Neal A. Lewis / Barbara J. Miller / Ted G. Eschenbach

Third Edition

The Economic Analysis of Industrial Projects

Instructor's Solutions Manual

Ted G. Eschenbach
University of Alaska Anchorage

Neal A. Lewis
University of Bridgeport

Joseph C. Hartman
University of Massachusetts Lowell

Lynn E. Bussey

CONTENTS

ACKNOWLEDGEMENTS

There are a number of people that I wish to thank for their help in completing this Instructor's Manual. Barbara Miller and Ted Eschenbach's instructor's manual for the 2nd edition was the starting point for this new edition. Joe Hartman provided most of the answers for two chapters, and Heather Nachtmann provided most of the answers for the Estimating Costs and Benefits chapter.

A number of students from the University of Bridgeport helped in creating this Instructor's Manual, and deserve recognition. These include Liang Zhang, Chengcheng Ding, Jing Wei, and Peter Ojo. Without their help, this manual would have taken much longer to create.

And of course, I would like to thank my coauthors and friends, Ted Eschenbach and Joe Hartman, for bringing me into the project. It's been a great learning experience.

Neal Lewis

1.1 A firm is any entity, of whatever legal or organizational form, that engages in economic exchanges for consideration or for things of economic value.

1-2 (a) An economic good is a physical object desired and chosen by consumer or firm. Manufactured merchandise and machinery are respective examples.
(b) An economic service is an activity performed to satisfy the desires of a consumer or firm. Examples are concerts, air flights and insurance.
(c) An input is any economic good or service, including money, that is received by the firm in economic exchange. Inputs are recorded as debits to the firm.
(d) An output is any good or service to be given up by the firm in an economic exchange. Outputs are recorded as credits to the firm.
(e) An exchange is the process of trading considerations or goods of economic value between firms or between a firm and an individual.
(f) Money is cash and promises of future value. Cash is a government guarantee to provide an economic equivalent upon demand. Promises may be bonds, notes, stocks, and other securities which represent the firm's promise to pay certain economic equivalents at a future date.
(g) Cash is defined by law as legal tender in exchange for all public and private debts, guaranteed and issued by th government.
(h) Credit is the value of a good or service received by a debtor originates a promise to "pay in future" from the firm. It is actually a value of the promise, since it is not necessarily guaranteed by a government.

1-3 An economic exchange is the process in which a firm's or an individual's economic goods or services.

1-4 The three fundamental exchanges of a business firm are:
(a) Financial exchanges to secure funding for present and future activities
(b) Investment exchanges to employ available capital,
(c) Operating or productive exchanges to produce goods or services for sale
A fourth exchange is paying dividends or distributing capital, which repays lenders and owners for their funds used. can be regarded as a subset of financial exchanges.

1-5 Investing means to use a part of the firm's available capital to start a new activity.

1-6 An investment is any planned future activity that used part of the firm's capital, and which may generate a return or benefit for the firm.

1-7 A firm's financing function is how the firm obtains funds for investments from owners and lenders. These may be loans, bonds or other funds borrowed from lenders, or equity funds obtained from owners by sale of stock and the retention of earnings.

1-8 The financing and investing functions are related by the firm's implicit promise to pay future returns on capital to the owners and lenders for the use of their cpaital to finance the firm's ongoing operations and new projects. This payment may take the form of dividends and/or interest.

1-9 An owner supplies capital to a firm in exchange for a share of the invetment, that is, the right of ownership. These are equity funds with no quarantee of repayment or profit. A lender provides capital with no onership exchanged. These are borrowed funds with the firm's promise to repay them in a stated time frame, with interest.

1-10 A project is the smallest portion of an investment that can be separately identified from an economic and functional standpoint. An investment project is an identifieable discrete future activity which uses part of the firm's funds in exchange for future benefits to the firm.

1-11 A firm's management uses the funds and resources of others (lenders and owners). A large firm almost never uses only the manager's funds. Because managers are "agents" of others in the employment of other's wealth, managers are held accountable (to a greater or lesser extent) for their actions. Most states consider this form of agency to be of public importance and define fiduciary responsibilities of managers under the state's corporation laws and "laws of agency".

1-12 Three possible goals of an entrepreneurial firm would be:
(a) maximize the firm's net income over time (profits)
(b) maximize net revenue over time (gross income from sales)
(c) maximize future wealth of shareholders over time.
Goal (c) includes the amount of income and its timing. It focuses on increasing the firm's future value through present and future activities.

1-13 Maximizing net income incorporates all techniques for reducing cash outflow which would cut into profits. These often include minimizing capital expenditures and retaining earnings within the firm, rather than disbursing them as dividends to the owners. Although temporarily appealing, it often does not maintain existing financial sources, nor does it attract new sources. Because owners expect a return on their investment in the long term, this decreases the firm's perceived value over time.

1-14 Net profit after taxes is the calculated profit that remains after deducting all possible expenses, including non-cash items(such as depreciation) from net income. There are also cash flows which are not included in net profit, such as cash income from sales of assets or cash expended for new equipment purchases. Net cash flow utilizes cash flows only, which are completely identifiable for any particular period. Therefore the net cash flow of a project accurately reflects both the project's investment and return aspects.

1-15 Net cash flow utilizes cash flows only, which are completely identifiable for any particlular period. Therefore the net cash flow of a project accurately reflects both the project's investment and return aspects.

1-16 Market share is that part of the consumer base which the firm controls by its product. The larger the market share, the higher the sale of goods or services. This directly affects the cash flow into the firm, providing ongoing operating funds, capital for investment and returns to owners. Having a larger market share often results in larger profit margins.

1-17 The appeal of maximized growth or firm size rests in the "bigger is better" attitude. A larger firm can supply more products and support market expansion. Howevers, maximizing growth may require cutting prices and profits or cutting dividends to owners. In addition, an overly-diversified firm may not have enough knowledgeable managerial staff or capital resources to support its activities.

1-18 Agency theory arises from the concern that a firm's management is not its major owner. There must be guidelines and incentives to follow those guidelines that ensure that management maximizes benefits to the shareholders, while avoiding conflicts between management and shareholders in such areas as risk-taking and dividend distribution.

1-19

LEVEL	GOAL	
	Aligned	Nonaligned
Chief Scientist	hire best team	too much capital equipment
Lab Manager	plan lab expansion	kickbacks from suppliers
Research Teams	bonuses from successful project	interesting challenges
VP of R&D	FDA regs. research	skimp on QA dept. costs
Executive	POI for owners	demand for large bonuses

1-20 Assume that working capital is required from the beginning of operations, and is a one-time infusion of capital which will be returned when the project is completed.

Year					
0	-$125,000(1/2 start-up cost)				
1	$125,000 (1/2 start up cost)	-$45000 = (working $)			−$170,000
2-5	-$50,000 (operating cost)	+125,000 = (revenue)			+$75,000
6	−$50,000	+$125,000	+$30,000	+$45,000 =	+$150,000
	(ops costs)	(revenue)	(salvage)	(working cap)	

EOY	0	1	2	3	4	5	6
Net Cash	−$125k	-$170k	+$75k	+$75k	+$75k	+$75k	+$150k

1-21 Some people view that the role of the corporation is only to make money for the stockholders. Others view that the firm has a responsibility to treat its people and its communities well. There are many examples of firms simply walking away from industrial factories or mines, leaving toxic sites behind rather than spending the money to clean them up at the end of their lives. It is usually cheaper for society when the firm is socially responsible rather than the government having to spend public money to correct the wrong doing of the corporation. correct the wrong doing of the corporation.

