Module 5 Section 4 Exercises:

1. For the profit signature, \( \pi = (-300, 280, 48) \), determine
   
   (a) the IRR
   
   (b) the NPV and DPP using a hurdle rate of 6%

2. For a fully discrete 2-year term insurance on \( x \), you are given:
   
   (i) \( q_x = 0.2 \)
   
   (ii) The profit vector is \( Pr = (-300, 280, 60) \)

   Determine
   
   (a) \( \pi_2 \)
   
   (b) the surplus emerging at the end of the 2nd year for a policy in force at time 1
   
   (c) the profit emerging at the end of the 2nd year for a policy in force at issue

3. For a fully discrete whole life insurance issued to \( x \), you are given:
   
   (i) Mortality follows a constant force model with \( \mu = -\ln (0.9) \)
   
   (ii) The profit vector is \( Pr = (-2500, 1900, 250, 360, 470, 580, 690, ...) \)
   
   (iii) Profits are discounted using \( d = 10\% \)

   Determine
   
   (a) pre-contract expenses
   
   (b) the surplus emerging at the end of the 5th year for a policy in force at issue
   
   (c) NPV(5)
4. For a fully discrete 10-year term insurance on \((x)\), you are given:

(i) the profit signature is \(\pi = (-700, 120, 125, 130, 130, 130, 130, 130, 125, 120, 110)\)

(ii) the risk discount rate is 8%

(iii) annual premiums are 1250

(iv) \(\ddot{a}_{x:10} = 8\) using policy mortality and an 8% annual effective interest rate

Determine

(a) the IRR

(b) the NPV

(c) the profit margin

(d) the discounted payback period

5. For a fully discrete 3-year term insurance on \((x)\), you are given:

(i) the profit vector is \(Pr = (-1000, 750, 200, 200)\)

(ii) the net present value is 17.49, using a hurdle rate of 5%

(iii) mortality follows a constant force model

Determine \(q_x\).

6. For a fully discrete 3-year term insurance on \((x)\), you are given:

(i) the profit vector is \(Pr = (-1000, 750, 200, 200)\)

(ii) the internal rate of return is 6%

(iii) mortality follows a constant force model

Determine \(q_x\).
7. For a fully discrete 5-year term insurance on \((x)\), you are given:

(i)

<table>
<thead>
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<th>(t)</th>
<th>(P_r_t)</th>
<th>(\pi_t)</th>
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<tr>
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<td>-230</td>
</tr>
<tr>
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<td>(X)</td>
</tr>
<tr>
<td>2</td>
<td>(Y)</td>
<td>77</td>
</tr>
<tr>
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<tr>
<td>5</td>
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</tbody>
</table>

(ii) the annual premium is 285

(iii) the hurdle rate is 10%

(iv) \(p_x = 0.9625\)

Determine

(a) \(X\)

(b) \(Y\)

(c) the value of \(3p_x\)

(d) the value of \(q_{x+2}\)

(e) NPV(3)

(f) the discounted payback period

(g) profit margin