

UCL Statistics for Data Sets with Non-Detects

User Selected
Date/Time of C ProUCL 5.16/19/17 5:17:58 PM
From File ProUCLinput_53-008_0-10.xls
Full Precision OFF
Confidence Cc 95%
Number of Boc 2000

Aroclor-1260

General Statistics

Total Number of Observations	34	Number of Distinct Observations	24
Number of Detects	5	Number of Non-Detects	29
Number of Distinct Detects	5	Number of Distinct Non-Detects	19
Minimum Detect	0.0027	Minimum Non-Detect	0.00338
Maximum Detect	0.0917	Maximum Non-Detect	0.035
Variance Detects	0.00148	Percent Non-Detects	85.29%
Mean Detects	0.0236	SD Detects	0.0385
Median Detects	0.0034	CV Detects	1.63
Skewness Detects	2.107	Kurtosis Detects	4.478
Mean of Logged Detects	-4.754	SD of Logged Detects	1.516

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.658	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.762	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.367	Lilliefors GOF Test
5% Lilliefors Critical Value	0.343	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

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

KM Mean	0.0061	KM Standard Error of Mean	0.0029
KM SD	0.0151	95% KM (BCA) UCL	0.0113
95% KM (t) UCL	0.011	95% KM (Percentile Bootstrap) UCL	0.0112
95% KM (z) UCL	0.0109	95% KM Bootstrap t UCL	0.061
90% KM Chebyshev UCL	0.0148	95% KM Chebyshev UCL	0.0187
97.5% KM Chebyshev UCL	0.0242	99% KM Chebyshev UCL	0.035

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.67	Anderson-Darling GOF Test
5% A-D Critical Value	0.705	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.355	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.369	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)	0.611	k star (bias corrected ML)	0.378
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Theta hat (MLE)	0.0387	Theta star (bias corrected)	0.0626
nu hat (MLE)	6.106	nu star (bias corrected)	3.776
Mean (detects)	0.0236		

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	0.0027	Mean	0.012
Maximum	0.0917	Median	0.01
SD	0.0143	CV	1.189
k hat (MLE)	2.597	k star (bias corrected ML	2.388
Theta hat (MLE)	0.00462	Theta star (bias corrected	0.00503
nu hat (MLE)	176.6	nu star (bias corrected)	162.4
Adjusted Level of Signific	0.0422		
Approximate Chi Square	133.9	Adjusted Chi Square Val	132.6
95% Gamma Approxima	0.0146	95% Gamma Adjusted U	0.0147

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0061	SD (KM)	0.0151
Variance (KM)	2.2792E-4	SE of Mean (KM)	0.0029
k hat (KM)	0.163	k star (KM)	0.168
nu hat (KM)	11.1	nu star (KM)	11.45
theta hat (KM)	0.0374	theta star (KM)	0.0362
80% gamma percentile (	0.00724	90% gamma percentile (	0.0183
95% gamma percentile (	0.0328	99% gamma percentile (	0.0738

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square	4.869	Adjusted Chi Square Val	4.657
95% Gamma Approxima	0.0143	95% Gamma Adjusted K	0.015

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statist	0.816	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical	0.762	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.33	Lilliefors GOF Test
5% Lilliefors Critical Valu	0.343	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	0.00615	Mean in Log Scale	-5.68
SD in Original Scale	0.0153	SD in Log Scale	0.748
95% t UCL (assumes r	0.0106	95% Percentile Bootstr	0.0111
95% BCA Bootstrap UCL	0.0142	95% Bootstrap t UCL	0.0489
95% H-UCL (Log ROS	0.00599		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-5.64	KM Geo Mean	0.00355
KM SD (logged)	0.646	95% Critical H Value (t)	2.066
KM Standard Error of Me	0.139	95% H-UCL (KM -Log)	0.00552
KM SD (logged)	0.646	95% Critical H Value (t)	2.066
KM Standard Error of Me	0.139		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.00544	Mean in Log Scale	-6.044
SD in Original Scale	0.0157	SD in Log Scale	0.854
95% t UCL (Assumes r	0.00999	95% H-Stat UCL	0.0048

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

Gamma Adjusted KM-UC 0.015

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.

Arsenic**General Statistics**

Total Number of Observa	34	Number of Distinct Obse	33
Number of Detects	28	Number of Non-Detects	6
Number of Distinct Detect	28	Number of Distinct Non-I	6
Minimum Detect	0.394	Minimum Non-Detect	0.239
Maximum Detect	5.64	Maximum Non-Detect	1.16
Variance Detects	0.934	Percent Non-Detects	17.65%
Mean Detects	1.479	SD Detects	0.967
Median Detects	1.33	CV Detects	0.654
Skewness Detects	3.075	Kurtosis Detects	12.81
Mean of Logged Detects	0.248	SD of Logged Detects	0.527

Normal GOF Test on Detects Only

Shapiro Wilk Test Statist	0.715	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical	0.924	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.191	Lilliefors GOF Test
5% Lilliefors Critical Valu	0.164	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

