

# D

## HHRA ProUCL Input and Output Files



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Table D-1. Near-Shore Sediment ProUCL Input

General Location	vs. Offshore	Sample ID	Station ID	Field Duplicate	Aluminum	D_Aluminum	Antimony	D_Antimony	Arsenic	D_Arsenic	Barium	D_Barium	Beryllium	D_Beryllium
Near-RDM	Shoreline	10KR04SD	<b>KR04</b>		12600	1	0.62	0	30	1	161	1	0.5	1
Near-RDM	Shoreline	11KR05SD	<b>KR05</b>		6460	1	99	1	135	1	91.6	1	0.344	1
Near-RDM	Shoreline	11KR06SD	<b>KR06</b>		12100	1	2.1	1	17.5	1	128	1	0.293	1
Near-RDM	Shoreline	10KR07SD	<b>KR07</b>		4510	1	40	1	800	1	145	1	0.8	1
Near-RDM	Shoreline	11KR08SD	<b>KR08</b>		9550	1	5.48	1	52	1	120	1	0.297	1
Near-RDM	Shoreline	11KR09SD	<b>KR09</b> <b>(KR09A)</b>		9770	1	9.51	1	20.9	1	122	1	0.501	1
Near-RDM	Shoreline	10KR10SD	<b>KR10</b>		7080	1	1.2	0	160	1	151	1	0.6	1
Near-RDM	Shoreline	10KR11SD	<b>KR11</b>		10600	1	0.56	0	21	1	138	1	0.4	1
Near-RDM	Shoreline	11KR17SD	<b>KR17</b>		8610	1	4.26	1	17.5	1	111	1	0.334	1
Near-RDM	Shoreline	10KR03SD	<b>KR03</b>		17000	1	10	1	60	1	227	1	0.6	1
Near-RDM	Shoreline	11KR14SD	<b>KR14</b>		11300	1	5.41	1	12.5	1	116	1	0.283	1
Near-RDM	Shoreline	11KR15SD	<b>KR15</b>		6810	1	272	1	414	1	124	1	0.268	1
Near-RDM	Shoreline	11KR16SD	<b>KR16</b>		13500	1	15.2	1	39.2	1	152	1	0.339	1
Near-RDM	Offshore	15KR085SD	<b>KR085</b>		6600	1	3100	1	2100	1	520	1	0.64	1
Downriver	Offshore	15KR200SD	KR098	15KR098SD	3700	1	1.7	1	14	1	65	1	0.2	1
Downriver	Offshore	15KR100SD	<b>KR100</b>		4400	1	2	1	9.8	1	60	1	0.18	1

**Duplicates (98) or Replicate (02)**

Downriver of RDC Delta	Offshore	15KR098SD	<b>KR098</b>	15KR200SD	5300									
RDC delta	Shoreline	10KR02SD	KR02		9750		1280	1	1790	1	418	1	0.8	1

Table D-1. Near-Shore Sediment ProUCL Input

General Location	vs. Offshore	Sample ID	Station ID	Field Duplicate	Cadmium	D_Cadmium	Chromium	D_Chromium	Cobalt	D_Cobalt	Copper	D_Copper	Lead	D_Lead
Near-RDM	Shoreline	10KR04SD	<b>KR04</b>		0.4	1	26.7	1	9.9	1	22	1	7	1
Near-RDM	Shoreline	11KR05SD	<b>KR05</b>		0.27	1	14.2	1	9.36	1	25.1	1	7.78	1
Near-RDM	Shoreline	11KR06SD	<b>KR06</b>		0.281	1	20.1	1	7.14	1	19	1	7.32	1
Near-RDM	Shoreline	10KR07SD	<b>KR07</b>		0.061	0	18	1	18	1	56.5	1	10	1
Near-RDM	Shoreline	11KR08SD	<b>KR08</b>		0.282	1	18.3	1	7.78	1	18.8	1	6.71	1
Near-RDM	Shoreline	11KR09SD	<b>KR09 (KR09A)</b>		0.338	1	21.1	1	10.8	1	26.8	1	9.34	1
Near-RDM	Shoreline	10KR10SD	<b>KR10</b>		0.056	0	17	1	15.1	1	41.9	1	10	1
Near-RDM	Shoreline	10KR11SD	<b>KR11</b>		0.4	1	23.3	1	9.2	1	19.6	1	6	1
Near-RDM	Shoreline	11KR17SD	<b>KR17</b>		0.345	1	17.7	1	10	1	24.9	1	9.27	1
Near-RDM	Shoreline	10KR03SD	<b>KR03</b>		0.6	1	36	1	12.8	1	31	1	10	1
Near-RDM	Shoreline	11KR14SD	<b>KR14</b>		0.251	1	19.7	1	6.93	1	15	1	6.62	1
Near-RDM	Shoreline	11KR15SD	<b>KR15</b>		0.219	1	11.1	1	7.69	1	20.3	1	6.06	1
Near-RDM	Shoreline	11KR16SD	<b>KR16</b>		0.342	1	21.9	1	8.14	1	23.2	1	8.82	1
Near-RDM	Offshore	15KR085SD	<b>KR085</b>		0.34	1	35	1	15	1	51	1	11	1
Downriver	Offshore	15KR200SD	KR098	15KR098SD	0.19	1	15	1	7.6	1	12	1	3.8	1
Downriver	Offshore	15KR100SD	<b>KR100</b>		0.13	1	15	1	5.4	1	12	1	3	1

**Duplicates (98) or Replicate (02)**

Downriver of RDC Delta	Offshore	15KR098SD	<b>KR098</b>	15KR200SD										
RDC delta	Shoreline	10KR02SD	KR02		0.058	0	25	1	14.8	1	37.2	1	7	1

Table D-1. Near-Shore Sediment ProUCL Input

General Location	vs. Offshore	Sample ID	Station ID	Field Duplicate	Manganese	D_Manganese	Mercury	D_Mercury	Nickel	D_Nickel	Selenium	D_Selenium	Silver	D_Silver
Near-RDM	Shoreline	10KR04SD	<b>KR04</b>		429	1	0.82	1	28	1	0.9	0	0.061	0
Near-RDM	Shoreline	11KR05SD	<b>KR05</b>		708	1	119	1	25.7	1	0.39	1	0.198	1
Near-RDM	Shoreline	11KR06SD	<b>KR06</b>		557	1	0.169	1	23.1	1	0.39	1	0.167	1
Near-RDM	Shoreline	10KR07SD	<b>KR07</b>		684	1	13.2	1	55	1	1.8	0	0.121	0
Near-RDM	Shoreline	11KR08SD	<b>KR08</b>		505	1	1.15	1	23.8	1	0.31	1	0.128	1
Near-RDM	Shoreline	11KR09SD	<b>KR09</b> <b>(KR09A)</b>		649	1	0.566	1	30.9	1	0.5	1	0.172	1
Near-RDM	Shoreline	10KR10SD	<b>KR10</b>		735	1	3.6	1	38	1	1.7	0	0.113	0
Near-RDM	Shoreline	10KR11SD	<b>KR11</b>		451	1	0.52	1	27	1	0.81	0	0.055	0
Near-RDM	Shoreline	11KR17SD	<b>KR17</b>		527	1	0.442	1	26.1	1	0.39	1	0.15	1
Near-RDM	Shoreline	10KR03SD	<b>KR03</b>		712	1	2.1	1	35	1	1.2	0	0.081	0
Near-RDM	Shoreline	11KR14SD	<b>KR14</b>		404	1	0.387	1	19.4	1	0.42	1	0.141	1
Near-RDM	Shoreline	11KR15SD	<b>KR15</b>		5410	1	39.2	1	21	1	0.55	1	0.098	1
Near-RDM	Shoreline	11KR16SD	<b>KR16</b>		586	1	2.36	1	25.3	1	0.52	1	0.229	1
Near-RDM	Offshore	15KR085SD	<b>KR085</b>		580	1	310	1	55	1	1.7	1	0.15	1
Downriver	Offshore	15KR200SD	KR098	15KR098SD	420	1	2.1	1	22	1	0.75	1	0.061	1
Downriver	Offshore	15KR100SD	<b>KR100</b>		250	1	0.24	1	15	1	0.56	1	0.034	1

**Duplicates (98) or Replicate (02)**

Downriver of RDC Delta	Offshore	15KR098SD	<b>KR098</b>	15KR200SD										
RDC delta	Shoreline	10KR02SD	KR02		750	1	56	1	48	1	1.7	0	0.116	0

Table D-1. Near-Shore Sediment ProUCL Input

General Location	vs. Offshore	Sample ID	Station ID	Field Duplicate	Thallium	D_Thallium	Vanadium	D_Vanadium	Zinc	D_Zinc	Iron	D_Iron	MeHg	D_MeHg
Near-RDM	Shoreline	10KR04SD	<b>KR04</b>		0.38	0	36.9	1	80	1	25100	1	0.000285	1
Near-RDM	Shoreline	11KR05SD	<b>KR05</b>		0.076	1	22.4	1	76.6	1	33400	1	0.00073	1
Near-RDM	Shoreline	11KR06SD	<b>KR06</b>		0.12	1	26.1	1	71.7	1	25900	1	0.00024	1
Near-RDM	Shoreline	10KR07SD	<b>KR07</b>		0.8	0	32.5	1	119	1	48100	1	0.000009	0
Near-RDM	Shoreline	11KR08SD	<b>KR08</b>		0.105	1	23.6	1	67.9	1	24000	1	0.00043	1
Near-RDM	Shoreline	11KR09SD	<b>KR09</b> <b>(KR09A)</b>		0.123	1	30.1	1	93.9	1	32400	1	0.0003	1
Near-RDM	Shoreline	10KR10SD	<b>KR10</b>		0.7	0	31.4	1	99	1	31200	1	0.000654	1
Near-RDM	Shoreline	10KR11SD	<b>KR11</b>		0.34	0	31.8	1	75	1	23200	1	0.000184	1
Near-RDM	Shoreline	11KR17SD	<b>KR17</b>		0.109	1	27.7	1	82.1	1	26000	1	0.00032	1
Near-RDM	Shoreline	10KR03SD	<b>KR03</b>		0.5	0	48.5	1	105	1	33900	1	0.000812	1
Near-RDM	Shoreline	11KR14SD	<b>KR14</b>		0.104	1	25.5	1	65.3	1	24200	1	0.0002	1
Near-RDM	Shoreline	11KR15SD	<b>KR15</b>		0.09	1	16.6	1	53.8	1	9800	1	0.00264	1
Near-RDM	Shoreline	11KR16SD	<b>KR16</b>		0.136	1	28.6	1	80	1	29900	1	0.00133	1
Near-RDM	Offshore	15KR085SD	<b>KR085</b>		0.33	1	29	1	85	1	27000	1	0.000592	1
Downriver	Offshore	15KR200SD	KR098	15KR098SD	0.074	0	23	1	43	1	9800	1	0.00001	0
Downriver	Offshore	15KR100SD	<b>KR100</b>		0.068	0	18	1	30	1	11000	1	0.000019	1

**Duplicates (98) or Replicate (02)**

Downriver of RDC Delta	Offshore	15KR098SD	<b>KR098</b>	15KR200SD							14000	1	0.00001	0
RDC delta	Shoreline	10KR02SD	KR02		0.7	0	27.3	1	83	1	29100	1	0.000592	1

Near-Shore Sediment ProUCL Output

UCL Statistics for Data Sets with Non-Detects

User Selected Options

Date/Time of Computation ProUCL 5.17/10/2017 4:30:40 PM  
 From File WorkSheet.xls  
 Full Precision OFF  
 Confidence Coefficient 95%  
 Number of Bootstrap Operations 2000

Aluminum

General Statistics

Total Number of Observations	14	Number of Distinct Observations	14
		Number of Missing Observations	0
Minimum	4510	Mean	9749
Maximum	17000	Median	9660
SD	3382	Std. Error of Mean	903.9
Coefficient of Variation	0.347	Skewness	0.505

Normal GOF Test

Shapiro Wilk Test Statistic 0.968 Shapiro Wilk GOF Test  
 5% Shapiro Wilk Critical Value 0.874 Data appear Normal at 5% Significance Level  
 Lilliefors Test Statistic 0.142 Lilliefors GOF Test  
 5% Lilliefors Critical Value 0.226 Data appear Normal at 5% Significance Level  
 Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	11350	95% Adjusted-CLT UCL (Chen-1995)	11367
		95% Modified-t UCL (Johnson-1978)	11370

Gamma GOF Test

A-D Test Statistic 0.2 Anderson-Darling Gamma GOF Test  
 5% A-D Critical Value 0.735 Detected data appear Gamma Distributed at 5% Significance Level  
 K-S Test Statistic 0.141 Kolmogorov-Smirnov Gamma GOF Test  
 5% K-S Critical Value 0.229 Detected data appear Gamma Distributed at 5% Significance Level  
 Detected data appear Gamma Distributed at 5% Significance Level

Near-Shore Sediment ProUCL Output

Gamma Statistics			
k hat (MLE)	8.818	k star (bias corrected MLE)	6.976
Theta hat (MLE)	1106	Theta star (bias corrected MLE)	1398
nu hat (MLE)	246.9	nu star (bias corrected)	195.3
MLE Mean (bias corrected)	9749	MLE Sd (bias corrected)	3691
		Approximate Chi Square Value (0.05)	164
Adjusted Level of Significance	0.0312	Adjusted Chi Square Value	160.2
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50)	11612	95% Adjusted Gamma UCL (use when n<50)	11888
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.976	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.874	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.125	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.226	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	8.414	Mean of logged Data	9.127
Maximum of Logged Data	9.741	SD of logged Data	0.359
Assuming Lognormal Distribution			
95% H-UCL	11908	90% Chebyshev (MVUE) UCL	12617
95% Chebyshev (MVUE) UCL	13909	97.5% Chebyshev (MVUE) UCL	15701
99% Chebyshev (MVUE) UCL	19222		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	11236	95% Jackknife UCL	11350
95% Standard Bootstrap UCL	11176	95% Bootstrap-t UCL	11518
95% Hall's Bootstrap UCL	11616	95% Percentile Bootstrap UCL	11156
95% BCA Bootstrap UCL	11221		
90% Chebyshev(Mean, Sd) UCL	12461	95% Chebyshev(Mean, Sd) UCL	13689
97.5% Chebyshev(Mean, Sd) UCL	15394	99% Chebyshev(Mean, Sd) UCL	18743
Suggested UCL to Use			
95% Student's-t UCL	11350		

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.



Near-Shore Sediment ProUCL Output

Antimony

General Statistics

Total Number of Observations	14	Number of Distinct Observations	14
Number of Detects	11	Number of Non-Detects	3
Number of Distinct Detects	11	Number of Distinct Non-Detects	3
Minimum Detect	2.1	Minimum Non-Detect	0.56
Maximum Detect	3100	Maximum Non-Detect	1.2
Variance Detects	854183	Percent Non-Detects	21.43%
Mean Detects	323.9	SD Detects	924.2
Median Detects	10	CV Detects	2.853
Skewness Detects	3.273	Kurtosis Detects	10.78
Mean of Logged Detects	3.162	SD of Logged Detects	2.167

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.401	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.85	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.431	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.251	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	254.6	KM Standard Error of Mean	222.1
KM SD	792.3	95% KM (BCA) UCL	681.2
95% KM (t) UCL	647.9	95% KM (Percentile Bootstrap) UCL	682
95% KM (z) UCL	619.9	95% KM Bootstrap t UCL	7958
90% KM Chebyshev UCL	920.9	95% KM Chebyshev UCL	1223
97.5% KM Chebyshev UCL	1642	99% KM Chebyshev UCL	2464

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.488	Anderson-Darling GOF Test	
5% A-D Critical Value	0.833	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.295	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.278	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)	0.268	k star (bias corrected MLE)	0.256
Theta hat (MLE)	1208	Theta star (bias corrected MLE)	1267
nu hat (MLE)	5.901	nu star (bias corrected)	5.625
Mean (detects)	323.9		

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	254.5
Maximum	3100	Median	7.495
SD	822.2	CV	3.231
k hat (MLE)	0.184	k star (bias corrected MLE)	0.193
Theta hat (MLE)	1380	Theta star (bias corrected MLE)	1322
nu hat (MLE)	5.163	nu star (bias corrected)	5.39
Adjusted Level of Significance ( $\beta$ )	0.0312		
Approximate Chi Square Value (5.39, $\alpha$ )	1.337	Adjusted Chi Square Value (5.39, $\beta$ )	1.09
95% Gamma Approximate UCL (use when $n \geq 50$ )	1026	95% Gamma Adjusted UCL (use when $n < 50$ )	1259

Near-Shore Sediment ProUCL Output

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	254.6 SD (KM)	792.3
Variance (KM)	627734 SE of Mean (KM)	222.1
k hat (KM)	0.103 k star (KM)	0.129
nu hat (KM)	2.892 nu star (KM)	3.605
theta hat (KM)	2465 theta star (KM)	1977
80% gamma percentile (KM)	240.9 90% gamma percentile (KM)	734.3
95% gamma percentile (KM)	1439 99% gamma percentile (KM)	3553

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (3.61, $\alpha$ )	0.572 Adjusted Chi Square Value (3.61, $\beta$ )	0.439
95% Gamma Approximate KM-UCL (use when $n \geq 50$ )	1604 95% Gamma Adjusted KM-UCL (use when $n < 50$ )	2093

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.883 Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.85 Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.217 Lilliefors GOF Test
5% Lilliefors Critical Value	0.251 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	254.5 Mean in Log Scale	2.085
SD in Original Scale	822.2 SD in Log Scale	2.862
95% t UCL (assumes normality of ROS data)	643.7 95% Percentile Bootstrap UCL	677.8
95% BCA Bootstrap UCL	928.8 95% Bootstrap t UCL	7758
95% H-UCL (Log ROS)	81081	

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	2.36 KM Geo Mean	10.6
KM SD (logged)	2.39 95% Critical H Value (KM-Log)	5.47
KM Standard Error of Mean (logged)	0.67 95% H-UCL (KM -Log)	6914
KM SD (logged)	2.39 95% Critical H Value (KM-Log)	5.47
KM Standard Error of Mean (logged)	0.67	

DL/2 Statistics

DL/2 Normal	DL/2 Log-Transformed	
Mean in Original Scale	254.6 Mean in Log Scale	2.274
SD in Original Scale	822.2 SD in Log Scale	2.599
95% t UCL (Assumes normality)	643.7 95% H-Stat UCL	20090

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

99% KM (Chebyshev) UCL	2464
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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.

Near-Shore Sediment ProUCL Output

Arsenic

General Statistics

Total Number of Observations	14	Number of Distinct Observations	13
		Number of Missing Observations	0
Minimum	12.5	Mean	277.1
Maximum	2100	Median	45.6
SD	568.4	Std. Error of Mean	151.9
Coefficient of Variation	2.051	Skewness	2.961

Normal GOF Test

Shapiro Wilk Test Statistic	0.532	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.874	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.367	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.226	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	546.2	95% Adjusted-CLT UCL (Chen-1995)	655.5
		95% Modified-t UCL (Johnson-1978)	566.2

Gamma GOF Test

A-D Test Statistic	1.262	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.798	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.271	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.242	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			

Gamma Statistics

k hat (MLE)	0.473	k star (bias corrected MLE)	0.419
Theta hat (MLE)	585.5	Theta star (bias corrected MLE)	660.6
nu hat (MLE)	13.25	nu star (bias corrected)	11.75
MLE Mean (bias corrected)	277.1	MLE Sd (bias corrected)	427.9
		Approximate Chi Square Value (0.05)	5.06
Adjusted Level of Significance	0.0312	Adjusted Chi Square Value	4.491

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	643.3	95% Adjusted Gamma UCL (use when n<50)	724.8
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Lognormal GOF Test

Shapiro Wilk Test Statistic	0.89	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.874	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.187	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.226	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			

## Near-Shore Sediment ProUCL Output

### Lognormal Statistics

Minimum of Logged Data	2.526 Mean of logged Data	4.271
Maximum of Logged Data	7.65 SD of logged Data	1.585

### Assuming Lognormal Distribution

95% H-UCL	1368 90% Chebyshev (MVUE) UCL	518.3
95% Chebyshev (MVUE) UCL	656.7 97.5% Chebyshev (MVUE) UCL	848.9
99% Chebyshev (MVUE) UCL	1226	

### Nonparametric Distribution Free UCL Statistics

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

### Nonparametric Distribution Free UCLs

95% CLT UCL	527 95% Jackknife UCL	546.2
95% Standard Bootstrap UCL	514.6 95% Bootstrap-t UCL	1358
95% Hall's Bootstrap UCL	1394 95% Percentile Bootstrap UCL	541.4
95% BCA Bootstrap UCL	681.5	
90% Chebyshev(Mean, Sd) UCL	732.9 95% Chebyshev(Mean, Sd) UCL	939.3
97.5% Chebyshev(Mean, Sd) UCL	1226 99% Chebyshev(Mean, Sd) UCL	1789

### Suggested UCL to Use

99% Chebyshev (Mean, Sd) UCL	1789	
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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.

Near-Shore Sediment ProUCL Output

Barium

General Statistics

Total Number of Observations	14	Number of Distinct Observations	14
		Number of Missing Observations	0
Minimum	91.6	Mean	164.8
Maximum	520	Median	133
SD	107.1	Std. Error of Mean	28.61
Coefficient of Variation	0.65	Skewness	3.225

Normal GOF Test

Shapiro Wilk Test Statistic	0.548	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.874	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.371	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.226	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	215.4	95% Adjusted-CLT UCL (Chen-1995)	238.2
		95% Modified-t UCL (Johnson-1978)	219.5

Gamma GOF Test

A-D Test Statistic	1.702	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.738	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.316	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.229	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			

Gamma Statistics

k hat (MLE)	4.787	k star (bias corrected MLE)	3.809
Theta hat (MLE)	34.42	Theta star (bias corrected MLE)	43.25
nu hat (MLE)	134	nu star (bias corrected)	106.7
MLE Mean (bias corrected)	164.8	MLE Sd (bias corrected)	84.42
		Approximate Chi Square Value (0.05)	83.82
Adjusted Level of Significance	0.0312	Adjusted Chi Square Value	81.14

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	209.6	95% Adjusted Gamma UCL (use when n<50)	216.6
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Lognormal GOF Test

Shapiro Wilk Test Statistic	0.754	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.874	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.277	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.226	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			

Lognormal Statistics

Minimum of Logged Data	4.517	Mean of logged Data	4.996
Maximum of Logged Data	6.254	SD of logged Data	0.419

Near-Shore Sediment ProUCL Output

Assuming Lognormal Distribution

95% H-UCL	203.5	90% Chebyshev (MVUE) UCL	215.3
95% Chebyshev (MVUE) UCL	240.2	97.5% Chebyshev (MVUE) UCL	274.8
99% Chebyshev (MVUE) UCL	342.6		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	211.8	95% Jackknife UCL	215.4
95% Standard Bootstrap UCL	210.2	95% Bootstrap-t UCL	361.8
95% Hall's Bootstrap UCL	437.1	95% Percentile Bootstrap UCL	219
95% BCA Bootstrap UCL	244.1		
90% Chebyshev(Mean, Sd) UCL	250.6	95% Chebyshev(Mean, Sd) UCL	289.5
97.5% Chebyshev(Mean, Sd) UCL	343.4	99% Chebyshev(Mean, Sd) UCL	449.5

Suggested UCL to Use

95% Student's-t UCL	215.4	or 95% Modified-t UCL	219.5
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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.

Near-Shore Sediment ProUCL Output

Cadmium

General Statistics

Total Number of Observations	14	Number of Distinct Observations	13
Number of Detects	12	Number of Non-Detects	2
Number of Distinct Detects	11	Number of Distinct Non-Detects	2
Minimum Detect	0.219	Minimum Non-Detect	0.056
Maximum Detect	0.6	Maximum Non-Detect	0.061
Variance Detects	0.00992	Percent Non-Detects	14.29%
Mean Detects	0.339	SD Detects	0.0996
Median Detects	0.339	CV Detects	0.294
Skewness Detects	1.669	Kurtosis Detects	3.94
Mean of Logged Detects	-1.116	SD of Logged Detects	0.264

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.849	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.859	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.226	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.243	Detected Data appear Normal at 5% Significance Level	

Detected Data appear Approximate Normal at 5% Significance Level

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

KM Mean	0.299	KM Standard Error of Mean	0.037
KM SD	0.133	95% KM (BCA) UCL	0.359
95% KM (t) UCL	0.364	95% KM (Percentile Bootstrap) UCL	0.356
95% KM (z) UCL	0.359	95% KM Bootstrap t UCL	0.361
90% KM Chebyshev UCL	0.41	95% KM Chebyshev UCL	0.46
97.5% KM Chebyshev UCL	0.53	99% KM Chebyshev UCL	0.667

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.44	Anderson-Darling GOF Test	
5% A-D Critical Value	0.731	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.189	Kolmogorov-Smirnov GOF	
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 on Detected Data Only

k hat (MLE)	14.85	k star (bias corrected MLE)	11.19
Theta hat (MLE)	0.0228	Theta star (bias corrected MLE)	0.0303
nu hat (MLE)	356.4	nu star (bias corrected)	268.6
Mean (detects)	0.339		

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	0.145	Mean	0.311
Maximum	0.6	Median	0.31
SD	0.115	CV	0.371
k hat (MLE)	7.856	k star (bias corrected MLE)	6.22
Theta hat (MLE)	0.0396	Theta star (bias corrected MLE)	0.0501
nu hat (MLE)	220	nu star (bias corrected)	174.2
Adjusted Level of Significance ( $\beta$ )	0.0312		
Approximate Chi Square Value (174.17, $\alpha$ )	144.7	Adjusted Chi Square Value (174.17, $\beta$ )	141.1
95% Gamma Approximate UCL (use when $n \geq 50$ )	0.375	95% Gamma Adjusted UCL (use when $n < 50$ )	0.384

Near-Shore Sediment ProUCL Output

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.299 SD (KM)	0.133
Variance (KM)	0.0176 SE of Mean (KM)	0.037
k hat (KM)	5.065 k star (KM)	4.027
nu hat (KM)	141.8 nu star (KM)	112.8
theta hat (KM)	0.059 theta star (KM)	0.0741
80% gamma percentile (KM)	0.411 90% gamma percentile (KM)	0.498
95% gamma percentile (KM)	0.578 99% gamma percentile (KM)	0.748

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (112.75, $\alpha$ )	89.24 Adjusted Chi Square Value (112.75, $\beta$ )	86.47
95% Gamma Approximate KM-UCL (use when $n \geq 50$ )	0.377 95% Gamma Adjusted KM-UCL (use when $n < 50$ )	0.389

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.938 Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.859 Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.173 Lilliefors GOF Test
5% Lilliefors Critical Value	0.243 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	0.316 Mean in Log Scale	-1.203
SD in Original Scale	0.109 SD in Log Scale	0.329
95% t UCL (assumes normality of ROS data)	0.367 95% Percentile Bootstrap UCL	0.366
95% BCA Bootstrap UCL	0.373 95% Bootstrap t UCL	0.381
95% H-UCL (Log ROS)	0.378	

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-1.368 KM Geo Mean	0.255
KM SD (logged)	0.661 95% Critical H Value (KM-Log)	2.294
KM Standard Error of Mean (logged)	0.185 95% H-UCL (KM -Log)	0.482
KM SD (logged)	0.661 95% Critical H Value (KM-Log)	2.294
KM Standard Error of Mean (logged)	0.185	

DL/2 Statistics

DL/2 Normal	DL/2 Log-Transformed	
Mean in Original Scale	0.295 Mean in Log Scale	-1.461
SD in Original Scale	0.145 SD in Log Scale	0.911
95% t UCL (Assumes normality)	0.363 95% H-Stat UCL	0.686

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	0.364
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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.



Near-Shore Sediment ProUCL Output

Chromium

General Statistics

Total Number of Observations	14	Number of Distinct Observations	14
		Number of Missing Observations	0
Minimum	11.1	Mean	21.44
Maximum	36	Median	19.9
SD	7.054	Std. Error of Mean	1.885
Coefficient of Variation	0.329	Skewness	1.032

Normal GOF Test

Shapiro Wilk Test Statistic	0.896	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.874	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.188	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.226	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	24.77	95% Adjusted-CLT UCL (Chen-1995)	25.09
		95% Modified-t UCL (Johnson-1978)	24.86

Gamma GOF Test

A-D Test Statistic	0.409	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.734	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.146	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.229	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			

Gamma Statistics

k hat (MLE)	10.81	k star (bias corrected MLE)	8.542
Theta hat (MLE)	1.983	Theta star (bias corrected MLE)	2.51
nu hat (MLE)	302.7	nu star (bias corrected)	239.2
MLE Mean (bias corrected)	21.44	MLE Sd (bias corrected)	7.334
		Approximate Chi Square Value (0.05)	204.4
Adjusted Level of Significance	0.0312	Adjusted Chi Square Value	200.1

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	25.09	95% Adjusted Gamma UCL (use when n<50)	25.62
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Lognormal GOF Test

Shapiro Wilk Test Statistic	0.957	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.874	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.136	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.226	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			

## Near-Shore Sediment ProUCL Output

### Lognormal Statistics

Minimum of Logged Data	2.407	Mean of logged Data	3.018
Maximum of Logged Data	3.584	SD of logged Data	0.316

### Assuming Lognormal Distribution

95% H-UCL	25.4	90% Chebyshev (MVUE) UCL	26.9
95% Chebyshev (MVUE) UCL	29.38	97.5% Chebyshev (MVUE) UCL	32.83
99% Chebyshev (MVUE) UCL	39.6		

### Nonparametric Distribution Free UCL Statistics

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

### Nonparametric Distribution Free UCLs

95% CLT UCL	24.54	95% Jackknife UCL	24.77
95% Standard Bootstrap UCL	24.34	95% Bootstrap-t UCL	26.29
95% Hall's Bootstrap UCL	28.79	95% Percentile Bootstrap UCL	24.55
95% BCA Bootstrap UCL	24.93		
90% Chebyshev(Mean, Sd) UCL	27.09	95% Chebyshev(Mean, Sd) UCL	29.65
97.5% Chebyshev(Mean, Sd) UCL	33.21	99% Chebyshev(Mean, Sd) UCL	40.19

### Suggested UCL to Use

95% Student's-t UCL	24.77
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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.

