

Software Failure and Reliability Assessment Tool: Report

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Tab 1: Select, Apply, and Analyze Data

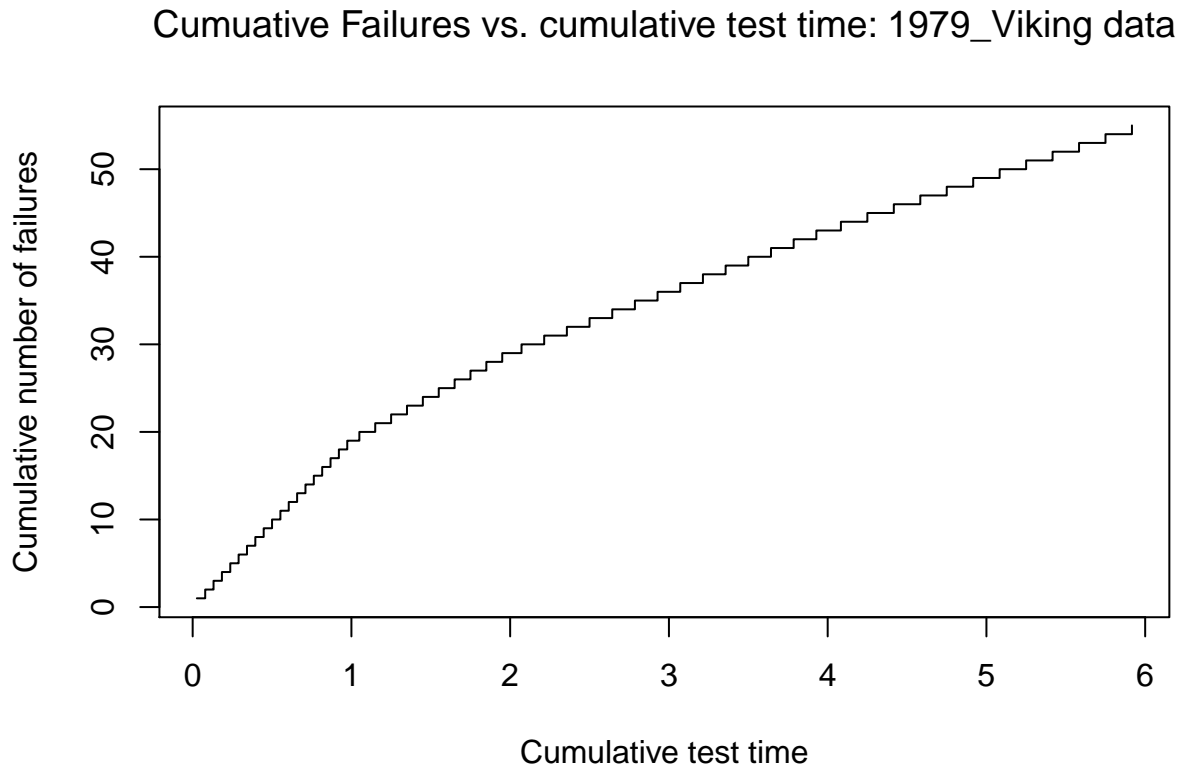
Sample of the updated data ('1979_Viking data') in different formats:

The table below shows the first ten points of the input data '1979_Viking data'. 'FC', 'CFC', 'FT', 'IF', and 'FN' indicates failure counts, cumulative failure counts, failure times, interfailure times, and number of failures respectively.

```
## [[1]]
##          FT          IF FN
## 1 0.02631579 0.02631579  1
## 2 0.07894737 0.05263158  2
## 3 0.13157895 0.05263158  3
## 4 0.18421053 0.05263158  4
## 5 0.23684211 0.05263158  5
## 6 0.28947368 0.05263158  6
##
## [[2]]
##    FC CFC
## 1 19  19
## 2 10  29
## 3  7  36
## 4  7  43
## 5  6  49
## 6  6  55
```

