MTH6157 Survival Models

Additional Question – Week 5 – Markov Process and Multi State models

[note this is a challenging question – Have a go at it and don't worry if you cannot answer it all, but please do ask after you have made an attempt. Part (b) requires you to combine Markov Process / Multi State work from week 5 of this module with valuing insurance type benefits from Actuarial Maths II MTH5125. If you did not study Actuarial Mathematics before taking this module you should still be able to develop a formula for the probability that the unemployment benefit is paid.]

A country's social security system pays benefits:

- during periods of unemployment
- when ill or injured and unable to work as a result
- as a pension on retirement after reaching state pension age.

These are financed by contributions paid by people in work (either employed or self-employed).

(a) Draw a diagram for a multi-state model that could be used to value the benefits and contributions in the social security system labelling all the states and transition intensities.

(b) A lump sum benefit of $500 is paid when someone in work becomes unemployed. Develop a formula for the expected present value of unemployment benefit over the next year for someone currently age 45. This formula should be expressed in terms of one or more of the transition intensities you defined in (a) above and an interest rate i per annum. State any assumptions you have made.

(c) For any transition intensities used in (b) list the data you would need to collect in order to calculate a maximum likelihood estimator of that transition intensity.