Question #94
Answer: B

$$\mu_{\overline{x+t:y+t}} = \frac{{}_tq_y\ {}_tp_x\mu_{x+t} + {}_tq_x\ {}_tp_y\ \mu_{y+t}}{{}_tq_x \times {}_tp_y + {}_tp_x \times {}_tq_y + {}_tp_x \times {}_tp_y}$$

For (*x*) = (*y*) = (50)

$$\mu_{\overline{50:50}}(10.5) = \frac{\left({}_{10.5}q_{50}\right)\left({}_{10}p_{50}\right)q_{60}\cdot 2}{\left({}_{10.5}q_{50}\right)\left({}_{10.5}p_{50}\right)\cdot 2 + \left({}_{10.5}p_{50}\right)^2} = \frac{(0.09152)(0.91478)(0.01376)(2)}{(0.09152)(0.90848)(2)+(0.90848)^2} = 0.0023$$

where

$${}_{10.5}p_{50} = \frac{\tfrac{1}{2}\left(l_{60}+l_{61}\right)}{l_{50}} = \frac{\tfrac{1}{2}(8{,}188{,}074+8{,}075{,}403)}{8{,}950{,}901} = 0.90848$$

$${}_{10.5}q_{50} = 1 - {}_{10.5}p_{50} = 0.09152$$

$${}_{10}p_{50} = \frac{8{,}188{,}074}{8{,}950{,}901} = 0.91478$$

${}_{10.5}p_{50}\ \mu(50+10.5) = \left({}_{10}p_{50}\right)q_{60}$ since UDD

Alternatively, ${}_{(10+t)}p_{50} = {}_{10}p_{50}\ {}_tp_{60}$

$${}_{(10+t)}p_{50:50} = \left({}_{10}p_{50}\right)^2\left({}_tp_{60}\right)^2$$

$${}_{(10+t)}p_{\overline{50:50}} = 2\ {}_{10}p_{50}\ {}_tp_{60} - \left({}_{10}p_{50}\right)^2\left({}_tp_{60}\right)^2$$

$$= 2\ {}_{10}p_{50}\left(1-tq_{60}\right) - \left({}_{10}p_{50}\right)^2\left(1-tq_{60}\right)^2 \text{ since UDD}$$

$$\text{Derivative } = -2\ {}_{10}p_{50}\ q_{60} + 2\left({}_{10}p_{50}\right)^2\left(1-tq_{60}\right)q_{60}$$

Derivative at $10+t=10.5$ is

$$-2(0.91478)(0.01376)+(0.91478)^2\left(1-(0.5)(0.01376)\right)(0.01376) = -0.0023$$

$${}_{10.5}p_{\overline{50:50}} = 2\ {}_{10.5}p_{50} - \left({}_{10.5}p_{50}\right)^2$$

$$= 2(0.90848)-(0.90848)^2$$

$$= 0.99162$$

μ (for any sort of lifetime) $= \dfrac{-\frac{dp}{dt}}{p} = \dfrac{-(-0.0023)}{0.99162} = 0.0023$