

# UCL Statistics for Data Sets with Non-Detects

User Selected  
Date/Time of C ProUCL 5.16/19/17 5:27:11 PM  
From File ProUCLinput\_53-012(e)\_0-10.xls  
Full Precision OFF  
Confidence Cc 95%  
Number of Boc 2000

## Antimony

### General Statistics

Total Number of Observations	15	Number of Distinct Observations	13
Number of Detects	7	Number of Non-Detects	8
Number of Distinct Detects	7	Number of Distinct Non-Detects	6
Minimum Detect	0.504	Minimum Non-Detect	1.03
Maximum Detect	2.3	Maximum Non-Detect	1.2
Variance Detects	0.358	Percent Non-Detects	53.33%
Mean Detects	1.365	SD Detects	0.598
Median Detects	1.37	CV Detects	0.438
Skewness Detects	0.0105	Kurtosis Detects	-0.0783
Mean of Logged Detects	0.21	SD of Logged Detects	0.517

### Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.969	<b>Shapiro Wilk GOF Test</b>
5% Shapiro Wilk Critical Value	0.803	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.184	<b>Lilliefors GOF Test</b>
5% Lilliefors Critical Value	0.304	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	0.975	KM Standard Error of Mean	0.16
KM SD	0.534	95% KM (BCA) UCL	1.347
95% KM (t) UCL	1.257	95% KM (Percentile Bootstrap) UCL	1.312
95% KM (z) UCL	1.239	95% KM Bootstrap t UCL	1.274
90% KM Chebyshev UCL	1.456	95% KM Chebyshev UCL	1.673
97.5% KM Chebyshev UCL	1.976	99% KM Chebyshev UCL	2.569

### Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.313	<b>Anderson-Darling GOF Test</b>
5% A-D Critical Value	0.71	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.243	<b>Kolmogorov-Smirnov GOF</b>
5% K-S Critical Value	0.313	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)	5.096	k star (bias corrected ML)	3.007
-------------	-------	----------------------------	-------

Theta hat (MLE)	0.268	Theta star (bias corrected)	0.454
nu hat (MLE)	71.34	nu star (bias corrected)	42.1
Mean (detects)	1.365		

### 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	0.344	Mean	0.967
Maximum	2.3	Median	0.62
SD	0.559	CV	0.579
k hat (MLE)	3.752	k star (bias corrected ML	3.046
Theta hat (MLE)	0.258	Theta star (bias correcte	0.317
nu hat (MLE)	112.6	nu star (bias corrected)	91.39
Adjusted Level of Signific	0.0324		
Approximate Chi Square	70.35	Adjusted Chi Square Val	68.07
95% Gamma Approxima	1.256	95% Gamma Adjusted U	1.298

### Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.975	SD (KM)	0.534
Variance (KM)	0.285	SE of Mean (KM)	0.16
k hat (KM)	3.331	k star (KM)	2.709
nu hat (KM)	99.93	nu star (KM)	81.28
theta hat (KM)	0.293	theta star (KM)	0.36
80% gamma percentile (	1.408	90% gamma percentile (	1.769
95% gamma percentile (	2.108	99% gamma percentile (	2.846

### Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square	61.5	Adjusted Chi Square Val	59.39
95% Gamma Approxir	1.288	95% Gamma Adjusted	1.334

### Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statist	0.921	<b>Shapiro Wilk GOF Test</b>
5% Shapiro Wilk Critical	0.803	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.266	<b>Lilliefors GOF Test</b>
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	0.979	Mean in Log Scale	-0.145
SD in Original Scale	0.546	SD in Log Scale	0.497
95% t UCL (assumes r	1.227	95% Percentile Bootstr	1.21
95% BCA Bootstrap UCL	1.27	95% Bootstrap t UCL	1.313
95% H-UCL (Log ROS	1.287		

**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**

KM Mean (logged)	-0.157	KM Geo Mean	0.855
KM SD (logged)	0.498	95% Critical H Value (t)	2.066
KM Standard Error of Mean	0.168	95% H-UCL (KM -Log)	1.274
KM SD (logged)	0.498	95% Critical H Value (t)	2.066
KM Standard Error of Mean	0.168		

**DL/2 Statistics**

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.936	Mean in Log Scale	-0.211
SD in Original Scale	0.571	SD in Log Scale	0.532
95% t UCL (Assumes r	1.196	95% H-Stat UCL	1.257

**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	1.257
----------------	-------

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.

