Engineering Economics

Annual Cash Flow Analysis

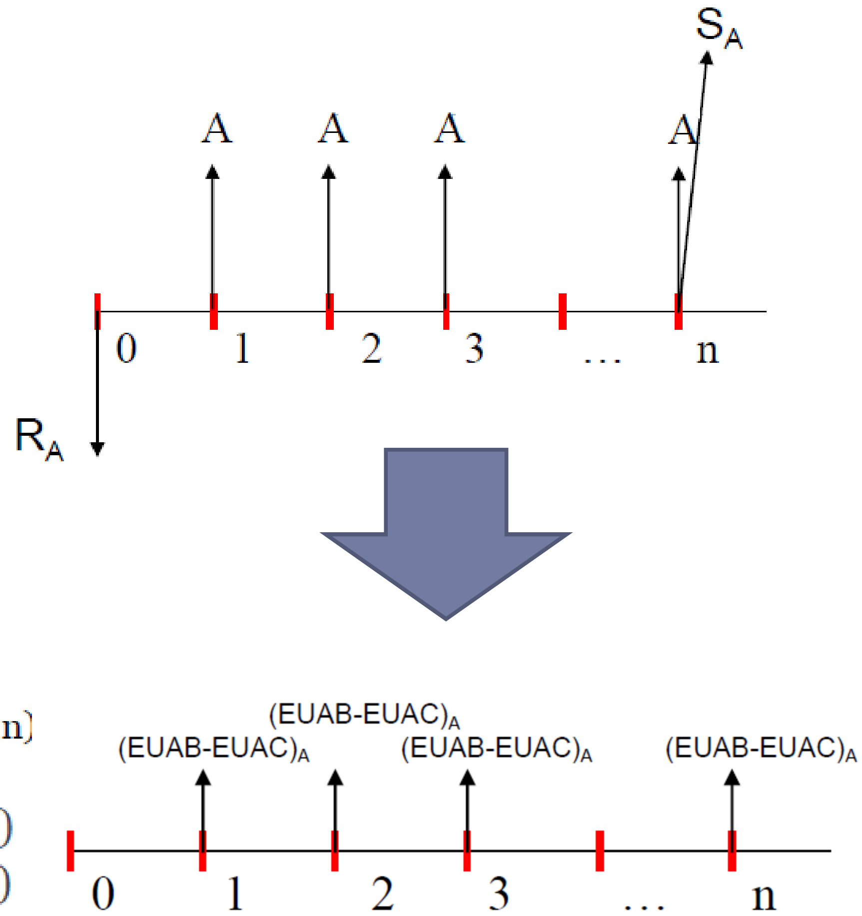
Annual Cash Flow Analysis

- Concepts of Annual Cash Flow Analysis

- Comparing Alternatives using Annual Cash Flow Analysis:
  - Same-Length Analysis Period
  - Different-Length Analysis Periods
  - Infinite-Length Analysis Period
  - Other Analysis Periods

