Solution 292

$$\text{Profit Margin} = \frac{NPV[\text{Profits}]}{EPV[\text{Future Premiums}]}$$

Pr_t denotes the year-t profit per policy in force at time t

$(Pr_0, Pr_1, \ldots, Pr_n)'$ → Profit vector denoting profit per survivor

Π_t denotes the year-t profit per policy issued

$(\Pi_0, \Pi_1, \ldots, \Pi_n)'$ → Profit signature showing year-by-year profit expected for each policy issued

$\Pi_0 = Pr_0$

$\Pi_t = {}_{t-1}P_x \; Pr_t \qquad t>0$

$P_{40} = 245/274$ $\qquad$ $G = 1000$

${}_2P_{40} = 300/395$ $\qquad$ $V = 1/1.12$

$$EPV[\text{Future Premiums}] = G\left[1 + VP_{40} + V^2 {}_2P_{40}\right]$$

$$= 1000\left[1 + (245/274)V + (300/395)V^2\right]$$

$$= 2403.821$$

$$EPV[\text{Profits}] = \sum_{K=0}^{n} \Pi_K v^K$$

$$= -400 + 150v + 245v^2 + 300v^3$$

$$= 142.775$$

$$\text{Profit Margin} = NPV(\text{Profits}) / EPV(\text{Premiums})$$

$$= 142.775 / 2403.821$$

$$= 5.94\% \approx 5.9\%$$

(C)