

2023-27 Transmission Revenue Reset

Appendix 9A: Fitting probability distributions to Service Component data

Updated for 2020 data

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1 Service Component Parameters

This Appendix sets out the information used to calculate AusNet's proposed Service Component caps and floors, as presented in section 8.3.1.2 of the Revised Revenue Proposal. This information was obtained using the @risk product, a risk analysis and simulation add-in tool for Microsoft Excel.

For each parameter, proposed caps and floors have been set equal to the 5th and 95th percentiles, respectively, of the probability distribution that provides the best fit to the relevant historical data. This approach aligns with that adopted by the AER in the Draft Decision and in recent determinations for ElectraNet, TransGrid and TasNetworks. The distributions and caps and floors have been revised since AusNet's Revenue Proposal to take account of 2020 actual data, which was unavailable at the time. Consistent with the requirements of the STPIS, the caps and floors set out in this document are based on the five most recent years of performance data (2016-20).

In the Draft Decision, the AER disagreed with AusNet's preference to adopt distributions based on the Anderson-Daring (A-D) fit statistics. Instead, the AER relied solely on the Kolmogorov-Smirnov (K-S) method of fitting probability distributions. For this Revised Revenue Proposal, AusNet has followed the AER's preferred method of using only the K-S method to determine the most appropriate distribution.

For the loss of supply event frequency parameters (>0.05 and >0.30 system minutes) performance data is not conducive to statistical analysis. This is due to the small number of events usually, but not always, recorded in any one year of a five year data series. To align with the Draft Decision and to ensure consistency between the two indicators, the Poisson distribution has been used to set caps and floors for these sub-parameters.

The following table summarises the probability distributions and percentiles underpinning the proposed caps and floors.

| Parameter | Preferred Distribution | 5th percentile | 95th percentile |
|----------------------------------------------------------------------|---------------------------|-------------------|--------------------|
| Average circuit outage rate | | | |
| Line event rate (fault) | Gamma | 0.1243 | 0.2237 |
| Transformer event rate (fault) | Erlang | 0.0649 | 0.1880 |
| Reactive plant event rate (fault) | Dagum | 0.1490 | 0.3043 |
| Line event rate (forced) | FatigueLife | 0.0382 | 0.2074 |
| Transformer event rate (forced) | Burr12 | 0.0754 | 0.1588 |
| Reactive plant event rate (forced) | Burr12 | 0.1965 | 0.3466 |
| Loss of supply event frequency | | | |
| Number of events >0.05 system minutes | Poisson | 0 | 4 |
| Number of events >0.30 system minutes | Poisson | 0 | 2 |
| Average outage duration | | | |
| Average outage duration | Rayleigh | 10.6 | 80.8 |
| Proper operation of equipment | | | |
| Failure of protection equipment | Poisson | 22 | 40 |
| Material failure of SCADA system | Geometric | 0 | 3 |
| Incorrect operational isolation of primary or secondary equipment | Poisson | 3 | 11 |

Table 1.1: Summary of probability distributions and percentiles

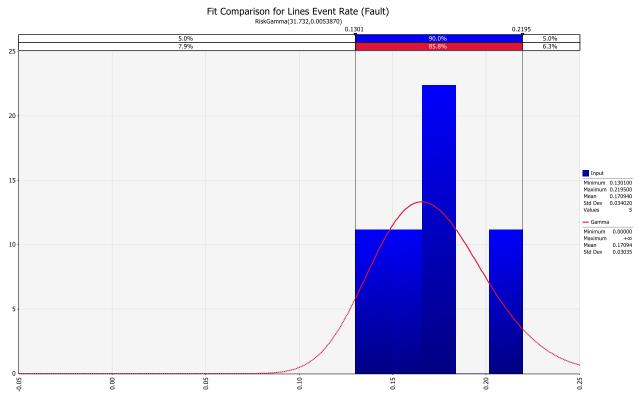
The remainder of this document sets out the rationale for selecting each distribution and the underlying percentile data as calculated by @risk.

1.1 Service parameter 1 – Average circuit outage rate

1.1.1 Lines event rate – fault (continuous)

The @risk software found that the Gamma distribution is the most appropriate fit.

Figure 1-1: Lines event rate (fault) – distribution fit using K-S



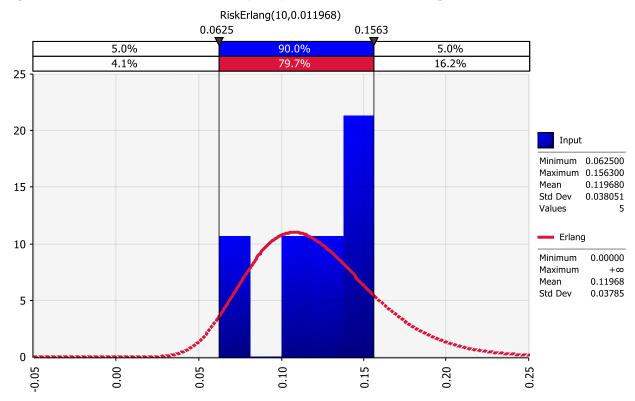


| k By K-S | v . | | Input | Gamma | Erlang | FatigueLife | Invgauss | Lognorm | Lognarm2 | Loglogistic | Pearson6 | Pearson5 | Burr12 | Weibull | Dagum | Frechet | BetaGeneral | Triang |
|--------------------|--------|--------------------------|---------------------|------------|-----------|-------------|-----------|-----------|------------|-------------|-----------|-----------|-----------|-----------|-----------|------------|-------------|----------|
| Fit | Value | - Distribution Statistic | 5 | | | | | | | | | | | | | | | |
| Gamma | 0.1887 | Minimum | 0.1301 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Erlang | 0.1889 | Maximum | 0.2195 | + Infinity | +infinity | +Infinity | +Infinity | +Infinity | +Infinity | +Infinity | +Infinity | +Infinity | +Infinity | +Infinity | +Infinity | +Infinity | 0.2266 | 0.2195 |
| FatigueLife | 0.1995 | Mean | 0.1709 | 0.17094 | 0.17094 | 0.1709 | 0.1709 | 0.1709 | 0.1709 | 0.1716 | 0.1710 | 0.1710 | 0.1674 | 0.1708 | 0.17300 | 0.1730 | 0.1724 | 0.1463 |
| Invgauss | 0.1996 | Mode | 0.1323 (est) | 0.16555 | 0.16560 | 0.1629 | 0.1629 | 0.1630 | 0.1630 | 0.1646 | 0.1621 | 0.1606 | 0.1786 | 0.1786 | 0.15030 | 0.1503 | 0.1971 | 0.2195 |
| Lognorm | 0.1997 | Median | 0.1760 | 0.16915 | 0.16916 | 0.1683 | 0.1682 | 0.1683 | 0.1683 | 0.1684 | 0.1679 | 0.1674 | 0.1732 | 0.1732 | 0.16336 | 0.1634 | 0.1784 | 0.1552 |
| Lognorm2 | 0.1997 | Std. Deviation | 0.0340 | 0.03035 | 0.03022 | 0.0306 | 0.0307 | 0.0307 | 0.0307 | 0.0340 | 0.0309 | 0.0313 | 0.0440 | 0.0325 | 0.04171 | 0.0417 | 0.0346 | 0.0517 |
| Loglogistic | 0.2018 | Skewness | 0.3861 | 0.3550 | 0.3536 | 0.5349 | 0.5380 | 0.5446 | 0.5446 | 1.0122 | 0.6276 | 0.7585 | -2.6578 | -0.3854 | 2.7139 | 2.7136 | -0.7771 | -0.5657 |
| Pearson6 | 0.2039 | Kurtosis | 3.0174 | 3.1891 | 3.1875 | 3.4865 | 3.4824 | 3.5319 | 3.5319 | 6.9284 | 3.7480 | 4.1099 | 18.3174 | 3.0542 | 22.7328 | 22.7233 | 3.1998 | 2,4000 |
| Pearson5 Burr12 | 0.2103 | = Percentiles | | | | | | | | | | | | | | | | |
| Weibull | 0.2120 | 5% | 0.1301 | 0.12427 | 0.12445 | 0.1256 | 0.1256 | 0.1255 | 0.1255 | 0.1229 | 0.1259 | 0.1266 | 0.1133 | 0.1132 | 0.12898 | 0.1290 | 0.1063 | 0.0491 |
| Dagum | 0.2461 | 10% | 0.1301 | 0.13339 | 0.13354 | 0.1339 | 0.1339 | 0.1339 | 0.1339 | 0.1332 | 0.1341 | 0.1343 | 0.1272 | 0.1273 | 0.13458 | 0.1346 | 0.1232 | 0.0694 |
| Frechet | 0.2461 | 15% | 0.1301 | 0.13339 | 0.13992 | 0.1399 | 0.1339 | 0.1399 | 0.1399 | 0.1332 | 0.1341 | 0.1399 | 0.1272 | 0.12/3 | 0.13455 | 0.1346 | 0.1346 | 0.0850 |
| RetaGeneral | 0.2794 | 20% | 0.1301 | 0.139/9 | 0.15992 | 0.1448 | 0.1599 | 0.1599 | 0.1399 | 0.1399 | 0.1399 | 0.1599 | 0.1367 | 0.1567 | 0.13005 | 0.1369 | 0.1435 | 0.0982 |
| Triang | 0.3513 | | | | | | | | | | | 0.1446 | | | | 0.1426 | | |
| Rayleigh | 0.4296 | 25% | 0,1488 | 0.14961 | 0.14971 | 0.1492 | 0.1492 | 0.1492 | 0.1492 | 0.1497 | 0.1491 | | 0.1500 | 0.1500 | 0.14607 | | 0.1510 | 0.1098 |
| Uniform | 0.4742 | 30% | 0.1488 | 0.15382 | 0.15390 | 0.1532 | 0.1532 | 0.1532 | 0.1532 | 0.1538 | 0.1530 | 0.1527 | 0.1554 | 0.1554 | 0.14943 | 0.1494 | 0.1575 | 0.1202 |
| Expon | 0.5328 | 35% | 0.1488 | 0.15779 | 0.15785 | 0.1571 | 0.1571 | 0.1571 | 0.1571 | 0.1576 | 0.1568 | 0.1564 | 0.1603 | 0.1603 | 0.15277 | 0.1528 | 0.1634 | 0.1299 |
| Pareto2 | 0.5328 | 40% | 0.1488 | 0.16162 | 0.16167 | 0.1608 | 0.1608 | 0.1608 | 0.1608 | 0.1613 | 0.1605 | 0.1600 | 0.1648 | 0.1648 | 0.15616 | 0.1562 | 0.1687 | 0.1388 |
| Kumaraswa | 0.5496 | 45% | 0.1760 | 0.16539 | 0.16542 | 0.1645 | 0.1645 | 0.1645 | 0.1645 | 0.1648 | 0.1642 | 0.1637 | 0.1691 | 0.1691 | 0.15967 | 0.1597 | 0.1737 | 0.1472 |
| Levy | 0.6149 | 50% | 0.1760 | 0.16915 | 0.16916 | 0.1683 | 0.1682 | 0.1683 | 0.1683 | 0.1684 | 0.1679 | 0.1674 | 0.1732 | 0.1732 | 0.16336 | 0.1634 | 0.1784 | 0.1552 |
| ChiSq | 0.6394 | 55% | 0.1760 | 0.17297 | 0.17297 | 0.1721 | 0.1721 | 0.1721 | 0.1721 | 0.1721 | 0.1717 | 0.1712 | 0.1772 | 0.1773 | 0.16731 | 0.1673 | 0.1829 | 0.1628 |
| Pareto | N/A | 60% | 0.1803 | 0.17690 | 0.17689 | 0.1760 | 0.1760 | 0.1760 | 0.1760 | 0.1759 | 0.1757 | 0.1752 | 0.1813 | 0.1813 | 0.17161 | 0.1716 | 0.1872 | 0.1700 |
|] Pert | N/A | 65% | 0.1803 | 0.18104 | 0.18100 | 0.1802 | 0.1802 | 0.1802 | 0.1802 | 0.1799 | 0.1799 | 0.1794 | 0.1854 | 0.1854 | 0.17640 | 0.1764 | 0.1914 | 0.1770 |
| | | 70% | 0.1803 | 0.18546 | 0.18541 | 0.1848 | 0.1848 | 0.1847 | 0.1847 | 0.1844 | 0.1844 | 0.1840 | 0.1896 | 0.1896 | 0.18186 | 0.1818 | 0.1956 | 0.1836 |
| | | 75% | 0.1803 | 0.19031 | 0.19024 | 0.1898 | 0.1896 | 0.1897 | 0.1897 | 0.1894 | 0.1895 | 0.1892 | 0.1940 | 0.1940 | 0.18528 | 0.1883 | 0.1997 | 0.1901 |
| | | 80% | 0.1803 | 0.19582 | 0.19572 | 0.1955 | 0.1955 | 0.1955 | 0.1955 | 0.1953 | 0.1953 | 0.1952 | 0.1988 | 0.1988 | 0.19616 | 0.1962 | 0.2038 | 0.1963 |
| | | 85% | 0.2195 | 0.20236 | 0.20223 | 0.2024 | 0.2024 | 0.2024 | 0.2024 | 0.2027 | 0.2024 | 0.2025 | 0.2042 | 0.2042 | 0.20646 | 0.2064 | 0.2081 | 0.2024 |
| | | 90% | 0.2195 | 0.21080 | 0.21063 | 0.2114 | 0.2114 | 0.2114 | 0.2114 | 0.2130 | 0.2117 | 0.2023 | 0.2107 | 0.2107 | 0.22142 | 0.2214 | 0.2127 | 0.2082 |
| | | 95% | 0.2195 | 0.22372 | 0.22349 | 0.2255 | 0.2255 | 0.2256 | 0.2256 | 0.2307 | 0.2264 | 0.2122 | 0.2200 | 0.2200 | 0.24871 | 0.2487 | 0.2127 | 0.2139 |
| | | | 0.2195 | 0.22372 | 0.22349 | 0.2255 | 0.2255 | 0.2236 | 0.2256 | 0.2307 | 0.2264 | 0.2211 | 0.2200 | 0.2200 | 0.24671 | 0.2407 | 0.2176 | 0.2139 |
| | | - Information Criteria | | -10.8676 | -10.8674 | | | -10.8833 | -10.8833 | -10.4923 | 9.1232 | -10.8751 | | -10.5011 | N/A | | | |
| | | Akaike (AIC) | | | | 9.1024 | -10.8975 | | | | | | N/A | | | 9.4336 | 9.4551 | -9.4367 |
| | | Bayesian (BIC) | | -17.6487 | -17.6485 | -16.0693 | -17.6786 | -17.6644 | -17.6644 | -17.2735 | -16,0485 | -17.6563 | -14.0633 | -17.2822 | -14.1287 | -15.7381 | -15.7166 | -16.2178 |
| | | Av. LogL | | 2.0868 | 2.0867 | 2.0898 | 2.0898 | 2.0883 | 2.0883 | 2.0492 | 2.0877 | 2.0875 | 2.0501 | 2.0501 | 2.0566 | 2.0566 | 2.0545 | 1.9437 |
| | | = Chi-Squared Test - [* | Values unavailable | | | | | | | | | | | | | | | |
| | | Chi-Sq Statistic | | 0.2000 | 0.2000 | 0.2000 | 0.2000 | 0.2000 | 0.2000 | 0.2000 | 0.2000 | 0.2000 | 0.2000 | 0.2000 | 0.2000 | 0.2000 | 0.2000 | 0.2000 |
| | | P-Value* | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| | | Cr. Value @ 0.750* | | N/A | N/A. | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| | | Cr. Value @ 0.500* | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| | | Cr. Value @ 0.250* | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A. | N/A | N/A | N/A | N/A | N/A | N/A |
| | | Cr. Value @ 0.150* | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| | | Cr. Value @ 0.100* | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| | | Cr. Value @ 0.050* | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| | | Cr. Value @ 0.025* | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| | | Cr. Value @ 0.010* | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| | | Cr. Value @ 0.005* | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| | | Cr. Value @ 0.001* | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| | | | and a second second | N/A | nve. | N/A | N/A | R/A | PK/A | Rea. | PL/A | N/A | 11/14 | NUA. | R/A | PE/A | new. | R/A |
| | | Chi-Sq Test (Binning | intormatión) | 0.0000 | 0.0005 | 0.0000 | 0.0000 | 0.0007 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0505 | |
| | | Bin #1 : Minimum | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| | | Bin #1 : Maximum | | 0.16915 | 0.16916 | 0.1683 | 0.1682 | 0.1683 | 0.1683 | 0.1684 | 0.1679 | 0.1674 | 0.1732 | 0.1732 | 0.16336 | 0.1634 | 0.1784 | 0.1552 |
| | | Bin #1 : Input | | 2,0000 | 2.0000 | 2.0000 | 2.0000 | 2.0000 | 2.0000 | 2.0000 | 2.0000 | 2.0000 | 2.0000 | 2.0000 | 2.0000 | 2.0000 | 3.0000 | 2.0000 |
| | | Bin #1 : Fit | | 2.5000 | 2.5000 | 2.5000 | 2.5000 | 2.5000 | 2.5000 | 2.5000 | 2.5000 | 2.5000 | 2.5000 | 2.5000 | 2.5000 | 2.5000 | 2.5000 | 2.5000 |
| | | Bin #2 : Minimum | | 0.16915 | 0.16916 | 0.1683 | 0.1682 | 0.1683 | 0.1683 | 0.1684 | 0.1679 | 0.1674 | 0.1732 | 0.1732 | 0.16336 | 0.1634 | 0.1784 | 0.1552 |
| | | Bin #2 : Maximum | | + Infinity | +Infinity | +Infinity | +Infinity | +Infinity | + Infinity | +Infinity | +Infinity | +Infinity | +Infinity | +Infinity | +Infinity | + Infinity | 0.2266 | 0.2195 |
| | | | | | | | | | | | | | | | | | | |

1.1.2 Transformer event rate – fault (continuous)

The @risk software found that the Erlang distribution is the most appropriate fit.