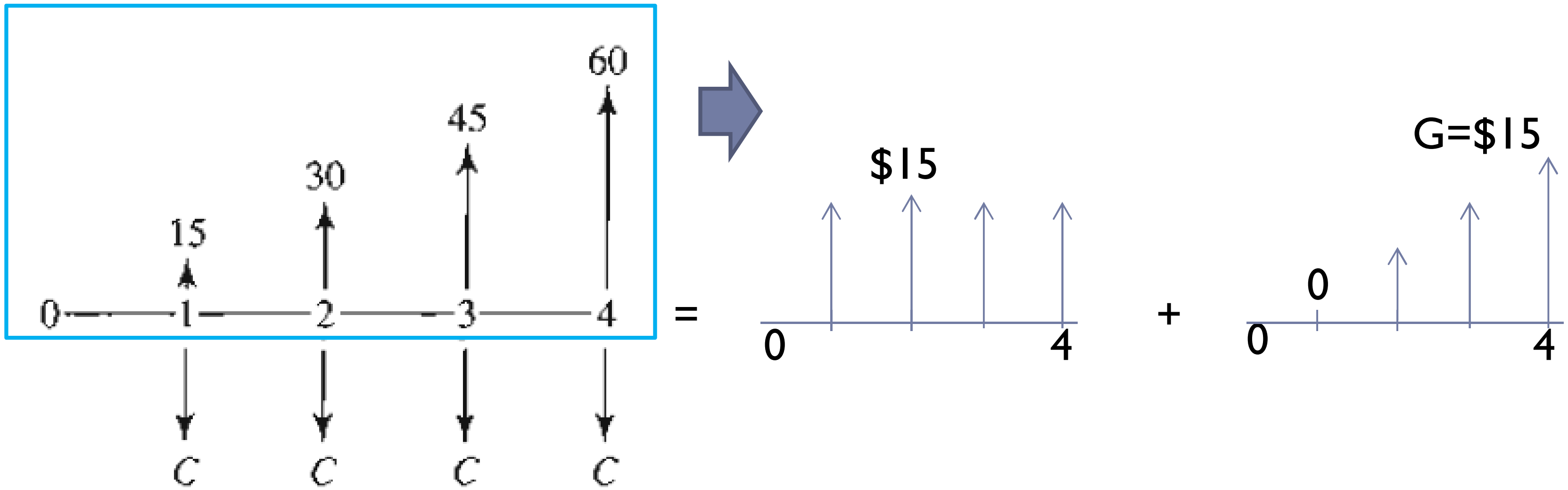
Techniques for Cash Flow Analysis

- Present Worth Analysis:
  - $PW_A = -R_A + A_A\,(P/A,i,n) + S_A\,(P/F,i,n)$
  - $PW_B = -R_B + R_B\,(P/A,i,n) + S_B\,(P/F,i,n)$
  - If $PW_A > PW_B$ => Choose A,
    - otherwise => choose B.
- Annual Cash Flow Analysis:
  - EUAC: Equivalent Uniform Annual Cost
    - $EUAC_A = R_A(A/P,i,n)$; $EUAC_B = R_B(A/P,i,n)$
  - EUAB: Equivalent Uniform Annual Benefit
    - $EUAB_A = A_A + S_A(A/F,i,n)$; $EUAB_B = A_B + S_B(A/F,i,n)$
  - $(EUAB\text{-}EUAC)_A = A + S_A(A/F,i,n) - R_A(A/P,i,n)$
  - $(EUAB\text{-}EUAC)_B = B + S_B(A/F,i,n) - R_B(A/P,i,n)$
  - If $(EUAB\text{-}EUAC)_A > (EUAB\text{-}EUAC)_B$
    - => Choose A, otherwise => choose B.



Problem 6-1

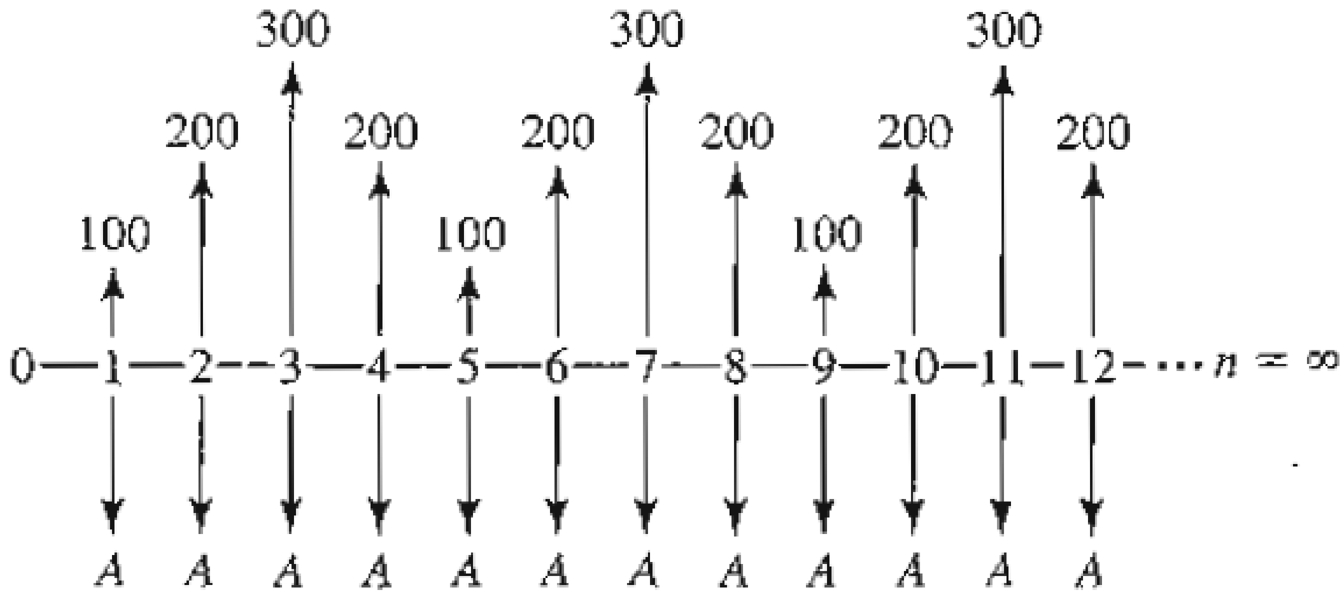
- Compute the value of C for the following diagram, based on "10% interest rate.



