Chapter 2: Time Value of Money

2.1) $I = (iP)N = (0.06)(\$2,000)(5) = \$600$

2.2)

- Simple interest:

$$\begin{aligned} F &= P(1+iN) \\ \$6,000 &= \$3,000(1+0.08N) \\ N &= 12.5 \text{ years (or 13 years)} \end{aligned}$$

- Compound interest:

$$\begin{aligned} \$6,000 &= \$3,000(1+0.07)^N \\ 2 &= 1.07^N \\ \log 2 &= N \log 1.07 \\ N &= 10.24 \text{ years (or 11 years)} \end{aligned}$$

2.3)

- Simple interest:

$$\begin{aligned} I &= (iP)N = (0.07)(\$15,000)(25) \\ &= \$26,250 \end{aligned}$$

- Compound interest:

$$\begin{aligned} I &= P\left[(1+i)^N - 1\right] = \$15,000\left[(1.07)^{25} - 1\right] \\ &= \$66,411.50 \end{aligned}$$

2.4)

- A : Simple interest:

$$\begin{aligned} I &= (iP)N = (0.06)(\$10,000)(15) \\ &= \$9,000 \end{aligned}$$

- B : Compound interest:

$$\begin{aligned} I &= P\left[(1+i)^N - 1\right] = \$10,000\left[(1.055)^{15} - 1\right] \\ &= \$12,324.76 \end{aligned}$$

B is a better option.

2.5)

- Compound interest:

$$F = \$1,000(1+0.065)^5$$
$$= \$1,370.09$$

- Simple interest:

$$F = \$1,000(1+0.068(5))$$
$$= \$1,340$$

The compound interest option is better.

2.6)

- Loan balance calculation:

End of period	Principal Payment	Interest Payment	Remaining Balance
0	$0.00	$0.00	$10,000.00
1	$1,670.92	$900.00	$8,329.08
2	$1,821.30	$749.62	$6,507.78
3	$1,985.22	$585.70	$4,522.56
4	$2,163.89	$407.03	$2,358.67
5	$2,358.64	$212.28	$0.00

2.7) $P = \$5,000(P/F, 7\%, 5) = \$5,000(0.7130) = \$3,565$

2.8) $F = \$25,000(F/P, 8\%, 2) = \$25,000(1.1664) = \$29,160$

2.9)

- Alternative 1

$$P = \$100$$

- Alternative 2

$$P = \$120(P/F, 10\%, 2) = \$120(0.8264) = \$99.168$$

- Alternative 3

$$P = \$170(P/F, 10\%, 5) = \$170(0.6209) = \$105.553$$

- Alternative 3 is preferred

2.10) $F = \$1,000(F/P, 5\%, 3) = \$1,000(1.1576) = \$1,157.6$

2.11) $F = \$500(P/F, 9\%, 5) = \$500(0.6499) = \$324.95$

2.12) $i = 10.5\%$, two-year discount rate is $(1+0.105)^2 = 1.221(22.1\%)$

2.13) (a) $F = \$6,000(F/P, 6\%, 8) = \$6,000(1.5938) = \$9,563$

(b) $F = \$1,550(F/P, 5\%, 12) = \$1,550(1.7959) = \$2,784$

(c) $F = \$8,000(F/P, 9\%, 32) = \$8,000(15.7633) = \$126,106$

(d) $F = \$12,000(F/P, 8\%, 9) = \$12,000(1.999) = \$23,988$

2.14) (a) $P = \$5,500(P/F, 10\%, 6) = \$5,500(0.5645) = \$3,105$

(b) $P = \$7,000(P/F, 9\%, 3) = \$7,000(0.7722) = \$5,405$

(c) $P = \$22,000(P/F, 8\%, 5) = \$22,000(0.6806) = \$14,973$

(d) $P = \$13,000(P/F, 7\%, 8) = \$13,000(0.5820) = \$7,566$

2.15) (a) $P = \$8,000(P/F, 8\%, 5) = \$8,000(0.6806) = \$5,445$

(b) $F = \$10,000(F/P, 8\%, 4) = \$10,000(1.3605) = \$13,605$

2.16)

$$F = 3P = P(1+0.07)^N$$
$$\log 3 = N \log 1.07$$
$$N = 16.24 \text{ years (or 17 years)}$$