**Aroclor-1254****General Statistics**

Total Number of Observations	15	Number of Distinct Observations	15
Number of Detects	6	Number of Non-Detects	9
Number of Distinct Detects	6	Number of Distinct Non-Detects	9
Minimum Detect	0.0177	Minimum Non-Detect	0.00349
Maximum Detect	0.351	Maximum Non-Detect	0.0437
Variance Detects	0.0154	Percent Non-Detects	60%
Mean Detects	0.103	SD Detects	0.124
Median Detects	0.0625	CV Detects	1.21
Skewness Detects	2.224	Kurtosis Detects	5.155
Mean of Logged Detects	-2.743	SD of Logged Detects	1.012

**Normal GOF Test on Detects Only**

Shapiro Wilk Test Statistic	0.689	<b>Shapiro Wilk GOF Test</b>
5% Shapiro Wilk Critical	0.788	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.374	<b>Lilliefors GOF Test</b>
5% Lilliefors Critical Value	0.325	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	0.0473	KM Standard Error of Me	0.0243
KM SD	0.085	95% KM (BCA) UCL	0.0981
95% KM (t) UCL	0.09	95% KM (Percentile Bc	0.087
95% KM (z) UCL	0.0872	95% KM Bootstrap t U	0.147
90% KM Chebyshev UCL	0.12	95% KM Chebyshev UCL	0.153
97.5% KM Chebyshev U	0.199	99% KM Chebyshev UCL	0.289

### Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.459	<b>Anderson-Darling GOF Test</b>	
5% A-D Critical Value	0.712	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.267	<b>Kolmogorov-Smirnov GOF</b>	
5% K-S Critical Value	0.339	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)	1.21	k star (bias corrected ML	0.716
Theta hat (MLE)	0.0849	Theta star (bias correcte	0.143
nu hat (MLE)	14.52	nu star (bias corrected)	8.594
Mean (detects)	0.103		

### 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	0.0471
Maximum	0.351	Median	0.01
SD	0.0879	CV	1.867
k hat (MLE)	0.745	k star (bias corrected ML	0.64
Theta hat (MLE)	0.0632	Theta star (bias correcte	0.0735
nu hat (MLE)	22.35	nu star (bias corrected)	19.21
Adjusted Level of Signific	0.0324		
Approximate Chi Square	10.27	Adjusted Chi Square Val	9.475
95% Gamma Approxima	0.0881	95% Gamma Adjusted U	0.0955

### Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0473	SD (KM)	0.085
Variance (KM)	0.00723	SE of Mean (KM)	0.0243
k hat (KM)	0.309	k star (KM)	0.292
nu hat (KM)	9.281	nu star (KM)	8.758
theta hat (KM)	0.153	theta star (KM)	0.162
80% gamma percentile (	0.072	90% gamma percentile (	0.14
95% gamma percentile (	0.218	99% gamma percentile (	0.422

### Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square	3.181	Adjusted Chi Square Val	2.781
------------------------	-------	-------------------------	-------

95% Gamma Approxima	0.13	95% Gamma Adjusted K	0.149
---------------------	------	----------------------	-------

### Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statist	0.953	<b>Shapiro Wilk GOF Test</b>
5% Shapiro Wilk Critical	0.788	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.204	<b>Lilliefors GOF Test</b>
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	0.0452	Mean in Log Scale	-4.102
SD in Original Scale	0.0887	SD in Log Scale	1.321
95% t UCL (assumes r	0.0856	95% Percentile Bootstr	0.0865
95% BCA Bootstrap UCL	0.108	95% Bootstrap t UCL	0.172
95% H-UCL (Log ROS	0.126		

### Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-4.038	KM Geo Mean	0.0176
KM SD (logged)	1.369	95% Critical H Value (t	3.372
KM Standard Error of Me	0.535	95% H-UCL (KM -Log)	0.154
KM SD (logged)	1.369	95% Critical H Value (t	3.372
KM Standard Error of Me	0.535		

### DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.0479	Mean in Log Scale	-3.888
SD in Original Scale	0.0876	SD in Log Scale	1.263
95% t UCL (Assumes r	0.0877	95% H-Stat UCL	0.133

**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-UCL	0.149
-----------------------	-------

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.

### Aroclor-1260

#### General Statistics

Total Number of Observa	15	Number of Distinct Obse	15
Number of Detects	12	Number of Non-Detects	3
Number of Distinct Detec	12	Number of Distinct Non-I	3

Minimum Detect	0.0171	Minimum Non-Detect	0.00349
Maximum Detect	0.335	Maximum Non-Detect	0.0399
Variance Detects	0.014	Percent Non-Detects	20%
Mean Detects	0.0947	SD Detects	0.118
Median Detects	0.0322	CV Detects	1.25
Skewness Detects	1.645	Kurtosis Detects	1.343
Mean of Logged Detects	-2.96	SD of Logged Detects	1.085

#### Normal GOF Test on Detects Only

Shapiro Wilk Test Statist	0.672	<b>Shapiro Wilk GOF Test</b>
5% Shapiro Wilk Critical	0.859	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.327	<b>Lilliefors GOF Test</b>
5% Lilliefors Critical Valu	0.243	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	0.0782	KM Standard Error of Me	0.0288
KM SD	0.107	95% KM (BCA) UCL	0.127
95% KM (t) UCL	0.129	95% KM (Percentile Bc	0.128
95% KM (z) UCL	0.126	95% KM Bootstrap t U	0.197
90% KM Chebyshev UCL	0.165	95% KM Chebyshev UCL	0.204
97.5% KM Chebyshev U	0.258	99% KM Chebyshev UCL	0.365

#### Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.083	<b>Anderson-Darling GOF Test</b>
5% A-D Critical Value	0.758	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.257	<b>Kolmogorov-Smirnov GOF</b>
5% K-S Critical Value	0.253	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)	0.962	k star (bias corrected ML	0.777
Theta hat (MLE)	0.0984	Theta star (bias correcte	0.122
nu hat (MLE)	23.09	nu star (bias corrected)	18.65
Mean (detects)	0.0947		