Figure 1-2: Transformer event rate (fault) – distribution fit using K-S



| Figure 1.2: Transformer event rate | (fault) – statistics table using K-S |
|------------------------------------|--------------------------------------|
|------------------------------------|--------------------------------------|

| By K-S | ~ | | Input | Erlang | Gamma | Lognorm2 | Lognorm | Burr12 | Weibull | BetaGeneral | FatigueLife | Invgauss | Pearson6 | Pearson5 | Frechet | Rayleigh | Triang | Uniform |
|----------------|--------|---------------------------|-------------------|-------------------|------------|-----------|-----------|-----------|-----------|-------------|-------------|-----------|-------------|------------|-----------|------------|----------|----------|
| Fit | Value | Distribution Statistics | | | | | | | | | | | | | | | | |
| ang | 0.2062 | Minimum | 0.0625 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| mma | 0.2064 | Maximum | 0.1563 | +Infinity | -Infinity | -Infinity | +Infinity | +Infinity | +Infinity | 0.1563 | +Infinity | +Infinity | - Infinity | + Infinity | +Infinity | + Infinity | 0.1563 | 0.1954 |
| morm2 | 0.2195 | Mean | 0.1197 | 0.1197 | 0.1197 | 0.1204 | 0.1204 | 0.1203 | 0.1203 | 0.1237 | 0.1197 | 0.1197 | 0.121588283 | 0.1216 | 0.1337 | 0.1103 | 0.1042 | 0.0977 |
| norm | 0.2195 | Mode | 0.0648 [est] | 0.1077 | 0.1080 | 0.1020 | 0.1020 | 0.1243 | 0.1243 | 0.1563 | 0.1008 | 0.1006 | 0.095884178 | 0.0959 | 0.0852 | 0.0880 | 0.1563 | 0.0000 |
| r12 | 0.2202 | Median | 0.1260 | 0.1157 | 0.1158 | 0.1139 | 0.1139 | 0.1214 | 0.1214 | 0.1394 | 0.1133 | 0.1132 | 0.111581163 | 0.1116 | 0.1086 | 0.1036 | 0.1105 | 0.0977 |
| ibull | 0.2203 | Std. Deviation | 0.0381 | 0.0378 | 0.0374 | 0.0412 | 0.0412 | 0.0314 | 0.0314 | 0.0374 | 0.0407 | 0.0408 | 0.047836039 | 0.0478 | 0.1062 | 0.0576 | 0.0368 | 0.0564 |
| aGeneral | 0.2210 | Skewness | -0.8672 | 0.6325 | 0.6255 | 1.0661 | 1.0661 | -0.1495 | -0.1509 | -1.2561 | 0.9987 | 1.0228 | 1.8519 | 1.8619 | +Infinity | 0.6311 | -0.5657 | 0.0000 |
| | 0.2245 | Kurtosis | 2.9611 | 3.6000 | 3.5869 | 5.0867 | 5.0867 | 2.7808 | 2.7869 | 3,6523 | 4.6765 | 4.7436 | 10.7108 | 10.7109 | +Infinity | 3.2451 | 2.4000 | 1.8000 |
| pauss rson6 | 0.2254 | = Percentiles | 2.3011 | 3.0000 | 5,5005 | 2.0001 | 3,0007 | 217000 | 2.1005 | 20000 | 4,0705 | 4,1450 | 10.1100 | 1011103 | - mining | 212421 | 24000 | |
| rsone | 0.2334 | 5% | 0.0625 | 0.0649 | 0.0654 | 0.0659 | 0.0659 | 0.0668 | 0.0666 | 0.0418 | 0.0656 | 0.0657 | 0.066006714 | 0.0660 | 0.0642 | 0.0282 | 0.0349 | 0.00977 |
| thet | 0.2572 | 10% | 0.0625 | 0.0745 | 0.0034 | 0.0539 | 0.0035 | 0.0086 | 0.0786 | 0.0635 | 0.0738 | 0.0739 | | 0.0080 | 0.0705 | 0.0404 | 0.0349 | 0.0195 |
| leigh | 0.3027 | | | | | | | | | | | | 0.073532716 | | | | | |
| ng | 0.3161 | 15% | 0.0625 | 0.0814 | 0.0818 | 0.0807 | 0.0807 | 0.0869 | 0.0869 | 0.0800 | 0.0801 | 0.0801 | 0.079280172 | 0.0793 | 0.0756 | 0.0502 | 0.0605 | 0.0293 |
| form | 0.3323 | 20% | 0.0625 | 0.0872 | 0.0876 | 0.0861 | 0.0861 | 0.0935 | 0.0935 | 0.0934 | 0.0854 | 0.0854 | 0.084288702 | 0.0843 | 0.0802 | 0.0588 | 0.0699 | 0.0391 |
| taraswa | 0.3815 | 25% | 0.1040 | 0.0925 | 0.0928 | 0.0910 | 0.0910 | 0.0991 | 0.0991 | 0.1045 | 0.0903 | 0.0903 | 0.088930999 | 0.0889 | 0.0847 | 0.0667 | 0.0782 | 0.0488 |
| on | 0.4068 | 30% | 0.1040 | 0.0973 | 0.0976 | 0.0957 | 0.0957 | 0.1042 | 0.1042 | 0.1139 | 0.0950 | 0.0949 | 0.093397388 | 0.0934 | 0.0891 | 0.0743 | 0.0856 | 0.0586 |
| to2 | 0.4068 | 35% | 0.1040 | 0.1020 | 0.1022 | 0.1002 | 0.1002 | 0.1068 | 0.1088 | 0.1219 | 0.0995 | 0.0994 | 0.097808750 | 0.0978 | 0.0936 | 0.0817 | 0.0925 | 0.0684 |
| | 0.5925 | 40% | 0.1040 | 0.1066 | 0.1067 | 0.1047 | 0.1047 | 0.1132 | 0.1131 | 0.1287 | 0.1040 | 0.1039 | 0.102256375 | 0.1023 | 0.0983 | 0.0889 | 0.0989 | 0.0782 |
| 59 | 0.6926 | 45% | 0.1260 | 0.1111 | 0.1112 | 0.1092 | 0.1092 | 0.1173 | 0.1173 | 0.1345 | 0.1086 | 0.1085 | 0.106820406 | 0.1068 | 0.1032 | 0.0962 | 0.1048 | 0.0879 |
| um | 0.8000 | 50% | 0.1260 | 0.1157 | 0.1158 | 0.1139 | 0.1139 | 0.1214 | 0.1214 | 0.1394 | 0.1133 | 0.1132 | 0.111581163 | 0.1116 | 0.1086 | 0.1036 | 0.1105 | 0.0977 |
| ogistic | N/A | 55% | 0.1260 | 0.1204 | 0,1205 | 0.1187 | 0.1187 | 0.1254 | 0.1254 | 0.1435 | 0.1181 | 0.1180 | 0.116628507 | 0,1166 | 0.1146 | 0.1112 | 0.1159 | 0.1075 |
| eto | N/A | 60% | 0.1496 | 0.1254 | 0.1254 | 0.1239 | 0.1239 | 0.1294 | 0.1295 | 0.1469 | 0.1233 | 0.1232 | 0.122072620 | 0.1221 | 0.1213 | 0.1191 | 0.1211 | 0.1172 |
| | N/A | 65% | 0,1495 | 0.1306 | 0.1305 | 0.1294 | 0.1294 | 0.1336 | 0.1336 | 0.1497 | 0.1289 | 0.1288 | 0.128059382 | 0.1281 | 0.1289 | 0.1275 | 0.1260 | 0.1270 |
| | | 70% | 0.1496 | 0.1363 | 0.1361 | 0.1356 | 0.1356 | 0.1378 | 0.1379 | 0.1518 | 0.1351 | 0.1350 | 0.134796289 | 0.1345 | 0.1380 | 0.1365 | 0.1308 | 0.1368 |
| | | 75% | 0.1496 | 0.1426 | 0.1424 | 0.1330 | 0.1330 | 0.1424 | 0.1424 | 0.1535 | 0.1420 | 0.1419 | 0.142601535 | | 0.1491 | 0.1465 | 0.1354 | 0.1465 |
| | | | | | | | | | | | | | | 0.1426 | | | | |
| | | 80% | 0.1496 | 0.1498 | 0.1495 | 0.1507 | 0.1507 | 0.1474 | 0.1474 | 0.1547 | 0.1502 | 0.1501 | 0.152009024 | 0.1520 | 0.1634 | 0.1579 | 0.1398 | 0.1563 |
| | | 85% | 0.1563 | 0.1586 | 0.1581 | 0.1607 | 0.1607 | 0.1531 | 0.1531 | 0.1555 | 0.1602 | 0.1602 | 0.164031087 | 0.1640 | 0.1831 | 0.1714 | 0.1441 | 0.1661 |
| | | 90% | 0.1563 | 0.1700 | 0.1695 | 0.1744 | 0.1744 | 0.1601 | 0.1601 | 0.1560 | 0.1737 | 0.1738 | 0.180989538 | 0.1810 | 0.2140 | 0.1888 | 0.1483 | 0.1758 |
| | | 95% | 0.1563 | 0.1880 | 0.1872 | 0.1968 | 0.1968 | 0.1701 | 0.1701 | 0.1563 | 0.1956 | 0.1959 | 0.210579406 | 0.2106 | 0.2773 | 0.2154 | 0.1523 | 0.1856 |
| | | - Information Criteria | | | | | | | | | | | | | | | | |
| | | Akaike (AIC) | | -8.9961 | -8.9974 | -8.5450 | -8.5450 | N/A | -9.9655 | | 11.4263 | -8.5460 | 11.9827 | -8.0173 | 13.0272 | -13.5528 | -12.3246 | -12.9950 |
| | | Bayesian (BIC) | | -15.7772 | -15.7785 | -15.3262 | -15.3262 | -13.5278 | -16.7466 | - | -13.7454 | -15.3272 | -13.1890 | -14.7984 | -12.1445 | -15.2767 | -19.1058 | -14,7189 |
| | | Av. LogL | | 1.8996 | 1.8997 | 1.8545 | 1.8545 | 1.9966 | 1.9966 | | 1.8574 | 1.8546 | 1.8017 | 1.8017 | 1.6973 | 1.6886 | 2.2325 | 1.6328 |
| | | - Chi-Squared Test - [*) | alues unavailable | without running a | bootstrapl | | | | | | | | | | | | | |
| | | Chi-Sq Statistic | | 0.2000 | 0.2000 | 0.2000 | 0.2000 | 0.2000 | 0.2000 | 0.2000 | 0.2000 | 0.2000 | 0.2000 | 0.2000 | 0.2000 | 1.8000 | 0.2000 | 1.8000 |
| | | P-Value* | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| | | Cr. Value @ 0.750* | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| | | Cr. Value @ 0.500* | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| | | | | | N/A | N/A | | | N/A | N/A | N/A | | N/A | | N/A | N/A | | N/A |
| | | Cr. Value @ 0.250* | | N/A | | | N/A | N/A | | | | N/A | | N/A | | | N/A | |
| | | Cr. Value @ 0.150* | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| | | Cr. Value @ 0.100* | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| | | Cr. Value @ 0.050* | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| | | Cr. Value @ 0.025* | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| | | Cr. Value @ 0.010* | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| | | Cr. Value @ 0.005* | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| | | Cr. Value @ 0.001* | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| | | - Chi-Sa Test (Binning In | formation) | | | | | | | | | | | | | | | |
| | | Bin #1 : Minimum | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| | | Ein #1 : Maximum | | 0.1157 | 0.1158 | 0.1139 | 0.1139 | 0.1214 | 0.1214 | 0.1394 | 0.1133 | 0.1132 | 0.111581163 | 0.1116 | 0.1086 | 0.1036 | 0.1105 | 0.0977 |
| | | | | | | | | | | | | | | | | | | 1.0000 |
| | | Ein #1 : Input | | 2.0000 | 2.0000 | 2.0000 | 2.0000 | 2.0000 | 2.0000 | 3.0000 | 2.0000 | 2.0000 | 2.0000 | 2.0000 | 2.0000 | 1.0000 | 2.0000 | |
| | | Bin #1 : Fit | | 2.5000 | 2.5000 | 2.5000 | 2.5000 | 2.5000 | 2.5000 | 2.5000 | 2,5000 | 2.5000 | 2.5000 | 2.5000 | 2.5000 | 2.5000 | 2.5000 | 2.5000 |
| | | Bin #2 : Minimum | | 0.1157 | 0.1158 | 0.1139 | 0.1139 | 0.1214 | 0.1214 | 0.1394 | 0.1133 | 0.1132 | 0.111581163 | 0.1116 | 0.1086 | 0.1036 | 0.1105 | 0.0977 |
| | | Ein #2 : Maximum | | +Infinity | -Infinity | +Infinity | +Infinity | +Infinity | +Infinity | 0.1563 | +Infinity | +Infinity | +Infinity | +Infinity | +Infinity | +Infinity | 0.1563 | 0.1954 |
| | | | | | | | | | | | | | | | | | | |

1.1.3 Reactive plant event rate – fault (continuous)

The @risk software found that the Dagum distribution is the most appropriate fit.

Figure 1-3: Reactive plant event rate (fault) – distribution fit using K-S

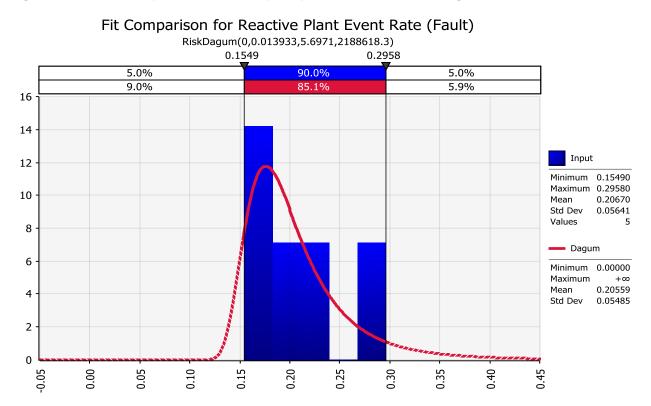


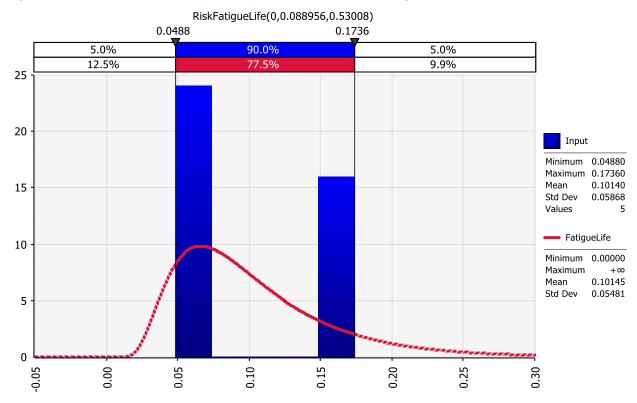
Figure 1-4: Reactive plant event rate (fault) – statistics table using K-S

| nk By K-5 | ~ | | Input | Dagum | Frechet | Pearson5 | Pearson6 | Lognorm | Lognorm2 | Invgauss | FatigueLife | Erlang | Gamma | Weibull | Pert | Triang | BetaGeneral | Rayleigh |
|-------------------------|--------|-------------------------|--------------------|------------|---------------|------------|------------|---------------|---------------|------------|-------------|---------------|------------|---------------|----------|----------|---------------|---------------|
| Fit | Value | Distribution Statistic | 5 | | | | | | | | | | | | | | | |
| Dagum | 0.1686 | Minimum | 0.1549 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Frechet | 0.1686 | Maximum | 0.2958 | + Infinity | +Infinity | + Infinity | +Infinity | +Infinity | +Infinity | + Infinity | +Infinity | +Infinity | + Infinity | +Infinity | 0.3202 | 0.2958 | 0.3045 | +Infinity |
| Pearson5 | 0.2005 | Mean | 0.2067 | 0.2056 | 0.2056 | 0.2064 | 0.20639745 | 0.2065 | 0.2065 | 0.2067 | 0.2067 | 0.2067 | 0.2067 | 0.2064 | 0.2088 | 0.1972 | 0.2118 | 0.1886 |
| Pearson6 | 0.2005 | Mode | 0.1584 [est] | 0.1756 | 0.1756 | 0.1868 | 0.18676989 | 0.1907 | 0.1907 | 0.1906 | 0.1907 | 0.1952 | 0.1954 | 0.2131 | 0.2331 | 0.2958 | 0.2582 | 0.1505 |
| Lognorm | 0.2116 | Median | 0.1884 | 0.1927 | 0.1927 | 0.1994 | 0.19940192 | 0.2011 | 0.2011 | 0.2013 | 0.2013 | 0.2029 | 0.2030 | 0.2082 | 0.2145 | 0.2092 | 0.2211 | 0.1771 |
| Lognorm2 | 0.2116 | Std. Deviation | 0.0564 | 0.0548 | 0.0549 | 0.0486 | 0.04860608 | 0.0481 | 0.0481 | 0.0481 | 0.0480 | 0.0487 | 0.0483 | 0.0547 | 0.0577 | 0.0697 | 0.0594 | 0.0986 |
| Invgauss | 0.2127 | Skewness | 1,1959 | 2.9725 | 2.9726 | 0.9973 | 0.9973 | 0.7120 | 0.7120 | 0.6977 | 0.6907 | 0.4714 | 0.4670 | -0.1366 | -0.4221 | -0.5657 | -0.6107 | 0.6311 |
| FatigueLife | 0.2131 | Kurtosis | 3.9480 | 28.6750 | 28.6773 | 4.9592 | 4.9592 | 3.9146 | 3.9146 | 3.8113 | 3.8085 | 3.3333 | 3.3271 | 2.7769 | 2.5709 | 2.4000 | 2.6932 | 3.2451 |
| Erlang | 0.2210 | Percentiles | 3.5400 | 20.0130 | 20.0113 | 4.5552 | 4.0002 | 5.5140 | 3.3140 | 202113 | 3.0003 | 2.2222 | July 1 | 2.1763 | 2.3703 | 2.4000 | 2.0002 | 2.2421 |
| Gamma | 0.2227 | | 0.1549 | 0.1490 | 0.1490 | 0.1407 | 0.14070655 | 0.1377 | 0.1377 | 0.1380 | 0.1380 | | 0.1342 | 0.1130 | 0.1048 | 0.0661 | 0.1003 | 0.0482 |
| Weibull | 0.2357 | 5% | | | | | | | | | | 0.1336 | | | | | | |
| Pert Triang | 0.2535 | 10% | 0.1549 | 0.1561 | 0.1561 | 0.1514 | 0.15143646 | 0.1498 | 0.1498 | 0.1499 | 0.1499 | 0.1472 | 0.1478 | 0.1338 | 0.1280 | 0.0935 | 0.1261 | 0.0691 |
| | 0.2742 | 15% | 0.1549 | 0.1615 | 0.1615 | 0.1593 | 0,15930691 | 0.1584 | 0.1584 | 0.1586 | 0.1586 | 0.1570 | 0.1574 | 0.1481 | 0.1444 | 0.1146 | 0.1445 | 0.0858 |
| BetaGeneral Rayleigh | 0.2773 | 20% | 0.1549 | 0.1662 | 0.1662 | 0.1660 | 0.16595921 | 0.1657 | 0.1657 | 0.1658 | 0.1658 | 0.1650 | 0.1654 | 0.1595 | 0.1577 | 0.1323 | 0.1594 | 0.1005 |
| Uniform | | 25% | 0.1690 | 0.1706 | 0.1706 | 0.1720 | 0.17196681 | 0.1722 | 0.1722 | 0.1723 | 0.1723 | 0.1721 | 0.1724 | 0.1693 | 0.1692 | 0.1479 | 0.1722 | 0.1141 |
| Expon | 0.4189 | 30% | 0.1690 | 0.1749 | 0.1749 | 0.1776 | 0.17761287 | 0.1782 | 0.1782 | 0.1783 | 0.1784 | 0.1787 | 0.1789 | 0.1781 | 0.1796 | 0.1620 | 0.1836 | 0.1271 |
| Kumaraswa. | 0.5275 | 35% | 0.1690 | 0.1792 | 0.1792 | 0.1831 | 0.18306851 | 0.1840 | 0.1840 | 0.1841 | 0.1842 | 0.1849 | 0.1851 | 0.1862 | 0.1890 | 0.1750 | 0.1939 | 0.1396 |
| Levy | 0.5845 | 40% | 0.1690 | 0.1835 | 0.1835 | 0.1885 | 0.18845454 | 0.1897 | 0.1897 | 0.1898 | 0.1899 | 0.1909 | 0.1911 | 0.1938 | 0.1979 | 0.1871 | 0.2035 | 0.1521 |
| ChiSa | 0.5865 | 45% | 0.1884 | 0.1880 | 0.1880 | 0.1939 | 0.19386889 | 0.1954 | 0.1954 | 0.1955 | 0.1956 | 0.1969 | 0.1970 | 0.2011 | 0.2064 | 0.1984 | 0.2125 | 0.1645 |
| Burr12 | N/A | 50% | 0.1884 | 0.1927 | 0.1927 | 0.1994 | 0.19940192 | 0.2011 | 0.2011 | 0.2013 | 0.2013 | 0.2029 | 0.2030 | 0.2082 | 0.2145 | 0.2092 | 0.2211 | 0.1771 |
| Logiogistic | N/A | 55% | 0.1884 | 0.1978 | 0.1978 | 0.2051 | 0.20514733 | 0.2070 | 0.2070 | 0.2072 | 0.2073 | 0.2090 | 0.2090 | 0.2152 | 0.2224 | 0.2194 | 0.2292 | 0.1901 |
| Pareto | N/A | 60% | 0.2254 | 0.2033 | 0.2033 | 0.2112 | 0.21121318 | 0.2132 | 0.2132 | 0.2134 | 0.2135 | 0.2153 | 0.2153 | 0.2223 | 0.2302 | 0.2291 | 0.2371 | 0.2037 |
| Pareto2 | N/A | 65% | 0.2254 | 0.2095 | 0.2095 | 0.2177 | 0.21773583 | 0.2197 | 0.2197 | 0.2200 | 0.2201 | 0.2220 | 0.2219 | 0.2295 | 0.2380 | 0.2385 | 0.2448 | 0.2180 |
| | | | 0.2254 | 0.2095 | | | | | | | | | | 0.2295 | 0.2380 | 0.2385 | | 0.2180 |
| | | 70% | | | 0.2165 | 0.2249 | 0.22490230 | 0.2269 | 0.2269 | 0.2272 | 0.2272 | 0.2292 | 0.2290 | | | | 0.2524 | |
| | | 75% | 0.2254 | 0.2249 | 0.2249 | 0.2330 | 0.23299111 | 0.2348 | 0.2348 | 0.2352 | 0.2352 | 0.2372 | 0.2369 | 0.2450 | 0.2538 | 0.2562 | 0.2599 | 0.2505 |
| | | 80% | 0.2254 | 0.2351 | 0.2351 | 0.2425 | 0.24245783 | 0.2440 | 0.2440 | 0.2444 | 0.2445 | 0.2462 | 0.2458 | 0.2537 | 0.2621 | 0.2646 | 0.2674 | 0.2699 |
| | | 85% | 0.2958 | 0.2486 | 0.2486 | 0.2541 | 0.25414474 | 0.2552 | 0.2552 | 0.2556 | 0.2557 | 0.2570 | 0.2566 | 0.2637 | 0.2710 | 0.2727 | 0.2750 | 0.2931 |
| | | 90% | 0.2958 | 0.2682 | 0.2682 | 0.2699 | 0.26992848 | 0.2700 | 0.2700 | 0.2704 | 0.2704 | 0.2711 | 0.2705 | 0.2760 | 0.2810 | 0.2806 | 0.2830 | 0.3229 |
| | | 95% | 0.2958 | 0.3043 | 0.3043 | 0.2958 | 0.29578025 | 0.2936 | 0.2936 | 0.2938 | 0.2937 | 0.2928 | 0.2920 | 0.2936 | 0.2931 | 0.2883 | 0.2918 | 0.3683 |
| | | Information Criteria | | | | | | | | | | | | | | | | |
| | | Akaike (AIC) | | N/A | 12.6564 | -6.7539 | 13.2462 | -6.5464 | -6.5464 | -6.5738 | 13.4316 | -6.3048 | -6.3057 | -5.3861 | -5.2436 | -5.2530 | 14.8667 | -8.5092 |
| | | Bayesian (BIC) | | -10.9058 | -12.5153 | -13.5350 | -11.9255 | -13.3275 | -13.3275 | -13.3549 | -11.7401 | -13.0859 | -13.0868 | -12.1672 | -12.0247 | -12.0341 | -10.3050 | -10.2331 |
| | | Av. LogL | | 1.7344 | 1.7344 | 1.6754 | 1.6754 | 1.6546 | 1.6546 | 1.6574 | 1.6568 | 1.6305 | 1.6306 | 1.5386 | 1.5244 | 1.5253 | 1.5133 | 1.1843 |
| | | - Chi-Squared Test - [" | Valuer uppositable | | | | | | | | | | | | | | | |
| | | Chi-Sq Statistic | Turdes difutanaute | 0.2000 | 0.2000 | 0.2000 | 0.2000 | 0.2000 | 0.2000 | 0.2000 | 0.2000 | 0.2000 | 0.2000 | 0.2000 | 0.2000 | 0.2000 | 0.2000 | 0.2000 |
| | | P-Value* | | N/A | 0.2000 N/A | N/A | N/A | 0.2000 N/A | N/A | N/A | N/A | 0.2000 N/A | N/A | 0.2000 N/A | N/A | N/A | 0.2000 N/A | 0.2000 N/A |
| | | | | | | | | | | | | | | | | | | |
| | | Cr. Value @ 0.750* | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| | | Cr. Value @ 0.500* | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| | | Cr. Value @ 0.250* | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| | | Cr. Value @ 0.150* | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| | | Cr. Value @ 0.100* | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| | | Cr. Value @ 0.050* | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| | | Cr. Value @ 0.025* | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| | | Cr. Value @ 0.010* | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| | | Cr. Value @ 0.005* | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| | | Cr. Value @ 0.001* | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| | | Chi-Sq Test (Binning | Information) | | | | | | | | | | | | | | | |
| | | Bin #1: Minimum | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| | | Bin #1: Maximum | | | 0.1927 | 0.1994 | 0.19940192 | 0.2011 | | 0.2013 | 0.2013 | | 0.2030 | 0.2052 | 0.2145 | 0.2092 | | 0.1771 |
| | | | | 0.1927 | 3,0000 | | | 3.0000 | 0.2011 3.0000 | 3.0000 | 3.0000 | 0.2029 | 3.0000 | 3.0000 | | 3.0000 | 0.2211 3.0000 | 2,0000 |
| | | Bin #1 : Input | | | | 3.0000 | 3.0000 | | | | | | | | 3.0000 | | | |
| | | Bin #1: Fit | | 2.5000 | 2,5000 | 2.5000 | 2.5000 | 2.5000 | 2.5000 | 2.5000 | 2.5000 | 2.5000 | 2.5000 | 2.5000 | 2.5000 | 2.5000 | 2.5000 | 2.5000 |
| | | Bin #2 : Minimum | | 0.1927 | 0.1927 | 0.1994 | 0.19940192 | 0.2011 | 0.2011 | 0.2013 | 0.2013 | 0.2029 | 0.2030 | 0.2082 | 0.2145 | 0.2092 | 0.2211 | 0.1771 |
| | | 8in #2 : Maximum | | + Infinity | +Infinity | +Infinity | +Infinity | +Infinity | +Infinity | + Infinity | + Infinity | +Infinity | + Infinity | +Infinity | 0.3202 | 0.2958 | 0.3045 | +Infinity |
| | | | | | | | | | | | | | | | | | | |