2.17)

$$F = 2P = P(1+0.06)^N$$
$$\log 2 = N \log 1.06$$
$$N = 11.896 \text{ years (or 12 years)}$$

2.18)

- Rule of 72:

$$72/8 = 9 \text{ years}$$

$$
\begin{aligned}
F &= 2P = P(1+0.08)^N \\
\log 2 &= N \ \log 1.08 \\
N &= 9 \text{ years}
\end{aligned}
$$

2.19) $F = \$1(1.08)^{389} = \$10,042,477,894,213$

2.20)

$$
\begin{aligned}
P &= \$35,000(P/F, 9\%, 4) + \$10,000(P/F, 9\%, 2) \\
&= \$35,000(0.7084) + \$10,000(0.8417) \\
&= \$33,211
\end{aligned}
$$

2.21) $P = \$450,000(P/F, 5\%, 5) = 450,000(0.7835) = \$352,575$

2.22)

- Simple interest (John):

$$I = iPN = (0.1)(\$1,000)(5) = \$500$$

- Compound interest (Susan):

$$
\begin{aligned}
I &= P\left[(1+i)^N - 1\right] = \$1,000\left[(1+.095)^5 - 1\right] \\
&= \$574.24
\end{aligned}
$$

- Susan's balance will be greater by \$74 (or \$74.24 to be exact)

2.23) $P = \dfrac{\$2,000}{1.1^1} + \dfrac{\$800}{1.1^2} + \dfrac{\$1,000}{1.1^3} = \$3,230.65$

2.24) $P = \dfrac{\$3,000}{1.05^2} + \dfrac{\$3,500}{1.05^3} + \dfrac{\$4,200}{1.05^4} + \dfrac{\$6,500}{1.05^5} = \$14,292.8$

2.25)

$$
\begin{aligned}
F &= \$2,000(F/P, 8\%, 10) + \$3,000(F/P, 8\%, 8) \\
&\quad + \$4,000(F/P, 8\%, 6) \\
&= \$16,218
\end{aligned}
$$

2.26)

$$\begin{aligned}P &= \$3,000,000 + \$2,400,000(P/A, 8\%, 5) \\ &\quad + \$3,000,000(P/A, 8\%, 5)(P/F, 8\%, 5) \\ &= \$20,734,774.86\end{aligned}$$

2.27)

$$\begin{aligned}P &= \$3,000(P/F, 9\%, 2) + \$4,000(P/F, 9\%, 5) \\ &\quad + \$5,000(P/F, 9\%, 7) \\ &= \$7,859.7\end{aligned}$$

2.28)

- Method 1:

$$\begin{aligned}F &= \$2,000(1.05)(1.1)(1.15) + \$3,000(1.1)(1.15) + \$5,000 \\ &= \$11,451.5\end{aligned}$$

- Method 2:

$$\begin{aligned}F &= \overbrace{\underbrace{(\$2,000(1.05) + \$3,000)}_{\$5,100}(1.10)(1.15)}^{\$6,451.50} + \$5,000 \\ &= \$11,451.50\end{aligned}$$

2.29)

$$\begin{aligned}\$180,000 &= \$20,000(P/A, 9\%, 5) - \$10,000(P/F, 9\%, 3) + \\ &\quad X(P/F, 9\%, 6) 180,000 - 20,000(3.8897) + 10,000(0.7722) \\ &= X(0.5963) \\ X &= \$184,350.16\end{aligned}$$

2.30)

$$\begin{aligned}F &= \$80,000 = \$10,000(1.08)^5 + \$12,000(1.08)^3 + X(1.08)^2 \\ X &= \$43,029.99\end{aligned}$$

2.31)

$$\begin{aligned}100(1.08)^4 &= 8(1.08)^3 + 9(1.08)^2 + 10(1.08) + 11 + X \\ X &= \$93.67\end{aligned}$$

This is the minimum selling price. If John can sell the stock for a higher price than \$93.67, his return on investment will be higher than 8%.

