L-TAM Module 1 Section 9 Exercises

1. Given a double decrement table with $q_x^{(1)} = .04$ and $p_x^{(r)} = .94$, determine $q_x^{(2)}$.

2. For a double decrement table, given $p_x^{(1)} = 0.95$ and $q_x^{(2)} = 0.1$, determine $q_x^{(r)}$.

3. For a double decrement table, given $p_x^{(1)} = 0.9$, $q_x^{(1)} = 0.09$, and $p_x^{(r)} = 0.72$, determine
   (a) $q_x^{(2)}$ 
   (b) $q_x^{(1)}$

4. You are given the double decrement table:

<table>
<thead>
<tr>
<th>$x$</th>
<th>$l_x^{(r)}$</th>
<th>$q_x^{(1)}$</th>
<th>$q_x^{(2)}$</th>
<th>$q_x^{(r)}$</th>
<th>$q_x^{(2)(r)}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>1000</td>
<td>0.09</td>
<td></td>
<td></td>
<td>0.20</td>
</tr>
<tr>
<td>31</td>
<td>712</td>
<td>0.20</td>
<td>0.15</td>
<td>0.20</td>
<td></td>
</tr>
<tr>
<td>32</td>
<td></td>
<td>0.15</td>
<td>0.16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>33</td>
<td>305.0208</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

   Determine
   (a) $2q_{31}^{(2)}$
   (b) $q_{30}^{(1)}$

5. For a triple decrement table, given $\mu_x^{(1)}(t) = .1$, $\mu_x^{(2)}(t) = .2$, and $\mu_x^{(3)}(t) = .3$. determine
   (a) $5q_x^{(r)}$
   (b) $5|10q_x^{(2)}$

6. For a triple decrement table, given $\mu_x^{(1)}(t) = .01$, $\mu_x^{(2)}(t) = .02$, and $\mu_x^{(3)}(t) = .03$. determine
   (a) $10q_x^{(r)}$
   (b) $10q_x^{(2)}$
   (c) $10|10q_x^{(r)}$
   (d) $10|10q_x^{(1)}$
   (e) the expected time until departure, $e_x^{(r)}$
7. For a double decrement table given: \( \mu_x^{(1)}(t) = 0.01 + 0.01t \), \( \mu_x^{(2)}(t) = 0.02 + 0.02t \), and \( \mu_x^{(3)}(t) = 0.03 + 0.03t \), determine

(a) \( q_x^{(r)} \)
(b) \( q_x^{(3)} \)
(c) the conditional probability that departure was by decrement 2, given that departure occurred at age \( x+5 \)
(d) the conditional probability that departure was by decrement 1, given that departure occurred before age \( x+5 \)

8. You are given the double decrement table:

<table>
<thead>
<tr>
<th>( x )</th>
<th>( l_x^{(r)} )</th>
<th>( d_x^{(1)} )</th>
<th>( d_x^{(2)} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td></td>
<td>75</td>
<td></td>
</tr>
<tr>
<td>51</td>
<td>900</td>
<td></td>
<td></td>
</tr>
<tr>
<td>52</td>
<td></td>
<td></td>
<td>25</td>
</tr>
<tr>
<td>53</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

You are also given:

(i) \( q_{50}^{(r)} = 0.1 \)
(ii) \( 2p_{50}^{(r)} = 0.825 \)
(iii) there are twice as many departures from decrement 1 at age 51 as there are from decrement 2 at age 51
(iv) \( 2q_{50}^{(1)} = 0.025 \)

Determine

(a) \( q_{50}^{(2)} \)
(b) \( 2q_{51}^{(r)} \)
(c) \( 1q_{51}^{(1)} \)
(d) \( 1/2q_{50}^{(2)} \)

9. Given \( l_x^{(r)} = 1000 \) and a triple decrement table with \( \mu_x^{(j)} = 0.1 + 0.2(j - 1) \) for \( j = 1, 2, \) and \( 3 \), determine the expected number of departures between ages \( x \) and \( x+1 \) by decrement 2.
10. Given a double decrement model with $\mu_x^{(1)} = 0.02$ and $\mu_x^{(2)} = 0.03$, determine

(a) $2p_x^{(r)}$
(b) $2q_x^{(1)}$
(c) $2q_x^{(2)}$
(d) $2q_x''^{(1)}$
(e) $2q_x''^{(2)}$

11. Given a double decrement table where decrement 1 is DML(80) in the associated single decrement table and decrement 2 has $\mu_x^{(2)} = 0.1$, determine

(a) $10q_{50}^{(1)}$
(b) $\mu_{50}^{(r)}(10)$

12. Given a double decrement table where decrement 1 is DML(100) in the associated single decrement table and decrement 2 has $\mu_x^{(2)} = 0.05$, determine

(a) $10q_{30}^{(1)}$
(b) $10q_{30}^{(2)}$

13. Given a double decrement model with $p_x''^{(1)} = 0.9$ and $p_x''^{(2)} = 0.8$, determine $q_x^{(1)}$ and $q_x^{(2)}$ using

(a) MUDD
(b) SUDD

14. Given a double decrement model with $q_x^{(1)} = 0.1$ and $q_x^{(2)} = 0.2$, determine $q_x''^{(1)}$ and $q_x''^{(2)}$ using

(a) MUDD
(b) SUDD

15. For a double decrement table where each decrement is UDD in the double decrement table, given $q_x''^{(1)} = 0.1$ and $q_x''^{(2)} = 0.2$, determine

(a) $0.3q_x^{(2)}$
(b) $0.5|0.3q_x^{(2)}$
(c) $0.3q_x^{(2)}$
16. Given a double decrement model with \( p_{40}^{(1)} = p_{41}^{(1)} = 0.9 \) and \( p_{40}^{(2)} = p_{41}^{(2)} = 0.8 \), determine \( 1.5q_{40}^{(1)} \) using the SUDD assumption.

17. Given a double decrement table where decrement 1 is BOY and decrement 2 is UDD in the associated single decrement table, and given \( q_x^{(1)} = 0.1 \) and \( q_x^{(2)} = 0.2 \), determine

(a) \( q_x^{(1)} \)
(b) \( q_x^{(2)} \)

18. For a triple decrement table where decrement 1 and decrement 2 are each UDD in their associated single decrement tables, and decrement 3 is EOY, given \( q_x^{(j)} = 0.2j \) for \( j = 1, 2, \) and 3, determine

(a) \( q_x^{(1)} \)
(b) \( q_x^{(2)} \)
(c) \( q_x^{(3)} \)

19. For a double decrement table where decrement 1 is MOY and decrement 2 is UDD in the associated single decrement table, given \( q_x^{(1)} = 0.1 \) and \( q_x^{(2)} = 0.3 \) determine

(a) \( q_x^{(1)} \)
(b) \( q_x^{(2)} \)

20. For a double decrement table where decrement 1 is SUDD and 25% of decrement 2 occurs at time 0.3 with the rest occurring at time 0.7, given \( q_x^{(1)} = 0.2 \) and \( q_x^{(2)} = 0.4 \) determine

(a) \( q_x^{(1)} \)
(b) \( q_x^{(2)} \)