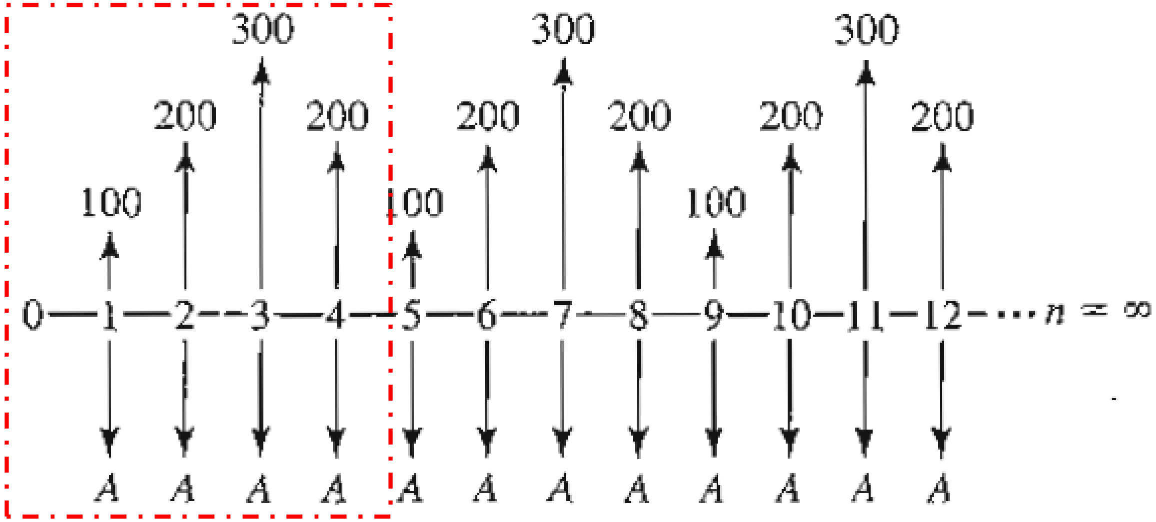
C = \$15 + \$15 (A/G, 10%, 4)
= \$15 + \$15 (1.381) = \$35.72

Problem 6-8

- As shown in the cash flow diagram, there is an annual disbursement of money that varies from year to year from $100 to $300 in a fixed pattern that repeats forever. If interest is 10%, compute the value of *A*, also continuing forever, that is equivalent to the fluctuating disbursements.