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

KM Mean	1.306	KM Standard Error of Me	0.166
KM SD	0.945	95% KM (BCA) UCL	1.609
95% KM (t) UCL	1.587	95% KM (Percentile Bc	1.603
95% KM (z) UCL	1.579	95% KM Bootstrap t U	1.709
90% KM Chebyshev UCL	1.804	95% KM Chebyshev UCL	2.029
97.5% KM Chebyshev U	2.342	99% KM Chebyshev UCL	2.957

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.481	Anderson-Darling GOF Test
5% A-D Critical Value	0.751	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.114	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.166	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)	3.656	k star (bias corrected ML	3.288
Theta hat (MLE)	0.404	Theta star (bias correcte	0.45
nu hat (MLE)	204.7	nu star (bias corrected)	184.1
Mean (detects)	1.479		

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	0.01	Mean	1.275
Maximum	5.64	Median	1.155
SD	0.986	CV	0.773
k hat (MLE)	1.614	k star (bias corrected ML	1.491
Theta hat (MLE)	0.79	Theta star (bias correcte	0.855
nu hat (MLE)	109.8	nu star (bias corrected)	101.4
Adjusted Level of Signific	0.0422		
Approximate Chi Square	79.17	Adjusted Chi Square Val	78.2
95% Gamma Approxima	1.633	95% Gamma Adjusted U	1.653

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	1.306	SD (KM)	0.945
Variance (KM)	0.892	SE of Mean (KM)	0.166
k hat (KM)	1.912	k star (KM)	1.763
nu hat (KM)	130	nu star (KM)	119.9
theta hat (KM)	0.683	theta star (KM)	0.741
80% gamma percentile (	1.985	90% gamma percentile (	2.618
95% gamma percentile (	3.226	99% gamma percentile (	4.586

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square	95.61	Adjusted Chi Square Val	94.54
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95% Gamma Approxima	1.638	95% Gamma Adjusted K	1.657
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Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statist	0.971	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical	0.924	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0986	Lilliefors GOF Test
5% Lilliefors Critical Valu	0.164	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	1.315	Mean in Log Scale	0.0942
SD in Original Scale	0.946	SD in Log Scale	0.595
95% t UCL (assumes r	1.59	95% Percentile Bootstr	1.572
95% BCA Bootstrap UCL	1.682	95% Bootstrap t UCL	1.749
95% H-UCL (Log ROS	1.617		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	0.0587	KM Geo Mean	1.06
KM SD (logged)	0.661	95% Critical H Value (t	2.08
KM Standard Error of Me	0.12	95% H-UCL (KM -Log)	1.676
KM SD (logged)	0.661	95% Critical H Value (t	2.08
KM Standard Error of Me	0.12		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	1.29	Mean in Log Scale	0.0256
SD in Original Scale	0.969	SD in Log Scale	0.723
95% t UCL (Assumes r	1.572	95% H-Stat UCL	1.744

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM Adjusted Gamr	1.657	95% GROS Adjusted Ga	1.653
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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.

Barium

General Statistics

Total Number of Observa	34	Number of Distinct Obse	34
		Number of Missing Obse	0

Minimum	10.1	Mean	58.67
Maximum	184	Median	52.55
SD	37.66	Std. Error of Mean	6.459
Coefficient of Variation	0.642	Skewness	1.588

Normal GOF Test

Shapiro Wilk Test Statist	0.869	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical	0.933	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.171	Lilliefors GOF Test
5% Lilliefors Critical Valu	0.15	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	69.6	95% Adjusted-CLT UC 71.17
		95% Modified-t UCL (J 69.89

Gamma GOF Test

A-D Test Statistic	0.293	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.754	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.0972	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.152	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.838	k star (bias corrected ML	2.607
Theta hat (MLE)	20.68	Theta star (bias correcte	22.51
nu hat (MLE)	193	nu star (bias corrected)	177.3
MLE Mean (bias correcte	58.67	MLE Sd (bias corrected)	36.34
		Approximate Chi Square	147.5
Adjusted Level of Signific	0.0422	Adjusted Chi Square Val	146.1

Assuming Gamma Distribution

95% Approximate Garr	70.52	95% Adjusted Gamma	71.17
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Lognormal GOF Test

Shapiro Wilk Test Statist	0.978	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical	0.933	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0973	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Valu	0.15	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	2.313	Mean of logged Data	3.886
Maximum of Logged Dat	5.215	SD of logged Data	0.638

Assuming Lognormal Distribution

95% H-UCL	75.04	90% Chebyshev (MVU	80.14
95% Chebyshev (MVU	89.6	97.5% Chebyshev (MVL	102.7
99% Chebyshev (MVU	128.5		

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

Nonparametric Distribution Free UCLs			
95% CLT UCL	69.29	95% Jackknife UCL	69.6
95% Standard Bootstrap	69.21	95% Bootstrap-t UCL	72.15
95% Hall's Bootstrap U	73.48	95% Percentile Bootstrap	69.61
95% BCA Bootstrap U	71.09		
90% Chebyshev(Mean	78.05	95% Chebyshev(Mean	86.82
97.5% Chebyshev(Mear	99.01	99% Chebyshev(Mean	122.9

Suggested UCL to Use
95% Adjusted Gamma U 71.17

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.