Near-Shore Sediment ProUCL Output

Cobalt

General Statistics

Total Number of Observations	14	Number of Distinct Observations	14
		Number of Missing Observations	0
Minimum	6.93	Mean	10.56
Maximum	18	Median	9.63
SD	3.414	Std. Error of Mean	0.912
Coefficient of Variation	0.323	Skewness	1.021

Normal GOF Test

Shapiro Wilk Test Statistic	0.882	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.874	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.208	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.226	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	12.18	95% Adjusted-CLT UCL (Chen-1995)	12.33
		95% Modified-t UCL (Johnson-1978)	12.22

Gamma GOF Test

A-D Test Statistic	0.502	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.734	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.177	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.229	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			

Gamma Statistics

k hat (MLE)	11.52	k star (bias corrected MLE)	9.101
Theta hat (MLE)	0.916	Theta star (bias corrected MLE)	1.16
nu hat (MLE)	322.6	nu star (bias corrected)	254.8
MLE Mean (bias corrected)	10.56	MLE Sd (bias corrected)	3.5
		Approximate Chi Square Value (0.05)	218.9
Adjusted Level of Significance	0.0312	Adjusted Chi Square Value	214.4

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	12.3	95% Adjusted Gamma UCL (use when n<50)	12.55
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Near-Shore Sediment ProUCL Output

Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.929	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.874	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.157	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.226	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	1.936	Mean of logged Data	2.313
Maximum of Logged Data	2.89	SD of logged Data	0.301
Assuming Lognormal Distribution			
95% H-UCL	12.39	90% Chebyshev (MVUE) UCL	13.11
95% Chebyshev (MVUE) UCL	14.28	97.5% Chebyshev (MVUE) UCL	15.89
99% Chebyshev (MVUE) UCL	19.07		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	12.06	95% Jackknife UCL	12.18
95% Standard Bootstrap UCL	12.02	95% Bootstrap-t UCL	12.68
95% Hall's Bootstrap UCL	12.39	95% Percentile Bootstrap UCL	12.06
95% BCA Bootstrap UCL	12.25		
90% Chebyshev(Mean, Sd) UCL	13.3	95% Chebyshev(Mean, Sd) UCL	14.54
97.5% Chebyshev(Mean, Sd) UCL	16.26	99% Chebyshev(Mean, Sd) UCL	19.64
Suggested UCL to Use			
95% Student's-t UCL	12.18		

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.

Near-Shore Sediment ProUCL Output

Copper

General Statistics

Total Number of Observations	14	Number of Distinct Observations	14
		Number of Missing Observations	0
Minimum	15	Mean	28.22
Maximum	56.5	Median	24.05
SD	12.67	Std. Error of Mean	3.385
Coefficient of Variation	0.449	Skewness	1.391

Normal GOF Test

Shapiro Wilk Test Statistic	0.815	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.874	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.259	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.226	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	34.22	95% Adjusted-CLT UCL (Chen-1995)	35.13
		95% Modified-t UCL (Johnson-1978)	34.43

Gamma GOF Test

A-D Test Statistic	0.772	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.737	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.214	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.229	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data follow Appr. Gamma Distribution at 5% Significance Level			

Gamma Statistics

k hat (MLE)	6.573	k star (bias corrected MLE)	5.212
Theta hat (MLE)	4.294	Theta star (bias corrected MLE)	5.415
nu hat (MLE)	184	nu star (bias corrected)	145.9
MLE Mean (bias corrected)	28.22	MLE Sd (bias corrected)	12.36
		Approximate Chi Square Value (0.05)	119
Adjusted Level of Significance	0.0312	Adjusted Chi Square Value	115.8

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	34.6	95% Adjusted Gamma UCL (use when n<50)	35.57
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Lognormal GOF Test

Shapiro Wilk Test Statistic	0.909	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.874	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.188	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.226	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			

## Near-Shore Sediment ProUCL Output

### Lognormal Statistics

Minimum of Logged Data	2.708	Mean of logged Data		3.262
Maximum of Logged Data	4.034	SD of logged Data		0.393

### Assuming Lognormal Distribution

95% H-UCL	34.98	90% Chebyshev (MVUE) UCL		37.02
95% Chebyshev (MVUE) UCL	41.1	97.5% Chebyshev (MVUE) UCL		46.75
99% Chebyshev (MVUE) UCL	57.85			

### Nonparametric Distribution Free UCL Statistics

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

### Nonparametric Distribution Free UCLs

95% CLT UCL	33.79	95% Jackknife UCL		34.22
95% Standard Bootstrap UCL	33.54	95% Bootstrap-t UCL		37.25
95% Hall's Bootstrap UCL	35.73	95% Percentile Bootstrap UCL		33.88
95% BCA Bootstrap UCL	34.61			
90% Chebyshev(Mean, Sd) UCL	38.38	95% Chebyshev(Mean, Sd) UCL		42.98
97.5% Chebyshev(Mean, Sd) UCL	49.36	99% Chebyshev(Mean, Sd) UCL		61.9

### Suggested UCL to Use

95% Adjusted Gamma UCL	35.57			
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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.

Near-Shore Sediment ProUCL Output

Manganese

General Statistics

Total Number of Observations	14	Number of Distinct Observations	14
		Number of Missing Observations	0
Minimum	404	Mean	924.1
Maximum	5410	Median	583
SD	1296	Std. Error of Mean	346.3
Coefficient of Variation	1.402	Skewness	3.696

Normal GOF Test

Shapiro Wilk Test Statistic	0.374	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.874	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.487	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.226	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	1537	95% Adjusted-CLT UCL (Chen-1995)	1859
		95% Modified-t UCL (Johnson-1978)	1594

Gamma GOF Test

A-D Test Statistic	2.939	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.749	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.438	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.232	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			

Gamma Statistics

k hat (MLE)	1.686	k star (bias corrected MLE)	1.373
Theta hat (MLE)	547.9	Theta star (bias corrected MLE)	673.2
nu hat (MLE)	47.22	nu star (bias corrected)	38.44
MLE Mean (bias corrected)	924.1	MLE Sd (bias corrected)	788.7
		Approximate Chi Square Value (0.05)	25.24
Adjusted Level of Significance	0.0312	Adjusted Chi Square Value	23.82

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	1407	95% Adjusted Gamma UCL (use when n<50)	1491
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Lognormal GOF Test

Shapiro Wilk Test Statistic	0.594	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.874	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.368	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.226	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			

Near-Shore Sediment ProUCL Output

Lognormal Statistics

Minimum of Logged Data	6.001	Mean of logged Data	6.504
Maximum of Logged Data	8.596	SD of logged Data	0.633

Assuming Lognormal Distribution

95% H-UCL	1212	90% Chebyshev (MVUE) UCL	1226
95% Chebyshev (MVUE) UCL	1419	97.5% Chebyshev (MVUE) UCL	1685
99% Chebyshev (MVUE) UCL	2209		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	1494	95% Jackknife UCL	1537
95% Standard Bootstrap UCL	1469	95% Bootstrap-t UCL	5857
95% Hall's Bootstrap UCL	4758	95% Percentile Bootstrap UCL	1608
95% BCA Bootstrap UCL	1940		
90% Chebyshev(Mean, Sd) UCL	1963	95% Chebyshev(Mean, Sd) UCL	2433
97.5% Chebyshev(Mean, Sd) UCL	3087	99% Chebyshev(Mean, Sd) UCL	4370

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	2433
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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.



Near-Shore Sediment ProUCL Output

Mercury

General Statistics

Total Number of Observations	14	Number of Distinct Observations	14
		Number of Missing Observations	0
Minimum	0.169	Mean	35.25
Maximum	310	Median	1.625
SD	85.31	Std. Error of Mean	22.8
Coefficient of Variation	2.42	Skewness	3.025

Normal GOF Test

Shapiro Wilk Test Statistic	0.486	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.874	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.388	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.226	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	75.63	95% Adjusted-CLT UCL (Chen-1995)	92.44
		95% Modified-t UCL (Johnson-1978)	78.7

Gamma GOF Test

A-D Test Statistic	1.443	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.842	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.305	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.249	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			

Gamma Statistics

k hat (MLE)	0.279	k star (bias corrected MLE)	0.267
Theta hat (MLE)	126.5	Theta star (bias corrected MLE)	132.2
nu hat (MLE)	7.804	nu star (bias corrected)	7.465
MLE Mean (bias corrected)	35.25	MLE Sd (bias corrected)	68.27
		Approximate Chi Square Value (0.05)	2.429
Adjusted Level of Significance	0.0312	Adjusted Chi Square Value	2.066

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	108.3	95% Adjusted Gamma UCL (use when n<50)	127.4
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Near-Shore Sediment ProUCL Output

Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.898	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.874	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.178	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.226	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-1.778	Mean of logged Data	1.059
Maximum of Logged Data	5.737	SD of logged Data	2.298
Assuming Lognormal Distribution			
95% H-UCL	1169	90% Chebyshev (MVUE) UCL	75.84
95% Chebyshev (MVUE) UCL	98.92	97.5% Chebyshev (MVUE) UCL	131
99% Chebyshev (MVUE) UCL	193.9		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	72.75	95% Jackknife UCL	75.63
95% Standard Bootstrap UCL	71.29	95% Bootstrap-t UCL	283.8
95% Hall's Bootstrap UCL	293.5	95% Percentile Bootstrap UCL	75.27
95% BCA Bootstrap UCL	98.41		
90% Chebyshev(Mean, Sd) UCL	103.6	95% Chebyshev(Mean, Sd) UCL	134.6
97.5% Chebyshev(Mean, Sd) UCL	177.6	99% Chebyshev(Mean, Sd) UCL	262.1
Suggested UCL to Use			
99% Chebyshev (Mean, Sd) UCL	262.1		

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.

Near-Shore Sediment ProUCL Output

Nickel

General Statistics

Total Number of Observations	14	Number of Distinct Observations	13
		Number of Missing Observations	0
Minimum	19.4	Mean	30.95
Maximum	55	Median	26.55
SD	11.35	Std. Error of Mean	3.034
Coefficient of Variation	0.367	Skewness	1.493

Normal GOF Test

Shapiro Wilk Test Statistic	0.797	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.874	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.245	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.226	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	36.32	95% Adjusted-CLT UCL (Chen-1995)	37.23
		95% Modified-t UCL (Johnson-1978)	36.52

Gamma GOF Test

A-D Test Statistic	0.814	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.735	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.222	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.229	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data follow Appr. Gamma Distribution at 5% Significance Level			

Gamma Statistics

k hat (MLE)	9.775	k star (bias corrected MLE)	7.728
Theta hat (MLE)	3.166	Theta star (bias corrected MLE)	4.005
nu hat (MLE)	273.7	nu star (bias corrected)	216.4
MLE Mean (bias corrected)	30.95	MLE Sd (bias corrected)	11.13
		Approximate Chi Square Value (0.05)	183.3
Adjusted Level of Significance	0.0312	Adjusted Chi Square Value	179.3

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	36.53	95% Adjusted Gamma UCL (use when n<50)	37.35
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Lognormal GOF Test

Shapiro Wilk Test Statistic	0.89	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.874	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.203	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.226	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			

Near-Shore Sediment ProUCL Output

Lognormal Statistics

Minimum of Logged Data	2.965	Mean of logged Data	3.38
Maximum of Logged Data	4.007	SD of logged Data	0.321

Assuming Lognormal Distribution

95% H-UCL	36.66	90% Chebyshev (MVUE) UCL	38.83
95% Chebyshev (MVUE) UCL	42.46	97.5% Chebyshev (MVUE) UCL	47.51
99% Chebyshev (MVUE) UCL	57.41		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	35.94	95% Jackknife UCL	36.32
95% Standard Bootstrap UCL	35.88	95% Bootstrap-t UCL	40.61
95% Hall's Bootstrap UCL	44.05	95% Percentile Bootstrap UCL	36.19
95% BCA Bootstrap UCL	36.94		
90% Chebyshev(Mean, Sd) UCL	40.05	95% Chebyshev(Mean, Sd) UCL	44.18
97.5% Chebyshev(Mean, Sd) UCL	49.9	99% Chebyshev(Mean, Sd) UCL	61.14

Suggested UCL to Use

95% Adjusted Gamma UCL	37.35
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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.

## Near-Shore Sediment ProUCL Output

## Selenium

## General Statistics

Total Number of Observations	14	Number of Distinct Observations	11
Number of Detects	9	Number of Non-Detects	5
Number of Distinct Detects	7	Number of Distinct Non-Detects	5
Minimum Detect	0.31	Minimum Non-Detect	0.81
Maximum Detect	1.7	Maximum Non-Detect	1.8
Variance Detects	0.184	Percent Non-Detects	35.71%
Mean Detects	0.574	SD Detects	0.429
Median Detects	0.42	CV Detects	0.747
Skewness Detects	2.819	Kurtosis Detects	8.201
Mean of Logged Detects	-0.698	SD of Logged Detects	0.494

## Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.558	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.829	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.412	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	0.531	KM Standard Error of Mean	0.103
KM SD	0.345	95% KM (BCA) UCL	0.721
95% KM (t) UCL	0.713	95% KM (Percentile Bootstrap) UCL	0.706
95% KM (z) UCL	0.7	95% KM Bootstrap t UCL	1.088
90% KM Chebyshev UCL	0.839	95% KM Chebyshev UCL	0.979
97.5% KM Chebyshev UCL	1.173	99% KM Chebyshev UCL	1.553

## Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.352	Anderson-Darling GOF Test	
5% A-D Critical Value	0.726	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.352	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.281	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)	3.65	k star (bias corrected MLE)	2.508
Theta hat (MLE)	0.157	Theta star (bias corrected MLE)	0.229
nu hat (MLE)	65.71	nu star (bias corrected)	45.14
Mean (detects)	0.574		

## 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	0.31	Mean	0.535
Maximum	1.7	Median	0.457
SD	0.341	CV	0.637
k hat (MLE)	5.299	k star (bias corrected MLE)	4.211
Theta hat (MLE)	0.101	Theta star (bias corrected MLE)	0.127
nu hat (MLE)	148.4	nu star (bias corrected)	117.9
Adjusted Level of Significance ( $\beta$ )	0.0312		
Approximate Chi Square Value (117.90, $\alpha$ )	93.83	Adjusted Chi Square Value (117.90, $\beta$ )	90.99
95% Gamma Approximate UCL (use when $n \geq 50$ )	0.672	95% Gamma Adjusted UCL (use when $n < 50$ )	0.693

Near-Shore Sediment ProUCL Output

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.531 SD (KM)	0.345
Variance (KM)	0.119 SE of Mean (KM)	0.103
k hat (KM)	2.366 k star (KM)	1.907
nu hat (KM)	66.26 nu star (KM)	53.39
theta hat (KM)	0.224 theta star (KM)	0.279
80% gamma percentile (KM)	0.8 90% gamma percentile (KM)	1.045
95% gamma percentile (KM)	1.279 99% gamma percentile (KM)	1.8

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (53.39, $\alpha$ )	37.61 Adjusted Chi Square Value (53.39, $\beta$ )	35.85
95% Gamma Approximate KM-UCL (use when $n \geq 50$ )	0.754 95% Gamma Adjusted KM-UCL (use when $n < 50$ )	0.791

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.73 Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.829 Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.309 Lilliefors GOF Test
5% Lilliefors Critical Value	0.274 Detected Data Not Lognormal at 5% Significance Level
Detected Data Not Lognormal at 5% Significance Level	

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.534 Mean in Log Scale	-0.725
SD in Original Scale	0.341 SD in Log Scale	0.39
95% t UCL (assumes normality of ROS data)	0.695 95% Percentile Bootstrap UCL	0.711
95% BCA Bootstrap UCL	0.811 95% Bootstrap t UCL	1.197
95% H-UCL (Log ROS)	0.647	

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-0.745 KM Geo Mean	0.475
KM SD (logged)	0.406 95% Critical H Value (KM-Log)	1.987
KM Standard Error of Mean (logged)	0.125 95% H-UCL (KM -Log)	0.645
KM SD (logged)	0.406 95% Critical H Value (KM-Log)	1.987
KM Standard Error of Mean (logged)	0.125	

DL/2 Statistics

DL/2 Normal	DL/2 Log-Transformed	
Mean in Original Scale	0.598 Mean in Log Scale	-0.626
SD in Original Scale	0.361 SD in Log Scale	0.448
95% t UCL (Assumes normality)	0.769 95% H-Stat UCL	0.758

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

95% KM (t) UCL	0.713 KM H-UCL	0.645
95% KM (BCA) UCL	0.721	

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.

Near-Shore Sediment ProUCL Output

Silver

General Statistics

Total Number of Observations	14	Number of Distinct Observations	13
Number of Detects	9	Number of Non-Detects	5
Number of Distinct Detects	8	Number of Distinct Non-Detects	5
Minimum Detect	0.098	Minimum Non-Detect	0.055
Maximum Detect	0.229	Maximum Non-Detect	0.121
Variance Detects	0.00148	Percent Non-Detects	35.71%
Mean Detects	0.159	SD Detects	0.0384
Median Detects	0.15	CV Detects	0.241
Skewness Detects	0.377	Kurtosis Detects	0.473
Mean of Logged Detects	-1.864	SD of Logged Detects	0.247

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.979	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.829	Detected Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.15	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.274	Detected Data appear Normal at 5% Significance Level	
Detected Data appear Normal at 5% Significance Level			

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

KM Mean	0.124	KM Standard Error of Mean	0.0162
KM SD	0.0565	95% KM (BCA) UCL	0.153
95% KM (t) UCL	0.152	95% KM (Percentile Bootstrap) UCL	0.152
95% KM (z) UCL	0.15	95% KM Bootstrap t UCL	0.152
90% KM Chebyshev UCL	0.172	95% KM Chebyshev UCL	0.194
97.5% KM Chebyshev UCL	0.225	99% KM Chebyshev UCL	0.285

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.175	Anderson-Darling GOF Test	
5% A-D Critical Value	0.721	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.127	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.279	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only

k hat (MLE)	19.06	k star (bias corrected MLE)	12.78
Theta hat (MLE)	0.00836	Theta star (bias corrected MLE)	0.0125
nu hat (MLE)	343	nu star (bias corrected)	230
Mean (detects)	0.159		

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	0.0706	Mean	0.129
Maximum	0.229	Median	0.135
SD	0.0518	CV	0.401
k hat (MLE)	6.59	k star (bias corrected MLE)	5.226
Theta hat (MLE)	0.0196	Theta star (bias corrected MLE)	0.0247
nu hat (MLE)	184.5	nu star (bias corrected)	146.3
Adjusted Level of Significance ( $\beta$ )	0.0312		
Approximate Chi Square Value (146.32, $\alpha$ )	119.4	Adjusted Chi Square Value (146.32, $\beta$ )	116.1
95% Gamma Approximate UCL (use when $n \geq 50$ )	0.158	95% Gamma Adjusted UCL (use when $n < 50$ )	0.163

Near-Shore Sediment ProUCL Output

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.124 SD (KM)	0.0565
Variance (KM)	0.0032 SE of Mean (KM)	0.0162
k hat (KM)	4.775 k star (KM)	3.799
nu hat (KM)	133.7 nu star (KM)	106.4
theta hat (KM)	0.0259 theta star (KM)	0.0325
80% gamma percentile (KM)	0.171 90% gamma percentile (KM)	0.209
95% gamma percentile (KM)	0.243 99% gamma percentile (KM)	0.316

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (106.38, $\alpha$ )	83.58 Adjusted Chi Square Value (106.38, $\beta$ )	80.9
95% Gamma Approximate KM-UCL (use when $n \geq 50$ )	0.157 95% Gamma Adjusted KM-UCL (use when $n < 50$ )	0.162

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.98 Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.829 Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.128 Lilliefors GOF Test
5% Lilliefors Critical Value	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	0.133 Mean in Log Scale	-2.076
SD in Original Scale	0.0474 SD in Log Scale	0.354
95% t UCL (assumes normality of ROS data)	0.155 95% Percentile Bootstrap UCL	0.154
95% BCA Bootstrap UCL	0.156 95% Bootstrap t UCL	0.158
95% H-UCL (Log ROS)	0.162	

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-2.213 KM Geo Mean	0.109
KM SD (logged)	0.515 95% Critical H Value (KM-Log)	2.027
KM Standard Error of Mean (logged)	0.15 95% H-UCL (KM -Log)	0.167
KM SD (logged)	0.515 95% Critical H Value (KM-Log)	2.027
KM Standard Error of Mean (logged)	0.15	

DL/2 Statistics

DL/2 Normal	DL/2 Log-Transformed	
Mean in Original Scale	0.118 Mean in Log Scale	-2.339
SD in Original Scale	0.0657 SD in Log Scale	0.716
95% t UCL (Assumes normality)	0.149 95% H-Stat UCL	0.199

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	0.152
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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.



## Near-Shore Sediment ProUCL Output

## Thallium

## General Statistics

Total Number of Observations	14	Number of Distinct Observations	14
Number of Detects	9	Number of Non-Detects	5
Number of Distinct Detects	9	Number of Distinct Non-Detects	5
Minimum Detect	0.076	Minimum Non-Detect	0.34
Maximum Detect	0.33	Maximum Non-Detect	0.8
Variance Detects	0.0058	Percent Non-Detects	35.71%
Mean Detects	0.133	SD Detects	0.0761
Median Detects	0.109	CV Detects	0.574
Skewness Detects	2.686	Kurtosis Detects	7.658
Mean of Logged Detects	-2.115	SD of Logged Detects	0.415

## Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.621	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.829	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.371	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	0.133	KM Standard Error of Mean	0.0254
KM SD	0.0718	95% KM (BCA) UCL	0.183
95% KM (t) UCL	0.178	95% KM (Percentile Bootstrap) UCL	0.178
95% KM (z) UCL	0.174	95% KM Bootstrap t UCL	0.285
90% KM Chebyshev UCL	0.209	95% KM Chebyshev UCL	0.243
97.5% KM Chebyshev UCL	0.291	99% KM Chebyshev UCL	0.385

## Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.078	Anderson-Darling GOF Test	
5% A-D Critical Value	0.723	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.308	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.28	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)	5.447	k star (bias corrected MLE)	3.705
Theta hat (MLE)	0.0243	Theta star (bias corrected MLE)	0.0358
nu hat (MLE)	98.04	nu star (bias corrected)	66.7
Mean (detects)	0.133		

## 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	0.076	Mean	0.13
Maximum	0.33	Median	0.125
SD	0.0598	CV	0.459
k hat (MLE)	8.346	k star (bias corrected MLE)	6.606
Theta hat (MLE)	0.0156	Theta star (bias corrected MLE)	0.0197
nu hat (MLE)	233.7	nu star (bias corrected)	185
Adjusted Level of Significance ( $\beta$ )	0.0312		
Approximate Chi Square Value (184.96, $\alpha$ )	154.5	Adjusted Chi Square Value (184.96, $\beta$ )	150.8
95% Gamma Approximate UCL (use when $n \geq 50$ )	0.156	95% Gamma Adjusted UCL (use when $n < 50$ )	0.16

Near-Shore Sediment ProUCL Output

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.133 SD (KM)	0.0718
Variance (KM)	0.00515 SE of Mean (KM)	0.0254
k hat (KM)	3.409 k star (KM)	2.726
nu hat (KM)	95.46 nu star (KM)	76.34
theta hat (KM)	0.0389 theta star (KM)	0.0486
80% gamma percentile (KM)	0.191 90% gamma percentile (KM)	0.24
95% gamma percentile (KM)	0.286 99% gamma percentile (KM)	0.386

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (76.34, $\alpha$ )	57.21 Adjusted Chi Square Value (76.34, $\beta$ )	55.02
95% Gamma Approximate KM-UCL (use when $n \geq 50$ )	0.177 95% Gamma Adjusted KM-UCL (use when $n < 50$ )	0.184

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.791 Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.829 Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.275 Lilliefors GOF Test	
5% Lilliefors Critical Value	0.274 Detected Data Not Lognormal at 5% Significance Level	
Detected Data Not Lognormal at 5% Significance Level		

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.128 Mean in Log Scale	-2.115
SD in Original Scale	0.06 SD in Log Scale	0.326
95% t UCL (assumes normality of ROS data)	0.157 95% Percentile Bootstrap UCL	0.158
95% BCA Bootstrap UCL	0.165 95% Bootstrap t UCL	0.207
95% H-UCL (Log ROS)	0.151	

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-2.115 KM Geo Mean	0.121
KM SD (logged)	0.391 95% Critical H Value (KM-Log)	1.976
KM Standard Error of Mean (logged)	0.138 95% H-UCL (KM -Log)	0.161
KM SD (logged)	0.391 95% Critical H Value (KM-Log)	1.976
KM Standard Error of Mean (logged)	0.138	

DL/2 Statistics

DL/2 Normal	DL/2 Log-Transformed	
Mean in Original Scale	0.182 Mean in Log Scale	-1.845
SD in Original Scale	0.107 SD in Log Scale	0.539
95% t UCL (Assumes normality)	0.233 95% H-Stat UCL	0.249

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

95% KM (t) UCL	0.178 KM H-UCL	0.161
95% KM (BCA) UCL	0.183	

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.

Near-Shore Sediment ProUCL Output

Vanadium

General Statistics

Total Number of Observations	14	Number of Distinct Observations	14
		Number of Missing Observations	0
Minimum	16.6	Mean	29.34
Maximum	48.5	Median	28.8
SD	7.427	Std. Error of Mean	1.985
Coefficient of Variation	0.253	Skewness	1.061

Normal GOF Test

Shapiro Wilk Test Statistic	0.923	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.874	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.192	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.226	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	32.85	95% Adjusted-CLT UCL (Chen-1995)	33.2
		95% Modified-t UCL (Johnson-1978)	32.94

Gamma GOF Test

A-D Test Statistic	0.317	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.734	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.16	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.228	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			

Gamma Statistics

k hat (MLE)	17.71	k star (bias corrected MLE)	13.96
Theta hat (MLE)	1.657	Theta star (bias corrected MLE)	2.101
nu hat (MLE)	495.8	nu star (bias corrected)	390.9
MLE Mean (bias corrected)	29.34	MLE Sd (bias corrected)	7.851
		Approximate Chi Square Value (0.05)	346.1
Adjusted Level of Significance	0.0312	Adjusted Chi Square Value	340.5

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	33.14	95% Adjusted Gamma UCL (use when n<50)	33.68
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Lognormal GOF Test

Shapiro Wilk Test Statistic	0.963	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.874	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.156	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.226	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			

Near-Shore Sediment ProUCL Output

Lognormal Statistics

Minimum of Logged Data	2.809	Mean of logged Data	3.35
Maximum of Logged Data	3.882	SD of logged Data	0.248

Assuming Lognormal Distribution

95% H-UCL	33.39	90% Chebyshev (MVUE) UCL	35.2
95% Chebyshev (MVUE) UCL	37.86	97.5% Chebyshev (MVUE) UCL	41.55
99% Chebyshev (MVUE) UCL	48.8		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	32.6	95% Jackknife UCL	32.85
95% Standard Bootstrap UCL	32.46	95% Bootstrap-t UCL	33.88
95% Hall's Bootstrap UCL	36	95% Percentile Bootstrap UCL	32.49
95% BCA Bootstrap UCL	33.06		
90% Chebyshev(Mean, Sd) UCL	35.29	95% Chebyshev(Mean, Sd) UCL	37.99
97.5% Chebyshev(Mean, Sd) UCL	41.73	99% Chebyshev(Mean, Sd) UCL	49.09

Suggested UCL to Use

95% Student's-t UCL	32.85
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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.

Near-Shore Sediment ProUCL Output

Zinc

General Statistics

Total Number of Observations	14	Number of Distinct Observations	13
		Number of Missing Observations	0
Minimum	53.8	Mean	82.45
Maximum	119	Median	80
SD	17.1	Std. Error of Mean	4.569
Coefficient of Variation	0.207	Skewness	0.589

Normal GOF Test

Shapiro Wilk Test Statistic	0.97	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.874	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.155	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.226	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	90.54	95% Adjusted-CLT UCL (Chen-1995)	90.73
		95% Modified-t UCL (Johnson-1978)	90.66

Gamma GOF Test

A-D Test Statistic	0.185	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.734	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.127	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.228	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			

Gamma Statistics

k hat (MLE)	25.64	k star (bias corrected MLE)	20.2
Theta hat (MLE)	3.215	Theta star (bias corrected MLE)	4.082
nu hat (MLE)	718.1	nu star (bias corrected)	565.5
MLE Mean (bias corrected)	82.45	MLE Sd (bias corrected)	18.35
		Approximate Chi Square Value (0.05)	511.4
Adjusted Level of Significance	0.0312	Adjusted Chi Square Value	504.5

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	91.18	95% Adjusted Gamma UCL (use when n<50)	92.42
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Lognormal GOF Test

Shapiro Wilk Test Statistic	0.988	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.874	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.118	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.226	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			

Near-Shore Sediment ProUCL Output

Lognormal Statistics

Minimum of Logged Data	3.985	Mean of logged Data	4.393
Maximum of Logged Data	4.779	SD of logged Data	0.206

Assuming Lognormal Distribution

95% H-UCL	91.61	90% Chebyshev (MVUE) UCL	96.1
95% Chebyshev (MVUE) UCL	102.3	97.5% Chebyshev (MVUE) UCL	110.9
99% Chebyshev (MVUE) UCL	127.7		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	89.97	95% Jackknife UCL	90.54
95% Standard Bootstrap UCL	89.81	95% Bootstrap-t UCL	92.22
95% Hall's Bootstrap UCL	92.8	95% Percentile Bootstrap UCL	90.06
95% BCA Bootstrap UCL	91.1		
90% Chebyshev(Mean, Sd) UCL	96.16	95% Chebyshev(Mean, Sd) UCL	102.4
97.5% Chebyshev(Mean, Sd) UCL	111	99% Chebyshev(Mean, Sd) UCL	127.9

Suggested UCL to Use

95% Student's-t UCL	90.54
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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.

Near-Shore Sediment ProUCL Output

Iron

General Statistics

Total Number of Observations	14	Number of Distinct Observations	14
		Number of Missing Observations	0
Minimum	9800	Mean	28150
Maximum	48100	Median	26500
SD	8336	Std. Error of Mean	2228
Coefficient of Variation	0.296	Skewness	0.294

Normal GOF Test

Shapiro Wilk Test Statistic	0.901	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.874	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.205	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.226	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	32096	95% Adjusted-CLT UCL (Chen-1995)	32002
		95% Modified-t UCL (Johnson-1978)	32125

Gamma GOF Test

A-D Test Statistic	0.794	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.735	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.237	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.229	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			

Gamma Statistics

k hat (MLE)	10.43	k star (bias corrected MLE)	8.241
Theta hat (MLE)	2699	Theta star (bias corrected MLE)	3416
nu hat (MLE)	292	nu star (bias corrected)	230.7
MLE Mean (bias corrected)	28150	MLE Sd (bias corrected)	9806
		Approximate Chi Square Value (0.05)	196.6
Adjusted Level of Significance	0.0312	Adjusted Chi Square Value	192.4

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	33042	95% Adjusted Gamma UCL (use when n<50)	33760
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Near-Shore Sediment ProUCL Output

Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.814	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.874	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.268	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.226	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	9.19	Mean of logged Data	10.2
Maximum of Logged Data	10.78	SD of logged Data	0.348
Assuming Lognormal Distribution			
95% H-UCL	34352	90% Chebyshev (MVUE) UCL	36399
95% Chebyshev (MVUE) UCL	40040	97.5% Chebyshev (MVUE) UCL	45093
99% Chebyshev (MVUE) UCL	55020		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	31815	95% Jackknife UCL	32096
95% Standard Bootstrap UCL	31732	95% Bootstrap-t UCL	32350
95% Hall's Bootstrap UCL	33155	95% Percentile Bootstrap UCL	31564
95% BCA Bootstrap UCL	31764		
90% Chebyshev(Mean, Sd) UCL	34834	95% Chebyshev(Mean, Sd) UCL	37861
97.5% Chebyshev(Mean, Sd) UCL	42064	99% Chebyshev(Mean, Sd) UCL	50318
Suggested UCL to Use			
95% Student's-t UCL	32096		

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.