Cumulative failures

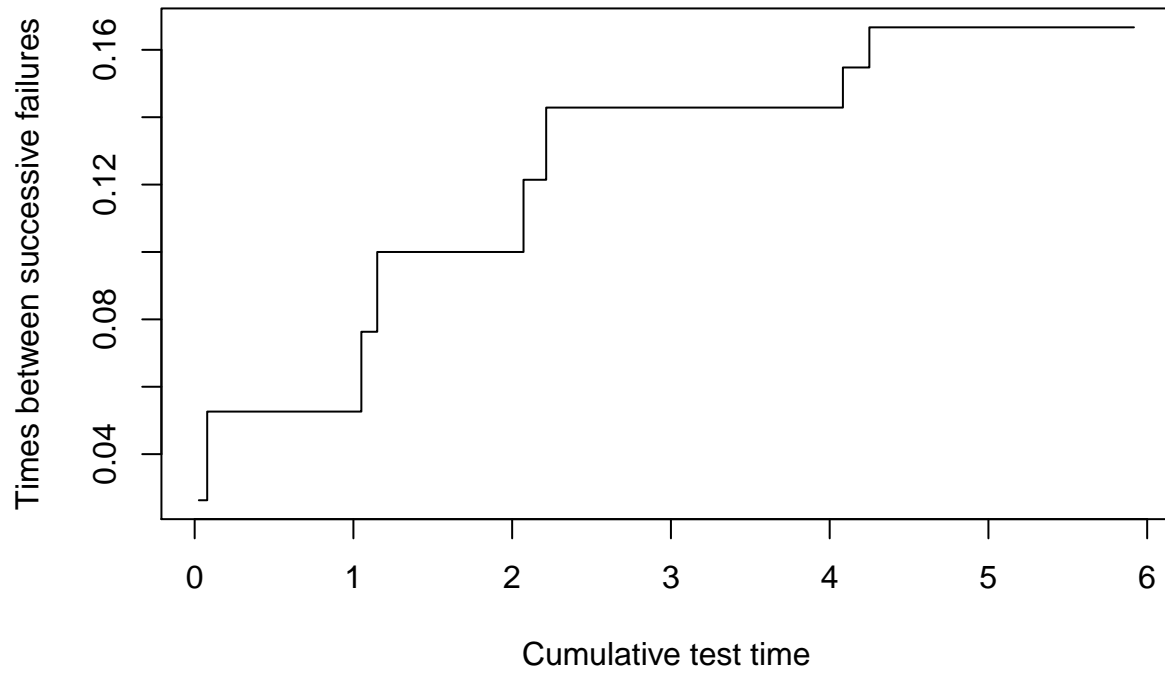
Figure below shows the cumulative number of failures as a function a cumulative test time for '1979_Viking data'. Increasing trend indicates detection of more failures. Ideally, the cumulative failure should converge to a constant value as testing progresses indicating zero number of failures in the software.



Times between failures/Interfailure times

Ideally, times between failures should increase over time.

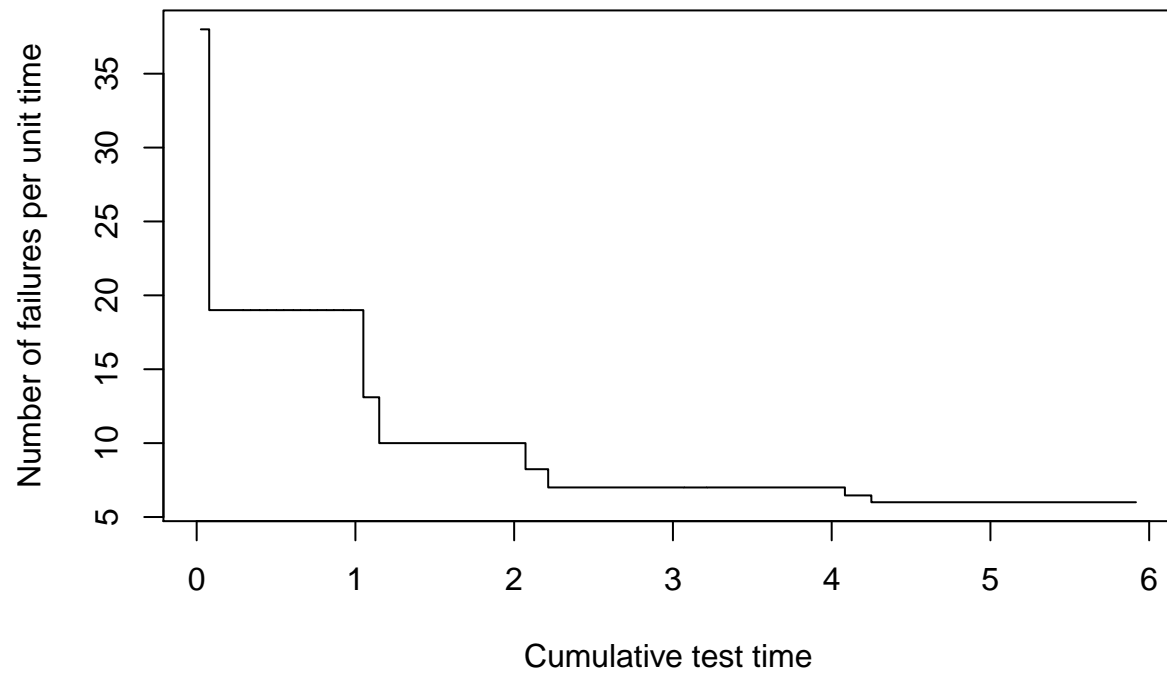
Interfailure times vs. cumulative test time: 1979_Viking data