Cesium-137

General Statistics			
Total Number of Observations	34	Number of Distinct Observations	34
Number of Detects	13	Number of Non-Detects	21
Number of Distinct Detects	13	Number of Distinct Non-Detects	21
Minimum Detect	0.0924	Minimum Non-Detect	-0.0894
Maximum Detect	0.607	Maximum Non-Detect	0.0505
Variance Detects	0.0279	Percent Non-Detects	61.76%
Mean Detects	0.359	SD Detects	0.167
Median Detects	0.344	CV Detects	0.465
Skewness Detects	-0.06	Kurtosis Detects	-0.991

Normal GOF Test on Detects Only
Shapiro Wilk Test Statist 0.948 **Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical 0.866 Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic 0.153 **Lilliefors GOF Test**
5% Lilliefors Critical Value 0.234 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	0.0819	KM Standard Error of Mean	0.0427
KM SD	0.239	95% KM (BCA) UCL	0.18
95% KM (t) UCL	0.154	95% KM (Percentile Bootstrap)	0.165

95% KM (z) UCL	0.152	95% KM Bootstrap t UCL	0.156
90% KM Chebyshev UCL	0.21	95% KM Chebyshev UCL	0.268
97.5% KM Chebyshev U	0.349	99% KM Chebyshev UCL	0.507

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.434	Anderson-Darling GOF Test	
5% A-D Critical Value	0.737	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.21	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.238	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)	3.993	k star (bias corrected ML)	3.123
Theta hat (MLE)	0.0898	Theta star (bias corrected)	0.115
nu hat (MLE)	103.8	nu star (bias corrected)	81.2
Mean (detects)	0.359		

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0819	SD (KM)	0.239
Variance (KM)	0.0573	SE of Mean (KM)	0.0427
k hat (KM)	0.117	k star (KM)	0.127
nu hat (KM)	7.974	nu star (KM)	8.604
theta hat (KM)	0.699	theta star (KM)	0.648
80% gamma percentile (	0.0761	90% gamma percentile (	0.235
95% gamma percentile (	0.464	99% gamma percentile (	1.154

Gamma Kaplan-Meier (KM) Statistics

		Adjusted Level of Significance	0.0422
Approximate Chi Square	3.089	Adjusted Chi Square Value	2.928
95% Gamma Approximate	0.228	95% Gamma Adjusted	0.241

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	N/A	KM Geo Mean	N/A
KM SD (logged)	N/A	95% Critical H Value (t)	N/A
KM Standard Error of Mean	N/A	95% H-UCL (KM -Log)	N/A
KM SD (logged)	N/A	95% Critical H Value (t)	N/A
KM Standard Error of Mean	N/A		

DL/2 Statistics

Mean in Original Scale	0.135	SD in Original Scale	0.206
95% t UCL (Assumes r = 10)	0.194		

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 0.154

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 Observations	34	Number of Distinct Observations	34
		Number of Missing Observations	0
Minimum	0.809	Mean	11.49
Maximum	150	Median	5.055
SD	25.44	Std. Error of Mean	4.363
Coefficient of Variation	2.213	Skewness	5.202

Normal GOF Test

Shapiro Wilk Test Statistic	0.354	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.933	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.365	Lilliefors GOF Test
5% Lilliefors Critical Value	0.15	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	18.88	95% Adjusted-CLT UCL	22.83
		95% Modified-t UCL (J)	19.53

Gamma GOF Test

A-D Test Statistic	3.279	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.781	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.266	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.156	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.891	k star (bias corrected MLE)	0.832
Theta hat (MLE)	12.9	Theta star (bias corrected MLE)	13.81
nu hat (MLE)	60.61	nu star (bias corrected)	56.6
MLE Mean (bias corrected)	11.49	MLE Sd (bias corrected)	12.6
		Approximate Chi Square	40.3
Adjusted Level of Significance	0.0422	Adjusted Chi Square Value	39.62

Assuming Gamma Distribution

95% Approximate Gamma UCL	16.14	95% Adjusted Gamma UCL	16.42
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Lognormal GOF Test		
Shapiro Wilk Test Statist	0.905	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical	0.933	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.157	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Valu	0.15	Data Not Lognormal at 5% Significance Level
Data Not Lognormal at 5% Significance Level		

Lognormal Statistics			
Minimum of Logged Data	-0.212	Mean of logged Data	1.785
Maximum of Logged Dat	5.011	SD of logged Data	0.932

Assuming Lognormal Distribution			
95% H-UCL	13.51	90% Chebyshev (MVU	13.98
95% Chebyshev (MVU	16.22	97.5% Chebyshev (MVL	19.33
99% Chebyshev (MVU	25.43		

Nonparametric Distribution Free UCL Statistics
Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs			
95% CLT UCL	18.67	95% Jackknife UCL	18.88
95% Standard Bootstra	18.52	95% Bootstrap-t UCL	40.25
95% Hall's Bootstrap U	41.13	95% Percentile Bootstr	20.07
95% BCA Bootstrap U	24.24		
90% Chebyshev(Mean	24.58	95% Chebyshev(Mean	30.51
97.5% Chebyshev(Mear	38.74	99% Chebyshev(Mean	54.9