1-22 Paying a dividend returns funds to the stockholder, but decreases the retained earnings for the firm. If the company is focused on growth, they will often not pay a dividend, deciding instead to maximize the assets of the firm. Many established companies will pay a dividend, showing that they are able to sustain a cash payment to shareholders. Dividends require positive cash flow, and dividends are an indicator that the firm is able to convert profit into hard cash.

1-23 Net earnings can be used in two ways: they can be kept (as retained earnings) or they can be given to stockholders (as dividends). Retained earnings are used to help grow the firm, while dividends are distributed as cash payments to the owners of the firm. The decision of how to divide net earnings is up to the firm.

2-1

F = P + I = P + PrN = P(1+rN)

r	N	F
0.05	10	$10,000

P= $6,667

2-2

F = P(1+rN)

r	P	F
0.06	$1,000	$1,500

$1500 = $1,000(1+0.06N)

N= ($1,500-$1,000)/[$1,000(0.6)] = 8.3 years

2-3

F = P(1+rN)

N	P	F
4	$1,000	$1,250

$1,250 = $1,000 + 4,000r

r = ($1,250-$1,000)/$4,000 =0.0625 = 6.25%

2-4

Annual interest = rP

Total interest =rPN

r	N	P
0.08	10	$10,000

F = $10,000 + ($10,000)(0.08)(10) = $18,000

2-5

F = P(F/P,8%,10) = $10,000(2.1589) = $21,589

OR

=FV(rate,nper,pmt,-pv,type)=FV(0.08,10,0,-10000,0) = $21,589

2-6

F = P(F/P,r/m%,mN)

r	m	N
8	4	10

F = $1,000(F/P,2%,40) = ($1,000)(2.2080) = $2,208.00

OR

F = FV(rate,nper,pmt,pv,type) = FV(0.02,40,0,-1000,0) = 2,208.04

2-7

(a) i =8%

(b)$i = (1+r/m)^N-1 = (1+0.08/2)^2-1 =$ 8.16%

(c.) $i = (1+r/m)^N-1 = (1+0.08/4)^4-1 =$ 8.24%

(d)$i = (1+0.02)^4-1 =$ 8.24%

OR

i = (F/P,2%,4) -1 = 1.0824-1 = 0.0824 = 8.24%

2-8

(a) P = F(P/F,15%,10) = $5,000(0.2472)= $1,236

OR

=PV(rate, nper, pmt,-fv, type) = PV(0.15,10,0,-5000,0) = $1,236

(b) P = F(P/F,5%,20) = $1,000(0.3769)= $376.9

OR

=PV(rate, nper, pmt, -fv, type) = PV(0.05,20,0,-1000,0) = $376.89

(c) P = F(P/F,2%,20) = $2,000(0.6730)= $1,346

OR

=PV(rate, nper, pmt, fv, type) =PV(0.02,20,0,-2000,0) = $1,346

In (b) each period is 6 months long, to match semiannual compounding.
Ten years become 20 periods and the interest rate for each is 10%/2.
In (c), each period is a quarter.

2-9

A = F(A/F,8%,10) = $10,000(0.0690)= $690

OR

=PMT(rate, nper, pv,- fv, type) =PMT(0.08,10,0,-10000,0) = $690.29

2-10

P = F(P/F,8%,6) = $10,000(0.6302)= $6302

OR

=PV(rate, nper, pmt, fv, type) =PV(0.08,6,0,10000,0) = $6,302

2-11

2,000(P/F,10%,3) = F(P/F,10%,10)

F=2,000(P/F,10%,3) / (P/F,10%,10) = 2000 / (P/F,10%,7)

=2000 / 0.5132 = $3,897

OR

=PV(10%,3,0,-2000) = F * PV(10%,10,0,-1)

=PV(10%,3,0,-2000) = 1502.63

=PV(10%,10,0,-1) = 0.3855

F = 1502.63 / 0.3855 = $3,897.43

2-12

i	N	A	P	F	Solve for
	35	10	-300	0	i

0.88% per week

i =RATE(35,10,-300,0), per week = 0.88%

$i_a = (1+i)^N = (1 + 0.0088)^{52} - 1 =$ 0.577117 =57.7% per year

OR

=EFFECT(0.0088*52,52) = 0.577117

2-13

P = F(P/F, 6%/2, 2(10)) = 5,000(P/F, 3%, 20) = 5,000(0.5537) = $2,768

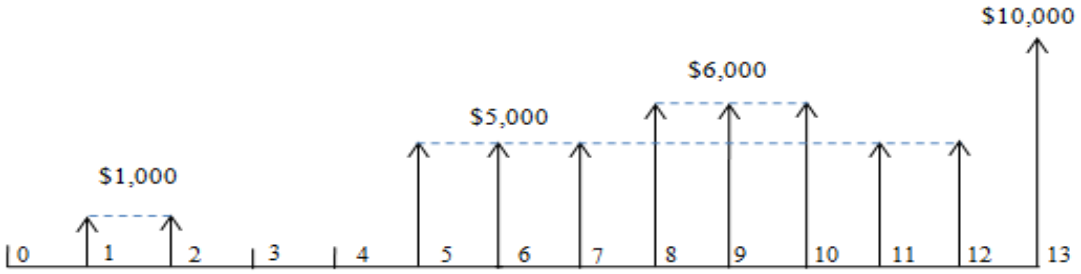
OR

i	N	A	P	F	Solve for
3%	20	0		-5000	PV

$2,768

=PV(rate, nper, pmt, fv, type) =PV(0.03,20,0,5000,0) = $2,768.38

2-14



(a) P = 1,000(P/A,8%,2) + 5,000(P/A,8%,8) (P/F,8%,4)
+ 1,000(P/A,8%,3) (P/F,8%,7) + 10,000(P/F,8%,13)
= 1,000(1.783) + 5,000(5.747)(0.7350) = 1,000(2.577)(0.5835) + 10,000(0.3677)
= 1,783 + 21,120 + 1,504 + 3,677 = $28,084

OR

=PV(8%,2,-1000) + PV(8%,8,-5000)*PV(8%,4,0,-1) + PV(8%,3,-1000)*pv(8%,7,0,-1)
+PV(8%,13,0,-10000) = $28,084

(b) A = P(A/P,8%,13) = 28,084(0.1265) = $3,552.63

OR

= PMT(rate, nper, -pv, fv, type) =PMT(0.08,13, -28084,0,0) = $3,553

(c) F_5 = P(F/P,8%,5) = 28,084(1.469) = $41,255

OR

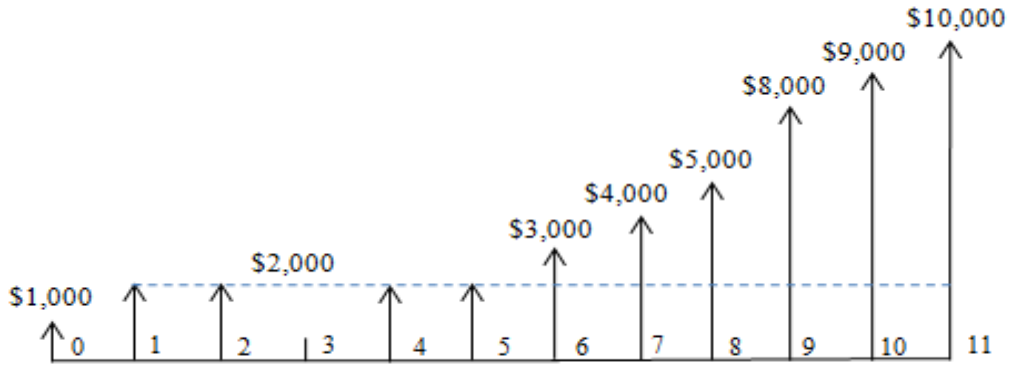
= FV(rate, nper, pmt,-pv, type) = FV(0.08,5,0, -28084,0) = $41,265

