**TQ2**

1. Suppose the failure time history of a component is given (where downward -facing arrows indicate failure times):



1. Assume the failure process follows a NHPP with λ(t) = exp(α+βt). Estimate the model parameters α and β using the MLE.
2. What is the expected number of failures from the current time until 72 months?
3. Check if the failure process has a time trend [α = 0.1]. If it does not, find the ROCOF.
4. Suppose the following data were observed in a repairable system:



1. Assume the failure process follows a renewal process and the interarrival time have



Estimate the parameter α based on the failure data. (Hint: find the MLE)

1. Now, assume that the failure process follows a renewal process with an exponentially distributed interarrival time  Estimate the value of α.
2. The failure time distribution of a product can be described by the following CDF:

 

Where b is the parameter to be estimated. We have observed the following failure times (note + means that the time corresponds to a censored unit – i.e., the component has not failed at the point in time): 10, 12, 15, 18+, 23, 28, 35, 44, 45+, 51, 56+. Construct the likelihood function and the MLF of b.

1. Seven Pumps have failure times (in months) of 15.1, 10.7, 8.8, 11.3, 12.6, 14.4, and 8.7. Assume the pump failure follows an exponential distribution.
2. Find the MLF of λ.
3. Estimate the reliability of a pump at t = 12 months.
4. Calculate the 95% two-sided interval of λ
5. The following data were collected by Frank Proschan in 1983. Operating hours to first failure of an engine cooling part in 13 aircrafts were:



Do these data support an increasing, decreasing, or constant failure rate assumption?