1.1.4 Lines event rate – forced (continuous)

The @risk software found that the FatigueLife distribution is the most appropriate fit.

Figure 1-5: Lines event rate (forced) – distribution fit using K-S

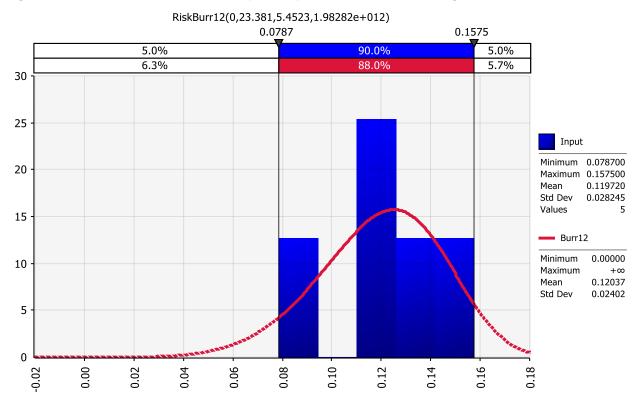


| ik By K-S | × | | Input | FatigueLife | Invgauss | Loglogistic | Lognorm | Lognorm2 | Pearson6 | Pearson5 | Uniform | Dagum | Frechet | Rayleigh | Gamma | Erlang | Weibull | Pert |
|-------------------------|--------|--------------------------|-----------------|----------------------|----------------------|---------------------|----------------------|------------|-------------|------------|----------|------------------------|------------|----------------------|---------------------|----------------------|------------|------------|
| Fit | Value | Distribution Statistics | 0.0488 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| FatigueLite Invgauss | 0.2577 | Minimum Maximum | 0.1736 | +Infinity | +Infinity | +Infinity | + Infinity | +Infinity | +Infinity | + Infinity | 0.0000 | + Infinity | +Infinity | + Infinity | +Infinity | + Infinity | +infinity | 0.2552 |
| nvgauss Loglogistic | 0.2583 | | 0.1736 | + Infinity 0.1015 | + Infinity 0.1014 | +infinity 0.1033 | + Infinity 0.1014 | | | | 0.2170 | + infinity 0.105061 | | + Infinity 0.1012 | +Infinity 0.1014 | + Infinity 0.1014 | | 0.2552 |
| Lognorm | 0.2591 | Mean | | | | | | 0.1014 | 0.102863107 | 0.1029 | 0.0000 | 0.105061 | 0.1051 | 0.1012 | 0.1014 | | 0.1022 | 0.1020 |
| Lognorm2 | 0.2606 | | 0.0519 [est] | 0.0661 | 0.0655 | 0.0685 | 0.0673 | 0.0673 | 0.062760131 | 0.0628 | | | 0.0595 | | | 0.0761 | | |
| Pearson6 | 0.2617 | Median | 0.0720 | 0.0890 | 0.0684 | 0.0858 | 0.0884 | 0.0554 | 0.084684623 | 0.0847 | 0.1085 | 0.080103 | 0.0801 | 0.0951 | 0.0927 | 0.0931 | 0.0969 | 0.0990 |
| Pearson5 | 0.2617 | Std. Deviation | 0.0587 | 0.0548 | 0.0556 | 0.0819 | 0.0568 | 0.0568 | 0.070481476 | 0.0705 | 0.0626 | 0.123109 | 0.1231 | 0.0529 | 0.0520 | 0.0507 | 0.0511 | 0.0473 |
| Uniform | 0.2682 | Skewness | 0.5721 | 1.5340 | 1.6452 | 97.9763 | 1.8568 | 1.8568 | 5.1664 | 5.1664 | 0.0000 | N/A | +Infinity | 0.6311 | 1.0249 | 1.0000 | 0.5671 | 0.2710 |
| Dagum | 0.2690 | Kurtosis | 0.0811 | 6.8742 | 7.5109 | +Infinity | 9.6965 | 9.6965 | 397.2956 | 397.3145 | 1.8000 | N/A | +Infinity | 3.2451 | 4.5755 | 4.5000 | 3.1321 | 2.4313 |
| Frechet | 0.2690 | - Percentiles | | | | | | | | | | | | | | | | |
| Rayleigh | 0.2719 | 5% | 0.0488 | 0.0382 | 0.0384 | 0.0325 | 0.0374 | 0.0374 | 0.040557007 | 0.0406 | 0.0109 | 0.043554 | 0.0436 | 0.0259 | 0.0334 | 0.0346 | 0.0280 | 0.0297 |
| Gamma | 0.2758 | 10% | 0.0488 | 0.0457 | 0.0458 | 0.0416 | 0.0453 | 0.0453 | 0.046976365 | 0.0470 | 0.0217 | 0.048597 | 0.0486 | 0.0371 | 0.0431 | 0.0442 | 0.0395 | 0.0412 |
| Erlang | 0.2830 | 15% | 0.0488 | 0.0517 | 0.0517 | 0.0484 | 0.0514 | 0.0514 | 0.052111637 | 0.0521 | 0.0326 | 0.052677 | 0.0527 | 0.0460 | 0.0506 | 0.0517 | 0.0486 | 0.0503 |
| Weibull Pert | 0.2896 | 20% | 0.0488 | 0.0571 | 0.0570 | 0.0543 | 0.0570 | 0.0570 | 0.056750344 | 0.0568 | 0.0434 | 0.056410 | 0.0564 | 0.0539 | 0.0572 | 0.0582 | 0.0565 | 0.0583 |
| Expon | 0.3820 | 25% | 0.0569 | 0.0623 | 0.0621 | 0.0597 | 0.0622 | 0.0622 | 0.061185436 | 0.0612 | 0.0543 | 0.060026 | 0.0600 | 0.0612 | 0.0633 | 0.0643 | 0.0637 | 0.0656 |
| Pareto2 | 0.3820 | 30% | 0.0569 | 0.0674 | 0.0671 | 0.0649 | 0.0672 | 0.0672 | 0.065575251 | 0.0656 | 0.0651 | 0.063654 | 0.0637 | 0.0682 | 0.0692 | 0.0701 | 0.0706 | 0.0726 |
| Kumaraswa. | 0.4189 | 35% | 0.0569 | 0.0725 | 0.0722 | 0.0700 | 0.0723 | 0.0723 | 0.070028880 | 0.0700 | 0.0760 | 0.067390 | 0.0674 | 0.0749 | 0.0750 | 0.0757 | 0.0772 | 0.0793 |
| Triang | 0.4280 | 40% | 0.0569 | 0.0778 | 0.0773 | 0.0751 | 0.0775 | 0.0775 | 0.074637507 | 0.0746 | 0.0868 | 0.071317 | 0.0713 | 0.0816 | 0.0808 | 0.0814 | 0.0838 | 0.0859 |
| Levy | 0.4972 | 45% | 0.0720 | 0.0832 | 0.0827 | 0.0803 | 0.0828 | 0.0828 | 0.079490039 | 0.0795 | 0.0977 | 0.075521 | 0.0755 | 0.0883 | 0.0866 | 0.0872 | 0.0903 | 0.0924 |
| ChiSq | 0.6769 | 50% | 0.0720 | 0.0890 | 0.0884 | 0.0858 | 0.0884 | 0.0884 | 0.084684623 | 0.0647 | 0.1085 | 0.080103 | 0.0801 | 0.0951 | 0.0927 | 0.0931 | 0.0969 | 0.0990 |
| BetoGenerol | N/A | 55% | 0.0720 | 0.0951 | 0.0944 | 0.0917 | 0.0944 | 0.0944 | 0.090339923 | 0.0903 | 0.1194 | 0.085190 | 0.0852 | 0.1020 | 0.0990 | 0.0993 | 0.1036 | 0.1057 |
| Burr12 | N/A | 60% | 0.1557 | 0.1017 | 0.1010 | 0.0981 | 0.1009 | 0.1009 | 0.096610236 | 0.0966 | 0.1302 | 0.090955 | 0.0910 | 0.1093 | 0.1057 | 0.1058 | 0.1106 | 0.1126 |
| Pareto | N/A | 65% | 0.1557 | 0.1091 | 0.1084 | 0.1052 | 0.1081 | 0.1081 | 0.103709538 | 0.1037 | 0.1411 | 0.097642 | 0.0976 | 0.1170 | 0.1130 | 0.1129 | 0.1180 | 0.1197 |
| | | 70% | 0.1557 | 0.1174 | 0.1167 | 0.1135 | 0.1163 | 0.1163 | 0.111953588 | 0.1120 | 0.1519 | 0.105625 | 0.1056 | 0.1253 | 0.1210 | 0.1207 | 0.1260 | 0.1273 |
| | | 75% | 0.1557 | 0.1270 | 0.1263 | 0.1233 | 0.1258 | 0.1258 | 0.121842529 | 0.1218 | 0.1628 | 0.115512 | 0.1155 | 0,1344 | 0.1300 | 0.1295 | 0.1348 | 0.1355 |
| | | 80% | 0.1557 | 0.1385 | 0.1379 | 0.1355 | 0.1373 | 0.1373 | 0.134242518 | 0.1342 | 0.1736 | 0.128397 | 0.1284 | 0.1448 | 0.1406 | 0.1398 | 0.1447 | 0.1445 |
| | | 85% | 0.1736 | 0.1531 | 0.1528 | 0.1520 | 0.1520 | 0.1520 | 0.150853451 | 0.1509 | 0.1845 | 0.146510 | 0.1465 | 0.1573 | 0.1536 | 0.1524 | 0.1565 | 0.1548 |
| | | 90% | 0.1736 | 0.1733 | 0,1735 | 0.1770 | 0.1727 | 0.1727 | 0.175742708 | 0.1757 | 0.1953 | 0.175478 | 0.1755 | 0,1733 | 0.1711 | 0.1694 | 0.1716 | 0.1673 |
| | | 95% | 0.1736 | 0.2074 | 0.2088 | 0.2265 | 0.2088 | 0.2088 | 0.223254441 | 0.2233 | 0.2062 | 0.236787 | 0.2368 | 0,1976 | 0.1991 | 0.1966 | 0.1945 | 0.1847 |
| | | - Information Criteria | | | | | | | | | | | | | | | | |
| | | Akaike (AJC) | | 13.2488 | -6.7602 | -5.9065 | -6.5584 | -6.5584 | 13.2433 | -6.7567 | -11.9452 | N/A | 13.0168 | -12.7414 | -6.3177 | -6.3111 | -6.0932 | -6.4286 |
| | | Bayesian (BIC) | | -11.9229 | -13.5413 | -12.6876 | -13.3396 | -13.3396 | -11.9284 | -13.5378 | -13.6691 | -10.5454 | -12.1549 | -14.4653 | -13.0988 | -13.0922 | -12.8744 | -13.2097 |
| | | Av. LogL | | 1.6751 | 1.6760 | 1.5906 | 1.6558 | 1.6558 | 1.6757 | 1.6757 | 1.5279 | 1.6983 | 1.6983 | 1.6075 | 1.6318 | 1.6311 | 1.6093 | 1.6429 |
| | | - Chi-Squared Test - [* | alues unavailab | | | | | | | | | | | | | | | |
| | | Chi-Sg Statistic | | 0.2000 | 0.2000 | 0.2000 | 0.2000 | 0.2000 | 0.2000 | 0.2000 | 0.2000 | 0.2000 | 0.2000 | 0.2000 | 0.2000 | 0.2000 | 0.2000 | 0.2000 |
| | | P-Value* | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| | | Cr. Value @ 0.750* | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| | | Cr. Value @ 0.500* | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| | | Cr. Value @ 0.250* | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| | | Cr. Value @ 0.150* | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| | | Cr. Value @ 0.100* | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| | | Cr. Value @ 0.050* | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| | | Cr. Value @ 0.050* | | N/A | N/A | N/A N/A | N/A | N/A N/A | N/A N/A | N/A | N/A | N/A N/A | N/A | N/A N/A | N/A N/A | N/A | N/A | N/A |
| | | | | | | | | | | | | | | | | | | N/A N/A |
| | | Cr. Value @ 0.010* | | N/A N/A | N/A N/A | N/A | N/A N/A | N/A N/A | N/A N/A | N/A N/A | N/A | N/A N/A | N/A N/A | N/A N/A | N/A | N/A N/A | N/A N/A | N/A |
| | | Cr. Value @ 0.005* | | | | N/A | | | | | N/A | | | | N/A | | | |
| | | Cr. Value @ 0.001* | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| | | - Chi-Sq Test (Binning I | nformation) | | | | | | | | | | | | | | | |
| | | Bin #1 : Minimum | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| | | Ein #1 : Maximum | | 0.0890 | 0.0684 | 0.0858 | 0.0884 | 0.0884 | 0.084684623 | 0.0847 | 0.1085 | 0.080103 | 0.0801 | 0.0951 | 0.0927 | 0.0931 | 0.0969 | 0.0990 |
| | | Ein #1 : Input | | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 |
| | | Bin #1 : Fit | | 2.5000 | 2.5000 | 2.5000 | 2.5000 | 2.5000 | 2.5000 | 2.5000 | 2.5000 | 2.5000 | 2.5000 | 2.5000 | 2.5000 | 2.5000 | 2.5000 | 2.5000 |
| | | Bin #2 : Minimum | | 0.0890 | 0.0854 | 0.0858 | 0.0884 | 0.0884 | 0.084684623 | 0.0847 | 0.1085 | 0.080103 | 0.0801 | 0.0951 | 0.0927 | 0.0931 | 0.0969 | 0.0990 |
| | | Bin #2 : Maximum | | +Infinity | +Infinity | +Infinity | +Infinity | +Infinity | +Infinity | +Infinity | 0.2170 | +Infinity | +Infinity | +Infinity | +Infinity | + Infinity | +Infinity | 0.2552 |

1.1.5 Transformer event rate – forced (continuous)

The @risk software found that the Burr12 distribution is the most appropriate fit.