Near-Shore Sediment ProUCL Output

MeHg

General Statistics

Total Number of Observations	14	Number of Distinct Observations	14
Number of Detects	13	Number of Non-Detects	1
Number of Distinct Detects	13	Number of Distinct Non-Detects	1
Minimum Detect	1.84E-04	Minimum Non-Detect	9.00E-06
Maximum Detect	0.00264	Maximum Non-Detect	9.00E-06
Variance Detects	4.54E-07	Percent Non-Detects	7.14%
Mean Detects	6.71E-04	SD Detects	6.74E-04
Median Detects	4.30E-04	CV Detects	1.005
Skewness Detects	2.399	Kurtosis Detects	6.375
Mean of Logged Detects	-7.63	SD of Logged Detects	0.784

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.704	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.866	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.263	Lilliefors GOF Test	
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	6.23E-04	KM Standard Error of Mean	1.80E-04
KM SD	6.47E-04	95% KM (BCA) UCL	9.52E-04
95% KM (t) UCL	9.42E-04	95% KM (Percentile Bootstrap) UCL	9.43E-04
95% KM (z) UCL	9.19E-04	95% KM Bootstrap t UCL	0.00131
90% KM Chebyshev UCL	0.00116	95% KM Chebyshev UCL	0.00141
97.5% KM Chebyshev UCL	0.00175	99% KM Chebyshev UCL	0.00241

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.568	Anderson-Darling GOF Test	
5% A-D Critical Value	0.747	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.183	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.24	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			

Near-Shore Sediment ProUCL Output

Gamma Statistics on Detected Data Only

k hat (MLE)	1.698 k star (bias corrected MLE)	1.358
Theta hat (MLE)	3.95E-04 Theta star (bias corrected MLE)	4.94E-04
nu hat (MLE)	44.15 nu star (bias corrected)	35.3
Mean (detects)	6.71E-04	

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	1.84E-04 Mean	0.00134
Maximum	0.01 Median	5.11E-04
SD	0.00258 CV	1.927
k hat (MLE)	0.751 k star (bias corrected MLE)	0.638
Theta hat (MLE)	0.00178 Theta star (bias corrected MLE)	0.0021
nu hat (MLE)	21.04 nu star (bias corrected)	17.86
Adjusted Level of Significance ( $\beta$ )	0.0312	
Approximate Chi Square Value (17.86, $\alpha$ )	9.293 Adjusted Chi Square Value (17.86, $\beta$ )	8.483
95% Gamma Approximate UCL (use when n>=50)	0.00257 95% Gamma Adjusted UCL (use when n<50)	0.00282

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	6.23E-04 SD (KM)	6.47E-04
Variance (KM)	4.19E-07 SE of Mean (KM)	1.80E-04
k hat (KM)	0.928 k star (KM)	0.777
nu hat (KM)	25.99 nu star (KM)	21.75
theta hat (KM)	6.72E-04 theta star (KM)	8.02E-04
80% gamma percentile (KM)	0.00102 90% gamma percentile (KM)	0.00153
95% gamma percentile (KM)	0.00204 99% gamma percentile (KM)	0.00327

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (21.75, $\alpha$ )	12.15 Adjusted Chi Square Value (21.75, $\beta$ )	11.21
95% Gamma Approximate KM-UCL (use when n>=50)	0.00112 95% Gamma Adjusted KM-UCL (use when n<50)	0.00121

Near-Shore Sediment ProUCL Output

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.939	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.866	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.164	Lilliefors GOF Test	
5% Lilliefors Critical Value	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	6.28E-04	Mean in Log Scale	-7.767
SD in Original Scale	6.67E-04	SD in Log Scale	0.91
95% t UCL (assumes normality of ROS data)	9.44E-04	95% Percentile Bootstrap UCL	9.34E-04
95% BCA Bootstrap UCL	0.00104	95% Bootstrap t UCL	0.00133
95% H-UCL (Log ROS)	0.00125		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-7.915	KM Geo Mean	3.65E-04
KM SD (logged)	1.258	95% Critical H Value (KM-Log)	3.24
KM Standard Error of Mean (logged)	0.35	95% H-UCL (KM -Log)	0.00249
KM SD (logged)	1.258	95% Critical H Value (KM-Log)	3.24
KM Standard Error of Mean (logged)	0.35		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	6.23E-04	Mean in Log Scale	-7.964
SD in Original Scale	6.72E-04	SD in Log Scale	1.46
95% t UCL (Assumes normality)	9.41E-04	95% H-Stat UCL	0.00437

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 Gamma UCL	0.00121	95% GROS Adjusted Gamma UCL	0.00282
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Warning: Recommended UCL exceeds the maximum observation

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

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

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



















## UCL Statistics for Data Sets with Non-Detects

## User Selected Options

Date/Time of Computation	ProUCL 5.16/19/2017 3:20:52 PM
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

## Aluminum (Al)

## General Statistics

Total Number of Observations	457	Number of Distinct Observations	103
Number of Detects	161	Number of Non-Detects	296
Number of Distinct Detects	99	Number of Distinct Non-Detects	25
Minimum Detect	0.4	Minimum Non-Detect	0.4
Maximum Detect	242	Maximum Non-Detect	6.4
Variance Detects	930	Percent Non-Detects	64.77%
Mean Detects	14.26	SD Detects	30.5
Median Detects	3.1	CV Detects	2.139
Skewness Detects	5.101	Kurtosis Detects	31.59
Mean of Logged Detects	1.557	SD of Logged Detects	1.412

## Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.469	Normal GOF Test on Detected Observations Only
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.325	Lilliefors GOF Test
5% Lilliefors Critical Value	0.0702	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	5.324	KM Standard Error of Mean	0.901
KM SD	19.21	95% KM (BCA) UCL	6.915
95% KM (t) UCL	6.81	95% KM (Percentile Bootstrap) UCL	6.884
95% KM (z) UCL	6.807	95% KM Bootstrap t UCL	7.619
90% KM Chebyshev UCL	8.029	95% KM Chebyshev UCL	9.254
97.5% KM Chebyshev UCL	10.95	99% KM Chebyshev UCL	14.29

## Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	8.231	Anderson-Darling GOF Test
5% A-D Critical Value	0.814	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.19	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.0776	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)	0.566	k star (bias corrected MLE)	0.56
Theta hat (MLE)	25.18	Theta star (bias corrected MLE)	25.47
nu hat (MLE)	182.3	nu star (bias corrected)	180.2
Mean (detects)	14.26		

Fish Tissue EPC Output - Northern Pike

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	5.03
Maximum	242 Median	0.01
SD	19.31 CV	3.838
k hat (MLE)	0.184 k star (bias corrected MLE)	0.184
Theta hat (MLE)	27.33 Theta star (bias corrected MLE)	27.29
nu hat (MLE)	168.2 nu star (bias corrected)	168.5
Adjusted Level of Significance ( $\beta$ )	0.0495	
Approximate Chi Square Value (168.47, $\alpha$ )	139.5 Adjusted Chi Square Value (168.47, $\beta$ )	139.4
95% Gamma Approximate UCL (use when n>=50)	6.076 95% Gamma Adjusted UCL (use when n<50)	6.08

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	5.324 SD (KM)	19.21
Variance (KM)	369 SE of Mean (KM)	0.901
k hat (KM)	0.0768 k star (KM)	0.0778
nu hat (KM)	70.21 nu star (KM)	71.09
theta hat (KM)	69.31 theta star (KM)	68.46
80% gamma percentile (KM)	2.396 90% gamma percentile (KM)	12.4
95% gamma percentile (KM)	30.92 99% gamma percentile (KM)	95.56

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (71.09, $\alpha$ )	52.67 Adjusted Chi Square Value (71.09, $\beta$ )	52.62
95% Gamma Approximate KM-UCL (use when n>=50)	7.185 95% Gamma Adjusted KM-UCL (use when n<50)	7.192

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.927 Shapiro Wilk GOF Test	
5% Shapiro Wilk P Value	5.97E-10 Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.139 Lilliefors GOF Test	
5% Lilliefors Critical Value	0.0702 Detected Data Not Lognormal at 5% Significance Level	
Detected Data Not Lognormal at 5% Significance Level		

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	5.152 Mean in Log Scale	-1.035
SD in Original Scale	19.28 SD in Log Scale	2.43
95% t UCL (assumes normality of ROS data)	6.638 95% Percentile Bootstrap UCL	6.685
95% BCA Bootstrap UCL	7.041 95% Bootstrap t UCL	7.393
95% H-UCL (Log ROS)	10.28	

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	0.0265 KM Geo Mean	1.027
KM SD (logged)	1.418 95% Critical H Value (KM-Log)	2.471
KM Standard Error of Mean (logged)	0.0692 95% H-UCL (KM -Log)	3.309
KM SD (logged)	1.418 95% Critical H Value (KM-Log)	2.471
KM Standard Error of Mean (logged)	0.0692	

DL/2 Statistics

DL/2 Normal	DL/2 Log-Transformed	
Mean in Original Scale	5.368 Mean in Log Scale	0.0965
SD in Original Scale	19.22 SD in Log Scale	1.391
95% t UCL (Assumes normality)	6.85 95% H-Stat UCL	3.398
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

95% KM (Chebyshev) UCL	9.254
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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.

Fish Tissue EPC Output - Northern Pike

Antimony (Sb)

General Statistics

Total Number of Observations	297	Number of Distinct Observations	44
Number of Detects	25	Number of Non-Detects	272
Number of Distinct Detects	16	Number of Distinct Non-Detects	40
Minimum Detect	0.007	Minimum Non-Detect	0.006
Maximum Detect	0.067	Maximum Non-Detect	0.085
Variance Detects	3.10E-04	Percent Non-Detects	91.58%
Mean Detects	0.0215	SD Detects	0.0176
Median Detects	0.015	CV Detects	0.82
Skewness Detects	1.942	Kurtosis Detects	2.678
Mean of Logged Detects	-4.061	SD of Logged Detects	0.621

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.678	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.918	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.293	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.173	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	0.00908	KM Standard Error of Mean	5.80E-04
KM SD	0.00704	95% KM (BCA) UCL	0.0105
95% KM (t) UCL	0.01	95% KM (Percentile Bootstrap) UCL	0.0103
95% KM (z) UCL	0.01	95% KM Bootstrap t UCL	0.0101
90% KM Chebyshev UCL	0.0108	95% KM Chebyshev UCL	0.0116
97.5% KM Chebyshev UCL	0.0127	99% KM Chebyshev UCL	0.0148

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.856	Anderson-Darling GOF Test	
5% A-D Critical Value	0.754	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.217	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.176	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)	2.421	k star (bias corrected MLE)	2.157
Theta hat (MLE)	0.00887	Theta star (bias corrected MLE)	0.00996
nu hat (MLE)	121.1	nu star (bias corrected)	107.9
Mean (detects)	0.0215		

Fish Tissue EPC Output - Northern Pike

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	0.007 Mean	0.0116
Maximum	0.067 Median	0.01
SD	0.00647 CV	0.556
k hat (MLE)	8.4 k star (bias corrected MLE)	8.318
Theta hat (MLE)	0.00139 Theta star (bias corrected MLE)	0.0014
nu hat (MLE)	4990 nu star (bias corrected)	4941
Adjusted Level of Significance ( $\beta$ )	0.0492	
Approximate Chi Square Value (N/A, $\alpha$ )	4778 Adjusted Chi Square Value (N/A, $\beta$ )	4778
95% Gamma Approximate UCL (use when n>=50)	0.012 95% Gamma Adjusted UCL (use when n<50)	0.012

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.00908 SD (KM)	0.00704
Variance (KM)	4.95E-05 SE of Mean (KM)	5.80E-04
k hat (KM)	1.664 k star (KM)	1.65
nu hat (KM)	988.7 nu star (KM)	980
theta hat (KM)	0.00546 theta star (KM)	0.0055
80% gamma percentile (KM)	0.0139 90% gamma percentile (KM)	0.0185
95% gamma percentile (KM)	0.0229 99% gamma percentile (KM)	0.0329

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (980.05, $\alpha$ )	908.4 Adjusted Chi Square Value (980.05, $\beta$ )	908
95% Gamma Approximate KM-UCL (use when n>=50)	0.0098 95% Gamma Adjusted KM-UCL (use when n<50)	0.0098

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.879 Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.918 Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.165 Lilliefors GOF Test	
5% Lilliefors Critical Value	0.173 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	0.00722 Mean in Log Scale	-5.245
SD in Original Scale	0.00778 SD in Log Scale	0.758
95% t UCL (assumes normality of ROS data)	0.00796 95% Percentile Bootstrap UCL	0.00794
95% BCA Bootstrap UCL	0.00809 95% Bootstrap t UCL	0.00818
95% H-UCL (Log ROS)	0.00766	

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-4.829 KM Geo Mean	0.008
KM SD (logged)	0.429 95% Critical H Value (KM-Log)	1.764
KM Standard Error of Mean (logged)	0.0513 95% H-UCL (KM -Log)	0.00916
KM SD (logged)	0.429 95% Critical H Value (KM-Log)	1.764
KM Standard Error of Mean (logged)	0.0513	

DL/2 Statistics

DL/2 Normal	DL/2 Log-Transformed	
Mean in Original Scale	0.0124 Mean in Log Scale	-4.496
SD in Original Scale	0.00715 SD in Log Scale	0.458
95% t UCL (Assumes normality)	0.0131 95% H-Stat UCL	0.013
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

KM H-UCL	0.00916
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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.

Fish Tissue EPC Output - Northern Pike

Arsenic (As)

General Statistics

Total Number of Observations	457	Number of Distinct Observations	177
Number of Detects	195	Number of Non-Detects	262
Number of Distinct Detects	155	Number of Distinct Non-Detects	44
Minimum Detect	0.04	Minimum Non-Detect	0.06
Maximum Detect	2.634	Maximum Non-Detect	1.31
Variance Detects	0.125	Percent Non-Detects	57.33%
Mean Detects	0.321	SD Detects	0.353
Median Detects	0.19	CV Detects	1.099
Skewness Detects	2.814	Kurtosis Detects	11.55
Mean of Logged Detects	-1.571	SD of Logged Detects	0.913

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.722	Normal GOF Test on Detected Observations Only
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.213	Lilliefors GOF Test
5% Lilliefors Critical Value	0.0639	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	0.189	KM Standard Error of Mean	0.0124
KM SD	0.26	95% KM (BCA) UCL	0.211
95% KM (t) UCL	0.209	95% KM (Percentile Bootstrap) UCL	0.209
95% KM (z) UCL	0.209	95% KM Bootstrap t UCL	0.213
90% KM Chebyshev UCL	0.226	95% KM Chebyshev UCL	0.243
97.5% KM Chebyshev UCL	0.266	99% KM Chebyshev UCL	0.312

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	4.308	Anderson-Darling GOF Test
5% A-D Critical Value	0.777	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.116	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.0664	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)	1.288	k star (bias corrected MLE)	1.272
Theta hat (MLE)	0.25	Theta star (bias corrected MLE)	0.253
nu hat (MLE)	502.3	nu star (bias corrected)	495.9
Mean (detects)	0.321		



Fish Tissue EPC Output - Northern Pike

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	0.167
Maximum	2.634 Median	0.08
SD	0.271 CV	1.621
k hat (MLE)	0.617 k star (bias corrected MLE)	0.615
Theta hat (MLE)	0.271 Theta star (bias corrected MLE)	0.272
nu hat (MLE)	564.4 nu star (bias corrected)	562
Adjusted Level of Significance ( $\beta$ )	0.0495	
Approximate Chi Square Value (562.02, $\alpha$ )	508 Adjusted Chi Square Value (562.02, $\beta$ )	507.9
95% Gamma Approximate UCL (use when n>=50)	0.185 95% Gamma Adjusted UCL (use when n<50)	0.185

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.189 SD (KM)	0.26
Variance (KM)	0.0675 SE of Mean (KM)	0.0124
k hat (KM)	0.526 k star (KM)	0.524
nu hat (KM)	481.2 nu star (KM)	479.4
theta hat (KM)	0.358 theta star (KM)	0.36
80% gamma percentile (KM)	0.31 90% gamma percentile (KM)	0.505
95% gamma percentile (KM)	0.712 99% gamma percentile (KM)	1.219

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (479.36, $\alpha$ )	429.6 Adjusted Chi Square Value (479.36, $\beta$ )	429.4
95% Gamma Approximate KM-UCL (use when n>=50)	0.21 95% Gamma Adjusted KM-UCL (use when n<50)	0.21

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.955 Shapiro Wilk GOF Test	
5% Shapiro Wilk P Value	2.31E-05 Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.095 Lilliefors GOF Test	
5% Lilliefors Critical Value	0.0639 Detected Data Not Lognormal at 5% Significance Level	
Detected Data Not Lognormal at 5% Significance Level		

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.189 Mean in Log Scale	-2.134
SD in Original Scale	0.26 SD in Log Scale	0.887
95% t UCL (assumes normality of ROS data)	0.209 95% Percentile Bootstrap UCL	0.211
95% BCA Bootstrap UCL	0.212 95% Bootstrap t UCL	0.212
95% H-UCL (Log ROS)	0.191	

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-2.112 KM Geo Mean	0.121
KM SD (logged)	0.824 95% Critical H Value (KM-Log)	1.977
KM Standard Error of Mean (logged)	0.0452 95% H-UCL (KM -Log)	0.183
KM SD (logged)	0.824 95% Critical H Value (KM-Log)	1.977
KM Standard Error of Mean (logged)	0.0452	

DL/2 Statistics

DL/2 Normal	DL/2 Log-Transformed	
Mean in Original Scale	0.2 Mean in Log Scale	-2.011
SD in Original Scale	0.258 SD in Log Scale	0.795
95% t UCL (Assumes normality)	0.22 95% H-Stat UCL	0.197
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

95% KM (Chebyshev) UCL	0.243
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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.

Fish Tissue EPC Output - Northern Pike

Barium (Ba)

General Statistics

Total Number of Observations	457	Number of Distinct Observations	181
Number of Detects	222	Number of Non-Detects	235
Number of Distinct Detects	156	Number of Distinct Non-Detects	68
Minimum Detect	0.02	Minimum Non-Detect	0.015
Maximum Detect	4.25	Maximum Non-Detect	0.267
Variance Detects	0.172	Percent Non-Detects	51.42%
Mean Detects	0.195	SD Detects	0.415
Median Detects	0.119	CV Detects	2.123
Skewness Detects	8.319	Kurtosis Detects	77.41
Mean of Logged Detects	-2.12	SD of Logged Detects	0.826

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.313	Normal GOF Test on Detected Observations Only
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.338	Lilliefors GOF Test
5% Lilliefors Critical Value	0.0599	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	0.105	KM Standard Error of Mean	0.0141
KM SD	0.302	95% KM (BCA) UCL	0.135
95% KM (t) UCL	0.129	95% KM (Percentile Bootstrap) UCL	0.13
95% KM (z) UCL	0.129	95% KM Bootstrap t UCL	0.153
90% KM Chebyshev UCL	0.148	95% KM Chebyshev UCL	0.167
97.5% KM Chebyshev UCL	0.194	99% KM Chebyshev UCL	0.246

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	12.31	Anderson-Darling GOF Test
5% A-D Critical Value	0.78	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.202	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.0627	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)	1.165	k star (bias corrected MLE)	1.152
Theta hat (MLE)	0.168	Theta star (bias corrected MLE)	0.17
nu hat (MLE)	517.3	nu star (bias corrected)	511.6
Mean (detects)	0.195		

Fish Tissue EPC Output - Northern Pike

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	0.1
Maximum	4.25 Median	0.01
SD	0.303 CV	3.031
k hat (MLE)	0.568 k star (bias corrected MLE)	0.566
Theta hat (MLE)	0.176 Theta star (bias corrected MLE)	0.177
nu hat (MLE)	519.6 nu star (bias corrected)	517.5
Adjusted Level of Significance ( $\beta$ )	0.0495	
Approximate Chi Square Value (517.49, $\alpha$ )	465.7 Adjusted Chi Square Value (517.49, $\beta$ )	465.6
95% Gamma Approximate UCL (use when n>=50)	0.111 95% Gamma Adjusted UCL (use when n<50)	0.111

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.105 SD (KM)	0.302
Variance (KM)	0.0909 SE of Mean (KM)	0.0141
k hat (KM)	0.122 k star (KM)	0.123
nu hat (KM)	111.6 nu star (KM)	112.2
theta hat (KM)	0.863 theta star (KM)	0.858
80% gamma percentile (KM)	0.0948 90% gamma percentile (KM)	0.3
95% gamma percentile (KM)	0.599 99% gamma percentile (KM)	1.507

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (112.22, $\alpha$ )	88.76 Adjusted Chi Square Value (112.22, $\beta$ )	88.7
95% Gamma Approximate KM-UCL (use when n>=50)	0.133 95% Gamma Adjusted KM-UCL (use when n<50)	0.133

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.943 Shapiro Wilk GOF Test	
5% Shapiro Wilk P Value	1.03E-09 Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.108 Lilliefors GOF Test	
5% Lilliefors Critical Value	0.0599 Detected Data Not Lognormal at 5% Significance Level	
Detected Data Not Lognormal at 5% Significance Level		

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.105 Mean in Log Scale	-3.122
SD in Original Scale	0.302 SD in Log Scale	1.201
95% t UCL (assumes normality of ROS data)	0.128 95% Percentile Bootstrap UCL	0.131
95% BCA Bootstrap UCL	0.139 95% Bootstrap t UCL	0.155
95% H-UCL (Log ROS)	0.103	

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-3.077 KM Geo Mean	0.0461
KM SD (logged)	1.125 95% Critical H Value (KM-Log)	2.208
KM Standard Error of Mean (logged)	0.0575 95% H-UCL (KM -Log)	0.0974
KM SD (logged)	1.125 95% Critical H Value (KM-Log)	2.208
KM Standard Error of Mean (logged)	0.0575	

DL/2 Statistics

DL/2 Normal	DL/2 Log-Transformed	
Mean in Original Scale	0.107 Mean in Log Scale	-3.022
SD in Original Scale	0.301 SD in Log Scale	1.094
95% t UCL (Assumes normality)	0.13 95% H-Stat UCL	0.099
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

95% KM (Chebyshev) UCL	0.167
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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.

Fish Tissue EPC Output - Northern Pike

Cadmium (Cd)

General Statistics

Total Number of Observations	457	Number of Distinct Observations	26
Number of Detects	19	Number of Non-Detects	438
Number of Distinct Detects	10	Number of Distinct Non-Detects	21
Minimum Detect	0.002	Minimum Non-Detect	0.002
Maximum Detect	0.066	Maximum Non-Detect	0.04
Variance Detects	5.30E-04	Percent Non-Detects	95.84%
Mean Detects	0.0181	SD Detects	0.023
Median Detects	0.003	CV Detects	1.271
Skewness Detects	1.119	Kurtosis Detects	-0.286
Mean of Logged Detects	-4.967	SD of Logged Detects	1.449

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.725	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.901	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.347	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.197	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	0.00271	KM Standard Error of Mean	2.70E-04
KM SD	0.00559	95% KM (BCA) UCL	0.00314
95% KM (t) UCL	0.00316	95% KM (Percentile Bootstrap) UCL	0.00318
95% KM (z) UCL	0.00316	95% KM Bootstrap t UCL	0.00335
90% KM Chebyshev UCL	0.00352	95% KM Chebyshev UCL	0.00389
97.5% KM Chebyshev UCL	0.0044	99% KM Chebyshev UCL	0.0054

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	2.064	Anderson-Darling GOF Test	
5% A-D Critical Value	0.789	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.289	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.208	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)	0.641	k star (bias corrected MLE)	0.575
Theta hat (MLE)	0.0283	Theta star (bias corrected MLE)	0.0315
nu hat (MLE)	24.34	nu star (bias corrected)	21.83
Mean (detects)	0.0181		

Fish Tissue EPC Output - Northern Pike

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	0.002 Mean	0.0104
Maximum	0.066 Median	0.01
SD	0.00492 CV	0.472
k hat (MLE)	10.1 k star (bias corrected MLE)	10.04
Theta hat (MLE)	0.00103 Theta star (bias corrected MLE)	0.00104
nu hat (MLE)	9233 nu star (bias corrected)	9174
Adjusted Level of Significance ( $\beta$ )	0.0495	
Approximate Chi Square Value (N/A, $\alpha$ )	8952 Adjusted Chi Square Value (N/A, $\beta$ )	8952
95% Gamma Approximate UCL (use when n>=50)	0.0107 95% Gamma Adjusted UCL (use when n<50)	0.0107

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.00271 SD (KM)	0.00559
Variance (KM)	3.12E-05 SE of Mean (KM)	2.70E-04
k hat (KM)	0.236 k star (KM)	0.236
nu hat (KM)	215.6 nu star (KM)	215.5
theta hat (KM)	0.0115 theta star (KM)	0.0115
80% gamma percentile (KM)	0.00386 90% gamma percentile (KM)	0.00818
95% gamma percentile (KM)	0.0134 99% gamma percentile (KM)	0.0273

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (215.49, $\alpha$ )	182.5 Adjusted Chi Square Value (215.49, $\beta$ )	182.4
95% Gamma Approximate KM-UCL (use when n>=50)	0.0032 95% Gamma Adjusted KM-UCL (use when n<50)	0.00321

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.764 Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.901 Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.246 Lilliefors GOF Test	
5% Lilliefors Critical Value	0.197 Detected Data Not Lognormal at 5% Significance Level	
Detected Data Not Lognormal at 5% Significance Level		

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.00142 Mean in Log Scale	-8.338
SD in Original Scale	0.00589 SD in Log Scale	1.803
95% t UCL (assumes normality of ROS data)	0.00187 95% Percentile Bootstrap UCL	0.0019
95% BCA Bootstrap UCL	0.00204 95% Bootstrap t UCL	0.00209
95% H-UCL (Log ROS)	0.00155	

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-6.147 KM Geo Mean	0.00214
KM SD (logged)	0.39 95% Critical H Value (KM-Log)	1.738
KM Standard Error of Mean (logged)	0.0209 95% H-UCL (KM -Log)	0.00238
KM SD (logged)	0.39 95% Critical H Value (KM-Log)	1.738
KM Standard Error of Mean (logged)	0.0209	

DL/2 Statistics

DL/2 Normal	DL/2 Log-Transformed	
Mean in Original Scale	0.00646 Mean in Log Scale	-5.441
SD in Original Scale	0.00689 SD in Log Scale	0.882
95% t UCL (Assumes normality)	0.00699 95% H-Stat UCL	0.00696
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

95% KM (Chebyshev) UCL	0.00389
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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.

Fish Tissue EPC Output - Northern Pike

Chromium (Cr)

General Statistics

Total Number of Observations	457	Number of Distinct Observations	49
Number of Detects	30	Number of Non-Detects	427
Number of Distinct Detects	24	Number of Distinct Non-Detects	31
Minimum Detect	0.026	Minimum Non-Detect	0.025
Maximum Detect	3.57	Maximum Non-Detect	0.76
Variance Detects	1.017	Percent Non-Detects	93.44%
Mean Detects	0.662	SD Detects	1.008
Median Detects	0.0715	CV Detects	1.523
Skewness Detects	1.797	Kurtosis Detects	2.677
Mean of Logged Detects	-1.753	SD of Logged Detects	1.725

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.681	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.927	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.33	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.159	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	0.0679	KM Standard Error of Mean	0.0142
KM SD	0.299	95% KM (BCA) UCL	0.0921
95% KM (t) UCL	0.0914	95% KM (Percentile Bootstrap) UCL	0.0924
95% KM (z) UCL	0.0913	95% KM Bootstrap t UCL	0.104
90% KM Chebyshev UCL	0.111	95% KM Chebyshev UCL	0.13
97.5% KM Chebyshev UCL	0.157	99% KM Chebyshev UCL	0.209

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	2.463	Anderson-Darling GOF Test	
5% A-D Critical Value	0.814	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.283	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.17	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)	0.477	k star (bias corrected MLE)	0.452
Theta hat (MLE)	1.386	Theta star (bias corrected MLE)	1.465
nu hat (MLE)	28.65	nu star (bias corrected)	27.11
Mean (detects)	0.662		

Fish Tissue EPC Output - Northern Pike

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	0.053
Maximum	3.57 Median	0.01
SD	0.301 CV	5.684
k hat (MLE)	0.439 k star (bias corrected MLE)	0.438
Theta hat (MLE)	0.121 Theta star (bias corrected MLE)	0.121
nu hat (MLE)	401.6 nu star (bias corrected)	400.3
Adjusted Level of Significance ( $\beta$ )	0.0495	
Approximate Chi Square Value (400.25, $\alpha$ )	354.9 Adjusted Chi Square Value (400.25, $\beta$ )	354.7
95% Gamma Approximate UCL (use when n>=50)	0.0598 95% Gamma Adjusted UCL (use when n<50)	0.0598

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0679 SD (KM)	0.299
Variance (KM)	0.0894 SE of Mean (KM)	0.0142
k hat (KM)	0.0516 k star (KM)	0.0527
nu hat (KM)	47.17 nu star (KM)	48.2
theta hat (KM)	1.316 theta star (KM)	1.288
80% gamma percentile (KM)	0.011 90% gamma percentile (KM)	0.111
95% gamma percentile (KM)	0.368 99% gamma percentile (KM)	1.446

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (48.20, $\alpha$ )	33.26 Adjusted Chi Square Value (48.20, $\beta$ )	33.22
95% Gamma Approximate KM-UCL (use when n>=50)	0.0984 95% Gamma Adjusted KM-UCL (use when n<50)	0.0985

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.837 Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.927 Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.24 Lilliefors GOF Test	
5% Lilliefors Critical Value	0.159 Detected Data Not Lognormal at 5% Significance Level	
Detected Data Not Lognormal at 5% Significance Level		

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0457 Mean in Log Scale	-8.376
SD in Original Scale	0.302 SD in Log Scale	3.319
95% t UCL (assumes normality of ROS data)	0.069 95% Percentile Bootstrap UCL	0.0701
95% BCA Bootstrap UCL	0.0814 95% Bootstrap t UCL	0.0804
95% H-UCL (Log ROS)	0.116	

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-3.534 KM Geo Mean	0.0292
KM SD (logged)	0.658 95% Critical H Value (KM-Log)	1.87
KM Standard Error of Mean (logged)	0.0328 95% H-UCL (KM -Log)	0.0384
KM SD (logged)	0.658 95% Critical H Value (KM-Log)	1.87
KM Standard Error of Mean (logged)	0.0328	

DL/2 Statistics

DL/2 Normal	DL/2 Log-Transformed	
Mean in Original Scale	0.0847 Mean in Log Scale	-3.305
SD in Original Scale	0.299 SD in Log Scale	0.958
95% t UCL (Assumes normality)	0.108 95% H-Stat UCL	0.0637
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

95% KM (Chebyshev) UCL	0.13
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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.