#### 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	0.0777
Maximum	0.335	Median	0.0247
SD	0.111	CV	1.423
k hat (MLE)	0.807	k star (bias corrected ML	0.69
Theta hat (MLE)	0.0963	Theta star (bias correcte	0.113

nu hat (MLE)	24.21	nu star (bias corrected)	20.7
Adjusted Level of Signific	0.0324		
Approximate Chi Square	11.37	Adjusted Chi Square Val	10.53
95% Gamma Approxima	0.142	95% Gamma Adjusted U	0.153

#### Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0782	SD (KM)	0.107
Variance (KM)	0.0114	SE of Mean (KM)	0.0288
k hat (KM)	0.538	k star (KM)	0.475
nu hat (KM)	16.13	nu star (KM)	14.24
theta hat (KM)	0.145	theta star (KM)	0.165
80% gamma percentile (	0.128	90% gamma percentile (	0.214
95% gamma percentile (	0.306	99% gamma percentile (	0.534

#### Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square	6.735	Adjusted Chi Square Val	6.11
95% Gamma Approxir	0.165	95% Gamma Adjusted	0.182

#### Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statist	0.85	<b>Shapiro Wilk GOF Test</b>	
5% Shapiro Wilk Critical	0.859	Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.214	<b>Lilliefors GOF Test</b>	
5% Lilliefors Critical Valu	0.243	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	0.078	Mean in Log Scale	-3.302
SD in Original Scale	0.11	SD in Log Scale	1.231
95% t UCL (assumes r	0.128	95% Percentile Bootstr	0.125
95% BCA Bootstrap UCL	0.142	95% Bootstrap t UCL	0.201
95% H-UCL (Log ROS	0.22		

#### Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-3.32	KM Geo Mean	0.0361
KM SD (logged)	1.243	95% Critical H Value (t	3.15
KM Standard Error of Me	0.346	95% H-UCL (KM -Log)	0.223
KM SD (logged)	1.243	95% Critical H Value (t	3.15
KM Standard Error of Me	0.346		

#### DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.0778	Mean in Log Scale	-3.361
SD in Original Scale	0.111	SD in Log Scale	1.356
95% t UCL (Assumes r	0.128	95% H-Stat UCL	0.293

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

#### Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (Chebyshev) UCL = 0.204

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	12	Number of Distinct Observations	12
		Number of Missing Observations	3
Number of Detects	6	Number of Non-Detects	6
Number of Distinct Detects	6	Number of Distinct Non-Detects	6
Minimum Detect	0.113	Minimum Non-Detect	-0.0291
Maximum Detect	1.16	Maximum Non-Detect	-4.170E-4
Variance Detects	0.164	Percent Non-Detects	50%
Mean Detects	0.43	SD Detects	0.404
Median Detects	0.289	CV Detects	0.942
Skewness Detects	1.439	Kurtosis Detects	1.807

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.828	<b>Shapiro Wilk GOF Test</b>
5% Shapiro Wilk Critical Value	0.788	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.248	<b>Lilliefors GOF Test</b>
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	0.2	KM Standard Error of Mean	0.11
KM SD	0.347	95% KM (BCA) UCL	0.395
95% KM (t) UCL	0.398	95% KM (Percentile Bootstrap) UCL	0.384
95% KM (z) UCL	0.381	95% KM Bootstrap t UCL	0.459
90% KM Chebyshev UCL	0.53	95% KM Chebyshev UCL	0.679
97.5% KM Chebyshev UCL	0.886	99% KM Chebyshev UCL	1.294

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.392	<b>Anderson-Darling GOF Test</b>
5% A-D Critical Value	0.708	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.277	<b>Kolmogorov-Smirnov GOF</b>
5% K-S Critical Value	0.337	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)	1.517	k star (bias corrected ML	0.87
Theta hat (MLE)	0.283	Theta star (bias correcte	0.494
nu hat (MLE)	18.2	nu star (bias corrected)	10.43
Mean (detects)	0.43		

#### Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.2	SD (KM)	0.347
Variance (KM)	0.121	SE of Mean (KM)	0.11
k hat (KM)	0.332	k star (KM)	0.304
nu hat (KM)	7.966	nu star (KM)	7.308
theta hat (KM)	0.603	theta star (KM)	0.657
80% gamma percentile (	0.308	90% gamma percentile (	0.589
95% gamma percentile (	0.911	99% gamma percentile (	1.747

#### Gamma Kaplan-Meier (KM) Statistics

		Adjusted Level of Signific	0.029
Approximate Chi Square	2.341	Adjusted Chi Square Val	1.936
95% Gamma Approxir	0.625	95% Gamma Adjusted	0.756

#### 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	0.212	SD in Original Scale	0.355
95% t UCL (Assumes r	0.396		

**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	0.398
----------------	-------

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	15	Number of Distinct Obse	14
-------------------------	----	-------------------------	----

		Number of Missing Obse	0
Minimum	1.34	Mean	31.71
Maximum	267	Median	9.37
SD	66.63	Std. Error of Mean	17.2
Coefficient of Variation	2.101	Skewness	3.585