Failure intensity

Decrease in failure intensity indicates increase in reliability of the software subjected to testing. Ideally, failure intensity should go to zero.

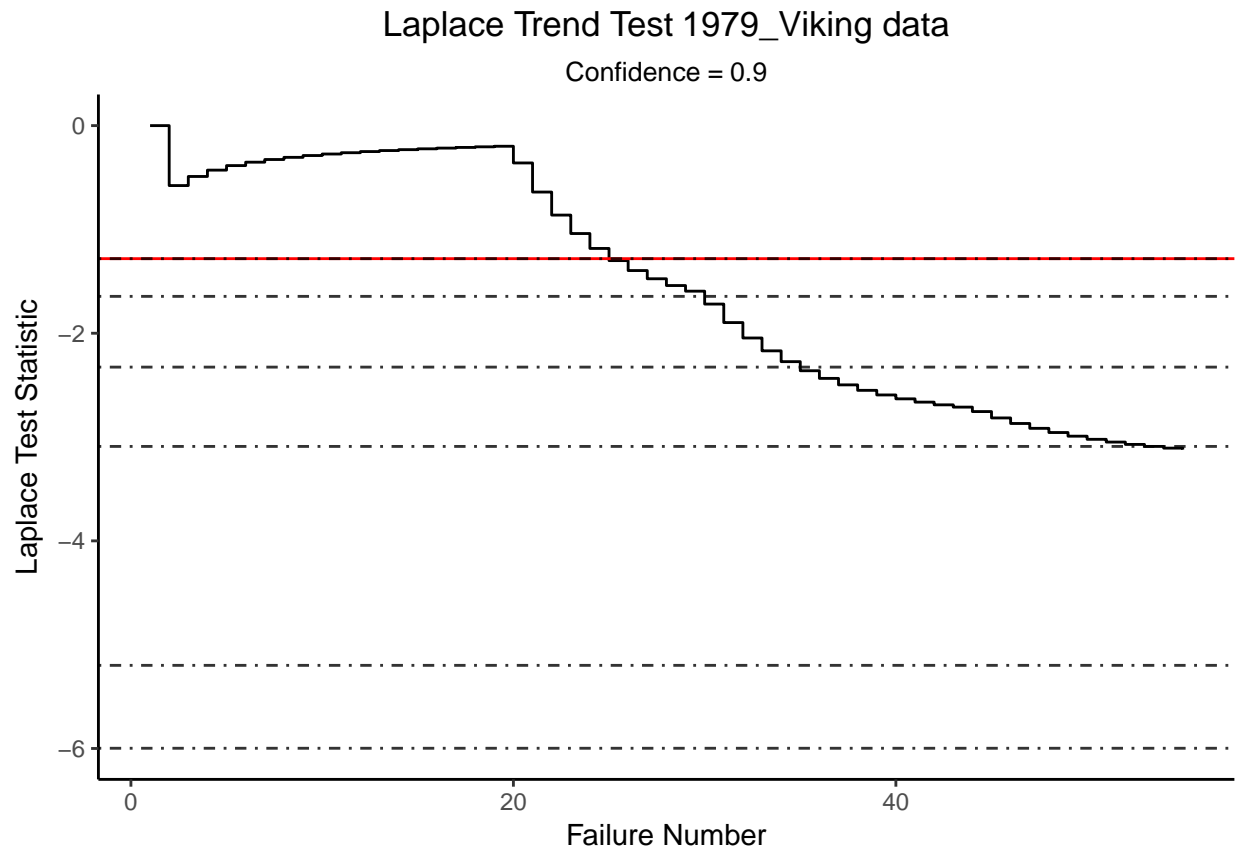
Empirical failure intensity vs. cumulative test time: 1979_Viking data



