

IE 400: Principles of Engineering Management

Study Set 6 Solutions

Summer 2021

Question 1.

Let c_{ij} be the total net cost incurred from year i to j .

c_{ij} = maintenance cost incurred during years $i, i+1, \dots, j-1$ + cost of purchasing a car at the beginning of year i - trade-in value received at the beginning of year j .

$$c_{12} = 300 + 12000 - 7000 = 5300$$

$$c_{13} = 300 + 500 + 12000 - 6000 = 6800$$

$$c_{14} = 300 + 500 + 800 + 12000 - 4000 = 9600$$

$$c_{15} = 300 + 500 + 800 + 1200 + 12000 - 3000 = 11800$$

$$c_{16} = 300 + 500 + 800 + 1200 + 1600 + 12000 - 2000 = 13500$$

$$c_{17} = 300 + 500 + 800 + 1200 + 1600 + 2200 + 12000 - 1000 = 16700$$

$$c_{23} = 300 + 12000 - 7000 = 5300$$

$$c_{24} = 300 + 500 + 12000 - 6000 = 6800$$

$$c_{25} = 300 + 500 + 800 + 12000 - 4000 = 9600$$

$$c_{26} = 300 + 500 + 800 + 1200 + 12000 - 3000 = 11800$$

$$c_{27} = 300 + 500 + 800 + 1200 + 1600 + 12000 - 2000 = 13500$$

$$c_{34} = 300 + 12000 - 7000 = 5300$$

$$c_{35} = 300 + 500 + 12000 - 6000 = 6800$$

$$c_{36} = 300 + 500 + 800 + 12000 - 4000 = 9600$$

$$c_{37} = 300 + 500 + 800 + 1200 + 12000 - 3000 = 11800$$

$$c_{45} = 300 + 12000 - 7000 = 5300$$

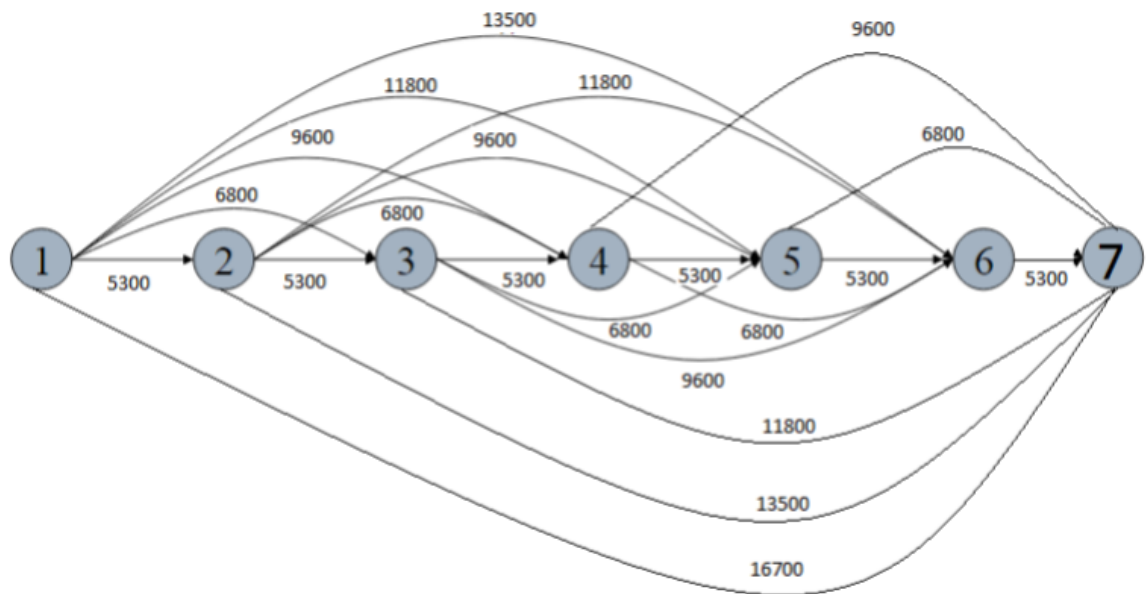
$$c_{46} = 300 + 500 + 12000 - 6000 = 6800$$

$$c_{47} = 300 + 500 + 800 + 12000 - 4000 = 9600$$

$$c_{56} = 300 + 12000 - 7000 = 5300$$

$$c_{57} = 300 + 500 + 12000 - 6000 = 6800$$

$$c_{67} = 300 + 12000 - 7000 = 5300$$



Replacing the car at years 2,4 and 6 yields the least costly solution.

Question 2.

End of Year	Principal Repayment	Interest Repayment	Remaining Balance
0			\$10000
1	\$1671	\$900	\$8329
2	\$1821	\$750	\$6508
3	\$1985	\$586	\$4523
4	\$2164	\$407	\$2359
5	\$2359	\$212	\$0

Question 3.

Our aim is to obtain:

$$F = 2P$$

It is known that

$$F = P(1 + 0.15)^N$$

Hence, we should find N that satisfies the following equality:

$$2P = P(1 + 0.15)^N$$

$$\log 2 = N \log(1.15)$$

$$N = 4.96 \text{ years}$$

Question 4.

$$\underbrace{\$25000 + \$30000 (P/F, 10\%, 6)}_{0.5645} - C \underbrace{(P/A, 10\%, 12)}_{6.814} + \$1000 \underbrace{(P/A, 10\%, 6)}_{4.355} \underbrace{(P/F, 10\%, 6)}_{0.5645}$$

$$39476.6025 = 6.814C$$

$$C = 5793.4550$$

Question 5.

If we select the base period at $n = 0$:

$$\underbrace{\$100 (P/A, 13\%, 5)}_{3.517} + \$20 \underbrace{(P/A, 13\%, 3)}_{2.361} \underbrace{(P/F, 13\%, 2)}_{0.7831} = A \underbrace{(P/A, 13\%, 5)}_{3.517}$$

$$388.678 = A3.517$$

$$A = 110.5141$$

Question 6.

Selecting the base period at $n = 3$:

$$\$950(i + 1)^3 + \$200 = \$250(i + 1)^2 + \$350(i + 1) + \$700$$

$$950i^3 + 2850i^2 + 2850i + 1150 = 250i^2 + 850i + 1300$$

$$950i^3 + 2600i^2 + 2000i - 150 = 0$$

$$i = 6.87\% \text{ (only positive real root)}$$