#### Normal GOF Test

Shapiro Wilk Test Statist	0.454	<b>Shapiro Wilk GOF Test</b>	
5% Shapiro Wilk Critical	0.881	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.347	<b>Lilliefors GOF Test</b>	
5% Lilliefors Critical Valu	0.22	Data Not Normal at 5% Significance Level	

**Data Not Normal at 5% Significance Level**

#### Assuming Normal Distribution

<b>95% Normal UCL</b>		<b>95% UCLs (Adjusted for Skewness)</b>	
95% Student's-t UCL	62.01	95% Adjusted-CLT UC	77.03
		95% Modified-t UCL (J	64.67

#### Gamma GOF Test

A-D Test Statistic	1.093	<b>Anderson-Darling Gamma GOF Test</b>	
5% A-D Critical Value	0.784	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.221	<b>Kolmogorov-Smirnov Gamma GOF Test</b>	
5% K-S Critical Value	0.232	Detected data appear Gamma Distributed at 5% Significance Level	

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

#### Gamma Statistics

k hat (MLE)	0.628	k star (bias corrected ML	0.547
Theta hat (MLE)	50.46	Theta star (bias correcte	57.96
nu hat (MLE)	18.85	nu star (bias corrected)	16.41
MLE Mean (bias correcte	31.71	MLE Sd (bias corrected)	42.87
		Approximate Chi Square	8.255
Adjusted Level of Signific	0.0324	Adjusted Chi Square Val	7.551

#### Assuming Gamma Distribution

95% Approximate Garr	63.05	95% Adjusted Gamma	68.92
----------------------	-------	--------------------	-------

#### Lognormal GOF Test

Shapiro Wilk Test Statist	0.96	<b>Shapiro Wilk Lognormal GOF Test</b>	
5% Shapiro Wilk Critical	0.881	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.108	<b>Lilliefors Lognormal GOF Test</b>	
5% Lilliefors Critical Valu	0.22	Data appear Lognormal at 5% Significance Level	

**Data appear Lognormal at 5% Significance Level**

#### Lognormal Statistics

Minimum of Logged Data	0.293	Mean of logged Data	2.48
Maximum of Logged Dat	5.587	SD of logged Data	1.299

Assuming Lognormal Distribution

95% H-UCL	85.78	90% Chebyshev (MVU	54.06
95% Chebyshev (MVU	67.06	97.5% Chebyshev (MVL	85.12
99% Chebyshev (MVU	120.6		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	60.01	95% Jackknife UCL	62.01
95% Standard Bootstrap	59.44	95% Bootstrap-t UCL	158.6
95% Hall's Bootstrap U	155.2	95% Percentile Bootstr	63.56
95% BCA Bootstrap U	82.23		
90% Chebyshev(Mean	83.32	95% Chebyshev(Mean	106.7
97.5% Chebyshev(Mear	139.2	99% Chebyshev(Mean	202.9

Suggested UCL to Use

95% Adjusted Gamma U	68.92
----------------------	-------

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.

Cyanide (Total)

General Statistics

Total Number of Observa	12	Number of Distinct Obse	12
		Number of Missing Obse	3
Number of Detects	9	Number of Non-Detects	3
Number of Distinct Detect	9	Number of Distinct Non-I	3
Minimum Detect	0.0834	Minimum Non-Detect	0.279
Maximum Detect	2.96	Maximum Non-Detect	0.295
Variance Detects	0.849	Percent Non-Detects	25%
Mean Detects	0.524	SD Detects	0.922
Median Detects	0.249	CV Detects	1.759
Skewness Detects	2.9	Kurtosis Detects	8.55
Mean of Logged Detects	-1.377	SD of Logged Detects	1.098

Normal GOF Test on Detects Only

Shapiro Wilk Test Statist	0.511	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical	0.829	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.428	Lilliefors GOF Test
5% Lilliefors Critical Valu	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	0.433	KM Standard Error of Mean	0.236
KM SD	0.77	95% KM (BCA) UCL	0.885
95% KM (t) UCL	0.857	95% KM (Percentile Bootstrap) UCL	0.881
95% KM (z) UCL	0.821	95% KM Bootstrap t UCL	2.506
90% KM Chebyshev UCL	1.141	95% KM Chebyshev UCL	1.462
97.5% KM Chebyshev UCL	1.907	99% KM Chebyshev UCL	2.782

### Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.03	<b>Anderson-Darling GOF Test</b>
5% A-D Critical Value	0.75	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.304	<b>Kolmogorov-Smirnov GOF</b>
5% K-S Critical Value	0.289	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)	0.811	k star (bias corrected MLE)	0.614
Theta hat (MLE)	0.646	Theta star (bias corrected MLE)	0.853
nu hat (MLE)	14.59	nu star (bias corrected)	11.06
Mean (detects)	0.524		

### 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	0.0358	Mean	0.402
Maximum	2.96	Median	0.135
SD	0.816	CV	2.031
k hat (MLE)	0.641	k star (bias corrected MLE)	0.537
Theta hat (MLE)	0.627	Theta star (bias corrected MLE)	0.749
nu hat (MLE)	15.39	nu star (bias corrected)	12.88
Adjusted Level of Significance	0.029		
Approximate Chi Square	5.811	Adjusted Chi Square Value	5.104
95% Gamma Approximate UCL	0.891	95% Gamma Adjusted UCL	1.014

### Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.433	SD (KM)	0.77
Variance (KM)	0.592	SE of Mean (KM)	0.236
k hat (KM)	0.317	k star (KM)	0.293
nu hat (KM)	7.598	nu star (KM)	7.032
theta hat (KM)	1.368	theta star (KM)	1.478
80% gamma percentile (KM)	0.66	90% gamma percentile (KM)	1.281
95% gamma percentile (KM)	1.996	99% gamma percentile (KM)	3.861

## Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square	2.188	Adjusted Chi Square Val	1.8
95% Gamma Approxir	1.392	95% Gamma Adjusted	1.692

### Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statist	0.865	<b>Shapiro Wilk GOF Test</b>
5% Shapiro Wilk Critical	0.829	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.199	<b>Lilliefors GOF Test</b>
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	0.431	Mean in Log Scale	-1.504
SD in Original Scale	0.804	SD in Log Scale	0.964
95% t UCL (assumes r	0.848	95% Percentile Bootstr	0.879
95% BCA Bootstrap U	1.141	95% Bootstrap t UCL	2.944
95% H-UCL (Log ROS	0.809		

### Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-1.517	KM Geo Mean	0.219
KM SD (logged)	0.957	95% Critical H Value (t)	2.837
KM Standard Error of Me	0.305	95% H-UCL (KM -Log)	0.786
KM SD (logged)	0.957	95% Critical H Value (t)	2.837
KM Standard Error of Me	0.305		

## DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.429	Mean in Log Scale	-1.517
SD in Original Scale	0.805	SD in Log Scale	0.97
95% t UCL (Assumes r	0.846	95% H-Stat UCL	0.81

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

## Nonparametric Distribution Free UCL Statistics

### Detected Data appear Lognormal Distributed at 5% Significance Level

## Suggested UCL to Use

95% KM (Chebyshev) U( 1.462

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

<b>General Statistics</b>			
Total Number of Observations	15	Number of Distinct Observations	15
		Number of Missing Observations	0
Minimum	4.73	Mean	14.38
Maximum	38.6	Median	12.2
SD	10.05	Std. Error of Mean	2.596
Coefficient of Variation	0.699	Skewness	1.256
<b>Normal GOF Test</b>			
Shapiro Wilk Test Statistic	0.86	<b>Shapiro Wilk GOF Test</b>	
5% Shapiro Wilk Critical Value	0.881	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.202	<b>Lilliefors GOF Test</b>	
5% Lilliefors Critical Value	0.22	Data appear Normal at 5% Significance Level	
<b>Data appear Approximate Normal at 5% Significance Level</b>			
<b>Assuming Normal Distribution</b>			
<b>95% Normal UCL</b>		<b>95% UCLs (Adjusted for Skewness)</b>	
95% Student's-t UCL	18.95	95% Adjusted-CLT UCL	19.55
		95% Modified-t UCL (J)	19.09
<b>Gamma GOF Test</b>			
A-D Test Statistic	0.385	<b>Anderson-Darling Gamma GOF Test</b>	
5% A-D Critical Value	0.746	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.135	<b>Kolmogorov-Smirnov Gamma GOF Test</b>	
5% K-S Critical Value	0.224	Detected data appear Gamma Distributed at 5% Significance Level	
<b>Detected data appear Gamma Distributed at 5% Significance Level</b>			
<b>Gamma Statistics</b>			
k hat (MLE)	2.542	k star (bias corrected MLE)	2.078
Theta hat (MLE)	5.657	Theta star (bias corrected MLE)	6.921
nu hat (MLE)	76.25	nu star (bias corrected MLE)	62.33
MLE Mean (bias corrected)	14.38	MLE Sd (bias corrected)	9.976
		Approximate Chi Square	45.17
Adjusted Level of Significance	0.0324	Adjusted Chi Square Value	43.38
<b>Assuming Gamma Distribution</b>			
95% Approximate Gamma	19.84	95% Adjusted Gamma	20.66
<b>Lognormal GOF Test</b>			
Shapiro Wilk Test Statistic	0.951	<b>Shapiro Wilk Lognormal GOF Test</b>	
5% Shapiro Wilk Critical Value	0.881	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.127	<b>Lilliefors Lognormal GOF Test</b>	
5% Lilliefors Critical Value	0.22	Data appear Lognormal at 5% Significance Level	
<b>Data appear Lognormal at 5% Significance Level</b>			
<b>Lognormal Statistics</b>			
Minimum of Logged Data	1.554	Mean of logged Data	2.456

Maximum of Logged Data	3.653	SD of logged Data	0.663
------------------------	-------	-------------------	-------

### Assuming Lognormal Distribution

95% H-UCL	21.67	90% Chebyshev (MVU)	21.97
95% Chebyshev (MVU)	25.46	97.5% Chebyshev (MVL)	30.29
99% Chebyshev (MVU)	39.79		

### Nonparametric Distribution Free UCL Statistics

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

### Nonparametric Distribution Free UCLs

95% CLT UCL	18.65	95% Jackknife UCL	18.95
95% Standard Bootstrap	18.46	95% Bootstrap-t UCL	20.7
95% Hall's Bootstrap UCL	20.35	95% Percentile Bootstrap	18.88
95% BCA Bootstrap UCL	19.36		
90% Chebyshev(Mean)	22.17	95% Chebyshev(Mean)	25.69
97.5% Chebyshev(Mean)	30.59	99% Chebyshev(Mean)	40.21

### Suggested UCL to Use

95% Student's-t UCL	18.95
---------------------	-------

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.