2.32) $P = \dfrac{\$60,000}{1.14} + \dfrac{\$77,000}{1.14^2} + \dfrac{\$65,000}{1.14^3} + \dfrac{\$57,000}{1.14^4} + \dfrac{45,000}{1.14^5} = \$212,873.89$

2.33) $F = \$5,000(F/A, 6\%, 10) = \$5,000(13.1808) = \$65,904$

2.34) (a) $F = \$5,000(F/A, 5\%, 7) = \$5,000(8.1420) = \$40,710$

(b) $$\begin{aligned} F &= \$5,000(F/A, 5\%, 7)(1.05) \\ &= \$5,000(8.1420)(1.05) = \$42,745.50 \end{aligned}$$

2.35) (a) $F = \$6,000(F/A, 6\%, 6) = \$6,000(6.9753) = \$41,851.80$

(b) $F = \$8,000(F/A, 7.25\%, 9) = \$96,825.60$

(c) $F = \$15,000(F/A, 8\%, 25) = \$15,000(73.1059) = \$1,096,588.50$

(d) $F = \$3,000(F/A, 9.75\%, 10) = \$47,242.80$

2.36) (a) $A = \$18,000(A/F, 5\%, 13) = \$18,000(0.0565) = \$1,017$

(b) $A = \$11,000(A/F, 6\%, 8) = \$11,000(0.1010) = \$1,111$

(c) $A = \$8,000(A/F, 8\%, 25) = \$8,000(0.0137) = \$109.6$

(d) $A = \$12,000(A/F, 6.85\%, 8) = \$1,176$

2.37) $A = \$250,000(A/F, 5\%, 5) = \$250,000(0.1810) = \$45,250$

2.38) $A = \$25,000(A/F, 5\%, 5) = \$25,000(0.1810) = \$4,525$

2.39)

$$\begin{aligned} \$35,000 &= \$3,000(F/A, 6\%, N) \\ (F/A, 6\%, N) &= 11.6666 \\ \frac{(1+0.06)^N - 1}{0.06} &= 11.6666 \\ N \cdot \log(1.06) &= \log(1.7) \end{aligned}$$

$$N = 9.11 \text{ years}$$

2.40)

$$\begin{aligned} A &= \$10,000(A/F, 9\%, 5) \\ &= \$1,670.92 \end{aligned}$$

2.41)

$$F = \$500(1.04)^{10} + \$1,000(1.04)^{8} + \$1,000(1.04)^{6}$$
$$+\$1,000(1.04)^{4} + \$1,000(1.04)^{2} + \$1,000$$
$$= \$6,625.47$$

2.42) (a) $A = \$18,000(A/P, 8\%, 5) = \$18,000(0.2505) = \$4,509$

(b) $A = \$4,200(A/P, 9.5\%, 4) = \$1,310.82$

(c) $A = \$7,700(A/P, 11\%, 3) = \$7,700(0.4092) = \$3,150.84$

(d) $A = \$23,000(A/P, 6\%, 20) = \$23,000(0.0872) = \$2,005.60$

2.43)

- Equal annual payment amount:

$$A = \$20,000(A/P, 10\%, 3) = \$20,000(0.4021) = \$8,042$$

- Loan balance calculation:

End of period	Principal Payment	Interest Payment	Remaining Balance
0	$0.00	$0.00	$20,000.00
1	$6,042.00	$2,000.00	$13,958.00
2	$6,646.20	$1,395.80	$7,311.80
3	$7,310.82	$731.18	$0

Interest payment for the second year = $1,395.80

2.44) (a) $P = \$9,000(P/A, 6\%, 8) = \$9,000(6.2098) = \$55,888.20$

(b) $P = \$1,500(P/A, 9\%, 10) = \$1,500(6.4177) = \$9,626.55$

(c) $P = \$7,500(P/A, 7.25\%, 6) = \$35,475$

(d) $P = \$9,000(P/A, 8.75\%, 30) = \$52,529$

2.45) (a) $$(A/P, 6.25\%, 36) = \frac{0.0625(1+0.0625)^{36}}{(1+0.0625)^{36}-1} = 0.07044$$

(b) $$(P/A, 9.25\%, 125) = \frac{(1+0.0925)^{125}-1}{0.0925(1+0.0925)^{125}} = 10.81064$$

2.46) $F = \$500(F/A, 7\%, 15)(1.07) = \$500(25.1290)(1.07) = \$13,444.02$

2.47) $A = \$5,000(A/P, 11\%, 5) = \$5,000(0.2706) = \$1,353$

If you make the first payment on the loan at the end of the second year:

$$F = \$5,000(F/P,11\%,1)(A/P,11\%,4) = \$5,000(1.11)(0.3223) = \$1,788.78$$

2.48)

New equipment: \$195,000

O&M cost: $P = \$30,000(P/A,10\%,10) = \$30,000(6.1446) = \$184,338$

New equipment isn't worth buying.