Figure 1-7: Transformer event rate (forced) – distribution fit using K-S



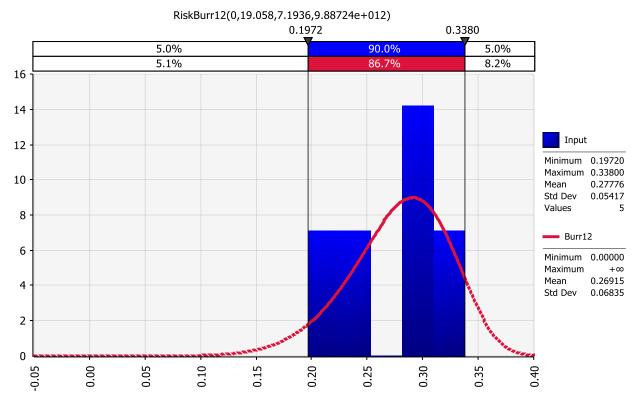
| Figure 1-8: Transformer event rate | (forced) – statistics table using K-S |
|--------------------------------------|---------------------------------------|
| i igule 1-0. Italisionnei event late | (1010eu) = 3(a(1310e) able using N-3) |

| nk By K-S | ~ | | Input | Burr12 | Weibull | Dagum | Pert | Erlang | Gamma | Lognorm | Lognorm2 | FatigueLife | Invgauss | Pearson6 | Pearson5 | Frechet | Triang | Uniform |
|----------------------------|------------|------------------------------------------|--------------------|------------------------------|------------|------------|------------|------------|------------|------------|------------|-------------|------------|------------|------------|------------|------------|------------|
| Fit | Value | - Distribution Statistic | | | | | | | | | | | | | | | | |
| Burr12 | 0.2356 | Minimum | 0.0787 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Weibull | 0.2356 | Maximum | 0.1575 | Infinity | + Infinity | +Infinity | 0.1621 | +Infinity | +Infinity | -Infinity | -Infinity | +Infinity | + Infinity | -Infinity | +Infinity | +Infinity | 0.1575 | 0.1969 |
| Dagum | 0.2425 | Mean | 0.1197 | 0.1196 | 0.1198 | 0.1199 | 0.1214 | 0.11972 | 0.11972 | 0.1199 | 0.1199 | 0.1197 | 0.1197 | 0.12010722 | 0.1201 | 0.1253 | 0.1050 | 0.0984 |
| Pert | 0.2723 | Mode | 0.1161 (est) | 0.1251 | 0.1251 | 0.1229 | 0.1416 | 0.11402 | 0.11398 | 0.1111 | 0.1111 | 0.1108 | 0.1108 | 0.10813954 | 0.1081 | 0.0987 | 0.1575 | 0.0000 |
| Erlang Gamma | 0.2903 | Median | 0.1172 | 0.1214 | 0.1214 | 0.1206 | 0.1261 | 0.11783 | 0.11781 | 0.1169 | 0.1169 | 0.1167 | 0.1167 | 0.11582761 | 0.1158 | 0.1132 | 0.1114 | 0.0984 |
| Lognorm | 0.2906 | Std. Deviation | 0.0282 | 0.0275 | 0.0254 | 0.0258 | 0.0266 | 0.02613 | 0.02622 | 0.0273 | 0.0273 | 0.0273 | 0.0273 | 0.02906893 | 0.0291 | 0.0492 | 0.0371 | 0.0568 |
| Lognorm2 | 0.3052 | Skewness | -0.2693 | -2.2594 | -0.3125 | 0.0782 | -0.7598 | 0.4364 | 0.4381 | 0.6963 | 0.6963 | 0.6771 | 0.6837 | 1.0283 | 1.0283 | 4.8413 | -0.5657 | 0.0000 |
| FatigueLife | 0.3072 | Kurtosis | 4.5706 | 23.1613 | 2.9499 | 4.1101 | 3.1031 | 3.2857 | 3.2879 | 3.8742 | 3.8742 | 3.7772 | 3.7790 | 5.0895 | 5.0896 | 222.5830 | 2.4000 | 1.8000 |
| Invgauss | 0.3075 | - Percentiles | | | | | | | | | | | | | | | | |
| Pearson6 | 0.3203 | 5% | 0.0787 | 0.0754 | 0.0753 | 0.0764 | 0.0707 | 0.08022 | 0.08009 | 0.0807 | 0.0807 | 0.0806 | 0.0806 | 0.08105976 | 0.0811 | 0.0801 | 0.0352 | 0.00984 |
| Pearson5 | 0.3203 | 10% | 0.0787 | 0.0859 | 0.0859 | 0.0872 | 0.0834 | 0.08770 | 0.08758 | 0.0876 | 0.0876 | 0.0874 | 0.0874 | 0.08738589 | 0.0874 | 0.0852 | 0.0498 | 0.0197 |
| Frechet | 0.3501 | 15% | 0.0787 | 0.0930 | 0.0930 | 0.0942 | 0.0922 | 0.09300 | 0.09290 | 0.0925 | 0.0925 | 0.0924 | 0.0924 | 0.09203507 | 0.0920 | 0.0892 | 0.0610 | 0.0295 |
| Triang | 0.3537 | 20% | 0.0787 | 0.0986 | 0.0986 | 0.0996 | 0.0990 | 0.09736 | 0.09728 | 0.0967 | 0.0967 | 0.0965 | 0.0965 | 0.09597033 | 0.0960 | 0.0927 | 0.0704 | 0.0394 |
| Uniform | 0.3997 | 25% | 0.1172 | 0.1033 | 0.1033 | 0.1041 | 0.1048 | 0.10122 | 0.10115 | 0.1004 | 0.1004 | 0.1002 | 0.1002 | 0.09952856 | 0.0995 | 0.0961 | 0.0788 | 0.0492 |
| Rayleigh | 0.4005 | 30% | 0.1172 | 0.1075 | 0.1075 | 0.1079 | 0.1098 | 0.10477 | 0.10471 | 0.1038 | 0.1038 | 0.1037 | 0.1036 | 0.10287631 | 0.1029 | 0.0993 | 0.0863 | 0.0591 |
| Expon | 0.4818 | 35% | 0.1172 | 0.1113 | 0.1113 | 0.1114 | 0.1144 | 0.10813 | 0.10606 | 0.1071 | 0.1071 | 0.1070 | 0.1070 | 0.10611443 | 0.1061 | 0.1026 | 0.0932 | 0.0689 |
| Kumaraswa | 0.5421 | 40% | 0.1172 | 0.1148 | 0.1145 | 0.1146 | 0.1185 | 0.11139 | 0.11135 | 0.1104 | 0.1104 | 0.1102 | 0.1102 | 0.10931436 | 0.1093 | 0.1059 | 0.0996 | 0.0788 |
| Levy | 0.6047 | 45% | 0.1172 | 0.1182 | 0.1182 | 0.1176 | 0.1224 | 0.11460 | 0.11458 | 0.1136 | 0.1136 | 0.1135 | 0.1134 | 0.11253416 | 0.1125 | 0.1094 | 0.1057 | 0.0886 |
| ChiSq | 0.6915 | 50% | 0.1172 | 0.1214 | 0.1214 | 0.1206 | 0.1261 | 0.11783 | 0.11781 | 0.1169 | 0.1169 | 0.1167 | 0.1167 | 0.11582761 | 0.1158 | 0.1132 | 0.1114 | 0.0984 |
| BetoGeneral Loglopistic | N/A N/A | | 0.1172 | 0.1214 | | | 0.1295 | 0.12111 | 0.12111 | 0.1202 | 0.1202 | 0.1201 | | 0.11925075 | 0.1150 | 0.1172 | 0.1168 | 0.1083 |
| Pareto | N/A | 55% | | | 0.1246 | 0.1234 | | | | | | | 0.1201 | | | | | |
| Pareto2 | N/A | 60% | 0.1280 | 0.1278 | 0.1278 | 0.1263 | 0.1329 | 0.12450 | 0.12452 | 0.1237 | 0.1237 | 0.1236 | 0.1236 | 0.12286830 | 0.1229 | 0.1216 | 0.1220 | 0.1181 |
| 1.010100 | 10/2 | 65% | 0.1280 | 0.1310 | 0.1310 | 0.1293 | 0.1361 | 0.12808 | 0.12811 | 0.1275 | 0.1275 | 0.1274 | 0.1273 | 0.12676223 | 0.1268 | 0.1266 | 0.1270 | 0.1280 |
| | | 70% | 0.1280 | 0.1343 | 0.1343 | 0.1324 | 0.1393 | 0.13192 | 0.13197 | 0.1315 | 0.1315 | 0.1314 | 0.1314 | 0.13104512 | 0.1310 | 0.1324 | 0.1318 | 0.1378 |
| | | 75% | 0.1280 | 0.1379 | 0.1379 | 0.1358 | 0.1425 | 0.13616 | 0.13621 | 0.1360 | 0.1360 | 0.1360 | 0.1360 | 0.13588488 | 0.1359 | 0.1393 | 0.1364 | 0.1477 |
| | | 80% | 0.1280 | 0.1417 | 0.1417 | 0.1396 | 0.1456 | 0.14097 | 0.14105 | 0.1413 | 0.1413 | 0.1412 | 0.1412 | 0.14155651 | 0.1416 | 0.1479 | 0.1409 | 0.1575 |
| | | 85% | 0.1575 | 0.1460 | 0.1460 | 0.1443 | 0.1489 | 0.14673 | 0.14683 | 0.1476 | 0.1476 | 0.1475 | 0.1475 | 0.14856902 | 0.1486 | 0.1594 | 0.1452 | 0.1673 |
| | | 90% | 0.1575 | 0.1513 | 0.1513 | 0.1505 | 0.1523 | 0.15418 | 0.15432 | 0.1560 | 0.1560 | 0.1559 | 0.1559 | 0.15805787 | 0.1581 | 0.1766 | 0.1494 | 0.1772 |
| | | 95% | 0.1575 | 0.1588 | 0.1588 | 0.1606 | 0.1561 | 0.16568 | 0.16587 | 0.1693 | 0.1693 | 0.1690 | 0.1691 | 0.17364226 | 0.1736 | 0.2094 | 0.1535 | 0.1870 |
| | | - Information Criteria | | | | | | | | | | | | | | | | |
| | | Akaike (AIC) | | N/A | -12.6839 | N/A | -12.9345 | -12.3829 | -12.3831 | -12.1843 | -12.1843 | 7.8057 | -12.1884 | 8.0679 | -11.9321 | 9.1336 | -12.4302 | -12.9185 |
| | | Bayesian (BIC) | | -16.2461 | -19.4650 | -16.1077 | -19.7156 | -19.1640 | -19.1642 | -18.9654 | -18.9654 | -17.3659 | -18.9695 | -17.1038 | -18.7132 | -16.0381 | -19.2114 | -14.6424 |
| | | Ay. LogL | | 2.2684 | 2.2684 | 2.2545 | 2.2935 | 2.2383 | 2.2383 | 2.2184 | 2.2184 | 2.2194 | 2.2188 | 2.1932 | 2.1932 | 2.0866 | 2.2430 | 1.6252 |
| | | - Chi-Squared Test - [* | Values unavailable | without running a | bootstrap] | | | | | | | | | | | | | |
| | | Chi-Sq Statistic | | 0.2000 | 0.2000 | 0.2000 | 0.2000 | 0.2000 | 0.2000 | 1.8000 | 1.8000 | 1.8000 | 1.8000 | 1.8000 | 1.8000 | 1.8000 | 1.8000 | 1.8000 |
| | | P-Value* | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| | | Cr. Value @ 0.750* | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| | | Cr. Value @ 0.500* | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| | | Cr. Value @ 0.250* | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| | | Cr. Value @ 0.150* | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| | | Cr. Value @ 0.100* | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| | | Cr. Value @ 0.050* | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| | | | | N/A | N/A N/A | N/A N/A | N/A N/A | N/A | N/A | N/A N/A | N/A N/A | N/A N/A | N/A | N/A N/A | N/A | N/A N/A | N/A N/A | N/A N/A |
| | | Cr. Value @ 0.025* Cr. Value @ 0.010* | | N/A | N/A | N/A N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| | | | | N/A | N/A N/A | | N/A N/A | N/A N/A | N/A N/A | | | N/A N/A | N/A | N/A | N/A N/A | N/A N/A | N/A N/A | N/A |
| | | Cr. Value @ 0.005* | | N/A N/A | N/A N/A | N/A N/A | N/A N/A | N/A N/A | N/A N/A | N/A N/A | N/A | N/A N/A | N/A N/A | N/A N/A | N/A N/A | N/A N/A | N/A N/A | N/A N/A |
| | | Cr. Value @ 0.001* | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| | | - Chi-Sq Test (Binning | Information) | | | | | | | | | | | | | | | |
| | | Ein #1 : Minimum | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| | | Bin #1 : Maximum | | 0.1214 | 0.1214 | 0.1206 | 0.1261 | 0.11783 | 0.11781 | 0.1169 | 0.1169 | 0.1167 | 0.1167 | 0.11582761 | 0.1158 | 0.1132 | 0.1114 | 0.0984 |
| | | Bin #1 : Input | | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 1.0000 | 1,0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| | | Bin #1 : Fit | | 2.5000 | 2.5000 | 2.5000 | 2.5000 | 2.5000 | 2.5000 | 2.5000 | 2.5000 | 2.5000 | 2.5000 | 2.5000 | 2.5000 | 2.5000 | 2.5000 | 2,5000 |
| | | Bin #2 : Minimum | | 0.1214 | 0.1214 | 0.1206 | 0.1261 | 0.11783 | 0.11781 | 0.1169 | 0.1169 | 0.1167 | 0.1167 | 0.11582761 | 0.1158 | 0.1132 | 0.1114 | 0.0984 |
| | | Bin #2 : Maximum | | +Infinity | +Infinity | +Infinity | 0.1621 | +Infinity | +Infinity | -Infinity | +Infinity | +Infinity | +Infinity | +Infinity | +Infinity | +Infinity | 0.1575 | 0.1969 |
| | | | | | | | | | | | | | | | | | | |

1.1.6 Reactive plant event rate – forced (continuous)

The @risk software found that the Burr12 distribution is the most appropriate fit.

Figure 1-9: Reactive plant event rate (forced) – distribution fit using K-S





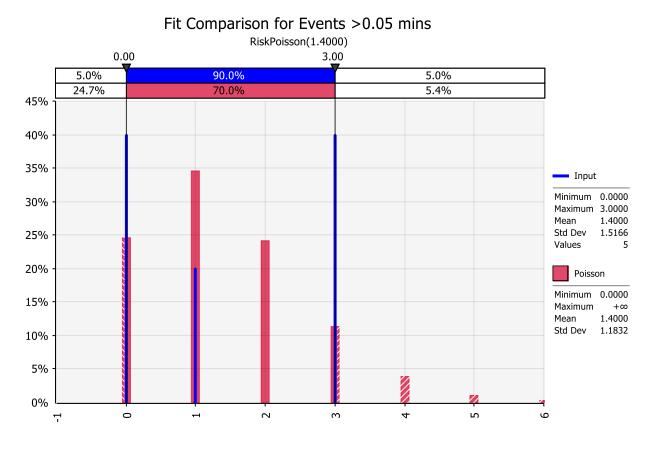
| nk By | | ~ | | Input | Burr12 | Weibull | Erlang | Gamma | Lognorm2 | Lognorm | FatigueLife | Invgauss | Dagum | Frechet | Pearson6 | Pearson5 | BetaGeneral | Triang | Rayfeigh |
|--------|---------|--------|----------------------------|--------------------|-------------------|------------|------------|------------|------------|------------|-------------|------------|------------|------------|------------|------------|-------------|----------|------------|
| Fit | | Value | Distribution Statistic | | | | | | | | | | | | | | | | |
| Burr | | 0.2160 | Minimum | 0.1972 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Erlar | | 0.2163 | Maximum | 0.3380 | +Infinity | +Infinity | +Infinity | + Infinity | +Infinity | + Infinity | +Infinity | = Infinity | +Infinity | + Infinity | -infinity | + Infinity | 0.3380 | 0.3380 | +Infinity |
| Gam | | 0.2589 | Mean | 0.2778 | 0.2886 | 0.2788 | 0.27776 | 0.27776 | 0.2780 | 0.2780 | 0.2778 | 0.2778 | 0.2870 | 0.2870 | 0.27831915 | 0.2783 | 0.2839 | 0.2253 | 0.2499 |
| | norm2 | 0.2647 | Mode | 0.2007 [est] | 0.2914 | 0.2914 | 0.26850 | 0.26854 | 0.2638 | 0.2638 | 0.2634 | 0.2633 | 0.2387 | 0.2387 | 0.25883292 | 0.2588 | 0.3380 | 0.3380 | 0.1994 |
| Logr | | 0.2647 | Median | 0.2958 | 0.2828 | 0.2828 | 0.27468 | 0.27469 | 0.2732 | 0.2732 | 0.2729 | 0.2729 | 0.2658 | 0.2658 | 0.27149849 | 0.2715 | 0.3098 | 0.2390 | 0.2347 |
| Fatig | gueLife | 0.2658 | Std. Deviation | 0.0542 | N/A | 0.0457 | 0.05071 | 0.05061 | 0.0525 | 0.0525 | 0.0524 | 0.0524 | 0.0883 | 0.0882 | 0.05504469 | 0.0550 | 0.0638 | 0.0797 | 0.1306 |
| Invg | auss | 0.2660 | Skewness | -0.7705 | N/A | -0.4781 | 0.3651 | 0.3644 | 0.5731 | 0.5731 | 0.5621 | 0.5657 | 3.4481 | 3,4478 | 0.8233 | 0.8233 | +1.5093 | -0.5657 | 0.6311 |
| Dag | | 0.2687 | Kurtosis | 3.1643 | 0.1708 | 3,2154 | 3.2000 | 3.1992 | 3.5896 | 3.5896 | 3.5369 | 3.5334 | 44.3136 | 44.2983 | 4.3145 | 4.3145 | 4.7860 | 2.4000 | 3.2451 |
| Frec | | 0.2687 | - Percentiles | | | | | | | | | | | | | | | | |
| Pear | | 0.2706 | 5% | 0.1972 | 0.1965 | 0.1969 | 0.19993 | 0.20007 | 0.2008 | 0.2008 | 0.2007 | 0.2007 | 0.1993 | 0.1993 | 0.20128975 | 0.2013 | 0.1441 | 0.0756 | 0.0639 |
| Pear | | 0.2706 | 10% | 0.1972 | 0.2176 | 0.2176 | 0.21507 | 0.21519 | 0.2149 | 0.2149 | 0.2147 | 0.2147 | 0.2099 | 0.2099 | 0.21448604 | 0.2145 | 0.1872 | 0.1069 | 0.0915 |
| Triar | General | 0.3375 | 15% | 0.1972 | 0.2311 | 0.2312 | 0.22572 | 0.22582 | 0.2250 | 0.2250 | 0.2248 | 0.2248 | 0.2181 | 0.2181 | 0.22405449 | 0.2241 | 0.2163 | 0.1309 | 0.1137 |
| Rayl | | 0.3869 | 20% | 0.1972 | 0.2417 | 0.2416 | 0.23443 | 0.23452 | 0.2334 | 0.2334 | 0.2331 | 0.2331 | 0.2252 | 0.2252 | 0.23207238 | 0.2321 | 0.2385 | 0.1512 | 0.1332 |
| Unif | | 0.4667 | 25% | 0.2535 | 0.2502 | 0.2503 | 0.24209 | 0.24216 | 0.2408 | 0.2408 | 0.2405 | 0.2405 | 0.2319 | 0.2319 | 0.23926065 | 0.2393 | 0.2562 | 0.1690 | 0.1512 |
| | araswa | 0.5039 | 30% | 0.2535 | 0.2577 | 0.2578 | 0.24910 | 0.24916 | 0.2476 | 0.2476 | 0.2474 | 0.2473 | 0.2385 | 0.2385 | 0.24597238 | 0.2460 | 0.2709 | 0.1851 | 0.1684 |
| Expo | | 0.5083 | 35% | 0.2535 | 0.2647 | 0.2647 | 0.25572 | 0.25577 | 0.2542 | 0.2542 | 0.2539 | 0.2539 | 0.2450 | 0.2450 | 0.25241859 | 0.2524 | 0.2831 | 0.2000 | 0.1851 |
| Chis | iq | 0.5610 | 40% | 0.2535 | 0.2711 | 0.2710 | 0.26211 | 0.26215 | 0.2605 | 0.2605 | 0.2603 | 0.2602 | 0.2516 | 0.2516 | 0.25874589 | 0.2587 | 0.2935 | 0.2138 | 0.2015 |
| Levy | | 0.6270 | 45% | 0.2958 | 0.2770 | 0.2770 | 0.26840 | 0.26842 | 0.2668 | 0.2668 | 0.2666 | 0.2666 | 0.2585 | 0.2585 | 0.26507083 | 0.2651 | 0.3023 | 0.2267 | 0.2180 |
| Logh | | N/A | 50% | 0.2958 | 0.2828 | 0.2828 | 0.27468 | 0.27469 | 0.2732 | 0.2732 | 0.2729 | 0.2729 | 0.2658 | 0.2658 | 0.27149849 | 0.2715 | 0.3098 | 0.2390 | 0.2347 |
| Pare | | N/A | 55% | 0.2958 | 0.2884 | 0.2884 | 0.28106 | 0.28106 | 0.2797 | 0.2797 | 0.2795 | 0.2794 | 0.2737 | 0.2736 | 0.27813550 | 0.2781 | 0.3161 | 0.2507 | 0.2520 |
| Pare | | N/A | 60% | 0.3043 | 0.2939 | 0.2940 | 0.28764 | 0.28763 | 0.2864 | 0.2864 | 0.2862 | 0.2862 | 0.2823 | 0.2822 | 0.28510253 | 0.2851 | 0.3215 | 0.2618 | 0.2699 |
| - Pert | | N/A | 65% | 0.3043 | 0.2996 | 0.2996 | 0.29455 | 0.29453 | 0.2936 | 0.2936 | 0.2934 | 0.2934 | 0.2919 | 0.2919 | 0.29254956 | 0.2925 | 0.3259 | 0.2725 | 0.2889 |
| | | | 70% | 0.3043 | 0.3053 | 0.3054 | 0.30196 | 0.30191 | 0.3013 | 0.3013 | 0.3012 | 0.3012 | 0.3029 | 0.3029 | 0.30067989 | 0.3007 | 0.3295 | 0.2828 | 0.3094 |
| | | | 75% | 0.3043 | 0.3114 | 0.3114 | 0.31008 | 0.31002 | 0.3099 | 0.3099 | 0.3098 | 0.3098 | 0.3160 | 0.3160 | 0.30979362 | 0.3098 | 0.3324 | 0.2927 | 0.3320 |
| | | | 80% | 0.3043 | 0.3179 | 0.3179 | 0.31929 | 0.31921 | 0.3198 | 0.3198 | 0.3196 | 0.3196 | 0.3322 | 0.3322 | 0.32037807 | 0.3204 | 0.3347 | 0.3023 | 0.3577 |
| | | | 85% | 0.3380 | 0.3253 | 0.3253 | 0.33026 | 0.33016 | 0.3316 | 0.3316 | 0.3315 | 0.3315 | 0.3536 | 0.3535 | 0.33332813 | 0.3333 | 0.3363 | 0.3116 | 0.3884 |
| | | | 90% | 0.3380 | 0.3342 | 0.3342 | 0.34441 | 0.34427 | 0.3472 | 0.3472 | 0.3470 | 0.3470 | 0.3850 | 0.3850 | 0.35062318 | 0.3506 | 0.3373 | 0.3207 | 0.4278 |
| | | | 95% | 0.3380 | 0.3466 | 0.3466 | 0.36610 | 0.36591 | 0.3716 | 0.3716 | 0.3712 | 0.3713 | 0.4436 | 0.4435 | 0.37849934 | 0.3785 | 0.3379 | 0.3294 | 0.4880 |
| | | | - Information Criteria | | | | | | | | | | | | | | | | |
| | | | Akaike (AJC) | | N/A | -6.5514 | -5.7580 | -5.7581 | -5.5464 | -5.5464 | 14.4421 | -5.5539 | N/A | 15.8144 | 14.6901 | -5.3099 | | -5.6488 | -5.9415 |
| | | | Bayesian (BIC) | | -10.1136 | -13.3325 | -12.5392 | -12.5392 | -12.3276 | -12.3276 | -10.7296 | -12.3350 | -7.7478 | -9.3572 | -10.4816 | -12.0910 | | -12.4299 | -7.6654 |
| | | | Av. LogL | | 1.6551 | 1.6551 | 1.5758 | 1.5758 | 1.5546 | 1.5546 | 1.5558 | 1.5554 | 1.4186 | 1.4186 | 1.5310 | 1.5310 | | 1.5649 | 0.9275 |
| | | | - Chi-Squared Test - I* | Values unavailable | without running a | bootstrapl | | | | | | | | | | | | | |
| | | | Chi-Sq Statistic | | 0.2000 | 0.2000 | 0.2000 | 0.2000 | 0.2000 | 0.2000 | 0.2000 | 0.2000 | 0.2000 | 0.2000 | 0.2000 | 0.2000 | 1.8000 | 1.8000 | 1.8000 |
| | | | P-Value* | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| | | | Cr. Value @ 0.750* | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| | | | Cr. Value @ 0.500* | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| | | | Cr. Value @ 0.250* | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| | | | Cr. Value @ 0.150* | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| | | | Cr. Value @ 0.100* | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| | | | Cr. Value @ 0.050* | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| | | | Cr. Value @ 0.025* | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| | | | Cr. Value @ 0.023* | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| | | | Cr. Value @ 0.005* | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A N/A |
| | | | Cr. Value @ 0.005* | | N/A N/A | N/A N/A | N/A N/A | N/A | N/A N/A | N/A N/A | N/A N/A | N/A N/A | N/A N/A | N/A | N/A N/A | N/A N/A | N/A | N/A | N/A N/A |
| | | | | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| | | | - Chi-Sq Test (Binning | information) | | | 0.0000 | | | | | 0.0000 | | 0.0000 | 0.0000 | | | | |
| | | | Bin #1 : Minimum | | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| | | | Bin #1 : Maximum | | | 0.2828 | 0.27468 | 0.27469 | | | | | | 0.2658 | | 0.2715 | 0.3098 | 0.2390 | |
| | | | Bin #1 : Input | | 2.0000 | 2.0000 | 2.0000 | 2.0000 | 2.0000 | 2.0000 | 2.0000 | 2.0000 | 2.0000 | 2.0000 | 2.0000 | 2.0000 | 4.0000 | 1.0000 | 1.0000 |
| | | | Bin #1 : Fit | | 2.5000 | 2.5000 | 2.5000 | 2.5000 | 2.5000 | 2.5000 | 2.5000 | 2.5000 | 2.5000 | 2.5000 | 2.5000 | 2.5000 | 2.5000 | 2.5000 | 2.5000 |
| | | | Bin #2 : Minimum | | 0.2828 | 0.2828 | 0.27468 | 0.27469 | 0.2732 | 0.2732 | 0.2729 | 0.2729 | 0.2658 | 0.2658 | 0.27149849 | 0.2715 | 0.3098 | 0.2390 | 0.2347 |
| | | | Ein #2 : Maximum | | +Infinity | +Infinity | +Infinity | + Infinity | +Infinity | +Infinity | +Infinity | +Infinity | +Infinity | +Infinity | +Infinity | +Infinity | 0.3380 | 0.3380 | +Infinity |
| | | | Contra - E - response dans | | | | | | | | | | | | | | | | |