Suggested UCL to Use
95% Chebyshev (Mean, 30.51

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 Observa	34	Number of Distinct Obse	34
Number of Detects	32	Number of Non-Detects	2
Number of Distinct Detect	32	Number of Distinct Non-I	2
Minimum Detect	0.907	Minimum Non-Detect	0.93
Maximum Detect	6.52	Maximum Non-Detect	1.68
Variance Detects	2.942	Percent Non-Detects	5.882%
Mean Detects	3.962	SD Detects	1.715
Median Detects	4.16	CV Detects	0.433

Skewness Detects	-0.233	Kurtosis Detects	-1.076
Mean of Logged Detects	1.252	SD of Logged Detects	0.559

Normal GOF Test on Detects Only

Shapiro Wilk Test Statist	0.942	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical	0.93	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.0999	Lilliefors GOF Test
5% Lilliefors Critical Valu	0.154	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	3.787	KM Standard Error of Me	0.31
KM SD	1.782	95% KM (BCA) UCL	4.285
95% KM (t) UCL	4.312	95% KM (Percentile Boo	4.289
95% KM (z) UCL	4.297	95% KM Bootstrap t U	4.285
90% KM Chebyshev UCL	4.718	95% KM Chebyshev UCL	5.14
97.5% KM Chebyshev U	5.726	99% KM Chebyshev UCL	6.876

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.849	Anderson-Darling GOF Test
5% A-D Critical Value	0.75	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.134	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.156	Detected data appear Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	4.162	k star (bias corrected ML	3.792
Theta hat (MLE)	0.952	Theta star (bias correcte	1.045
nu hat (MLE)	266.4	nu star (bias corrected)	242.7
Mean (detects)	3.962		

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	0.907	Mean	3.817
Maximum	6.52	Median	3.965
SD	1.765	CV	0.462
k hat (MLE)	3.775	k star (bias corrected ML	3.462
Theta hat (MLE)	1.011	Theta star (bias correcte	1.103
nu hat (MLE)	256.7	nu star (bias corrected)	235.4
Adjusted Level of Signific	0.0422		
Approximate Chi Square	200.9	Adjusted Chi Square Val	199.3
95% Gamma Approxima	4.472	95% Gamma Adjusted U	4.508

Estimates of Gamma Parameters using KM Estimates			
Mean (KM)	3.787	SD (KM)	1.782
Variance (KM)	3.175	SE of Mean (KM)	0.31
k hat (KM)	4.517	k star (KM)	4.138
nu hat (KM)	307.1	nu star (KM)	281.4
theta hat (KM)	0.838	theta star (KM)	0.915
80% gamma percentile (	5.2	90% gamma percentile (	6.281
95% gamma percentile (	7.275	99% gamma percentile (	9.393

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square	243.5	Adjusted Chi Square Val	241.8
95% Gamma Approxirr	4.375	95% Gamma Adjusted	4.407

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statist	0.877	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical	0.93	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.15	Lilliefors GOF Test
5% Lilliefors Critical Valu	0.154	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Approximate Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	3.805	Mean in Log Scale	1.193
SD in Original Scale	1.781	SD in Log Scale	0.593
95% t UCL (assumes r	4.322	95% Percentile Bootstr	4.311
95% BCA Bootstrap U	4.289	95% Bootstrap t UCL	4.295
95% H-UCL (Log ROS	4.839		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	1.177	KM Geo Mean	3.244
KM SD (logged)	0.613	95% Critical H Value (t	2.035
KM Standard Error of Me	0.107	95% H-UCL (KM -Log)	4.862
KM SD (logged)	0.613	95% Critical H Value (t	2.035
KM Standard Error of Me	0.107		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	3.767	Mean in Log Scale	1.15
SD in Original Scale	1.841	SD in Log Scale	0.684
95% t UCL (Assumes r	4.302	95% H-Stat UCL	5.126

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	4.312
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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.

Cyanide (Total)

General Statistics

Total Number of Observations	34	Number of Distinct Observations	29
Number of Detects	7	Number of Non-Detects	27
Number of Distinct Detects	7	Number of Distinct Non-Detects	22
Minimum Detect	0.081	Minimum Non-Detect	0.221
Maximum Detect	14.9	Maximum Non-Detect	0.269
Variance Detects	28.87	Percent Non-Detects	79.41%
Mean Detects	3.434	SD Detects	5.373
Median Detects	0.485	CV Detects	1.565
Skewness Detects	2.072	Kurtosis Detects	4.518
Mean of Logged Detects	-0.157	SD of Logged Detects	1.998

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.695	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.803	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.308	Lilliefors GOF Test
5% Lilliefors Critical Value	0.304	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

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

KM Mean	0.788	KM Standard Error of Mean	0.487
KM SD	2.628	95% KM (BCA) UCL	1.759
95% KM (t) UCL	1.613	95% KM (Percentile Bootstrap) UCL	1.66
95% KM (z) UCL	1.589	95% KM Bootstrap t UCL	2.918
90% KM Chebyshev UCL	2.25	95% KM Chebyshev UCL	2.911
97.5% KM Chebyshev UCL	3.83	99% KM Chebyshev UCL	5.635

