Solutions to end-of-chapter problems
Engineering Economy, 7th edition

Chapter 2
Factors: How Time and Interest Affect Money

2.1 (1) (P/F, 6%, 8) = 0.6274
(2) (A/P, 10%,10) = 0.16275
(3) (A/G,15%,20) = 5.3651
(4) (A/F,2%,30) = 0.02465
(5) (P/G,35%,15) = 7.5974

2.2 P = 21,300(P/A,10%,5)
= 21,300(3.7908)
= $80,744

2.3 Cost now = 142(0.60)
= $85.20
Present worth at regular cost = 142(P/F,10%,2)
= 142(0.8264)
= $117.35

Present worth of savings = 117.35 – 85.20
= $32.15

2.4 F = 100,000(F/P,10%,3) + 885,000
= 100,000(1.3310) + 885,000
= $1,018,100

2.5 F = 50,000(F/P,6%,14)
= 50,000(2.2609)
= $113,045

2.6 F = 1,900,000(F/P,15%,3)
F = 1,900,000(1.5209)
= $2,889,710

2.7 A = 220,000(A/P,10%,3)
= 220,000(0.40211)
= $88,464

2.8 P = 75,000(P/F,12%,4)
= 75,000(0.6355)
= $47,663

2.9 F = 1.3(F/P,18%,10)
= 1.3(5.2338)
= 6.80394 ($6,803,940)

2.10 P = 200,000(P/F,15%,1) + 300,000(P/F,15%3)
= 200,000(0.8696) + 300,000(0.6575)
= $371,170

2.11 Gain in worth of building after repairs = (600,000/0.75 – 600,000) - 25,000 = 175,000

F = 175,000(F/P,8%,5)
= 175,000(1.4693)
= $257,128

2.12 F = 100,000(F/P,8%,4) + 150,000(F/P,8%,3)
= 100,000(1.3605) + 150,000(1.2597)
= $325,005

2.13 P = (110,000* 0.3)(P/A,12%,4)
= (33,000)(3.0373)
= $100,231

2.14 P = 600,000(0.04)(P/A,10%,3)
= 24,000(2.4869)
= $59,686

2.15 A = 950,000(A/P,6%,20)
= 950,000(0.08718)
= $82,821

2.16 A = 434(A/P,8%,5)
= 434(0.25046)
= $108.70

2.17 F = (0.18 – 0.04)(100)(F/A,6%,8)
= 14(9.8975)
= $138.57

2.18 $F_{difference}$ = 10,500(F/P,7%,18) - 10,500(F/P,4%,18)
= 10,500(3.3799) - 10,500(2.2058)
= $12,328

2**.19** F = (200 – 90)(F/A,10%,8)
= 110(11.4359)
= $1,257,949

2.20 A = 350,000(A/F,10%,3)
= 350,000(0.30211)
= $105,739

2.21 (a) 1. Interpolate between i = 12% and i = 14% at n = 15.

1/2 = x/(0.17102 – 0.14682)
x = 0.0121

(A/P,13%,15) = 0.14682 + 0.0121
= 0.15892

2. Interpolate between i = 25% and i = 30% at n = 10.

2/5 = x/(9.9870 -7.7872)
x = 0.8799

(P/G,27%,10) = 9.9870 – 0.8799
= 9.1071

(b) 1. $(A/P,13\%,15) = [0.13(1 + 0.13)^{15}]/[(1 + 0.13)^{15} - 1]$
= 0.15474

2. $(P/G,27\%,10) = [(1 + 0.27)^{10} – (0.27)(10) - 1]/[0.27^2(1 + 0.27)^{10}]$
= 9.0676

2.22 (a) 1. Interpolate between n = 60 and n = 65:

2/5 = x/(4998.22 – 2595.92)
x = 960.92

(F/P,14%,62) = 4998.22 – 960.92
= 4037.30

2. Interpolate between n = 40 and n = 48:
5/8 = x/(0.02046 – 0.01633)
x = 0.00258

(A/F,1%,45) = 0.02046 – 0.00258
= 0.01788

(b) 1. $(F/P,14\%,62) = (1+0.14)^{62} - 1$
= 3373.66

2. $(A/F,1\%,45) = 0.01/[(1+ 0.01)^{45} – 1]$
= 0.01771

(c) 1. = -FV(14%,62,,1) displays 3373.66

3. = PMT(1%,45,,1) displays 0.01771

2.23 Interpolated value: Interpolate between n = 40 and n = 45:

$$3/5 = x/(72.8905 - 45.2593)$$
$$x = 16.5787$$

$$(F/P,10\%,43) = 45.2593 + 16.5787$$
$$= 61.8380$$

Formula value: $(F/P,10\%,43) = (1+ 0.10)^{43} - 1 = 59.2401$

% difference = [(61.8380 - 59.2401)/ 59.2401]*100 = 4.4%

2.24 Interpolated value: Interpolate between n = 50 and n = 55:

$$2/5 = x/(14524 - 7217.72)$$
$$x = 2922.51$$

$$(F/A,15\%,52) = 7217.72 + 2922.51$$
$$= 10,140$$

Formula value: $(F/A,15\%,52) = [(1+ 0.15)^{52} - 1]/0.15 = 9547.58$

% difference = [(10,140 - 9547.58)/ 9547.58](100)
= 6.2%

2.25 (a) Profit in year 5 = 6000 + 1100(4) = $10,400

(b) P = 6000(P/A,8%,5) + 1100(P/G,8%,5)
= 6000(3.9927) + 1100(7.3724)
= $32,066

2.26 (a) G = (241 – 7)/9 = $26 billion per year

(b) Loss in year 5 = 7 +4(26) = $111 billion

(c) A = 7 + 26(A/G,8%,10)
= 7 + 26(3.8713)
= $107.7 billion

2.27 A = 200 – 5(A/G,8%,8)
= 200 – 5(3.0985)
= $184.51

2.28 P = 60,000(P/A,10%,5) + 10,000(P/G,10%,5)
= 60,000(3.7908) + 10,000(6.8618)
= $296,066

2.29 (a) CF_3 = 70 + 3(4) = $82 ($82,000)

(b) P = 74(P/A,10%,10) + 4(P/G,10%,10)
= 74(6.1446) + 4(22.8913)
= $546.266 ($546,266)

F = 546.266(F/P,10%,10)
= 521.687(2.5937)
= $1416.850 ($1,416,850)

2.30 601.17 = A + 30(A/G,10%,9)
601.17 = A + 30(3.3724)
A = $500

2.31 P = 2.1B (P/F,18%,5)
= 2.1B (0.4371)
= $917,910,000

917,910,000 = 50,000,000(P/A,18%,5) + G(P/G,18%,5)
917,910,000 = 50,000,000(3.1272) + G(5.2312)
G = $14,557,845

2.32 75,000 = 15,000 + G(A/G,10%,5)
75,000 = 15,000 + G(1.8101)
G = $33,147

2.33 First find P_g (using equation) and then convert to A

For n = 1: $P_g = \{1 - [(1 + 0.04)/(1 + 0.10)]^1\}/(0.10 - 0.04)$
= 0.90909

A = 0.90909(A/P,10%,1)
= 0.90909(1.1000)
= 1.0000

For n = 2: $P_g = \{1 - [(1 + 0.04)/(1 + 0.10)]^2\}/(0.10 - 0.04)$
= 1.7686

A = 1.7686(A/P,10%,2)
= 1.7686(0.57619)
= 1.0190

2.34 $P_g = 50{,}000\{1 - [(1 + 0.06)/(1 + 0.10)]^8\}/(0.10 - 0.06)$
$= \$320{,}573$

2.35 $P_{g1} = 10{,}000\{1 - [(1 + 0.04)/(1 + 0.08)]^{10}\}/(0.08 - 0.04)$
$= \$78{,}590$

$P_{g2} = 10{,}000\{1 - [(1 + 0.06)/(1 + 0.08)]^{11}\}/(0.08 - 0.06)$
$= \$92{,}926$

Difference = $14,336

2.36 $P_g = 260\{1 - [(1 + 0.04)/(1 + 0.06)]^{20}\}/(0.06 - 0.04)$
$= 260(15.8399)$
= $4118.37 per acre-ft

2.37 $P = 30{,}000[10/(1 + 0.06)] = \$283{,}019$

2.38 $18{,}000{,}000 = 3{,}576{,}420(P/A,i,7)$
$(P/A,i,7) = 5.0330$

From interest tables in P/A column and n = 7, i = 9% per year.

