① (50) 1000 policies $\qquad \Pi$ = premium

$i = 5\%$

$P(\text{Total loss} < 0) \geq 0.95$

$\Downarrow$

$$L_{agg} = \sum_{i=1}^{1000} L_{0,i}$$

$A_{50} = .18931$

${}^2A_{50} = .05108$

$$E[L_{0,i}] = \underbrace{APVFB_0}_{A_{50}} - APVFP_0$$

$$= A_{50} - \Pi\,\ddot{a}_{50}$$

A_{50}: .18931

$$\ddot{a}_{50} = \underbrace{\frac{1 - (.18931)}{\frac{.05}{1.05}}}_{17.0245}$$

$$Var[L_{0,i}] = \left[{}^2A_{50} - (A_{50})^2\right]\left(1+\frac{\Pi}{d}\right)^2 = \left(1+\frac{\Pi}{d}\right)^2(.01524172)$$

$$\frac{1-v^{K+1}}{d}$$

$$PVFB_0 - PVFP_0 = v^{K+1} - \Pi\,\ddot{a}_{\overline{K+1|}} = v^{K+1}\left(1+\frac{\Pi}{d}\right) - \frac{\Pi}{d}$$

$E[L_{agg}] = 1000\,E[L_{0,i}] \qquad Var[L_{agg}] = 1000\,Var[L_{0,i}]$

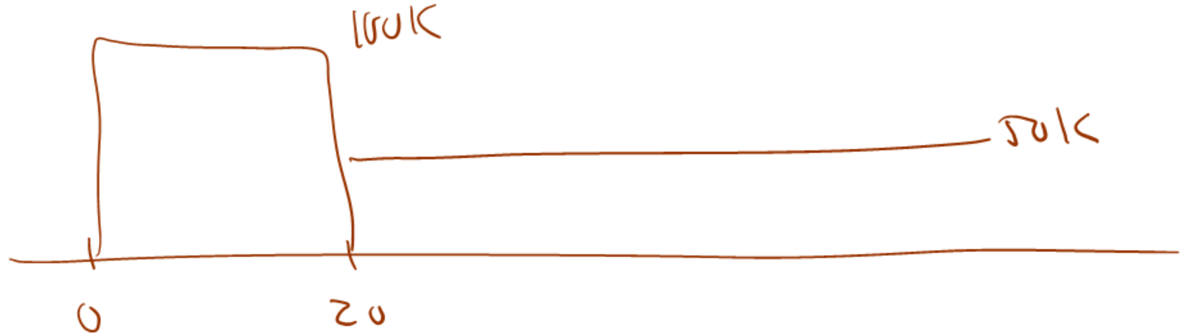
$$P(L_{agg} < 0) \cong P\left(Z < \underbrace{\frac{0 - (1000)(.18931 - \pi(17.0245))}{\sqrt{1000(.0152472)(1+21\pi)^2}}}_{\geq 1.645} \right) \geq 0.95$$

Solve for π.

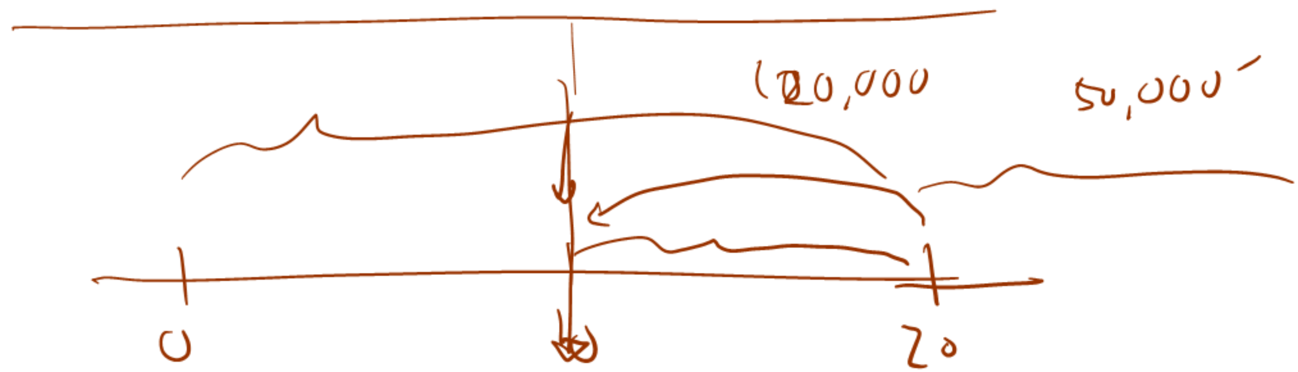
$$\pi \geq \frac{195.7322}{16889.63} = \underline{\underline{.01158889}}$$

$$\frac{A_{50}}{\ddot{a}_{50}} = \leq \pi$$

2 discrete benefit



4,945 → for 20 years only



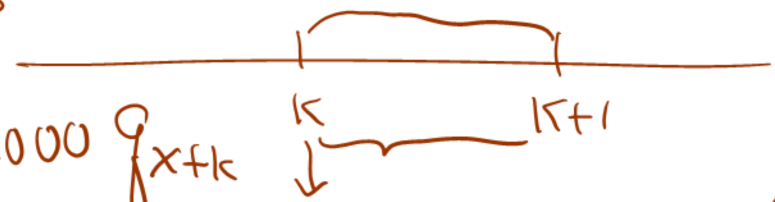
$$_{10}V = APV(FB_{10}) - APV(FP_{10})$$

