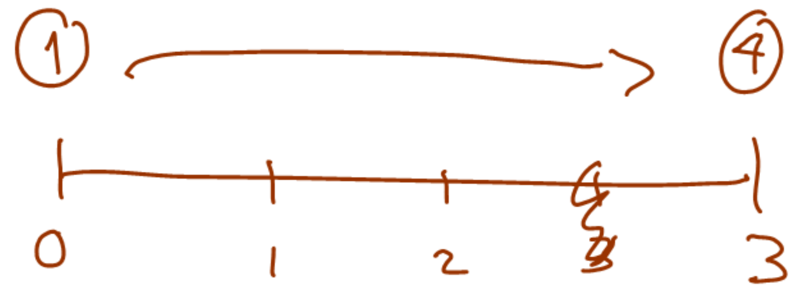
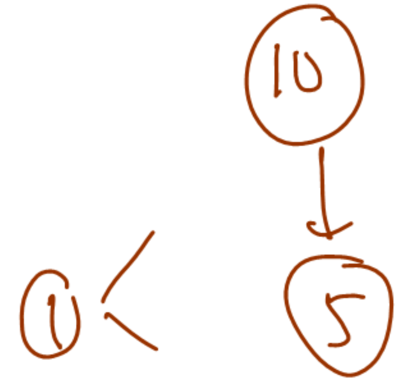
1

transitions

$1 \to 2 \to 4$	$(.1)(.1) = .01$
$1 \to 3 \to 4$	$.03$
$1 \to 1 \to 2 \to 4$	$.008$
$1 \to 1 \to 3 \to 4$	$.024$
$1 \to 2 \to 2 \to 4$	$.005$
$1 \to 2 \to 3 \to 4$	$.006$
$1 \to 3 \to 2 \to 4$	$.001$
$1 \to 3 \to 3 \to 4$	$.018$

$$\sum = 0.102$$





$$\underbrace{\binom{10}{5}(.102)^5(1-.102)^5}$$

$$= .0016$$

$Q * Q * Q \Rightarrow 4 \times 4 \to 1 \to 4$

② non-smoker smoker $i = 10\%$ $v = 1/1.10$

non-smoker a

transitions	prob	$1 CF	discount	product
$a \to d$	0.1		v	$.0909$
$a \to a \to d$	$.8(.1) = .08$	$.12$	v^2	$+ .0992$
$a \to b \to d$	$.1(.4) = .04$			

$$\text{Sum} = APV_a = 0.1901$$

smoker b

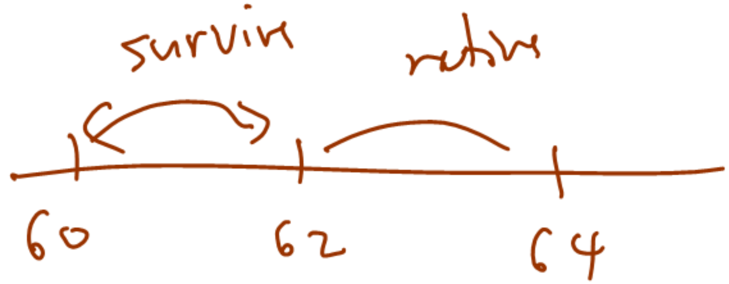
transitions	prob		discount	product
$b \to d$	0.4		v	$.3636$
$b \to b \to d$	$0.4^2 = 0.16$	$.22$	v^2	$.1818$
$b \to c \to d$	$(.2)(.3) = .06$			

$$APV_b = 0.5454 \checkmark$$

3

MDT

$${}_{2|2}q_{60}^{(r)}$$



$${}_{2}p_{60}^{(\tau)} \quad {}_{2}q_{62}^{(r)}$$

$$\frac{\cancel{l_{62}^{(\tau)}}}{l_{60}^{(\tau)}} \quad \frac{d_{62}^{(r)} + d_{63}^{(r)}}{\cancel{l_{62}^{(\tau)}}}$$

$$\frac{2692 + 1350}{23856} = 0.1694$$

(4) P = annual premium

accidental (1)

not (2)