(d) F_{13} = P(F/P,8%,13) = 28,084(2.720) = $76,388

OR

= FV(rate, nper, pmt, -pv, type) = FV(0.08,13,0, -28084,0) = $76,378

2-15



(a) P = 1,000 + 2,000(P/A,8%,11) – 2000(P/F,8%,3) + 1000(P/G,8%,4)(P/F,8%,4)

Start Baseline years 1-11 Missing year 3 CF Gradient, years 5-8

+ [1,000(P/G,8%,3) + 6,000(P/A,8%,3)] (P/F,8%,8)

Gradient, years 9-11 Baseline offset

= 1,000 + 2,000(7.1930) – 2,000(0.7938) + 1,000(4.650)(0.7350)

+ [1,000(2.445) + 6000(2.5771)] (0.5403) = $ 26,891.63

(b) A = P(A/P,8%,11) = 26,891.63(0.1401) = $3,768

OR

= PMT(rate, nper, pv, fv, type) = PMT(0.08,11,-26891.63,0) = $3,766.88

(c) *End of year 7 = Beginning of year 8

F = P(F/P,8%,7) = 26,891.63(1.7138) = $46,087

OR

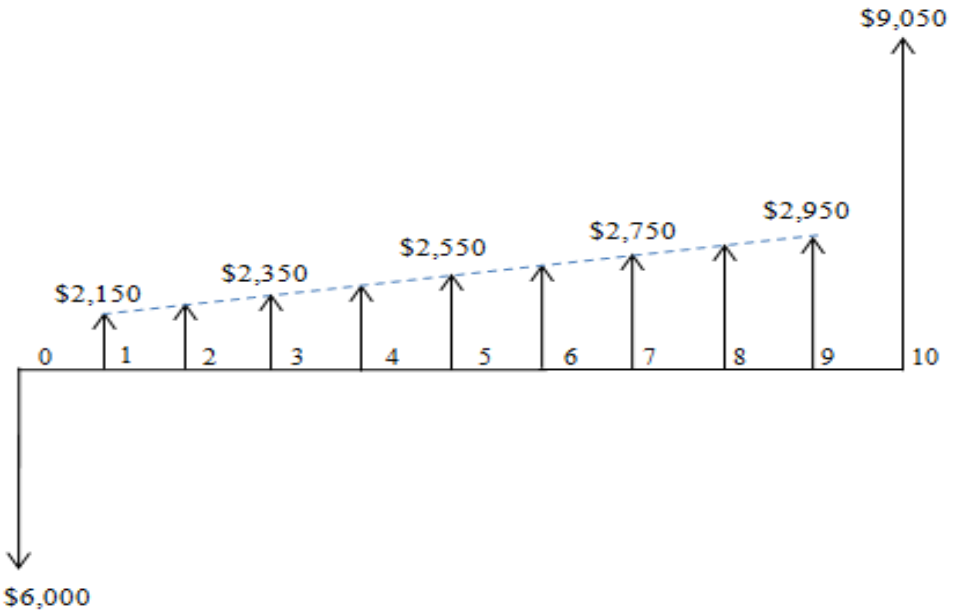
= FV(rate, nper, pmt, pv, type) = FV(0.08,7,0,-26891.63,0) = $46,087.53

(d) F = P(F/P,8%,11) = 26,891.63(2.3316) = $62,701

OR

= FV(rate, nper, pmt, pv, type) = FV(0.08,11,0,-26891.63,0) = $62,701.57

2-16



(a) $P = P_0 + [A_1 + G(A/G,8\%,9)] (P/A,8\%,9) + F(P/F,8\%,10)$

$= -6,000 + [2,150 + 100(3.491)] (6.2469) + 9,050(0.4632)$

$= -6,000 + 15,611.63 + 4,191.96$

$= \$13,804$

(b) $A = P(A/P,8\%,10) = 13,804(0.1490) = \$2,057$

OR

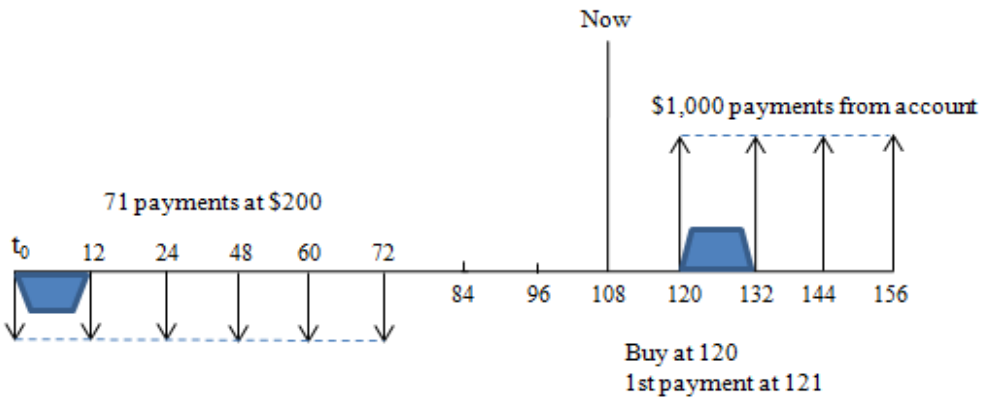
= PMT(rate, nper, -pv, fv, type) = PMT(0.08,10,1-3804,0,0) = $2,057.20

(c) $F = P(F/P,8\%,10) = 13,804(2.1589) = \$29,801$

OR

= FV(rate, nper, pmt, -pv, type) = FV(0.08,10,0,-13804,0) = $29,801.80

2-17



9 years = 108 months 6% / annual cmpd monthly = 0.5% / mo

Present amount: P_{108} = [200 + 200(P/A,0.5%,70)] (F/P,0.5%,108)

= 11,987.88(1.7137) = $20,543.63

Starting output balance: F_{120} = 20,543.63(F/P,0.5%,12) = $21,810.72

0 = $-F_{120}$ +1,000(P/A,0.5%,N)

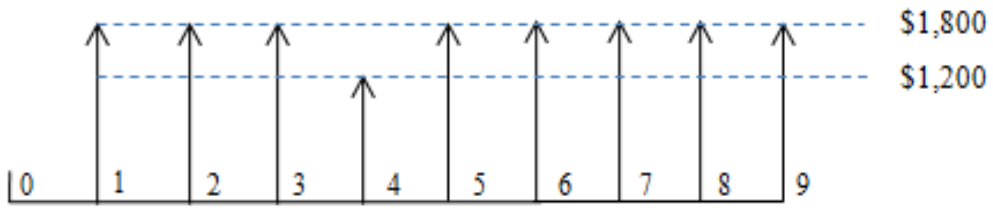
(P/A,0.5%,N) = 21,810.72 / 1000 = 21.81

Using the tables : (P/A,0.5%,N) = 21.81 N = 23.15 months

OR

= NPER(rate, pmt, pv, fv, type) (0.005,-1000, 21810.72,0,0) = 23.15 months

2-18



(a) P = A(P/A,8%,3) + F(P/F,8%,4) + A(P/A,8%,5) (P/F,8%,4)

