IE2111 ISE Principles & Practice 2
Solutions to Assignment #3

	Alternative A Invest Large	Alternative B Invest Medium	Alternative C Invest Small
Initial Investment Cost	\$1,800,000	\$1,200,000	\$600,000
Annual Revenue	\$450,000	\$370,000	\$300,000
Annual Operation Cost	\$30,000	\$20,000	\$15,000
Useful Life	9 years	6 years	3 years
Market value at EoY 3	\$900,000	\$450,000	\$60,000
Market value at EoY 6	\$450,000	\$120,000	-
Market value at EoY 9	\$120,000	-	-

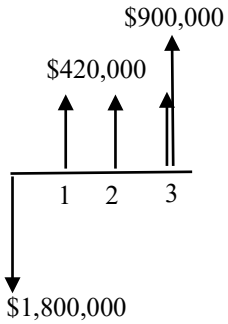
$MARR = 10\%$.

(*a*) Study period = 3 years.

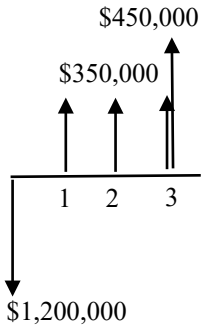
Assume that
- Alternative A is co-terminated at EoY 3.
- Alternative B is co-terminated at EoY 3.

Cash flow diagrams for each alternative over 3 years:

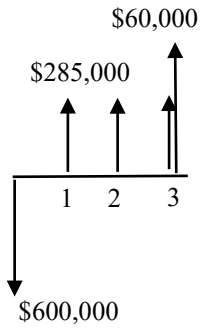
Alternative A



Alternative B



Alternative C



$$\begin{aligned} AW(10\%) \text{ of A over 3 years} &= -1{,}800{,}000\,[A/P, 10\%, 3] + 420{,}000 + 900{,}000\,[A/F, 10\%, 3] \\ &= -1{,}800{,}000\,(0.402114804) + 420{,}000 + 900{,}000\,(0.302114804) \\ &= -\$\,31{,}903.32 < 0 \end{aligned}$$

$$\begin{aligned} AW(10\%) \text{ of B over 3 years} &= -1{,}200{,}000\,[A/P, 10\%, 3] + 350{,}000 + 450{,}000\,[A/F, 10\%, 3] \\ &= -1{,}200{,}000\,(0.402114804) + 350{,}000 + 450{,}000\,(0.302114804) \\ &= \$\,3{,}413.90 \end{aligned}$$

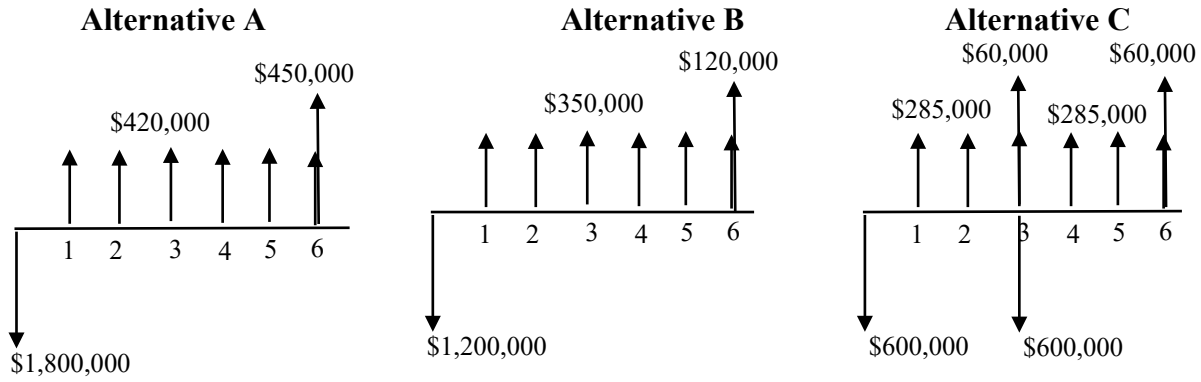
$$\begin{aligned} AW(10\%) \text{ of C over 3 years} &= -600{,}000\,[A/P, 10\%, 3] + 285{,}000 + 60{,}000\,[A/F, 10\%, 3] \\ &= -600{,}000\,(0.402114804) + 285{,}000 + 60{,}000\,(0.302114804) \\ &= \$\,61{,}858.01 \end{aligned}$$

Hence choose Alternative C which has the highest $AW(10\%)$ over the 3-year study period.

(*b*) Study period = 6 years.