## Mercury

### General Statistics

Total Number of Observations	15	Number of Distinct Observations	14
Number of Detects	13	Number of Non-Detects	2
Number of Distinct Detects	13	Number of Distinct Non-Detects	1
Minimum Detect	0.0061	Minimum Non-Detect	0.11
Maximum Detect	0.27	Maximum Non-Detect	0.11
Variance Detects	0.00499	Percent Non-Detects	13.33%
Mean Detects	0.0378	SD Detects	0.0706
Median Detects	0.0205	CV Detects	1.867
Skewness Detects	3.453	Kurtosis Detects	12.2
Mean of Logged Detects	-3.967	SD of Logged Detects	1.028

### Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.451	<b>Shapiro Wilk GOF Test</b>
5% Shapiro Wilk Critical	0.866	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.417	<b>Lilliefors GOF Test</b>

5% Lilliefors Critical Value 0.234 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	0.0352	KM Standard Error of Mean	0.0171
KM SD	0.0636	95% KM (BCA) UCL	0.0711
95% KM (t) UCL	0.0654	95% KM (Percentile Bootstrap) UCL	0.068
95% KM (z) UCL	0.0634	95% KM Bootstrap t UCL	0.163
90% KM Chebyshev UCL	0.0867	95% KM Chebyshev UCL	0.11
97.5% KM Chebyshev UCL	0.142	99% KM Chebyshev UCL	0.206

#### Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.3	<b>Anderson-Darling GOF Test</b>
5% A-D Critical Value	0.765	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.271	<b>Kolmogorov-Smirnov GOF</b>
5% K-S Critical Value	0.245	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)	0.85	k star (bias corrected MLE)	0.705
Theta hat (MLE)	0.0445	Theta star (bias corrected MLE)	0.0536
nu hat (MLE)	22.1	nu star (bias corrected)	18.34
Mean (detects)	0.0378		

#### 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	0.0061	Mean	0.0359
Maximum	0.27	Median	0.0205
SD	0.0658	CV	1.834
k hat (MLE)	0.914	k star (bias corrected MLE)	0.775
Theta hat (MLE)	0.0393	Theta star (bias corrected MLE)	0.0463
nu hat (MLE)	27.41	nu star (bias corrected)	23.26
Adjusted Level of Significance	0.0324		
Approximate Chi Square	13.29	Adjusted Chi Square Value	12.37
95% Gamma Approximate UCL	0.0628	95% Gamma Adjusted UCL	0.0675

#### Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0352	SD (KM)	0.0636
Variance (KM)	0.00405	SE of Mean (KM)	0.0171
k hat (KM)	0.307	k star (KM)	0.29
nu hat (KM)	9.201	nu star (KM)	8.694
theta hat (KM)	0.115	theta star (KM)	0.122
80% gamma percentile (KM)	0.0536	90% gamma percentile (KM)	0.104



95% gamma percentile (	0.163	99% gamma percentile (	0.316
------------------------	-------	------------------------	-------

### Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square	3.143	Adjusted Chi Square Val	2.746
95% Gamma Approxir	0.0975	95% Gamma Adjusted	0.112

### Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statist	0.874	<b>Shapiro Wilk GOF Test</b>
5% Shapiro Wilk Critical	0.866	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.165	<b>Lilliefors GOF Test</b>
5% Lilliefors Critical Valu	0.234	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	0.0352	Mean in Log Scale	-3.985
SD in Original Scale	0.0658	SD in Log Scale	0.967
95% t UCL (assumes r	0.0651	95% Percentile Bootstr	0.0676
95% BCA Bootstrap UCL	0.0857	95% Bootstrap t UCL	0.176
95% H-UCL (Log ROS	0.0595		

### Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-3.997	KM Geo Mean	0.0184
KM SD (logged)	0.952	95% Critical H Value (t	2.669
KM Standard Error of Me	0.265	95% H-UCL (KM -Log)	0.057
KM SD (logged)	0.952	95% Critical H Value (t	2.669
KM Standard Error of Me	0.265		

### DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.0401	Mean in Log Scale	-3.825
SD in Original Scale	0.0657	SD in Log Scale	1.023
95% t UCL (Assumes r	0.07	95% H-Stat UCL	0.0788

