

UCL Statistics for Data Sets with Non-Detects

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Full Precision OFF
Confidence Cc 95%
Number of Boc 2000

Antimony

General Statistics

Total Number of Observations	16	Number of Distinct Observations	16
Number of Detects	6	Number of Non-Detects	10
Number of Distinct Detects	6	Number of Distinct Non-Detects	10
Minimum Detect	0.62	Minimum Non-Detect	0.891
Maximum Detect	1.12	Maximum Non-Detect	1.05
Variance Detects	0.0325	Percent Non-Detects	62.5%
Mean Detects	0.826	SD Detects	0.18
Median Detects	0.824	CV Detects	0.218
Skewness Detects	0.66	Kurtosis Detects	0.338
Mean of Logged Detects	-0.21	SD of Logged Detects	0.215

Normal GOF Test on Detects Only

Shapiro Wilk Test Statist	0.955	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical	0.788	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.165	Lilliefors GOF Test
5% Lilliefors Critical Value	0.325	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.78	KM Standard Error of Mean	0.0533
KM SD	0.135	95% KM (BCA) UCL	0.864
95% KM (t) UCL	0.874	95% KM (Percentile Bootstrap) UCL	0.874
95% KM (z) UCL	0.868	95% KM Bootstrap t UCL	0.879
90% KM Chebyshev UCL	0.94	95% KM Chebyshev UCL	1.013
97.5% KM Chebyshev UCL	1.113	99% KM Chebyshev UCL	1.311

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.209	Anderson-Darling GOF Test
5% A-D Critical Value	0.697	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.173	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.332	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	25.98	k star (bias corrected ML)	13.1
Theta hat (MLE)	0.0318	Theta star (bias corrected ML)	0.0631
nu hat (MLE)	311.8	nu star (bias corrected)	157.2
Mean (detects)	0.826		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
For such situations, GROS method may yield incorrect values of UCLs and BTVs
This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.62	Mean	0.778
Maximum	1.12	Median	0.754
SD	0.111	CV	0.143
k hat (MLE)	59.19	k star (bias corrected ML)	48.13

Theta hat (MLE)	0.0131	Theta star (bias corrected)	0.0162
nu hat (MLE)	1894	nu star (bias corrected)	1540
Adjusted Level of Significance	0.0335		
Approximate Chi Square	1450	Adjusted Chi Square Value	1440
95% Gamma Approximate	0.826	95% Gamma Adjusted UCL	0.832

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.78	SD (KM)	0.135
Variance (KM)	0.0182	SE of Mean (KM)	0.0533
k hat (KM)	33.46	k star (KM)	27.22
nu hat (KM)	1071	nu star (KM)	871.2
theta hat (KM)	0.0233	theta star (KM)	0.0287
80% gamma percentile (k)	0.903	90% gamma percentile (k)	0.977
95% gamma percentile (k)	1.042	99% gamma percentile (k)	1.17

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square	803.7	Adjusted Chi Square Value	796.3
95% Gamma Approximate	0.846	95% Gamma Adjusted UCL	0.854

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.971	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.788	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.153	Lilliefors GOF Test
5% Lilliefors Critical Value	0.325	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.775	Mean in Log Scale	-0.263
SD in Original Scale	0.112	SD in Log Scale	0.131
95% t UCL (assumes normality)	0.824	95% Percentile Bootstrap UCL	0.821
95% BCA Bootstrap UCL	0.836	95% Bootstrap t UCL	0.865
95% H-UCL (Log ROS)	0.823		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-0.262	KM Geo Mean	0.769
KM SD (logged)	0.168	95% Critical H Value (t)	1.78
KM Standard Error of Mean	0.0693	95% H-UCL (KM -Log)	0.843
KM SD (logged)	0.168	95% Critical H Value (t)	1.78
KM Standard Error of Mean	0.0693		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.61	Mean in Log Scale	-0.537
SD in Original Scale	0.203	SD in Log Scale	0.293
95% t UCL (Assumes normality)	0.699	95% H-Stat UCL	0.702

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	0.874
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Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness. These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006). However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