1.2 Service parameter 2 – loss of supply event frequency

1.2.1 Number of events > 0.05 system minutes (discrete)

Whilst @risk found that the Geometric distribution is the best fit according to AIC and IntUniform according to BIC, the Poisson distribution has been adopted, consistent with both the loss of supply event frequency (>0.30 system minutes) parameter and the Draft Decision.

Figure 1-11: Number of events >0.05 system minutes – Poisson distribution



| k By AIC | \sim | | Input | Geomet | Poisson | IntUniform | NegBin | Hyperge |
|------------|---------|----------------------------|-------------------|-----------|-----------|------------|-----------|---------|
| Fit | Value | 95% Lower Limit* | | | | | | N |
| Geomet | 19.6340 | 95% Upper Limit* | | | | | | N |
| Poisson | 19.7898 | Conf. Interval Width* | | | | | | N |
| IntUniform | 23.8629 | - Distribution Statistics | | | | | | |
| NegBin | 26.1033 | Minimum | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.00 |
| Hypergeo | 46.5133 | Maximum | 3.0000 | +Infinity | +Infinity | 3.0000 | +Infinity | 44.00 |
| Binomial | N/A | Mean | 1.4000 | 1.4000 | 1.4000 | 1.5000 | 1.4000 | 1.38 |
| | | Mode | 0.0000 | 0.0000 | 1.0000 | 0.0000 | 0.0000 | 1.00 |
| | | Median | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.00 |
| | | Std. Deviation | 1.5166 | 1.8330 | 1.1832 | 1.1180 | 1.5427 | 1.15 |
| | | Skewness | 0.3154 | 2.0731 | 0.8452 | 0.0000 | 1.5557 | 0.80 |
| | | | -0.0813 | 9,2976 | | | | 3.60 |
| | | Kurtosis | -0.0015 | 9.2976 | 3.7143 | 1.6400 | 6.4202 | 5.00 |
| | | - Percentiles | | | | | | |
| | | 5% | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.00 |
| | | 10% | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.00 |
| | | 15% | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.00 |
| | | 20% | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.00 |
| | | 25% | 0.0000 | 0.0000 | 1.0000 | 0.0000 | 0.0000 | 1.00 |
| | | 30% | 0.0000 | 0.0000 | 1.0000 | 1.0000 | 0.0000 | 1.00 |
| | | 35% | 0.0000 | 0.0000 | 1.0000 | 1.0000 | 1.0000 | 1.00 |
| | | 40% | 0.0000 | 0.0000 | 1.0000 | 1.0000 | 1.0000 | 1.00 |
| | | 45% | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.00 |
| | | 50% | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.00 |
| | | 55% | 1.0000 | 1.0000 | 1.0000 | 2.0000 | 1.0000 | 1.00 |
| | | 60% | 1.0000 | 1.0000 | 2.0000 | 2.0000 | 1.0000 | 2.00 |
| | | 65% | 3.0000 | 1.0000 | 2.0000 | 2.0000 | 2.0000 | 2.00 |
| | | 70% | 3.0000 | 2.0000 | 2.0000 | 2.0000 | 2.0000 | 2.00 |
| | | 75% | 3.0000 | 2.0000 | 2.0000 | 2.0000 | 2.0000 | 2.00 |
| | | 80% | 3.0000 | 2.0000 | 2.0000 | 3.0000 | 2.0000 | 2.00 |
| | | 85% | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.00 |
| | | 90% | 3.0000 | 4,0000 | 3.0000 | 3.0000 | 3.0000 | 3.00 |
| | | 95% | 3.0000 | 5.0000 | 4.0000 | 3.0000 | 4.0000 | 3.0 |
| | | - Information Criteria | 5.0000 | 510000 | | 510000 | | 510 |
| | | Akaike (AIC) | | 19.6340 | 19.7898 | 23.8629 | 26.1033 | 46.51 |
| | | Bayesian (BIC) | | 17.9101 | 18.0659 | 17.0818 | 19.3222 | 21.3 |
| | | Av. LogL | | -1.6301 | -1.6456 | -1.3863 | -1.6103 | -1.6 |
| | | | | | | -1.3003 | -1.0105 | -1.0 |
| | | - Chi-Squared Test - [* Va | liues unavailable | | | 0.0000 | 0.0000 | |
| | | Chi-Sq Statistic | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0 |
| | | | | N/A | N/A | N/A | N/A | |
| | | Cr. Value @ 0.750* | | N/A | N/A | N/A | N/A | N. |
| | | Cr. Value @ 0.500* | | N/A | N/A | N/A | N/A | P. |
| | | Cr. Value @ 0.250* | | N/A | N/A | N/A | N/A | P. |
| | | Cr. Value @ 0.150* | | N/A | N/A | N/A | N/A | |
| | | Cr. Value @ 0.100* | | N/A | N/A | N/A | N/A | |
| | | Cr. Value @ 0.050* | | N/A | N/A | N/A | N/A | 1 |
| | | Cr. Value @ 0.025* | | N/A | N/A | N/A | N/A | P. |
| | | Cr. Value @ 0.010* | | N/A | N/A | N/A | N/A | 1 |
| | | Cr. Value @ 0.005* | | N/A | N/A | N/A | N/A | N |
| | | Cr. Value @ 0.001* | | N/A | N/A | N/A | N/A | N |
| | | - Chi-Sq Test (Binning Inf | formation) | | | | | |
| | | Bin #1 : Minimum | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.00 |
| | | Bin #1 : Maximum | | +Infinity | +Infinity | 3.0000 | +Infinity | 44.00 |
| | | Bin #1 : Input | | 5.0000 | 5.0000 | 5.0000 | 5.0000 | 5.00 |
| | | | | | 5.0000 | 5.0000 | | |

Figure 1-12: Number of events >0.05 system minutes – AIC statistics table

| Figure 1-13: Number of events >0.05 s | system minutes – BIC statistics table |
|------------------------------------------|---------------------------------------|
| i igule i-is. Nullibel of evenus 20.05 s | |

| nk By BIC | \sim | | Input | IntUniform | Geomet | Poisson | NegBin | Hyperge |
|------------|---------|----------------------------|-----------------|------------|---------------------|---------------------|----------------------|---------|
| Fit | Value | 95% Lower Limit* | | | | | | N/. |
| IntUniform | 17.0818 | 95% Upper Limit* | | | | | | N/ |
| Geomet | 17.9101 | Conf. Interval Width* | | | | | | N/. |
| Poisson | 18.0659 | - Distribution Statistics | | | | | | |
| NegBin | 19.3222 | Minimum | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.000 |
| Hypergeo | 21.3416 | Maximum | 3,0000 | 3.0000 | +Infinity | +Infinity | +Infinity | 44.000 |
| Binomial | N/A | Mean | 1,4000 | 1.5000 | 1,4000 | 1,4000 | 1.4000 | 1.380 |
| | | Mode | 0.0000 | 0.0000 | 0.0000 | 1.0000 | 0.0000 | 1.000 |
| | | Median | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.000 |
| | | Std. Deviation | 1.5166 | 1.1180 | 1.8330 | 1.1832 | 1.5427 | 1.155 |
| | | Skewness | 0.3154 | 0.0000 | 2.0731 | 0.8452 | 1.5557 | 0.808 |
| | | Kurtosis | -0.0813 | 1.6400 | 9.2976 | 3.7143 | 6.4202 | 3.607 |
| | | | -0.0015 | 1.0400 | 9.2976 | 5.7 145 | 6.4202 | 5.001 |
| | | Percentiles | | | | | | |
| | | 5% | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.000 |
| | | 10% | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.000 |
| | | 15% | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.000 |
| | | 20% | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.00 |
| | | 25% | 0.0000 | 0.0000 | 0.0000 | 1.0000 | 0.0000 | 1.00 |
| | | 30% | 0.0000 | 1.0000 | 0.0000 | 1.0000 | 0.0000 | 1.00 |
| | | 35% | 0.0000 | 1.0000 | 0.0000 | 1.0000 | 1.0000 | 1.000 |
| | | 40% | 0.0000 | 1.0000 | 0.0000 | 1.0000 | 1.0000 | 1.00 |
| | | 45% | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.000 |
| | | 50% | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.000 |
| | | 55% | 1.0000 | 2.0000 | 1.0000 | 1.0000 | 1.0000 | 1.000 |
| | | 60% | 1.0000 | 2.0000 | 1.0000 | 2.0000 | 1.0000 | 2.00 |
| | | 65% | 3.0000 | 2.0000 | 1.0000 | 2.0000 | 2.0000 | 2.000 |
| | | 70% | 3.0000 | 2,0000 | 2.0000 | 2.0000 | 2.0000 | 2.000 |
| | | 75% | 3.0000 | 2.0000 | 2.0000 | 2.0000 | 2.0000 | 2.00 |
| | | 80% | 3.0000 | 3.0000 | 2,0000 | 2.0000 | 2.0000 | 2.000 |
| | | 85% | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.000 |
| | | 90% | 3.0000 | 3.0000 | 4.0000 | 3.0000 | 3.0000 | 3.000 |
| | | 95% | 3.0000 | 3.0000 | 5.0000 | 4.0000 | 4.0000 | 3.000 |
| | | | 5.0000 | 5.0000 | 5.0000 | 4.0000 | 4.0000 | 5.000 |
| | | - Information Criteria | | 22.0520 | 10 53 10 | 10 7000 | 26 4 2 2 2 | 10.04 |
| | | Akaike (AIC) | | 23.8629 | 19.6340 | 19.7898 | 26.1033 | 46.513 |
| | | Bayesian (BIC) | | 17.0818 | 17.9101 | 18.0659 | 19.3222 | 21.341 |
| | | Av. LogL | | -1.3863 | -1.6301 | -1.6456 | -1.6103 | -1.651 |
| | | Chi-Squared Test - [* Va | lues unavailabl | | | | | |
| | | Chi-Sq Statistic | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.000 |
| | | P-Value* | | N/A | N/A | N/A | N/A | N/ |
| | | Cr. Value @ 0.750* | | N/A | N/A | N/A | N/A | N/ |
| | | Cr. Value @ 0.500* | | N/A | N/A | N/A | N/A | N/ |
| | | Cr. Value @ 0.250* | | N/A | N/A | N/A | N/A | N/ |
| | | Cr. Value @ 0.150* | | N/A | N/A | N/A | N/A | N/ |
| | | Cr. Value @ 0.100* | | N/A | N/A | N/A | N/A | N/ |
| | | Cr. Value @ 0.050* | | N/A | N/A | N/A | N/A | N/ |
| | | Cr. Value @ 0.025* | | N/A | N/A | N/A | N/A | N |
| | | Cr. Value @ 0.010* | | N/A | N/A | N/A | N/A | N, |
| | | Cr. Value @ 0.005* | | N/A | N/A | N/A | N/A | N |
| | | Cr. Value @ 0.001* | | N/A | N/A | N/A | N/A | N/ |
| | | - Chi-Sq Test (Binning Inf | ormation | | | 1975 | | |
| | | Bin #1 : Minimum | ormationy | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.000 |
| | | Bin #1: Maximum | | 3.0000 | +Infinity | +Infinity | +Infinity | 44.000 |
| | | Bin #1: Input | | 5.0000 | +infinity 5.0000 | +infinity 5.0000 | + Infinity 5.0000 | |
| | | | | | | | | 5.000 |
| | | Bin #1 : Fit | | 5.0000 | 5.0000 | 5.0000 | 5.0000 | 5.000 |

1.2.2 Number of events > 0.30 system minutes (discrete)

The data does not lend itself easily to statistical analysis, as it is comprised of either zero or one events. To retain consistency with the 0.05 minutes parameter and the Draft Decision, the Poisson distribution has been adopted and is in accordance with AIC.