Laplace Trend Test

The red horizontal line in the figure indicates the specified confidence level of 90%. Additional default levels in black include 90, 95, 99, 99.9, 99.9999, and 99.999999. Values below these lines indicates that the data exhibits reliability growth with the specified level of statistical significance and it is therefore suitable to apply software reliability models.

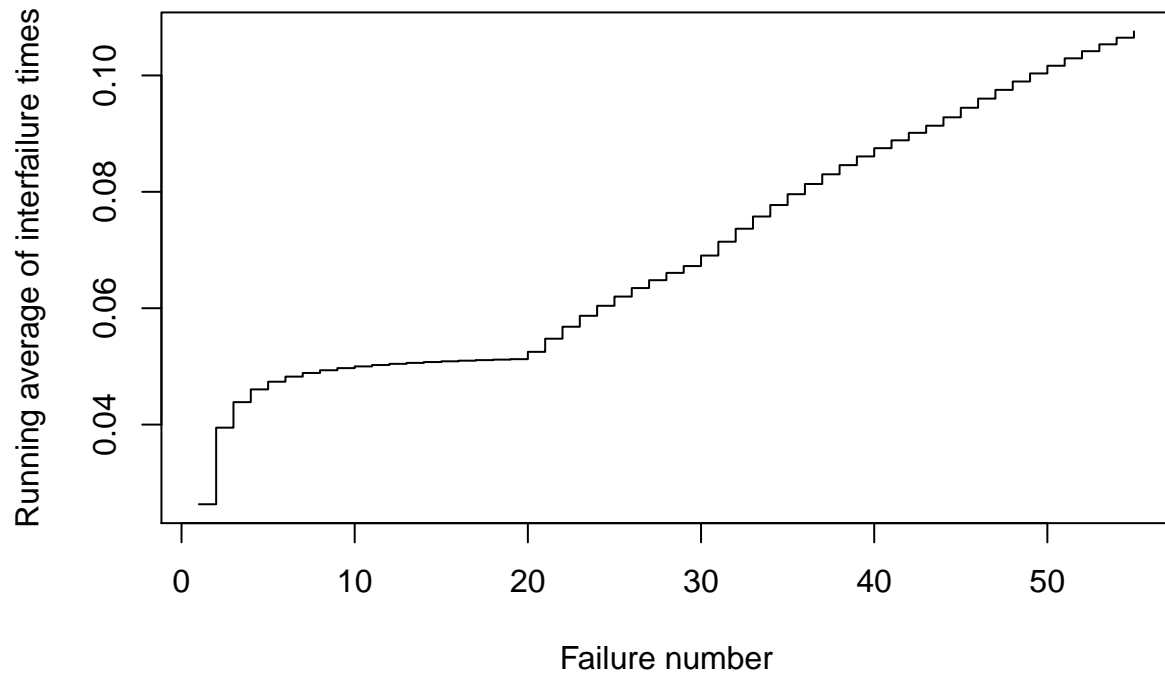
If the Laplace test statistic increases above the horizontal red line, this indicates that the data does not exhibit reliability growth. Thus, it is unlikely that a model can be applied successfully because the results may be inaccurate.



Running arithmetic average

The running arithmetic average, computes and plots a running average of the times between failures. Intuitively, if the time between failures increases then the running arithmetic average increases, indicating system reliability is improving. A decreasing running arithmetic average indicates reliability deterioration.