General Statistics			
Total Number of Observations	8	Number of Distinct Observations	8
		Number of Missing Observations	8
Minimum	0.0022	Mean	0.0282
Maximum	0.0648	Median	0.0146
SD	0.0264	Std. Error of Mean	0.00935
Coefficient of Variation	0.938	Skewness	0.643

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test		
Shapiro Wilk Test Statist	0.813	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical	0.818	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.29	Lilliefors GOF Test
5% Lilliefors Critical Valu	0.283	Data Not Normal at 5% Significance Level
Data Not Normal at 5% Significance Level		

Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.0459	95% Adjusted-CLT UCL	0.0458
		95% Modified-t UCL (J)	0.0462

Gamma GOF Test		
A-D Test Statistic	0.409	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.734	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.208	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.301	Detected data appear Gamma Distributed at 5% Significance Level
Detected data appear Gamma Distributed at 5% Significance Level		

Gamma Statistics			
k hat (MLE)	1.084	k star (bias corrected MLE)	0.761
Theta hat (MLE)	0.026	Theta star (bias corrected MLE)	0.037
nu hat (MLE)	17.35	nu star (bias corrected)	12.18
MLE Mean (bias corrected)	0.0282	MLE Sd (bias corrected)	0.0323
		Approximate Chi Square	5.344
Adjusted Level of Significance	0.0195	Adjusted Chi Square Value	4.256

Assuming Gamma Distribution			
95% Approximate Gamma UCL	0.0642	95% Adjusted Gamma UCL	0.0806

Lognormal GOF Test		
Shapiro Wilk Test Statist	0.925	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical	0.818	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.193	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Valu	0.283	Data appear Lognormal at 5% Significance Level
Data appear Lognormal at 5% Significance Level		

Lognormal Statistics			
Minimum of Logged Data	-6.119	Mean of logged Data	-4.097
Maximum of Logged Data	-2.736	SD of logged Data	1.209

Assuming Lognormal Distribution			
95% H-UCL	0.211	90% Chebyshev (MVU)	0.0699
95% Chebyshev (MVU)	0.0878	97.5% Chebyshev (MVL)	0.113
99% Chebyshev (MVU)	0.162		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs			
95% CLT UCL	0.0435	95% Jackknife UCL	0.0459
95% Standard Bootstrap	0.0425	95% Bootstrap-t UCL	0.0503
95% Hall's Bootstrap U	0.0393	95% Percentile Bootstr	0.0426
95% BCA Bootstrap U	0.0448		
90% Chebyshev(Mean	0.0562	95% Chebyshev(Mean	0.0689
97.5% Chebyshev(Mear	0.0865	99% Chebyshev(Mean	0.121

Suggested UCL to Use
95% Adjusted Gamma U 0.0806

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness. These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006). However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Barium

General Statistics			
Total Number of Observa	16	Number of Distinct Obse	16
		Number of Missing Obse	0
Minimum	13.2	Mean	47.08
Maximum	88.6	Median	35.95
SD	26.21	Std. Error of Mean	6.552
Coefficient of Variation	0.557	Skewness	0.307

Normal GOF Test		
Shapiro Wilk Test Statist	0.894	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical	0.887	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.199	Lilliefors GOF Test
5% Lilliefors Critical Valu	0.213	Data appear Normal at 5% Significance Level
Data appear Normal at 5% Significance Level		

Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	58.57	95% Adjusted-CLT UC	58.39
		95% Modified-t UCL (J	58.65

Gamma GOF Test			
A-D Test Statistic	0.546	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.744	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.159	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.217	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			

Gamma Statistics			
k hat (MLE)	3.157	k star (bias corrected ML	2.607
Theta hat (MLE)	14.91	Theta star (bias correcte	18.06
nu hat (MLE)	101	nu star (bias corrected)	83.42
MLE Mean (bias correcte	47.08	MLE Sd (bias corrected)	29.16
		Approximate Chi Square	63.37
Adjusted Level of Signific	0.0335	Adjusted Chi Square Val	61.39

Assuming Gamma Distribution			
95% Approximate Garr	61.98	95% Adjusted Gamma	63.98

Lognormal GOF Test

Shapiro Wilk Test Statist	0.925	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical	0.887	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.161	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Valu	0.213	Data appear Lognormal at 5% Significance Level
Data appear Lognormal at 5% Significance Level		