= 1,800(2.5771) + 1,200(0.7350) + 1,800(3.9927)(0.7350)

= 4638.78 + 882.00 + 5282.34 = $10,803

OR

'P = A(P/A,8%,9) − F(P/F,8%,4) = 1,800(6.2469) – 600(0.7350) = $10,803.42

(b) A = P(A/P,8%,9) = 10,803 (0.1601) = $1,730

OR

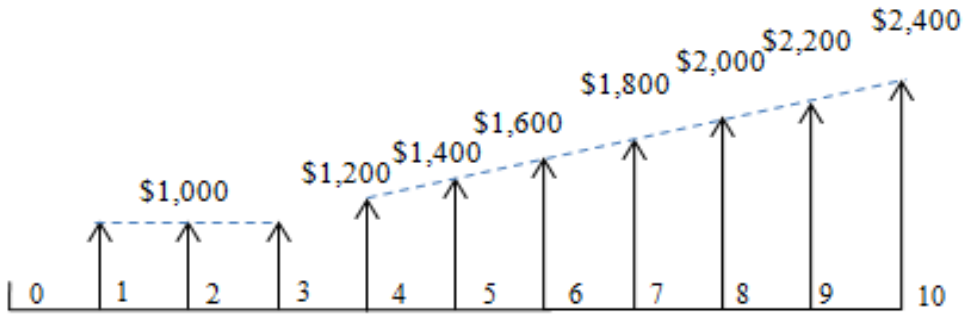
= PMT(rate, nper, -pv, fv, type)= PMT(0.08,9, -10803,0,0) = $1,729.34

(c) F = P(F/P,8%,9) = 10,803(1.9990) = $21,595

OR

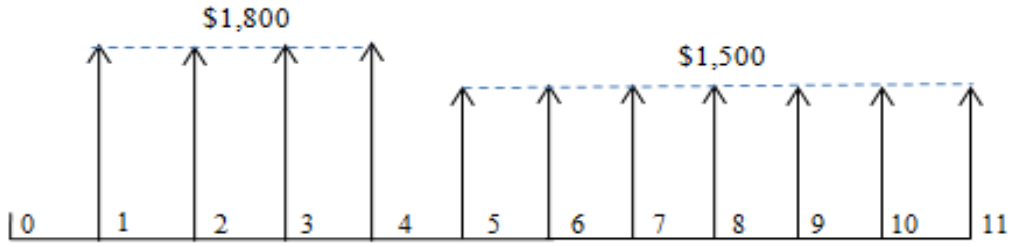
= FV(rate, nper, pmt, -pv, type) = FV(0.08,9,0, -10803,0) = $21,595.25

2-19



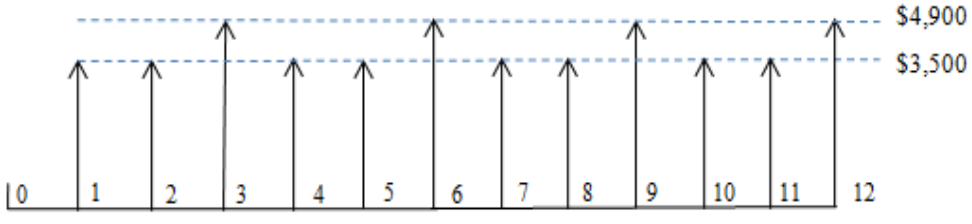
(a) P = A(P/A,8%,3) + [A_1 + G(A/G,8%,7)] (P/A,8%,7) (P/F,8%,3)
= 1,000(2.5771) + [1,200 + 200(2.693)](5.2064)(0.7938)
= 2577.1 + 7185 = $ 9,762
(b) A = P(A/P,8%,10) = 9,762(0.1490) = $1,456
OR
= PMT(rate, nper, -pv, fv, type) = PMT(0.08,10, -9762,0,0) = $1,454.83
(c) F = P(F/P,8%,10) = 9,762(2.1589) = $21,078
OR
= FV(rate, nper, pmt,- pv, type) = FV(0.08,10,0, -9762,0) = $21,075.43

2-20



(a) P = A(P/A,8%,4) + A(P/A,8%,7) (P/F,8%,4)
= 1,800(3.3121) + 1,500(5.2064)(0.7350)
= 5,961.78 + 5740.06 = $11,702
OR
P = 1,500(P/A,8%,11) + 300(P/A,8%,4) =$11,702
(b) A = P(A/P,8%,11) = 11,702 (0.1401) = $1,639
OR
= PMT(rate, nper, -pv, fv, type) = −PMT(0.08,11, -11702,0,0) = $1639.17
(c) F = P(F/P,8%,11) = 11,702 (2.3316) = $27,284
OR
= FV(rate, nper, pmt, -pv, type) = FV(0.08,11,0, -11702,0) = $27,284.84

2-21



(a) P = 3,500(P/A,8%,12) + 1,400[(P/F,8%,3) + (P/F,8%,6)+ (P/F,8%,9) + (P/F,8%,12)]
= 3,500(7.5361) + 1,400(2.3213)
= 26,376 + 3,250 = $29,626

(b) EAC = A + F(A/F,8%,3) = 3,500 + 1400(0.3080) = $3,931

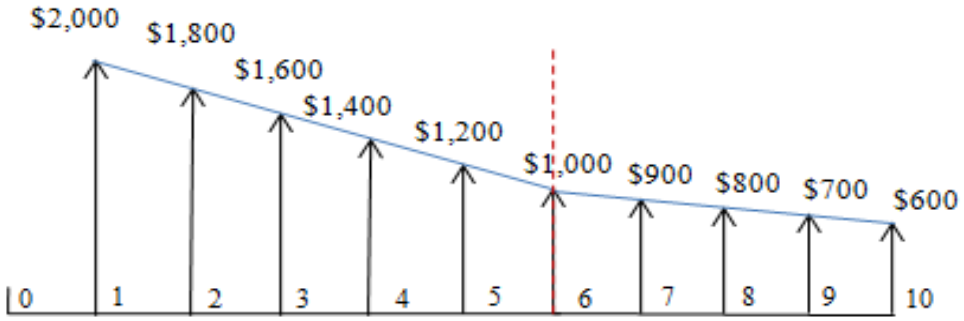
Notice the same cycle repeats every 3 years.

(c) F = P(F/P,8%,12) = 29,626 (2.5182) = $74,604

OR

= FV(rate, nper, pmt, -pv, type) = FV(0.08,12,0, -29626,0) = $74,603.31

2-22



(a) This is broken into a year 1-6 series and a year 7-10 series since the gradient changes.

