

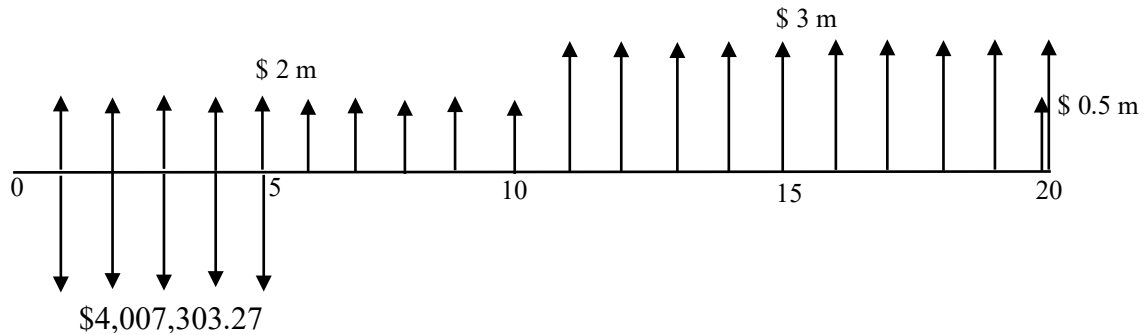
## IE2111 ISE Principles & Practice II Solutions to Assignment #2

(a)

$$\begin{aligned}
 \text{Annual repayment amount} &= 16,000,000 [A/P, 8\%, 5] \\
 &= 16,000,000 (0.250456455) \\
 &= \$ 4,007,303.27
 \end{aligned}$$

(b)

Cash flow diagram:



(c)

$$\begin{aligned}
 PW(10\%) &= -4,007,303.27 [P/A, 10\%, 5] && // \text{Loan repayments} \\
 &+ 2,000,000 [P/A, 10\%, 10] && // \text{Profits for years 1 to 10} \\
 &+ 3,000,000 [P/A, 10\%, 10] [P/F, 10\%, 10] && // \text{Profit for years 11 to 20} \\
 &+ 500,000 [P/F, 10\%, 20] && // \text{SV at EoY 20} \\
 \\ 
 &= -4,007,303.27 (3.790786769) \\
 &+ 2,000,000 (6.144567106) \\
 &+ 3,000,000 (6.144567106) (0.385543289) \\
 &+ 500,000 (0.148643628) \\
 &= \$ 4,279,613.64 > 0
 \end{aligned}$$

**The project is financially feasible.**

(d)

The *IRR* is *i* such that

$$\begin{aligned}PW(i) &= -4,007,303.27 [P/A, i, 5] + 2,000,000 [P/A, i, 10] \\&\quad + 3,000,000 [P/A, i, 10] [P/F, 10\%, 10] + 500,000 [P/F, i, 20] = 0 \\&= -4,007,303.27 \left( \frac{1-(1+i)^{-5}}{i} \right) + 2,000,000 \left( \frac{1-(1+i)^{-10}}{i} \right) + 3,000,000 \left( \frac{1-(1+i)^{-10}}{i} \right) \left( \frac{1}{(1+i)^{10}} \right) + \\&\quad 500,000 \left( \frac{1}{(1+i)^{20}} \right) = 0\end{aligned}$$

Using an equation solver:  $i = 0.1570$

Hence *IRR* = **15.70 %**

(e)

Financing rate = 8%

Reinvestment rate = 10%?

$$\begin{aligned}|PW(-ve \text{ CF at } 8\%)| &= (4,007,303.27 - 2,000,000) [P/A, 8\%, 5] \\&= 2,007,303.27 (3.992710037) \\&= \$ 8,014,579.93\end{aligned}$$

$$\begin{aligned}FW(+ve \text{ CF at } 10\%) &= 2,000,000 [F/A, 10\%, 5] [F/P, 10\%, 10] \\&\quad + 3,000,000 [F/A, 10\%, 10] \\&\quad + 500,000 \\&= 2,000,000 (6.1051) (2.59374246) \\&\quad + 3,000,000 (15.93742460) \\&\quad + 500,000 \\&= \$79,982,387.99\end{aligned}$$

$$\begin{aligned}MIRR &= \sqrt[20]{\frac{79,982,387.99}{8,014,579.93}} - 1 = 0.1219 \\&= \mathbf{\underline{12.19\%}}\end{aligned}$$

(f)

$PW(10\%)$  of CF for the Years 1 to 13 =

$$\begin{aligned} & -2,007,303.27 [P/A, 10\%, 5] \\ & + 2,000,000 [P/A, 10\%, 5] [P/F, 10\%, 5] \\ & + 3,000,000 [P/A, 10\%, 3] [P/F, 10\%, 10] \\ = & -2,007,303.27 (3.79078677) \\ & + 2,000,000 (3.79078677) (0.62092132) \\ & + 3,000,000 (2.48685199) (0.38554329) \\ = & -\$25,330.73 < 0 \end{aligned}$$

$PW(10\%)$  of CF for the Years 1 to 14 =

$$\begin{aligned} & = PW(10\%) \text{ of CF for the Years 1 to 13} + 3,000,000 [P/F, 10\%, 14] \\ & = -25,330.73 + 3,000,000 (0.26333125) \\ & = -25,330.73 + 789,993.76 \\ & = \$764,663.04 > 0 \end{aligned}$$

Since  $PW(10\%, 13 \text{ years}) < 0 < PW(10\%, 14 \text{ years})$ , it follows that the discounted payoff period of the project is **14 years**.