Chapter 2

Solutions

2.1 Drill Problems

1. (a) Year 0: -$100,000
   Year 1 - 5: $48,000

   (b) Month 1-24: -$5000

   (c) Year 0: -$25,000
   Year 1: -$1000
   Year 2: -$1500
   Year 3: -$2000
   Year 4: -$2500
   Year 5: -$1000

   (d) Quarter 1-4: -$250,000
   Quarter n : $\$40,000(1+0.024)^{n-4}, \quad n=5,6,\ldots,23$
   Quarter 24: $\$40,000(1+0.25)^{(20)} - \$10,000$

   (e) Year 1: -$75,000
   Year 2: -$75,000
   Year 3: -$75,000
   Year 4: $235,000

   (f) Year 0: -$500,000
   Year n : $\$100,000 + \$10,000(n-1) - \$15,000(1+0.032)^{n-1} \quad n=1,2,\ldots,5$
   Year m : $\$140,000 - \$12,000(m-5) - \$15,000(1+0.032)^{m-1} \quad m=6,7,\ldots,10$

   (g) Year 0: -$10,000
   Semi-Year 1 - 10: $350
   Semi-Year 10: $10,000

   (h) Year 0: $95,000
   Year 1 - 6: $18,000

   (i) Year 0: -$15 million
   Years 1 - 7: $60,000 per day continuous flow
   Year 7: -$1 million

Engineering Economy and the Decision-Making Process by Joseph C. Hartman, ISBN 0-13-142401-7

(j) Year 0: -$2 million

Year 1 - 4: $125,000

Year 5: $175,000

2. The amount owed is:

For $N = 1$:

$$F = \$250,000 + \$250,000(.073)(1) = \$268,250$$

For $N = 2$:

$$F = \$250,000 + \$250,000(.073)(2) = \$286,500$$

For $N = 3.5$:

$$F = \$250,000 + \$250,000(.073)(3.5) = \$313,875$$

3. The interest rate is:

$$i = \frac{\$175,000 - \$150,000}{(\$150,000)(4)} = 0.0417 = 4.17\%$$

4. The interest table is given in the spreadsheet in Figure 2.1.

	A	B	C	D	E	F	G
1	Drill Problem 2.4				**Input**		
2					Principal	$85,000.00	
3	**Period**	**Interest**	**Amount Owed**		Interest	4.50%	per year
4	0	--	$85,000.00				
5	1	$3,825.00	$88,825.00		**Output**		
6	2	$3,997.13	$92,822.13		Table		
7	3	$4,177.00	$96,999.12				
8	4	$4,364.96	$101,364.08				
9	5	$4,561.38	$105,925.46				
10							

Figure 2.1: Interest due on five-year loan with 4.5% interest rate.

5. The total owed is:

$$F = \$40,000(1.038)^6 = \$50,031.57$$

Thus, the total interest paid is $50,031.57-$40,000.00=$10,031.57.

6. An interest rate of 6.25% compounded monthly is a nominal rate.

(a) Effective Monthly Rate:

$$i_m = \frac{r}{M} = \frac{0.0625}{12} = 0.0052 = 0.52\%$$

(b) Effective Quarterly Rate:

$$i_q = (1 + i_m)^3 - 1 = (1 + 0.0052)^3 - 1 = 0.0157 = 1.57\%$$

(c) Effective Semi-annual Rate:

$$i_{sa} = (1 + i_q)^2 - 1 = (1 + 0.0157)^2 - 1 = 0.0316 = 3.16\%$$

(d) Effective Annual Rate:

$$i_a = (1 + \frac{r}{M})^M - 1 = (1 + \frac{0.0625}{12})^{12} - 1 = 0.0643 = 6.43\%$$

7. An interest rate of 9.5% compounded quarterly is a nominal rate.

(a) Effective Monthly Rate:

$$i_{\text{m}} = (1 + \frac{r}{M})^{lM} - 1 = (1 + \frac{0.095}{4})^{(\frac{1}{12})(4)} - 1 = 0.0079 = 0.79\%$$

(b) Effective Quarterly Rate:

$$i_{\text{q}} = \frac{r}{M} = \frac{0.095}{4} = 0.0238 = 2.38\%$$

(c) Effective Semi-annual Rate:

$$i_{\text{sa}} = (1 + \frac{r}{M})^{lM} - 1 = (1 + \frac{0.095}{4})^{(\frac{1}{2})(4)} - 1 = 0.0481 = 4.81\%$$