$P = [A_1 – G_1(A/G,8\%,6)] (P/A,8\%,6) + [A_2 – G_2(A/G,8\%,4)] (P/A,8\%,4)(P/F,8\%,6)$

= [2,000-200(2.276)](4.6229) + [900-100(1.404)](3.3121)(0.6302)

= 7141 + 1586 = $8,727

(b) A = P(A/P,8%,10) = 8,727 (0.1490) = $1,300

OR

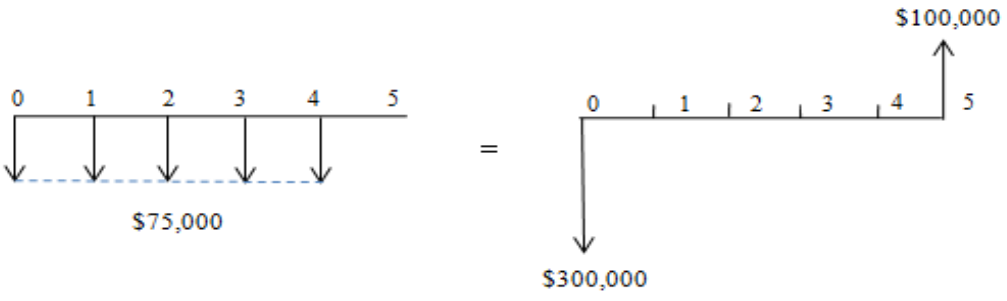
=−PMT(rate, nper, -pv, fv, type) = PMT(0.08,10, -8727,0,0) = $1,300.58

(c) F = P(F/P,8%,10) = 8,727 (2.1589) = $18,841

OR

= FV(rate, nper, pmt,- pv, type) =−FV(0.08,10,0, -8727,0) = $18,840.94

2-23



P + A(P/A,i,4) = P + F(P/F,i,5)

-75,000-75,000(P/A,i,4) = -300,000+100,000(P/F,i,5)

225,000 = 100,000(P/F,i,5) + 75,000(P/A,i,4)

Using values from the table:

For $i_{20\%}$: 100,000(0.4019) + 75,000(2.5887) = 234,343

For $i_{25\%}$: 100,000(0.3277) + 75,000(2.3616) = 209,890

i = 20%+5%(234,343-225,000) / (234,343-209,890) = 21.9%

OR

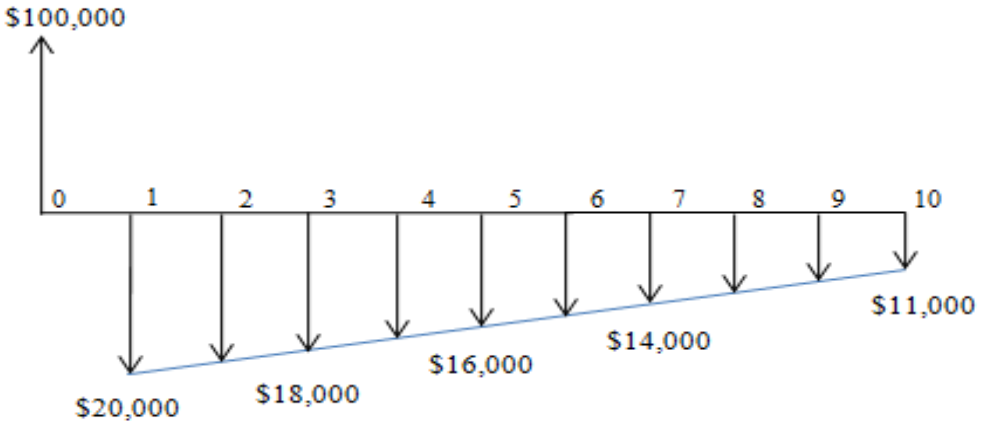
Using Goal Seek,

225,000 = PV(i,5,0,-100000)+PV(i,4,-75000)

i = 21.80%

i	21.80%
225000	225000

2-24



$0 = P_0 + [A_1 + G(A/G,i,N)] (P/A,i,N)$

= 100,000 + [-20,000 + 1,000(A/G,i,10)] (P/A,i,10)

For $i_{10\%}$: (P/A,10%,10) = 6.1446 (A/G,10%,10) = 3.725

100,000 – 100,003 = 0 i =10%

OR

-100000
20000 =IRR = 10.00%
19000
18000
17000
16000
15000
14000
13000
12000
11000

2-25

P = [c/(1+g)] (P/A,x,N) c = $15,000 x = [(1+i)/(1+g)]-1

x = [1.11/1.08] − 1 = 0.0278

(P/A,x,N) = PV(0.0278,10,-1,0) = 8.6268

P = (15,000/1.08)(8.6268) = $119,817

2-26

P = [c/(1+i)] (F/A,x,N) c = $15,000 x = [(1+g)/(1+i)]-1

x = [1.08/1.06] − 1 = 0.0189

(F/A,x,N) = FV(0.0189,10,-1,0) = 10.895

P = (15,000/1.06)(10.895) = $154,175

2-27

Prove: $c(P/A,g,i,N) = [c/(1+g)](P/A,x,N)$

$c[1-(1+g)^N(1+i)^{-N}]/(i-g) = [c/(1+g)][(1+x)^N-1]/[x(1+x)^N]$

Where $x = [(1+i)/(1+g)]-1$ and $(1+x) = (1+i)/(1+g)$

Substituting for x and simplifying:

$$= \frac{c}{(1+g)} \quad \frac{\frac{(1+i)^N}{(1+g)^N}-1}{\left[\frac{1+i}{1+g}-1\right]\left[\frac{(1+i)^N}{(1+g)^N}\right]}$$

Multiply both the numerator and denominator of the right hand side by $(1+g)^N/(1+i)^N$

$$= \frac{c}{(1+g)} \quad \frac{1-\frac{(1+g)^N}{(1+i)^N}}{\frac{i-g}{1+g}}$$

Cancelling (1+g) gives:

$c[1-(1+g)^N/(1+i)^N]/(i-g)$

2/28

Stream A: P = [20,000 + 1,000(A/G,6%,20)] (P/A,6%,20)

= [20,000 + 1,000(7.605)] (11.4699)

= 27,605(11.4699) = $316,627

Stream B

N = 20 g = 0.05

c = 17,500 i = 0.06

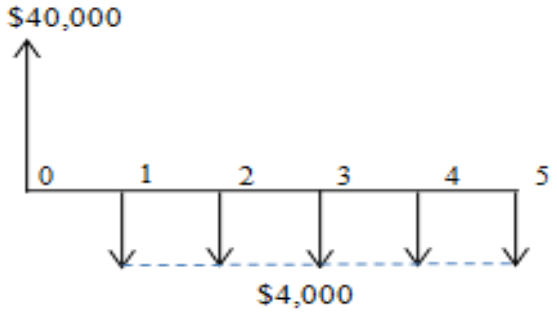
x = [(1+i)/(1+g)]-1 x = [1.06/1.05] − 1 = 0.0.00952

(P/A,x,N) = PV(0.952%,20,-1,0) = 18.133

'P = [c/(1+g)](P/A,x,N) = (17,500/1.05)(18.133) = $302,217

Stream A has a larger present worth by: $316,627 - $302,217 = $14,410

2-29



0 = 40,000 – 4,000(P/A,i,5)

(P/A,i,5) = 10

Since the entire amount is not repaid, it will be negative interest rate, and the original formula must be used.