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.447	Anderson-Darling GOF Test
5% A-D Critical Value	0.758	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.258	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.329	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)	0.462	k star (bias corrected MLE)	0.359
Theta hat (MLE)	7.426	Theta star (bias corrected MLE)	9.552
nu hat (MLE)	6.473	nu star (bias corrected)	5.032
Mean (detects)	3.434		

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	0.01	Mean	0.715
Maximum	14.9	Median	0.01
SD	2.687	CV	3.76
k hat (MLE)	0.217	k star (bias corrected ML	0.217
Theta hat (MLE)	3.299	Theta star (bias correcte	3.292
nu hat (MLE)	14.73	nu star (bias corrected)	14.77
Adjusted Level of Signific	0.0422		
Approximate Chi Square	7.101	Adjusted Chi Square Val	6.838
95% Gamma Approxima	1.487	95% Gamma Adjusted U	1.544

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.788	SD (KM)	2.628
Variance (KM)	6.908	SE of Mean (KM)	0.487
k hat (KM)	0.09	k star (KM)	0.102
nu hat (KM)	6.117	nu star (KM)	6.91
theta hat (KM)	8.764	theta star (KM)	7.757
80% gamma percentile (	0.56	90% gamma percentile (	2.112
95% gamma percentile (	4.571	99% gamma percentile (	12.42

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square	2.122	Adjusted Chi Square Val	1.993
95% Gamma Approxima	2.568	95% Gamma Adjusted K	2.734
95% Gamma Adjusted KM-UCL (use when k<=1 and 15 < n < 50)			

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statist	0.918	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical	0.803	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.211	Lilliefors GOF Test
5% Lilliefors Critical Valu	0.304	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	0.778	Mean in Log Scale	-2.036
SD in Original Scale	2.671	SD in Log Scale	1.357
95% t UCL (assumes r	1.553	95% Percentile Bootstr	1.645
95% BCA Bootstrap UCL	2.216	95% Bootstrap t UCL	2.997
95% H-UCL (Log ROS	0.653		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-1.859	KM Geo Mean	0.156
KM SD (logged)	1.221	95% Critical H Value (t	2.73

KM Standard Error of Mean	0.263	95% H-UCL (KM -Log)	0.587
KM SD (logged)	1.221	95% Critical H Value (t)	2.73
KM Standard Error of Mean	0.263		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.806	Mean in Log Scale	-1.683
SD in Original Scale	2.663	SD in Log Scale	1.162
95% t UCL (Assumes r	1.579	95% H-Stat UCL	0.624

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

Gamma Adjusted KM-UC	2.734
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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	34	Number of Distinct Observations	33
		Number of Missing Observations	0
Minimum	3.29	Mean	8.952
Maximum	26.2	Median	7.73
SD	4.331	Std. Error of Mean	0.743
Coefficient of Variation	0.484	Skewness	1.92

Normal GOF Test

Shapiro Wilk Test Statistic	0.847	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical	0.933	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.168	Lilliefors GOF Test
5% Lilliefors Critical Value	0.15	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	10.21	95% Adjusted-CLT UCL	10.44
		95% Modified-t UCL (J)	10.25

Gamma GOF Test

A-D Test Statistic	0.484	Anderson-Darling Gamma GOF Test
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5% A-D Critical Value	0.749	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.112	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.151	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	5.245	k star (bias corrected ML	4.802
Theta hat (MLE)	1.707	Theta star (bias correcte	1.864
nu hat (MLE)	356.7	nu star (bias corrected)	326.5
MLE Mean (bias correcte	8.952	MLE Sd (bias corrected)	4.085
		Approximate Chi Square	285.7
Adjusted Level of Signific	0.0422	Adjusted Chi Square Val	283.8

Assuming Gamma Distribution

95% Approximate Garr	10.23	95% Adjusted Gamma	10.3
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Lognormal GOF Test

Shapiro Wilk Test Statist	0.963	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical	0.933	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0994	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Valu	0.15	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.191	Mean of logged Data	2.094
Maximum of Logged Dat	3.266	SD of logged Data	0.449

Assuming Lognormal Distribution

95% H-UCL	10.41	90% Chebyshev (MVU	11.08
95% Chebyshev (MVU	12.05	97.5% Chebyshev (MVL	13.4
99% Chebyshev (MVU	16.04		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	10.17	95% Jackknife UCL	10.21
95% Standard Bootstra	10.14	95% Bootstrap-t UCL	10.54
95% Hall's Bootstrap U	11	95% Percentile Bootstr	10.26
95% BCA Bootstrap U	10.46		
90% Chebyshev(Mean	11.18	95% Chebyshev(Mean	12.19
97.5% Chebyshev(Mear	13.59	99% Chebyshev(Mean	16.34

Suggested UCL to Use

95% Adjusted Gamma U	10.3
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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.