Lognormal Statistics			
Minimum of Logged Data	2.58	Mean of logged Data	3.685
Maximum of Logged Dat	4.484	SD of logged Data	0.619

Assuming Lognormal Distribution			
95% H-UCL	68.45	90% Chebyshev (MVU	70.76
95% Chebyshev (MVU	81.25	97.5% Chebyshev (MVL	95.8
99% Chebyshev (MVU	124.4		

Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			

Nonparametric Distribution Free UCLs			
95% CLT UCL	57.86	95% Jackknife UCL	58.57
95% Standard Bootstra	57.78	95% Bootstrap-t UCL	59.59
95% Hall's Bootstrap U	57.79	95% Percentile Bootstr	57.96
95% BCA Bootstrap U	58.54		
90% Chebyshev(Mean	66.74	95% Chebyshev(Mean	75.64
97.5% Chebyshev(Mear	88	99% Chebyshev(Mean	112.3

Suggested UCL to Use	
95% Student's-t UCL	58.57

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness. These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006). However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Chromium

General Statistics			
Total Number of Observa	16	Number of Distinct Obse	16
		Number of Missing Obse	0
Minimum	4.04	Mean	22.72
Maximum	60.7	Median	8.39
SD	21.79	Std. Error of Mean	5.447
Coefficient of Variation	0.959	Skewness	0.701

Normal GOF Test		
Shapiro Wilk Test Statist	0.758	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical	0.887	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.325	Lilliefors GOF Test
5% Lilliefors Critical Valu	0.213	Data Not Normal at 5% Significance Level
Data Not Normal at 5% Significance Level		

Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	32.27	95% Adjusted-CLT UC	32.7
		95% Modified-t UCL (J	32.42

Gamma GOF Test		
A-D Test Statistic	1.52	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.761	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.258	Kolmogorov-Smirnov Gamma GOF Test

5% K-S Critical Value 0.221 Data Not Gamma Distributed at 5% Significance Level
Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.143	k star (bias corrected ML	0.97
Theta hat (MLE)	19.88	Theta star (bias correcte	23.42
nu hat (MLE)	36.57	nu star (bias corrected)	31.04
MLE Mean (bias correcte	22.72	MLE Sd (bias corrected)	23.06
		Approximate Chi Square	19.31
Adjusted Level of Signific	0.0335	Adjusted Chi Square Val	18.27

Assuming Gamma Distribution

95% Approximate Garr	36.51	95% Adjusted Gamma	38.61
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Lognormal GOF Test

Shapiro Wilk Test Statist	0.821	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical	0.887	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.23	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Valu	0.213	Data Not Lognormal at 5% Significance Level	

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.396	Mean of logged Data	2.625
Maximum of Logged Dat	4.106	SD of logged Data	1.043

Assuming Lognormal Distribution

95% H-UCL	50.13	90% Chebyshev (MVU	42.24
95% Chebyshev (MVU	51.1	97.5% Chebyshev (MVL	63.41
99% Chebyshev (MVU	87.59		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	31.68	95% Jackknife UCL	32.27
95% Standard Bootstr	31.25	95% Bootstrap-t UCL	33.82
95% Hall's Bootstrap U	31.01	95% Percentile Bootstr	31.65
95% BCA Bootstrap U	32.21		
90% Chebyshev(Mean	39.06	95% Chebyshev(Mean	46.46
97.5% Chebyshev(Mear	56.74	99% Chebyshev(Mean	76.92

Suggested UCL to Use

95% Chebyshev (Mean,	46.46
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Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness. These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006). However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Copper

General Statistics

Total Number of Observ	16	Number of Distinct Obse	16
		Number of Missing Obse	0
Minimum	1.45	Mean	5.772
Maximum	13.7	Median	2.97
SD	4.569	Std. Error of Mean	1.142
Coefficient of Variation	0.792	Skewness	0.663

Normal GOF Test

Shapiro Wilk Test Statist	0.789	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical	0.887	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.29	Lilliefors GOF Test
5% Lilliefors Critical Valu	0.213	Data Not Normal at 5% Significance Level
Data Not Normal at 5% Significance Level		