$$= 100{,}000\, \underset{.5628}{A_{55}} - 50{,}000\, \underset{.7532}{A_{65}} \cdot \overset{.0758}{{}_{10}E_{55}} - 4945\, \underbrace{\ddot{a}_{55:\overline{10|}}}$$

$$\ddot{a}_{55:\overline{10|}} = \underset{4.8091}{\ddot{a}_{55}} - \underset{.0015}{{}_{10}E_{55}}\, \underset{2.7147}{\ddot{a}_{65}}$$

$$= 30{,}661.93$$

(3) ${}_kV^g = 602.45$ ${}_{k+1}V^g = 629.72$ q_{x+k}



- Expenses

.05

$${}_{k+1}V^g = \frac{({}_kV^g + G)(1+i) - 1000\, q_{x+k}}{1 - q_{x+k}}$$

$$1000\,\frac{A_x}{\cancel{\ddot{a}_x}}$$

$$G\ddot{a}_x = 1000A_x + .10P\,\cancel{\ddot{a}_x}$$

$G =$

$$G = 1100A_x / \ddot{a}_x \qquad \frac{1-A_x}{d}$$

$$= 83.14544$$

$$q_{x+k} = \frac{(602.45 + 75.58677)(1.05) - 629.72}{1000 - 629.72}$$

$$= .2220444$$

③ Gain/loss

expenses — expected 5% of G
actual 6% of G

interest
↓
expenses
↓
mortality

Gain due to expenses $= \underbrace{385100 * (.05G - .06G)(1.05)}$

$G = 2600$

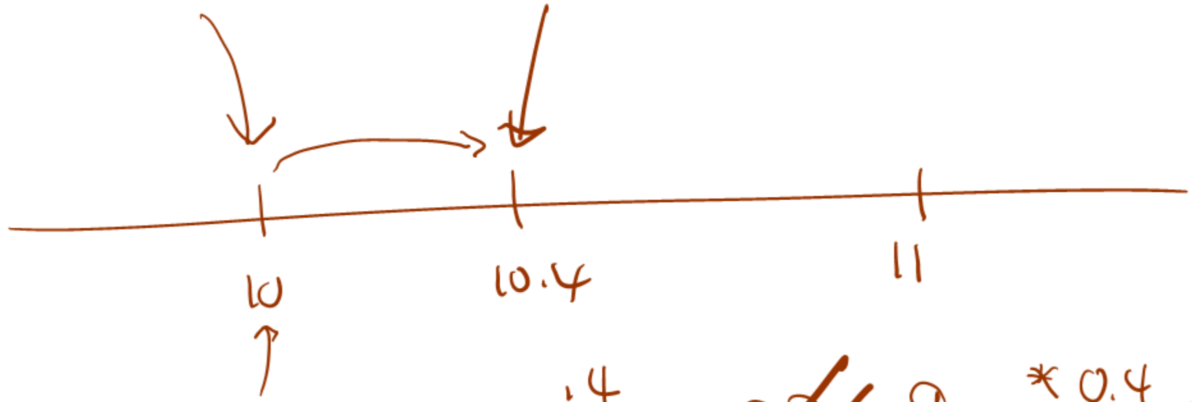
interest comes first so use actual

$= -10{,}513{,}230$

Gain due to interest $= \underbrace{385100 * (2044.32 + 2600(1-.05))(.05-.02)}$

$= 52{,}153{,}939$

(5)



DB = 2

.045 = P

net

UDD

$${}_{10.4}V = \frac{({}_{10}V + P)(1.06)^{.4} - \cancel{DB} * q_{x+10} * 0.4 \; v^{.6}}{1 - 0.4\, q_{x+10}}$$

