CS 4472A

Software Specification, Testing,

and Quality Assurance

Assignment 3

Software Reliability

Introduction

In this assignment you will apply Musa's Software Reliability growth models on a data set which is simulating MTTF values observed in a software system under test. For this assignment you will use and apply Musa's logarithmic model. You will conduct this assignment **individually** and not as groups.

The Data Set

The data set is provided in terms of an excel file indicating:

- The failure ID
- The Mean Time Between Failures (MTBF) value
- The Mean Time to Repair (MTTR) value

Here we assume that there are several testing processes running and we obtain the Mean Time collected from theses different testing processes.

The Context

For this assignment you will have to consider that

MTBF = MTTF + MTTR *(Eq. 1)*, where MTTF stands for Mean Time to Fail. Schematically the MTBF, MTTR, and MTTF values are depicted in Figure 1 below.

Also consider that MTTF = 1/λ *(Eq. 2).*

This assignment assumes we use Musa's logarithmic model where (see also Figure 3).

$\lambda(\mu) = \lambda_0 \, e^{(-\theta\mu)}$ *(Eq. 3)*

$\lambda(\tau) = \frac{\lambda_0}{(\lambda_0\theta\tau+1)}$ *(Eq. 4)*

$\mu(\tau) = \frac{ln(\lambda_0\theta\tau+1)}{\theta}$ *(Eq. 5)*

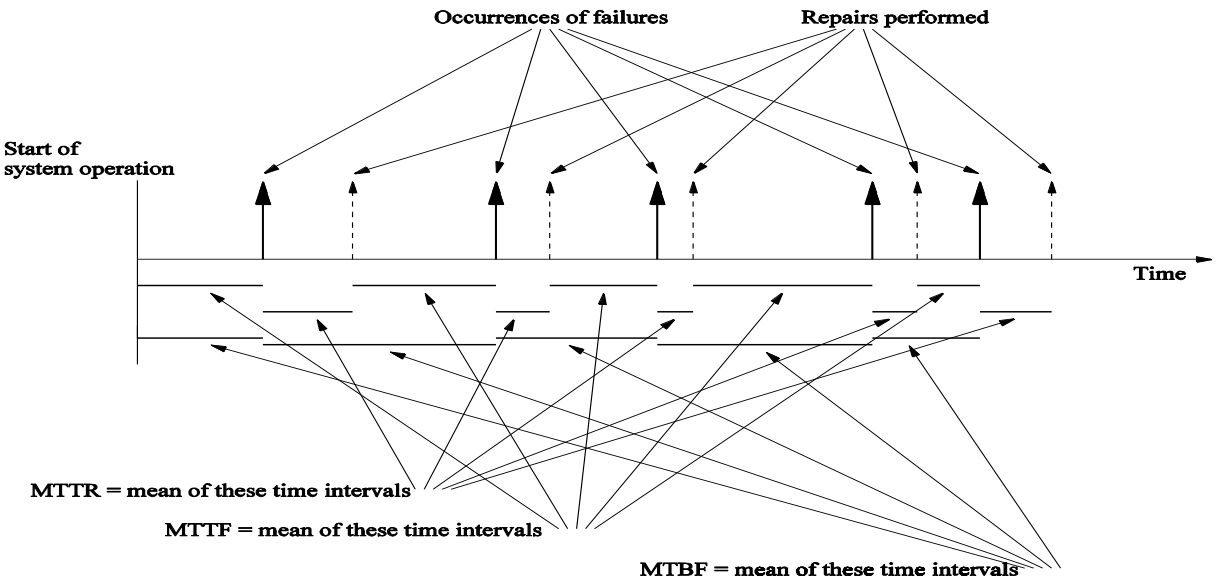

Figure 1. Relationship between MTBF, MTTF, MTTR.

Failure ID	MTBF	MTTR	τ	MTTF	θ	λ(τ)	Estimated λ(τ)
0	4	1	4				
1	9	4	13				
2	9	2	22				
3	7	5	29				
4	6	5	35				
5	8	6	43				
6	7	2	50				
7	9	6	59				
8	7	6	66				
9	7	6	73				
….	….	….	….				

Figure 2. The first ten values of the data set.

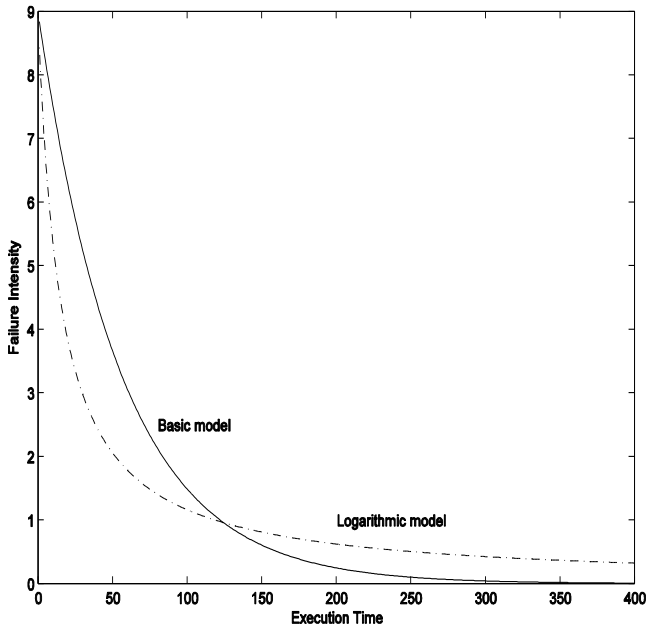

Figure 3. The failure intensity as a function of execution time.

The Questions and the Process

To complete this assignment you will need to compute:

1. The MTTF
2. The computed value of $\lambda(\tau)$ (using Eq. 2)
3. The estimated value of θ
4. The estimated value of $\lambda(\tau)$ (using the Eq. 4, and the estimated value of θ)
5. Assuming we want to release the software when we reach failure intensity equal to 0.01 failures/hour find the time τ_{target} where $\lambda(\tau_{target}) = 0.01$.

The value of θ can be estimated by solving the equation 4 (Eq. 4) above. You may want to select some points (e.g. 4 points) and get the average of the values you have obtained for θ, or compute the value of θ for any point in the data set and get the average value over all 100 points. Using this value of θ you have computed you can then apply equation 4 (Eq. 4) to obtain the *estimated* value of $\lambda(\tau)$. You can use equation 2 to obtain the observed value of $\lambda(\tau)$ for any given point τ.

What to Deliver

Submit **individually** to OWL by Thursday December 5 midnight the following:

a) The completed spreadsheet (i.e. the columns MTTF, θ, $\lambda(\tau)$ and, Estimated $\lambda(\tau)$).
b) A plot of time (x-axis) vs $\lambda(\tau)$ and Estimated $\lambda(\tau)$ (y-axis) (in the spreadsheet).
c) A short document (half page to one page maximum) outlining:
   i) the steps behind completing the spreadsheet
   ii) your solution for computing the value of τ_{target}, for which $\lambda(\tau_{target}) = 0.01$.