$(P/A,i,5) = [(1+i)^N-1]/[i(1+i)^N]$

For i-19%: -0.6513/-0.0662 = 9.8384

For i-20%: -0.6723/-0.0655 = 10.2641

Interpolating: -0.19 -0.01(10-9.8384)/(10.2641-9.8384) i = -19.4%

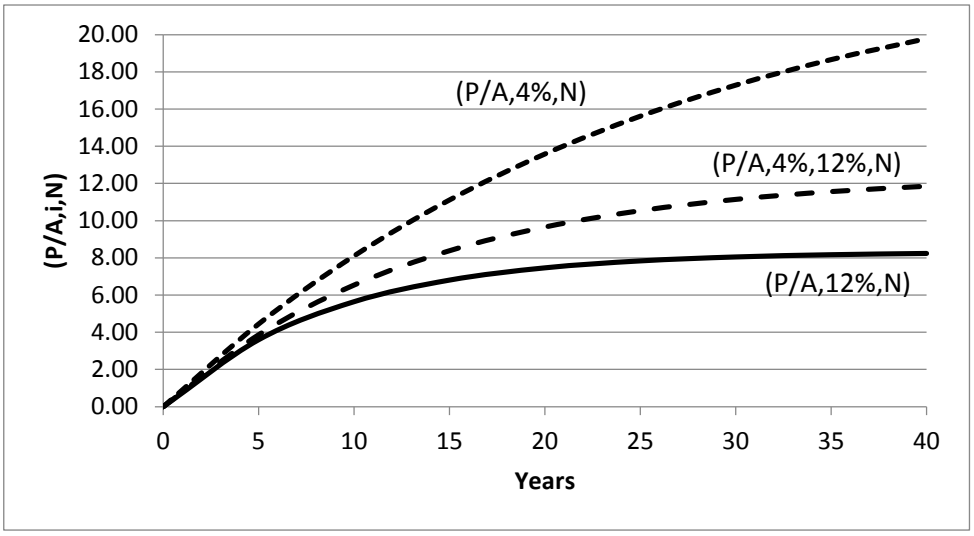
OR

= RATE(nper, pmt, pv, fv, type, guess)

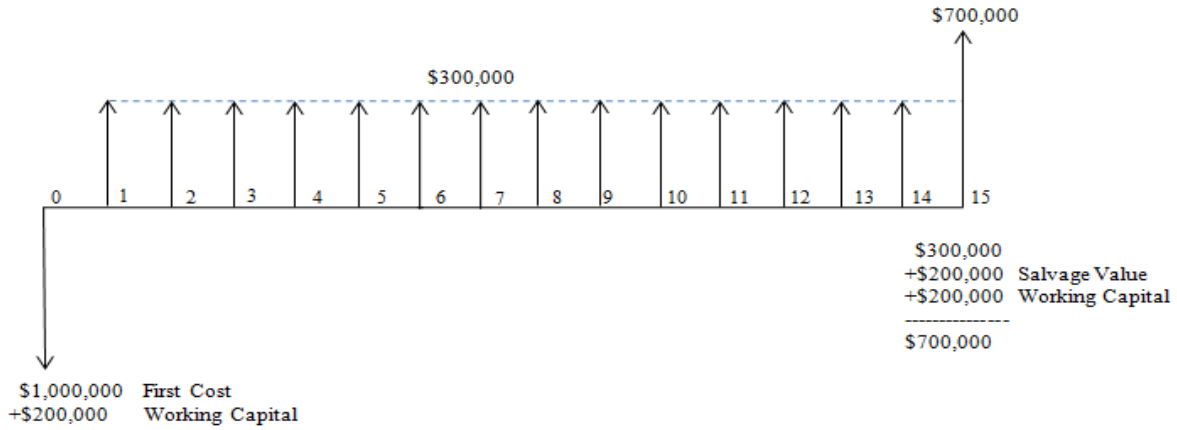
=RATE(5,-4000,40000,0,0,0) = -19.4%

2-30

	(P/A,12%,N)	(P/A,4%,N)	(P/A,4%,12%,N)
0	0.00	0.00	0
5	3.60	4.45	3.870481
10	5.65	8.11	6.542512
15	6.81	11.12	8.387179
20	7.47	13.59	9.660667
25	7.84	15.62	10.53983
30	8.06	17.29	11.14678
35	8.18	18.66	11.56579
40	8.24	19.79	11.85506



2-31



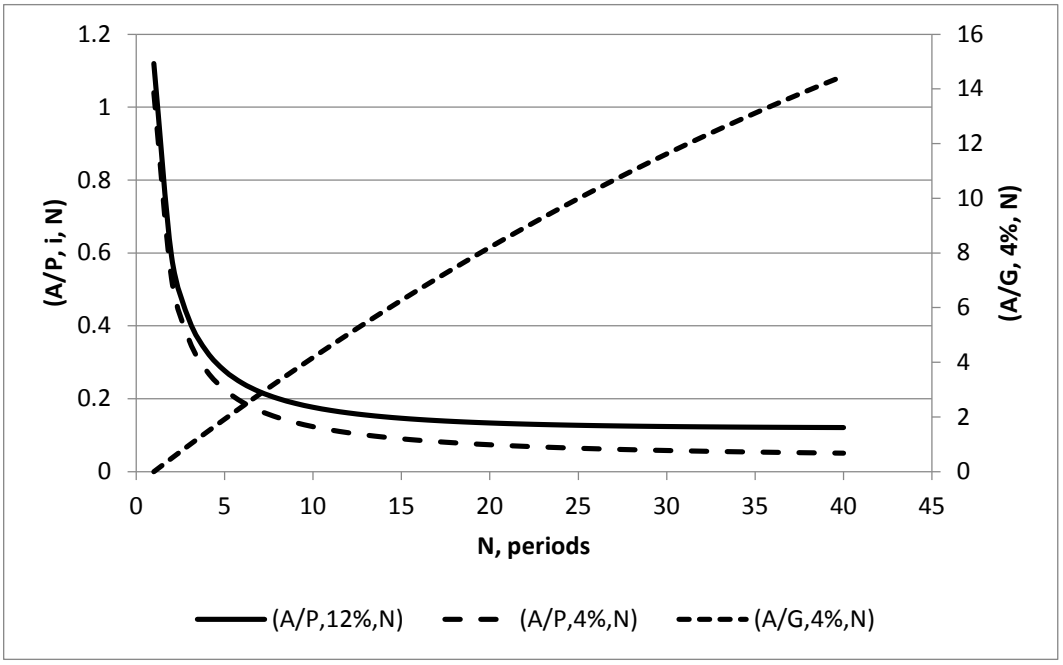
$P = P_0 + A(P/A,8\%,15) + F(P/F,8\%,15)$

$= -1,200,000 + 300,000(8.5595) + 400,000(0.3152)$

$= -1,200,000 + 2,567,850 + 126,080$

$= \$1,493,930$

2-32



2-33

Nominal = 1.5% * 12 = 18%

Effective - $(1+r/m)^N - 1 = (1.015)^{12} - 1 = 19.56\%$

OR

Effective: =EFFECT(0.18,12) = 0.195618

2-34

Effective - $(1+r/m)^N - 1 = (1 + 0.069/12)^{12} - 1 = 7.122\%$

OR

Effective: =EFFECT(0.069,12) = 0.071224

2-35

(a) F = P(F/P,i,N) = 1,000(F/P, 3.9%, 5) = $1210.81

OR

= FV(rate, nper, pmt,−pv, type) = FV(0.039,5,0, -1000,0) = $1210.81

(b) F = P(F/P,i,N) = 1,000(F/P, 1.95%, 10) = $1213.03

OR

= FV(rate, nper, −pmt, pv, type) = FV(0.0195,10,0, -1000,0) = $1213.03

(c) F = P(F/P,i,N) = 1,000(F/P, 0.975%, 20) = $1214.16

OR

= FV(rate, nper, −pmt, pv, type) = FV(0.00975,20,0, -1000,0) = $1214.16

(d) F = P(F/P,i,N) = 1,000(F/P, 0.325%, 60) = $1214.93

OR

= FV(rate, nper, pmt, −pv, type) = FV(0.00325,60,0, -1000,0) = $1214.93

(e) $F = Pe^{rN} = 1{,}000*e^{3.9\%*5} = \$1215.31$

2-36

NPV = 500 - 25 - 525(*P/F* , *i* , 14) = 0

(*P/F* , *i* , 14) = 0.9048

Interpolating from tables:

(P/F, 0.75%, 14) = 0.9007

(P/F, 1%, 14) = 0.87 i = 0.72% per day

OR

= RATE(nper, pmt, pv, fv, type, guess) = RATE(14,0,-475,525,0,0) = 0.72% per day

Effective: =EFFECT(0.0072*360,360) = 12.233

or 1223.30% per year

2-37

$F = Pe^{rN} = 1{,}000*e^{4.5\%*1} = \$1046.03$

2-38

Financed = 24,000 + 2,000 - 12,000 = $14,000

'Monthly payment =14,000(A/P, 0.575%, 48) = $334.6

OR

= PMT(rate, nper, −pv, fv, type) = PMT(0.00575,48, -14000,0,0) = $334.60

2-39

(a) 1000 − 28.77(P/A, 2%, N) = 0

(P/A, 2%, N) = 34.758

Interpolating from tables: (P/A, 2%, 60) = 34.761 N = 60 months

OR

= NPER(rate, pmt, pv, fv, type) = (0.02,-28.77,1000,0,0) = 59.99 = 60 months

(b) 28.77 * 60 = $1726.20

2-40

(a) i =3.5%

(b) $i = (1 + r/m)^n - 1 = (1+0.035/2)^2 - 1 = 3.53\%$

(c) $i = (1 + r/m)^n - 1 = (1+0.035/4)^4 - 1 = 3.55\%$

(d) $i = (1 + r/m)^n - 1 = (1+0.035/12)^{12} - 1 = 3.56\%$

(e) $i = (1 + r/m)^n - 1 = (1+0.035/52)^{52} - 1 = 3.56\%$

(f) $i = e^r - 1 = e^{0.035} - 1 = 3.56\%$

3-1 A good cost estimate is independent (not affected by other estimates), unbiased (unaffected by preconceived preference), and realistic (considered judgment of what can happen). Real world cost and benefit estimation is challenging due to uncertainty related to the dynamic nature of industrial projects, potential lack of representative data, and level of complexity required to estimate a large-scale industrial project.

3-2 The pressure to reduce project resources and task completion times is inherent in the management of industrial projects. However, the need for accurate cost estimates is also understand. Project managers are faced with the tradeoffs between achieving desired cost estimate accuracy and conservation of resources and time.

3-3 A good cost estimate is pertinent to achieving profitable pricing policies. Estimators cannot allow prior knowledge of the achievable price point to influence their cost estimates. Otherwise, under- or over- estimates may lead to a loss of profit due to decreased market share or production of unprofitable good and services.

3-4 The four project life cycle phases are: 1) Concept: the project concept is identified and defined, 2) Definition: the project concept is verified and a plan for implementation is developed, 3) Execution: an implementation plan is carried out, and 4) Closeout: the project is completed and finished product is transferred to the owner. Knowledge of what phase of the life cycle the project is in guides the estimator towards the appropriate estimation methodology based on the level of available information and desired estimate accuracy.

3-5 The Cost Estimation Classification System is a recommended set of guidelines for applying estimate classification principles to project cost estimates as shown in TABLE 3.2. The system guides estimators to appropriate estimation methodologies, projected level of preparation effort, and expected estimate accuracy range based on expected estimate usage and current level of project definition.

3-6 Cost estimates follow the “Garbage In, Garbage Out” principle. An estimate will never be more accurate than the data it is based on. Access to accurate, timely, and representative data is essential to developing accurate cost estimates.

3-7 Answer may vary. Indexes are used to develop current and future cash flows estimates from historical data by accounting for variation in aspects such as technological advancement, geographical location, and inflation over time. The unit technique develops estimates simply by multiplying the value of a particular unit of interest by a per-unit rate.

3-8 A cost estimation relationship (CER) is a mathematical equation that relates cost to one or more physical or performance variables associated with the item being estimated. CERs are extensively used to estimate cost and forecast benefits during industrial project management. Estimating accurate labor, material, and overhead costs of a project along with forecasting future revenues is essential to selecting, executing, and overseeing industrial projects.

3-9 Regression models. Advantages: more initiative to interpret and explain, simple forms are readily developed via spreadsheet software. Disadvantages: limited to known statistical functions, limited to estimating a single output at a time.

Neural Networks. Advantage: can model nonlinear data without adherence to underlying statistical property assumptions, can model multiple outputs simultaneously. Disadvantages: "black box" methodology that is less intuitive to explain, exact results are non-replicable due to random seed generation, generally requires specialized software.

3-10 Answer will vary.

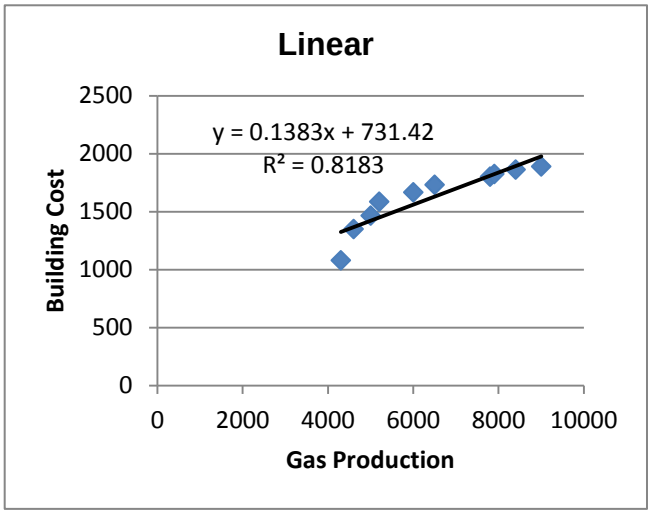
Linear. Direct material costs. Most direct material typically has a steady per unit cost, so the cost of direct material increases linearly as the amount of direct material increases.

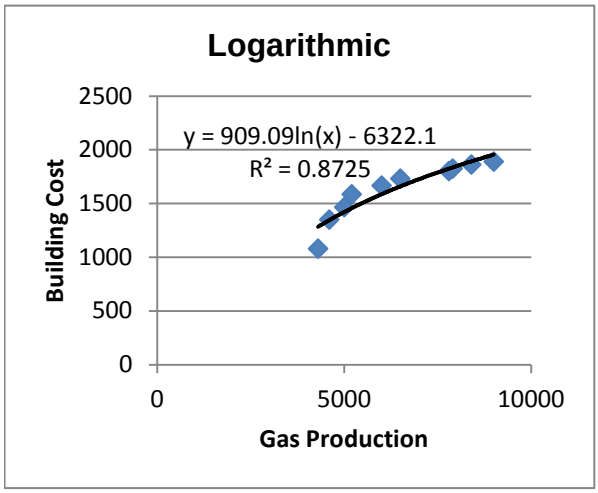
Power. Learning curves applied to labor costs can be represented with a power CER because the percent change in hours per unit causes a constant percent change in cost.

