Tutorial 6

A metal plating company is considering four different methods of recovering by-product heavy metals from manufacturing site's liquid waste. The investment costs and incomes associated with each method have been estimated. All methods have a 10-year life. The MARR is 12% per year.
If the methods are mutually exclusive, determine which one method can be selected using exact calculation of ROR.

Method	*First cost*	*Annual income*	*SV*
A	***-15,000***	***4,000***	***1,000***
B	***-18,000***	***5,000***	***2,000***
C	***-25,000***	***6,000***	***-500***
D	***-35,000***	***8,000***	***-700***

Alternative compared: **A – DN:**

$0 = -PW_D + PW_R \longrightarrow 0 = -15{,}000 + 4{,}000(P/A,i^*,10) + 1{,}000(P/F,i^*,10)$

For initial i, since the value of salvage is small after 10 years, we can ignore it from the above equation;

$0 = -15{,}000 + 4{,}000(P/A,i^*,10) \longrightarrow (P/A,i^*,10) = 3.75$, so we can start by selecting i = 24% (why?)

$0 = -15{,}000 + 4{,}000(P/A,24\%,10) + 1{,}000(24\%,24\%,10) = -156$

Negative value indicates that $i^*<24\%$,

At 22%, the value is 829.7; we now interpolate to determine i^*

$i^* = 24\% - [(0.02*156)/985.7] = 23.68\%$ >= MARR or >=12% , so eliminate DN, select A as defender and B as challenger.

The incremental cash flow tabulation:

Year	A	B	C	D	B-A	C-B	D-B
0	-15,000	-18,000	-25,000	-35,000	-3,000	-7,000	-17,000
1-10	4,000	5,000	6,000	8,000	1,000	1,000	3,000
10	1,000	2,000	-500	-700	1,000	-2,500	-2,700

B – A: $0 = -3000 + 1000(P/A,\Delta i^*,10) + 1000(P/F,\Delta i^*,10)$

In order to find the initial Δi, same as previous part, we ignore the value of salvage;

$0 = -3000 + 1000(P/A,\Delta i,10) \longrightarrow (P/A,\Delta i,10) = 3$

Since at i = 30%, $(P/A,\Delta i,10) = 3.0915$, we start by selecting $\Delta i = 30\%$,

$0 = -3000 + 1000(P/A,30\%,10) + 1000(P/F,30\%,10) = 164$

Positive value indicates that $\Delta i^* > 30\%$, so increase $\Delta i = 35\%$,

$0 = -3000 + 1000(P/A,35\%,10) + 1000(P/F,35\%,10) = -235.3$

we now interpolate to determine Δi^*, $\Delta i^* = 30\% + [(0.05*164)/399.3] = 32\%$

Since $\Delta i^* = 32\% > 12\%$, select B and eliminate A.

C – B: $0 = -7000 + 1000.(P/A,\Delta i^*,10) - 2500.(P/F,\Delta i^*,10)$

we start by selecting $\Delta i = 7\%$ (same as before ignore the salvage value to find the initial point of investigation)

$0 = -7000 + 1000(P/A,7\%,10) - 2500(P/F,7\%,10) = -1,247.15$

At 5%, the value is -813

At 3%, the value is -329.8

At 2%, the value is -67.4

At 1.5%, the value is 69.7

The value of Δi^* is between 2% and 1.5% per year.

$\Delta i^* = 2\% - [(0.005*67.4)/137.1] = 1.76\%$

Since $\Delta i^* = 1.76\% > 12\%$, select B again and eliminate C

D – B: $0 = -17000 + 3000(P/A,\Delta i^*,10) – 2700(P/F,\Delta i^*,10)$
Here, again by doing same calculation, we can find that $\Delta i^* <$ MARR. Therefore, B is still the selection. **Select B**.