

## Flashcards for SOA Exam LTAM

1<sup>st</sup> Edition, 3<sup>rd</sup> Printing

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# Three formulas for $t|_{u}q_{x}$ in terms of non-deferred p's and q's



$$t|uq_x = tp_x uq_{x+t}$$
  

$$t|uq_x = tp_x - t + up_x$$
  

$$t|uq_x = t + uq_x - tq_x$$



 $_{k}p_{x}$  in terms of l's



$$_{k}p_{x}=\frac{l_{x+k}}{l_{x}}$$



 $_kq_x$  in terms of l's and d's



$$kq_x = \frac{kd_x}{l_x} = \frac{l_x - l_{x+k}}{l_x}$$



 $t|uq_x$  in terms of l's and d's



$$l_{t|u}q_{x} = \frac{ud_{x+t}}{l_{x}} = \frac{l_{x+t} - l_{x+t+u}}{l_{x}}$$



Definition of  $tq_x$  in terms of probabilities of X, the random variable for age at death.



$$_tq_x = \Pr(x < X \le x + t \mid X > x)$$



Definition of  $_tp_x$  in terms of probabilities of X, the random variable for age at death.



$$_t p_x = \Pr(X > x + t \mid X > x)$$



Definition of  $t|_{u}q_{x}$  in terms of probabilities of X, the random variable for age at death.



$$_{t|u}q_x = \Pr(x + t < X \le x + t + u \mid X > x)$$



## General formula for $A_x$

Insurances

$$A_x = \sum_{k=0}^{\infty} v^{k+1} {}_k p_x q_{x+k}$$



## General formula for $\mathbf{E}[Z_x^2]$

Insurances



$$\mathbf{E}[Z_x^2] = \sum_{k=0}^{\infty} {}_{k|} q_x v^{2(k+1)} = \sum_{k=0}^{\infty} {}_{k} p_x q_{x+k} v^{2(k+1)}$$



## General formula for $A^1_{x:\overline{n}}$

Insurances



$$A_{x:\overline{n}|}^{1} = \sum_{k=0}^{n-1} v^{k+1} {}_{k} p_{x} q_{x+k}$$



General formula for  $A_{x:\overline{n}|}$ 

Insurances



$$A_{x:\overline{n}|} = \sum_{k=0}^{n-1} v^{k+1} {}_{k} p_{x} q_{x+k} + v^{n} {}_{n} p_{x}$$

Lesson 12



## General formula for $n \mid A_x$

Insurances



$$_{n|}A_{x}=\sum_{k=n}^{\infty}v^{k+1}{}_{k}p_{x}q_{x+k}$$



## General formula for $n|mA_x$

Insurances



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$$_{n|m}A_{x} = \sum_{k=n}^{n+m-1} v^{k+1} {}_{k}p_{x} q_{x+k}$$

Lesson 12



# Formula for EPV of benefit premium annuity-due

#### Retiree Health Benefits



$$\ddot{a}_B(x,t) = \sum_{k=0}^{\infty} v^k {}_k p_x \left( \frac{B(x+k,t+k)}{B(x,t)} \right)$$



Formula for EPV of benefit premium annuity-due when health costs by age increase geometrically with B(x+1,t)/B(x,t) = c and health cost inflation is constant at rate j.

#### Retiree Health Benefits



$$\ddot{a}_B(x,t) = \sum_{k=0}^{\infty} v^k{}_k p_x c^k (1+j)^k$$



When health costs by age increase geometrically with B(x + 1, t)/B(x, t) = c and health cost inflation is constant at rate j, benefit premium annuity-due can be valued at whole life annuity at adjusted interest rate i\*.

What is i\*?

#### Retiree Health Benefits



$$i^* = \frac{1+i}{c(1+j)} - 1$$