Running arithmetic average test: 1979_Viking data

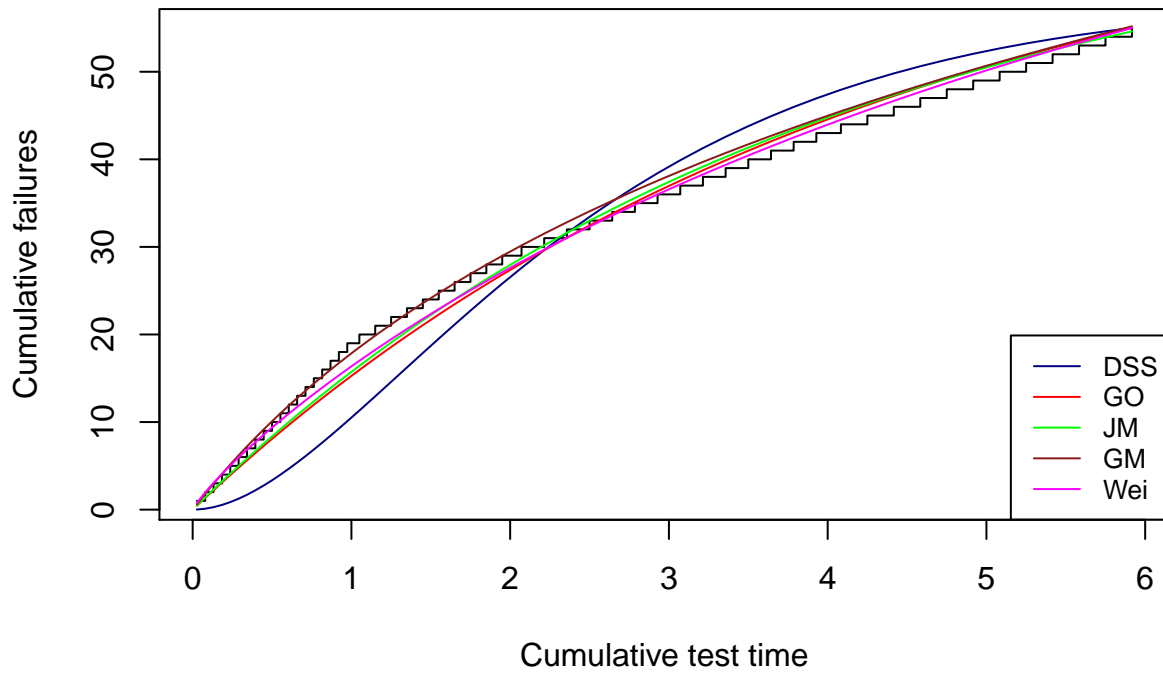


Tab2: Set Up and Apply Models

Cumulative failures

The figure show model result plots for the input data '1979_Viking data'. Models DSS, GM, Wei, GO, JM are applied.

