122A-C. Note to candidates – in reformatting the prior question 122 to match the new syllabus it has been split into three parts. While this problem uses a constant force for the common shock (which was the only version presented in the prior syllabus), it should be noted that in the multi-state context, that assumption is not necessary. 122C represents the former problem 122.

Use the following information for problems 122A-122C.

You want to impress your supervisor by calculating the expected present value of a last-survivor whole life insurance of 1 on (x) and (y) using multi-state methodology. You defined states as

State 0 = both alive
State 1 = only (x) alive
State 2 = only (y) alive
State 3 = neither alive

You assume:

(i) Death benefits are payable at the moment of death.
(ii) The future lifetimes of (x) and (y) are independent.
(iii) $\mu^{01}_{x+t:y+t} = \mu^{02}_{x+t:y+t} = \mu^{33}_{x+t:y+t} = \mu^{23}_{x+t:y+t} = 0.06, t \geq 0$
(iv) $\mu^{03}_{x+t:y+t} = 0, t \geq 0$
(v) $\delta = 0.05$

Your supervisor points out that the particular lives in question do not have independent future lifetimes. While your model correctly projects the survival function of (x) and (y), a common shock model should be used for their joint future lifetime. Based on her input, you realize you should be using

$\mu^{03}_{x+t:y+t} = 0.02, t \geq 0$.

122A. To ensure that you get off to a good start, your supervisor suggests that you calculate the expected present value of a whole life insurance of 1 payable at the first death of (x) and (y). You make the necessary changes to your model to incorporate the common shock.

Calculate the expected present value for the first-to-die benefit.

(A) 0.55

(B) 0.61

(C) 0.67

(D) 0.73

(E) 0.79

122B. Having checked your work and ensured it is correct, she now asks you to calculate the probability that both have died by the end of year 3.

Calculate that probability.

(A) 0.03

(B) 0.04

(C) 0.05

(D) 0.06

(E) 0.07

122C. You are now ready to calculate the expected present value of the last-to-die insurance, payable at the moment of the second death.

Calculate the expected present value for the last-to-die benefit.

(A) 0.39

(B) 0.40

(C) 0.41

(D) 0.42

(E) 0.43