Can be solved using the RATE function = RATE(7,3576420,18000000).

2.39 $813{,}000 = 170{,}000(F/P,i,15)$
$813{,}000 = 170{,}000(1 + i)^{15}$

$\log 4.78235 = (15)\log (1 + i)$
$0.6796/15 = \log (1 + i)$
$\log (1 + i) = 0.04531$

$1 + i = 1.11$
$i = 11\%$ per year

Can be solved using the RATE function = RATE(15,,-170000,813000).

2.40 $100{,}000 = 210{,}325(P/F,i,30)$
$(P/F,i,30) = 0.47545$

Find i by interpolation between 2% and 3%, by solving the P/F equation for i, or by spreadsheet. By spreadsheet function = RATE(30,,100000,-210325), i = 2.51%.

2.41 (1,000,000 – 1,900,000) = 200,000(F/P,i,4)
(F/P,i,4) = 4.5

Find i by interpolation between 40% and 50%, by solving F/P equation, or by spreadsheet. By spreadsheet function = RATE(4,,-200000,900000), i = 45.7% per year.

2.42 800,000 = 250,000(P/A,i,5)
(P/A,i,5) = 3.20

Interpolate between 16% and 18% interest tables or use a spreadsheet. By spreadsheet function, i = 16.99% ≈ 17% per year.

2.43 87,360 = 24,000(F/A,i,3)
(F/A,i,3) = 3.6400

For n = 3 in F/A column, 3.6400 is in 20% interest table. Therefore, i = 20% per year.

2.44 48,436 = 42,000 + 4000(A/G,i,5)
6436 = 4000(A/G,i,5)
(A/G,i,5) = 1.6090

For n = 5 in A/G column, value of 1.6090 is in 22% interest table.

2.45 600,000 = 80,000(F/A,15%,n)
(F/A,15%,n) = 7.50

Interpolate in the 15% interest table or use a spreadsheet function. By spreadsheet, n = 5.4 years.

2.46 Starting amount = 1,600,000(0.55) = $880,000

1,600,000 = 880,000(F/P,9%,n)
(F/P,9%,n) = 1.8182

Interpolate in 9% interest table or use the spreadsheet function
= NPER(9%,,-880000,1600000) to determine that n = 6.94 ≈7 years.

2.47 200,000 = 29,000(P/A,10%,n)
(P/A,10%,n) = 6.8966

Interpolate in 10% interest table or use a spreadsheet function to display n = 12.3 years.

2.48 1,500,000 = 18,000(F/A,12%,n)
(F/A,12%,n) = 83.3333

Interpolate in 12% interest table or use the spreadsheet function

= NPER(12%, -18000,,1500000) to display n = 21.2 years. Time from now is

21.2 -15 = 6.2 years.

2.49 350,000 = 15,000(P/A,4%,n) + 21,700(P/G,4%,n)

Solve by trial and error in 4% interest table between 5 and 6 years to determine
n ≈ 6 years

2.50 16,000 = 13,000 + 400(A/G,8%,n)
(A/G,8%,n) = 7.5000

Interpolate in 8% interest table or use a spreadsheet to determine that n = 21.8 years.

2.51 $140(0.06 - 0.03) = 12\{1 - [(0.97170)]^{x}\}$
$4.2/12 = 1 - [0.97170]^{x}$
$0.35 - 1 = - [0.97170]^{x}$
$0.65 = [0.97170]^{x}$

$\log 0.65 = (x)(\log 0.97170)$
x = 15 years

2.52 135,300 = 35,000 + 19,000(A/G,10%,n)
100,300 = 19,000(A/G,10%,n)
(A/G,10%,n) = 5.2789

From A/G column in 10% interest table, n = 15 years.

