1. (a) Compute the cumulative cash flow for each project, \( PB_A = 3 \text{ years} \), \( PB_B = 3 \text{ years} \), and \( PB_C = 2 + \frac{5,000 - 2,000}{5,000} = 2.6 \text{ years} \). Choose project C.

(b) Discounted cash flows for all three projects @10\% are:

<table>
<thead>
<tr>
<th></th>
<th>( I_0 )</th>
<th>CF( _1 )</th>
<th>CF( _2 )</th>
<th>CF( _3 )</th>
<th>CF( _4 )</th>
<th>NPV</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>-5,000</td>
<td>909</td>
<td>826</td>
<td>2,254</td>
<td>0</td>
<td>-1,011</td>
</tr>
<tr>
<td>B</td>
<td>-3,000</td>
<td>0</td>
<td>826</td>
<td>1,503</td>
<td>3,415</td>
<td>2,744</td>
</tr>
<tr>
<td>C</td>
<td>-5,000</td>
<td>909</td>
<td>826</td>
<td>3,757</td>
<td>2,049</td>
<td>2,541</td>
</tr>
</tbody>
</table>

In project A, the cumulative DCF is 3,989 < 5,000. The initial investment will never be recovered. Thus, \( DPB_A = \infty \).

\[
DPB_B = 3 + \frac{3,000 - 826 - 1,503}{3,415} = 3.1965 \text{ years.}
\]

\[
DPB_C = 2 + \frac{5,000 - 909 - 826}{3,757} = 2.869 \text{ years < 3 years. Choose C.}
\]

(c) Both \( NPV_B \) and \( NPV_C \) are positive. Choose both projects.

2. \( k_a = 10\% \). For a lump-sum cash flow,

\[
NPV = \frac{CF_T}{(1 + k)^T} - I_0, \quad IRR = \left(\frac{CF_T}{I_0}\right)^{\frac{1}{T}} - 1.
\]

(a) \( NPV = \frac{10,000}{(1.1)^6} - 5,000 = 644.74 > 0, \quad IRR = \left(\frac{10,000}{5,000}\right)^{\frac{1}{6}} - 1 = 12.25\% > 10\%.
\]

The project should be accepted.

(b) \( NPV = \frac{10,000}{(1.1)^{6.5}} - 5,000 = 382.05 > 0, \quad IRR = \left(\frac{10,000}{5,000}\right)^{\frac{1}{6.5}} - 1 = 11.25\% > 10\%.
\]

The project should be accepted.

(c) \( NPV = \frac{10,000}{(1.1)^{6.75}} - 5,000 = 255.32 > 0, \quad IRR = \left(\frac{10,000}{5,000}\right)^{\frac{1}{6.75}} - 1 = 10.81\% > 10\%.
\]

The project should be accepted.

3. \( k_a = 12\% \).

(a) Input: \( N = 15 \) \( \quad \) Input: \( N = 15 \)

\begin{align*}
\text{PMT} &= 1,000 \\
\text{PV} &= -10,000 \\
\text{I/Y} &= 12 \\
\text{PMT} &= 1,000
\end{align*}
CPT: PV = -6,810.86  
NPV = 6,810.86 – 10,000 = -3,189.14;  IRR = 5.56% <12% 
The project should be rejected.

(b) 
(i) N = 60  
(ii) Time Period = one quarter  
(iii) Periodic Rate = \( k_4 = (1.12)^{1/4} - 1 = 0.028737 \)  
Input: N = 60  
PMT = 400  
I/Y = 2.8737  
CPT: PV = -11,376.28  
NPV = 11,373.28 – 10,000 = 1,373.28;  IRR = \( (1.03489)^{4} - 1 = 14.7\% \)  
The project should be accepted.

(c) 
(i) N = 180  
(ii) Time Period = one month  
(iii) Periodic Rate = \( k_{12} = (1.12)^{1/12} - 1 = 0.009489 \)  
Input: N = 180  
PMT = 100  
I/Y = 0.9489  
CPT: PV = -8,613.36  
NPV = 8,613.86 – 10,000 = -1,386.64;  IRR = \( (1.007299)^{12} - 1 = 9.12\% \)  
The project should be rejected.