Assume that
- Alternative A is co-terminated at EoY 6.
- Alternative C is repeated at EoY 3.

Cash flow diagrams for each alternative over 6 years:



$AW(10\%)$ of A over 6 years $= -1{,}800{,}000\,[A/P, 10\%, 6] + 420{,}000 + 450{,}000\,[A/F, 10\%, 6]$
$= -1{,}800{,}000\,(0.22960738) + 420{,}000 + 450{,}000\,(0.12960738)$
$= \$\ 65{,}030.04$

$AW(10\%)$ of B over 6 years $= -1{,}200{,}000\,[A/P, 10\%, 6] + 350{,}000 + 120{,}000\,[A/F, 10\%, 6]$
$= -1{,}200{,}000\,(0.22960738) + 350{,}000 + 120{,}000\,(0.12960738)$
$= \mathbf{\$\ \underline{90{,}024.03}}$

$AW(10\%)$ of C over 6 years $=$ $AW(10\%)$ of C over first 3 years
$= \$\ 61{,}858.01$ // from part (*a*)

Hence choose Alternative B which has the highest $AW(10\%)$ over the 6-year study period.

(*c*) Study period = 6 years.

Assume that
- Alternative A is co-terminated at EoY 6.
- Alternative C is repeated at EoY 3.

The cash flow diagrams are as in Part (b)
Using Incremental *IRR* Method:

Projects sorted in increasing initial cost = [C, B, A]
As these are investment projects"

Base project = "do nothing".
Next project = "C"

EoY	C – "do-nothing"
0	-600,000
1	285,000
2	285,000
3	-255,000
4	285,000
5	285,000
6	345,000

IRR(C-"do-nothing") = 23.58% > 10% $\Rightarrow$ Feasible.
Base project = C
Next project = B

EoY	B - C
0	-600,000
1	65,000
2	65,000
3	605,000
4	65,000
5	65,000
6	125,000

IRR(B - C) = 16.62% > 10% $\Rightarrow$ Feasible.
Base project = B
Next project = A

EoY	A - B
0	-600,000
1	70,000
2	70,000
3	70,000
4	70,000
5	70,000
6	400,000

IRR(A - B) = 5.06% < 10% $\Rightarrow$ Infeasible.
Base project = B
Next project = Nil

Hence choose Alternative B based on incremental IRR over the 6-year study period.

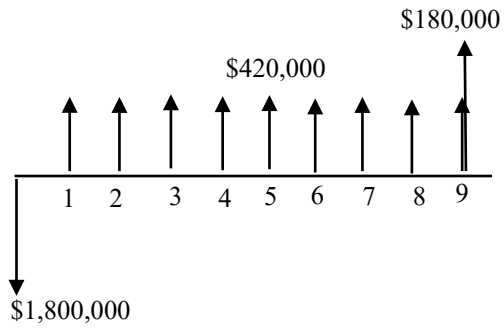
Notice that the individual IRR for A, B and C over 6 years are 14.70%, 20.13% and 23.58% respectively. The best project B does not have the maximum IRR over 6 years.

(*d*) Study period = infinity

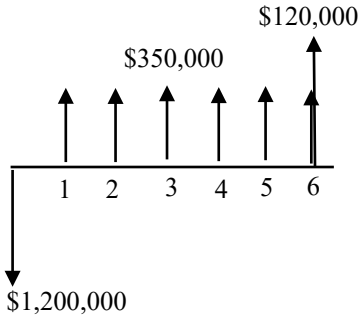
Assume all alternatives can be repeated at the end of their useful life.

Cash flow diagrams for each alternative over their first life cycle:

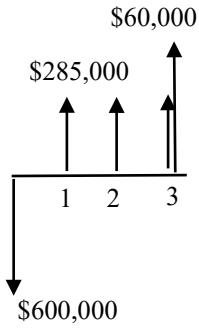
Alternative A



Alternative B



Alternative C



AW(10%) of A over infinity = AW(10%) of A over first 9 years
= –1,800,000 [A/P, 10%, 9] + 420,000 + 180,000 [A/F, 10%, 9]
= –1,800,000 (0.173640539) + 420,000 +180,000 (0.073640539)
= **$ <u>120,702.33</u>**

AW(10%) of B over infinity = AW(10%) of B over first 6 years
= $ 90,024.03 // from part (b)

AW(10%) of C over infinity = AW(10%) of C over first 3 years
= $ 61,858.01 // from part (a)

Hence choose Alternative A which has the highest AW over the infinite study period