A manufacturing firm is considering the following alternative projects (Project A and Project B) with the corresponding sequences of cash flows given below:

<table>
<thead>
<tr>
<th>$n$</th>
<th>Net Cash Flow ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Project A</td>
</tr>
<tr>
<td>0</td>
<td>-2 000</td>
</tr>
<tr>
<td>1</td>
<td>1 400</td>
</tr>
<tr>
<td>2</td>
<td>1 640</td>
</tr>
</tbody>
</table>

a) Compute the IRR for each project.
b) At a MARR = 15 %, determine the acceptability of each project.
c) If A and B are mutually exclusive projects, which project would you select, based on the rate of return (ROR) on incremental investment?
d) Which project would you select, based on the NPW method at MARR?
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SOLUTION

a) Compute IRR for each project as follows:

\[
[NPW(i^*)]_A = -2000 + 1400 \left( \frac{1}{1+i^*} \right) + 1640 \left( \frac{1}{1+i^*} \right)^2 = 0
\]

\[
\left( \frac{1}{1+i^*} \right) = X
\]

\[
[NPW(X)]_A = -2000 + 1400X + 1640X^2 = 0
\]

\[
X = \frac{-1400 \pm \sqrt{1400^2 - 4(1640)(-2000)}}{2(1640)} = \frac{-1400 \pm 3883.30}{3280} = 0.7571 \text{ or } -1.6108
\]

\[
0.7571 = \frac{1}{1+i^*} \rightarrow i^* = 0.3208(32.08\%)
\]

\[
-1.6108 = \frac{1}{1+i^*} \rightarrow i^* = -1.62(-162\%)
\]

Since an interest rate less than -100% has no economic significance, we find that the project A’s \((i^*)_A\) is 32.08%.

\[
[NPW(i^*)]_B = -3000 + 2400 \left( \frac{1}{1+i^*} \right) + 2000 \left( \frac{1}{1+i^*} \right)^2 = 0
\]

\[
\left( \frac{1}{1+i^*} \right) = X
\]

\[
[NPW(X)]_B = -3000 + 2400X + 2000X^2 = 0
\]

\[
X = \frac{-2400 \pm \sqrt{2400^2 - 4(2000)(-3000)}}{2(2000)} = \frac{-2400 \pm 5455.27}{4000} = 0.76 \text{ or } -1.9638
\]

\[
0.76 = \frac{1}{1+i^*} \rightarrow i^* = 0.3092(30.92\%)
\]

\[
-1.9638 = \frac{1}{1+i^*} \rightarrow i^* = -1.509(-150.9\%)
\]

Since an interest rate less than -100% has no economic significance, we find that the project B’s \((i^*)_B\) is 30.92%.

b) Since the both projects have IRR higher than MARR (15%), they are acceptable projects.

c) To select one of them, IRR based on Incremental Cash Flow must be calculated:

<table>
<thead>
<tr>
<th>(n)</th>
<th>Net Cash Flow ($)</th>
<th>Incremental Cash Flow</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Project A</td>
<td>Project B</td>
</tr>
<tr>
<td>0</td>
<td>-2 000</td>
<td>-3 000</td>
</tr>
<tr>
<td>1</td>
<td>1 400</td>
<td>2 400</td>
</tr>
<tr>
<td>2</td>
<td>1 640</td>
<td>2 000</td>
</tr>
</tbody>
</table>
$[NPW(i^*)]_{B-A} = -1000 + 1000 \left( \frac{1}{1+i^*} \right) + 360 \left( \frac{1}{1+i^*} \right)^2 = 0$

$$\left( \frac{1}{1+i^*} \right) = x$$

$[NPW(x)]_{B-A} = -1000 + 1000x + 360x^2 = 0$

$$x = \frac{-1000 \pm \sqrt{1000^2 - 4(360)(-1000)}}{2(360)} = \frac{-1000 \pm 1562.05}{720} = 0.7806 \text{ or } -3.5584$$

$0.7806 = \frac{1}{1+i^*} \rightarrow i^* = 0.2811(28.11\%)$

$-3.5584 = \frac{1}{1+i^*} \rightarrow i^* = -1.28(-128\%)$

Since an interest rate less than -100% has no economic significance, $IRR_{B-A}$ is 28.11%>15%

Select Project B.

d) $[NPW(15\%)]_A = -2000 + 1400(P/F,15\%,1) + 1640(P/F,15\%,2)$

$[NPW(15\%)]_A = -2000 + 1400(0.8696) + 1640(0.7561) = 457.44$

$[NPW(15\%)]_B = -3000 + 2400(P/F,15\%,1) + 2000(P/F,15\%,2)$

$[NPW(15\%)]_B = -3000 + 2400(0.8696) + 2000(0.7561) = 599.24$

$[NPW(15\%)]_B \neq [NPW(15\%)]_A$

Select Project B.