Fish Tissue EPC Output - Northern Pike

Copper (Cu)

General Statistics

Total Number of Observations	457	Number of Distinct Observations	186
Number of Detects	430	Number of Non-Detects	27
Number of Distinct Detects	178	Number of Distinct Non-Detects	11
Minimum Detect	0.12	Minimum Non-Detect	0.03
Maximum Detect	5.853	Maximum Non-Detect	0.23
Variance Detects	0.172	Percent Non-Detects	5.91%
Mean Detects	0.399	SD Detects	0.414
Median Detects	0.303	CV Detects	1.037
Skewness Detects	7.467	Kurtosis Detects	79.69
Mean of Logged Detects	-1.11	SD of Logged Detects	0.534

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.476	Normal GOF Test on Detected Observations Only	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.261	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.0431	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	0.378	KM Standard Error of Mean	0.0192
KM SD	0.41	95% KM (BCA) UCL	0.412
95% KM (t) UCL	0.41	95% KM (Percentile Bootstrap) UCL	0.411
95% KM (z) UCL	0.41	95% KM Bootstrap t UCL	0.422
90% KM Chebyshev UCL	0.436	95% KM Chebyshev UCL	0.462
97.5% KM Chebyshev UCL	0.498	99% KM Chebyshev UCL	0.569

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	18.64	Anderson-Darling GOF Test	
5% A-D Critical Value	0.762	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.164	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.0441	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)	2.755	k star (bias corrected MLE)	2.737
Theta hat (MLE)	0.145	Theta star (bias corrected MLE)	0.146
nu hat (MLE)	2369	nu star (bias corrected)	2354
Mean (detects)	0.399		



Fish Tissue EPC Output - Northern Pike

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	0.376
Maximum	5.853 Median	0.293
SD	0.412 CV	1.095
k hat (MLE)	1.631 k star (bias corrected MLE)	1.622
Theta hat (MLE)	0.231 Theta star (bias corrected MLE)	0.232
nu hat (MLE)	1491 nu star (bias corrected)	1483
Adjusted Level of Significance ( $\beta$ )	0.0495	
Approximate Chi Square Value (N/A, $\alpha$ )	1394 Adjusted Chi Square Value (N/A, $\beta$ )	1394
95% Gamma Approximate UCL (use when n>=50)	0.4 95% Gamma Adjusted UCL (use when n<50)	0.4

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.378 SD (KM)	0.41
Variance (KM)	0.168 SE of Mean (KM)	0.0192
k hat (KM)	0.849 k star (KM)	0.844
nu hat (KM)	775.6 nu star (KM)	771.8
theta hat (KM)	0.445 theta star (KM)	0.448
80% gamma percentile (KM)	0.616 90% gamma percentile (KM)	0.907
95% gamma percentile (KM)	1.203 99% gamma percentile (KM)	1.897

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (771.85, $\alpha$ )	708.4 Adjusted Chi Square Value (771.85, $\beta$ )	708.2
95% Gamma Approximate KM-UCL (use when n>=50)	0.412 95% Gamma Adjusted KM-UCL (use when n<50)	0.412

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.917 Shapiro Wilk GOF Test	
5% Shapiro Wilk P Value	0 Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.122 Lilliefors GOF Test	
5% Lilliefors Critical Value	0.0431 Detected Data Not Lognormal at 5% Significance Level	
Detected Data Not Lognormal at 5% Significance Level		

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.382 Mean in Log Scale	-1.18
SD in Original Scale	0.408 SD in Log Scale	0.589
95% t UCL (assumes normality of ROS data)	0.413 95% Percentile Bootstrap UCL	0.416
95% BCA Bootstrap UCL	0.42 95% Bootstrap t UCL	0.424
95% H-UCL (Log ROS)	0.384	

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-1.246 KM Geo Mean	0.288
KM SD (logged)	0.755 95% Critical H Value (KM-Log)	1.93
KM Standard Error of Mean (logged)	0.0354 95% H-UCL (KM -Log)	0.409
KM SD (logged)	0.755 95% Critical H Value (KM-Log)	1.93
KM Standard Error of Mean (logged)	0.0354	

DL/2 Statistics

DL/2 Normal	DL/2 Log-Transformed	
Mean in Original Scale	0.378 Mean in Log Scale	-1.244
SD in Original Scale	0.411 SD in Log Scale	0.751
95% t UCL (Assumes normality)	0.41 95% H-Stat UCL	0.409
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

95% KM (Chebyshev) UCL	0.462
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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.

Fish Tissue EPC Output - Northern Pike

Iron (Fe)

General Statistics

Total Number of Observations	457	Number of Distinct Observations	73
Number of Detects	219	Number of Non-Detects	238
Number of Distinct Detects	67	Number of Distinct Non-Detects	25
Minimum Detect	1.1	Minimum Non-Detect	2
Maximum Detect	174	Maximum Non-Detect	41
Variance Detects	361.3	Percent Non-Detects	52.08%
Mean Detects	8.941	SD Detects	19.01
Median Detects	3.9	CV Detects	2.126
Skewness Detects	5.744	Kurtosis Detects	38.97
Mean of Logged Detects	1.546	SD of Logged Detects	0.914

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.39	Normal GOF Test on Detected Observations Only
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.34	Lilliefors GOF Test
5% Lilliefors Critical Value	0.0603	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	5.775	KM Standard Error of Mean	0.636
KM SD	13.51	95% KM (BCA) UCL	6.954
95% KM (t) UCL	6.822	95% KM (Percentile Bootstrap) UCL	6.933
95% KM (z) UCL	6.82	95% KM Bootstrap t UCL	7.348
90% KM Chebyshev UCL	7.681	95% KM Chebyshev UCL	8.545
97.5% KM Chebyshev UCL	9.744	99% KM Chebyshev UCL	12.1

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	19.73	Anderson-Darling GOF Test
5% A-D Critical Value	0.789	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.232	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.0635	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)	0.906	k star (bias corrected MLE)	0.896
Theta hat (MLE)	9.871	Theta star (bias corrected MLE)	9.974
nu hat (MLE)	396.7	nu star (bias corrected)	392.6
Mean (detects)	8.941		

Fish Tissue EPC Output - Northern Pike

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	5.244
Maximum	174 Median	2.4
SD	13.83 CV	2.638
k hat (MLE)	0.307 k star (bias corrected MLE)	0.306
Theta hat (MLE)	17.08 Theta star (bias corrected MLE)	17.12
nu hat (MLE)	280.6 nu star (bias corrected)	280.1
Adjusted Level of Significance ( $\beta$ )	0.0495	
Approximate Chi Square Value (280.06, $\alpha$ )	242.3 Adjusted Chi Square Value (280.06, $\beta$ )	242.2
95% Gamma Approximate UCL (use when n>=50)	6.062 95% Gamma Adjusted UCL (use when n<50)	6.064

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	5.775 SD (KM)	13.51
Variance (KM)	182.4 SE of Mean (KM)	0.636
k hat (KM)	0.183 k star (KM)	0.183
nu hat (KM)	167.1 nu star (KM)	167.3
theta hat (KM)	31.59 theta star (KM)	31.55
80% gamma percentile (KM)	7.239 90% gamma percentile (KM)	17.43
95% gamma percentile (KM)	30.43 99% gamma percentile (KM)	66.75

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (167.31, $\alpha$ )	138.4 Adjusted Chi Square Value (167.31, $\beta$ )	138.3
95% Gamma Approximate KM-UCL (use when n>=50)	6.981 95% Gamma Adjusted KM-UCL (use when n<50)	6.985

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.879 Shapiro Wilk GOF Test	
5% Shapiro Wilk P Value	0 Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.129 Lilliefors GOF Test	
5% Lilliefors Critical Value	0.0603 Detected Data Not Lognormal at 5% Significance Level	
Detected Data Not Lognormal at 5% Significance Level		

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	5.905 Mean in Log Scale	1.254
SD in Original Scale	13.52 SD in Log Scale	0.803
95% t UCL (assumes normality of ROS data)	6.947 95% Percentile Bootstrap UCL	6.998
95% BCA Bootstrap UCL	7.259 95% Bootstrap t UCL	7.495
95% H-UCL (Log ROS)	5.207	

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	1.247 KM Geo Mean	3.481
KM SD (logged)	0.746 95% Critical H Value (KM-Log)	1.924
KM Standard Error of Mean (logged)	0.0394 95% H-UCL (KM -Log)	4.919
KM SD (logged)	0.746 95% Critical H Value (KM-Log)	1.924
KM Standard Error of Mean (logged)	0.0394	

DL/2 Statistics

DL/2 Normal	DL/2 Log-Transformed	
Mean in Original Scale	6.109 Mean in Log Scale	1.339
SD in Original Scale	13.5 SD in Log Scale	0.734
95% t UCL (Assumes normality)	7.15 95% H-Stat UCL	5.335
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

95% KM (Chebyshev) UCL	8.545
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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.

Fish Tissue EPC Output - Northern Pike

Manganese (Mn)

General Statistics

Total Number of Observations	457	Number of Distinct Observations	268
Number of Detects	357	Number of Non-Detects	100
Number of Distinct Detects	241	Number of Distinct Non-Detects	28
Minimum Detect	0.06	Minimum Non-Detect	0.009
Maximum Detect	3.26	Maximum Non-Detect	0.1
Variance Detects	0.114	Percent Non-Detects	21.88%
Mean Detects	0.303	SD Detects	0.337
Median Detects	0.194	CV Detects	1.112
Skewness Detects	4.111	Kurtosis Detects	25.31
Mean of Logged Detects	-1.525	SD of Logged Detects	0.747

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.624	Normal GOF Test on Detected Observations Only	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.241	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.0473	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	0.239	KM Standard Error of Mean	0.0151
KM SD	0.321	95% KM (BCA) UCL	0.265
95% KM (t) UCL	0.264	95% KM (Percentile Bootstrap) UCL	0.265
95% KM (z) UCL	0.264	95% KM Bootstrap t UCL	0.268
90% KM Chebyshev UCL	0.284	95% KM Chebyshev UCL	0.305
97.5% KM Chebyshev UCL	0.333	99% KM Chebyshev UCL	0.389

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	12.26	Anderson-Darling GOF Test	
5% A-D Critical Value	0.77	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.118	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.049	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)	1.655	k star (bias corrected MLE)	1.643
Theta hat (MLE)	0.183	Theta star (bias corrected MLE)	0.185
nu hat (MLE)	1181	nu star (bias corrected)	1173
Mean (detects)	0.303		

Fish Tissue EPC Output - Northern Pike

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	0.239
Maximum	3.26 Median	0.141
SD	0.322 CV	1.345
k hat (MLE)	0.776 k star (bias corrected MLE)	0.772
Theta hat (MLE)	0.308 Theta star (bias corrected MLE)	0.31
nu hat (MLE)	709.3 nu star (bias corrected)	705.9
Adjusted Level of Significance ( $\beta$ )	0.0495	
Approximate Chi Square Value (705.94, $\alpha$ )	645.3 Adjusted Chi Square Value (705.94, $\beta$ )	645.1
95% Gamma Approximate UCL (use when n>=50)	0.262 95% Gamma Adjusted UCL (use when n<50)	0.262

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.239 SD (KM)	0.321
Variance (KM)	0.103 SE of Mean (KM)	0.0151
k hat (KM)	0.553 k star (KM)	0.551
nu hat (KM)	505.2 nu star (KM)	503.2
theta hat (KM)	0.432 theta star (KM)	0.434
80% gamma percentile (KM)	0.394 90% gamma percentile (KM)	0.633
95% gamma percentile (KM)	0.887 99% gamma percentile (KM)	1.504

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (503.18, $\alpha$ )	452.2 Adjusted Chi Square Value (503.18, $\beta$ )	452
95% Gamma Approximate KM-UCL (use when n>=50)	0.266 95% Gamma Adjusted KM-UCL (use when n<50)	0.266

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.933 Shapiro Wilk GOF Test	
5% Shapiro Wilk P Value	0 Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.0809 Lilliefors GOF Test	
5% Lilliefors Critical Value	0.0473 Detected Data Not Lognormal at 5% Significance Level	
Detected Data Not Lognormal at 5% Significance Level		

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.246 Mean in Log Scale	-1.888
SD in Original Scale	0.317 SD in Log Scale	0.963
95% t UCL (assumes normality of ROS data)	0.271 95% Percentile Bootstrap UCL	0.272
95% BCA Bootstrap UCL	0.274 95% Bootstrap t UCL	0.273
95% H-UCL (Log ROS)	0.264	

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-2.22 KM Geo Mean	0.109
KM SD (logged)	1.471 95% Critical H Value (KM-Log)	2.522
KM Standard Error of Mean (logged)	0.069 95% H-UCL (KM -Log)	0.381
KM SD (logged)	1.471 95% Critical H Value (KM-Log)	2.522
KM Standard Error of Mean (logged)	0.069	

DL/2 Statistics

DL/2 Normal	DL/2 Log-Transformed	
Mean in Original Scale	0.239 Mean in Log Scale	-2.218
SD in Original Scale	0.322 SD in Log Scale	1.48
95% t UCL (Assumes normality)	0.264 95% H-Stat UCL	0.388
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

95% KM (Chebyshev) UCL	0.305
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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.

Fish Tissue EPC Output - Northern Pike

Mercury (Hg)

General Statistics

Total Number of Observations	456	Number of Distinct Observations	349
		Number of Missing Observations	0
Minimum	0.0169	Mean	0.434
Maximum	1.38	Median	0.38
SD	0.283	Std. Error of Mean	0.0133
Coefficient of Variation	0.653	Skewness	0.937

Normal GOF Test

Shapiro Wilk Test Statistic	0.909	Shapiro Wilk GOF Test	
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.0998	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.0419	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.456	95% Adjusted-CLT UCL (Chen-1995)	0.456
		95% Modified-t UCL (Johnson-1978)	0.456

Gamma GOF Test

A-D Test Statistic	0.819	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.765	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.0363	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.043	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data follow Appr. Gamma Distribution at 5% Significance Level			

Gamma Statistics

k hat (MLE)	2.252	k star (bias corrected MLE)	2.239
Theta hat (MLE)	0.193	Theta star (bias corrected MLE)	0.194
nu hat (MLE)	2054	nu star (bias corrected)	2042
MLE Mean (bias corrected)	0.434	MLE Sd (bias corrected)	0.29
		Approximate Chi Square Value (0.05)	1938
Adjusted Level of Significance	0.0495	Adjusted Chi Square Value	1938

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	0.457	95% Adjusted Gamma UCL (use when n<50)	0.457
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Fish Tissue EPC Output - Northern Pike

Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.964	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk P Value	3.19E-08	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.0759	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.0419	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-4.078	Mean of logged Data	-1.073
Maximum of Logged Data	0.322	SD of logged Data	0.74
Assuming Lognormal Distribution			
95% H-UCL	0.481	90% Chebyshev (MVUE) UCL	0.502
95% Chebyshev (MVUE) UCL	0.526	97.5% Chebyshev (MVUE) UCL	0.559
99% Chebyshev (MVUE) UCL	0.624		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	0.456	95% Jackknife UCL	0.456
95% Standard Bootstrap UCL	0.456	95% Bootstrap-t UCL	0.456
95% Hall's Bootstrap UCL	0.456	95% Percentile Bootstrap UCL	0.457
95% BCA Bootstrap UCL	0.456		
90% Chebyshev(Mean, Sd) UCL	0.474	95% Chebyshev(Mean, Sd) UCL	0.492
97.5% Chebyshev(Mean, Sd) UCL	0.517	99% Chebyshev(Mean, Sd) UCL	0.566
Suggested UCL to Use			
95% Approximate Gamma UCL	0.457		

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.

## Fish Tissue EPC Output - Northern Pike

## Nickel (Ni)

## General Statistics

Total Number of Observations	457	Number of Distinct Observations	101
Number of Detects	71	Number of Non-Detects	386
Number of Distinct Detects	58	Number of Distinct Non-Detects	68
Minimum Detect	0.01	Minimum Non-Detect	0.011
Maximum Detect	11.8	Maximum Non-Detect	0.243
Variance Detects	5.736	Percent Non-Detects	84.46%
Mean Detects	1.039	SD Detects	2.395
Median Detects	0.055	CV Detects	2.305
Skewness Detects	3.272	Kurtosis Detects	10.79
Mean of Logged Detects	-2.042	SD of Logged Detects	2.053

## Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.49	Normal GOF Test on Detected Observations Only
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.334	Lilliefors GOF Test
5% Lilliefors Critical Value	0.105	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	0.172	KM Standard Error of Mean	0.0475
KM SD	1.008	95% KM (BCA) UCL	0.261
95% KM (t) UCL	0.25	95% KM (Percentile Bootstrap) UCL	0.256
95% KM (z) UCL	0.25	95% KM Bootstrap t UCL	0.289
90% KM Chebyshev UCL	0.315	95% KM Chebyshev UCL	0.379
97.5% KM Chebyshev UCL	0.469	99% KM Chebyshev UCL	0.645

## Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	5.936	Anderson-Darling GOF Test
5% A-D Critical Value	0.859	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.247	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.115	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)	0.327	k star (bias corrected MLE)	0.322
Theta hat (MLE)	3.179	Theta star (bias corrected MLE)	3.223
nu hat (MLE)	46.42	nu star (bias corrected)	45.79
Mean (detects)	1.039		

## 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	0.17
Maximum	11.8	Median	0.01
SD	1.01	CV	5.944
k hat (MLE)	0.286	k star (bias corrected MLE)	0.285
Theta hat (MLE)	0.595	Theta star (bias corrected MLE)	0.596
nu hat (MLE)	261	nu star (bias corrected)	260.6
Adjusted Level of Significance ( $\beta$ )	0.0495		
Approximate Chi Square Value (260.62, $\alpha$ )	224.2	Adjusted Chi Square Value (260.62, $\beta$ )	224.1
95% Gamma Approximate UCL (use when $n \geq 50$ )	0.197	95% Gamma Adjusted UCL (use when $n < 50$ )	0.198



Fish Tissue EPC Output - Northern Pike

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.172 SD (KM)	1.008
Variance (KM)	1.017 SE of Mean (KM)	0.0475
k hat (KM)	0.0291 k star (KM)	0.0304
nu hat (KM)	26.64 nu star (KM)	27.79
theta hat (KM)	5.907 theta star (KM)	5.661
80% gamma percentile (KM)	0.00212 90% gamma percentile (KM)	0.104
95% gamma percentile (KM)	0.675 99% gamma percentile (KM)	4.428

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (27.79, $\alpha$ )	16.77 Adjusted Chi Square Value (27.79, $\beta$ )	16.74
95% Gamma Approximate KM-UCL (use when $n \geq 50$ )	0.285 95% Gamma Adjusted KM-UCL (use when $n < 50$ )	0.286

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.864 Shapiro Wilk GOF Test	
5% Shapiro Wilk P Value	1.19E-08 Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.199 Lilliefors GOF Test	
5% Lilliefors Critical Value	0.105 Detected Data Not Lognormal at 5% Significance Level	
Detected Data Not Lognormal at 5% Significance Level		

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.165 Mean in Log Scale	-6.19
SD in Original Scale	1.011 SD in Log Scale	2.678
95% t UCL (assumes normality of ROS data)	0.243 95% Percentile Bootstrap UCL	0.248
95% BCA Bootstrap UCL	0.263 95% Bootstrap t UCL	0.283
95% H-UCL (Log ROS)	0.121	

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-4.052 KM Geo Mean	0.0174
KM SD (logged)	1.209 95% Critical H Value (KM-Log)	2.28
KM Standard Error of Mean (logged)	0.0651 95% H-UCL (KM -Log)	0.0411
KM SD (logged)	1.209 95% Critical H Value (KM-Log)	2.28
KM Standard Error of Mean (logged)	0.0651	

DL/2 Statistics

DL/2 Normal	DL/2 Log-Transformed	
Mean in Original Scale	0.176 Mean in Log Scale	-3.844
SD in Original Scale	1.009 SD in Log Scale	1.191
95% t UCL (Assumes normality)	0.254 95% H-Stat UCL	0.0493
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

95% KM (Chebyshev) UCL	0.379
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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.

## Fish Tissue EPC Output - Northern Pike

## Selenium (Se)

## General Statistics

Total Number of Observations	457	Number of Distinct Observations	180
Number of Detects	215	Number of Non-Detects	242
Number of Distinct Detects	162	Number of Distinct Non-Detects	52
Minimum Detect	0.18	Minimum Non-Detect	0.09
Maximum Detect	1.03	Maximum Non-Detect	1.7
Variance Detects	0.0267	Percent Non-Detects	52.95%
Mean Detects	0.538	SD Detects	0.163
Median Detects	0.54	CV Detects	0.304
Skewness Detects	0.333	Kurtosis Detects	0.111
Mean of Logged Detects	-0.67	SD of Logged Detects	0.324

## Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.973	Normal GOF Test on Detected Observations Only	
5% Shapiro Wilk P Value	0.0481	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.0403	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.0608	Detected Data appear Normal at 5% Significance Level	
Detected Data appear Approximate Normal at 5% Significance Level			

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

KM Mean	0.314	KM Standard Error of Mean	0.0119
KM SD	0.246	95% KM (BCA) UCL	0.346
95% KM (t) UCL	0.334	95% KM (Percentile Bootstrap) UCL	0.341
95% KM (z) UCL	0.334	95% KM Bootstrap t UCL	0.332
90% KM Chebyshev UCL	0.35	95% KM Chebyshev UCL	0.366
97.5% KM Chebyshev UCL	0.388	99% KM Chebyshev UCL	0.432

## Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.959	Anderson-Darling GOF Test	
5% A-D Critical Value	0.752	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.0766	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.0618	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)	10.29	k star (bias corrected MLE)	10.15
Theta hat (MLE)	0.0523	Theta star (bias corrected MLE)	0.053
nu hat (MLE)	4426	nu star (bias corrected)	4366
Mean (detects)	0.538		

## 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	0.0179	Mean	0.365
Maximum	1.03	Median	0.31
SD	0.207	CV	0.567
k hat (MLE)	2.766	k star (bias corrected MLE)	2.75
Theta hat (MLE)	0.132	Theta star (bias corrected MLE)	0.133
nu hat (MLE)	2528	nu star (bias corrected)	2513
Adjusted Level of Significance ( $\beta$ )	0.0495		
Approximate Chi Square Value (N/A, $\alpha$ )	2398	Adjusted Chi Square Value (N/A, $\beta$ )	2397
95% Gamma Approximate UCL (use when n>=50)	0.382	95% Gamma Adjusted UCL (use when n<50)	0.383

## Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.314	SD (KM)	0.246
Variance (KM)	0.0606	SE of Mean (KM)	0.0119
k hat (KM)	1.629	k star (KM)	1.619
nu hat (KM)	1489	nu star (KM)	1480
theta hat (KM)	0.193	theta star (KM)	0.194
80% gamma percentile (KM)	0.482	90% gamma percentile (KM)	0.642
95% gamma percentile (KM)	0.798	99% gamma percentile (KM)	1.146

Fish Tissue EPC Output - Northern Pike

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (N/A, $\alpha$ )	1392	Adjusted Chi Square Value (N/A, $\beta$ )	1391
95% Gamma Approximate KM-UCL (use when $n \geq 50$ )	0.334	95% Gamma Adjusted KM-UCL (use when $n < 50$ )	0.334

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.964	Shapiro Wilk GOF Test	
5% Shapiro Wilk P Value	0.00122	Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.0961	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.0608	Detected Data Not Lognormal at 5% Significance Level	

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.385	Mean in Log Scale	-1.065
SD in Original Scale	0.187	SD in Log Scale	0.467
95% t UCL (assumes normality of ROS data)	0.399	95% Percentile Bootstrap UCL	0.399
95% BCA Bootstrap UCL	0.399	95% Bootstrap t UCL	0.4
95% H-UCL (Log ROS)	0.4		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-1.519	KM Geo Mean	0.219
KM SD (logged)	0.879	95% Critical H Value (KM-Log)	2.016
KM Standard Error of Mean (logged)	0.044	95% H-UCL (KM -Log)	0.35
KM SD (logged)	0.879	95% Critical H Value (KM-Log)	2.016
KM Standard Error of Mean (logged)	0.044		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.331	Mean in Log Scale	-1.385
SD in Original Scale	0.233	SD in Log Scale	0.774
95% t UCL (Assumes normality)	0.349	95% H-Stat UCL	0.363

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL 0.334

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.

Fish Tissue EPC Output - Northern Pike

Vanadium (V)

General Statistics

Total Number of Observations	457	Number of Distinct Observations	132
Number of Detects	4	Number of Non-Detects	453
Number of Distinct Detects	4	Number of Distinct Non-Detects	132
Minimum Detect	0.039	Minimum Non-Detect	0.024
Maximum Detect	0.057	Maximum Non-Detect	0.591
Variance Detects	6.43E-05	Percent Non-Detects	99.12%
Mean Detects	0.0468	SD Detects	0.00802
Median Detects	0.0455	CV Detects	0.171
Skewness Detects	0.667	Kurtosis Detects	-1.242
Mean of Logged Detects	-3.074	SD of Logged Detects	0.169

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.952	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Detected Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.223	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.375	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	0.0244	KM Standard Error of Mean	2.54E-04
KM SD	0.00322	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.0248	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.0248	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.0252	95% KM Chebyshev UCL	0.0255
97.5% KM Chebyshev UCL	0.026	99% KM Chebyshev UCL	0.027

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.261	Anderson-Darling GOF Test	
5% A-D Critical Value	0.656	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.248	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.394	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)	46.51	k star (bias corrected MLE)	11.79
Theta hat (MLE)	0.00101	Theta star (bias corrected MLE)	0.00396
nu hat (MLE)	372.1	nu star (bias corrected)	94.36
Mean (detects)	0.0468		

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	0.0109
Maximum	0.057	Median	0.01
SD	0.00435	CV	0.399
k hat (MLE)	14.89	k star (bias corrected MLE)	14.79
Theta hat (MLE)	7.32E-04	Theta star (bias corrected MLE)	7.37E-04
nu hat (MLE)	13610	nu star (bias corrected)	13522
Adjusted Level of Significance ( $\beta$ )	0.0495		
Approximate Chi Square Value (N/A, $\alpha$ )	13253	Adjusted Chi Square Value (N/A, $\beta$ )	13252
95% Gamma Approximate UCL (use when n>=50)	0.0111	95% Gamma Adjusted UCL (use when n<50)	N/A

Fish Tissue EPC Output - Northern Pike

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0244	SD (KM)	0.00322
Variance (KM)	1.03E-05	SE of Mean (KM)	2.54E-04
k hat (KM)	57.72	k star (KM)	57.34
nu hat (KM)	52758	nu star (KM)	52413
theta hat (KM)	4.23E-04	theta star (KM)	4.26E-04
80% gamma percentile (KM)	0.0271	90% gamma percentile (KM)	0.0286
95% gamma percentile (KM)	0.03	99% gamma percentile (KM)	0.0326

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (N/A, $\alpha$ )	51882	Adjusted Chi Square Value (N/A, $\beta$ )	51880
95% Gamma Approximate KM-UCL (use when $n \geq 50$ )	0.0247	95% Gamma Adjusted KM-UCL (use when $n < 50$ )	0.0247

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.962	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.216	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.375	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	0.0136	Mean in Log Scale	-4.377
SD in Original Scale	0.00585	SD in Log Scale	0.386
95% t UCL (assumes normality of ROS data)	0.014	95% Percentile Bootstrap UCL	0.014
95% BCA Bootstrap UCL	0.014	95% Bootstrap t UCL	0.0141
95% H-UCL (Log ROS)	0.014		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-3.717	KM Geo Mean	0.0243
KM SD (logged)	0.0912	95% Critical H Value (KM-Log)	N/A
KM Standard Error of Mean (logged)	0.00723	95% H-UCL (KM -Log)	N/A
KM SD (logged)	0.0912	95% Critical H Value (KM-Log)	N/A
KM Standard Error of Mean (logged)	0.00723		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.0348	Mean in Log Scale	-3.603
SD in Original Scale	0.0281	SD in Log Scale	0.686
95% t UCL (Assumes normality)	0.037	95% H-Stat UCL	0.0366
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	0.0248
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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.

## Fish Tissue EPC Output - Northern Pike

Zinc (Zn)

## General Statistics

Total Number of Observations	458	Number of Distinct Observations	388
		Number of Missing Observations	0
Minimum	2.8	Mean	8.074
Maximum	39.4	Median	6.753
SD	4.701	Std. Error of Mean	0.22
Coefficient of Variation	0.582	Skewness	2.49

## Normal GOF Test

Shapiro Wilk Test Statistic	0.784	Shapiro Wilk GOF Test	
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.152	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.0418	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	8.436	95% Adjusted-CLT UCL (Chen-1995)	8.462
		95% Modified-t UCL (Johnson-1978)	8.44

## Gamma GOF Test

A-D Test Statistic	7.742	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.758	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.0848	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.0426	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			

## Gamma Statistics

k hat (MLE)	4.233	k star (bias corrected MLE)	4.207
Theta hat (MLE)	1.907	Theta star (bias corrected MLE)	1.919
nu hat (MLE)	3877	nu star (bias corrected)	3853
MLE Mean (bias corrected)	8.074	MLE Sd (bias corrected)	3.936
		Approximate Chi Square Value (0.05)	3710
Adjusted Level of Significance	0.0495	Adjusted Chi Square Value	3710

## Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	8.386	95% Adjusted Gamma UCL (use when n<50)	8.387
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## Lognormal GOF Test

Shapiro Wilk Test Statistic	0.953	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk P Value	1.11E-16	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.0611	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.0418	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			

## Lognormal Statistics

Minimum of Logged Data	1.03	Mean of logged Data	1.966
Maximum of Logged Data	3.674	SD of logged Data	0.471

## Assuming Lognormal Distribution

95% H-UCL	8.298	90% Chebyshev (MVUE) UCL	8.532
95% Chebyshev (MVUE) UCL	8.784	97.5% Chebyshev (MVUE) UCL	9.133
99% Chebyshev (MVUE) UCL	9.818		

## Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Fish Tissue EPC Output - Northern Pike

Nonparametric Distribution Free UCLs

95% CLT UCL	8.435	95% Jackknife UCL	8.436
95% Standard Bootstrap UCL	8.429	95% Bootstrap-t UCL	8.461
95% Hall's Bootstrap UCL	8.461	95% Percentile Bootstrap UCL	8.427
95% BCA Bootstrap UCL	8.471		
90% Chebyshev(Mean, Sd) UCL	8.733	95% Chebyshev(Mean, Sd) UCL	9.031
97.5% Chebyshev(Mean, Sd) UCL	9.446	99% Chebyshev(Mean, Sd) UCL	10.26

Suggested UCL to Use

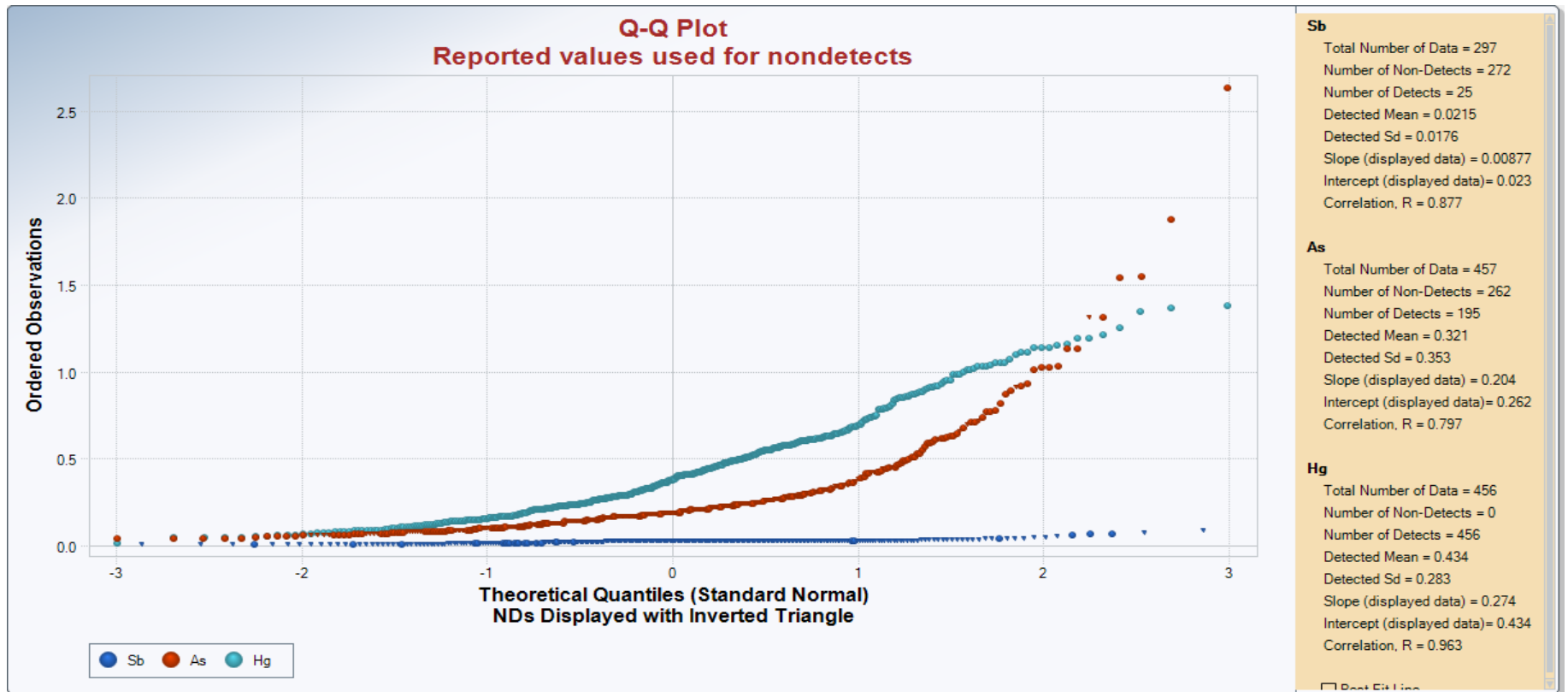
95% Student's-t UCL	8.436	or 95% Modified-t UCL	8.44
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Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness.

