Exercise 4.19

(a) At any age, the standard deviation is given by

$$\begin{aligned} \text{SD} &= 100000 \times \sqrt{{}^2A_{30} - (A_{30})^2} \\ &= 100000 \times \sqrt{0.01109 - (.07698^2)} \\ &= 7,186.153 \end{aligned}$$

(b) Before age 50, the standard deviation is given by

$$\text{SD} = 100000 \times \sqrt{{}^2A^1_{30:\overline{20|}} - \left(A^1_{30:\overline{20|}}\right)^2}$$

where

$${}^2A^1_{30:\overline{20|}} = {}^2A_{30} - v^{20}\,{}_{20}E_{30}\,{}^2A_{50} = 0.01109 - (1/1.05^{20})(0.37254)(0.05108) = 0.003918041$$

and

$$A^1_{30:\overline{20|}} = A_{30} - {}_{20}E_{30}\,A_{50} = -.07698 - (0.37254)(0.18931) = 0.006454453$$

Therefore,

$$\text{SD} = 100000 \times \sqrt{0.003918041 - (0.006454453)^2} = 6226.059$$