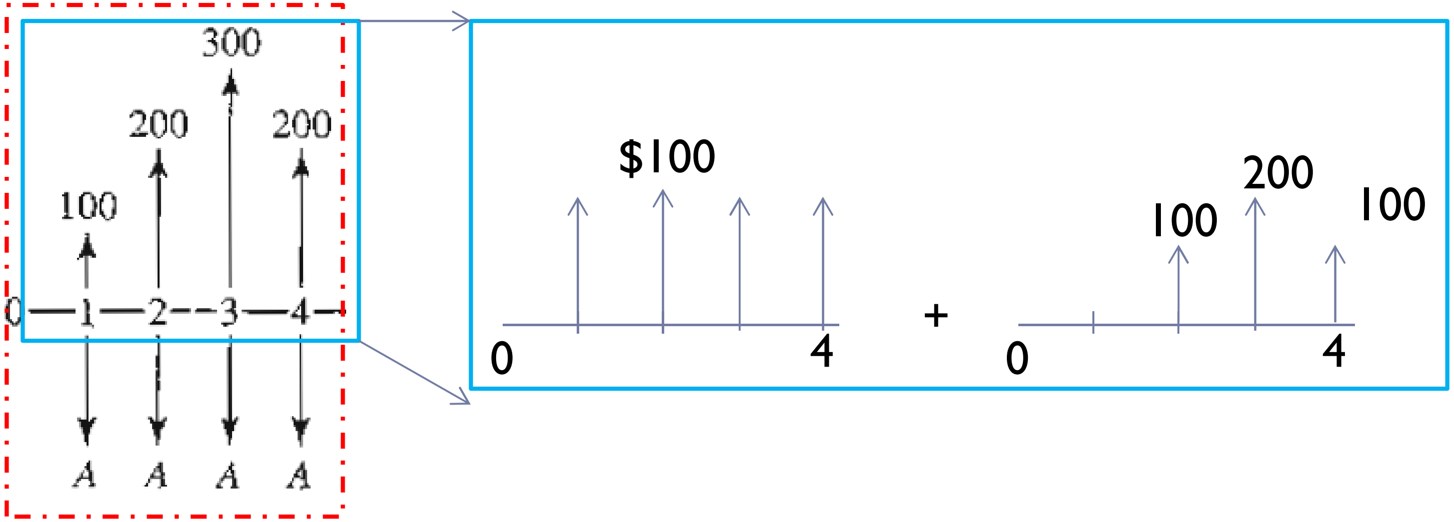
Problem 6-8



Pattern repeats infinitely

There is a repeating series:; 100 – 200 – 300 – 200. Solving this series for A gives us the A for the infinite series.

Problem 6-8



$$
\begin{aligned}
A &= \$100 + [\$100\ (P/F, 10\%, 2) + \$200\ (P/F, 10\%, 3) + \$100\ (P/F, 10\%, 4)]\ (A/P, 10\%, 4) \\
&= \$100 + [\$100\ (0.8254) + \$200\ (0.7513) + \$100\ (0.6830)]\ (0.3155) \\
&= \$100 + [\$301.20]\ (0.3155) \\
&= \$195.03
\end{aligned}
$$

Annual Cash Flow Analysis

- The basic idea is to convert all cash flows to a series of EUAW (equivalent uniform annual worth):

  Net EUAW = EUAB -EUAC

  - EUAC: Equivalent Uniform Annual Cost
  - EUAB: Equivalent Uniform Annual Benefit
- An expenditure increases EUAC and a receipt of money decreases EUAC.
- To convert a PW of a cost to EUAC, use:

  EUAC = (PW of cost) (A/P, i%, n)

- Where there is salvage value?

  A = F(A/F, i%, n)

  - A salvage value will reduce EUAC and increase EUAB
- When there is an arithmetic gradient, use the (A/G, i%, n) factor.
- If there are irregular cash flows, try to first find PW of these flows; then, EUAC may be calculated from this PW.
- Criteria for selection of an alternative:
  - Maximize Net EUAW (EUAB –EUAC)
  - Minimize EUAC OR Maximize EUAB

Analysis Period Equal to Alternative Lives

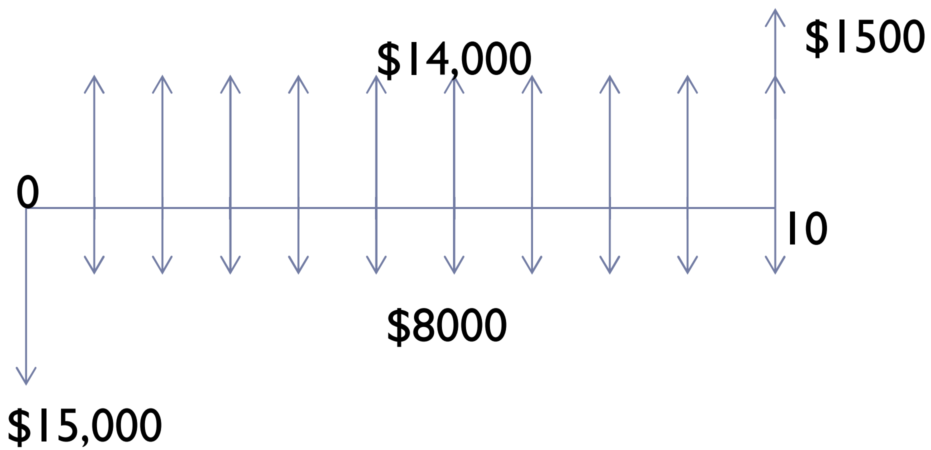
- We have an ideal situation (rarely the case in 'real-life'):
  - Study period = life-cycle of any of the alternatives

- **Example 6-6:** In addition to the do-nothing alternative, three alternatives are being considered for improving the operation of an assembly line. Each of the alternatives has a 10-years life and a scrap value equal to 10% of its original cost. If interest is 8%, which alternative should be adopted.