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.

Figure D-1. Q-Q Plot - Northern Pike





## Northern Pike Outlier Test

Outlier Tests for Selected Variables replacing nondetects with 1/2 the Detection Limit

User Selected Options

Date/Time of Computation ProUCL 5.17/24/2017 2:43:47 PM

From File WorkSheet.xls

Full Precision OFF

Rosner's Outlier Test for 1 Outliers in Sb

Total N 297  
Number NDs 272  
Number Detects 297  
Mean with NDs=DL/2 0.0124  
SD with NDs=DL/2 0.00715  
Number of data 297  
Number of suspected outliers 1  
NDs replaced with half value.

#	Mean	sd	Potential outlier	Obs. Number	Test value	Critical value (5%)	Critical value (1%)
1	0.0124	0.00714	0.067	201	7.647	3.717	4.087

For 5% Significance Level, there is 1 Potential Outlier  
Therefore, Observation 0.067 is a Potential Statistical Outlier

For 1% Significance Level, there is 1 Potential Outlier

Rosner's Outlier Test for 1 Outliers in As

Total N 457  
Number NDs 262  
Number Detects 457  
Mean with NDs=DL/2 0.2  
SD with NDs=DL/2 0.258  
Number of data 457  
Number of suspected outliers 1  
NDs replaced with half value.

### Northern Pike Outlier Test

#	Mean	sd	Potential outlier	Obs. Number	Test value	Critical value (5%)	Critical value (1%)
1	0.2	0.258	2.634	3	9.442	3.841	4.204

For 5% Significance Level, there is 1 Potential Outlier  
Therefore, Observation 2.634 is a Potential Statistical Outlier

For 1% Significance Level, there is 1 Potential Outlier

### Rosner's Outlier Test for 1 Outliers in Hg

Total N	456
Number NDs	0
Number Detects	456
Mean with NDs=DL/2	0.434
SD with NDs=DL/2	0.283
Number of data	456
Number of suspected outliers	1
NDs replaced with half value.	

#	Mean	sd	Potential outlier	Obs. Number	Test value	Critical value (5%)	Critical value (1%)
1	0.434	0.283	1.38	419	3.343	3.841	4.204

For 5% Significance Level, there is no Potential Outlier

For 1% Significance Level, there is no Potential Outlier

Table D-3. Fish Tissue ProUCL Input - Burbot

Species: Burbot  
 Waterbody: All  
 Muscle, replicates removed  
 Units: mg/kg - Hg units converted

Sample Species	Al	D_Al	Sb	D_Sb	As	D_As	Ba	D_Ba	Cd	D_Cd	Cr	D_Cr	Cu	D_Cu	Fe	D_Fe	Mn	D_Mn	Hg	D_Hg	Ni	D_Ni	Se	D_Se	V	D_V	Zn	D_Zn
Burbot	1.000	0	0.025	0	3.306	1	0.091	1	0.025	0	0.025	0	0.305	1	3.700	1	0.213	1	0.11	1	0.025	1	0.562	1	0.025	1	5.411	1
Burbot	1.000	0	0.025	0	3.667	1	0.110	1	0.025	0	0.025	0	0.259	1	3.900	1	0.147	1	0.32	1	0.025	1	0.880	1	0.025	1	6.515	1
Burbot	1.000	0	0.025	0	3.178	1	0.090	1	0.025	0	0.025	0	0.433	1	5.100	1	0.076	1	0.15101	1	0.025	1	0.563	1	0.025	1	5.308	1
Burbot	1.000	0	0.025	0	0.203	1	0.065	1	0.025	0	0.025	0	0.344	1	3.700	1	0.098	1	0.58064	1	0.025	1	0.897	1	0.025	1	5.296	1
Burbot	1.000	0	0.025	0	1.584	1	0.108	1	0.025	0	0.025	0	0.328	1	2.900	1	0.105	1	0.26537	1	0.025	1	0.725	1	0.025	1	5.705	1
Burbot	1.200	1	0.025	0	0.209	1	0.097	1	0.025	0	0.151	1	0.419	1	5.900	1	0.170	1	0.41169	1	0.025	1	0.911	1	0.025	1	5.808	1
Burbot	1.000	0	0.025	0	4.144	1	0.176	1	0.025	0	0.025	0	0.426	1	4.500	1	0.197	1	0.3587	1	0.042	1	0.848	1	0.025	1	6.242	1
Burbot	1.000	0	0.025	0	2.231	1	0.141	1	0.025	0	0.055	1	0.362	1	3.700	1	0.141	1	0.19828	1	0.025	1	0.753	1	0.025	1	5.338	1
Burbot	1.000	0	0.025	0	0.171	1	0.091	1	0.025	0	0.025	0	0.382	1	3.600	1	0.147	1	0.45515	1	0.025	1	0.867	1	0.025	1	4.890	1
Burbot	1.000	0	0.025	0	0.251	1	0.085	1	0.025	0	0.025	0	0.270	1	1.700	1	0.195	1	0.45378	1	0.025	1	0.850	1	0.025	1	4.287	1
Burbot	1.000	0	0.025	0	3.914	1	0.069	1	0.025	0	0.025	0	0.443	1	3.600	1	0.168	1	0.12487	1	0.025	1	0.606	1	0.025	1	5.749	1
Burbot	1.000	0	0.025	0	0.453	1	0.064	1	0.025	0	0.025	0	0.313	1	2.900	1	0.144	1	0.1684	1	0.025	1	0.778	1	0.025	1	4.661	1
Burbot	1.000	0	0.025	0	4.340	1	0.093	1	0.025	0	0.025	0	0.584	1	4.600	1	0.132	1	0.15298	1	0.025	1	0.653	1	0.025	1	6.908	1
Burbot	1.000	0	0.025	0	0.287	1	0.055	1	0.025	0	0.025	1	0.464	1	3.600	1	0.178	1	0.39736	1	0.027	1	0.875	1	0.025	1	6.244	1
Burbot	1.000	0	0.025	0	0.288	1	0.127	1	0.025	0	0.025	0	0.535	1	4.900	1	0.379	1	0.33263	1	0.025	1	1.092	1	0.025	1	5.540	1
Burbot	1.000	0	0.025	0	3.847	1	0.104	1	0.025	0	0.025	0	0.364	1	3.900	1	0.146	1	0.32681	1	0.025	1	0.750	1	0.025	1	5.832	1
Burbot	1.000	0	0.025	0	1.694	1	0.110	1	0.025	0	0.025	0	0.305	1	4.000	1	0.171	1	0.18398	1	0.025	1	0.628	1	0.025	1	5.929	1
Burbot	1.000	0	0.025	0	0.158	1	0.080	1	0.025	0	0.025	0	0.529	1	3.400	1	0.106	1	0.57594	1	0.025	1	0.856	1	0.025	1	5.423	1
Burbot	1.000	0	0.025	0	1.351	1	0.125	1	0.025	0	0.025	0	0.378	1	3.800	1	0.188	1	0.22485	1	0.025	1	0.626	1	0.025	1	5.873	1
Burbot	1.000	0	0.025	0	3.142	1	0.137	1	0.025	0	0.025	0	0.357	1	3.500	1	0.240	1	0.0892	1	0.025	1	0.638	1	0.025	1	5.678	1
Burbot	1.000	0	0.025	0	0.204	1	0.142	1	0.025	0	0.034	1	0.337	1	2.700	1	0.185	1	0.3834	1	0.025	1	0.991	1	0.025	1	4.713	1
Burbot	2.100	1	0.025	0	3.078	1	0.114	1	0.025	0	0.025	0	0.262	1	4.900	1	0.205	1	0.18564	1	0.025	1	0.585	1	0.025	1	4.597	1
Burbot	1.000	0	0.025	0	0.238	1	0.131	1	0.025	0	0.025	0	0.345	1	3.900	1	0.256	1	0.51745	1	0.025	1	0.948	1	0.025	1	4.724	1
Burbot	1.000	0	0.025	0	2.127	1	0.095	1	0.025	0	0.025	0	0.345	1	3.200	1	0.161	1	0.1343	1	0.025	1	0.547	1	0.025	1	5.593	1
Burbot	1.000	0	0.025	0	8.451	1	0.122	1	0.025	0	0.025	0	0.405	1	3.500	1	0.156	1	0.28082	1	0.025	1	0.731	1	0.025	1	5.987	1
Burbot	1.000	0	0.025	0	0.241	1	0.091	1	0.025	0	0.025	0	0.207	1	1.800	1	0.107	1	0.13973	1	0.025	1	0.594	1	0.025	1	4.354	1
Burbot	1.000	0	0.025	0	0.899	1	0.102	1	0.025	0	0.025	0	0.306	1	2.300	1	0.127	1	0.42991	1	0.025	1	0.814	1	0.025	1	5.421	1
Burbot	1.000	0	0.025	0	1.938	1	0.092	1	0.025	0	0.025	0	0.304	1	2.600	1	0.178	1	0.38499	1	0.025	1	0.549	1	0.025	1	5.914	1
Burbot	1.000	0	0.025	0	0.153	1	0.107	1	0.025	0	0.025	0	0.351	1	2.300	1	0.136	1	0.54469	1	0.025	1	1.007	1	0.025	1	5.170	1
Burbot	1.000	0	0.025	0	2.237	1	0.143	1	0.025	0	0.025	0	0.323	1	5.400	1	0.153	1	0.34769	1	0.025	1	0.757	1	0.025	1	5.102	1
Burbot	1.000	0	0.025	0	0.162	1	0.095	1	0.025	0	0.025	0	0.387	1	2.900	1	0.164	1	0.41906	1	0.025	1	0.942	1	0.025	1	5.834	1
Burbot	1.000	0	0.025	0	1.903	1	0.062	1	0.025	0	0.025	0	0.303	1	3.400	1	0.213	1	0.13145	1	0.025	1	0.465	1	0.025	1	5.090	1
Burbot	1.000	0	0.025	0	0.120	1	0.108	1	0.025	0	0.025	0	0.360	1	2.400	1	0.282	1	0.6949	1	0.025	1	1.058	1	0.025	1	4.876	1
Burbot	1.100	1	0.025	0	2.190	1	0.098	1	0.025	0	0.025	0	0.333	1	5.900	1	0.280	1	0.31491	1	0.025	1	0.614	1	0.025	1	5.302	1
Burbot	1.000	0	0.025	0	7.026	1	0.055	1	0.025	0	0.078	1	0.299	1	3.000	1	0.266	1	0.13536	1	0.025	1	0.538	1	0.025	1	5.673	1
Burbot	1.000	0	0.025	0	0.081	1	0.083	1	0.025	0	0.025	0	0.258	1	1.800	1	0.219	1	0.43112	1	0.025	1	0.799	1	0.025	1	4.704	1
Burbot	1.000	0	0.025	0	5.680	1	0.085	1	0.025	0	0.025	0	0.272	1	3.100	1	0.259	1	0.13258	1	0.025	1	0.427	1	0.025	1	4.451	1
Burbot	1.000	0	0.025	0	0.322	1	0.095	1	0.025	0	0.025	0	0.322	1	3.500	1	0.219	1	0.65196	1	0.025	1	0.787	1	0.025	1	5.235	1
Burbot	1.000	0	0.025	0	0.677	1	0.169	1	0.025	0	0.155	1	0.249	1	4.200	1	0.185	1	0.78118	1	0.025	1	0.734	1	0.025	1	4.695	1
Burbot	1.000	0	0.025	0	0.435	1	0.095	1	0.025	0	0.435	0	0.304	1	3.400	1	0.114	1	0.56891	1	0.025	1	0.910	1	0.025	1	4.363	1
Burbot	1.000	0	0.025	0	0.114	1	0.080	1	0.025	0	0.026	1	0.275	1	2.300	1	0.132	1	0.63783	1	0.025	1	0.750	1	0.025	1	4.915	1
Burbot	1.000	0	0.025	0	0.088	1	0.157	1	0.025	0	0.025	0	0.392	1	3.800	1	0.205	1	1.04818	1	0.025	1	1.040	1	0.025	1	6.354	1
Burbot	1.000	0	0.025	0	0.072	1	0.126	1	0.025	0	0.025	0	0.294	1	3.100	1	0.223	1	0.60171	1	0.025	1	0.867	1	0.025	1	4.764	1
Burbot	1.000	0	0.025	0	0.087	1	0.097	1	0.025	0	0.025	0	0.345	1	3.500	1	0.140	1	0.77991	1	0.032	1	0.978	1	0.025	1	4.998	1
Burbot	1.000	0	0.025	0	0.235	1	0.071	1	0.025	0	0.025	0	0.383	1	4.200	1	0.174	1	0.53817	1	0.025	1	0.734	1	0.025	1	5.532	1
Burbot	1.000	0	0.025	0	0.089	1	0.105	1	0.025	0	0.089	0	0.352	1	2.500	1	0.204	1	0.66284	1	0.025	1	0.944	1	0.025	1	5.221	1
Burbot	1.000	0	0.025	0	3.135	1	0.142	1	0.025	0	0.025	0	0.226	1	2.500	1	0.117	1	0.23544	1	0.025	1	0.592	1	0.025	1	4.792	1
Burbot	1.000	0	0.025	0	0.127	1	0.105	1	0.025	0	0.156	1	0.253	1	3.400	1	0.274	1	0.88946	1	0.025	1	0.804	1	0.025	1	4.903	1
Burbot	1.000	0	0.025	0	0.090	1	0.098	1	0.025	0	0.025	0	0.368	1	2.700	1	0.153	1	0.91726	1	0.025	1	1.103	1	0.025	1	5.072	1
Burbot	1.000	0	0.025	0	0.090	1	0.088	1	0.025	0	0.025	0	0.291	1	2.600	1	0.232	1	0.62196	1	0.025	1	0.683	1	0.025	1	5.039	1
Burbot	1.000	0	0.025	0	0.189	1	0.104	1	0.025	0	0.025	0	0.192	1	1.600	1	0.198</											

Table D-3. Fish Tissue ProUCL Input - Burbot

Species: Burbot  
 Waterbody: All  
 Muscle, replicates removed  
 Units: mg/kg - Hg units converted

Sample Species	Al	D_Al	Sb	D_Sb	As	D_As	Ba	D_Ba	Cd	D_Cd	Cr	D_Cr	Cu	D_Cu	Fe	D_Fe	Mn	D_Mn	Hg	D_Hg	Ni	D_Ni	Se	D_Se	V	D_V	Zn	D_Zn
Burbot	1.000	0	0.025	0	0.204	1	0.120	1	0.025	0	0.025	0	0.332	1	4.000	1	0.242	1	0.95838	1	0.025	1	0.820	1	0.025	1	5.560	1
Burbot	1.000	0	0.025	0	0.644	1	0.156	1	0.025	0	0.025	0	0.358	1	3.100	1	0.121	1	0.45172	1	0.025	1	0.765	1	0.025	1	4.548	1
Burbot	1.000	1	0.025	0	0.244	1	0.116	1	0.025	0	0.201	1	0.335	1	4.200	1	0.181	1	0.65217	1	0.025	1	0.792	1	0.025	1	5.417	1
Burbot	1.000	1	0.025	0	0.113	1	0.159	1	0.025	0	0.048	1	0.427	1	2.900	1	0.228	1	0.38485	1	0.025	1	0.922	1	0.025	1	4.754	1
Burbot	1.000	0	0.025	0	0.157	1	0.051	1	0.025	0	0.025	0	0.261	1	2.700	1	0.208	1	0.45284	1	0.025	1	0.686	1	0.025	1	4.619	1
Burbot	1.000	0	0.025	0	0.166	1	0.597	1	0.025	0	0.025	0	0.429	1	3.800	1	0.142	1	0.26591	1	0.025	1	0.794	1	0.025	1	5.016	1
Burbot	1.000	0	0.025	0	0.154	1	0.119	1	0.025	0	0.025	0	0.311	1	3.200	1	0.148	1	0.72301	1	0.025	1	0.884	1	0.025	1	4.624	1
Burbot	1.000	0	0.025	0	0.108	1	0.154	1	0.025	0	0.025	0	0.351	1	2.800	1	0.165	1	0.61906	1	0.025	1	1.473	1	0.025	1	4.524	1
Burbot	1.000	0	0.025	0	0.175	1	0.369	1	0.025	0	0.025	0	0.456	1	4.200	1	0.189	1	0.8287	1	0.025	1	0.973	1	0.025	1	4.719	1
Burbot	1.000	0	0.025	0	0.126	1	0.552	1	0.025	0	0.028	1	0.368	1	3.000	1	0.120	1	0.34141	1	0.025	1	0.785	1	0.025	1	4.847	1
Burbot	1.000	0	0.025	0	0.110	1	0.102	1	0.025	0	0.025	0	0.259	1	2.500	1	0.223	1	0.24852	1	0.025	1	0.737	1	0.025	1	4.771	1
Burbot	1.000	0	0.025	0	0.087	1	0.107	1	0.025	0	0.025	0	0.286	1	2.400	1	0.199	1	0.26054	1	0.025	1	0.792	1	0.025	1	4.494	1
Burbot	1.000	0	0.025	0	0.154	1	0.116	1	0.025	0	0.071	1	0.340	1	4.000	1	0.142	1	0.54134	1	0.025	1	0.945	1	0.025	1	5.214	1
Burbot	1.000	0	0.025	0	0.106	1	0.577	1	0.025	0	0.025	0	0.463	1	4.700	1	0.242	1	0.52218	1	0.025	1	0.859	1	0.025	1	5.198	1
Burbot	1.000	0	0.025	0	0.121	1	0.086	1	0.025	0	0.025	0	0.416	1	2.900	1	0.208	1	0.27585	1	0.025	1	0.868	1	0.025	1	4.668	1
Burbot	1.000	0	0.025	0	0.101	1	0.467	1	0.025	0	0.025	0	0.465	1	3.200	1	0.175	1	0.42369	1	0.025	1	1.011	1	0.025	1	4.798	1
Burbot	1.000	0	0.025	0	0.100	1	0.576	1	0.025	0	0.025	0	0.439	1	3.000	1	0.177	1	0.31296	1	0.025	1	0.764	1	0.025	1	4.666	1
Burbot	1.000	0	0.025	0	0.145	1	0.308	1	0.025	0	0.025	0	0.496	1	5.400	1	0.210	1	0.7873	1	0.025	1	1.021	1	0.025	1	5.002	1
Burbot	1.000	0	0.025	0	0.824	1	0.122	1	0.025	0	0.025	0	0.275	1	2.800	1	0.137	1	0.34195	1	0.025	1	0.688	1	0.025	1	4.501	1
Burbot	1.000	0	0.025	0	0.137	1	0.056	1	0.025	0	0.036	1	0.240	1	2.400	1	0.265	1	0.57007	1	0.025	1	0.753	1	0.025	1	4.768	1
Burbot	1.000	0	0.025	0	0.373	1	0.332	1	0.025	0	0.025	0	0.317	1	3.600	1	0.224	1	0.3101	1	0.025	1	0.746	1	0.025	1	4.197	1
Burbot	1.000	0	0.025	0	0.193	1	0.118	1	0.025	0	0.025	0	0.533	1	5.000	1	0.260	1	0.76465	1	0.025	1	0.708	1	0.025	1	5.861	1
Burbot	1.000	0	0.025	0	0.146	1	0.281	1	0.025	0	0.025	0	0.411	1	4.000	1	0.218	1	0.817	1	0.025	1	0.989	1	0.025	1	5.111	1
Burbot	1.000	0	0.025	0	0.143	1	0.293	1	0.025	0	0.025	0	0.448	1	3.400	1	0.181	1	0.39192	1	0.025	1	0.838	1	0.025	1	4.666	1
Burbot	1.000	0	0.025	0	0.146	1	0.137	1	0.025	0	0.025	0	0.566	1	5.900	1	0.122	1	0.76398	1	0.025	1	0.720	1	0.025	1	6.061	1
Burbot	1.000	0	0.025	0	0.165	1	0.149	1	0.025	0	0.025	0	0.410	1	4.100	1	0.194	1	0.67235	1	0.025	1	0.908	1	0.025	1	4.957	1
Burbot	1.000	0	0.025	0	0.935	1	0.083	1	0.025	0	0.040	1	0.392	1	4.400	1	0.185	1	0.58519	1	0.025	1	0.750	1	0.025	1	5.768	1
Burbot	1.000	0	0.025	0	4.589	1	0.089	1	0.025	0	0.036	1	0.362	1	3.232	1	0.153	1	0.08284	1	0.025	1	0.480	1	0.025	1	6.241	1
Burbot	1.000	0	0.025	0	4.679	1	0.141	1	0.025	0	0.025	0	0.293	1	2.564	1	0.148	1	0.07909	1	0.025	1	0.380	1	0.025	1	5.321	1
Burbot	1.000	0	0.025	0	9.951	1	0.117	1	0.025	0	0.178	1	0.381	1	4.891	1	0.155	1	0.3075	1	0.025	1	0.541	1	0.025	1	6.819	1
Burbot	1.000	0	0.025	0	4.139	1	0.146	1	0.025	0	0.153	1	0.485	1	5.572	1	0.150	1	0.09027	1	0.030	1	0.487	1	0.025	1	7.060	1
Burbot	1.000	0	0.025	0	1.356	1	0.141	1	0.025	0	0.025	0	0.464	1	6.518	1	0.149	1	0.50184	1	0.025	1	0.576	1	0.025	1	7.376	1
Burbot	1.000	0	0.025	0	9.536	1	0.149	1	0.025	0	0.025	0	0.456	1	4.224	1	0.132	1	0.09093	1	0.025	1	0.430	1	0.025	1	7.041	1
Burbot	1.000	0	0.025	0	4.358	1	0.152	1	0.025	0	0.041	1	0.508	1	4.312	1	0.142	1	0.07711	1	0.025	1	0.424	1	0.025	1	6.783	1
Burbot	1.000	0	0.025	0	3.675	1	0.166	1	0.025	0	0.025	0	0.386	1	4.011	1	0.116	1	0.10914	1	0.025	1	0.473	1	0.025	1	6.145	1
Burbot	1.000	0	0.025	0	4.340	1	0.143	1	0.025	0	0.025	0	0.413	1	4.936	1	0.123	1	0.2714	1	0.025	1	0.462	1	0.025	1	7.080	1
Burbot	1.000	0	0.025	0	11.288	1	0.148	1	0.025	0	0.025	0	0.479	1	4.544	1	0.154	1	0.246	1	0.025	1	0.504	1	0.025	1	6.950	1
Burbot	1.000	0	0.025	0	2.522	1	0.158	1	0.025	0	0.025	0	0.342	1	2.692	1	0.114	1	0.09126	1	0.025	1	0.438	1	0.025	1	5.325	1
Burbot	1.000	0	0.025	0	3.344	1	0.216	1	0.025	0	0.025	0	0.481	1	3.198	1	0.109	1	0.1597	1	0.025	1	0.813	1	0.025	1	5.934	1
Burbot	1.000	0	0.025	0	4.048	1	0.162	1	0.025	0	0.162	1	0.377	1	4.007	1	0.104	1	0.06338	1	0.025	1	0.397	1	0.025	1	6.093	1
Burbot	1.000	0	0.025	0	1.440	1	0.169	1	0.025	0	0.025	0	0.487	1	4.069	1	0.094	1	0.14168	1	0.025	1	0.446	1	0.025	1	6.997	1
Burbot	1.000	0	0.025	0	3.734	1	0.192	1	0.025	0	0.025	0	0.450	1	5.357	1	0.093	1	0.10441	1	0.025	1	0.623	1	0.025	1	7.295	1
Burbot	1.331	1	0.025	0	1.707	1	0.191	1	0.025	0	0.025	0	0.481	1	5.996	1	0.079	1	0.13722	1	0.025	1	0.651	1	0.025	1	6.162	1
Burbot	2.611	1	0.025	0	1.949	1	0.174	1	0.025	0	0.025	0	0.569	1	7.926	1	0.089	1	0.13338	1	0.025	1	0.644	1	0.025	1	6.394	1
Burbot	1.145	1	0.025	0	6.215	1	0.162	1	0.025	0	0.025	0	0.476	1	5.591	1	0.085	1	0.10325	1	0.025	1	0.578	1	0.025	1	6.006	1
Burbot	1.000	0	0.025	0	1.280	1	0.154	1	0.025	0	0.025	0	0.594	1	4.429	1	0.091	1	0.07441	1	0.025	1	0.404	1	0.025	1	6.102	1
Burbot	1.000	0	0.025	0	1.930	1	0.197	1	0.025	0	0.025	0	0.386	1	3.218	1	0.087	1	0.11391	1	0.025	1	0.531	1	0.025	1	5.730	1
Burbot	1.000	0	0.025	0	3.538	1	0.097	1	0.025	0	0.992	1	0.406	1	10.542	1	0.158	1	0.07751	1	0.025	1	0.459	1	0.025	1	7.089	1
Burbot	1.000	0	0.025	0	1.986	1	0.168	1	0.025	0	0.025	0	0.531	1	6.102	1	0.138	1	0.08284	1	0.025	1	0.381	1	0.025	1	6.840	1
Burbot	1.000	0	0.025	0	3.696	1	0.100	1	0.025	0	0.025	0	0.459	1	6.662	1	0.098	1	0.07584	1	0.025	1	0.428	1	0.025	1	6.739	1
Burbot	1.000	0	0.025	0	0.892	1	0.111	1	0.025	0	0.025	0	0.487	1	4.410	1	0.											

