1996 Paper 9 Question 3

Computer System Modelling

The Erlangian distribution E_r, with parameters (r, μ) is given by

$$f_X(x) = \frac{\mu(\mu x)^{r-1}}{(r-1)!}\mathrm{e}^{-\mu x} \quad x \geqslant 0$$

(*a*) Given an $M/E_2/1$ queue, draw a Markov Chain describing the queueing system, and derive a formula for the variance of the service time distribution. Give an example of a queueing system in which the use of an Erlang service time distribution would be useful. [5 marks]

(*b*) Describe how random variables from a given distribution function $f_X(x)$ can be sampled for use in a discrete event simulator. [3 marks]

(*c*) Use your answer from (*b*) to develop pseudo-code for a function in a discrete event simulator which when called returns a sampled value from the distribution function E_r. State any assumptions made and explain any arguments to the function. Comment on the efficiency of your code. [12 marks]