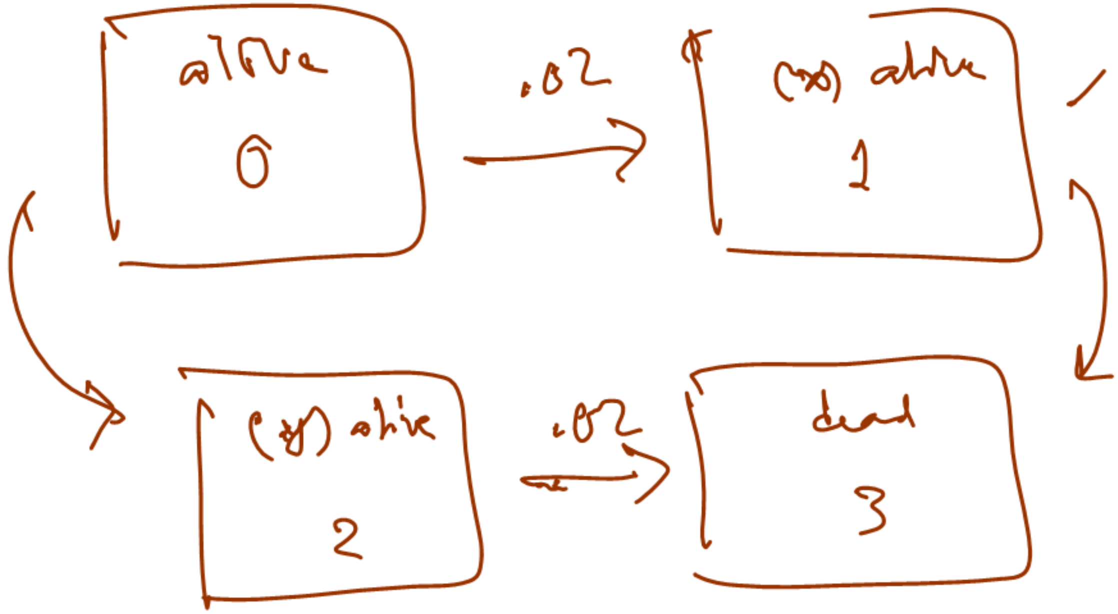
$$= \frac{(.325 + .045)(1.06)^{.4} - .075(.4)\left(\frac{1}{1.06}\right)^{.6}}{1 - .075(.4)}$$

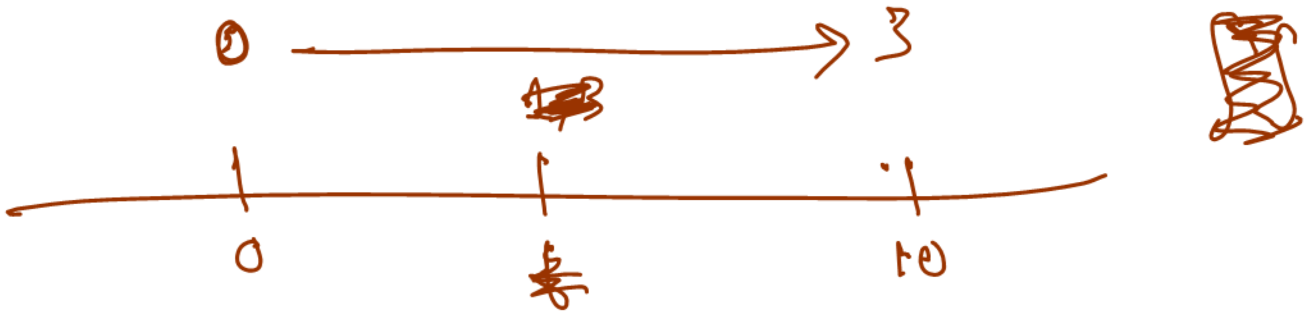
$.360573$

6

x male .03

y female .02

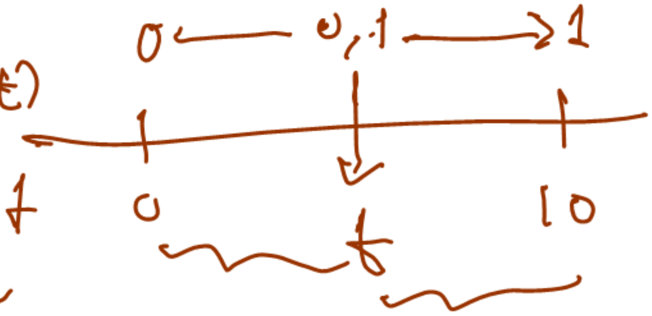




$$ {}_{10}p^{03} = 1 - \left({}_{10}p^{00} + {}_{10}p^{01} + {}_{10}p^{02} \right) $$

$$ {}_{10}p^{\overline{00}} = e^{-\int_0^{10} .05\,dt} = e^{-.5} $$

$$ {}_{10}P^{01} = \underbrace{\int_0^{10} e^{-.05t} \cdot .02\, e^{-.03(10-t)}\, dt}_{\cancel{.02}\, e^{-.3} \underbrace{\int_0^{10} e^{-.02t}\, dt}_{\frac{1}{.02}\left(1-e^{-.2}\right)}} $$



$$ \frac{\cancel{.02}}{.02}\, e^{-.3} \left(1-e^{-.2}\right) $$

$$ {}_{10}P^{02} = \underbrace{\int_0^{10} e^{-.05t} \cdot .03\, e^{-.02(10-t)}\, dt}_{.03\, e^{-.2} \underbrace{\int_0^{10} e^{-.03t}\, dt}} $$

$$ \frac{\cancel{.03}}{.03}\, e^{-.2} \left(1-e^{-.3}\right) $$

$$1-\left(\omega p^{\alpha_1}+\omega p^{\alpha_2}+\omega p^{\alpha_3}\right)=\underbrace{1-e^{-.3}+e^{-.5}-e^{-.2}}_{.04698169}$$

$$e^{-.3}-e^{-.5}\qquad e^{-.2}-\cancel{e^{-.8}}\qquad \cancel{e^{-.5}}$$

$$\left(1-e^{-.3}\right)\left(1-e^{-.2}\right)$$ same result.