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	7.774	95% Adjusted-CLT UC	7.853
		95% Modified-t UCL (J	7.806

Gamma GOF Test

A-D Test Statistic	1.255	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.753	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.258	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.218	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.747	k star (bias corrected ML	1.461
Theta hat (MLE)	3.304	Theta star (bias correcte	3.951
nu hat (MLE)	55.89	nu star (bias corrected)	46.75
MLE Mean (bias correcte	5.772	MLE Sd (bias corrected)	4.775
		Approximate Chi Square	32.06
Adjusted Level of Signific	0.0335	Adjusted Chi Square Val	30.68

Assuming Gamma Distribution

95% Approximate Garr	8.417	95% Adjusted Gamma	8.796
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Lognormal GOF Test

Shapiro Wilk Test Statist	0.855	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical	0.887	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.222	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Valu	0.213	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.372	Mean of logged Data	1.44
Maximum of Logged Dat	2.617	SD of logged Data	0.82

Assuming Lognormal Distribution

95% H-UCL	9.912	90% Chebyshev (MVU	9.558
95% Chebyshev (MVU	11.28	97.5% Chebyshev (MVL	13.67
99% Chebyshev (MVU	18.37		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	7.651	95% Jackknife UCL	7.774
95% Standard Bootstrap	7.607	95% Bootstrap-t UCL	8.038
95% Hall's Bootstrap U	7.47	95% Percentile Bootstr	7.608
95% BCA Bootstrap UC	7.743		
90% Chebyshev(Mean	9.199	95% Chebyshev(Mean	10.75
97.5% Chebyshev(Mear	12.91	99% Chebyshev(Mean	17.14

Suggested UCL to Use

95% Chebyshev (Mean,	10.75
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Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006). However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Lead

General Statistics

Total Number of Observations	16	Number of Distinct Observations	16
		Number of Missing Observations	0
Minimum	2.54	Mean	12.15
Maximum	24.6	Median	8.235
SD	7.54	Std. Error of Mean	1.885
Coefficient of Variation	0.621	Skewness	0.471

Normal GOF Test

Shapiro Wilk Test Statistic	0.842	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.887	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.264	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.213	Data Not Normal at 5% Significance Level	

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	15.45	95% Adjusted-CLT UCL	15.49
		95% Modified-t UCL (J)	15.49

Gamma GOF Test

A-D Test Statistic	0.886	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.747	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.223	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.217	Data Not Gamma Distributed at 5% Significance Level	

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.609	k star (bias corrected MLE)	2.161
Theta hat (MLE)	4.658	Theta star (bias corrected MLE)	5.622
nu hat (MLE)	83.47	nu star (bias corrected)	69.15
MLE Mean (bias corrected)	12.15	MLE Sd (bias corrected)	8.265
		Approximate Chi Square	51.01
Adjusted Level of Significance	0.0335	Adjusted Chi Square Value	49.24

Assuming Gamma Distribution

95% Approximate Gamma UCL	16.47	95% Adjusted Gamma UCL	17.06
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Lognormal GOF Test

Shapiro Wilk Test Statistic	0.902	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.887	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.213	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.213	Data Not Lognormal at 5% Significance Level	

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.932	Mean of logged Data	2.294
Maximum of Logged Data	3.203	SD of logged Data	0.687

Assuming Lognormal Distribution

95% H-UCL	18.74	90% Chebyshev (MVU)	19.03
95% Chebyshev (MVU)	22.06	97.5% Chebyshev (MVU)	26.27
99% Chebyshev (MVU)	34.55		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	15.25	95% Jackknife UCL	15.45
95% Standard Bootstrap	15.2	95% Bootstrap-t UCL	15.9
95% Hall's Bootstrap U	15.07	95% Percentile Bootstr	15.24
95% BCA Bootstrap UCL	15.39		
90% Chebyshev(Mean	17.8	95% Chebyshev(Mean	20.37
97.5% Chebyshev(Mear	23.92	99% Chebyshev(Mean	30.91

Suggested UCL to Use

95% H-UCL	18.74
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Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness. These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006). However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

ProUCL computes and outputs H-statistic based UCLs for historical reasons only. H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide. It is therefore recommended to avoid the use of H-statistic based 95% UCLs. Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.