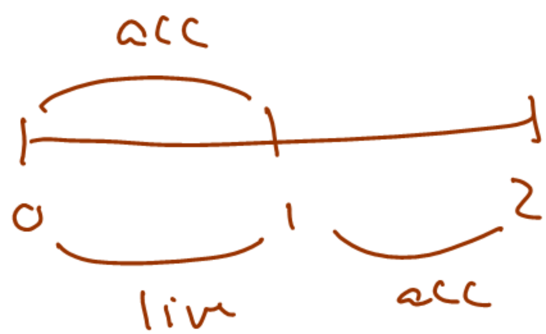
3,000

2-year

APV(premium)

$$= P\left[1 + \frac{l_{51}^{(\tau)}}{l_{50}^{(\tau)}}\cdot v\right]$$

$$= P\left(1+\frac{9200}{10000}\,\frac{1}{1.05}\right) = 1.87619P$$



APV(benefits)

$$= 3000\left[\frac{d_{50}^{(1)}}{l_{50}^{(\tau)}}\cdot v + \frac{d_{51}^{(1)}}{l_{50}^{(\tau)}}\cdot v^2\right]$$

$$= \frac{3000}{10,000}\left[440\left(\frac{1}{1.05}\right) + 1350\left(\frac{1}{1.05}\right)^2\right] = 1624.49$$

$$P = \frac{1624.49 * .3}{1.87619} = 865.8448 \; * .3 = 262.80$$

5 Constant force

husband x 20

wife y 5

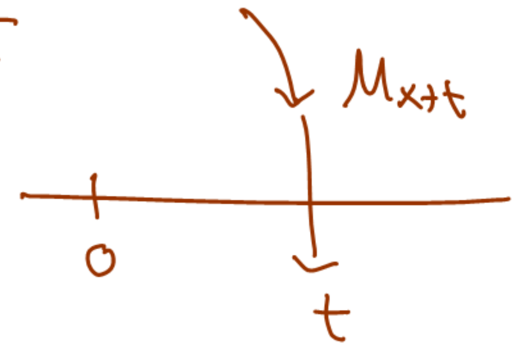
$$APV(\text{insurance}) = 20\int_0^\infty e^{-.05t}\,{}_tp_y\,{}_tp_x\,\mu_{x+t}\,dt$$

$$e^{-.01t} \quad e^{-.03t} \quad .03$$

$$+\ 5\int_0^\infty e^{-.05t}\,{}_tq_y\,{}_tp_x\,\mu_{x+t}\,dt$$

$$(1-e^{-.01t})\ e^{-.03t}\ .03$$

$$1-{}_tp_y$$



$\bar{A}_{xy}$ A_{xy}

$\bar{a}_{xy}$ a_{xy}

$\bar{A}_{\overline{xy}}$ $A_{\overline{xy}}$

$\bar{a}_{\overline{xy}}$ $a_{\overline{xy}}$

$$= \frac{15(.03)}{.09} + \frac{20(.03)}{.08} = 6.875$$

(c)

$$AS_0 = 0$$

$$AS_1 = \frac{(0 + 3620 - 1650)(1.055) - 150\,000(.0059) - 0(.0350)}{1 - .0059 - .0350}$$

$$1{,}244.239$$

$$AS_2 = \frac{(1244.239 + 3620 - 400)(1.045) - 150\,000(.0064) - 2760(.0325)}{1 - .0064 - .0325}$$

$$= 3{,}761.763$$

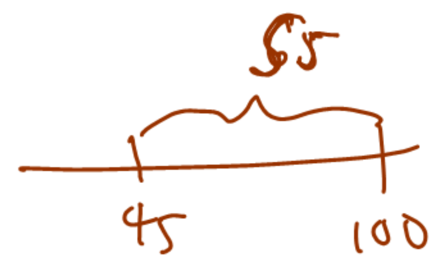
7

(45) h $\quad \mu_{45+t} = .03$

(45) wife $\quad$ Uniform $\omega = 100$

$$\bar{a}_{45:45} = \int_0^{\infty} e^{-.06t} \, {}_tp_{45}^{h} \, {}_tp_{45}^{w} \, dt$$

$${}_tp_{45}^{h} \to e^{-.03t} \qquad {}_tp_{45}^{w} \to \underbrace{\Pr\left[T_{45} > t\right]}$$