Methylene Chloride

General Statistics

Total Number of Observations	34	Number of Distinct Observations	28
Number of Detects	6	Number of Non-Detects	28
Number of Distinct Detects	6	Number of Distinct Non-Detects	22
Minimum Detect	0.00224	Minimum Non-Detect	0.00507
Maximum Detect	0.00353	Maximum Non-Detect	0.0056
Variance Detects	2.5583E-7	Percent Non-Detects	82.35%
Mean Detects	0.00283	SD Detects	5.0580E-4
Median Detects	0.00269	CV Detects	0.179
Skewness Detects	0.536	Kurtosis Detects	-1.4
Mean of Logged Detects	-5.882	SD of Logged Detects	0.176

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.921	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.788	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.233	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	0.00283	KM Standard Error of Mean	2.0649E-4
KM SD	4.6173E-4	95% KM (BCA) UCL	0.00317
95% KM (t) UCL	0.00317	95% KM (Percentile Bootstrap) UCL	0.00319
95% KM (z) UCL	0.00316	95% KM Bootstrap t UCL	0.00354
90% KM Chebyshev UCL	0.00344	95% KM Chebyshev UCL	0.00373
97.5% KM Chebyshev UCL	0.00411	99% KM Chebyshev UCL	0.00488

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.315	Anderson-Darling GOF Test
5% A-D Critical Value	0.697	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.22	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)	38.43	k star (bias corrected ML)	19.32
Theta hat (MLE)	7.3515E-5	Theta star (bias corrected ML)	1.4618E-4
nu hat (MLE)	461.1	nu star (bias corrected)	231.9
Mean (detects)	0.00283		

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	0.00224	Mean	0.00873
Maximum	0.01	Median	0.01
SD	0.00278	CV	0.319
k hat (MLE)	5.717	k star (bias corrected ML	5.232
Theta hat (MLE)	0.00153	Theta star (bias correcte	0.00167
nu hat (MLE)	388.8	nu star (bias corrected)	355.8
Adjusted Level of Signific	0.0422		
Approximate Chi Square	313.1	Adjusted Chi Square Val	311.1
95% Gamma Approxima	0.00993	95% Gamma Adjusted U	0.00999

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.00283	SD (KM)	4.6173E-4
Variance (KM)	2.1319E-7	SE of Mean (KM)	2.0649E-4
k hat (KM)	37.43	k star (KM)	34.15
nu hat (KM)	2546	nu star (KM)	2322
theta hat (KM)	7.5466E-5	theta star (KM)	8.2722E-5
80% gamma percentile (	0.00322	90% gamma percentile (	0.00346
95% gamma percentile (	0.00366	99% gamma percentile (	0.00407

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square	2211	Adjusted Chi Square Val	2206
95% Gamma Approxir	0.00297	95% Gamma Adjusted	0.00297

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statist	0.938	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical	0.788	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.206	Lilliefors GOF Test
5% Lilliefors Critical Valu	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	0.0028	Mean in Log Scale	-5.882
SD in Original Scale	2.5910E-4	SD in Log Scale	0.0911
95% t UCL (assumes r	0.00287	95% Percentile Bootstr	0.00287
95% BCA Bootstrap U	0.00288	95% Bootstrap t UCL	0.00288
95% H-UCL (Log ROS	N/A		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-5.882	KM Geo Mean	0.00279
KM SD (logged)	0.161	95% Critical H Value (t	1.729
KM Standard Error of Me	0.0719	95% H-UCL (KM -Log)	0.00296
KM SD (logged)	0.161	95% Critical H Value (t	1.729

KM Standard Error of Me 0.0719

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.00267	Mean in Log Scale	-5.928
SD in Original Scale	2.1980E-4	SD in Log Scale	0.076
95% t UCL (Assumes r	0.00274	95% H-Stat UCL	N/A

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 0.00317

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.

Nickel

General Statistics

Total Number of Observations	34	Number of Distinct Observations	34
		Number of Missing Observations	0
Minimum	0.751	Mean	5.425
Maximum	18	Median	4.07
SD	3.672	Std. Error of Mean	0.63
Coefficient of Variation	0.677	Skewness	1.768

Normal GOF Test

Shapiro Wilk Test Statistic	0.821	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.933	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.224	Lilliefors GOF Test
5% Lilliefors Critical Value	0.15	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	6.491	95% Adjusted-CLT UCL	6.665
		95% Modified-t UCL (J)	6.523

Gamma GOF Test

A-D Test Statistic	0.796	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.755	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.147	Kolmogorov-Smirnov Gamma GOF Test

5% K-S Critical Value 0.152 Detected data appear Gamma Distributed at 5% Significance Level
Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.811	k star (bias corrected ML	2.583
Theta hat (MLE)	1.93	Theta star (bias correcte	2.101
nu hat (MLE)	191.1	nu star (bias corrected)	175.6
MLE Mean (bias correcte	5.425	MLE Sd (bias corrected)	3.376
		Approximate Chi Square	146
Adjusted Level of Signific	0.0422	Adjusted Chi Square Val	144.6

Assuming Gamma Distribution

95% Approximate Garr	6.527	95% Adjusted Gamma	6.587
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Lognormal GOF Test

Shapiro Wilk Test Statist	0.967	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical	0.933	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.107	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Valu	0.15	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-0.286	Mean of logged Data	1.503
Maximum of Logged Dat	2.89	SD of logged Data	0.627

Assuming Lognormal Distribution

95% H-UCL	6.837	90% Chebyshev (MVU	7.304
95% Chebyshev (MVU	8.153	97.5% Chebyshev (MVL	9.33
99% Chebyshev (MVU	11.64		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	6.461	95% Jackknife UCL	6.491
95% Standard Bootstra	6.449	95% Bootstrap-t UCL	6.811
95% Hall's Bootstrap U	6.818	95% Percentile Bootstr	6.491
95% BCA Bootstrap U	6.746		
90% Chebyshev(Mean	7.314	95% Chebyshev(Mean	8.17
97.5% Chebyshev(Mear	9.357	99% Chebyshev(Mean	11.69

Suggested UCL to Use

95% Adjusted Gamma U	6.587
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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.