(d) 
(i) N = 8  
(ii) Time Period = two years  
(iii) Periodic Rate = \( (1.12)^{2} - 1 = 0.2544 \)  
Input: N = 8  
PMT = 2,000  
I/Y = 25.44  
CPT: PV = -6,579.23  
NPV = 6,579.23 – 10,000 = -3,420.77;  IRR = \( (1.1181)^{1/2} - 1 = 5.74\% \)  
The project should be rejected.

4. \( k_a = 10\% \) 
(a) 
(i) N = 15  
(ii) Time Period = one year  
(iii) Periodic Rate = 12\%  
Input: N = 15  
PMT = 1,000  
FV = 2,000  
I/Y = 10  
CPT: PV = -8,084.86  
NPV = 8,084.86 – 10,000 = -1,915.14;  IRR = 6.76%  
The project should be rejected.
(b) 
(i) \( N = 60 \)
(ii) Time Period = one quarter
(iii) Periodic Rate = \( k_4/4 = (1.1)^{1/4} - 1 = 0.024114 \)

\[
\text{Input: } \begin{align*}
N &= 60 \\
PMT &= 400 \\
PV &= -10,000 \\
FV &= 1,000 \\
I/Y &= 2.4114 \\
PMT &= 400 \\
\end{align*}
\]

CPT: \( PV = -12,856.42 \)
NPV = 12,856.42 – 10,000 = 2,856.42; IRR = \((1.035507)^{4} - 1 = 14.98\%\)

The project should be accepted.

(c) 
(i) \( N = 180 \)
(ii) Time Period = one month
(iii) Periodic Rate = \( k_{12}/12 = (1.1)^{1/12} - 1 = 0.007974 \)

\[
\text{Input: } \begin{align*}
N &= 180 \\
PMT &= 100 \\
PV &= -10,000 \\
FV &= 1,000 \\
I/Y &= 0.7974 \\
PMT &= 100 \\
\end{align*}
\]

CPT: \( PV = -9,777.82 \)
NPV = 9,777.82 – 10,000 = -222.18; IRR = \((1.007663)^{12} - 1 = 9.59\%\)

The project should be rejected.

(d) 
(i) \( N = 8 \)
(ii) Time Period = two years
(iii) Periodic Rate = \((1.1)^{2} - 1 = 0.21\)

\[
\text{Input: } \begin{align*}
N &= 8 \\
PMT &= 2,000 \\
PV &= -10,000 \\
FV &= 5,000 \\
I/Y &= 21 \\
PMT &= 2,000 \\
\end{align*}
\]

CPT: \( PV = -8,539.30 \)
NPV = 8,539.30 – 10,000 = -1,460.70; IRR = \((1.165603)^{1/2} - 1 = 7.96\%\)

The project should be rejected.

5. In continuous annuity we use \( PV = A \cdot \left[ \frac{1 - e^{-k_c T}}{k_c} \right]\), \( k_c = \ln(1 + k_a) = \ln(1.1) = 9.53\% \).

(a) \( NPV = -10,000 + 1,000 \cdot \left[ \frac{1 - e^{-(0.0953\times15)}}{0.0953} \right] \)
\[= -10,000 + 7,980.81 = -2,019.19 < 0. \text{ Reject.} \]

(b) \( NPV = -10,000 + 1,000 \cdot \left[ \frac{1 - e^{-(0.0953\times15)}}{0.0953} \right] + \frac{5,000}{(1.1)^{15}} \)
\[= -10,000 + 7,980.81 + 1,196.96 = -822.23 < 0. \text{ Reject.} \]
6. For a perpetuity, \( NPV = \frac{CF}{k} - I_0 \), \( IRR = \frac{CF}{I_0} \).

(a) \( NPV = -10,000 + \frac{1.250}{0.1} = 2,500 > 0 \),
\( IRR = 1.250/10,000 = 12.5\% > 10\% \). Accept.