2.49) $P = -\$3,460 + \dfrac{250}{i} = 0 \quad \rightarrow$ I = 7.225%

2.50) $P = \dfrac{1,000}{0.1} = \$10,000$

2.51)

$$\begin{aligned} F &= F_1 + F_2 \\ &= \$5,000(F/A,8\%,5) + \$2,000(F/G,8\%,5) \\ &= \$5,000(F/A,8\%,5) + \$2,000(A/G,8\%,5)(F/A,8\%,5) \\ &= \$5,000(5.8666) + \$2,000(1.8465)(5.8666) \\ &= \$50,998.35 \end{aligned}$$

2.52)

$$\begin{aligned} F &= \$5,000(F/A,10\%,5) - \$500(F/G,10\%,5) \\ &= \$5,000(F/A,10\%,5) - \$500(P/G,10\%,5)(F/P,10\%,5) \\ &= \$5,000(6.1051) - \$500(6.8618)(1.6105) \\ &= \$25,000.04 \end{aligned}$$

2.53)

$$\begin{aligned} P &= \$100(P/F,8\%,1) + \$150(P/F,8\%,3) \\ &\quad + \$200(P/F,8\%,5) + \$250(P/F,8\%,7) \\ &\quad + \$300(P/F,8\%,9) + \$350(P/F,8\%,11) \\ &= \$793.83 \end{aligned}$$

2.54)

$$\begin{aligned} A &= \$30,000 - \$3,000(A/G,8\%,10) \\ &= \$30,000 - \$3,000(3.8713) \\ &= \$18,386.1 \end{aligned}$$

2.55)

$$
\begin{aligned}
P &= \$3,000(P/A,12\%,8) + \$600(P/G,12\%,8) \\
&= \$3,000(4.9676) + \$600(14.4714) \\
&= \$23,585.64
\end{aligned}
$$

2.56)

$$
\begin{aligned}
C(P/G,9\%,6) &= \$1000(F/P,9\%,4) + \$800(F/P,9\%,3) + \$600(F/P,9\%,2) \\
&\quad + \$400(F/P,9\%,1) + \$200 \\
C(10.0924) &= \$3796.46 \\
&\rightarrow 1,000(F/P,9\%,4) + 800(F/A,9\%,4) - 200(P/G,9\%,4)(F/P,9\%,4) \\
&\therefore C = \$376.17
\end{aligned}
$$

2.57)

$$
\begin{aligned}
P &= \$6,000(P/A_{1,}5\%,9\%,40) \\
&= \$6,000\frac{1-(1.05)^{40}(1.09)^{-40}}{0.09-0.05} \\
&= \$116,379.57
\end{aligned}
$$

$$\$116379.57 * (F/P,9\%,40) = \$3,655.412.47$$

2.58) (a)

$$
\begin{aligned}
P &= \$10,000,000(P/A_{1,}-10\%,12\%,7) \\
&= \$10,000,000 \cdot \frac{1-(1-0.1)^{7}(1+0.12)^{-7}}{0.12-(-0.1)} \\
&= \$35,620,126
\end{aligned}
$$

(b) Note that the oil price increases at the annual rate of 5% while the oil production decreases at the annual rate of 10%. Therefore, the annual revenue can be expressed as follows:

$$
\begin{aligned}
A_n &= \$100(1+0.05)^{n-1}100,000(1-0.10)^{n-1} \\
&= \$10,000,000(0.945)^{n-1} \\
&= \$10,000,000(1-0.055)^{n-1}
\end{aligned}
$$

This revenue series is equivalent to a decreasing geometric gradient series with g = -5.5%.