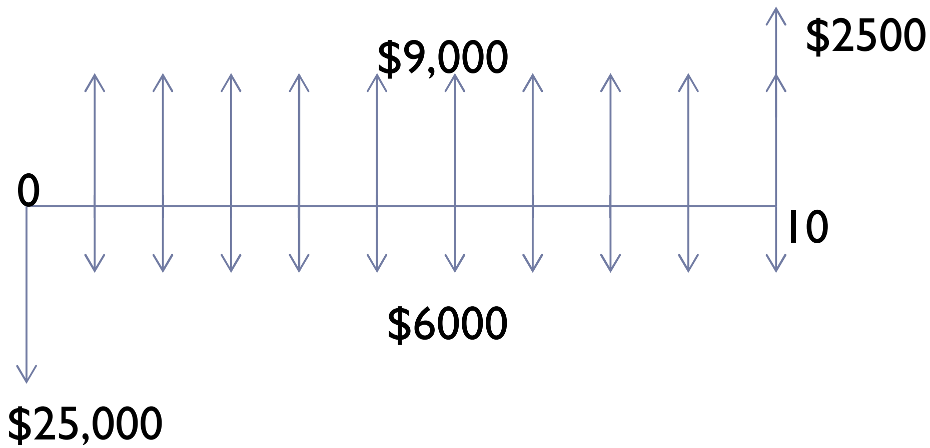
Plan	A	B	C
Installed cost of equipment	$15,000	$25,000	$33,000
Material and labor savings per year	$14,000	$9,000	$14,000
Annual operating expense	$8,000	$6,000	$6,000
End-of-useful life scrap value	$1,500	$2,500	$3,300

Analysis Period Equal to Alternative Lives

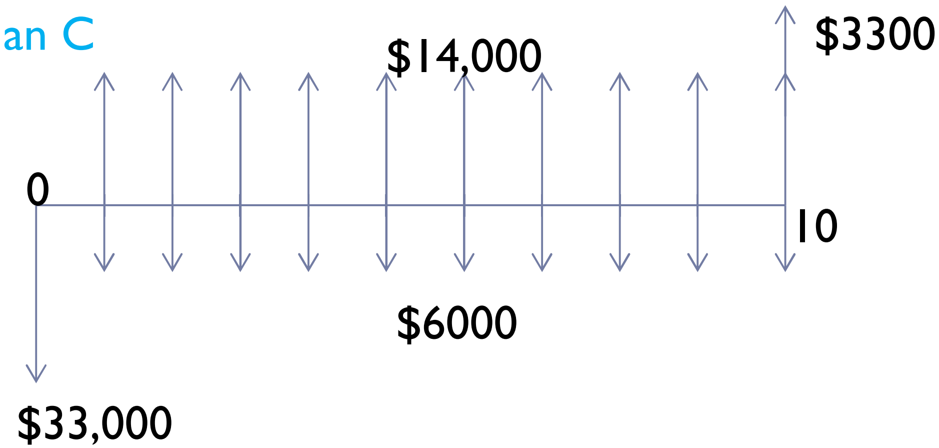
Plan A



Plan B



Plan C



Analysis Period Equal to Alternative Lives

Plan	A	B	C	Do Nothing
EUAB				
Material and labor savings per year	$14,000	$9,000	$14,000	$0
Scrap value (A/F,8%,10)	$104	$172	$228	0
Total EUAB	$14,104	$9,172	$14,228	$0
EUAC				
Installed cost (A/P,8%,10)	$2,235	$3,725	$4,927	0
Annual operating expenses	$8,000	$6,000	$6,000	0
Total EUAC	$10,235	$9,725	$10,927	0
EUAB - EUAC	$3,869	-$553	$3,311	$0

- (A/F,8%,10) = 0.0690
- (A/P,8%,10) = 0.1490

Choose Plan A

Problem 6-32

Two possible routes for a power line are under study. Data on the routes are as follows:

	Around the Lake	**Under the Lake**
Length	15 km	5 km
First cost	\$5000/km	\$25,000/km
Maintenance	\$200/km/yr	\$400/km/yr
Useful life, in years	15	15
Salvage value	\$3000/km	\$5000/km
Yearly power loss	\$500/km	\$500/km
Annual property taxes	2% of first cost	2% of first cost

