Exercise 8.20

Let P be the required annual premium and the discount factor $v = 1/1.05$. Then the actuarial present value (APV) of future premiums is equal to

$$P \times \left(1 + v p_{58}^{00}\right) = P \times (1 + v(.995)) = P \times 1.947619$$

The APV of future death benefit is equal to

$$
\begin{aligned}
&100000 \times \left(v p_{58}^{02} + v^2 p_{58}^{00} p_{59}^{02}\right) + 25000 \times v^2 p_{58}^{01} p_{59}^{12} \\
=\ &100000 \times \left(v(.003) + v^2(.995)(.004)\right) + 25000 \times v^2(.002)(.010) \\
=\ &647.1655
\end{aligned}
$$

Finally, the APV of future disability benefit is equal to

$$75000 \times \left(v p_{58}^{01} + v^2 p_{58}^{00} p_{59}^{01}\right) = 75000 \times \left(v(.002) + v^2(.995)(.003)\right) = 345.9184$$

Solving for the annual premium:

$$P = \frac{647.1655 + 345.9184}{1.947619} = 509.8964$$