(b) \( NPV = -10,000 + \frac{1.250}{0.1} \cdot (1.1)^{\sqrt{2}} = 3,110.11 > 0 \), accept.

(c) \( NPV = -10,000 + \frac{1.250}{0.1} \cdot (1.1)^{\sqrt{4}} = 2,801.42 > 0 \), accept.

7. For infinite cash flows with constant growth, \( NPV = -I_0 + \frac{CF}{k - g}, \ IRR = \frac{CF}{I_0} + g \).

(a) \( NPV = -10,000 + \frac{1,000}{0.15 - 0.06} = 1,111.11 > 0 \), accept.
\( IRR = \frac{1,000}{10,000} + 0.06 = 16\% > 15\% \), accept.

(b) (i) \( N = \infty \)
(ii) Time Period = one quarter
(iii) Periodic Rate = \( k/4 = (1.15)^{1/4} - 1 = 0.035558 \)
\( NPV = -10,000 + \frac{300}{0.035558 - 0.015} = 4,592.81 > 0 \), accept.
Quarterly rate = \( \frac{300}{10,000} + 0.015 = 0.45 \), \( IRR = (1.045)^{4} - 1 = 19.25\% \), accept.

(c) For finite cash flows with constant growth:
\[
NPV = -10,000 + 1,000 \cdot \left[ 1 - \frac{(1.05)}{(1.15)}^{15} \right] = -10,000 + 7,445.11
\]
\[= -2,554.89 < 0 \), reject.

8. 

(a) \( IRR = \left( \frac{2,000}{1,000} \right)^{1/10} - 1 = 7.18\% \).

(b) \( IRR = \frac{CF}{I_0} = \frac{60}{1,000} = 6\% \).

(c) \( IRR = \frac{CF}{I_0} + g = \frac{60}{1,000} + 2\% = 8\% \).

(d) \( 1,000 = 60 \cdot PVAF(IRR, 30) \). Using financial calculator, set \( PV = -1000, N = 30, PMT = 60 \), compute \( IRR = I/Y = 4.31\% \).

(e) \( 1,000 = 60 \cdot PVAF(IRR, 30) + 100/(1 + IRR)^{30} \). Set \( PV = -1000, N = 30, FV = \)
100, PMT = 60, compute IRR = I/Y = 4.53%.
(f) \(1,000 = 60 \cdot PVAF(IRR, 30) + 1,000/(1 + IRR)^{30}\). Set PV = -1000, N = 30, FV = 1,000, PMT = 60, compute IRR = I/Y = 6%. This is a “reversible” project. The IRR is the same as the “coupon rate”, 6%.

9. Choose the project with the lower equivalent annuity (EA) or equivalent annual cost (EAC):
   PV of cost A = 1,000 + 500/(1.07) + 200/(1.07)^2 = 1,641.98
   EAC_A = 1,641.98/PVAF(7%, 2) = 908.17 (Set PV = 1,641.98, N = 2, I/Y = 7, compute PMT = 908.17)
   PV of cost B = 1,400 + 300/(1.07) + 300/(1.07)^2 + 400/(1.07)^3 = 2,268.92
   EAC_B = 2,268.92/PVAF(7%, 3) = 864.58 (Set PV = 2,268.92, N = 3, I/Y = 7, compute PMT = 864.58)
   Project B should be selected.

10. Select the project with the higher equivalent annuity (EA) of the NPV:
    NPV_A = -1,000 + 600/(1.1) + 700/(1.1)^2 = 123.97
    EA_A = 123.97/PVAF(10%, 2) = 71.45 (Set PV = 123.97, N = 2, I/Y = 10, compute PMT = 71.45)
    NPV_B = -2,000 + 600/(1.1) + 700/(1.1)^2 + 800/(1.1)^3 + 900/(1.1)^4 = 339.73
    EA_B = 339.73/PVAF(10%, 4) = 107.26 (Set PV = 339.73, N = 4, I/Y = 10, compute PMT = 107.26)
    Choose project B.