Table D-3. Fish Tissue ProUCL Input - Burbot

Species: Burbot  
 Waterbody: All  
 Muscle, replicates removed  
 Units: mg/kg - Hg units converted

Sample Species	Al	D_Al	Sb	D_Sb	As	D_As	Ba	D_Ba	Cd	D_Cd	Cr	D_Cr	Cu	D_Cu	Fe	D_Fe	Mn	D_Mn	Hg	D_Hg	Ni	D_Ni	Se	D_Se	V	D_V	Zn	D_Zn
Burbot	1.000	0	0.025	0	0.740	1	0.176	1	0.025	0	0.025	0	0.511	1	5.136	1	0.187	1	0.4625	1	0.025	1	0.550	1	0.025	1	6.400	1
Burbot	1.000	0	0.025	0	6.883	1	0.159	1	0.025	0	0.025	0	0.324	1	2.368	1	0.148	1	0.17354	1	0.025	1	0.485	1	0.025	1	5.564	1
Burbot	1.000	0	0.025	0	0.244	1	0.176	1	0.025	0	0.025	0	0.369	1	5.518	1	0.185	1	0.28798	1	0.025	1	0.766	1	0.025	1	4.547	1
Burbot	1.000	0	0.025	0	0.529	1	0.177	1	0.025	0	0.025	0	0.278	1	2.193	1	0.196	1	0.5688	1	0.025	1	0.648	1	0.025	1	4.592	1
Burbot	1.000	0	0.025	0	6.206	1	0.141	1	0.025	0	0.025	0	0.412	1	2.848	1	0.166	1	0.1265	1	0.025	1	0.428	1	0.025	1	5.913	1
Burbot	1.000	0	0.025	0	5.745	1	0.130	1	0.025	0	0.025	0	0.355	1	2.544	1	0.243	1	0.09373	1	0.025	1	0.378	1	0.025	1	5.875	1
Burbot	1.000	0	0.025	0	4.975	1	0.125	1	0.025	0	0.025	0	0.263	1	2.047	1	0.204	1	0.07944	1	0.025	1	0.410	1	0.025	1	4.770	1
Burbot	1.000	0	0.025	0	4.674	1	0.122	1	0.025	0	0.025	0	0.348	1	3.177	1	0.217	1	0.16211	1	0.025	1	0.719	1	0.025	1	5.398	1
Burbot	1.000	0	0.025	0	5.251	1	0.191	1	0.025	0	0.699	1	0.467	1	9.586	1	0.183	1	0.16803	1	0.025	1	0.581	1	0.025	1	6.196	1
Burbot	1.523	1	0.025	0	1.229	1	0.154	1	0.025	0	0.036	1	0.394	1	3.192	1	0.180	1	0.35178	1	0.025	1	0.769	1	0.025	1	5.461	1
Burbot	1.056	1	0.025	0	5.392	1	0.162	1	0.025	0	0.025	0	0.305	1	2.617	1	0.186	1	0.11043	1	0.025	1	0.521	1	0.025	1	5.988	1
Burbot	1.000	0	0.025	0	2.647	1	0.167	1	0.025	0	0.025	0	0.381	1	2.750	1	0.190	1	0.1049	1	0.025	1	0.360	1	0.025	1	7.460	1
Burbot	1.000	0	0.025	0	4.023	1	0.103	1	0.025	0	0.025	0	0.375	1	3.241	1	0.192	1	0.2124	1	0.025	1	0.401	1	0.025	1	7.069	1
Burbot	1.000	0	0.025	0	0.437	1	0.127	1	0.025	0	0.025	0	0.478	1	3.676	1	0.284	1	0.43844	1	0.025	1	0.572	1	0.025	1	6.538	1
Burbot	1.000	0	0.025	0	0.889	1	0.133	1	0.025	0	0.025	0	0.359	1	3.142	1	0.178	1	0.15672	1	0.025	1	0.567	1	0.025	1	6.354	1
Burbot	1.000	0	0.025	0	3.568	1	0.150	1	0.025	0	0.025	0	0.467	1	4.328	1	0.159	1	0.15567	1	0.025	1	0.356	1	0.025	1	6.271	1
Burbot	1.000	0	0.025	0	4.124	1	0.145	1	0.025	0	0.025	0	0.405	1	2.105	1	0.198	1	0.04831	1	0.025	1	0.251	1	0.025	1	5.925	1
Burbot	1.000	0	0.025	0	9.127	1	0.151	1	0.025	0	0.025	0	0.604	1	8.222	1	0.150	1	0.10184	1	0.025	1	0.480	1	0.025	1	8.300	1
Burbot	1.000	0	0.025	0	4.818	1	0.133	1	0.025	0	0.025	0	0.357	1	2.048	1	0.226	1	0.07056	1	0.025	1	0.298	1	0.025	1	5.901	1
Burbot	1.000	0	0.025	0	3.178	1	0.134	1	0.025	0	0.025	0	0.370	1	2.985	1	0.189	1	0.23199	1	0.025	1	0.584	1	0.025	1	5.938	1
Burbot	1.000	0	0.025	0	4.016	1	0.116	1	0.025	0	0.025	0	0.386	1	3.978	1	0.194	1	0.09545	1	0.025	1	0.281	1	0.025	1	5.872	1
Burbot	1.000	0	0.025	0	2.983	1	0.165	1	0.025	0	0.025	0	0.492	1	3.587	1	0.174	1	0.2712	1	0.025	1	0.544	1	0.025	1	6.348	1
Burbot	1.700	0	0.008	1	4.850	1	0.072	0	0.011	0	0.210	0	0.080	1	11.000	1	0.027	1	0.0566	1	0.066	1	0.460	0	0.160	1	6.720	1
Burbot	0.800	0	0.011	0	2.910	1	0.032	0	0.005	0	0.090	0	0.040	1	5.000	1	0.340	1	0.0265	1	0.030	1	0.210	0	0.072	1	5.250	1
Burbot	0.800	0	0.008	0	4.700	1	0.035	0	0.005	0	0.100	0	0.290	1	5.000	1	0.254	1	0.138	1	0.032	1	0.220	0	0.078	1	5.920	1
Burbot	0.800	0	0.007	0	2.600	1	0.032	0	0.005	0	0.090	0	0.170	1	5.000	1	0.434	1	0.0335	1	0.030	1	0.210	0	0.072	1	3.370	1
Burbot	0.600	0	0.009	0	4.030	1	0.026	0	0.004	0	0.070	0	0.250	1	4.000	1	0.397	1	0.125	1	0.159	1	0.160	0	0.057	1	4.590	1
Burbot	0.700	0	0.011	0	0.140	0	0.029	0	0.004	0	0.080	0	0.200	1	4.000	1	0.341	1	0.339	1	0.026	1	0.180	0	0.064	1	4.830	1
Burbot	1.300	0	0.009	0	3.210	1	0.053	0	0.008	0	0.150	0	2.000	1	8.000	1	0.698	1	0.116	1	0.048	1	0.330	0	0.116	1	7.660	1
Burbot	0.700	0	0.007	0	0.130	0	0.027	0	0.004	0	0.080	0	0.170	1	4.000	1	0.420	1	0.18	1	0.025	1	0.170	0	0.060	1	3.340	1
Burbot	0.600	0	0.006	0	3.190	1	0.024	0	0.004	0	0.070	0	0.250	1	4.000	1	0.335	1	0.0501	1	0.021	1	0.150	0	0.052	1	4.700	1
Burbot	0.700	0	0.009	0	2.550	1	0.027	0	0.004	0	0.080	0	0.300	1	4.000	1	0.282	1	0.0546	1	0.025	1	0.170	0	0.061	1	4.790	1
Burbot	1.000	0	0.009	0	2.260	1	0.042	0	0.006	0	0.120	0	0.220	1	6.000	1	0.314	1	0.0793	1	0.038	1	0.260	0	0.092	1	6.090	1
Burbot	1.600	0	0.011	0	3.160	1	0.068	0	0.010	0	12.600	1	0.080	1	93.000	1	0.686	1	0.0552	1	0.359	1	0.430	0	0.149	1	5.350	1
Burbot	1.200	0	0.012	0	4.070	1	0.050	0	0.008	0	0.140	0	0.060	1	8.000	1	0.473	1	0.029	1	1.180	1	0.320	0	0.110	1	4.370	1
Burbot	1.000	0	0.006	0	2.630	1	0.043	0	0.006	0	0.120	0	0.240	1	7.000	1	0.302	1	0.176	1	0.039	1	0.270	0	0.094	1	7.220	1
Burbot	0.600	0	0.148	1	3.190	1	0.026	0	0.004	0	0.070	0	0.270	1	4.000	1	0.281	1	0.094	1	0.023	1	0.160	0	0.057	1	5.300	1
Burbot	0.700	0	0.027	1	3.370	1	0.029	0	0.004	0	0.080	0	0.640	1	5.000	1	0.302	1	0.13	1	0.027	1	0.190	0	0.065	1	8.340	1
Burbot	1.200	0	0.015	1	2.430	1	0.050	0	0.007	0	0.140	0	0.270	1	8.000	1	0.491	1	0.0419	1	0.045	1	0.310	0	0.109	1	5.680	1
Burbot	12.100	1	0.007	0	3.220	1	0.337	1	0.004	0	0.080	0	0.380	1	23.000	1	0.840	1	0.131	1	0.024	1	0.170	0	0.059	1	5.030	1
Burbot	0.600	0	0.006	0	3.290	1	0.026	0	0.004	0	0.070	0	0.280	1	4.000	1	0.360	1	0.0617	1	0.024	0	0.170	1	0.058	1	4.840	1
Burbot	0.600	0	0.010	0	1.870	1	0.027	0	0.004	0	0.080	0	0.240	1	4.000	1	0.329	1	0.0827	1	0.024	0	0.170	1	0.059	1	5.510	1
Burbot	0.600	0	0.092	1	4.290	1	0.026	0	0.004	0	0.070	0	0.230	1	4.000	1	0.425	1	0.091	1	0.024	0	0.170	1	0.058	1	4.360	1
Burbot	0.700	0	0.027	1	1.700	1	0.031	0	0.005	0	0.090	0	0.330	1	5.000	1	0.578	1	0.0768	1	0.028	0	0.200	1	0.069	1	5.620	1
Burbot	0.800	0	0.010	1	0.880	1	0.033	0	0.005	0	0.090	0	0.300	1	5.000	1	0.295	1	0.266	1	0.030	0	0.210	1	0.073	1	6.510	1
Burbot	1.100	0	0.007	0	3.870	1	0.045	0	0.007	0	0.130	0	0.220	1	7.000	1	0.453	1	0.0662	1	0.041	0	0.280	1	0.099	1	5.350	1
Burbot	9.200	1	0.010	0	5.160	1	0.043	0	0.006	0	0.120	0	0.280	1	7.000	1	1.420	1	0.0809	1	0.039	0	0.270	1	0.094	1	7.970	1
Burbot	0.800	0	0.017	1	0.170	0	0.035	0	0.005	0	0.100	0	1.400	1	5.000	1	0.671	1	0.217	1	0.032	0	0.230	1	0.078	1	6.060	1
Burbot	0.700	0	0.016	1	3.610	1	0.028	0	0.004	0	0.080	0	0.300	1	4.000	1	0.402	1	0.059	1	0.025	0	0.180	1	0.061	1	5.020	1
Burbot	0.800	0	0.015	1	3.780	1	0.033	0	0.005	0	0.090	0	0.250	1	5.000	1	0.378	1	0.0681	1	0.030	0	0.210	1	0.072	1	4.380	1
Burbot	2.300	0	0.010	1	0.470	0	0.096	0	0.014	0	5.580	1	0.110	1	15.000	1	0.88											

Table D-3. Fish Tissue ProUCL Input - Burbot

Species: Burbot  
 Waterbody: All  
 Muscle, replicates removed  
 Units: mg/kg - Hg units converted

Sample Species	Al	D_Al	Sb	D_Sb	As	D_As	Ba	D_Ba	Cd	D_Cd	Cr	D_Cr	Cu	D_Cu	Fe	D_Fe	Mn	D_Mn	Hg	D_Hg	Ni	D_Ni	Se	D_Se	V	D_V	Zn	D_Zn
Burbot	0.900	0			3.300	1	0.036	0	0.005	0	0.100	0	0.350	1	6.000	1	0.430	1	0.0119	0	0.033	1	0.230	1	0.079	1	6.370	1
Burbot	0.900	0			4.130	1	0.040	0	0.006	0	0.110	0	0.250	1	6.000	1	0.544	1	0.0863	1	3.150	1	0.250	1	0.088	1	5.190	1
Burbot	0.900	0			2.660	1	0.037	0	0.006	0	0.110	0	0.280	1	6.000	1	0.618	1	0.124	1	0.034	1	0.240	1	0.082	1	7.240	1
Burbot	2.300	0			5.850	1	0.098	0	0.015	0	0.280	0	0.110	1	15.000	1	0.037	1	0.203	1	0.089	1	0.620	1	0.217	1	4.840	1
Burbot	2.400	0			0.490	0	0.100	0	0.015	0	0.280	0	0.120	1	15.000	1	0.837	1	0.748	1	0.929	1	0.640	1	0.221	1	5.350	1
Burbot	1.700	0			0.350	0	0.070	0	0.011	0	0.200	0	0.080	1	11.000	1	0.812	1	0.527	1	5.120	1	0.450	1	0.156	1	7.690	1
Burbot	1.000	0			0.200	0	0.040	0	0.006	0	0.110	0	0.250	1	6.000	1	0.473	1	0.277	1	0.036	1	0.250	1	0.088	1	4.610	1
Burbot	2.100	0			0.430	0	0.088	0	0.013	0	1.440	1	0.100	1	14.000	1	0.658	1	0.141	1	0.036	1	0.560	1	0.194	1	5.840	1
Burbot	0.800	0			6.380	1	0.035	0	0.005	0	0.100	0	0.410	1	5.000	1	0.448	1	0.142	1	0.080	1	0.220	1	0.077	1	7.390	1
Burbot	1.800	0			3.320	1	0.075	0	0.011	0	6.870	1	0.090	1	75.000	1	0.490	1	0.0962	1	0.032	1	0.470	1	0.165	1	4.350	1
Burbot	1.500	0			3.190	1	0.786	1	0.009	0	2.610	1	0.070	1	10.000	1	0.582	1	0.0673	1	0.516	1	0.390	1	0.136	1	4.630	1
Burbot	0.800	0			6.170	1	0.034	0	0.005	0	0.100	0	0.620	1	5.000	1	0.590	1	0.0857	1	0.056	1	0.220	1	0.075	1	8.090	1
Burbot	2.200	0			0.450	0	0.091	0	0.014	0	0.260	0	0.100	1	14.000	1	0.034	1	0.51	1	0.031	1	0.580	1	0.201	1	9.660	1
Burbot	1.700	0			0.350	0	0.071	0	0.011	0	0.200	0	0.080	1	11.000	1	0.027	1	0.491	1	0.083	1	0.450	1	0.158	1	5.040	1
Burbot	1.200	0			3.290	1	0.051	0	0.008	0	7.000	1	0.300	1	72.000	1	0.811	1	0.0432	1	0.065	1	0.320	1	0.113	1	5.840	1
Burbot	0.900	0			5.820	1	0.036	0	0.005	0	0.100	0	0.040	1	6.000	1	0.550	1	0.0707	1	0.046	1	0.230	1	0.081	1	5.370	1
Burbot	0.800	0			2.350	1	0.032	0	0.005	0	0.090	0	0.310	1	25.000	1	0.493	1	0.102	1	0.603	1	0.200	1	0.070	1	6.520	1
Burbot	8.000	1			5.610	1	0.039	0	0.006	0	0.110	0	0.220	1	6.000	1	0.588	1	0.0624	1	0.325	1	0.250	1	0.087	1	5.040	1
Burbot	0.600	0			3.010	1	0.026	0	0.004	0	0.080	0	0.300	1	4.000	1	0.372	1	0.0836	1	0.657	1	0.170	1	0.058	1	4.530	1
Burbot	1.000	0			0.200	0	0.040	0	0.006	0	0.110	0	0.300	1	6.000	1	0.811	1	0.076	1	0.198	1	0.250	1	0.088	1	4.730	1
Burbot	1.900	0			2.500	1	0.079	0	0.012	0	0.230	0	0.090	1	12.000	1	0.030	1	0.0614	1	0.834	1	0.500	1	0.175	1	4.820	1
Burbot	0.900	0			2.200	1	0.036	0	0.005	0	0.100	0	0.340	1	6.000	1	0.390	1	0.114	1	0.862	1	0.230	1	0.081	1	4.910	1
Burbot	0.900	0			3.570	1	0.038	0	0.006	0	0.110	0	0.330	1	36.000	1	0.432	1	0.0689	1	1.280	1	0.240	1	0.084	1	7.010	1
Burbot	0.900	0			0.180	0	0.036	0	0.005	0	0.100	0	0.310	1	6.000	1	0.349	1	0.15	1	10.500	1	0.230	1	0.080	1	6.700	1
Burbot	1.100	0			4.840	1	0.048	0	0.007	0	0.140	0	0.060	1	7.000	1	0.425	1	0.103	1	0.033	1	0.310	1	0.106	1	6.900	1
Burbot	1.400	0			3.990	1	0.058	0	0.009	0	0.170	0	0.070	1	9.000	1	0.474	1	0.0623	1	0.044	1	0.370	1	0.128	1	7.130	1
Burbot	8.500	1			2.770	1	0.406	1	0.006	0	0.110	0	0.340	1	6.000	0	0.653	1	0.0629	1	0.053	1	0.250	1	0.086	1	5.510	1
Burbot	2.500	0			0.520	0	0.106	0	0.016	0	0.300	0	0.120	1	16.000	0	1.310	1	0.233	1	0.035	0	0.680	1	0.235	1	7.980	1
Burbot	1.000	0			3.770	1	0.042	0	0.006	0	0.120	0	0.230	1	6.000	0.97	0.325	1	0.0554	1	0.097	0	0.270	1	0.093	1	5.170	1
Burbot	1.400	0			2.690	1	0.058	0	0.009	0	0.170	0	0.070	1	9.000	0	0.677	1	0.0698	1	0.038	0	0.370	1	0.128	1	5.680	1
Burbot	1.200	0			1.840	1	0.050	0	0.008	0	0.140	0	0.260	1	8.000	0	0.404	1	0.197	1	0.053	0	0.320	1	0.110	1	4.240	1
Burbot	1.200	0			0.240	0	0.050	0	0.008	0	0.140	0	0.060	1	8.000	0	0.502	1	0.241	1	0.046	0	0.320	1	0.110	1	5.700	1
Burbot	9.600	1			4.030	1	0.038	0	0.006	0	0.110	0	0.430	1	6.000	0	0.780	1	0.201	1	0.046	0	0.240	1	0.085	1	6.680	1
Burbot	7.300	1			1.290	1	0.323	1	0.003	0	0.060	0	0.270	1	3.000	0	0.512	1	0.14	1	0.035	0	0.140	1	0.048	1	3.720	1
Burbot	14.800	1			3.310	1	0.594	1	0.008	0	0.160	0	0.810	1	9.000	0	0.313	1	0.112	1	0.020	0	0.350	1	0.123	1	7.960	1
Burbot	10.200	1			2.700	1	0.389	1	0.005	0	0.090	0	0.340	1	5.000	0	0.511	1	0.0374	1	0.051	0	0.200	1	0.069	1	5.300	1
Burbot	8.400	1			5.220	1	0.415	1	0.005	0	0.090	0	0.260	1	5.000	0	0.338	1	0.108	1	0.028	0	0.210	1	0.072	1	5.600	1
Burbot	10.000	1			3.820	1	0.452	1	0.005	0	0.100	0	0.400	1	6.000	0	0.472	1	0.0985	1	0.030	0	0.230	1	0.081	1	5.840	1
Burbot	9.100	1			0.190	0	0.454	1	0.006	0	0.110	0	0.500	1	6.000	0	0.551	1	0.113	1	0.033	0	0.240	1	0.084	1	7.030	1
Burbot	46.700	1			0.180	0	0.777	1	0.006	0	0.110	0	0.220	1	87.000	1	1.990	1	0.117	1	0.034	0	0.240	1	0.082	1	3.180	1
Burbot	0.900	0			0.190	0	0.038	0	0.006	0	0.110	0	0.330	1	6.000	0	0.799	1	0.143	1	0.034	0	0.240	1	0.084	1	5.260	1
Burbot	34.900	1			2.960	1	0.531	1	0.006	0	0.110	0	0.220	1	62.000	1	1.320	1	0.0594	1	0.034	0	0.240	1	0.082	1	6.260	1
Burbot	20.700	1			3.800	1	0.318	1	0.004	0	0.080	0	0.370	1	46.000	1	1.110	1	0.0679	1	0.034	0	0.180	1	0.064	1	5.490	1
Burbot	1.100	0			0.230	0	0.046	0	0.007	0	0.130	0	0.050	1	7.000	0	0.539	1	0.0995	1	0.026	0	0.290	1	0.102	1	5.970	1
Burbot	6.100	1			3.910	1	0.027	0	0.004	0	0.080	0	0.240	1	4.000	1	0.328	1	0.351	1	0.042	0	0.170	1	0.059	1	4.550	1
Burbot	0.800	0			0.170	0	0.035	0	0.005	0	0.100	0	0.280	1	5.000	1	0.826	1	0.175	1	0.024	0	1.320	1	0.077	1	4.900	1
Burbot	19.900	1			2.010	1	0.040	0	0.006	0	0.110	0	0.230	1	6.000	1	0.424	1	0.178	1	0.032	0	0.250	1	0.088	1	4.570	1
Burbot	0.400	0			2.870	1	0.018	0	0.003	0	0.050	0	0.250	1	3.000	1	0.376	1	0.217	1	0.036	0	0.120	1	0.040	1	4.170	1
Burbot	0.600	0			2.190	1	0.025	0	0.004	0	0.070	0	0.170	1	4.000	1	0.321	1	0.0426	1	0.017	0	0.160	1	0.055	1	4.010	1
Burbot	0.700	0			0.150	0	0.030	0	0.005	0	0.090	0	0.270	1	5.000	1	0.437	1	0.212	1	0.023	0	0.190	1	0.067	1	4.340	1
Burbot	69.100	1			0.180	0	0.883	1	0.006	0	0.110	0	0.390	1	138.000	1	3.500	1	0.428	1	0.028	0	0.240	1	0.083	1	5.650	1
Burbot	11.100	1			0.220	0	0.454	1	0.007	0	0.130	0	0.220	1	7.000	1	0.975	1	0.184	1	0.210	1	1.440	1	0.099	1	5.240	1
Burbot	0.600	0			0.120	0	0.025	0	0.004	0	0.070	0																

Table D-3. Fish Tissue ProUCL Input - Burbot

Species: Burbot  
 Waterbody: All  
 Muscle, replicates removed  
 Units: mg/kg - Hg units converted

Sample Species	Al	D_Al	Sb	D_Sb	As	D_As	Ba	D_Ba	Cd	D_Cd	Cr	D_Cr	Cu	D_Cu	Fe	D_Fe	Mn	D_Mn	Hg	D_Hg	Ni	D_Ni	Se	D_Se	V	D_V	Zn	D_Zn
Burbot	16.800	1			0.140	0	0.029	0	0.004	0	0.080	0	0.240	1	37.000	1	0.878	1	0.165	1	0.027	0	0.180	1	0.064	1	3.430	1
Burbot	0.700	0			6.200	1	0.030	0	0.004	0	0.080	0	0.240	1	5.000	1	0.265	1	0.108	1	0.026	0	0.190	1	0.066	1	7.530	1
Burbot	0.600	0			0.970	1	0.025	0	0.004	0	0.070	0	0.200	1	4.000	1	0.248	1	0.0738	1	0.027	0	0.160	1	0.054	1	2.810	1
Burbot	0.600	0			2.270	1	0.024	0	0.004	0	0.070	0	0.480	1	4.000	1	0.339	1	0.0491	1	0.022	0	0.150	1	0.053	1	4.000	1
Burbot	2.600	0			0.530	0	0.109	0	0.016	0	0.310	0	1.280	1	17.000	1	0.562	1	0.0779	1	0.022	1	0.690	1	0.240	1	5.370	1
Burbot	1.100	0			2.940	1	0.604	1	0.007	0	0.130	0	0.620	1	7.000	1	0.700	1	0.0871	1	0.099	1	0.300	1	0.103	1	5.590	1
Burbot	12.500	1			2.910	1	0.040	0	0.006	0	0.110	0	0.990	1	6.000	1	0.645	1	0.0613	1	0.043	1	0.250	1	0.088	1	5.440	1
Burbot	12.600	1			1.680	1	0.033	0	0.005	0	0.090	0	0.480	1	5.000	1	0.685	1	0.067	1	1.000	1	0.210	1	0.073	1	4.210	1
Burbot	18.600	1			3.570	1	0.463	1	0.005	0	0.090	0	0.620	1	33.000	1	0.937	1	0.0596	1	0.030	1	0.210	1	0.073	1	4.780	1
Burbot	0.500	0			0.100	0	0.021	0	0.003	0	0.060	0	0.330	1	3.000	1	0.462	1	0.169	1	0.030	1	0.130	1	0.045	1	3.110	1
Burbot	6.700	1			0.160	0	0.033	0	0.005	0	0.090	0	0.500	1	5.000	1	0.526	1	0.187	1	0.019	1	0.210	1	0.073	1	8.700	1
Burbot	18.900	1			2.370	1	0.497	1	0.006	0	0.120	0	0.640	1	38.000	1	0.963	1	0.117	1	0.030	1	0.260	1	0.091	1	6.730	1
Burbot	0.800	0			4.920	1	0.033	0	0.005	0	0.090	0	0.680	1	5.000	1	0.609	1	0.043	1	0.037	1	0.210	1	0.072	1	7.300	1
Burbot	0.500	0			0.110	0	0.023	0	0.003	0	0.070	0	0.340	1	4.000	1	0.267	1	0.148	1	0.030	1	0.140	1	0.050	1	3.220	1
Burbot	0.700	0			2.350	1	0.031	0	0.005	0	0.090	0	0.470	1	5.000	1	0.329	1	0.0856	1	0.021	1	0.190	1	0.068	1	5.070	1
Burbot	0.900	0			2.170	1	0.038	0	0.006	0	0.110	0	0.770	1	6.000	1	0.442	1	0.126	1	0.028	1	0.240	1	0.083	1	6.420	1
Burbot	0.900	0			4.220	1	0.038	0	0.006	0	0.110	0	0.850	1	6.000	1	0.417	1	0.122	1	0.034	1	0.240	1	0.083	1	6.900	1
Burbot	16.300	1			0.180	0	1.070	1	0.005	0	0.100	0	0.810	1	34.000	1	0.970	1	0.235	1	0.034	1	0.230	1	0.079	1	7.510	1
Burbot	11.000	1			3.950	1	0.042	0	0.006	0	0.120	0	0.640	1	6.000	1	0.636	1	0.0854	1	0.032	1	0.260	1	0.092	1	4.890	1
Burbot	13.100	1			1.160	1	0.404	1	0.003	0	0.060	0	0.570	1	33.000	1	0.889	1	0.163	1	0.038	1	0.140	1	0.048	1	4.270	1
Burbot	0.600	0			0.940	1	0.026	0	0.004	0	0.080	0	0.650	1	4.000	1	0.350	1	0.128	1	0.136	1	0.170	1	0.058	1	4.530	1
Burbot	2.200	0			0.450	0	0.091	0	0.014	0	0.260	0	1.300	1	14.000	1	0.034	1	0.251	1	0.024	1	0.580	1	0.201	1	7.970	1
Burbot	6.900	1			4.280	1	0.406	1	0.002	0	0.040	0	1.030	1	24.000	1	0.625	1	0.205	1	0.083	1	0.450	1	0.033	1	8.530	1
Burbot	10.800	1			0.190	1	0.589	1	0.003	0	0.070	1	0.380	1	32.000	1	0.818	1	0.52	1	0.061	1	1.210	1	0.093	1	4.950	1
Burbot	33.000	1			0.380	1	0.929	1	0.002	0	0.080	1	0.450	1	56.000	1	1.030	1	0.176	1	0.111	1	0.350	1	0.120	1	5.340	1
Burbot	1.500	1			0.150	1	0.184	1	0.002	0	0.030	0	0.540	1	9.000	1	0.306	1	0.756	1	0.093	1	0.310	1	0.025	1	6.640	1
Burbot	8.400	1			0.150	1	0.440	1	0.003	1	0.050	1	0.480	1	19.000	1	0.438	1	0.429	1	0.059	1	0.420	1	0.035	1	5.280	1
Burbot	10.000	1			0.190	1	0.404	1	0.003	0	0.050	0	0.580	1	25.000	1	0.589	1	0.387	1	0.094	1	0.840	1	0.062	1	5.570	1
Burbot	1.700	1			0.130	1	0.309	1	0.002	1	0.050	0	0.520	1	11.000	1	0.263	1	1.02	1	0.088	1	0.390	1	0.035	0	6.240	1
Burbot	2.100	1			0.180	1	0.308	1	0.002	0	0.030	1	0.690	1	14.000	1	0.325	1	0.846	1	0.048	1	0.700	1	0.027	1	7.100	1
Burbot	0.900	1			0.100	1	0.347	1	0.002	0	0.030	0	0.590	1	7.000	1	0.301	1	1.01	1	0.030	1	0.460	1	0.024	1	6.790	1
Burbot	0.800	1			0.070	1	0.161	1	0.002	0	0.040	0	0.690	1	6.000	1	0.246	1	0.883	1	0.029	1	0.440	1	0.032	1	5.660	1
Burbot	1.600	1			0.280	1	0.359	1	0.002	0	0.050	0	0.500	1	9.000	1	0.342	1	0.764	1	0.016	1	0.490	1	0.035	1	6.490	1
Burbot	1.000	1			0.090	0	0.209	1	0.003	0	0.050	0	0.400	1	8.000	1	0.267	1	0.792	1	0.028	1	0.740	1	0.041	1	7.180	1
Burbot	2.000	1			0.100	0	0.309	1	0.003	0	0.060	0	0.460	1	6.000	1	0.261	1	0.905	1	0.017	1	0.710	1	0.044	1	7.010	1
Burbot	2.400	1			0.100	1	0.333	1	0.002	1	0.180	0	0.380	1	7.000	1	0.287	1	0.701	1	0.043	1	0.320	1	0.024	0	4.950	1
Burbot	5.500	1			0.170	1	0.272	1	0.003	0	0.060	0	0.390	1	16.000	1	0.505	1	0.368	1	0.027	1	0.770	1	0.044	1	5.140	1
Burbot	28.200	1			0.150	1	0.703	1	0.002	1	0.100	1	0.690	1	51.000	1	1.070	1	0.64	1	0.084	1	0.730	1	0.059	1	6.630	1
Burbot	4.500	1			1.510	1	0.231	1	0.008	1	0.030	0	0.290	1	12.000	1	0.331	1	0.277	1	0.128	1	0.800	1	0.042	1	5.270	1
Burbot	5.000	1			0.530	1	0.167	1	0.002	0	0.050	0	0.560	1	12.000	1	0.321	1	0.338	1	0.033	1	0.160	1	0.026	1	6.490	1
Burbot	22.800	1			0.140	1	0.403	1	0.002	0	0.050	1	0.320	1	37.000	1	0.749	1	0.489	1	0.044	1	0.340	1	0.047	1	4.120	1
Burbot	5.500	1			0.160	1	0.386	1	0.002	0	0.050	0	0.480	1	14.000	1	0.311	1	0.439	1	0.062	1	0.400	1	0.037	1	5.190	1
Burbot	3.300	1			1.620	1	0.180	1	0.002	0	0.040	0	0.470	1	10.000	1	0.285	1	0.447	1	0.113	1	0.870	1	0.029	1	5.820	1
Burbot	6.500	1			0.170	1	0.182	1	0.003	1	0.030	0	0.280	1	13.000	1	0.399	1	0.632	1	0.073	1	0.920	1	0.041	1	4.630	1
Burbot	5.400	1			0.450	1	0.177	1	0.002	0	0.040	0	0.780	1	12.000	1	0.240	1	0.608	1	0.117	1	0.190	1	0.025	1	5.060	1
Burbot	4.500	1			0.110	1	0.265	1	0.002	0	0.030	0	0.360	1	14.000	1	0.314	1	0.277	1	0.041	1	0.280	1	0.024	1	4.450	1
Burbot	15.800	1			3.510	1	0.261	1	0.002	0	0.030	0	0.660	1	29.000	1	0.755	1	0.068	1	0.127	1	0.350	1	0.036	1	10.300	1
Burbot	1.000	1			4.160	1	0.166	1	0.002	0	0.050	0	0.700	1	13.000	1	0.221	1	0.366	1	0.107	1	0.610	1	0.037	1	7.630	1
Burbot	3.900	1			0.410	1	0.699	1	0.002	0	0.050	0	0.550	1	10.000	1	0.272	1	0.262	1	0.015	1	0.910	1	0.036	1	5.690	1
Burbot	2.200	1			0.490	1	0.496	1	0.003	0	0.050	0	0.770	1	10.000	1	0.317	1	0.303	1	0.017	1	0.950	1	0.040	1	6.820	1
Burbot	2.200	1			0.230	1	0.527	1	0.002	0	0.040	1	0.530	1	9.000	1	0.292	1	0.547	1	0.021	1	0.690	1	0.025	1	5.500	1
Burbot	2.000	1			0.220	1	0.359	1	0.002	0	0.040	0	0.520	1	8.000	1	0.299	1	0.765	1	0.014	1	0.920	1	0.034	1	5.680	1
Burbot	1.000	1			0.230	1	0.328	1	0.002	1	0.040	0																

## UCL Statistics for Data Sets with Non-Detects

## User Selected Options

Date/Time of Computation ProUCL 5.16/19/2017 3:56:05 PM  
 From File WorkSheet.xls  
 Full Precision OFF  
 Confidence Coefficient 95%  
 Number of Bootstrap Operations 2000

## Aluminum (Al)

## General Statistics

Total Number of Observations	293	Number of Distinct Observations	76
Number of Detects	77	Number of Non-Detects	216
Number of Distinct Detects	65	Number of Distinct Non-Detects	22
Minimum Detect	0.8	Minimum Non-Detect	0.4
Maximum Detect	549	Maximum Non-Detect	2.6
Variance Detects	3903	Percent Non-Detects	73.72%
Mean Detects	16.36	SD Detects	62.47
Median Detects	6.5	CV Detects	3.819
Skewness Detects	8.377	Kurtosis Detects	72.14
Mean of Logged Detects	1.754	SD of Logged Detects	1.199

## Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.216	Normal GOF Test on Detected Observations Only
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.402	Lilliefors GOF Test
5% Lilliefors Critical Value	0.101	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	4.609	KM Standard Error of Mean	1.916
KM SD	32.58	95% KM (BCA) UCL	8.671
95% KM (t) UCL	7.771	95% KM (Percentile Bootstrap) UCL	8.329
95% KM (z) UCL	7.761	95% KM Bootstrap t UCL	18.19
90% KM Chebyshev UCL	10.36	95% KM Chebyshev UCL	12.96
97.5% KM Chebyshev UCL	16.57	99% KM Chebyshev UCL	23.67

## Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	4.853	Anderson-Darling GOF Test
5% A-D Critical Value	0.809	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.196	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.107	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)	0.595	k star (bias corrected MLE)	0.58
Theta hat (MLE)	27.51	Theta star (bias corrected MLE)	28.2
nu hat (MLE)	91.57	nu star (bias corrected)	89.34
Mean (detects)	16.36		



Fish Tissue ProUCL Output - Burbot

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	4.306
Maximum	549 Median	0.01
SD	32.68 CV	7.588
k hat (MLE)	0.171 k star (bias corrected MLE)	0.172
Theta hat (MLE)	25.11 Theta star (bias corrected MLE)	25.04
nu hat (MLE)	100.5 nu star (bias corrected)	100.8
Adjusted Level of Significance ( $\beta$ )	0.0492	
Approximate Chi Square Value (100.79, $\alpha$ )	78.63 Adjusted Chi Square Value (100.79, $\beta$ )	78.53
95% Gamma Approximate UCL (use when n>=50)	5.52 95% Gamma Adjusted UCL (use when n<50)	5.527

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	4.609 SD (KM)	32.58
Variance (KM)	1062 SE of Mean (KM)	1.916
k hat (KM)	0.02 k star (KM)	0.0221
nu hat (KM)	11.73 nu star (KM)	12.94
theta hat (KM)	230.3 theta star (KM)	208.7
80% gamma percentile (KM)	0.00488 90% gamma percentile (KM)	1.016
95% gamma percentile (KM)	12.38 99% gamma percentile (KM)	127.1

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (12.94, $\alpha$ )	5.853 Adjusted Chi Square Value (12.94, $\beta$ )	5.829
95% Gamma Approximate KM-UCL (use when n>=50)	10.19 95% Gamma Adjusted KM-UCL (use when n<50)	10.23

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.95 Shapiro Wilk GOF Test	
5% Shapiro Wilk P Value	0.0109 Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.0754 Lilliefors GOF Test	
5% Lilliefors Critical Value	0.101 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	4.487 Mean in Log Scale	-1.169
SD in Original Scale	32.65 SD in Log Scale	2.281
95% t UCL (assumes normality of ROS data)	7.635 95% Percentile Bootstrap UCL	8.23
95% BCA Bootstrap UCL	11.33 95% Bootstrap t UCL	18.45
95% H-UCL (Log ROS)	6.634	

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-0.19 KM Geo Mean	0.827
KM SD (logged)	1.32 95% Critical H Value (KM-Log)	2.421
KM Standard Error of Mean (logged)	0.079 95% H-UCL (KM -Log)	2.38
KM SD (logged)	1.32 95% Critical H Value (KM-Log)	2.421
KM Standard Error of Mean (logged)	0.079	

DL/2 Statistics

DL/2 Normal	DL/2 Log-Transformed	
Mean in Original Scale	4.675 Mean in Log Scale	-0.0665
SD in Original Scale	32.63 SD in Log Scale	1.272
95% t UCL (Assumes normality)	7.82 95% H-Stat UCL	2.507
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

KM H-UCL	2.38
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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.