N	A_n

1	$10,000,000
2	$9,450,000
3	$8,930,250
4	$8,439,086
5	$7,974,937
6	$7,536,315
7	$7,121,818

$$\begin{aligned} P &= \$10,000,000(P/A_{1,}-5.5\%, 12\%, 7) \\ &= \$10,000,000 \cdot \frac{1-(1-0.055)^{7}(1+0.12)^{-7}}{0.12-(-0.055)} \\ &= \$39,746,494.51 \end{aligned}$$

(c) Computing the present worth of the remaining series (A_4, A_5, A_6, A_7) at the end of period 3 gives

$$\begin{aligned} P &= \$8,439,086.25(P/A_1, -5.5\%, 12\%, 4) \\ &= \$8,439,086.25 \cdot \frac{1-(1-0.055)^{4}(1+0.12)^{-4}}{0.12-(-0.055)} \\ &= \$23,782,713 \end{aligned}$$

2.59)

$$\begin{aligned} P &= \sum_{n=1}^{20} A_n(1+i)^{-n} \\ &= \sum_{n=1}^{20} (2,000,000)n(1.06)^{n-1}(1.06)^{-n} \\ &= (2,000,000/1.06)\sum_{n=1}^{20} n(\frac{1.06}{1.06})^{n} \\ &= (2,000,000/1.06)\sum_{n=1}^{20} n \\ &= (2,000,000/1.06)\frac{20(21)}{2} \\ &= \$396,226,415.1 \end{aligned}$$

2.60)

(a) The withdrawal series would be:

Period	Withdrawal
11	\$3,000
12	\$3,000(1.06)
13	$\$3{,}000(1.06)^2$
14	$\$3{,}000(1.06)^3$
15	$\$3{,}000(1.06)^4$

Equivalent worth of the withdrawal series at period 10, using i = 8%:

$$\begin{aligned} P &= \$3{,}000(P/A_1, 6\%, 8\%, 5) \\ &= \$3{,}000 \cdot \frac{1-(1+0.06)^5(1+0.08)^{-5}}{0.08-(0.06)} \\ &= \$13{,}383.92 \end{aligned}$$

Assuming that each deposit is made at the end of each year, the following equivalence must be hold:

$$\begin{aligned} \$13{,}384 &= A(F/A, 8\%, 10) \\ &= 14.4866A \\ A &= \$923.88 \end{aligned}$$

(b) Equivalent present worth of the withdrawal series at 6%

$$P = \$3{,}000(P/A_1, 6\%, 6\%, 5) = \$3{,}000\frac{5}{1+0.06} = \$14{,}150.94$$

$$\begin{aligned} \$14{,}151 &= A(F/A, 6\%, 10) \\ &= 13.1808A \\ A &= \$1{,}073.60 \end{aligned}$$

2.61) $\$1{,}000{,}000 = A(F/A, 6\%, 30) = A(79.0582)$

➔ A = \$12,649 should be set aside on the account

a) $\$1{,}000{,}000 = A(P/A, 6\%, 20) = A(11.4699)$

➔ A = \$87,185 / year

b)

$$
\begin{aligned}
\$1,000,000 &= A_1(P/A_{1,}3\%,6\%,20) \\
&= A_1\frac{1-(1.03)^{20}(1.06)^{-20}}{0.06-0.03} \\
&= \$68,674/\text{year}
\end{aligned}
$$

2.62)

$$\frac{\$50}{1.1}+\frac{\$70}{1.1^2}+\frac{\$50}{1.1^3}=\frac{2C}{1.1}+\frac{C}{1.1^2}+\frac{2C}{1.1^3}=\frac{5.52C}{1.331}$$

$$\rightarrow 140.8715 = 4.1473C$$

$$C = \$33.97$$

2.63)

$$
\begin{aligned}
P &= [\$100(F/A,10\%,8)+\$50(F/A,10\%,6) \\
&\quad +\$50(F/A,10\%,4)](P/F,10\%,8) \\
&= [\$100(11.4359)+\$50(7.7156) \\
&\quad +\$50(4.6410)](0.4665) \\
&= \$821.70
\end{aligned}
$$

2.64) Select (a).