Plutonium-239/240

General Statistics

Total Number of Observations	34	Number of Distinct Observations	31
Number of Detects	9	Number of Non-Detects	25
Number of Distinct Detects	9	Number of Distinct Non-Detects	22
Minimum Detect	0.0206	Minimum Non-Detect	-0.0342
Maximum Detect	0.388	Maximum Non-Detect	0.0318
Variance Detects	0.0137	Percent Non-Detects	73.53%
Mean Detects	0.0777	SD Detects	0.117
Median Detects	0.0392	CV Detects	1.507
Skewness Detects	2.924	Kurtosis Detects	8.655

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.495	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.829	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.422	Lilliefors GOF Test
5% Lilliefors Critical Value	0.274	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

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

KM Mean	-0.00444	KM Standard Error of Mean	0.0137
KM SD	0.0753	95% KM (BCA) UCL	0.0359
95% KM (t) UCL	0.0187	95% KM (Percentile Bootstrap) UCL	0.0287
95% KM (z) UCL	0.0181	95% KM Bootstrap t UCL	0.0381
90% KM Chebyshev UCL	0.0367	95% KM Chebyshev UCL	0.0553
97.5% KM Chebyshev UCL	0.0811	99% KM Chebyshev UCL	0.132

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.454	Anderson-Darling GOF Test
5% A-D Critical Value	0.74	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.351	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.286	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	1.163	k star (bias corrected ML)	0.85
Theta hat (MLE)	0.0668	Theta star (bias corrected ML)	0.0915
nu hat (MLE)	20.94	nu star (bias corrected)	15.29
Mean (detects)	0.0777		

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	-0.00444	SD (KM)	0.0753
Variance (KM)	0.00567	SE of Mean (KM)	0.0137
k hat (KM)	0.00349	k star (KM)	0.0228
nu hat (KM)	0.237	nu star (KM)	1.549
theta hat (KM)	-1.275	theta star (KM)	-0.195
80% gamma percentile (	-6.230E-6	90% gamma percentile (	-0.0011
95% gamma percentile (	-0.0125	99% gamma percentile (	-0.122

Gamma Kaplan-Meier (KM) Statistics

		Adjusted Level of Signific	0.0422
Approximate Chi Square	0.117	Adjusted Chi Square Val	0.115
95% Gamma Approxirr	-0.0588	95% Gamma Adjusted	-0.06
95% Gamma Adjusted KM-UCL (use when k<=1 and 15 < n < 50)			

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	N/A	KM Geo Mean	N/A
KM SD (logged)	N/A	95% Critical H Value (t	N/A
KM Standard Error of Me	N/A	95% H-UCL (KM -Log)	N/A
KM SD (logged)	N/A	95% Critical H Value (t	N/A
KM Standard Error of Me	N/A		

DL/2 Statistics

Mean in Original Scale	0.0203	SD in Original Scale	0.0676
95% t UCL (Assumes r	0.0399		

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

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

99% KM (Chebyshev) UCL	0.132
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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.

Tritium

General Statistics

Total Number of Observa	34	Number of Distinct Obse	34
Number of Detects	20	Number of Non-Detects	14
Number of Distinct Detec	20	Number of Distinct Non-I	14
Minimum Detect	0.00475	Minimum Non-Detect	-0.00251
Maximum Detect	0.715	Maximum Non-Detect	0.0156
Variance Detects	0.0382	Percent Non-Detects	41.18%
Mean Detects	0.102	SD Detects	0.196

Median Detects	0.0191	CV Detects	1.921
Skewness Detects	2.433	Kurtosis Detects	5.259

Normal GOF Test on Detects Only

Shapiro Wilk Test Statist	0.554	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical	0.905	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.39	Lilliefors GOF Test	
5% Lilliefors Critical Valu	0.192	Detected Data Not Normal at 5% Significance Level	

Detected Data Not Normal at 5% Significance Level

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

KM Mean	0.0598	KM Standard Error of Me	0.0272
KM SD	0.155	95% KM (BCA) UCL	0.108
95% KM (t) UCL	0.106	95% KM (Percentile Bc	0.104
95% KM (z) UCL	0.105	95% KM Bootstrap t U	0.168
90% KM Chebyshev UCL	0.141	95% KM Chebyshev UCL	0.178
97.5% KM Chebyshev U	0.23	99% KM Chebyshev UCL	0.33

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.949	Anderson-Darling GOF Test	
5% A-D Critical Value	0.804	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.266	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.205	Detected Data Not Gamma Distributed at 5% Significance Level	

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.494	k star (bias corrected ML	0.453
Theta hat (MLE)	0.206	Theta star (bias correcte	0.225
nu hat (MLE)	19.74	nu star (bias corrected)	18.11
Mean (detects)	0.102		

