Avd. Matematisk statistik

KTH Matematik

Computer excercise 1 for SF2937 , autumn 2008
TTT-plot

To be given at the latest Tuesday 23 sep to Gunnar Englund (Put your name and number on your hand in.)

a) Construct a TTT-plot from the life lengths in the data sheet. Decide if the distribution seems to be IFR or DFR or neither.

   Usefule Matlab funtions are `sort`, which sort the elements in a vector and `cumsum`, which give successive sums of elements in a vector.

b) We want a maintainance strategy for the type of components having the data. If the component fails the cost for a new component is c_2 while a pure maintainance cost is c_1. After maintainance the component is as new. Calculate an optimal maintainance strategy, i e the time interval between maintainance.

c) Calculate the Nelson estimate of the survival function and plot it.

d) Draw the Nelson plot with the estimate of the cumulkative failure rate $\Lambda(t) = \int_0^t \lambda(x)\, dx$. Does it indicate if the distribution is IFR, DFR or neither?

For costs and life lengths, look at the data sheet.

Computer excercise 2 for SF2937 , autumn 2008
Weibull analys

To be given at the latest Tuesday 30 sep to Gunnar Englund (Put your name and number on your hand in.)

The observations are from a test of 30 items whose life lengths are described by independent Weibull distributed random variables with form parameter c and scale paramter λ, i.e. the survival function for a component is $R(t) = \mathrm{e}^{-(\lambda t)^c}$. The test was stopped when 15 units had failed.

a) Estimate λ and c using a Weibull diagram. You get the Weibull diagram from the home page.

b) Calculate numerically the maximum likelihood estimates of λ and c.

It is suitable to let $b = \lambda^c$. You then get $R(t) = e^{-bt^c}$. Calculate the estimates of b and c. The ML-estimate of b can easily be expressed in c, so you get an optimization problem in one variable, c. To get the ML-estimate you can use the MatLabfunction `fzero` or `fmin`.

Computer excercise 3 for SF2937 , autumn 2008
Markov chains

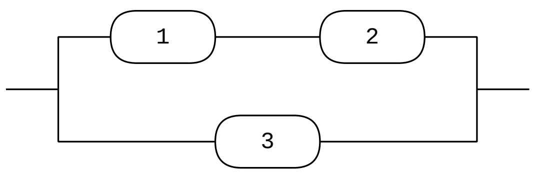
To be given at the latest Monday 6 october to Gunnar Englund (Put your name and number on your hand in.)

a) A Markov chain with the states $\{1, 2, 3, 4, 5\}$ and a transition matrix according to the data sheet strats in state1, $X_0 = 1$. Calculate the expected number of steps it has visited state 2 before it resturns to state 1.

b) Calculate the probability that the Markov chain up to time 6 has not visited state 2 at any time point.

c) Calculate the expected time until the chain visits state 2 for the second time.

d) A system with thre components looks like the graph.



The system works if both component 1 and 2 work, and/or if component 3 works. The life lengths of the components (in weeks) are independent of each other.and are exponentially distributed with intensities λ_1, λ_2, and λ_3 respectively, where λ_1 and λ_2 are equal.As soon as a component fails it is switched to a new one and the exchange time (in weeks)is exponentially distributed with mean $1/\mu$ for all components. The exchange times are independent of each other and of the life lengths. Several repair crews are available so several exchanges can occur in parallel.

Calculate the asymptotic availability, i e the probability that the system is working at an "asymptotic" time.

The transition matrix and other parameter values can be found in the data sheet.

Avd. Matematisk statistik

KTH Matematik

Computer excercise 4 for SF2937 , autumn 2008
MOCUS

To be given at the latest Thursday 16 oktober to Gunnar Englund (Put your name and number on your hand in.)

Calculate with the help of the MOCUS-algorithm the minimal cuts in the fault tree found in the special data sheet.
Your solution should contain all steps in the algorithm, but it is allowed to exclude those which obviously can not be minimal. Indicate base events with numbers; $1, 2, \ldots$ etc.
Use the fault tree with your student number.
Comment: Not all base events in the tree need to be relevant.