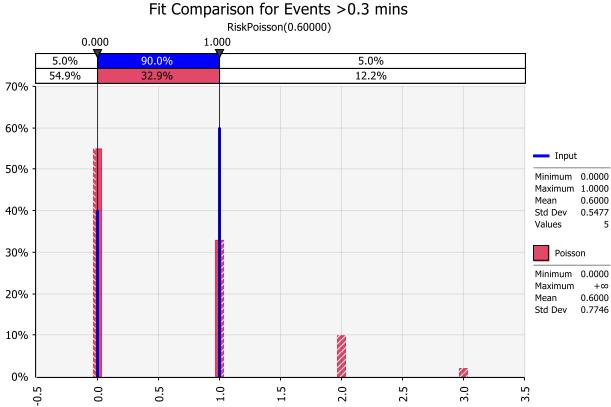


Figure 1-14: Number of events >0.30 system minutes – Poisson distribution

| Ву | AIC | ~ | | Input | Poisson | Geomet | Binomial | IntUniform | Hypergeo |
|-----------------|-------|--------------------|---------------------------|-------------------|-------------------|------------|----------|------------|----------|
| Fit | | Value | 95% Lower Limit* | | | | | | N// |
| oisso | | 12.3983 | 95% Upper Limit* | | | | | | N// |
| eom | | 13.9183 | Conf. Interval Width* | | | | | | N// |
| inom | | 16.7301 | Distribution Statistics | | | | | | |
| | iform | 16.9315 36.7301 | Minimum | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.000 |
| lyper IegBii | | 56.7501 N/A | Maximum | 1.0000 | +Infinity | +Infinity | 1.0000 | 1.0000 | 1.000 |
| -cybi | | 100 | Mean | 0.6000 | 0.6000 | 0.6000 | 0.6000 | 0.5000 | 0.600 |
| | | | Mode | 1.0000 | 0.0000 | 0.0000 | 1.0000 | 0.0000 | 1.000 |
| | | | Median | 1.0000 | 0.0000 | 0.0000 | 1.0000 | 0.0000 | 1.000 |
| | | | Std. Deviation | 0.5477 | 0.7746 | 0.9798 | 0.4899 | 0.5000 | 0.489 |
| | | | Skewness | -0.6086 | 1.2910 | 2.2454 | -0.4082 | 0.0000 | -0.408 |
| | | | Kurtosis | -0.3333 | 4.6667 | 10.0417 | 1.1667 | 1.0000 | 1.166 |
| | | | - Percentiles | | | | | | |
| | | | 5% | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.000 |
| | | | 10% | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.000 |
| | | | 15% | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.000 |
| | | | 20% | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.000 |
| | | | 25% | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.000 |
| | | | 30% | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.000 |
| | | | 35% | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.000 |
| | | | 40% | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.000 |
| | | | 45% | 1.0000 | 0.0000 | 0.0000 | 1.0000 | 0.0000 | 1.000 |
| | | | 50% | 1.0000 | 0.0000 | 0.0000 | 1.0000 | 0.0000 | 1.000 |
| | | | 55% | 1.0000 | 1.0000 | 0.0000 | 1.0000 | 1.0000 | 1.000 |
| | | | 60% | 1.0000 | 1.0000 | 0.0000 | 1.0000 | 1.0000 | 1.000 |
| | | | 65% | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.000 |
| | | | 70% | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.000 |
| | | | 75% | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.000 |
| | | | 80% | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.000 |
| | | | 85% | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.000 |
| | | | 90% | 1.0000 | 2.0000 | 2.0000 | 1.0000 | 1.0000 | 1.000 |
| | | | 95% | 1.0000 | 2.0000 | 3.0000 | 1.0000 | 1.0000 | 1.000 |
| | | | - Information Criteria | | | | | | |
| | | | Akaike (AIC) | | 12.3983 | 13.9183 | 16.7301 | 16.9315 | 36.730 |
| | | | Bayesian (BIC) | | 10.6744 | 12.1944 | 9.9490 | 10.1503 | 11.558 |
| | | | Av. LogL | | -0.9065 | -1.0585 | -0.6730 | -0.6931 | -0.6730 |
| | | | - Chi-Squared Test - [* V | alues unavailable | without running a | bootstrap] | | | |
| | | | Chi-Sq Statistic | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.000 |
| | | | P-Value* | | N/A | N/A | N/A | N/A | N// |
| | | | Cr. Value @ 0.750* | | N/A | N/A | N/A | N/A | N// |
| | | | Cr. Value @ 0.500* | | N/A | N/A | N/A | N/A | N// |
| | | | Cr. Value @ 0.250* | | N/A | N/A | N/A | N/A | N// |
| | | | Cr. Value @ 0.150* | | N/A | N/A | N/A | N/A | N// |
| | | | Cr. Value @ 0.100* | | N/A | N/A | N/A | N/A | N// |
| | | | Cr. Value @ 0.050* | | N/A | N/A | N/A | N/A | N// |
| | | | Cr. Value @ 0.025* | | N/A | N/A | N/A | N/A | N// |
| | | | Cr. Value @ 0.010* | | N/A | N/A | N/A | N/A | N// |
| | | | Cr. Value @ 0.005* | | N/A | N/A | N/A | N/A | N/# |
| | | | Cr. Value @ 0.001* | | N/A | N/A | N/A | N/A | N// |
| | | | - Chi-Sq Test (Binning In | formation) | | | | | |
| | | | Bin #1 : Minimum | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.000 |
| | | | Bin #1 : Maximum | | +Infinity | +Infinity | 1.0000 | 1.0000 | 1.000 |
| | | | Bin #1 : Input | | 5.0000 | 5.0000 | 5.0000 | 5.0000 | 5.000 |
| | | | Bin #1 : Fit | | 5.0000 | 5.0000 | 5.0000 | 5.0000 | 5.000 |

Figure 1-15: Number of events >0.30 system minutes – AIC distribution

| Figure 1-16: Number of events >0.30 s | vetom minutos – BIC distribution |
|---------------------------------------|----------------------------------------------|
| Figure 1-10. Number of events >0.30 S | y_{Stem} minutes – Dic distribution |

| ank By BIC | \sim | | Input | Binomial | IntUniform | Poisson | Hypergeo | Geome |
|------------|---------|----------------------------|------------------|-------------------|------------|-----------|----------|----------|
| Fit | Value | 95% Lower Limit* | | | | | N/A | |
| Binomial | 9.9490 | 95% Upper Limit* | | | | | N/A | |
| IntUniform | 10.1503 | Conf. Interval Width* | | | | | N/A | |
| Poisson | 10.6744 | - Distribution Statistics | | | | | | |
| Hypergeo | 11.5584 | Minimum | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.000 |
| Geomet | 12.1944 | Maximum | 1.0000 | 1.0000 | 1.0000 | +Infinity | 1.0000 | +Infinit |
| NegBin | N/A | Mean | 0.6000 | 0.6000 | 0.5000 | 0.6000 | 0.6000 | 0.600 |
| | | Mode | 1.0000 | 1.0000 | 0.0000 | 0.0000 | 1.0000 | 0.000 |
| | | Median | 1.0000 | 1.0000 | 0.0000 | 0.0000 | 1.0000 | 0.000 |
| | | Std. Deviation | 0.5477 | 0.4899 | 0.5000 | 0.7746 | 0.4899 | 0.979 |
| | | Skewness | -0.6086 | -0.4082 | 0.0000 | 1.2910 | -0.4082 | 2.245 |
| | | Kurtosis | -0.3333 | 1.1667 | 1.0000 | 4.6667 | 1.1667 | 10.041 |
| | | - Percentiles | | | | | | |
| | | 5% | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.000 |
| | | 10% | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.000 |
| | | 15% | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.000 |
| | | 20% | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.000 |
| | | 25% | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.000 |
| | | 30% | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.000 |
| | | 35% | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.000 |
| | | 40% | | | | | | 0.000 |
| | | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | |
| | | 45% | 1.0000 | 1.0000 | 0.0000 | 0.0000 | 1.0000 | 0.000 |
| | | 50% | 1.0000 | 1.0000 | 0.0000 | 0.0000 | 1.0000 | 0.000 |
| | | 55% | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.000 |
| | | 60% | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.000 |
| | | 65% | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.000 |
| | | 70% | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.000 |
| | | 75% | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.000 |
| | | 80% | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.000 |
| | | 85% | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.000 |
| | | 90% | 1.0000 | 1.0000 | 1.0000 | 2.0000 | 1.0000 | 2.000 |
| | | 95% | 1.0000 | 1.0000 | 1.0000 | 2.0000 | 1.0000 | 3.000 |
| | | Information Criteria | | | | | | |
| | | Akaike (AIC) | | 16.7301 | 16.9315 | 12.3983 | 36.7301 | 13.918 |
| | | Bayesian (BIC) | | 9.9490 | 10.1503 | 10.6744 | 11.5584 | 12.194 |
| | | Av. LogL | | -0.6730 | -0.6931 | -0.9065 | -0.6730 | -1.058 |
| | | - Chi-Squared Test - (* Va | lues unavailable | without running a | bootstrap] | | | |
| | | Chi-Sq Statistic | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.000 |
| | | P-Value* | | N/A | N/A | N/A | N/A | N/ |
| | | Cr. Value @ 0.750* | | N/A | N/A | N/A | N/A | N/ |
| | | Cr. Value @ 0.500* | | N/A | N/A | N/A | N/A | N/ |
| | | Cr. Value @ 0.250* | | N/A | N/A | N/A | N/A | N |
| | | Cr. Value @ 0.150* | | N/A | N/A | N/A | N/A | N |
| | | Cr. Value @ 0.100* | | N/A | N/A | N/A | N/A | N |
| | | Cr. Value @ 0.050* | | N/A | N/A | N/A | N/A | N |
| | | Cr. Value @ 0.025* | | N/A | N/A | N/A | N/A | N |
| | | Cr. Value @ 0.010* | | N/A | N/A | N/A | N/A | N |
| | | Cr. Value @ 0.005* | | N/A | N/A | N/A | N/A | N |
| | | Cr. Value @ 0.003 | | N/A | N/A | N/A | N/A | N |
| | | - Chi-Sa Test (Binning Inf | (and the set | 1974 | 13/25 | 17/5 | 1975 | DQ. |
| | | | ormation) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.000 |
| | | Bin #1 : Minimum | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.000 |
| | | Bin #1 : Maximum | | 1.0000 | 1.0000 | +Infinity | 1.0000 | +Infini |
| | | Bin #1 : Input | | 5.0000 | 5.0000 | 5.0000 | 5.0000 | 5.000 |

1.3 Service parameter 3 – average outage duration

1.3.1 Average outage duration (continuous)

The @risk software found the Rayleigh distribution is the most appropriate fit.

Figure 1-17: Average outage duration – distribution fit using K-S

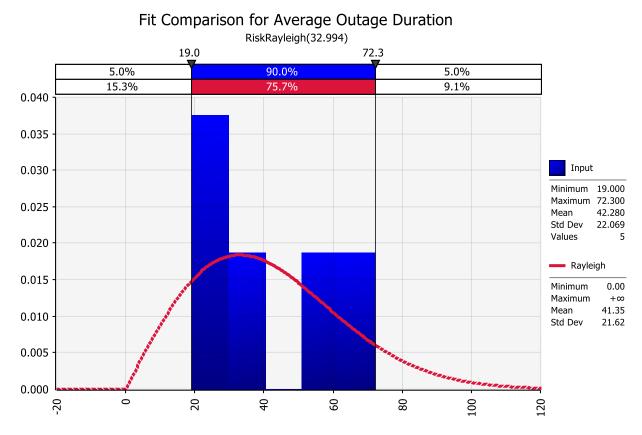


Figure 1-18: Average outage duration – statistics table using K-S

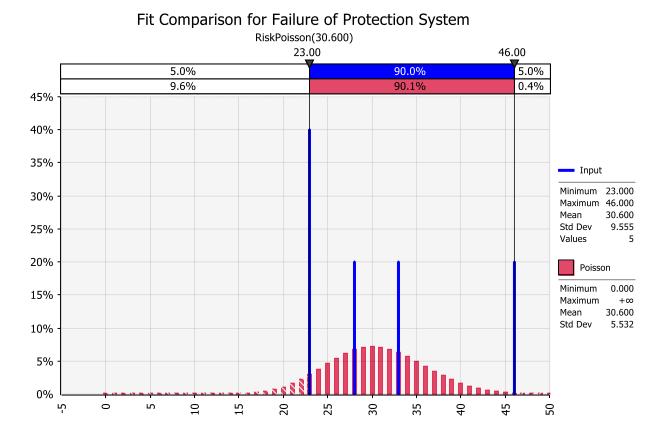
| nk By K-S | ~ | | Input | Rayleigh | Pearson5 | Pearson6 | Erlang | Invgauss | FatigueLife | Loglogistic | Lognorm | Lognorm2 | Frechet | Dagum | Uniform | Gamma | Weibull | Burr12 | |
|-----------------------|------------------|------------------------|----------------------|-----------|-----------|-----------|------------|-----------|-------------|-------------|-----------|------------|-----------|-----------|---------|------------|-----------|------------|--|
| Fit | Value | - Distribution Statist | | | | | | | | | | | | | | | | | |
| Rayleigh | 0.1607 | Minimum | 19.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | |
| Pearson5 | 0.1950 | Maximum | 72.3000 | +Infinity | +Infinity | +Infinity | +Infinity | +infinity | +Infinity | + Infinity | +Infinity | + Infinity | +Infinity | +Infinity | 90.3750 | +Infinity | +Infinity | +Infinity | |
| Pearson6 | 0.1950 | Mean | 42.2800 | 41.3522 | 43.4206 | 43.420588 | 42.2800 | 42.2800 | 42.2742 | 44.5713 | 42.5001 | 42.5001 | 46.9572 | 46.9569 | 45.1875 | 42.2800 | 42.5060 | 42.5140 | |
| Erlang | 0.1957 0.2017 | Mode | 20.3325 [est] | 32.9943 | 26.9543 | 26.954394 | 31.7100 | 28.4467 | 28.6607 | 31.1079 | 29.3336 | 29.3336 | 24.8461 | 24.8461 | 0.0000 | 32.6332 | 37.7608 | 37.7608 | |
| FatigueLife | 0.2017 | Median | 39.8000 | 38.8478 | 36.0287 | 36.028802 | 38.8137 | 37.3093 | 37.4953 | 37.8951 | 37.5591 | 37.5591 | 34,4733 | 34.4732 | 45.1875 | 39.1115 | 41.0034 | 41.0034 | |
| Loglogistic | 0.2040 | Std. Deviation | 22.0694 | 21.6157 | 28.7948 | 28.794447 | 21.1400 | 22.0163 | 21.7387 | 31.6856 | 22.5055 | 22.5055 | 72.5056 | 72.5027 | 26.0890 | 20.1957 | 19.3317 | 19.2801 | |
| Lognorm | 0.2049 | Skewness | 0.4370 | 0.6311 | 4.7350 | 4.7348 | 1.0000 | 1.5622 | 1.4678 | 14.8721 | 1.7371 | 1.7371 | +Infinity | N/A | 0.0000 | 0.9553 | 0.4367 | 0.4609 | |
| Lognorm2 | 0.2049 | Kurtosis | 1.5300 | 3.2451 | 181.3391 | 181.2751 | 4.5000 | 7.0673 | 6.5573 | +Infinity | 8.8046 | 8.8046 | +Infinity | N/A | 1.8000 | 4.3690 | 2.9432 | 2.9341 | |
| Frechet | 0.2053 | = Percentites | | | | | | | | | | | | | | | | | |
| Dagum | 0.2053 | 5% | 19.0000 | 10.5678 | 17.4596 | 17.459533 | 14.4420 | 16.8209 | 16.7087 | 15.2581 | 16.5790 | 16.5790 | 17.9578 | 17.9578 | 4.5188 | 15.3580 | 13.4480 | 13.4467 | |
| Uniform | 0.2102 | 10% | 19.0000 | 15.1458 | 20.1804 | 20.180435 | 18.4422 | 19.9052 | 19.8452 | 19.2204 | 19.8610 | 19.8610 | 20.1918 | 20.1918 | 9.0375 | 19.3289 | 18.3025 | 18.3032 | |
| Gamma | 0.2108 | 15% | 19.0000 | 18.8107 | 22.3515 | 22.351545 | 21.5533 | 22.3647 | 22.3478 | 22.1736 | 22.4351 | 22.4351 | 22.0118 | 22.0118 | 13.5563 | 22.3902 | 22.0346 | 22.0343 | |
| Weibull | 0.2120 | 20% | 19.0000 | 22.0417 | 24.3088 | 24.308825 | 24.2770 | 24.5710 | 24.5921 | 24.6929 | 24.7168 | 24.7168 | 23.6852 | 23.6852 | 18.0750 | 25.0551 | 25.2380 | 25.2387 | |
| Burr12 | 0.2121 | 25% | 24.5000 | 25.0271 | 26.1769 | 26.176955 | 26.7983 | 26.6614 | 26.7169 | 26.9881 | 26.8583 | 26.8583 | 25.3138 | 25.3138 | 22.5938 | 27.5113 | 28.1381 | 28.1388 | |
| Pert | 0.2176 | 30% | 24.5000 | 27.8670 | 28.0230 | 28.023075 | 29.2124 | 28.7084 | 28.7955 | 29.1671 | 28.9392 | 28.9392 | 26.9552 | 26.9552 | 27.1125 | 29.8547 | 30.8510 | 30.8512 | |
| Triang BetaGeneral | 0.2970 | 35% | 24.5000 | 30.6255 | 29.8932 | 29.893203 | 31.5794 | 30.7599 | 30.8759 | 31.2983 | 31.0111 | 31.0111 | 28.6519 | 28.6519 | 31.6313 | 32.1455 | 33.4482 | 33.4488 | |
| Expon | 0.3620 | 40% | 24,5000 | 33,3495 | 31.8255 | 31,825546 | 33.9437 | 32.8537 | 32,9961 | 33,4332 | 33,1140 | 33,1140 | 30.4423 | 30.4423 | 36,1500 | 34,4276 | 35,9802 | 35.9800 | |
| ChiSq | 0.3662 | 45% | 39.8000 | 36.0782 | 33.8571 | 33.857187 | 36.3430 | 35.0248 | 35,1906 | 35.6170 | 35.2844 | 35.2844 | 32.3669 | 32.3669 | 40.6688 | 36.7379 | 38.4869 | 38.4867 | |
| Kumaraswa | 0.4827 | 50% | 39,8000 | 38.8478 | 36.0287 | 36.028802 | 38.8137 | 37,3093 | 37,4953 | 37.8951 | 37,5591 | 37.5591 | 34.4733 | 34.4732 | 45.1875 | 39.1115 | 41.0034 | 41.0034 | |
| Levy | 0.5024 | 55% | 39.8000 | 41,6959 | 18,3893 | 38,389397 | 41.3948 | 39,7487 | 39,9508 | 40.3189 | 39.9805 | 39,9805 | 36.8219 | 36.8218 | 49,7063 | 41.5861 | 43.5645 | 43.5647 | |
| Pareto | N/A | 60% | 55.8000 | 44.6653 | 41.0025 | 41.002539 | 44.1325 | 42.3949 | 42.6079 | 42.9525 | 42.6008 | 42.6008 | 39.4950 | 39.4948 | 54.2250 | 44.2054 | 46.2080 | 46.2083 | |
| Pareto2 | N/A | 65% | 55.8000 | 47.8092 | 43.9561 | 43,956142 | 47.0860 | 45.3168 | 45.5337 | 45.8823 | 45,4897 | 45.4897 | 42,6108 | 42,6106 | 58,7438 | 47.0256 | 48,9796 | 48,9797 | |
| | | 70% | 55,8000 | 51,1990 | 47.3796 | 47.379700 | 50.3368 | 48.6125 | 48.8234 | 49.2349 | 43,7465 | 48,7465 | 46.3499 | 46.3496 | 63.2625 | 50.1237 | 51.9388 | 51,9386 | |
| | | 75% | 55.8000 | 54,9391 | 51,4779 | 51,477956 | 54.0066 | 52,4318 | 52.6218 | 53,2101 | 52,5232 | 52.5232 | 51.0088 | 51.0086 | 67,7813 | 53.6144 | 55.1712 | 55.1712 | |
| | | 80% | 55,8000 | 59.1958 | 56.6048 | 56.604832 | 58,2940 | 57.0231 | 57,1686 | 58,1561 | \$7.0740 | 57.0740 | 57.1219 | 57.1216 | 72.3000 | 57,6841 | 58,8120 | 58.8122 | |
| | | 85% | 72.3000 | 64.2689 | 63.4535 | 63.453484 | 63.5631 | 62.8508 | 62.9099 | 64.7636 | 62.8785 | 62.8785 | 65.7880 | 65.7875 | 76.8188 | 62.6749 | 63.1025 | 63.1024 | |
| | | 90% | 72.3000 | 70.8046 | 73.6782 | 73.678104 | 70.6159 | 70.9579 | 70.8431 | 74.7146 | 71.0277 | 71.0277 | 79.8016 | 79.8009 | 81.3375 | 69.3391 | 68.5590 | 68.5592 | |
| | | 95% | 72.3000 | 80.7616 | 93.0901 | 93.089707 | 81.9561 | 84.6817 | 84.1412 | 94.1165 | 85.0888 | 85.0888 | 109.9764 | 109.9753 | 85.8563 | 80.0220 | 76.7360 | 76.7361 | |
| | | - Information Criteria | | 00.7010 | 93.0901 | 95.069707 | 01.9301 | 04.0017 | 04.1412 | 34.1103 | 63.0606 | 63.0000 | 103.3/64 | 109.9755 | 00-0003 | 60.0220 | 10.1300 | /0./301 | |
| | | | | 47.0009 | 53.5745 | 73.5745 | 51,4609 | 53.3312 | 22.2444 | 54.0288 | 53.4604 | 53,4604 | 78.7641 | 11.00 | | 53,4391 | \$3,4911 | N/A | |
| | | Akaike (AIC) | | | | | | | 73.3100 | | | | | N/A | 48.3730 | | | | |
| | | Bayesian (BIC) | | 45.2770 | 46.7934 | 48.4028 | 46.6798 | 46.5501 | 48.1383 | 47.2477 | 46.6793 | 46.6793 | 48.5924 | 50.2018 | 46.6491 | 46.6580 | 46.7100 | 49.9289 | |
| | | Av. LogL | | | | -4.3575 | -4.3401 | -4.3331 | -4,3310 | -4.4029 | -4.3400 | -4.3400 | -4.3/04 | -4.3/04 | -4.5040 | -4-3439 | -4.3491 | -4.3491 | |
| | | - Chi-Squared Test - | * Values unavailable | | | | | | | | | | | | | | | | |
| | | Chi-Sq Statistic | | 0.2000 | 0.2000 | 0.2000 | 0.2000 | 0.2000 | 0.2000 | 0.2000 | 0.2000 | 0.2000 | 0.2000 | 0.2000 | 0.2000 | 0.2000 | 0.2000 | 0.2000 | |
| | | P-Value* | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | |
| | | Cr. Value @ 0.750* | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | |
| | | Cr. Value @ 0.500* | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A. | N/A | N/A | N/A | |
| | | Cr. Value @ 0.250* | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A. | N/A | N/A | N/A | |
| | | Cr. Value @ 0.150* | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | |
| | | Cr. Value @ 0.100* | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | |
| | | Cr. Value @ 0.050* | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | |
| | | Cr. Value @ 0.025* | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | |
| | | Cr. Value @ 0.010* | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | |
| | | Cr. Value @ 0.005* | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | |
| | | Cr. Value @ 0.001* | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | |
| | | Chi-Sq Test (Binnin) | Information) | | | | | | | | | | | | | | | | |
| | | Sin #1 : Minimum | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | |
| | | Bin #1 : Maximum | | 38.8478 | 36.0287 | 36.028802 | 38.8137 | 37.3093 | 37,4953 | 37.8951 | 37.5591 | 37.5591 | 34.4733 | 34.4732 | 45.1875 | 39.1115 | 41.0034 | 41.0034 | |
| | | Bin #1 : Input | | 2.0000 | 2.0000 | 2.0000 | 2.0000 | 2.0000 | 2.0000 | 2.0000 | 2.0000 | 2.0000 | 2.0000 | 2.0000 | 3.0000 | 2.0000 | 3.0000 | 3.0000 | |
| | | Bin #1 : Fit | | 2.5000 | 2.5000 | 2.5000 | 2.5000 | 2.5000 | 2.5000 | 2.5000 | 2.5000 | 2.5000 | 2.5000 | 2.5000 | 2.5000 | 2.5000 | 2.5000 | 2.5000 | |
| | | Bin #2 : Minimum | | 38.8478 | 36.0287 | 36.028802 | 38,8137 | 37.3093 | 37,4953 | 37.8951 | 37.5591 | 37.5591 | 34.4733 | 34.4732 | 45.1875 | 39.1115 | 41.0034 | 41.0034 | |
| | | Bin #2 : Maximum | | +Infinity | +Infinity | +Infinity | + infinity | +infinity | +Infinity | +Infinity | +Infinity | +Infinity | +Infinity | +Infinity | 90.3750 | + Infinity | +Infinity | + Infinity | |
| | | | | | | | | | | | | | | | | | | | |