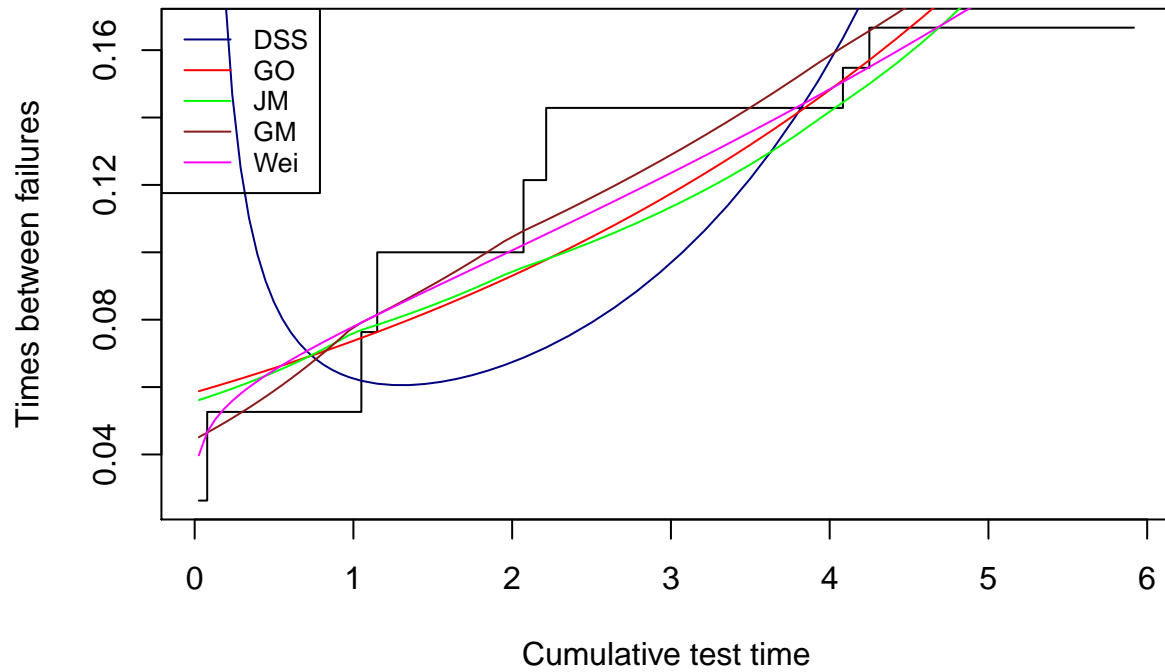
Cumulative failures vs. cumulative test time: 1979_Viking data



Models DSS, GO, JM, GM, Wei successfully characterized the input data. The staircase plot indicates the input data and models that closely matches the input data are preferred.