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0598	SD (KM)	0.155
Variance (KM)	0.0239	SE of Mean (KM)	0.0272
k hat (KM)	0.15	k star (KM)	0.156
nu hat (KM)	10.17	nu star (KM)	10.61
theta hat (KM)	0.4	theta star (KM)	0.383
80% gamma percentile (	0.0671	90% gamma percentile (	0.178
95% gamma percentile (	0.327	99% gamma percentile (	0.754

Gamma Kaplan-Meier (KM) Statistics

		Adjusted Level of Signific	0.0422
Approximate Chi Square	4.324	Adjusted Chi Square Val	4.126
95% Gamma Approxirr	0.147	95% Gamma Adjusted	0.154

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	N/A	KM Geo Mean	N/A
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KM SD (logged)	N/A	95% Critical H Value (t)	N/A
KM Standard Error of Me	N/A	95% H-UCL (KM -Log)	N/A
KM SD (logged)	N/A	95% Critical H Value (t)	N/A
KM Standard Error of Me	N/A		

DL/2 Statistics

Mean in Original Scale	0.0612	SD in Original Scale	0.156
95% t UCL (Assumes r	0.107		

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

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

99% KM (Chebyshev) UCL	0.33
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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.

Uranium-235/236

General Statistics

Total Number of Observations	34	Number of Distinct Observations	33
Number of Detects	19	Number of Non-Detects	15
Number of Distinct Detects	19	Number of Distinct Non-Detects	15
Minimum Detect	0.0502	Minimum Non-Detect	0.0301
Maximum Detect	0.106	Maximum Non-Detect	0.0572
Variance Detects	2.6320E-4	Percent Non-Detects	44.12%
Mean Detects	0.0714	SD Detects	0.0162
Median Detects	0.0664	CV Detects	0.227
Skewness Detects	0.65	Kurtosis Detects	-0.464
Mean of Logged Detects	-2.663	SD of Logged Detects	0.221

Normal GOF Test on Detects Only

Shapiro Wilk Test Statist	0.925	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical	0.901	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.165	Lilliefors GOF Test
5% Lilliefors Critical Value	0.197	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	0.0535	KM Standard Error of Mean	0.00416
KM SD	0.0235	95% KM (BCA) UCL	0.0639
95% KM (t) UCL	0.0606	95% KM (Percentile Bootstrap) UCL	0.0621
95% KM (z) UCL	0.0604	95% KM Bootstrap t UCL	0.0604

90% KM Chebyshev UCI	0.066	95% KM Chebyshev UCI	0.0717
97.5% KM Chebyshev U	0.0796	99% KM Chebyshev UCI	0.095

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.495	Anderson-Darling GOF Test
5% A-D Critical Value	0.74	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.156	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.198	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)	21.45	k star (bias corrected ML	18.1
Theta hat (MLE)	0.00333	Theta star (bias correcte	0.00394
nu hat (MLE)	815.2	nu star (bias corrected)	687.8
Mean (detects)	0.0714		

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	0.0347	Mean	0.0555
Maximum	0.106	Median	0.0547
SD	0.0217	CV	0.392
k hat (MLE)	7.181	k star (bias corrected ML	6.567
Theta hat (MLE)	0.00773	Theta star (bias correcte	0.00846
nu hat (MLE)	488.3	nu star (bias corrected)	446.6
Adjusted Level of Signific	0.0422		
Approximate Chi Square	398.6	Adjusted Chi Square Val	396.3
95% Gamma Approxima	0.0622	95% Gamma Adjusted U	0.0626

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0535	SD (KM)	0.0235
Variance (KM)	5.5095E-4	SE of Mean (KM)	0.00416
k hat (KM)	5.204	k star (KM)	4.764
nu hat (KM)	353.9	nu star (KM)	324
theta hat (KM)	0.0103	theta star (KM)	0.0112
80% gamma percentile (	0.0724	90% gamma percentile (	0.0864
95% gamma percentile (	0.0992	99% gamma percentile (	0.126

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square	283.3	Adjusted Chi Square Val	281.4
95% Gamma Approxirr	0.0612	95% Gamma Adjusted	0.0616

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statist	0.944	Shapiro Wilk GOF Test
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5% Shapiro Wilk Critical	0.901	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.143	Lilliefors GOF Test
5% Lilliefors Critical Valu	0.197	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	0.0578	Mean in Log Scale	-2.902
SD in Original Scale	0.0196	SD in Log Scale	0.319
95% t UCL (assumes r	0.0635	95% Percentile Bootstr	0.0633
95% BCA Bootstrap UCL	0.0643	95% Bootstrap t UCL	0.0642
95% H-UCL (Log ROS	0.0639		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-3.025	KM Geo Mean	0.0486
KM SD (logged)	0.443	95% Critical H Value (t	1.896
KM Standard Error of Me	0.079	95% H-UCL (KM -Log)	0.062
KM SD (logged)	0.443	95% Critical H Value (t	1.896
KM Standard Error of Me	0.079		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.0497	Mean in Log Scale	-3.175
SD in Original Scale	0.0277	SD in Log Scale	0.616
95% t UCL (Assumes r	0.0577	95% H-Stat UCL	0.0629

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	0.0606
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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.