1.4 Service parameter 4 – proper operation of equipment

1.4.1 Failure of protection system (discrete)

Whilst @risk found that the IntUniform distribution is the best fit according to BIC, the Poisson distribution has been adopted, consistent with distribution used for the other sub-parameters with discrete distributions (loss of supply event frequency).

Figure 1-19: Failure of protection system – Poisson distribution



| an | nk By AIC | \sim | | Input | Poisson | IntUniform | NegBin | Geomet | Hyperge |
|----|------------|---------|------------------------------------------|-------------------|-----------------|--------------|-----------|-----------|---------|
| | Fit | Value | 95% Lower Limit* | | | | | | N// |
| 7 | Poisson | 40.7276 | 95% Upper Limit* | | | | | | N// |
| | IntUniform | 41.7805 | Conf. Interval Width* | | | | | | N// |
| | NegBin | 45.0301 | Distribution Statistics | | | | | | |
| | Geomet | 47.7050 | Minimum | 23.0000 | 0.0000 | 23.0000 | 0.0000 | 0.0000 | 0.000 |
| 1 | Hypergeo | 67.8519 | Maximum | 46.0000 | +Infinity | 46.0000 | +Infinity | +Infinity | 938.000 |
| | Binomial | N/A | Mean | 30.6000 | 30.6000 | 34.5000 | 30.6000 | 30.6000 | 30.572 |
| | | | Mode | 23.0000 | 30.0000 | 23.0000 | 29.0000 | 0.0000 | 30.000 |
| | | | Median | 28.0000 | 30.0000 | 34.0000 | 30.0000 | 21.0000 | 30.000 |
| | | | Std. Deviation | 9.5551 | 5.5317 | 6.9222 | 8.2495 | 31.0960 | 5.359 |
| | | | Skewness | 1.3233 | 0.1808 | 0.0000 | 0.4180 | 2.0003 | 0.164 |
| | | | Kurtosis | 4.4468 | 3.0327 | 1.7958 | 3.2547 | 9.0010 | 3.023 |
| | | | - Percentiles | | | | | | |
| | | | 5% | 23.0000 | 22.0000 | 24.0000 | 18.0000 | 1.0000 | 22.000 |
| | | | 10% | 23.0000 | 24.0000 | 25.0000 | 20.0000 | 3.0000 | 24.000 |
| | | | 15% | 23.0000 | 25.0000 | 26.0000 | 22.0000 | 5.0000 | 25.000 |
| | | | 20% | 23.0000 | 26.0000 | 27.0000 | 24.0000 | 6.0000 | 26.000 |
| | | | 25% | 23.0000 | 27.0000 | 28.0000 | 25.0000 | 8.0000 | 27.000 |
| | | | 30% | 23.0000 | 28.0000 | 30.0000 | 26.0000 | 11.0000 | 28.000 |
| | | | 35% | 23.0000 | 28.0000 | 31.0000 | 27.0000 | 13.0000 | 28.000 |
| | | | 40% | 23.0000 | 29.0000 | 32.0000 | 28.0000 | 15.0000 | 29.000 |
| | | | 45% | 28.0000 | 30.0000 | 33.0000 | 29.0000 | 18.0000 | 30.000 |
| | | | 50% | 28.0000 | 30.0000 | 34.0000 | 30.0000 | 21.0000 | 30.000 |
| | | | | | | | | | |
| | | | 55% | 28.0000 | 31.0000 | 36.0000 | 31.0000 | 24.0000 | 31.000 |
| | | | 60% | 28.0000 | 32.0000 | 37.0000 | 32.0000 | 28.0000 | 32.000 |
| | | | 65% | 33.0000 | 33.0000 | 38.0000 | 33.0000 | 32.0000 | 33.000 |
| | | | 70% | 33.0000 | 33.0000 | 39.0000 | 34.0000 | 37.0000 | 33.000 |
| | | | 75% | 33.0000 | 34.0000 | 40.0000 | 36.0000 | 43.0000 | 34.000 |
| | | | 80% | 33.0000 | 35.0000 | 42.0000 | 37.0000 | 50.0000 | 35.000 |
| | | | 85% | 46.0000 | 36.0000 | 43.0000 | 39.0000 | 58.0000 | 36.000 |
| | | | 90% | 46.0000 | 38.0000 | 44.0000 | 41.0000 | 71.0000 | 38.000 |
| | | | 95% | 46.0000 | 40.0000 | 45.0000 | 45.0000 | 93.0000 | 40.000 |
| | | | Information Criteria | | | | | | |
| | | | Akaike (AIC) | | 40.7276 | 41.7805 | 45.0301 | 47.7050 | 67.851 |
| | | | Bayesian (BIC) | | 39.0037 | 34.9994 | 38.2490 | 45.9811 | 42.680 |
| | | | Av. LogL | | -3.7394 | -3.1781 | -3.5030 | -4.4372 | -3.785 |
| | | | - Chi-Squared Test - (* V | alues unavailable | without running | a bootstrap] | | | |
| | | | Chi-Sq Statistic | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.000 |
| | | | P-Value* | | N/A | N/A | N/A | N/A | N/ |
| | | | Cr. Value @ 0.750* | | N/A | N/A | N/A | N/A | N/ |
| | | | Cr. Value @ 0.500* | | N/A | N/A | N/A | N/A | N/ |
| | | | Cr. Value @ 0.250* | | N/A | N/A | N/A | N/A | N/ |
| | | | Cr. Value @ 0.150* | | N/A | N/A | N/A | N/A | N/ |
| | | | Cr. Value @ 0.100* | | N/A | N/A | N/A | N/A | N/ |
| | | | Cr. Value @ 0.050* | | N/A | N/A | N/A | N/A | N/ |
| | | | Cr. Value @ 0.025* | | N/A | N/A | N/A | N/A | N/ |
| | | | Cr. Value @ 0.010* | | N/A | N/A | N/A | N/A | N/ |
| | | | Cr. Value @ 0.005* | | N/A | N/A | N/A | N/A | N/ |
| | | | Cr. Value @ 0.001* | | N/A | N/A | N/A | N/A | N/ |
| | | | - Chi-Sq Test (Binning Ir | formation) | | | 1975 | | 14/ |
| | | | Bin #1 : Minimum | a strate (orig | 0.0000 | 23.0000 | 0.0000 | 0.0000 | 0.000 |
| | | | Bin #1 : Maximum | | +Infinity | 46.0000 | +Infinity | +Infinity | 938.000 |
| | | | on #1: Maximum | | | | | | |
| | | | Bin #1 : Input | | 5.0000 | 5.0000 | 5.0000 | 5.0000 | 5.000 |

Figure 1-20: Failure of protection system – AIC distribution

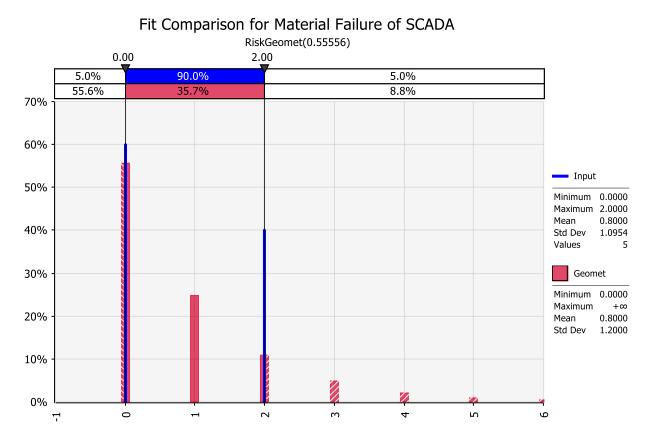
| Figure 1 21, Foilure of | protoction of | votom DIC distribu | 4100 |
|-------------------------|---------------|-----------------------|------|
| Figure 1-21: Failure of | protection s | ystein – Dic uistribu | uon |

| By BIC | \sim | | Input | IntUniform | NegBin | Poisson | Hypergeo | Geome |
|-----------|---------|------------------------------------|----------------|------------|-----------|-----------|----------|----------|
| Fit | Value | 95% Lower Limit* | | | | | N/A | |
| ntUniform | 34.9994 | 95% Upper Limit* | | | | | N/A | |
| NegBin | 38.2490 | Conf. Interval Width* | | | | | N/A | |
| Poisson | 39.0037 | - Distribution Statistics | | | | | | |
| Hypergeo | 42.6802 | Minimum | 23.0000 | 23.0000 | 0.0000 | 0.0000 | 0.0000 | 0.000 |
| Seomet | 45.9811 | Maximum | 46.0000 | 46.0000 | +Infinity | +Infinity | 938.0000 | +Infinit |
| Sinomial | N/A | Mean | 30.6000 | 34.5000 | 30.6000 | 30.6000 | 30.5729 | 30.600 |
| | | Mode | 23.0000 | 23.0000 | 29.0000 | 30.0000 | 30.0000 | 0.000 |
| | | Median | 28.0000 | 34.0000 | 30.0000 | 30.0000 | 30.0000 | 21.000 |
| | | Std. Deviation | 9.5551 | 6.9222 | 8.2495 | 5.5317 | 5.3599 | 31.096 |
| | | Skewness | 1.3233 | 0.0000 | 0.4180 | 0.1808 | 0.1644 | 2.000 |
| | | Kurtosis | 4.4468 | 1.7958 | 3.2547 | 3.0327 | 3.0233 | 9.001 |
| | | - Percentiles | | | | | | |
| | | 5% | 23.0000 | 24.0000 | 18.0000 | 22.0000 | 22.0000 | 1.000 |
| | | 10% | 23.0000 | 25.0000 | 20.0000 | 24.0000 | 24.0000 | 3.000 |
| | | 15% | 23.0000 | 26.0000 | 22.0000 | 25.0000 | 25.0000 | 5.000 |
| | | 20% | 23,0000 | 27,0000 | 24.0000 | 26,0000 | 26.0000 | 6.000 |
| | | 25% | 23.0000 | 28.0000 | 25.0000 | 27.0000 | 27.0000 | 8.000 |
| | | 30% | 23.0000 | 30.0000 | 26.0000 | 28,0000 | 28,0000 | 11.000 |
| | | 35% | 23.0000 | 31.0000 | 27.0000 | 28.0000 | 28.0000 | 13.000 |
| | | 40% | 23.0000 | 32.0000 | 28.0000 | 29.0000 | 29.0000 | 15.000 |
| | | 45% | 28.0000 | 33.0000 | 29.0000 | 30.0000 | 30.0000 | 18.000 |
| | | 50% | 28.0000 | 34.0000 | 30.0000 | 30.0000 | 30.0000 | 21.000 |
| | | 55% | 28.0000 | 36.0000 | 31.0000 | 31.0000 | 31.0000 | 24.000 |
| | | 60% | 28.0000 | 37.0000 | 32.0000 | 32.0000 | 32.0000 | 24.000 |
| | | 65% | 33.0000 | 38.0000 | 33,0000 | 33.0000 | 33.0000 | 32.000 |
| | | 70% | 33.0000 | 39.0000 | 33.0000 | 33.0000 | 33.0000 | 32.000 |
| | | 70% | 33.0000 | | | 33.0000 | 33.0000 | 43.000 |
| | | | | 40.0000 | 36.0000 | | | |
| | | 80% | 33.0000 | 42.0000 | 37.0000 | 35.0000 | 35.0000 | 50.000 |
| | | 85% | 46.0000 | 43.0000 | 39.0000 | 36.0000 | 36.0000 | 58.000 |
| | | 90% | 46.0000 | 44.0000 | 41.0000 | 38.0000 | 38.0000 | 71.000 |
| | | 95% | 46.0000 | 45.0000 | 45.0000 | 40.0000 | 40.0000 | 93.000 |
| | | - Information Criteria | | | | | | |
| | | Akaike (AIC) | | 41.7805 | 45.0301 | 40.7276 | 67.8519 | 47.705 |
| | | Bayesian (BIC) | | 34.9994 | 38.2490 | 39.0037 | 42.6802 | 45.981 |
| | | Av. LogL | | -3.1781 | -3.5030 | -3.7394 | -3.7852 | -4.437 |
| | | Chi-Squared Test - [* Val | ues unavailabl | | | | | |
| | | Chi-Sq Statistic | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.000 |
| | | P-Value* | | N/A | N/A | N/A | N/A | N/ |
| | | Cr. Value @ 0.750* | | N/A | N/A | N/A | N/A | N/. |
| | | Cr. Value @ 0.500* | | N/A | N/A | N/A | N/A | N/ |
| | | Cr. Value @ 0.250* | | N/A | N/A | N/A | N/A | N/ |
| | | Cr. Value @ 0.150* | | N/A | N/A | N/A | N/A | N/ |
| | | Cr. Value @ 0.100* | | N/A | N/A | N/A | N/A | N/ |
| | | Cr. Value @ 0.050* | | N/A | N/A | N/A | N/A | N/ |
| | | Cr. Value @ 0.025* | | N/A | N/A | N/A | N/A | N/ |
| | | Cr. Value @ 0.010* | | N/A | N/A | N/A | N/A | N/ |
| | | Cr. Value @ 0.005* | | N/A | N/A | N/A | N/A | N/ |
| | | Cr. Value @ 0.001* | | N/A | N/A | N/A | N/A | N/ |
| | | - Chi-Sq Test (Binning Inf | ormation) | | | | | |
| | | Bin #1 : Minimum | | 23.0000 | 0.0000 | 0.0000 | 0.0000 | 0.000 |
| | | | | 46.0000 | +Infinity | +Infinity | 938.0000 | +Infinit |
| | | Bin #1 : Maximum | | | | | | |
| | | Bin #1 : Maximum Bin #1 : Input | | 5.0000 | 5.0000 | 5.0000 | 5.0000 | 5.000 |

1.4.2 Material failure of SCADA system (discrete)

The @risk software found the Geometric distribution is the most appropriate fit.

Figure 1-22: Material failure of SCADA system – Geometric distribution



| lank l | By AIC | ~ | | Input | Geomet | Poisson | IntUniform | NegBin | Hypergeo |
|--------|----------------------|----------------|--------------------------------------------------------|-------------------|---------------------|----------------------|------------|---------------------|----------|
| F | Fit | Value | 95% Lower Limit* | | | | | | N/4 |
| | Seomet | 15.6986 | 95% Upper Limit* | | | | | | N/4 |
| | oisson | 15.8911 | Conf. Interval Width* | | | | | | N/4 |
| | ntUniform | 20.9861 | Distribution Statistics | | | | | | |
| | legBin | 22.3571 | Minimum | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.000 |
| | typergeo linomial | 42.5944 N/A | Maximum | 2.0000 | +Infinity | +Infinity | 2.0000 | +Infinity | 25.000 |
| | enorman | N/A | Mean | 0.8000 | 0.8000 | 0.8000 | 1.0000 | 0.8000 | 0.783 |
| | | | Mode | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.000 |
| | | | Median | 0.0000 | 0.0000 | 1.0000 | 1.0000 | 0.0000 | 1.000 |
| | | | Std. Deviation | 1.0954 | 1.2000 | 0.8944 | 0.8165 | 1.0583 | 0.870 |
| | | | Skewness | 0.6086 | 2.1667 | 1.1180 | 0.0000 | 1.7008 | 1.074 |
| | | | Kurtosis | -0.3333 | 9.6944 | 4.2500 | 1.5000 | 6.8929 | 4.073 |
| | | | - Percentiles | | | | | | |
| | | | 5% | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.000 |
| | | | 10% | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.000 |
| | | | 15% | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.000 |
| | | | 20% | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.000 |
| | | | 25% | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.000 |
| | | | 30% | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.000 |
| | | | 35% | 0.0000 | 0.0000 | 0.0000 | 1.0000 | 0.0000 | 0.000 |
| | | | 40% | 0.0000 | 0.0000 | 0.0000 | 1.0000 | 0.0000 | 0.000 |
| | | | 45% | 0.0000 | 0.0000 | 1.0000 | 1.0000 | 0.0000 | 0.000 |
| | | | 50% | 0.0000 | 0.0000 | 1.0000 | 1.0000 | 0.0000 | 1.000 |
| | | | 55% | 0.0000 | 0.0000 | 1.0000 | 1.0000 | 1.0000 | 1.000 |
| | | | 60% | 0.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.000 |
| | | | 65% | 2.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.000 |
| | | | 70% | 2.0000 | 1.0000 | 1.0000 | 2.0000 | 1.0000 | 1.000 |
| | | | 75% | 2.0000 | 1.0000 | 1.0000 | 2.0000 | 1.0000 | 1.000 |
| | | | 80% | 2.0000 | 1.0000 | 1.0000 | 2.0000 | 1.0000 | 1.000 |
| | | | 85% | 2.0000 | 2.0000 | 2.0000 | 2.0000 | 2.0000 | 2.000 |
| | | | 90% | 2.0000 | 2.0000 | 2.0000 | 2.0000 | 2.0000 | 2.000 |
| | | | 95% | 2.0000 | 3.0000 | 2.0000 | 2.0000 | 3.0000 | 2.000 |
| | | | - Information Criteria | | | | | | |
| | | | Akaike (AIC) | | 15.6986 | 15.8911 | 20.9861 | 22.3571 | 42.594 |
| | | | Bayesian (BIC) | | 13.9747 | 14.1672 | 14.2050 | 15.5760 | 17.422 |
| | | | Av. LogL | | -1.2365 | -1.2558 | -1.0986 | -1.2357 | -1.259 |
| | | | - Chi-Squared Test - [*) | alues unavailable | | | | | |
| | | | Chi-Sq Statistic | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.000 |
| | | | P-Value* | | N/A | N/A | N/A | N/A | N/ |
| | | | Cr. Value @ 0.750* | | N/A | N/A | N/A | N/A | N/ |
| | | | Cr. Value @ 0.500* | | N/A | N/A | N/A | N/A | N/ |
| | | | Cr. Value @ 0.250* | | N/A | N/A | N/A | N/A | N/ |
| | | | Cr. Value @ 0.150* | | N/A | N/A | N/A | N/A | N/ |
| | | | Cr. Value @ 0.100* Cr. Value @ 0.050* | | N/A | N/A | N/A N/A | N/A | N/ |
| | | | | | N/A | N/A | | N/A | N/ |
| | | | Cr. Value @ 0.025* | | N/A | N/A | N/A | N/A | N/ |
| | | | Cr. Value @ 0.010* Cr. Value @ 0.005* | | N/A N/A | N/A N/A | N/A N/A | N/A N/A | N/ |
| | | | Cr. Value @ 0.005* Cr. Value @ 0.001* | | N/A N/A | N/A N/A | N/A N/A | N/A N/A | N/. |
| | | | | | N/A | N/A | N/A | N/A | N/ |
| | | | Chi-Sq Test (Binning I | nrormation) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.000 |
| | | | | | | | | | |
| | | | Bin #1 : Minimum | | | | | | |
| | | | Bin #1 : Minimum Bin #1 : Maximum Bin #1 : Input | | +Infinity 5.0000 | + Infinity 5.0000 | 2.0000 | +Infinity 5.0000 | 25.000 |