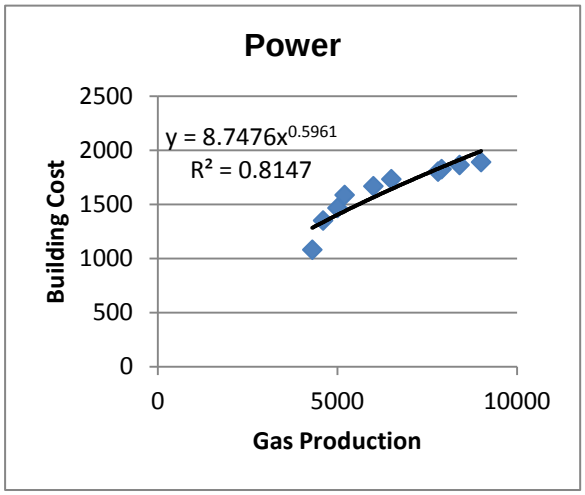
Exponential. Required inventory cost to maintain various levels of fill rates. As the desired fill rate increases, the cost to carry the associated inventory typically increases exponentially.

3-11

Gas (MBTU/h)	Building ($M)
4300	1080
4600	1350
5000	1466
5200	1586
6000	1667
6500	1732
7800	1802
7900	1825
8400	1863
9000	1890

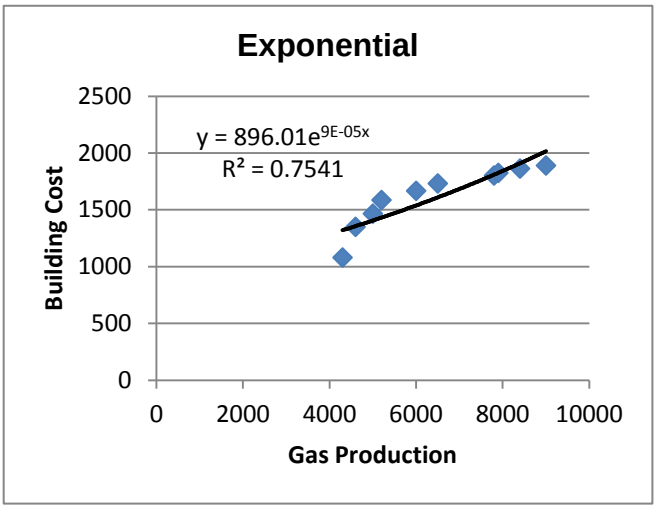






The Lang factor follows the power CER form.

There are a variety of ways to approach this problem. We fit trend lines to yield CERs as linear, logarithmic, power, and exponential functions. The logarithmic CER yields a coefficient of determination closest to one (best fit to the data set). The R^2 is slightly lower for the logarithmic CER but the linear function is intuitive and easy to describe in practice.



3-12 As learning occurs, the time to complete one unit decreases. Ignoring that learning occurs can result in an overestimation of labor costs, which may lead to inaccurate decision making.

3-13 (a) At the completion of production, it is known that 35 hours in total were required to complete the last 100 units. If the 85% learning rate applies, how many hours were expended to build the first unit?

For an 85% curve, n = −0.234 from TABLE 3.7 $X_L = 500$

$T_{1\text{-}500} = KX_L^{1+n}$

$T_{1\text{-}500} = K(500)^{(1-0.234)} = 116.79K$ $T_{1\text{-}400} = K(400)^{(0.766)} = 98.44K$

$T_{401\text{-}500} = T_{1\text{-}500} - T_{1\text{-}400} = 116.79K - 98.44K$

35 hours = 18.35K K = 1.907 hours

(b) How many units were produced before the standard time was reached?

$U = (1+n)KX^n$ U = 0.5 hours

$0.5 = (1-0.234)1.907X^{-0.234}$

$X^{-0.234} = 0.342$ X = 97.68 ~ 98 units

(c) How many hours were spent to build the 200th unit?

$U = (1+n)KX^n$

$U = (1-0.234)1.907(200)^{-0.234}$ U = 0.423 hours

(d) How many hours were spent to build units #50 through #100 inclusive?

$T_1 = KX_L^{1+n} - KX_f^n(X_f - 1)$

$T_1 = 1.907(100)^{(1-0.234)} - 1.907(50)^{-0.234}(50 - 1)$

$T_1 = 27.5$ hours

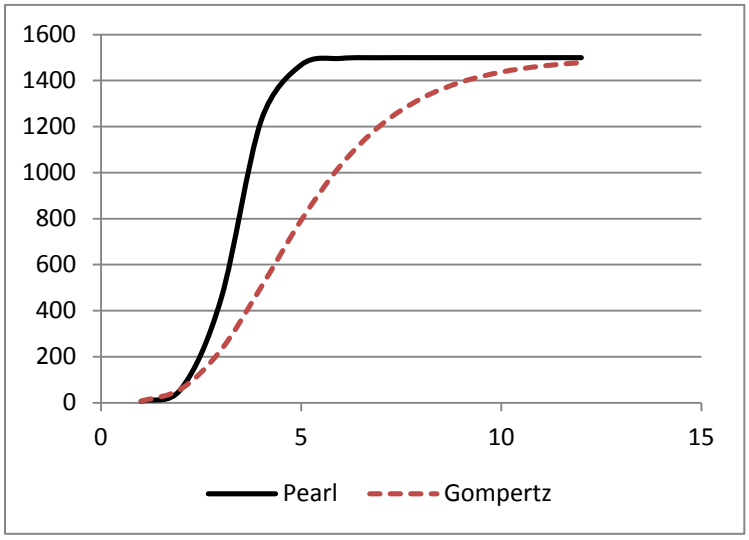
3-14

L	1500	

a	2583.375
b	2.339399

c	9.471173
d	0.53961

	S Pearl	S Gompertz
1	6	6
2	60	60
3	452.73	229.68
4	1226.53	502.33
5	1468.44	792.72
6	1496.90	1034.24
7	1499.70	1207.70
8	1499.97	1321.95
9	1500.00	1393.48
10	1500	1436.95
11	1500	1462.91
12	1500	1478.27



Constants were determined using Solver.

There is no mathematical basis for believing one is more accurate. The Pearl curve is a more aggressive growth curve, and the Gompertz is more conservative. The choice of the curve depends on past experience.

3-15 Traditional or volume-based costing combines overhead costs into a single cost pool and allocates overhead costs to cost objects with a single cost driver that is typically volume-based such as direct labor hours. Activity-based costing divides overhead costs into a set of multiple cost pools each with their own cost driver. Therefore, overhead costs are charged to cost objects based on how activities consume resources based on cost drivers. The primary motivation behind activity-based costing is the change in business practices in the United States. Today's companies operate in a global, competitive, and diverse business environment

3-16 (a) Determine the product cost of the standard and deluxe models using the present traditional cost accounting method.

Total Overhead Cost	$525,000
Driver: Direct Labor Hours (DLH)	15,000
TCA Overhead Rate	$35.00/DL

TCA Standard Overhead Cost	=$35*3DLH	= $105.00/DLH
TCA Deluxe Overhead Cost	=$35*6DLH	= $210.00/DLH

TCA Standard Total Product	=$25/DLH*3DLH + $100+$105	= $280.00
TCA Deluxe Total Product Cost	=$25/DLH*6DLH + $330+$1,200	= $660.00