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

### Nonparametric Distribution Free UCL Statistics

**Detected Data appear Lognormal Distributed at 5% Significance Level**

### Suggested UCL to Use

95% KM (Chebyshev) UCL	0.11
------------------------	------

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	12	Number of Distinct Observations	12
		Number of Missing Observations	3
Number of Detects	9	Number of Non-Detects	3
Number of Distinct Detects	9	Number of Distinct Non-Detects	3
Minimum Detect	0.0546	Minimum Non-Detect	0.0461
Maximum Detect	0.112	Maximum Non-Detect	0.0547
Variance Detects	4.3127E-4	Percent Non-Detects	25%
Mean Detects	0.0819	SD Detects	0.0208
Median Detects	0.0713	CV Detects	0.254
Skewness Detects	0.423	Kurtosis Detects	-1.482
Mean of Logged Detects	-2.531	SD of Logged Detects	0.252

### Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.896	<b>Shapiro Wilk GOF Test</b>
5% Shapiro Wilk Critical	0.829	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.25	<b>Lilliefors GOF Test</b>
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	0.0732	KM Standard Error of Mean	0.00697
KM SD	0.0227	95% KM (BCA) UCL	0.0859
95% KM (t) UCL	0.0857	95% KM (Percentile Bootstrap) UCL	0.0847
95% KM (z) UCL	0.0846	95% KM Bootstrap t UCL	0.087
90% KM Chebyshev UCL	0.0941	95% KM Chebyshev UCL	0.104
97.5% KM Chebyshev UCL	0.117	99% KM Chebyshev UCL	0.143

### Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.463	<b>Anderson-Darling GOF Test</b>
5% A-D Critical Value	0.721	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.244	<b>Kolmogorov-Smirnov GOF</b>
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)	17.84	k star (bias corrected ML)	11.97
Theta hat (MLE)	0.00459	Theta star (bias corrected ML)	0.00684
nu hat (MLE)	321.1	nu star (bias corrected)	215.4
Mean (detects)	0.0819		

### 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	0.0375	Mean	0.0713
Maximum	0.112	Median	0.0692
SD	0.0261	CV	0.367
k hat (MLE)	7.8	k star (bias corrected ML	5.906
Theta hat (MLE)	0.00914	Theta star (bias correcte	0.0121
nu hat (MLE)	187.2	nu star (bias corrected)	141.7
Adjusted Level of Signific	0.029		
Approximate Chi Square	115.2	Adjusted Chi Square Val	111.6
95% Gamma Approxima	0.0877	95% Gamma Adjusted U	0.0905

### Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0732	SD (KM)	0.0227
Variance (KM)	5.1651E-4	SE of Mean (KM)	0.00697
k hat (KM)	10.36	k star (KM)	7.826
nu hat (KM)	248.7	nu star (KM)	187.8
theta hat (KM)	0.00706	theta star (KM)	0.00935
80% gamma percentile (	0.0938	90% gamma percentile (	0.108
95% gamma percentile (	0.121	99% gamma percentile (	0.147

### Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square	157.1	Adjusted Chi Square Val	152.8
95% Gamma Approxirr	0.0874	95% Gamma Adjusted	0.0899

### Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statist	0.918	<b>Shapiro Wilk GOF Test</b>	
5% Shapiro Wilk Critical	0.829	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.224	<b>Lilliefors GOF Test</b>	
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	0.0726	Mean in Log Scale	-2.675
SD in Original Scale	0.0244	SD in Log Scale	0.338
95% t UCL (assumes r	0.0852	95% Percentile Bootstr	0.0838
95% BCA Bootstrap U	0.0845	95% Bootstrap t UCL	0.0869
95% H-UCL (Log ROS	0.0891		

### Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-2.663	KM Geo Mean	0.0697
KM SD (logged)	0.308	95% Critical H Value (t	1.935
KM Standard Error of Me	0.0947	95% H-UCL (KM -Log)	0.0876
KM SD (logged)	0.308	95% Critical H Value (t	1.935
KM Standard Error of Me	0.0947		

### DL/2 Statistics

#### DL/2 Normal DL/2 Log-Transformed

Mean in Original Scale	0.0678	Mean in Log Scale	-2.816
------------------------	--------	-------------------	--------

SD in Original Scale	0.031	SD in Log Scale	0.56
95% t UCL (Assumes r	0.0839	95% H-Stat UCL	0.102

**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	0.0857
----------------	--------

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-238

### General Statistics

Total Number of Observations	12	Number of Distinct Observations	12
		Number of Missing Observations	3
Minimum	0.68	Mean	1.271
Maximum	2.31	Median	1.23
SD	0.409	Std. Error of Mean	0.118
Coefficient of Variation	0.322	Skewness	1.478

### Normal GOF Test

Shapiro Wilk Test Statistic	0.868	<b>Shapiro Wilk GOF Test</b>
5% Shapiro Wilk Critical Value	0.859	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.286	<b>Lilliefors GOF Test</b>
5% Lilliefors Critical Value	0.243	Data Not Normal at 5% Significance Level

**Data appear Approximate Normal at 5% Significance Level**

### Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	1.483	95% Adjusted-CLT UCL	1.519
		95% Modified-t UCL (J)	1.491

### Gamma GOF Test

A-D Test Statistic	0.469	<b>Anderson-Darling Gamma GOF Test</b>
5% A-D Critical Value	0.731	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.243	<b>Kolmogorov-Smirnov Gamma GOF Test</b>
5% K-S Critical Value	0.245	Detected data appear Gamma Distributed at 5% Significance Level