Fish Tissue ProUCL Output - Burbot

Antimony (Sb)

General Statistics

Total Number of Observations	175	Number of Distinct Observations	15
Number of Detects	16	Number of Non-Detects	159
Number of Distinct Detects	10	Number of Distinct Non-Detects	8
Minimum Detect	0.008	Minimum Non-Detect	0.006
Maximum Detect	0.148	Maximum Non-Detect	0.025
Variance Detects	0.00144	Percent Non-Detects	90.86%
Mean Detects	0.0275	SD Detects	0.038
Median Detects	0.014	CV Detects	1.38
Skewness Detects	2.745	Kurtosis Detects	7.284
Mean of Logged Detects	-4.05	SD of Logged Detects	0.829

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.537	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.887	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.38	Lilliefors GOF Test
5% Lilliefors Critical Value	0.213	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	0.0101	KM Standard Error of Mean	0.00116
KM SD	0.0128	95% KM (BCA) UCL	0.0122
95% KM (t) UCL	0.012	95% KM (Percentile Bootstrap) UCL	0.0122
95% KM (z) UCL	0.012	95% KM Bootstrap t UCL	0.0129
90% KM Chebyshev UCL	0.0136	95% KM Chebyshev UCL	0.0151
97.5% KM Chebyshev UCL	0.0173	99% KM Chebyshev UCL	0.0216

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	2.081	Anderson-Darling GOF Test
5% A-D Critical Value	0.759	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.322	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.22	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)	1.236	k star (bias corrected MLE)	1.046
Theta hat (MLE)	0.0223	Theta star (bias corrected MLE)	0.0263
nu hat (MLE)	39.55	nu star (bias corrected)	33.47
Mean (detects)	0.0275		

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	0.008	Mean	0.0138
Maximum	0.148	Median	0.01
SD	0.0138	CV	0.997
k hat (MLE)	3.445	k star (bias corrected MLE)	3.39
Theta hat (MLE)	0.00402	Theta star (bias corrected MLE)	0.00408
nu hat (MLE)	1206	nu star (bias corrected)	1186
Adjusted Level of Significance ( $\beta$ )	0.0486		
Approximate Chi Square Value (N/A, $\alpha$ )	1107	Adjusted Chi Square Value (N/A, $\beta$ )	1107
95% Gamma Approximate UCL (use when n>=50)	0.0148	95% Gamma Adjusted UCL (use when n<50)	0.0148

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0101	SD (KM)	0.0128
Variance (KM)	1.64E-04	SE of Mean (KM)	0.00116
k hat (KM)	0.62	k star (KM)	0.613
nu hat (KM)	217	nu star (KM)	214.6
theta hat (KM)	0.0163	theta star (KM)	0.0165
80% gamma percentile (KM)	0.0166	90% gamma percentile (KM)	0.0261
95% gamma percentile (KM)	0.036	99% gamma percentile (KM)	0.0599

Fish Tissue ProUCL Output - Burbot

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (214.61, $\alpha$ )	181.7	Adjusted Chi Square Value (214.61, $\beta$ )	181.5
95% Gamma Approximate KM-UCL (use when $n \geq 50$ )	0.0119	95% Gamma Adjusted KM-UCL (use when $n < 50$ )	0.0119

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.787	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.887	Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.262	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.213	Detected Data Not Lognormal at 5% Significance Level	
Detected Data Not Lognormal at 5% Significance Level			

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.00886	Mean in Log Scale	-5.202
SD in Original Scale		SD in Log Scale	0.928
95% t UCL (assumes normality of ROS data)	0.0106	95% Percentile Bootstrap UCL	0.0109
95% BCA Bootstrap UCL	0.0114	95% Bootstrap t UCL	0.0121
95% H-UCL (Log ROS)	0.00982		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-4.78	KM Geo Mean	0.0084
KM SD (logged)	0.471	95% Critical H Value (KM-Log)	1.797
KM Standard Error of Mean (logged)	0.0722	95% H-UCL (KM-Log)	0.01
KM SD (logged)	0.471	95% Critical H Value (KM-Log)	1.797
KM Standard Error of Mean (logged)	0.0722		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.013	Mean in Log Scale	-4.47
SD in Original Scale	0.0123	SD in Log Scale	0.443
95% t UCL (Assumes normality)	0.0145	95% H-Stat UCL	0.0134
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

95% KM (Chebyshev) UCL	0.0151
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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.

Fish Tissue ProUCL Output - Burbot

Arsenic (As)

General Statistics

Total Number of Observations	293	Number of Distinct Observations	237
Number of Detects	260	Number of Non-Detects	33
Number of Distinct Detects	231	Number of Distinct Non-Detects	22
Minimum Detect	0.07	Minimum Non-Detect	0.09
Maximum Detect	11.29	Maximum Non-Detect	0.53
Variance Detects	4.646	Percent Non-Detects	11.26%
Mean Detects	2.363	SD Detects	2.155
Median Detects	2.216	CV Detects	0.912
Skewness Detects	1.046	Kurtosis Detects	1.499
Mean of Logged Detects	0.135	SD of Logged Detects	1.458

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.872	Normal GOF Test on Detected Observations Only
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.144	Lilliefors GOF Test
5% Lilliefors Critical Value	0.0554	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	2.111	KM Standard Error of Mean	0.126
KM SD	2.146	95% KM (BCA) UCL	2.324
95% KM (t) UCL	2.318	95% KM (Percentile Bootstrap) UCL	2.312
95% KM (z) UCL	2.318	95% KM Bootstrap t UCL	2.318
90% KM Chebyshev UCL	2.488	95% KM Chebyshev UCL	2.659
97.5% KM Chebyshev UCL	2.896	99% KM Chebyshev UCL	3.361

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	9.335	Anderson-Darling GOF Test
5% A-D Critical Value	0.793	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.137	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.0588	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)	0.817	k star (bias corrected MLE)	0.81
Theta hat (MLE)	2.892	Theta star (bias corrected MLE)	2.917
nu hat (MLE)	424.8	nu star (bias corrected)	421.2
Mean (detects)	2.363		

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	0.07	Mean	2.147
Maximum	11.29	Median	1.694
SD	2.12	CV	0.987
k hat (MLE)	0.802	k star (bias corrected MLE)	0.796
Theta hat (MLE)	2.677	Theta star (bias corrected MLE)	2.697
nu hat (MLE)	469.8	nu star (bias corrected)	466.3
Adjusted Level of Significance ( $\beta$ )	0.0492		
Approximate Chi Square Value (466.33, $\alpha$ )	417.3	Adjusted Chi Square Value (466.33, $\beta$ )	417
95% Gamma Approximate UCL (use when $n \geq 50$ )	2.399	95% Gamma Adjusted UCL (use when $n < 50$ )	2.4

Fish Tissue ProUCL Output - Burbot

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	2.111 SD (KM)	2.146
Variance (KM)	4.607 SE of Mean (KM)	0.126
k hat (KM)	0.967 k star (KM)	0.959
nu hat (KM)	566.7 nu star (KM)	562.3
theta hat (KM)	2.183 theta star (KM)	2.2
80% gamma percentile (KM)	3.408 90% gamma percentile (KM)	4.91
95% gamma percentile (KM)	6.417 99% gamma percentile (KM)	9.926

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (562.26, $\alpha$ )	508.3 Adjusted Chi Square Value (562.26, $\beta$ )	508
95% Gamma Approximate KM-UCL (use when n>=50)	2.335 95% Gamma Adjusted KM-UCL (use when n<50)	2.336

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.848 Shapiro Wilk GOF Test
5% Shapiro Wilk P Value	0 Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.185 Lilliefors GOF Test
5% Lilliefors Critical Value	0.0554 Detected Data Not Lognormal at 5% Significance Level
Detected Data Not Lognormal at 5% Significance Level	

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	2.117 Mean in Log Scale	-0.0862
SD in Original Scale	2.145 SD in Log Scale	1.518
95% t UCL (assumes normality of ROS data)	2.324 95% Percentile Bootstrap UCL	2.32
95% BCA Bootstrap UCL	2.338 95% Bootstrap t UCL	2.34
95% H-UCL (Log ROS)	3.667	

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-0.121 KM Geo Mean	0.886
KM SD (logged)	1.553 95% Critical H Value (KM-Log)	2.653
KM Standard Error of Mean (logged)	0.0912 95% H-UCL (KM -Log)	3.767
KM SD (logged)	1.553 95% Critical H Value (KM-Log)	2.653
KM Standard Error of Mean (logged)	0.0912	

DL/2 Statistics

DL/2 Normal	DL/2 Log-Transformed	
Mean in Original Scale	2.11 Mean in Log Scale	-0.134
SD in Original Scale	2.151 SD in Log Scale	1.579
95% t UCL (Assumes normality)	2.318 95% H-Stat UCL	3.894

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

95% KM (Chebyshev) UCL	2.659
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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.

Fish Tissue ProUCL Output - Burbot

Barium (Ba)

General Statistics

Total Number of Observations	293	Number of Distinct Observations	175
Number of Detects	196	Number of Non-Detects	97
Number of Distinct Detects	138	Number of Distinct Non-Detects	44
Minimum Detect	0.041	Minimum Non-Detect	0.018
Maximum Detect	8.25	Maximum Non-Detect	0.109
Variance Detects	0.363	Percent Non-Detects	33.11%
Mean Detects	0.264	SD Detects	0.602
Median Detects	0.152	CV Detects	2.284
Skewness Detects	12.12	Kurtosis Detects	160.5
Mean of Logged Detects	-1.73	SD of Logged Detects	0.721

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.254	Normal GOF Test on Detected Observations Only
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.356	Lilliefors GOF Test
5% Lilliefors Critical Value	0.0637	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	0.183	KM Standard Error of Mean	0.0296
KM SD	0.505	95% KM (BCA) UCL	0.244
95% KM (t) UCL	0.232	95% KM (Percentile Bootstrap) UCL	0.235
95% KM (z) UCL	0.232	95% KM Bootstrap t UCL	0.301
90% KM Chebyshev UCL	0.272	95% KM Chebyshev UCL	0.312
97.5% KM Chebyshev UCL	0.368	99% KM Chebyshev UCL	0.477

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	5.10E+28	Anderson-Darling GOF Test
5% A-D Critical Value	0.774	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.225	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.066	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)	1.402	k star (bias corrected MLE)	1.384
Theta hat (MLE)	0.188	Theta star (bias corrected MLE)	0.191
nu hat (MLE)	549.5	nu star (bias corrected)	542.4
Mean (detects)	0.264		

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	0.18
Maximum	8.25	Median	0.108
SD	0.507	CV	2.819
k hat (MLE)	0.635	k star (bias corrected MLE)	0.63
Theta hat (MLE)	0.283	Theta star (bias corrected MLE)	0.285
nu hat (MLE)	371.9	nu star (bias corrected)	369.4
Adjusted Level of Significance ( $\beta$ )	0.0492		
Approximate Chi Square Value (369.44, $\alpha$ )	325.9	Adjusted Chi Square Value (369.44, $\beta$ )	325.7
95% Gamma Approximate UCL (use when n>=50)	0.204	95% Gamma Adjusted UCL (use when n<50)	0.204

Fish Tissue ProUCL Output - Burbot

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.183 SD (KM)	0.505
Variance (KM)	0.255 SE of Mean (KM)	0.0296
k hat (KM)	0.131 k star (KM)	0.132
nu hat (KM)	77.02 nu star (KM)	77.56
theta hat (KM)	1.392 theta star (KM)	1.382
80% gamma percentile (KM)	0.178 90% gamma percentile (KM)	0.531
95% gamma percentile (KM)	1.029 99% gamma percentile (KM)	2.516

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (77.56, $\alpha$ )	58.27 Adjusted Chi Square Value (77.56, $\beta$ )	58.19
95% Gamma Approximate KM-UCL (use when n>=50)	0.243 95% Gamma Adjusted KM-UCL (use when n<50)	0.244

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.927 Shapiro Wilk GOF Test	
5% Shapiro Wilk P Value	5.12E-13 Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.159 Lilliefors GOF Test	
5% Lilliefors Critical Value	0.0637 Detected Data Not Lognormal at 5% Significance Level	
Detected Data Not Lognormal at 5% Significance Level		

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.189 Mean in Log Scale	-2.261
SD in Original Scale	0.504 SD in Log Scale	0.974
95% t UCL (assumes normality of ROS data)	0.237 95% Percentile Bootstrap UCL	0.245
95% BCA Bootstrap UCL	0.283 95% Bootstrap t UCL	0.31
95% H-UCL (Log ROS)	0.189	

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-2.472 KM Geo Mean	0.0844
KM SD (logged)	1.216 95% Critical H Value (KM-Log)	2.324
KM Standard Error of Mean (logged)	0.0716 95% H-UCL (KM -Log)	0.208
KM SD (logged)	1.216 95% Critical H Value (KM-Log)	2.324
KM Standard Error of Mean (logged)	0.0716	

DL/2 Statistics

DL/2 Normal	DL/2 Log-Transformed	
Mean in Original Scale	0.183 Mean in Log Scale	-2.462
SD in Original Scale	0.505 SD in Log Scale	1.221
95% t UCL (Assumes normality)	0.232 95% H-Stat UCL	0.212

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

95% KM (Chebyshev) UCL	0.312
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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.

Fish Tissue ProUCL Output - Burbot

Cadmium (Cd)

General Statistics

Total Number of Observations	293	Number of Distinct Observations	16
Number of Detects	7	Number of Non-Detects	286
Number of Distinct Detects	3	Number of Distinct Non-Detects	16
Minimum Detect	0.002	Minimum Non-Detect	0.002
Maximum Detect	0.008	Maximum Non-Detect	0.025
Variance Detects	4.81E-06	Percent Non-Detects	97.61%
Mean Detects	0.00314	SD Detects	0.00219
Median Detects	0.002	CV Detects	0.698
Skewness Detects	2.403	Kurtosis Detects	5.966
Mean of Logged Detects	-5.901	SD of Logged Detects	0.51

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.606	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.803	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.383	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	0.00209	KM Standard Error of Mean	5.96E-05
KM SD	5.54E-04	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.00219	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.00219	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.00227	95% KM Chebyshev UCL	0.00235
97.5% KM Chebyshev UCL	0.00247	99% KM Chebyshev UCL	0.00269

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.136	Anderson-Darling GOF Test	
5% A-D Critical Value	0.71	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.324	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.313	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)	3.779	k star (bias corrected MLE)	2.255
Theta hat (MLE)	8.32E-04	Theta star (bias corrected MLE)	0.00139
nu hat (MLE)	52.91	nu star (bias corrected)	31.57
Mean (detects)	0.00314		

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	0.002	Mean	0.00984
Maximum	0.01	Median	0.01
SD	0.0011	CV	0.111
k hat (MLE)	34.81	k star (bias corrected MLE)	34.45
Theta hat (MLE)	2.83E-04	Theta star (bias corrected MLE)	2.86E-04
nu hat (MLE)	20397	nu star (bias corrected)	20189
Adjusted Level of Significance ( $\beta$ )	0.0492		
Approximate Chi Square Value (N/A, $\alpha$ )	19860	Adjusted Chi Square Value (N/A, $\beta$ )	19858
95% Gamma Approximate UCL (use when n>=50)	0.01	95% Gamma Adjusted UCL (use when n<50)	0.01

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.00209	SD (KM)	5.54E-04
Variance (KM)	3.06E-07	SE of Mean (KM)	5.96E-05
k hat (KM)	14.29	k star (KM)	14.15
nu hat (KM)	8375	nu star (KM)	8291
theta hat (KM)	1.46E-04	theta star (KM)	1.48E-04
80% gamma percentile (KM)	0.00254	90% gamma percentile (KM)	0.00283
95% gamma percentile (KM)	0.00308	99% gamma percentile (KM)	0.0036



Fish Tissue ProUCL Output - Burbot

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (N/A, $\alpha$ )	8080	Adjusted Chi Square Value (N/A, $\beta$ )	8079
95% Gamma Approximate KM-UCL (use when n>=50)	0.00215	95% Gamma Adjusted KM-UCL (use when n<50)	0.00215

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.698	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.803	Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.302	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.304	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	0.00105	Mean in Log Scale	-7.117
SD in Original Scale	8.71E-04	SD in Log Scale	0.713
95% t UCL (assumes normality of ROS data)	0.00113	95% Percentile Bootstrap UCL	0.00113
95% BCA Bootstrap UCL	0.00114	95% Bootstrap t UCL	0.00114
95% H-UCL (Log ROS)	0.00113		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-6.185	KM Geo Mean	0.00206
KM SD (logged)	0.146	95% Critical H Value (KM-Log)	1.671
KM Standard Error of Mean (logged)	0.0182	95% H-UCL (KM -Log)	0.00211
KM SD (logged)	0.146	95% Critical H Value (KM-Log)	1.671
KM Standard Error of Mean (logged)	0.0182		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.00741	Mean in Log Scale	-5.243
SD in Original Scale	0.00501	SD in Log Scale	0.908
95% t UCL (Assumes normality)	0.0079	95% H-Stat UCL	0.0089

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

KM H-UCL	0.00211
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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.

Fish Tissue ProUCL Output - Burbot

Chromium (Cr)

General Statistics

Total Number of Observations	293	Number of Distinct Observations	54
Number of Detects	40	Number of Non-Detects	253
Number of Distinct Detects	36	Number of Distinct Non-Detects	25
Minimum Detect	0.025	Minimum Non-Detect	0.025
Maximum Detect	12.6	Maximum Non-Detect	0.31
Variance Detects	6.548	Percent Non-Detects	86.35%
Mean Detects	1.034	SD Detects	2.559
Median Detects	0.0745	CV Detects	2.476
Skewness Detects	3.269	Kurtosis Detects	11.25
Mean of Logged Detects	-1.925	SD of Logged Detects	1.773

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.462	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.94	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.403	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.139	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	0.164	KM Standard Error of Mean	0.0589
KM SD	0.996	95% KM (BCA) UCL	0.268
95% KM (t) UCL	0.261	95% KM (Percentile Bootstrap) UCL	0.266
95% KM (z) UCL	0.261	95% KM Bootstrap t UCL	0.382
90% KM Chebyshev UCL	0.341	95% KM Chebyshev UCL	0.421
97.5% KM Chebyshev UCL	0.532	99% KM Chebyshev UCL	0.75

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	5.298	Anderson-Darling GOF Test	
5% A-D Critical Value	0.848	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.34	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.151	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)	0.344	k star (bias corrected MLE)	0.335
Theta hat (MLE)	3.001	Theta star (bias corrected MLE)	3.083
nu hat (MLE)	27.55	nu star (bias corrected)	26.82
Mean (detects)	1.034		

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	0.15
Maximum	12.6	Median	0.01
SD	0.999	CV	6.674
k hat (MLE)	0.295	k star (bias corrected MLE)	0.295
Theta hat (MLE)	0.507	Theta star (bias corrected MLE)	0.508
nu hat (MLE)	173.1	nu star (bias corrected)	172.7
Adjusted Level of Significance ( $\beta$ )	0.0492		
Approximate Chi Square Value (172.66, $\alpha$ )	143.3	Adjusted Chi Square Value (172.66, $\beta$ )	143.1
95% Gamma Approximate UCL (use when $n \geq 50$ )	0.18	95% Gamma Adjusted UCL (use when $n < 50$ )	0.181

Fish Tissue ProUCL Output - Burbot

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.164 SD (KM)	0.996
Variance (KM)	0.991 SE of Mean (KM)	0.0589
k hat (KM)	0.0271 k star (KM)	0.0291
nu hat (KM)	15.9 nu star (KM)	17.07
theta hat (KM)	6.043 theta star (KM)	5.629
80% gamma percentile (KM)	0.00153 90% gamma percentile (KM)	0.0883
95% gamma percentile (KM)	0.617 99% gamma percentile (KM)	4.267

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (17.07, $\alpha$ )	8.724 Adjusted Chi Square Value (17.07, $\beta$ )	8.695
95% Gamma Approximate KM-UCL (use when n>=50)	0.321 95% Gamma Adjusted KM-UCL (use when n<50)	0.322

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.816 Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.94 Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.205 Lilliefors GOF Test	
5% Lilliefors Critical Value	0.139 Detected Data Not Lognormal at 5% Significance Level	
Detected Data Not Lognormal at 5% Significance Level		

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.143 Mean in Log Scale	-7.254
SD in Original Scale	1 SD in Log Scale	3.252
95% t UCL (assumes normality of ROS data)	0.24 95% Percentile Bootstrap UCL	0.243
95% BCA Bootstrap UCL	0.284 95% Bootstrap t UCL	0.344
95% H-UCL (Log ROS)	0.338	

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-3.416 KM Geo Mean	0.0329
KM SD (logged)	0.892 95% Critical H Value (KM-Log)	2.05
KM Standard Error of Mean (logged)	0.054 95% H-UCL (KM -Log)	0.0544
KM SD (logged)	0.892 95% Critical H Value (KM-Log)	2.05
KM Standard Error of Mean (logged)	0.054	

DL/2 Statistics

DL/2 Normal	DL/2 Log-Transformed	
Mean in Original Scale	0.17 Mean in Log Scale	-3.449
SD in Original Scale	0.997 SD in Log Scale	1.119
95% t UCL (Assumes normality)	0.266 95% H-Stat UCL	0.0688
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

95% KM (Chebyshev) UCL	0.421
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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.

Fish Tissue ProUCL Output - Burbot

Copper (Cu)

General Statistics

Total Number of Observations	293	Number of Distinct Observations	170
		Number of Missing Observations	0
Minimum	0.04	Mean	0.388
Maximum	2	Median	0.351
SD	0.217	Std. Error of Mean	0.0127
Coefficient of Variation	0.56	Skewness	2.682

Normal GOF Test

Shapiro Wilk Test Statistic	0.822	Shapiro Wilk GOF Test	
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.132	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.0522	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.408	95% Adjusted-CLT UCL (Chen-1995)	0.411
		95% Modified-t UCL (Johnson-1978)	0.409

Gamma GOF Test

A-D Test Statistic	4.676	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.759	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.103	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.0532	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			

Gamma Statistics

k hat (MLE)	3.685	k star (bias corrected MLE)	3.649
Theta hat (MLE)	0.105	Theta star (bias corrected MLE)	0.106
nu hat (MLE)	2159	nu star (bias corrected)	2138
MLE Mean (bias corrected)	0.388	MLE Sd (bias corrected)	0.203
		Approximate Chi Square Value (0.05)	2032
Adjusted Level of Significance	0.0492	Adjusted Chi Square Value	2032

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	0.408	95% Adjusted Gamma UCL (use when n<50)	0.408
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Lognormal GOF Test

Shapiro Wilk Test Statistic	0.913	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk P Value	0	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.123	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.0522	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			

Fish Tissue ProUCL Output - Burbot

Lognormal Statistics			
Minimum of Logged Data	-3.219	Mean of logged Data	-1.09
Maximum of Logged Data	0.693	SD of logged Data	0.568
Assuming Lognormal Distribution			
95% H-UCL	0.42	90% Chebyshev (MVUE) UCL	0.437
95% Chebyshev (MVUE) UCL	0.457	97.5% Chebyshev (MVUE) UCL	0.483
99% Chebyshev (MVUE) UCL	0.535		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	0.408	95% Jackknife UCL	0.408
95% Standard Bootstrap UCL	0.409	95% Bootstrap-t UCL	0.411
95% Hall's Bootstrap UCL	0.412	95% Percentile Bootstrap UCL	0.409
95% BCA Bootstrap UCL	0.412		
90% Chebyshev(Mean, Sd) UCL	0.426	95% Chebyshev(Mean, Sd) UCL	0.443
97.5% Chebyshev(Mean, Sd) UCL	0.467	99% Chebyshev(Mean, Sd) UCL	0.514
Suggested UCL to Use			
95% Chebyshev (Mean, Sd) UCL	0.443		

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.

Fish Tissue ProUCL Output - Burbot

Iron (Fe)

General Statistics

Total Number of Observations	293	Number of Distinct Observations	122
Number of Detects	278	Number of Non-Detects	15
Number of Distinct Detects	122	Number of Distinct Non-Detects	7
Minimum Detect	1.6	Minimum Non-Detect	3
Maximum Detect	1060	Maximum Non-Detect	16
Variance Detects	4187	Percent Non-Detects	5.12%
Mean Detects	12.81	SD Detects	64.71
Median Detects	4.896	CV Detects	5.05
Skewness Detects	15.46	Kurtosis Detects	250.1
Mean of Logged Detects	1.76	SD of Logged Detects	0.847

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.142	Normal GOF Test on Detected Observations Only	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.431	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.0536	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	12.36	KM Standard Error of Mean	3.684
KM SD	62.95	95% KM (BCA) UCL	19.57
95% KM (t) UCL	18.44	95% KM (Percentile Bootstrap) UCL	19.81
95% KM (z) UCL	18.42	95% KM Bootstrap t UCL	38.22
90% KM Chebyshev UCL	23.41	95% KM Chebyshev UCL	28.41
97.5% KM Chebyshev UCL	35.36	99% KM Chebyshev UCL	49.01

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	3.60E+28	Anderson-Darling GOF Test	
5% A-D Critical Value	0.796	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.286	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.0568	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)	0.756	k star (bias corrected MLE)	0.751
Theta hat (MLE)	16.94	Theta star (bias corrected MLE)	17.07
nu hat (MLE)	420.6	nu star (bias corrected)	417.4
Mean (detects)	12.81		

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	12.19
Maximum	1060	Median	4.5
SD	63.08	CV	5.173
k hat (MLE)	0.612	k star (bias corrected MLE)	0.608
Theta hat (MLE)	19.94	Theta star (bias corrected MLE)	20.07
nu hat (MLE)	358.4	nu star (bias corrected)	356.1
Adjusted Level of Significance ( $\beta$ )	0.0492		
Approximate Chi Square Value (356.11, $\alpha$ )	313.4	Adjusted Chi Square Value (356.11, $\beta$ )	313.2
95% Gamma Approximate UCL (use when n>=50)	13.86	95% Gamma Adjusted UCL (use when n<50)	13.87

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	12.36	SD (KM)	62.95
Variance (KM)	3962	SE of Mean (KM)	3.684
k hat (KM)	0.0385	k star (KM)	0.0404
nu hat (KM)	22.58	nu star (KM)	23.68
theta hat (KM)	320.7	theta star (KM)	305.8
80% gamma percentile (KM)	0.711	90% gamma percentile (KM)	13.64
95% gamma percentile (KM)	59.62	99% gamma percentile (KM)	291

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (23.68, $\alpha$ )	13.61	Adjusted Chi Square Value (23.68, $\beta$ )	13.57
95% Gamma Approximate KM-UCL (use when n>=50)	21.51	95% Gamma Adjusted KM-UCL (use when n<50)	21.56

Fish Tissue ProUCL Output - Burbot

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.841	Shapiro Wilk GOF Test	
5% Shapiro Wilk P Value		0	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.194	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.0536	Detected Data Not Lognormal at 5% Significance Level	

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	12.37	Mean in Log Scale	1.739
SD in Original Scale	63.05	SD in Log Scale	0.834
95% t UCL (assumes normality of ROS data)	18.45	95% Percentile Bootstrap UCL	19.44
95% BCA Bootstrap UCL	25.1	95% Bootstrap t UCL	37.74
95% H-UCL (Log ROS)	8.887		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	1.736	KM Geo Mean	5.677
KM SD (logged)	0.833	95% Critical H Value (KM-Log)	2.006
KM Standard Error of Mean (logged)	0.0489	95% H-UCL (KM -Log)	8.855
KM SD (logged)	0.833	95% Critical H Value (KM-Log)	2.006
KM Standard Error of Mean (logged)	0.0489		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	12.34	Mean in Log Scale	1.731
SD in Original Scale	63.06	SD in Log Scale	0.838
95% t UCL (Assumes normality)	18.42	95% H-Stat UCL	8.853

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

95% KM (Chebyshev) UCL	28.41
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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.

