IMM - DTU

04141 Stochastic Processes
1998-11-9
BFN/bfn

Exercise 7 - Markov renewal processes

It is possible to get equipment of two different brands obtainable from two different suppliers to apply as a control unit in the construcion sectior. For both types the equipment can be dective in such a way that it will fail during normal operation or the equipment will be worn in such a way that it can be replaced in a controlled manner without interference without the production line. The construction company has the following purchase strategy

> If a unit fails in a way that leads to production loss, the next equipment purchased will be of the other type than the failing one. If the equipment is replaced due to the normal procedure the next equipment will be purchased from the same supplier as the one being replaced.

Equipment of type 1 fails with probability $\frac{1}{5}$ while equipment of type 2 fails with probability $\frac{2}{7}$. Mean life time of type 1 equipment is 2 weeks, while type 2 equipment has a mean life time of 3 weeks. The mean life is unaffected of the cause for replacement. For both types of equipment the life time of failing equipment can be best be described by an exponential distribution, while the life time of equipment being replace due to wear is best described by an Erlang-2 distribution. It can be assumed that it is possible to replace equipment instantaneously such that the construction process can go on unaffected.

Question 1 Deduce a model describing the function of the control equipment. Opstil en model til at beskrive funktionen af kontroludstyret.

Question 2 Find a time dependent expression for the probability that the next item being installed is of type j knowing that an item of type i was installed at time $t = 0$.

Question 3 Find the expected value of the fraction of time where an item of type is being used under the assumption af stationarity.

A new civil engineer gets employed as responsible person in the construction company. The civil engineer introduces a new strategy, such that a new brand will be chosen at replacement regardless of the cause of the replacement.

Question 4 Redo question 1-3 taking this new assumption under account.