(d) Effective Annual Rate:

$$i_{\text{a}} = (1 + \frac{r}{M})^M - 1 = (1 + \frac{0.095}{4})^4 - 1 = 0.0984 = 9.84\%$$

8. An interest rate of 8.0% compounded annually is both a nominal and an effective rate.

(a) Effective Monthly Rate:

$$i_m = (1 + \frac{r}{M})^{lM} - 1 = (1 + \frac{0.08}{1})^{(\frac{1}{12})(1)} - 1 = 0.00643 = 0.643\%$$

(b) Effective Quarterly Rate:

$$i_{\text{q}} = (1 + \frac{r}{M})^{lM} - 1 = (1 + \frac{0.08}{1})^{(\frac{1}{4})(1)} - 11 = 0.0194 = 1.94\%$$

(c) Effective Semi-annual Rate:

$$i_{\text{sa}} = (1 + \frac{r}{M})^{lM} - 1 = (1 + \frac{0.08}{1})^{(\frac{1}{2})(1)} - 1 = 0.0392 = 3.92\%$$

(d) Effective Annual Rate:

$$i_{\text{a}} = \frac{r}{M} = \frac{0.08}{1} = 0.08 = 8\%$$

9. An interest rate of 7.45% compounded continuously is a nominal rate.

(a) Effective Daily Interest Rate:

$$i_d = e^{lr} - 1 = e^{(\frac{1}{365})0.0745} - 1 = 0.0002 = .02\%$$

(b) Effective Monthly Interest Rate:

$$i_m = e^{lr} - 1 = e^{(\frac{1}{12})0.0745} - 1 = 0.0062 = 0.62\%$$

(c) Effective Quarterly Interest Rate:

$$i_q = e^{lr} - 1 = e^{(\frac{1}{4})0.0745} - 1 = 0.0188 = 1.88\%$$

(d) Effective Semi-Annual Interest Rate:

$$i_{sa} = e^{lr} - 1 = e^{(\frac{1}{2})0.0745} - 1 = 0.0380 = 3.80\%$$

(e) Effective Annual Interest Rate:

$$i_a = e^r - 1 = e^{0.0745} - 1 = 0.0773 = 7.73\%$$

10.

$$r = i_q M = (0.032)4 = 0.128 = 12.8\% \text{ compounded quarterly.}$$

11.

$$r = i_m M = (0.0155)12 = 0.186 = 18.6\% \text{ compounded monthly.}$$

12.

$$r = i_a M = (0.102)1 = .102 = 10.2\% \text{ compounded annually.}$$

13. Define $i_1 = 1.25\%$ per month and $i_2 = 12.0\%$ compounded quarterly. Convert each to an effective quarterly rate for comparison:

$$i_1 = (1 + 0.0125)^3 - 1 = 0.0380 = 3.80\% \text{ per quarter.}$$

$$i_2 = \frac{0.12}{4} = 0.03 = 3.0\% \text{ per quarter.}$$

The 12% compounded quarterly loan is cheaper.

14. Define $i_1 = 14.3\%$ compounded semi-annually and $i_2 = 2.1\%$ per quarter. Convert each to an effective semi-annual rate for comparison:

$$i_1 = \frac{0.143}{2} = 0.0715 = 7.15\% \text{ per six months.}$$

$$i_2 = (1 + 0.021)^2 = 0.0424 = 4.24\% \text{ per six months.}$$

The 14.3% compounded semi-annually investment is better.

15. Define $i_1 = 7.35\%$ per year and $i_2 = 8.25\%$ compounded semi-annually. Convert each to an effective annual rate for comparison:

$$i_1 = 7.35\% \text{ per year.}$$

$$i_2 = (1 + \frac{0.0825}{2})^2 = 0.0842 = 8.42\% \text{ per year.}$$

The 7.35% per year loan is cheaper.

16. Define $i_1 = 4.35\%$ per quarter and $i_2 = 15.3\%$ compounded continuously. Convert each to an effective annual rate for comparison:

$$i_1 = (1 + 0.0435)^4 = 0.1857 = 18.57\% \text{ per year.}$$

$$i_2 = e^{0.153} - 1 = 0.1653 = 16.53\% \text{ per year.}$$

The 4.35% per quarter investment is better.