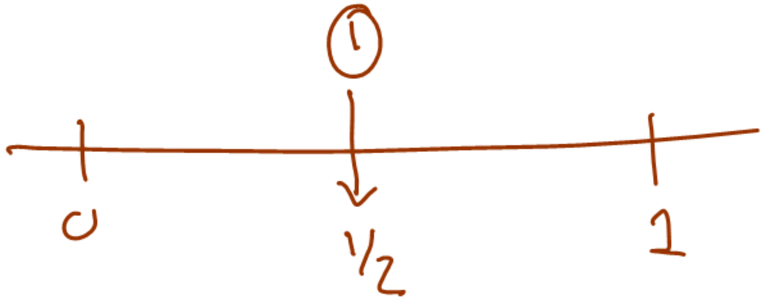
$$1 - t/55 = \int_t^{55} \frac{1}{55} \, ds$$

$$= \int_0^{\cancel{\infty}\, 55} e^{-.09t} \left(1 - \frac{t}{55}\right) dt$$

$$= \int_0^{\cancel{\infty}\, 55} e^{-.09t} \, dt - \frac{1}{55} \underbrace{\int_0^{\cancel{\infty}\, 55} t e^{-.09t} \, dt}$$

$$= \underline{8.882342}$$

8



MDT $\rightarrow$ SDT

$$q_x \rightleftarrows q_x'$$

$$q_x^{(j)} / q_x^{(\tau)}$$

2 UDD

$$q_x^{(2)} = \int_0^1 {}_sp_x^{(\tau)} \mu_{x+s}^{(2)}\, ds$$

$$\underbrace{{}_sp_x'^{(1)}}\ \underbrace{{}_sp_x'^{(2)} \mu_{x+s}'^{(2)}}_{q_x'^{(2)}} = \int_0^{1/2} .04\, ds + \int_{1/2}^1 .04(.98)\, ds$$

$$= \begin{cases} 1, & s < 1/2 \\ 1 - q_x'^{(1)}, & s > 1/2 \end{cases}$$

$$= \begin{cases} 1, & s < 1/2 \\ .98, & s > 1/2 \end{cases}$$

$$= .04\left(\tfrac{1}{2}\right) + .04(.98)\left(\tfrac{1}{2}\right)$$

$$= .0396$$

$$q_x^{(\tau)} = 1 - p_x^{(\tau)} = 1 - e^{-\left(\mu_x'^{(1)} + \mu_x'^{(2)}\right)}$$

$$= 1 - \underset{.98}{p_x'^{(1)}}\ \underset{.96}{p_x'^{(2)}} = 1 - .9408 = .0592$$

$$q_x^{(\tau)} = q_x^{(1)} + q_x^{(2)} \implies q_x^{(1)} = \underset{.0592}{\cancel{.9408}} - .0396 = \underline{\underline{.0196}}$$

$$\frac{.0196}{\underset{.0592}{\cancel{.9408}\ \cancel{.049}}} = 33.10811\%$$

(9)

$$\bar{a}_{xy} + \bar{a}_{\overline{xy}} = \bar{a}_x + \bar{a}_y$$

$$\bar{A}_{xy} + \bar{A}_{\overline{xy}} = \bar{A}_x + \bar{A}_y$$

$$\bar{A}_{\overset{1}{x}y} + \bar{A}_{x\overset{1}{y}} = \bar{A}_{xy}$$

$$\bar{A}_{\overset{2}{x}y} + \bar{A}_{x\overset{2}{y}} = \bar{A}_{\overline{xy}}$$

$$\bar{A}_{\overset{1}{x}y} = ??$$

$$\bar{A}_{x\overset{1}{y}} = .09$$

$$\bar{a}_{xy} = \bar{a}_x + \bar{a}_y - \bar{a}_{\overline{xy}} = 10.06 + 11.95 - 12.59 = 9.42$$

$$\bar{A}_{xy} = 1 - \delta\bar{a}_{xy} = 1 - .07(9.42) = .3406$$

$$\bar{A}_{\overset{1}{x}y} = .3406 - .09 = .2506$$