Perchlorate

General Statistics

Total Number of Observations	16	Number of Distinct Observations	14
Number of Detects	8	Number of Non-Detects	8
Number of Distinct Detects	8	Number of Distinct Non-Detects	6
Minimum Detect	6.7500E-4	Minimum Non-Detect	0.00205
Maximum Detect	0.00451	Maximum Non-Detect	0.00242
Variance Detects	1.7751E-6	Percent Non-Detects	50%
Mean Detects	0.00169	SD Detects	0.00133
Median Detects	0.00124	CV Detects	0.786
Skewness Detects	1.587	Kurtosis Detects	2.387
Mean of Logged Detects	-6.613	SD of Logged Detects	0.707

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.809	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.818	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.222	Lilliefors GOF Test
5% Lilliefors Critical Value	0.283	Detected Data appear Normal at 5% Significance Level

Detected Data appear Approximate Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.00138	KM Standard Error of Mean	2.9635E-4
KM SD	9.9040E-4	95% KM (BCA) UCL	0.00188
95% KM (t) UCL	0.0019	95% KM (Percentile Bootstrap) UCL	0.00188
95% KM (z) UCL	0.00187	95% KM Bootstrap t UCL	0.00218
90% KM Chebyshev UCL	0.00227	95% KM Chebyshev UCL	0.00267
97.5% KM Chebyshev UCL	0.00323	99% KM Chebyshev UCL	0.00433

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.442	Anderson-Darling GOF Test
5% A-D Critical Value	0.723	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.206	Kolmogorov-Smirnov GOF Test
5% K-S Critical Value	0.297	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	2.304	k star (bias corrected ML)	1.524
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Theta hat (MLE)	7.3537E-4	Theta star (bias corrected)	0.00111
nu hat (MLE)	36.87	nu star (bias corrected)	24.38
Mean (detects)	0.00169		

Gamma ROS Statistics using Imputed Non-Detects
GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
For such situations, GROS method may yield incorrect values of UCLs and BTVs
This is especially true when the sample size is small.
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	6.7500E-4	Mean	0.00585
Maximum	0.01	Median	0.00726
SD	0.00438	CV	0.75
k hat (MLE)	1.21	k star (bias corrected ML	1.025
Theta hat (MLE)	0.00483	Theta star (bias correcte	0.00571
nu hat (MLE)	38.71	nu star (bias corrected)	32.79
Adjusted Level of Signific	0.0335		
Approximate Chi Square	20.7	Adjusted Chi Square Val	19.61
95% Gamma Approxima	0.00926	95% Gamma Adjusted U	0.00978

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.00138	SD (KM)	9.9040E-4
Variance (KM)	9.8089E-7	SE of Mean (KM)	2.9635E-4
k hat (KM)	1.947	k star (KM)	1.624
nu hat (KM)	62.3	nu star (KM)	51.95
theta hat (KM)	7.0980E-4	theta star (KM)	8.5118E-4
80% gamma percentile (	0.00212	90% gamma percentile (	0.00282
95% gamma percentile (	0.00351	99% gamma percentile (	0.00504

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square	36.4	Adjusted Chi Square Val	34.92
95% Gamma Approxir	0.00197	95% Gamma Adjusted	0.00206

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statist	0.898	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical	0.818	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.203	Lilliefors GOF Test
5% Lilliefors Critical Valu	0.283	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.00136	Mean in Log Scale	-6.754
SD in Original Scale	9.8250E-4	SD in Log Scale	0.522
95% t UCL (assumes r	0.00179	95% Percentile Bootstr	0.0018
95% BCA Bootstrap U	0.00196	95% Bootstrap t UCL	0.00242
95% H-UCL (Log ROS	0.00177		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-6.77	KM Geo Mean	0.00115
KM SD (logged)	0.57	95% Critical H Value (t	2.126
KM Standard Error of Me	0.192	95% H-UCL (KM -Log)	0.00185
KM SD (logged)	0.57	95% Critical H Value (t	2.126
KM Standard Error of Me	0.192		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.00138	Mean in Log Scale	-6.729
SD in Original Scale	9.6713E-4	SD in Log Scale	0.499
95% t UCL (Assumes r	0.0018	95% H-Stat UCL	0.00176