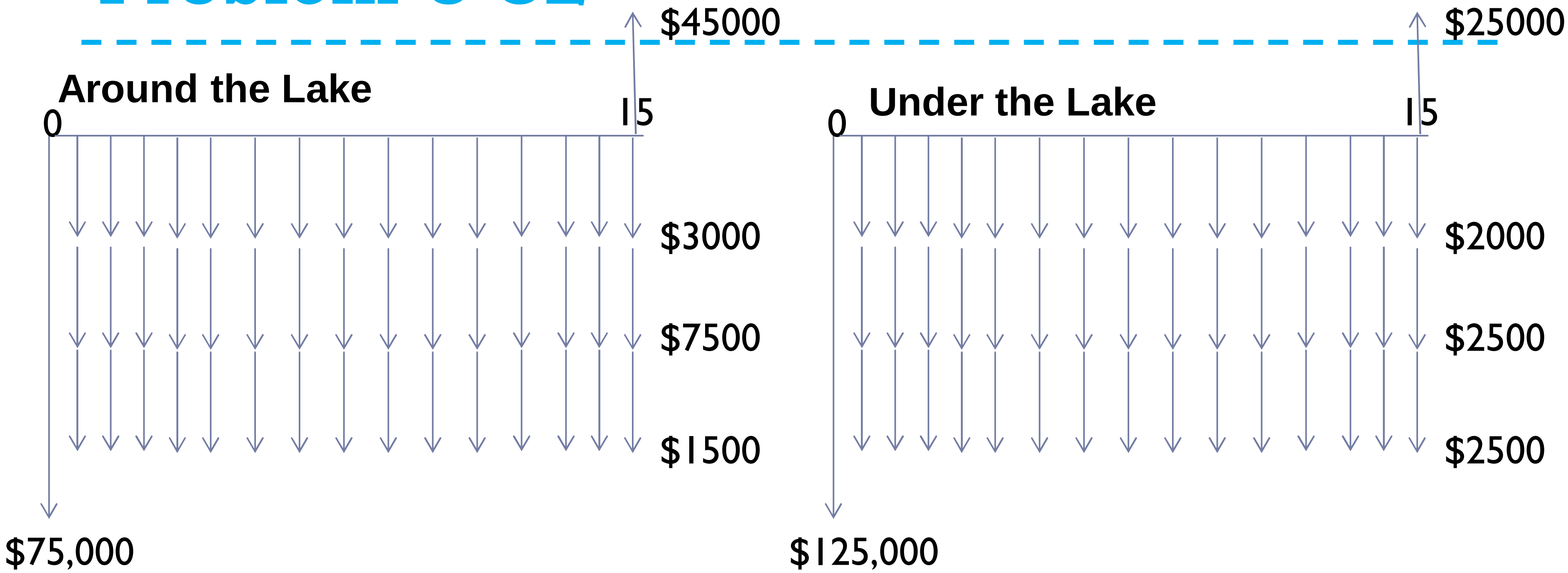
If 7% interest is used, should the power line be routed around the lake or under the lake? (*Answer:* Around the lake.)

Problem 6-32

	Around the Lake	Under the Lake
Length	15 km	5 km
First cost	$5000/km	$25,000/km
Maintenance	$200/km/yr	$400/km/yr
Useful life, in years	15	15
Salvage value	$3000/km	$5000/km
Yearly power loss	$500/km	$500/km
Annual property taxes	2% of first cost	2% of first cost

	Around the Lake	**Under the Lake**
First Cost	$75,000	$125,000
Maintenance	$3,000/yr	$2,000/yr
Annual Power Loss	$7,500/yr	$2,500/yr
Property Taxes	$1,500/yr	$2,500/yr
Salvage Value	$45,000	$25,000
Useful Life	15 years	15 years

Problem 6-32



Around the Lake

EUAC = $75,000 (A/P, 7%, 15) + $12,000 - $45,000 (A/F, 7%, 15)

= $75,000 (0.1098) + $12,000 - $45,000 (0.0398)

= $18,444

Under the Lake

EUAC = $125,000 (A/P, 7%, 15) + $7,000 - $25,000 (A/F, 7%, 15)

= $125,000 (0.1098) + $7,000 - $25,000 (0.0398)

= $19,730

Go around the lake.