2.65)

$$
\begin{aligned}
P &= -\$500(P/F,10\%,1)+\$300(P/A,10\%,3)(P/F,10\%,1) \\
&\quad +\$800(P/F,10\%,5) \\
&= -\$500(0.9091)+\$300(2.4869)(0.9091) \\
&\quad +\$800(0.6209) \\
P &= \$720.42
\end{aligned}
$$

2.66)

Computing the equivalent worth at period 3 will require only two different types of interest factors.

$$\begin{aligned}
P_1 &= \$200(P/A,10\%,5)(F/P,10\%,3) \\
&= \$200(3.7908)(1.3310) \\
&= \$1,009.11 \\
P_2 &= A(P/A,10\%,2)(F/P,10\%,3) + A(P/A,10\%,2) \\
&= A(1.7355)(1.3310) + A(1.7355) \\
&= A(4.0455) \\
A &= \$1,009.11/4.0455 \\
&= \$249.44
\end{aligned}$$

2.67)

$$\begin{aligned}
P_{1,1} &= \$200(P/A,10\%,4) - 100(P/A,10\%,2) \\
&= \$200(3.1699) - 100(1.7355) \\
&= 460.43
\end{aligned}$$

$$\begin{aligned}
P_{2,1} &= X + X(P/A,10\%,4) \\
&= X + X(3.1699) \\
&= 4.1699X
\end{aligned}$$

$$\begin{aligned}
P_{1,1} &= P_{2,1} \\
\$460.43 &= 4.1699X \\
X &= \$110.42
\end{aligned}$$

2.68)

$$\begin{aligned}
P_1 &= \$50(P/A,10\%,4) + \$35(P/A,10\%,2)(P/F,10\%,2) \\
&= \$50(3.1699) + \$35(1.7355)(0.8264) \\
&= 208.6926 \\
P_2 &= C(P/A,10\%,4) + C(P/A,10\%,2)(P/F,10\%,1) \\
&= C(3.1699) + C(1.7355)(0.9091) \\
&= 4.7476C
\end{aligned}$$

$$\begin{aligned}
P_1 &= P_2 \\
C &= \$43.96
\end{aligned}$$

2.69)

$$C(F/A,9\%,8)=\$5,000(P/A,9\%,2)+\$5000$$
$$C(11.0285)=\$5,000(1.7591)+\$5000$$
$$C=\$1,250.90$$

2.70) The original cash flow series is

n	A_n
0	\$0
1	\$800
2	\$820
3	\$840
4	\$860
5	\$880
6	\$900
7	\$920
8	\$300
9	\$300
10	\$300 - \$500

2.71)

$$2C+C(P/A,12\%,7)(P/F,12\%,1)$$
$$=\$1,200(P/A,12\%,8)-400(P/A,12\%,4)$$

$$2C+C(4.5638)(0.8929)$$
$$=\$1,200(4.9676)-400(3.0373)$$

$$6.075C=\$4,746.20$$
$$C=\$781.27$$

2.72)

$$200(1.06)(1.08)(1.12)(1.15)$$
$$+\ X(1.08)(1.12)(1.15)$$
$$+\ \$300(1.15)$$
$$=\$1000$$

$$247.9+1.39104X+345=1000$$
$$1.39104X=360.1$$
$$X=\$258.87$$

2.73)

$$A(F/A,8\%,18) = \$20,000 + \$20,000(P/A,8\%,3)$$
$$A(37.4502) = \$20,000 + \$20,000(2.5771)$$
$$= \$71,542$$
$$A = \$1,910.32$$

2.74)

$$P_1 = \$500 + \$500(P/A,10\%,5)$$
$$= \$500 + \$500(3.7908)$$
$$= \$2,395.4$$

$$P_2 = X\left[(P/A,10\%,4)\right]$$
$$= X\left[(3.1699)\right]$$
$$= 2,395.4$$

$$\therefore X = \$755.67$$

2.75)

$$P_{1,2} = X(P/F,8\%,3)$$
$$= X(0.7938)$$

$$P_{2,2} = 800(P/A,8\%,10)$$
$$= 800(6.7101)$$
$$= 5368.08$$

$$X = 6,762.51$$

2.76)

$$C(P/A,9\%,5)(P/F,9\%,1) = \$4,000$$
$$C(3.8897)(0.9174) = \$4,000$$
$$C = \$1,120.95$$

2.77)

$$
\begin{aligned}
P(1.05)(1.08)(1.1)(1.06) &= \$1,000(1.08)(1.1)(1.06) + \$1,500(1.1)(1.06) \\
&\quad + \$1,000(1.06) + \$1000 \\
P(1.322244) &= \$5,068.28 \\
P &= \$3,833.09
\end{aligned}
$$