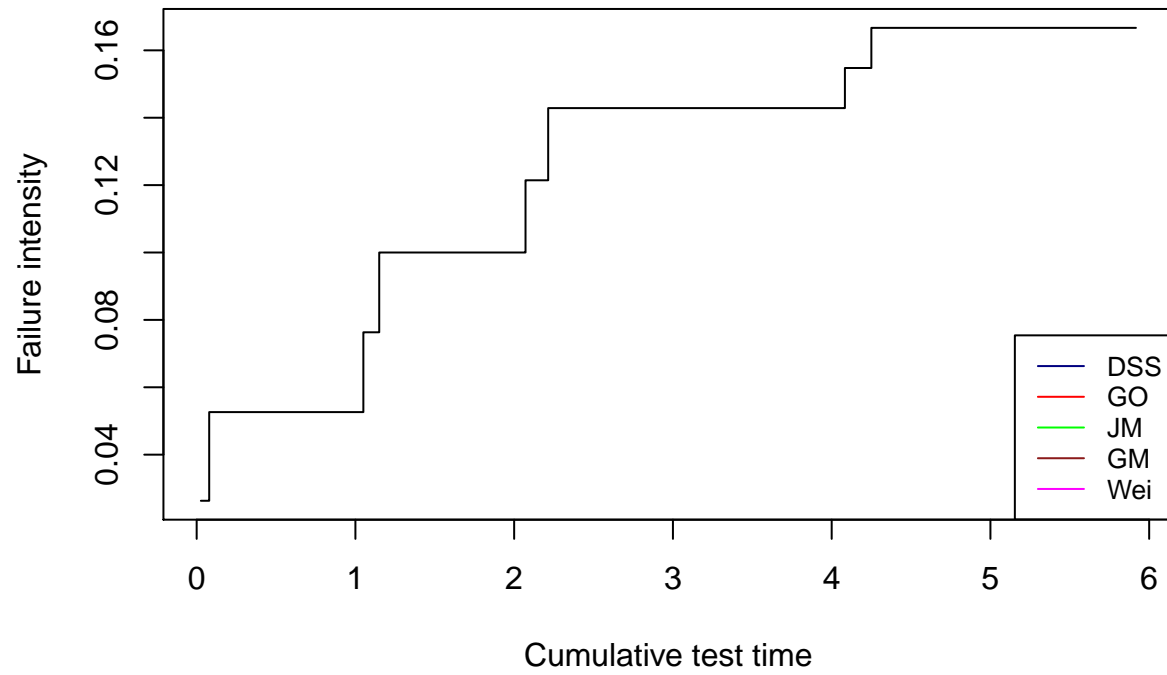
Times between failures

Times between failures vs. cumulative test time 1979_Viking data



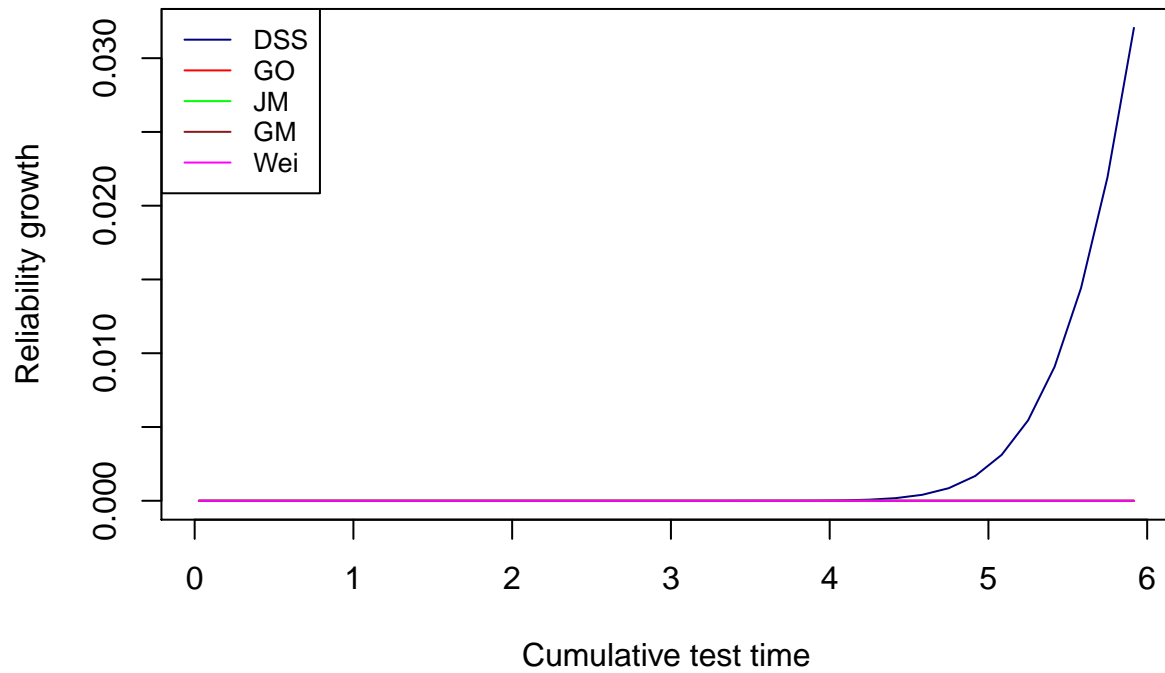
Failure intensity

Failure intensity vs. Cumualtive test time 1979_Viking data



Reliability growth

Reliability growth vs. cumulative test time 1979_Viking data



Tab3: Query Model Results

The plots and tabular displays of model results can provide a good overview of what the different models predict for the future failure behavior of the system being analyzing. However, there are some details that are difficult to see in the plots and tables, so the SFRAT allows detailed queries of the models to answer the following questions:

How many more failures will be observed in a given amount of time?

How long will it take to observe a given number of failures?

How much more testing time will be needed to obtain a given reliability for a specified operating time?

	Time to achieve specified reliability	Expected number of failures	Expected time to N failure
DSS	5.249e+00	3.44	0.5411
GO	2.222e+01	18.57	0.2379
JM	2.552e+01	15.72	0.2596
GM	1.923e+05	214.05	0.2207
Wei	5.305e+01	36.32	0.2071

Tab4: Evaluate Models

After applying one or more models to a set of failure data, the user can assess which model or models produce better predictions. This version of the SFRAT includes two methods to evaluate the performance of the models to identify those that will provide better predictions – the Akaike Information Criterion (AIC) and Predictive Sum of Squared Error (PSSE).

	Akaike Information Criterion (AIC)	“Predictive sum of squares error (PSSE)” ~ 0.9
DSS	-120.22	16.94
GO	-139.55	2.66
JM	-140.99	1.8
GM	*-142.26	3.46
Wei	-138.18	*1.03
##Smal	ler values of AIC and PSSE values are	preferred.