**Exercise 6.6**

Let \( G \) the required gross annual premium so that the APV of gross premiums is

\[
\text{APV(premiums)} = G \ddot{a}_{[45]:[20]}.
\]

The APV of the 20-year endowment insurance policy is

\[
\text{APV(benefits)} = 100000 \ A_{[45]:[20]}
\]

The APV of the expenses can be found using

\[
\text{APV(expenses)} = 0 \ddot{a}_{[45]:[20]} + 0.08G + 8\ddot{a}_{[45]:[20]} + 42
\]

This gives us, by the equivalence premium principle, the following:

\[
G = \frac{100000 \ A_{[45]:[20]} + 8\ddot{a}_{[45]:[20]} + 42}{0.98\ddot{a}_{[45]:[20]} - 0.08}.
\]

Based on the Standard Select Survival Model,

\[
A_{[45]:[20]} = 0.15149 - 0.35999(0.35477) + 0.35999 = 0.3837663
\]

and

\[
\ddot{a}_{[45]:[20]} = (1 - 0.3837663)/(1 - (0.05/1.05)) = 12.94091.
\]

Finally, the gross annual premium is

\[
G = \frac{100000(0.3837663) + 8(12.94091) + 42}{0.98(12.94091) - 0.08} = 3056.808.
\]