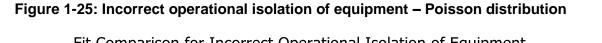
Figure 1-23: Material failure of SCADA system – AIC distribution

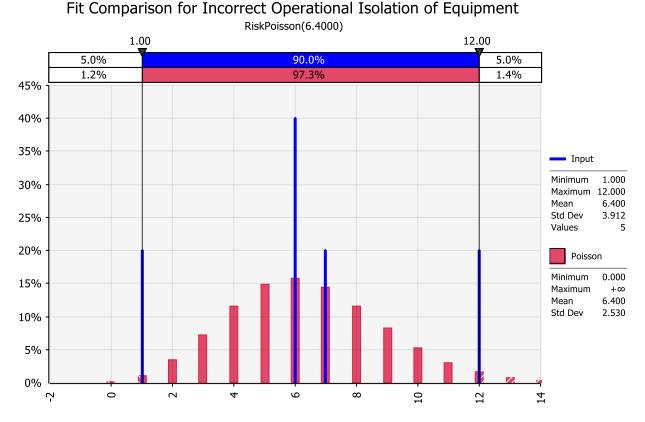
Figure 1-24: Material failure of SCADA system – BIC distribution

| an | nk By BIO | c ~ | | Input | Geomet | Poisson | IntUniform | NegBin | Hyperge |
|----|------------|---------|---------------------------|--------------------|-------------------|------------|------------|-----------|---------|
| | Fit | Value | 95% Lower Limit* | | | | | | N// |
| 7 | Geomet | 13.9747 | 95% Upper Limit* | | | | | | N// |
| | Poisson | 14.1672 | Conf. Interval Width* | | | | | | N// |
| 1 | IntUniform | | - Distribution Statistics | | | | | | |
| 2 | NegBin | 15.5760 | Minimum | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.000 |
| 1 | Hypergeo | 17.4227 | Maximum | 2.0000 | +Infinity | +Infinity | 2.0000 | +Infinity | 25.000 |
| 1 | Binomial | N/A | Mean | 0.8000 | 0.8000 | 0.8000 | 1.0000 | 0.8000 | 0.783 |
| | | | Mode | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.000 |
| | | | Median | 0.0000 | 0.0000 | 1.0000 | 1.0000 | 0.0000 | 1.000 |
| | | | Std. Deviation | 1.0954 | 1.2000 | 0.8944 | 0.8165 | 1.0583 | 0.870 |
| | | | Skewness | 0.6086 | 2.1667 | 1.1180 | 0.0000 | 1.7008 | 1.074 |
| | | | Kurtosis | -0.3333 | 9.6944 | 4.2500 | 1.5000 | 6.8929 | 4.073 |
| | | | - Percentiles | | | | | | |
| | | | 5% | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.000 |
| | | | 10% | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.000 |
| | | | 15% | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.000 |
| | | | 20% | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.000 |
| | | | 25% | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.000 |
| | | | 30% | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.000 |
| | | | 35% | 0.0000 | 0.0000 | 0.0000 | 1.0000 | 0.0000 | 0.000 |
| | | | 40% | 0.0000 | 0.0000 | 0.0000 | 1.0000 | 0.0000 | 0.000 |
| | | | 40% | 0.0000 | 0.0000 | 1.0000 | 1.0000 | 0.0000 | 0.000 |
| | | | 50% | 0.0000 | 0.0000 | 1.0000 | 1.0000 | 0.0000 | 1.000 |
| | | | 50% | 0.0000 | 0.0000 | 1.0000 | 1.0000 | 1.0000 | 1.000 |
| | | | 60% | 0.0000 | | 1.0000 | 1.0000 | 1.0000 | 1.000 |
| | | | 60% | | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.000 |
| | | | | 2.0000 | 1.0000 | | | | |
| | | | 70% | 2.0000 | 1.0000 | 1.0000 | 2.0000 | 1.0000 | 1.000 |
| | | | 75% | 2.0000 | 1.0000 | 1.0000 | 2.0000 | 1.0000 | 1.000 |
| | | | 80% | 2.0000 | 1.0000 | 1.0000 | 2.0000 | 1.0000 | 1.000 |
| | | | 85% | 2.0000 | 2.0000 | 2.0000 | 2.0000 | 2.0000 | 2.000 |
| | | | 90% | 2.0000 | 2.0000 | 2.0000 | 2.0000 | 2.0000 | 2.000 |
| | | | 95% | 2.0000 | 3.0000 | 2.0000 | 2.0000 | 3.0000 | 2.000 |
| | | | - Information Criteria | | | | | | |
| | | | Akaike (AIC) | | 15.6986 | 15.8911 | 20.9861 | 22.3571 | 42.594 |
| | | | Bayesian (BIC) | | 13.9747 | 14.1672 | 14.2050 | 15.5760 | 17.422 |
| | | | Av. LogL | | -1.2365 | -1.2558 | -1.0986 | -1.2357 | -1.259 |
| | | | - Chi-Squared Test - (*) | /alues unavailable | without running a | bootstrap] | | | |
| | | | Chi-Sq Statistic | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.000 |
| | | | P-Value* | | N/A | N/A | N/A | N/A | N/ |
| | | | Cr. Value @ 0.750* | | N/A | N/A | N/A | N/A | N/ |
| | | | Cr. Value @ 0.500* | | N/A | N/A | N/A | N/A | N/ |
| | | | Cr. Value @ 0.250* | | N/A | N/A | N/A | N/A | N/ |
| | | | Cr. Value @ 0.150* | | N/A | N/A | N/A | N/A | N/ |
| | | | Cr. Value @ 0.100* | | N/A | N/A | N/A | N/A | N/ |
| | | | Cr. Value @ 0.050* | | N/A | N/A | N/A | N/A | N/ |
| | | | Cr. Value @ 0.025* | | N/A | N/A | N/A | N/A | N/ |
| | | | Cr. Value @ 0.010* | | N/A | N/A | N/A | N/A | N/ |
| | | | Cr. Value @ 0.005* | | N/A | N/A | N/A | N/A | N/ |
| | | | Cr. Value @ 0.001* | | N/A | N/A | N/A | N/A | N/ |
| | | | - Chi-Sq Test (Binning I | nformation) | | | | | |
| | | | Bin #1 : Minimum | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.000 |
| | | | Bin #1 : Maximum | | +Infinity | +Infinity | 2.0000 | +Infinity | 25.000 |
| | | | Bin #1 : Input | | 5.0000 | 5.0000 | 5.0000 | 5.0000 | 5.000 |
| | | | Bin #1: Fit | | 5.0000 | 5.0000 | 5.0000 | 5.0000 | 5.000 |

1.4.3 Incorrect operational isolation of primary or secondary equipment (discrete)

Whilst @risk found that the IntUniform distribution is the best fit according to BIC, the Poisson distribution has been adopted, consistent with distribution used for the other sub-parameters with discrete distributions (loss of supply event frequency).





| k By AIC | \sim | | Input | Poisson | Geomet | IntUniform | NegBin | Hypergeo |
|------------|---------|---------------------------|-------------------|-----------|-----------|------------|-----------|----------|
| Fit | Value | 95% Lower Limit* | | | | | | N// |
| Poisson | 31.8720 | 95% Upper Limit* | | | | | | N// |
| Geomet | 32.6398 | Conf. Interval Width* | | | | | | N// |
| IntUniform | 34.8491 | - Distribution Statistics | | | | | | |
| NegBin | 36.9383 | Minimum | 1.0000 | 0.0000 | 0.0000 | 1.0000 | 0.0000 | 0.000 |
| Hypergeo | 58.7208 | Maximum | 12.0000 | +Infinity | +Infinity | 12.0000 | +Infinity | 202.000 |
| Binomial | N/A | Mean | 6.4000 | 6.4000 | 6.4000 | 6.5000 | 6.4000 | 6.386 |
| | | Mode | 6.0000 | 6.0000 | 0.0000 | 1.0000 | 5.0000 | 6.000 |
| | | Median | 6.0000 | 6.0000 | 4.0000 | 6.0000 | 6.0000 | 6.000 |
| | | Std. Deviation | 3.9115 | 2.5298 | 6.8819 | 3.4521 | 3.8199 | 2.479 |
| | | Skewness | 0.1270 | 0.3953 | 2.0053 | 0.0000 | 0.9319 | 0.373 |
| | | Kurtosis | 4.7929 | 3.1563 | 9.0211 | 1.7832 | 4.2685 | 3.127 |
| | | - Percentiles | | | | | | |
| | | 5% | 1.0000 | 3.0000 | 0.0000 | 1.0000 | 1.0000 | 3.000 |
| | | 10% | 1.0000 | 3.0000 | 0.0000 | 2.0000 | 2.0000 | 3.000 |
| | | 15% | 1.0000 | 4.0000 | 1.0000 | 2.0000 | 3.0000 | 4.000 |
| | | 20% | 1.0000 | 4.0000 | 1.0000 | 3.0000 | 3.0000 | 4.000 |
| | | 25% | 6.0000 | 5.0000 | 1.0000 | 3.0000 | 4.0000 | 5.000 |
| | | 30% | 6.0000 | 5.0000 | 2.0000 | 4.0000 | 4.0000 | 5.000 |
| | | 35% | 6.0000 | 5.0000 | 2.0000 | 5.0000 | 4.0000 | 5.000 |
| | | 40% | 6.0000 | 6.0000 | 3.0000 | 5.0000 | 5.0000 | 6.000 |
| | | 45% | 6.0000 | 6.0000 | 4.0000 | 6.0000 | 5.0000 | 6.000 |
| | | 50% | 6.0000 | 6.0000 | 4.0000 | 6.0000 | 6.0000 | 6.000 |
| | | 55% | 6.0000 | 7.0000 | 5.0000 | 7.0000 | 6.0000 | 7.000 |
| | | 60% | 6.0000 | 7.0000 | 6.0000 | 8.0000 | 7.0000 | 7.000 |
| | | 65% | 7.0000 | 7.0000 | 7.0000 | 8.0000 | 7,0000 | 7.000 |
| | | 70% | 7.0000 | 8.0000 | 8.0000 | 9.0000 | 8.0000 | 8.000 |
| | | 75% | 7.0000 | 8.0000 | 9.0000 | 9.0000 | 9.0000 | 8.000 |
| | | 80% | 7.0000 | 8.0000 | 11.0000 | 10.0000 | 9.0000 | 8.000 |
| | | 85% | 12.0000 | 9.0000 | 13.0000 | 11.0000 | 10.0000 | 9.000 |
| | | 90% | 12.0000 | 10.0000 | 15.0000 | 11.0000 | 12.0000 | 10.000 |
| | | 90% | 12.0000 | | | | | 11.000 |
| | | | 12.0000 | 11.0000 | 20.0000 | 12.0000 | 14.0000 | 11.000 |
| | | - Information Criteria | | | | | | |
| | | Akaike (AIC) | | 31.8720 | 32.6398 | 34.8491 | 36.9383 | 58.720 |
| | | Bayesian (BIC) | | 30.1481 | 30.9159 | 28.0679 | 30.1572 | 33.549 |
| | | Av. LogL | | -2.8539 | -2.9306 | -2.4849 | -2.6938 | -2.872 |
| | | Chi-Squared Test - (* V | alues unavailable | | | | | |
| | | Chi-Sq Statistic | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.000 |
| | | P-Value* | | N/A | N/A | N/A | N/A | N/ |
| | | Cr. Value @ 0.750* | | N/A | N/A | N/A | N/A | N/ |
| | | Cr. Value @ 0.500* | | N/A | N/A | N/A | N/A | N/ |
| | | Cr. Value @ 0.250* | | N/A | N/A | N/A | N/A | N/ |
| | | Cr. Value @ 0.150* | | N/A | N/A | N/A | N/A | N/ |
| | | Cr. Value @ 0.100* | | N/A | N/A | N/A | N/A | N/ |
| | | Cr. Value @ 0.050* | | N/A | N/A | N/A | N/A | N/ |
| | | Cr. Value @ 0.025* | | N/A | N/A | N/A | N/A | N/ |
| | | Cr. Value @ 0.010* | | N/A | N/A | N/A | N/A | N/ |
| | | Cr. Value @ 0.005* | | N/A | N/A | N/A | N/A | N/ |
| | | Cr. Value @ 0.001* | | N/A | N/A | N/A | N/A | N/ |
| | | - Chi-Sq Test (Binning In | formation) | | | | | |
| | | Bin #1 : Minimum | | 0.0000 | 0.0000 | 1.0000 | 0.0000 | 0.000 |
| | | Bin #1 : Maximum | | +Infinity | +Infinity | 12.0000 | +Infinity | 202.000 |
| | | | | | | | | |
| | | Bin #1 : Input | | 5.0000 | 5.0000 | 5.0000 | 5.0000 | 5.000 |

Figure 1-26: Incorrect operational isolation of equipment – AIC distribution

Figure 1-27: Incorrect operational isolation of equipment – BIC distribution

| Rank By BIC | \sim | | Input | IntUniform | Poisson | NegBin | Geomet | Hyperge |
|-------------|---------|------------------------------------------|------------------|------------|-----------|-----------|------------------|---------|
| Fit | Value | 95% Lower Limit* | | | | | | N// |
| IntUniform | 28.0679 | 95% Upper Limit* | | | | | | N// |
| Poisson | 30.1481 | Conf. Interval Width* | | | | | | N// |
| NegBin | 30.1572 | - Distribution Statistics | | | | | | |
| Geomet | 30.9159 | Minimum | 1.0000 | 1.0000 | 0.0000 | 0.0000 | 0.0000 | 0.000 |
| Hypergeo | 33.5491 | Maximum | 12.0000 | 12.0000 | +Infinity | +Infinity | +Infinity | 202.000 |
| Binomial | N/A | Mean | 6.4000 | 6.5000 | 6.4000 | 6.4000 | 6.4000 | 6.386 |
| | | Mode | 6.0000 | 1.0000 | 6.0000 | 5.0000 | 0.0000 | 6.000 |
| | | Median | 6.0000 | 6.0000 | 6.0000 | 6.0000 | 4.0000 | 6.000 |
| | | Std. Deviation | 3.9115 | 3.4521 | 2.5298 | 3.8199 | 6.8819 | 2.479 |
| | | Skewness | 0.1270 | 0.0000 | 0.3953 | 0.9319 | 2.0053 | 0.373 |
| | | Kurtosis | 4.7929 | 1.7832 | 3.1563 | 4.2685 | 9.0211 | 3.127 |
| | | - Percentiles | | | | | | |
| | | 5% | 1.0000 | 1.0000 | 3.0000 | 1.0000 | 0.0000 | 3.000 |
| | | 10% | 1.0000 | 2,0000 | 3.0000 | 2,0000 | 0.0000 | 3.000 |
| | | 15% | 1.0000 | 2.0000 | 4.0000 | 3.0000 | 1.0000 | 4.000 |
| | | 20% | 1.0000 | 3.0000 | 4.0000 | 3.0000 | 1.0000 | 4.000 |
| | | 25% | 6.0000 | 3.0000 | 5.0000 | 4.0000 | 1.0000 | 5.000 |
| | | 30% | 6.0000 | 4.0000 | 5.0000 | 4.0000 | 2.0000 | 5.000 |
| | | 35% | 6.0000 | 5.0000 | 5.0000 | 4.0000 | 2.0000 | 5.000 |
| | | 40% | 6.0000 | 5.0000 | 6.0000 | 5.0000 | 3.0000 | 6.000 |
| | | 45% | 6.0000 | 6.0000 | 6.0000 | 5.0000 | 4.0000 | 6.000 |
| | | 50% | 6.0000 | 6.0000 | 6.0000 | 6.0000 | 4.0000 | 6.000 |
| | | 55% | 6.0000 | 7.0000 | 7.0000 | 6.0000 | 5.0000 | 7.000 |
| | | 60% | | | | | | 7.000 |
| | | 65% | 6.0000 7.0000 | 8.0000 | 7.0000 | 7.0000 | 6.0000 7.0000 | 7.000 |
| | | 70% | 7.0000 | 9.0000 | 8.0000 | 8.0000 | 8.0000 | |
| | | 70% | | 9.0000 | 8.0000 | 9.0000 | | 8.000 |
| | | 80% | 7.0000 | | | 9.0000 | 9.0000 | 8.000 |
| | | 80% | 7.0000 | 10.0000 | 8.0000 | | 11.0000 | |
| | | | 12.0000 | 11.0000 | 9.0000 | 10.0000 | 13.0000 | 9.000 |
| | | 90% | 12.0000 | 11.0000 | 10.0000 | 12.0000 | 15.0000 | 10.000 |
| | | 95% | 12.0000 | 12.0000 | 11.0000 | 14.0000 | 20.0000 | 11.000 |
| | | Information Criteria | | | | | | |
| | | Akaike (AIC) | | 34.8491 | 31.8720 | 36.9383 | 32.6398 | 58.720 |
| | | Bayesian (BIC) | | 28.0679 | 30.1481 | 30.1572 | 30.9159 | 33.549 |
| | | Av. LogL | | -2.4849 | -2.8539 | -2.6938 | -2.9306 | -2.872 |
| | | - Chi-Squared Test - [* V | alues unavailabl | | | | | |
| | | Chi-Sq Statistic | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.000 |
| | | P-Value* | | N/A | N/A | N/A | N/A | N/ |
| | | Cr. Value @ 0.750* | | N/A | N/A | N/A | N/A | N/ |
| | | Cr. Value @ 0.500* | | N/A | N/A | N/A | N/A | N/ |
| | | Cr. Value @ 0.250* | | N/A | N/A | N/A | N/A | N/ |
| | | Cr. Value @ 0.150* | | N/A | N/A | N/A | N/A | N/ |
| | | Cr. Value @ 0.100* | | N/A | N/A | N/A | N/A | N/ |
| | | Cr. Value @ 0.050* | | N/A | N/A | N/A | N/A | N/ |
| | | Cr. Value @ 0.025* | | N/A | N/A | N/A | N/A | N/ |
| | | Cr. Value @ 0.010* | | N/A | N/A | N/A | N/A | N/ |
| | | Cr. Value @ 0.005* | | N/A | N/A | N/A | N/A | N/ |
| | | Cr. Value @ 0.001* | | N/A | N/A | N/A | N/A | N/ |
| | | - Chi-Sq Test (Binning In | formation) | | | | | |
| | | Bin #1 : Minimum | | 1.0000 | 0.0000 | 0.0000 | 0.0000 | 0.000 |
| | | Bin #1 : Maximum | | 12.0000 | +Infinity | +Infinity | +Infinity | 202.000 |
| | | Bin #1 : Input | | 5.0000 | 5.0000 | 5.0000 | 5.0000 | 5.000 |
| | | Bin #1 : Fit | | 5.0000 | 5.0000 | 5.0000 | 5.0000 | 5.000 |