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Predicting Software Reliability

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Outline

- Software Reliability Overview
- CASRE – Computer Aided Software Reliability Estimation
  - Overview
  - Features
  - Sample Output

Software Reliability Overview

Definition: "The probability that a software system will operate without failure for a specified time in a specified environment."

Many statistical models have been developed to estimate and predict software reliability during operational use from failure behavior observed during test:

- Input
  - Time between subsequent failures, or
  - Number of failures observed in each test interval, and the length of each test interval
- Output
  - Probability density function for time to next failure, or
  - Probability density function for number of failures that will be observed in next test interval.

Software Reliability Overview (cont'd)

- Using model results:
  - Determine whether required reliability has been achieved (can the system be shipped?).
  - Predict the resources (e.g., testing time, number of testers, computing time) that will be required to achieved the required reliability.
  - Quantify impact if insufficient resources are available to achieve required reliability.

CASRE – Computer Aided Software Reliability Engineering

- Overview
  - Windows-based tool for estimating and predicting software reliability during test.
  - Developed at JPL under sponsorship of U.S. Air Force Operational Test and Evaluation Center.
  - Version 3.0 available at no charge from Open Channel Foundation:
    - http://openchannelfoundation.org/projects/CASRE_3.0
  - Awards:
    - 2002 - Space Act Award
    - 2003 - NASA Inventions and Contributions Board Award

CASRE – Computer Aided Software Reliability Engineering (cont'd)

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- Features
  - Most popular models

Time Between Failures Models

- Geometric
- Jelinski-Moranda
- Littlewood Verrall (Linear or Quadratic)
- Musa Basic
- Musa Okumoto (Logarithmic Poisson)
- Nonhomogeneous Poisson Process

Grouped Data Models

- Generalized Poisson
- Nonhomogeneous Poisson Process
- Schneidewind Model
- Yamada S-Shaped Model

  - Failure data trend analysis – determine if failure data exhibits reliability growth
    - Laplace Test
    - Running Arithmetic Average
    - Don't apply models to data that does not exhibit reliability growth

CASRE – Computer Aided Software Reliability Engineering (cont'd)

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- Features (cont'd)
  - Graphical display of results
    - Time between failures
    - Failure intensity
    - Reliability
    - Model applicability criteria
    - …and more
  - Goodness of fit
  - Model ranking

CASRE – Computer Aided Software Reliability Engineering (cont'd) – Sample Output

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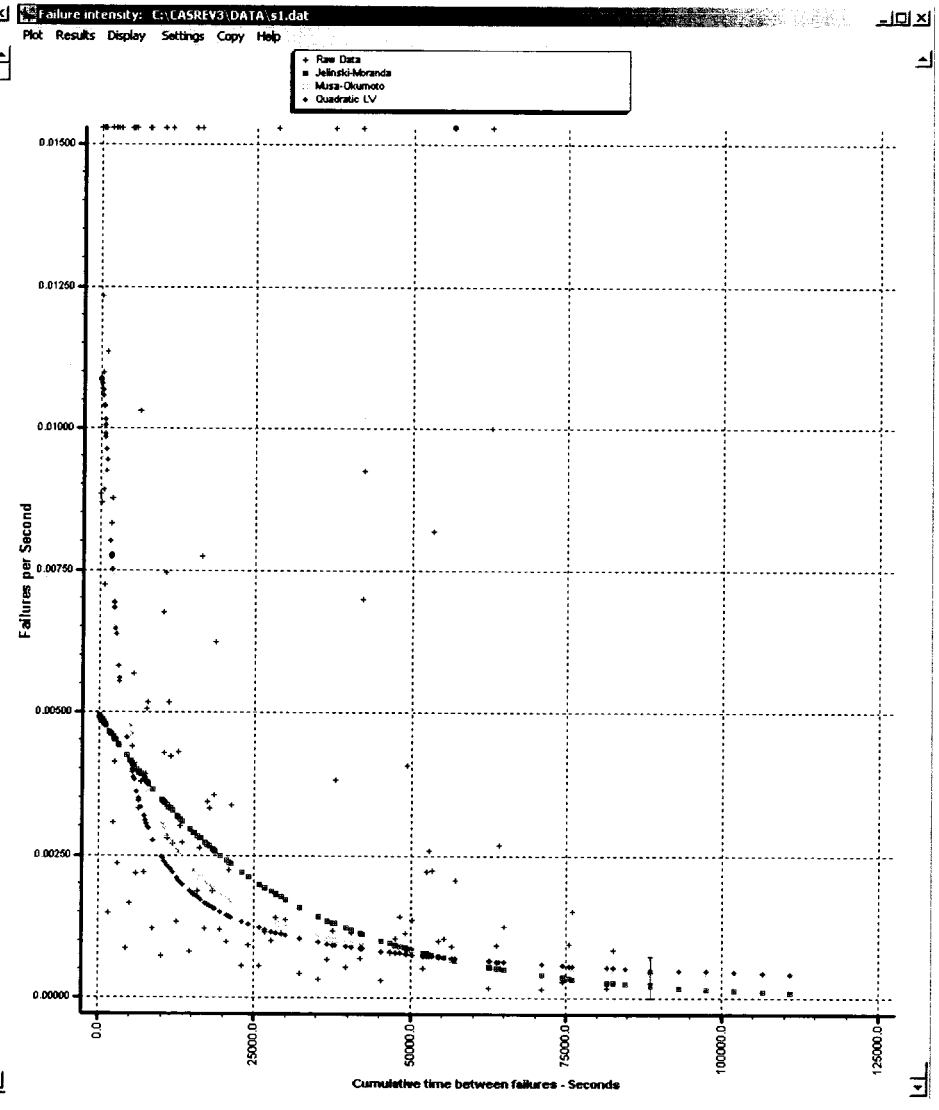
CASRE

File Edit Filters Trend Model Setup Plot Help

Error No.	Seconds Since Last Failure	Severity
1	3.000000e+000	1
2	3.000000e+001	1
3	1.130000e+002	1
4	8.100000e+001	1
5	1.150000e+002	1
6	9.000000e+000	1
7	2.000000e+000	1
8	9.100000e+001	1
9	1.120000e+002	1
10	1.500000e+001	1
11	1.380000e+002	1
12	5.000000e+001	1
13	7.700000e+001	1
14	2.400000e+001	1
15	1.080000e+002	1
16	8.800000e+001	1
17	6.700000e+002	1
18	1.200000e+002	1
19	2.600000e+001	1
20	1.140000e+002	1
21	3.250000e+002	1
22	5.500000e+001	1
23	2.420000e+002	1
24	6.800000e+001	1
25	4.220000e+002	1
26	1.800000e+002	1
27	1.000000e+001	1
28	1.146000e+003	1
29	6.000000e+002	1
30	1.500000e+001	1
31	3.600000e+001	1
32	4.000000e+000	1
33	0.000000e+000	1
34	8.000000e+000	1
35	2.270000e+002	1
36	6.500000e+001	1
37	1.760000e+002	1
38	5.800000e+001	1
39	4.570000e+002	1
40	3.000000e+002	1
41	9.700000e+001	1
42	2.630000e+002	1
43	4.520000e+002	1
44	2.550000e+002	1
45	1.970000e+002	1
46	1.930000e+002	1
47	6.000000e+000	1
48	7.900000e+001	1
49	8.160000e+002	1
50	1.351000e+003	1
51	1.480000e+002	1
52	2.100000e+001	1
53	2.330000e+002	1
54	1.340000e+002	1
55	3.570000e+002	1
56	1.930000e+002	1



Estimated and Predicted Failure Intensity