2.78)

$$
\begin{aligned}
P_1 &= 30,723(P/F, i\%, 5) \\
P_2 &= A(P/A, i\%, 10) \\
\$50,000(1+i)^{-5} &= \$5,000\left(\frac{(1+i)^{10}-1}{i(1+i)^{10}}\right) \\
\therefore i &= 13.06\%
\end{aligned}
$$

2.79)

- Exact:

$$
\begin{aligned}
2P &= P(1+i)^5 \\
2 &= (1+i)^5 \\
\log 2 &= 5 \log(1+i) \\
i &= 14.87\%
\end{aligned}
$$

- Rule of 72:

$$
\begin{aligned}
72/i &= 5\text{years} \\
i &= 14.4\%
\end{aligned}
$$

2.80)

- $$
\begin{aligned}
P_1 &= \$150(P/A, i, 5) - \$50(P/F, i, 1) \\
&= \$150\left(\frac{(1+i)^5-1}{i(1+i)^5}\right) - \$50 \cdot (1+i)^{-1}
\end{aligned}
$$
- $P_2 = \dfrac{\$200}{(1+i)} + \dfrac{\$150}{(1+i)^2} + \dfrac{\$50}{(1+i)^3} + \dfrac{\$200}{(1+i)^4} + \dfrac{\$50}{(1+i)^5}$
- $P_1 = P_2$ and solving i with Excel Goal Seek function,

$$i = 14.96\%$$

2.81)

$$
\begin{aligned}
\$35,000 &= \$10,000(F/P, i, 5) \\
&= \$10,000(1+i)^5 \\
i &= 28.47\%
\end{aligned}
$$

2.82)

$$
\begin{aligned}
\$104(1+i)^{25} &= \$7.92(F/A, i\%, 25)(1+i) \\
&= \$7.92\left(\frac{(1+i)^{25}-1}{i}\right)(1+i) \\
&\therefore i = 6.37\%
\end{aligned}
$$

2.83) The equivalent future worth of the prize payment series at the end of Year 20 (or beginning of Year 21) is

$$
\begin{aligned}
F_1 &= \$1,952,381(F/A, 6\%, 20) \\
&= \$1,952,381(36.7856) \\
&= \$71,819,506.51
\end{aligned}
$$

The equivalent future worth of the lottery receipts is

$$
\begin{aligned}
F_2 &= (\$36,100,000 - \$1,952,381)(F/P, 6\%, 20) \\
&= (\$36,100,000 - \$1,952,381)(3.2071) \\
&= \$109,514,828.9
\end{aligned}
$$

The resulting surplus at the end of Year 20 is

$$
\begin{aligned}
F_2 - F_1 &= \$109,514,828.9 - \$71,819,506.51 \\
&= \$37,695,322.4
\end{aligned}
$$

2.84)

$$
\begin{aligned}
&\$1,000(F/P, 9.4\%, 5) + \$500(F/A, 9.4\%, 5) \\
&= \$1,000((1+0.094)^5) + \$500(\frac{(1+0.094)^5-1}{0.094}) \\
&= \$1,000(1.5671) + \$500(6.0326) \\
&= \$4,583.4
\end{aligned}
$$

$$
\begin{aligned}
&\$4,583.4(F/P, 9.4\%, 60) \\
&= \$4,583.4((1+0.094)^{60}) \\
&= \$4,583.4(219.3) \\
&= \$1,005,141.21
\end{aligned}
$$

The main question is whether or not the U.S. government will be able to invest the social security deposits at 9.4% interest over 60 years.

2.85)

$$\begin{aligned}
P_{\text{Contract}} &= \$3,875,000 + \$3,125,000(P/F, 6\%, 1) + \$5,525,000(P/F, 6\%, 2) \\
&\quad + 6,275,000(P/F, 6\%, 3) + 6,625,000(P/F, 6\%, 4) \\
&\quad + 7575000(P/F, 6\%, 5) + 8125000(P/F, 6\%, 6) \\
&\quad + \$8,875,000(P/F, 6\%, 7) \\
&= \$3,875,000 + \$2,550,000(0.9434) \\
&\quad + \$5,525,000(0.8900) + \cdots \\
&\quad + \$8,875,000(0.6651) \\
&= \$39,548,212.5
\end{aligned}$$