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics
Detected Data appear Approximate Normal Distributed at 5% Significance Level

Suggested UCL to Use
95% KM (t) UCL 0.0019

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test
When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Uranium-235/236

General Statistics

Total Number of Observations	16	Number of Distinct Observations	16
Number of Detects	9	Number of Non-Detects	7
Number of Distinct Detects	9	Number of Distinct Non-Detects	7
Minimum Detect	0.0612	Minimum Non-Detect	0.0273
Maximum Detect	0.119	Maximum Non-Detect	0.0469
Variance Detects	2.7361E-4	Percent Non-Detects	43.75%
Mean Detects	0.0804	SD Detects	0.0165
Median Detects	0.0779	CV Detects	0.206
Skewness Detects	1.704	Kurtosis Detects	3.963
Mean of Logged Detects	-2.537	SD of Logged Detects	0.188

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.849	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.829	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.249	Lilliefors GOF Test
5% Lilliefors Critical Value	0.274	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.0572	KM Standard Error of Mean	0.00765
KM SD	0.0288	95% KM (BCA) UCL	0.0704
95% KM (t) UCL	0.0706	95% KM (Percentile Bootstrap) UCL	0.0693
95% KM (z) UCL	0.0698	95% KM Bootstrap t UCL	0.0695
90% KM Chebyshev UCL	0.0801	95% KM Chebyshev UCL	0.0905
97.5% KM Chebyshev UCL	0.105	99% KM Chebyshev UCL	0.133

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.44	Anderson-Darling GOF Test
5% A-D Critical Value	0.721	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.222	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.279	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	30.31	k star (bias corrected MLE)	20.28
Theta hat (MLE)	0.00265	Theta star (bias corrected MLE)	0.00397
nu hat (MLE)	545.5	nu star (bias corrected)	365
Mean (detects)	0.0804		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
For such situations, GROS method may yield incorrect values of UCLs and BTVs
This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.0418	Mean	0.0635
Maximum	0.119	Median	0.0649
SD	0.0232	CV	0.365
k hat (MLE)	8.528	k star (bias corrected ML	6.971
Theta hat (MLE)	0.00745	Theta star (bias correcte	0.00911
nu hat (MLE)	272.9	nu star (bias corrected)	223.1
Adjusted Level of Signific	0.0335		
Approximate Chi Square	189.5	Adjusted Chi Square Val	186
95% Gamma Approxima	0.0748	95% Gamma Adjusted U	0.0762

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0572	SD (KM)	0.0288
Variance (KM)	8.3127E-4	SE of Mean (KM)	0.00765
k hat (KM)	3.933	k star (KM)	3.238
nu hat (KM)	125.9	nu star (KM)	103.6
theta hat (KM)	0.0145	theta star (KM)	0.0177
80% gamma percentile (	0.0808	90% gamma percentile (	0.0998
95% gamma percentile (	0.117	99% gamma percentile (	0.156

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square	81.11	Adjusted Chi Square Val	78.85
95% Gamma Approxirr	0.073	95% Gamma Adjusted	0.0751

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statist	0.918	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical	0.829	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.212	Lilliefors GOF Test	
5% Lilliefors Critical Valu	0.274	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0665	Mean in Log Scale	-2.75
SD in Original Scale	0.0203	SD in Log Scale	0.285
95% t UCL (assumes r	0.0754	95% Percentile Bootstr	0.0747
95% BCA Bootstrap U	0.0758	95% Bootstrap t UCL	0.0783
95% H-UCL (Log ROS	0.0763		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-3.002	KM Geo Mean	0.0497
KM SD (logged)	0.544	95% Critical H Value (†	2.097
KM Standard Error of Me	0.144	95% H-UCL (KM -Log)	0.0773
KM SD (logged)	0.544	95% Critical H Value (†	2.097
KM Standard Error of Me	0.144		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.0533	Mean in Log Scale	-3.183
SD in Original Scale	0.0341	SD in Log Scale	0.78
95% t UCL (Assumes r	0.0682	95% H-Stat UCL	0.0908

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	0.0706
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Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.