**Detected data appear Gamma Distributed at 5% Significance Level**

### Gamma Statistics

k hat (MLE)	11.92	k star (bias corrected ML)	8.999
-------------	-------	----------------------------	-------

Theta hat (MLE)	0.107	Theta star (bias corrected)	0.141
nu hat (MLE)	286.2	nu star (bias corrected)	216
MLE Mean (bias corrected)	1.271	MLE Sd (bias corrected)	0.424
		Approximate Chi Square	183
Adjusted Level of Significance	0.029	Adjusted Chi Square Value	178.3

#### Assuming Gamma Distribution

95% Approximate Gamma	1.5	95% Adjusted Gamma	1.539
-----------------------	-----	--------------------	-------

#### Lognormal GOF Test

Shapiro Wilk Test Statistic	0.946	<b>Shapiro Wilk Lognormal GOF Test</b>	
5% Shapiro Wilk Critical	0.859	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.228	<b>Lilliefors Lognormal GOF Test</b>	
5% Lilliefors Critical Value	0.243	Data appear Lognormal at 5% Significance Level	

#### Data appear Lognormal at 5% Significance Level

#### Lognormal Statistics

Minimum of Logged Data	-0.386	Mean of logged Data	0.197
Maximum of Logged Data	0.837	SD of logged Data	0.3

#### Assuming Lognormal Distribution

95% H-UCL	1.517	90% Chebyshev (MVU)	1.602
95% Chebyshev (MVU)	1.753	97.5% Chebyshev (MVL)	1.963
99% Chebyshev (MVU)	2.374		

#### Nonparametric Distribution Free UCL Statistics

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

#### Nonparametric Distribution Free UCLs

95% CLT UCL	1.465	95% Jackknife UCL	1.483
95% Standard Bootstrap	1.453	95% Bootstrap-t UCL	1.584
95% Hall's Bootstrap UCL	2.76	95% Percentile Bootstrap	1.454
95% BCA Bootstrap UCL	1.528		
90% Chebyshev(Mean)	1.625	95% Chebyshev(Mean)	1.786
97.5% Chebyshev(Mean)	2.008	99% Chebyshev(Mean)	2.445

#### Suggested UCL to Use

95% Student's-t UCL	1.483
---------------------	-------

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.

Zinc

General Statistics

Total Number of Observations	15	Number of Distinct Observations	15
		Number of Missing Observations	0
Minimum	23.4	Mean	64.63
Maximum	218	Median	32.1
SD	61.43	Std. Error of Mean	15.86
Coefficient of Variation	0.951	Skewness	1.641

Normal GOF Test

Shapiro Wilk Test Statistic	0.71	<b>Shapiro Wilk GOF Test</b>
5% Shapiro Wilk Critical Value	0.881	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.301	<b>Lilliefors GOF Test</b>
5% Lilliefors Critical Value	0.22	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

<b>95% Normal UCL</b>		<b>95% UCLs (Adjusted for Skewness)</b>	
95% Student's-t UCL	92.57	95% Adjusted-CLT UCL	97.9
		95% Modified-t UCL (J)	93.69

Gamma GOF Test

A-D Test Statistic	1.417	<b>Anderson-Darling Gamma GOF Test</b>
5% A-D Critical Value	0.751	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.252	<b>Kolmogorov-Smirnov Gamma GOF Test</b>
5% K-S Critical Value	0.225	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.701	k star (bias corrected MLE)	1.405
Theta hat (MLE)	38	Theta star (bias corrected)	46
nu hat (MLE)	51.02	nu star (bias corrected)	42.15
MLE Mean (bias corrected)	64.63	MLE Sd (bias corrected)	54.52
		Approximate Chi Square	28.26
Adjusted Level of Significance	0.0324	Adjusted Chi Square Value	26.87

Assuming Gamma Distribution

95% Approximate Gamma UCL	96.37	95% Adjusted Gamma UCL	101.4
---------------------------	-------	------------------------	-------

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.82	<b>Shapiro Wilk Lognormal GOF Test</b>
5% Shapiro Wilk Critical Value	0.881	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.221	<b>Lilliefors Lognormal GOF Test</b>
5% Lilliefors Critical Value	0.22	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	3.153	Mean of logged Data	3.847
Maximum of Logged Data	5.384	SD of logged Data	0.771

Assuming Lognormal Distribution

95% H-UCL	103.4	90% Chebyshev (MVU)	100.6
95% Chebyshev (MVU)	118.3	97.5% Chebyshev (MVL)	142.8
99% Chebyshev (MVU)	191.1		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	90.72	95% Jackknife UCL	92.57
95% Standard Bootstrap	89.81	95% Bootstrap-t UCL	108.7
95% Hall's Bootstrap UCL	90.2	95% Percentile Bootstrap	90.72
95% BCA Bootstrap UCL	96.6		
90% Chebyshev(Mean)	112.2	95% Chebyshev(Mean)	133.8
97.5% Chebyshev(Mean)	163.7	99% Chebyshev(Mean)	222.5

Suggested UCL to Use

95% Chebyshev (Mean, 133.8

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.