 12,000) + (P 20 + P 2) N

Solving for N;

N = 1,228 blocks

Answer: 1,228 blocks

10-5. A local company assembling stereo radio cassette produces 300 units per month at a cost of 800 per unit. Each stereo radio cassette sells for 1,200. If the firm makes a profit of 10% on its 10,000 shares with a par value of 200 per share, and the fixed costs are 20,000 per month.

(a) What is the break-even point?

(b) How much is the loss or profit if only 100 units are produced in a given month?

Solution:

Income = 1,200 per unit

Fixed Costs = 20,000 per month

Variable Costs = 800 per unit

Dividend = 10% per year

(a) Let N = no. of radio cassette to produce for break-even

Income = 1,200(N)

Total Cost = Fixed Cost + Variable Cost

= 20,000 + 800(N)

Income = Total Cost

$$\frac{P1{,}200(N)}{unit} = \frac{P20{,}000}{month} + \frac{P800(N)}{unit}$$

$$P400(N) = P20{,}000$$

$$N = 50\ units\ per\ month$$

(b) Dividend = $\frac{(0.1)(P10{,}000)(P200)}{12}$

Dividend = 16,666.67 per month

Income = Total Cost + Dividend + profit/Loss

(1,200)(100) = 20,000 + (800) (100) + profit/Loss

Profit = 3,333.33 per month

Answer: (a)50 units per month; (b) 3,333.33 er month

10-6. A plant produces 300 units of equipment a month of 3,600 each. A unit sells for 4.00. The company has 10,000 shares of stock at 200 par values whose annual dividend is 20%. The fixed cost of production is 120,000 a month.

(a) What is the break-even point?
(b) What is the "unhealthy point"?
(c) What is the profit or loss if the production is 60% of capacity?

Solution:

Income = 4,000 per unit
Fixed Costs = 120,000 per month
Variable Costs = 3,600 per unit
Dividend = 20% per year

(a) Let N = no. of equipment produced in break-even
Income = 4,000(N)
Total Cost = Fixed Cost + Variable Cost
= 120,000 + 3,600(N)
Income = Total Cost

$$P4{,}000(N) = P120{,}000 + P3{,}600(N)$$

$$N = \frac{P120{,}000}{P400}$$

$$\text{N} = 300\,\text{units er month}$$

(b) Dividend = $\frac{(10{,}000)(P200)(0.2)}{12}$
Dividend = 33,333.33 per month
Let M = unhealthy point
4,000(M) = 120,000 + 3,600(M) + 33,333.33

$$\text{M} = 383.33 \approx 384\ \text{units er month}$$

(c) Units produced = (0.6) (300) = 180 units
Income = Total Cost + Dividend + profit/Loss
Loss/ profit = 4,000(180) – 120,000 – 3,600(180) – 33,333.33
Loss = 81,333.33

Answer: (a)300 units per month; (b) 384 units er month; (c) 81,333.33

CHATER 11
Benefit Cost Ratio
Solved Supplementary Problems

11-1. The Department of public Works and Highways (DWH) is considering the construction of a new highway through a scenic rural area. The road is expected to cost P50 million with annual use estimated at P400, 000. The improved accessibility is expected to result in additional income from tourists of P7 million per year. The road is expected to have a useful life of 25 years. If the rate of interest is 15%, should the road be constructed?

Solution:

Annual Benefit	=	P7,000,000
Annual Disbenefit	=	P400,000
Annual Cost	=	$\frac{\text{P50,000,000}}{\frac{[1-(1+0.15)^{-25}}{0.15}} = \text{P } 7{,}734{,}970.12$
Benefit-Cost Ratio	=	$\frac{\text{P7,000,000} - \text{P400,000}}{\text{P } 7{,}734{,}970.12} = 0.8533$

Answer: Since $^{B}/_{C} < 1$, the roject should not be constructed.

11-2. Determine the B/C ratio for the following project.

First Cost	P100, 000
Project life, years	5
Salvage value	P10, 000
Annual benefits	P60, 000
Annual O and M	P22, 000
Interest rate, %	15

Solution:

Annual Benefit	=	P60,000
Annual Disbenefit	=	P22,000

Annual Cost = $\frac{P100,000}{\frac{1-(1.15)^{-5}}{0.15}}$ = P 29,831.56

Benefit-Cost Ratio = $\frac{P60,000}{P29,831.56+P22,000}$ = 1.1576

Answer: $^{B}/_{C} \approx 1.16$

11-3. Data for two alternatives are as follows:

	Alternatives	
	A	B
Investment	P35, 000	P50, 000
Annual benefits	P20, 000	P25, 000
Annual O and M	P6, 450	P13, 830
Estimated life, years	4	8
Net salvage value	P3, 500	0

Using an interest rate of 20%, which alternative should be chosen?

Solution:

Alternative A

Annual Benefit = P20, 000

Annual Disbenefit = P6, 450

Annual Cost = P35,000 $\left(\frac{0.2}{1-(1+.02)^{-4}}\right)$ − P3,500 $\left(\frac{0.2}{(1+0.2)^{4}-1}\right)$

= P14, 172.13115

Benefit-Cost Ratio = $\frac{P20,000-P6,450}{P14,172.13115}$ = 0.9561

Alternative B

Annual Benefit = P25, 000

Annual Disbenefit = P13, 830

Annual Cost = P50,000 $\left(\frac{0.2}{1-(1+.02)^{-8}}\right)$ − 0 = P13, 030.47112

Benefit-Cost Ratio = $\frac{P25,000-P13,830}{P13,030.47112}$ = 0.8572

Answer: Alternative A is referred over Alternative B since it has B/C ratio nearest to 1.0.

11-4. there is five alternatives for improvement of a road. Determine which alternative should be chosen if the highway department is willing to invest money as long as there is a B/C ratio of at least 1.00.

Alternatives	Annual Benefits	Annual Cost
A	P900, 000	P1, 000,000
B	P1, 300,000	P1, 400,000
C	P2, 800,000	P2, 100,000
D	P3, 300,000	P2, 700,000
E	P4, 200,000	P3, 400,000

Solution:

By incremental analysis:

Rearranging the values:

Alternatives	Annual Benefits	Annual Costs
E	P4, 200,000	P3, 400,000
D	P3, 300,000	P2, 700,000
C	P2, 800,000	P2, 100,000
B	P1, 300,000	P1, 400,000
A	P900, 000	P1, 000,000

1. Compare E and D

$$\frac{\Delta B}{\Delta C} = \frac{\text{P4,200,000} - \text{P3,300,000}}{\text{P3,400,000} - \text{P2,700,000}} = 1.2857$$

Since B/C > 1.0, select alternative E

2. Compare E and C

$$\frac{\Delta B}{\Delta C} = \frac{\text{P4,200,000} - \text{P2,800,000}}{\text{P3,400,000} - \text{P2,100,000}} = 1.0769$$

Since B/C > 1.0, select alternative E

3. Compare E and B

$$\frac{\Delta B}{\Delta C} = \frac{\text{P4,200,000} - \text{P1,300,000}}{\text{P3,400,000} - \text{P1,400,000}} = 1.45$$

Since B/C > 1.0, select alternative E

4. Compare E and A

$$\frac{\Delta B}{\Delta C} = \frac{\text{P4,200,000} - \text{P900,000}}{\text{P3,400,000} - \text{P1,000,000}} = 1.375$$

Since B/C > 1.0, select alternative E

Answer: Since $^{B}/_{C} > 1$, Alternative E is referred.