2.53 $88,146 = 25,000\{1 - [(1 + 0.18)/(1 + 0.10)]^{n}\}/(0.10 - 0.18)$
$3.52584 = \{1 - [(1.18)/(1.10)]^{n}\}/(-.08)$
$-0.28207 = \{1 - [(1.18)/(1.10]^{n}\}$
$-1.28207 = - [(1.18)/(1.10]^{n}$
$1.28207 = [(1.07273]^{n}$

$\log 1.28207 = n \log 1.07273$
$0.10791 = n(0.03049)$
n = 3.54 years

2.54 P = 30,000(P/F,12%,3)
= 30,000(0.7118)
= $21,354

Answer is (d)

2.55 30,000 = 4200(P/A,8%,n)
(P/A,8%,n) = 7.14286

n is between 11 and 12 years

Answer is (c)

2.56 A = 22,000 + 1000(A/G,8%,5) = $23,847

Answer is (a)

2.57 Answer is (d)

2.58 A = 800 – 100(A/G,4%,6) = $561.43

Answer is (b)

2.59 Answer is (b)

2.60 F = 61,000(F/P,4%,4)
= 61,000(1.1699)
= $71,364

Answer is (c)

2.61 P = 90,000(P/A,10%,10)
= 90,000(6.1446)
= $553,014

Answer is (d)

2.62 A = 100,000(A/P,10%,7)
= 100,000(0.20541)
= $20,541

Answer is (b)

2.63 A = 1,500,000(A/F,10%,20)
= 1,500,000(0.01746)
= $26,190

Answer is (a)

2.64 In $1 million units

A = 3(10)(A/P,10%,10)
= 30(0.16275)
= $4.8825 (≈ $4.9 million)

Answer is (c)

2.65 75,000 = 20,000(P/A,10%,n)
(P/A,10%,n) = 3.75

By interpolation or NPER function, n = 4.9 years

Answer is (b)

2.66 50,000(F/A,6%,n) = 650,000
(F/A,6%,n) = 13.0000

By interpolation or NPER function, n = 9.9 years

Answer is (d)

2.67 40,000 = 13,400(P/A,i,5)
(P/A,i,5) = 2.9851

By interpolation or RATE function, i = 20.0 % per year

Answer is (a)

2.68 P = 26,000(P/A,10%,5) + 2000(P/G,10%,5)
= 26,000(3.7908) + 2000(6.8618)
= $112,284

Answer is (b)

2.69 F = [5000(P/A,10%,20) + 1000(P/G,10%,20)](F/P,10%,20)
= [5000(8.5136) + 1000(55.4069)](6.7275)
= $659,126

Answer is (d)

2.70 A = 300,000 – 30,000(A/G,10%,4)
= 300,000 – 30,000(1.3812)
= $258,564

Answer is (b)

2.71 $F = \{5000[1 - (1.03/1.10)^{20}]/(0.10 – 0.03)\}(F/P,10\%,20)$
$= \{5000[1 - (1.03/1.10)^{20}]/(0.10 – 0.03)\}(6.7275)$
$= \$351,528$

Answer is (c)

Solution to Case Study, Chapter 2

There is no definitive answer to case study exercises. The following are examples only.

Time Marches On; So Does the Interest Rate

1.

Situation	A	B	C	D
Interest rate	6% per year	6% per year	15% per year	Simple: 780% per year Comp'd: 143,213% per year

C: 2 million = 300,000(P/A,i%,65)

(P/A,i%,64) = 6.666667

i = 15%

D: 30/200 = 15% per week

Simple: 15%(52 weeks) = 780% per year

Compound: $(1.15)^{52} - 1 = 143{,}213\%$ per year

2. A: Start -- \$24

End -- $F = 24(1.06)^{385} = \$132$ billion

B: Start -- \$2000 per year or \$20,000 total over 10 years

End -- $F_{32} = A(F/A,6\%,10) = \$26{,}361.60$

$F_{70} = F_{32}(F/P,6\%,38) = \$241{,}320$

C: Start -- \$2 million

End -- 300,000(65) = \$19.5 million over 65 years

$F_{65} = 300{,}000(F/A,15\%,65) = \$17.6$ billion (equivalent)

D: Simple interest

Start -- \$200

End -- (0.15)(12)(200) + 200 = \$1760

Compound interest

Start -- \$200

End -- $200(1.15)^{52} = \$286{,}627$