Fish Tissue ProUCL Output - Burbot

Manganese (Mn)

General Statistics

Total Number of Observations	293	Number of Distinct Observations	239
		Number of Missing Observations	0
Minimum	0.027	Mean	0.429
Maximum	21.8	Median	0.263
SD	1.293	Std. Error of Mean	0.0756
Coefficient of Variation	3.016	Skewness	15.61

Normal GOF Test

Shapiro Wilk Test Statistic	0.182	Shapiro Wilk GOF Test	
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.378	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.0522	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.554	95% Adjusted-CLT UCL (Chen-1995)	0.627
		95% Modified-t UCL (Johnson-1978)	0.565

Gamma GOF Test

A-D Test Statistic	3.41E+28	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.777	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.133	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.0542	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			

Gamma Statistics

k hat (MLE)	1.275	k star (bias corrected MLE)	1.265
Theta hat (MLE)	0.336	Theta star (bias corrected MLE)	0.339
nu hat (MLE)	747.4	nu star (bias corrected)	741.1
MLE Mean (bias corrected)	0.429	MLE Sd (bias corrected)	0.381
		Approximate Chi Square Value (0.05)	678.9
Adjusted Level of Significance	0.0492	Adjusted Chi Square Value	678.6

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	0.468	95% Adjusted Gamma UCL (use when n<50)	0.468
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Lognormal GOF Test

Shapiro Wilk Test Statistic	0.971	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk P Value	0.00527	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.0568	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.0522	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			

Lognormal Statistics

Minimum of Logged Data	-3.612	Mean of logged Data	-1.287
Maximum of Logged Data	3.082	SD of logged Data	0.771



Fish Tissue ProUCL Output - Burbot

Assuming Lognormal Distribution

95% H-UCL	0.406	90% Chebyshev (MVUE) UCL	0.428
95% Chebyshev (MVUE) UCL	0.454	97.5% Chebyshev (MVUE) UCL	0.489
99% Chebyshev (MVUE) UCL	0.56		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	0.553	95% Jackknife UCL	0.554
95% Standard Bootstrap UCL	0.553	95% Bootstrap-t UCL	0.876
95% Hall's Bootstrap UCL	1.054	95% Percentile Bootstrap UCL	0.573
95% BCA Bootstrap UCL	0.655		
90% Chebyshev(Mean, Sd) UCL	0.656	95% Chebyshev(Mean, Sd) UCL	0.758
97.5% Chebyshev(Mean, Sd) UCL	0.901	99% Chebyshev(Mean, Sd) UCL	1.181

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	0.758
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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.

Fish Tissue ProUCL Output - Burbot

Mercury (Hg)

General Statistics

Total Number of Observations	293	Number of Distinct Observations	285
Number of Detects	292	Number of Non-Detects	1
Number of Distinct Detects	284	Number of Distinct Non-Detects	1
Minimum Detect	0.0255	Minimum Non-Detect	0.0119
Maximum Detect	1.048	Maximum Non-Detect	0.0119
Variance Detects	0.058	Percent Non-Detects	0.34%
Mean Detects	0.281	SD Detects	0.241
Median Detects	0.179	CV Detects	0.856
Skewness Detects	1.17	Kurtosis Detects	0.504
Mean of Logged Detects	-1.64	SD of Logged Detects	0.888

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.834	Normal GOF Test on Detected Observations Only
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.169	Lilliefors GOF Test
5% Lilliefors Critical Value	0.0523	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	0.28	KM Standard Error of Mean	0.0141
KM SD	0.241	95% KM (BCA) UCL	0.304
95% KM (t) UCL	0.304	95% KM (Percentile Bootstrap) UCL	0.304
95% KM (z) UCL	0.304	95% KM Bootstrap t UCL	0.304
90% KM Chebyshev UCL	0.323	95% KM Chebyshev UCL	0.342
97.5% KM Chebyshev UCL	0.368	99% KM Chebyshev UCL	0.421

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	4.756	Anderson-Darling GOF Test
5% A-D Critical Value	0.772	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.11	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.054	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)	1.489	k star (bias corrected MLE)	1.476
Theta hat (MLE)	0.189	Theta star (bias corrected MLE)	0.191
nu hat (MLE)	869.5	nu star (bias corrected)	861.9
Mean (detects)	0.281		

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	0.28
Maximum	1.048	Median	0.178
SD	0.241	CV	0.859
k hat (MLE)	1.464	k star (bias corrected MLE)	1.452
Theta hat (MLE)	0.192	Theta star (bias corrected MLE)	0.193
nu hat (MLE)	858	nu star (bias corrected)	850.6
Adjusted Level of Significance ( $\beta$ )	0.0492		
Approximate Chi Square Value (850.60, $\alpha$ )	783.9	Adjusted Chi Square Value (850.60, $\beta$ )	783.6
95% Gamma Approximate UCL (use when $n \geq 50$ )	0.304	95% Gamma Adjusted UCL (use when $n < 50$ )	0.304

Fish Tissue ProUCL Output - Burbot

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.28 SD (KM)	0.241
Variance (KM)	0.0579 SE of Mean (KM)	0.0141
k hat (KM)	1.359 k star (KM)	1.347
nu hat (KM)	796.1 nu star (KM)	789.3
theta hat (KM)	0.206 theta star (KM)	0.208
80% gamma percentile (KM)	0.439 90% gamma percentile (KM)	0.6
95% gamma percentile (KM)	0.758 99% gamma percentile (KM)	1.116

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (789.28, $\alpha$ )	725.1 Adjusted Chi Square Value (789.28, $\beta$ )	724.8
95% Gamma Approximate KM-UCL (use when n>=50)	0.305 95% Gamma Adjusted KM-UCL (use when n<50)	0.305

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.946 Shapiro Wilk GOF Test	
5% Shapiro Wilk P Value	3.15E-12 Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.0693 Lilliefors GOF Test	
5% Lilliefors Critical Value	0.0523 Detected Data Not Lognormal at 5% Significance Level	
Detected Data Not Lognormal at 5% Significance Level		

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.28 Mean in Log Scale	-1.649
SD in Original Scale	0.241 SD in Log Scale	0.9
95% t UCL (assumes normality of ROS data)	0.304 95% Percentile Bootstrap UCL	0.304
95% BCA Bootstrap UCL	0.305 95% Bootstrap t UCL	0.305
95% H-UCL (Log ROS)	0.321	

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-1.65 KM Geo Mean	0.192
KM SD (logged)	0.9 95% Critical H Value (KM-Log)	2.056
KM Standard Error of Mean (logged)	0.0526 95% H-UCL (KM -Log)	0.321
KM SD (logged)	0.9 95% Critical H Value (KM-Log)	2.056
KM Standard Error of Mean (logged)	0.0526	

DL/2 Statistics

DL/2 Normal	DL/2 Log-Transformed	
Mean in Original Scale	0.28 Mean in Log Scale	-1.652
SD in Original Scale	0.241 SD in Log Scale	0.909
95% t UCL (Assumes normality)	0.304 95% H-Stat UCL	0.323
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

95% KM (Chebyshev) UCL	0.342
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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.

Fish Tissue ProUCL Output - Burbot

Nickel (Ni)

General Statistics

Total Number of Observations	294	Number of Distinct Observations	77
Number of Detects	240	Number of Non-Detects	54
Number of Distinct Detects	72	Number of Distinct Non-Detects	27
Minimum Detect	0.014	Minimum Non-Detect	0.014
Maximum Detect	10.5	Maximum Non-Detect	0.097
Variance Detects	0.63	Percent Non-Detects	18.37%
Mean Detects	0.153	SD Detects	0.794
Median Detects	0.025	CV Detects	5.179
Skewness Detects	10.66	Kurtosis Detects	128.5
Mean of Logged Detects	-3.252	SD of Logged Detects	1.013

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.182	Normal GOF Test on Detected Observations Only
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.43	Lilliefors GOF Test
5% Lilliefors Critical Value	0.0576	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	0.129	KM Standard Error of Mean	0.0419
KM SD	0.717	95% KM (BCA) UCL	0.203
95% KM (t) UCL	0.198	95% KM (Percentile Bootstrap) UCL	0.206
95% KM (z) UCL	0.198	95% KM Bootstrap t UCL	0.336
90% KM Chebyshev UCL	0.255	95% KM Chebyshev UCL	0.312
97.5% KM Chebyshev UCL	0.391	99% KM Chebyshev UCL	0.546

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	60.03	Anderson-Darling GOF Test
5% A-D Critical Value	0.829	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.377	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.0627	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)	0.467	k star (bias corrected MLE)	0.464
Theta hat (MLE)	0.328	Theta star (bias corrected MLE)	0.33
nu hat (MLE)	224	nu star (bias corrected)	222.6
Mean (detects)	0.153		

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	0.127
Maximum	10.5	Median	0.025
SD	0.719	CV	5.662
k hat (MLE)	0.451	k star (bias corrected MLE)	0.448
Theta hat (MLE)	0.282	Theta star (bias corrected MLE)	0.283
nu hat (MLE)	264.9	nu star (bias corrected)	263.5
Adjusted Level of Significance ( $\beta$ )	0.0492		
Approximate Chi Square Value (263.53, $\alpha$ )	226.9	Adjusted Chi Square Value (263.53, $\beta$ )	226.8
95% Gamma Approximate UCL (use when $n \geq 50$ )	0.147	95% Gamma Adjusted UCL (use when $n < 50$ )	0.148

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.129	SD (KM)	0.717
Variance (KM)	0.515	SE of Mean (KM)	0.0419
k hat (KM)	0.0324	k star (KM)	0.0344
nu hat (KM)	19.08	nu star (KM)	20.22
theta hat (KM)	3.982	theta star (KM)	3.758
80% gamma percentile (KM)	0.0033	90% gamma percentile (KM)	0.104
95% gamma percentile (KM)	0.561	99% gamma percentile (KM)	3.208

Fish Tissue ProUCL Output - Burbot

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (20.22, $\alpha$ )	11.01	Adjusted Chi Square Value (20.22, $\beta$ )	10.98
95% Gamma Approximate KM-UCL (use when $n \geq 50$ )	0.237	95% Gamma Adjusted KM-UCL (use when $n < 50$ )	0.238

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.573	Shapiro Wilk GOF Test	
5% Shapiro Wilk P Value		0	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.304	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.0576	Detected Data Not Lognormal at 5% Significance Level	
Detected Data Not Lognormal at 5% Significance Level			

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.129	Mean in Log Scale	-3.389
SD in Original Scale	0.719	SD in Log Scale	0.997
95% t UCL (assumes normality of ROS data)	0.198	95% Percentile Bootstrap UCL	0.207
95% BCA Bootstrap UCL	0.247	95% Bootstrap t UCL	0.328
95% H-UCL (Log ROS)	0.0628		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-3.357	KM Geo Mean	0.0348
KM SD (logged)	0.946	95% Critical H Value (KM-Log)	2.093
KM Standard Error of Mean (logged)	0.0555	95% H-UCL (KM-Log)	0.0612
KM SD (logged)	0.946	95% Critical H Value (KM-Log)	2.093
KM Standard Error of Mean (logged)	0.0555		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.128	Mean in Log Scale	-3.417
SD in Original Scale	0.719	SD in Log Scale	0.992
95% t UCL (Assumes normality)	0.197	95% H-Stat UCL	0.0607
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

95% KM (Chebyshev) UCL	0.312
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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.

Fish Tissue ProUCL Output - Burbot

Selenium (Se)

General Statistics

Total Number of Observations	293	Number of Distinct Observations	185
Number of Detects	275	Number of Non-Detects	18
Number of Distinct Detects	184	Number of Distinct Non-Detects	14
Minimum Detect	0.12	Minimum Non-Detect	0.15
Maximum Detect	1.473	Maximum Non-Detect	0.46
Variance Detects	0.0831	Percent Non-Detects	6.14%
Mean Detects	0.535	SD Detects	0.288
Median Detects	0.49	CV Detects	0.539
Skewness Detects	0.569	Kurtosis Detects	-0.204
Mean of Logged Detects	-0.788	SD of Logged Detects	0.597

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.927	Normal GOF Test on Detected Observations Only
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.0987	Lilliefors GOF Test
5% Lilliefors Critical Value	0.0538	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	0.513	KM Standard Error of Mean	0.0171
KM SD	0.292	95% KM (BCA) UCL	0.54
95% KM (t) UCL	0.541	95% KM (Percentile Bootstrap) UCL	0.54
95% KM (z) UCL	0.541	95% KM Bootstrap t UCL	0.541
90% KM Chebyshev UCL	0.564	95% KM Chebyshev UCL	0.587
97.5% KM Chebyshev UCL	0.62	99% KM Chebyshev UCL	0.683

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	3.369	Anderson-Darling GOF Test
5% A-D Critical Value	0.759	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.0951	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.0553	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)	3.229	k star (bias corrected MLE)	3.196
Theta hat (MLE)	0.166	Theta star (bias corrected MLE)	0.167
nu hat (MLE)	1776	nu star (bias corrected)	1758
Mean (detects)	0.535		

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	0.0887	Mean	0.513
Maximum	1.473	Median	0.47
SD	0.293	CV	0.57
k hat (MLE)	2.897	k star (bias corrected MLE)	2.87
Theta hat (MLE)	0.177	Theta star (bias corrected MLE)	0.179
nu hat (MLE)	1698	nu star (bias corrected)	1682
Adjusted Level of Significance ( $\beta$ )	0.0492		
Approximate Chi Square Value (N/A, $\alpha$ )	1588	Adjusted Chi Square Value (N/A, $\beta$ )	1587
95% Gamma Approximate UCL (use when n>=50)	0.544	95% Gamma Adjusted UCL (use when n<50)	0.544

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.513	SD (KM)	0.292
Variance (KM)	0.0854	SE of Mean (KM)	0.0171
k hat (KM)	3.08	k star (KM)	3.051
nu hat (KM)	1805	nu star (KM)	1788
theta hat (KM)	0.167	theta star (KM)	0.168
80% gamma percentile (KM)	0.73	90% gamma percentile (KM)	0.907
95% gamma percentile (KM)	1.071	99% gamma percentile (KM)	1.428

Fish Tissue ProUCL Output - Burbot

Gamma Kaplan-Meier (KM) Statistics			
Approximate Chi Square Value (N/A, $\alpha$ )	1690	Adjusted Chi Square Value (N/A, $\beta$ )	1690
95% Gamma Approximate KM-UCL (use when n>=50)	0.542	95% Gamma Adjusted KM-UCL (use when n<50)	0.542
Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Approximate Test Statistic	0.934	Shapiro Wilk GOF Test	
5% Shapiro Wilk P Value	0	Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.0948	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.0538	Detected Data Not Lognormal at 5% Significance Level	
Detected Data Not Lognormal at 5% Significance Level			
Lognormal ROS Statistics Using Imputed Non-Detects			
Mean in Original Scale	0.513	Mean in Log Scale	-0.846
SD in Original Scale	0.292	SD in Log Scale	0.624
95% t UCL (assumes normality of ROS data)	0.542	95% Percentile Bootstrap UCL	0.542
95% BCA Bootstrap UCL	0.541	95% Bootstrap t UCL	0.542
95% H-UCL (Log ROS)	0.558		
Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution			
KM Mean (logged)	-0.85	KM Geo Mean	0.428
KM SD (logged)	0.628	95% Critical H Value (KM-Log)	1.871
KM Standard Error of Mean (logged)	0.0369	95% H-UCL (KM -Log)	0.558
KM SD (logged)	0.628	95% Critical H Value (KM-Log)	1.871
KM Standard Error of Mean (logged)	0.0369		
DL/2 Statistics			
DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.51	Mean in Log Scale	-0.873
SD in Original Scale	0.297	SD in Log Scale	0.672
95% t UCL (Assumes normality)	0.538	95% H-Stat UCL	0.564
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			
95% KM (Chebyshev) UCL	0.587		

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.

Fish Tissue ProUCL Output - Burbot

Vanadium (V)

General Statistics

Total Number of Observations	293	Number of Distinct Observations	84
Number of Detects	291	Number of Non-Detects	2
Number of Distinct Detects	84	Number of Distinct Non-Detects	2
Minimum Detect	0.024	Minimum Non-Detect	0.024
Maximum Detect	1.82	Maximum Non-Detect	0.035
	0.0125	Percent Non-Detects	0.68%
Mean Detects	0.0598	SD Detects	0.112
Median Detects	0.025	CV Detects	1.872
Skewness Detects	13.58	Kurtosis Detects	212.3
Mean of Logged Detects	-3.141	SD of Logged Detects	0.674

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.28	Normal GOF Test on Detected Observations Only
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.375	Lilliefors GOF Test
5% Lilliefors Critical Value	0.0523	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	0.0596	KM Standard Error of Mean	0.00652
KM SD	0.111	95% KM (BCA) UCL	0.0719
95% KM (t) UCL	0.0703	95% KM (Percentile Bootstrap) UCL	0.0713
95% KM (z) UCL	0.0703	95% KM Bootstrap t UCL	0.0847
90% KM Chebyshev UCL	0.0791	95% KM Chebyshev UCL	0.088
97.5% KM Chebyshev UCL	0.1	99% KM Chebyshev UCL	0.124

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	3.44E+28	Anderson-Darling GOF Test
5% A-D Critical Value	0.77	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.265	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.054	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)	1.692	k star (bias corrected MLE)	1.677
Theta hat (MLE)	0.0353	Theta star (bias corrected MLE)	0.0357
nu hat (MLE)	984.6	nu star (bias corrected)	975.8
Mean (detects)	0.0598		

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	0.0595
Maximum	1.82	Median	0.025
SD	0.112	CV	1.878
k hat (MLE)	1.673	k star (bias corrected MLE)	1.659
Theta hat (MLE)	0.0355	Theta star (bias corrected MLE)	0.0358
nu hat (MLE)	980.7	nu star (bias corrected)	972
Adjusted Level of Significance ( $\beta$ )	0.0492		
Approximate Chi Square Value (971.96, $\alpha$ )	900.6	Adjusted Chi Square Value (971.96, $\beta$ )	900.3
95% Gamma Approximate UCL (use when $n \geq 50$ )	0.0642	95% Gamma Adjusted UCL (use when $n < 50$ )	0.0642



Fish Tissue ProUCL Output - Burbot

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0596 SD (KM)	0.111
Variance (KM)	0.0124 SE of Mean (KM)	0.00652
k hat (KM)	0.286 k star (KM)	0.285
nu hat (KM)	167.4 nu star (KM)	167
theta hat (KM)	0.208 theta star (KM)	0.209
80% gamma percentile (KM)	0.0901 90% gamma percentile (KM)	0.177
95% gamma percentile (KM)	0.277 99% gamma percentile (KM)	0.539

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (167.03, $\alpha$ )	138.1 Adjusted Chi Square Value (167.03, $\beta$ )	138
95% Gamma Approximate KM-UCL (use when n>=50)	0.072 95% Gamma Adjusted KM-UCL (use when n<50)	0.0721

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.79 Shapiro Wilk GOF Test
5% Shapiro Wilk P Value	0 Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.294 Lilliefors GOF Test
5% Lilliefors Critical Value	0.0523 Detected Data Not Lognormal at 5% Significance Level
Detected Data Not Lognormal at 5% Significance Level	

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0595 Mean in Log Scale	-3.148
SD in Original Scale	0.112 SD in Log Scale	0.68
95% t UCL (assumes normality of ROS data)	0.0703 95% Percentile Bootstrap UCL	0.0711
95% BCA Bootstrap UCL	0.0799 95% Bootstrap t UCL	0.0835
95% H-UCL (Log ROS)	0.0583	

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-3.145 KM Geo Mean	0.0431
KM SD (logged)	0.672 95% Critical H Value (KM-Log)	1.897
KM Standard Error of Mean (logged)	0.0393 95% H-UCL (KM -Log)	0.0582
KM SD (logged)	0.672 95% Critical H Value (KM-Log)	1.897
KM Standard Error of Mean (logged)	0.0393	

DL/2 Statistics

DL/2 Normal	DL/2 Log-Transformed	
Mean in Original Scale	0.0595 Mean in Log Scale	-3.148
SD in Original Scale	0.112 SD in Log Scale	0.677
95% t UCL (Assumes normality)	0.0702 95% H-Stat UCL	0.0582

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

95% KM (Chebyshev) UCL	0.088
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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.

Fish Tissue ProUCL Output - Burbot

Zinc (Zn)

General Statistics

Total Number of Observations	293	Number of Distinct Observations	264
		Number of Missing Observations	0
Minimum	2.81	Mean	5.628
Maximum	10.4	Median	5.44
SD	1.188	Std. Error of Mean	0.0694
Coefficient of Variation	0.211	Skewness	0.758

Normal GOF Test

Shapiro Wilk Test Statistic	0.962	Shapiro Wilk GOF Test	
5% Shapiro Wilk P Value	1.27E-05	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.0695	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.0522	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	5.743	95% Adjusted-CLT UCL (Chen-1995)	5.746
		95% Modified-t UCL (Johnson-1978)	5.743

Gamma GOF Test

A-D Test Statistic	0.716	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.751	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.0431	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.0528	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			

Gamma Statistics

k hat (MLE)	23.36	k star (bias corrected MLE)	23.13
Theta hat (MLE)	0.241	Theta star (bias corrected MLE)	0.243
nu hat (MLE)	13690	nu star (bias corrected)	13552
MLE Mean (bias corrected)	5.628	MLE Sd (bias corrected)	1.17
		Approximate Chi Square Value (0.05)	13282
Adjusted Level of Significance	0.0492	Adjusted Chi Square Value	13281

Assuming Gamma Distribution

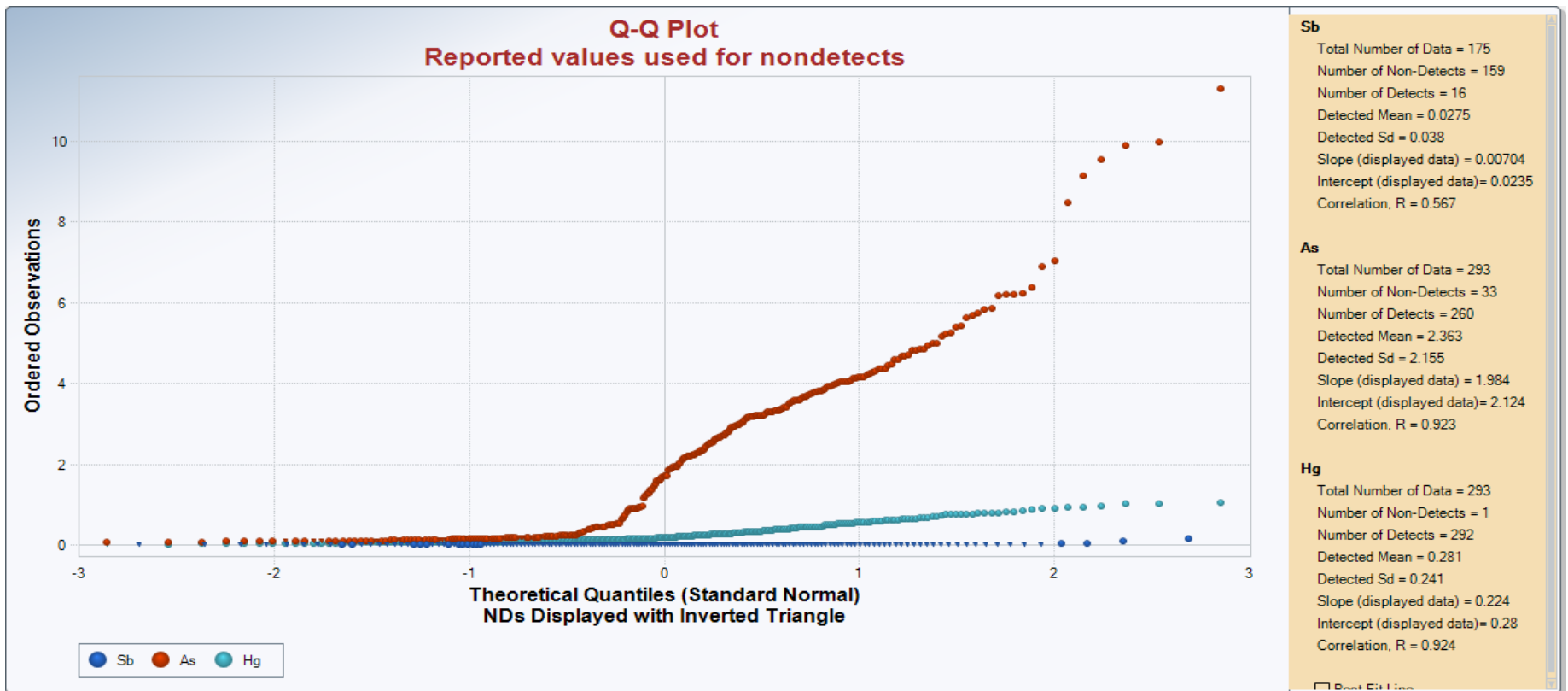
95% Approximate Gamma UCL (use when n>=50)	5.743	95% Adjusted Gamma UCL (use when n<50)	5.743
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Fish Tissue ProUCL Output - Burbot

Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.987	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk P Value	0.765	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.0422	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.0522	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	1.033	Mean of logged Data	1.706
Maximum of Logged Data	2.342	SD of logged Data	0.208
Assuming Lognormal Distribution			
95% H-UCL	5.745	90% Chebyshev (MVUE) UCL	5.836
95% Chebyshev (MVUE) UCL	5.929	97.5% Chebyshev (MVUE) UCL	6.06
99% Chebyshev (MVUE) UCL	6.316		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	5.743	95% Jackknife UCL	5.743
95% Standard Bootstrap UCL	5.744	95% Bootstrap-t UCL	5.745
95% Hall's Bootstrap UCL	5.746	95% Percentile Bootstrap UCL	5.742
95% BCA Bootstrap UCL	5.739		
90% Chebyshev(Mean, Sd) UCL	5.837	95% Chebyshev(Mean, Sd) UCL	5.931
97.5% Chebyshev(Mean, Sd) UCL	6.062	99% Chebyshev(Mean, Sd) UCL	6.319
Suggested UCL to Use			
95% Approximate Gamma UCL	5.743		

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.

Figure D-2. Q-Q Plot - Burbot



Burbot Output Test

Outlier Tests for Selected Variables replacing nondetects with 1/2 the Detection Limit

User Selected Options

Date/Time of Computation ProUCL 5.17/24/2017 2:56:13 PM

From File WorkSheet.xls

Full Precision OFF

Rosner's Outlier Test for 1 Outliers in Sb

Total N 175  
 Number NDs 159  
 Number Detects 175  
 Mean with NDs=DL/2 0.013  
 SD with NDs=DL/2 0.0123  
 Number of data 175  
 Number of suspected outliers 1  
 NDs replaced with half value.

#	Mean	sd	Potential outlier	Obs. Number	Test value	Critical value (5%)	Critical value (1%)
1	0.013	0.0123	0.148	155	10.98	3.565	3.935

For 5% Significance Level, there is 1 Potential Outlier  
 Therefore, Observation 0.148 is a Potential Statistical Outlier

For 1% Significance Level, there is 1 Potential Outlier

Rosner's Outlier Test for 1 Outliers in As

Total N 293  
 Number NDs 33  
 Number Detects 293  
 Mean with NDs=DL/2 2.11  
 SD with NDs=DL/2 2.151  
 Number of data 293  
 Number of suspected outliers 1  
 NDs replaced with half value.

#	Mean	sd	Potential outlier	Obs. Number	Test value	Critical value (5%)	Critical value (1%)
1	2.11	2.147	11.29	96	4.275	3.713	4.083

## Burbot Output Test

For 5% Significance Level, there is 1 Potential Outlier  
Therefore, Observation 11.29 is a Potential Statistical Outlier

For 1% Significance Level, there is 1 Potential Outlier

Rosner's Outlier Test for 1 Outliers in Hg

Total N	293
Number NDs	1
Number Detects	293
Mean with NDs=DL/2	0.28
SD with NDs=DL/2	0.241
Number of data	293
Number of suspected outliers	1

NDs replaced with half value.

#	Mean	sd	Potential outlier	Obs. Number	Test value	Critical value (5%)	Critical value (1%)
1	0.28	0.241	1.048	42	3.191	3.713	4.083

For 5% Significance Level, there is no Potential Outlier

For 1% Significance Level, there is no Potential Outlier



Fish Tissue ProUCL Output - Sheefish

UCL Statistics for Data Sets with Non-Detects

User Selected Options

Date/Time of Computation ProUCL 5.16/19/2017 10:02:57 PM  
 From File WorkSheet.xls  
 Full Precision OFF  
 Confidence Coefficient 95%  
 Number of Bootstrap Operations 2000

Aluminum (Al)

General Statistics

Total Number of Observations	38	Number of Distinct Observations	5
Number of Detects	17	Number of Non-Detects	21
Number of Distinct Detects	5	Number of Distinct Non-Detects	1
Minimum Detect	1	Minimum Non-Detect	1
Maximum Detect	1.6	Maximum Non-Detect	1
Variance Detects	0.0403	Percent Non-Detects	55.26%
Mean Detects	1.182	SD Detects	0.201
Median Detects	1.1	CV Detects	0.17
Skewness Detects	1.167	Kurtosis Detects	0.331
Mean of Logged Detects	0.155	SD of Logged Detects	0.159

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic 0.814 Shapiro Wilk GOF Test  
 5% Shapiro Wilk Critical Value 0.892 Detected Data Not Normal at 5% Significance Level  
 Lilliefors Test Statistic 0.247 Lilliefors GOF Test  
 5% Lilliefors Critical Value 0.207 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	1.082	KM Standard Error of Mean	0.0265
KM SD	0.159	95% KM (BCA) UCL	1.132
95% KM (t) UCL	1.126	95% KM (Percentile Bootstrap) UCL	1.126
95% KM (z) UCL	1.125	95% KM Bootstrap t UCL	1.143
90% KM Chebyshev UCL	1.161	95% KM Chebyshev UCL	1.197
97.5% KM Chebyshev UCL	1.247	99% KM Chebyshev UCL	1.346

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic 1.115 Anderson-Darling GOF Test  
 5% A-D Critical Value 0.737 Detected Data Not Gamma Distributed at 5% Significance Level  
 K-S Test Statistic 0.244 Kolmogorov-Smirnov GOF  
 5% K-S Critical Value 0.209 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)	40.42	k star (bias corrected MLE)	33.33
Theta hat (MLE)	0.0292	Theta star (bias corrected MLE)	0.0355
nu hat (MLE)	1374	nu star (bias corrected)	1133
Mean (detects)	1.182		

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	0.269	Mean	0.888
Maximum	1.6	Median	0.863
SD	0.326	CV	0.367
k hat (MLE)	6.938	k star (bias corrected MLE)	6.408
Theta hat (MLE)	0.128	Theta star (bias corrected MLE)	0.139
nu hat (MLE)	527.3	nu star (bias corrected)	487
Adjusted Level of Significance ( $\beta$ )	0.0434		
Approximate Chi Square Value (486.98, $\alpha$ )	436.8	Adjusted Chi Square Value (486.98, $\beta$ )	434.8
95% Gamma Approximate UCL (use when n>=50)	0.99	95% Gamma Adjusted UCL (use when n<50)	0.995



Fish Tissue ProUCL Output - Sheefish

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	1.082 SD (KM)	0.159
Variance (KM)	0.0252 SE of Mean (KM)	0.0265
k hat (KM)	46.45 k star (KM)	42.8
nu hat (KM)	3530 nu star (KM)	3252
theta hat (KM)	0.0233 theta star (KM)	0.0253
80% gamma percentile (KM)	1.218 90% gamma percentile (KM)	1.298
95% gamma percentile (KM)	1.367 99% gamma percentile (KM)	1.503

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (N/A, $\alpha$ )	3121 Adjusted Chi Square Value (N/A, $\beta$ )	3116
95% Gamma Approximate KM-UCL (use when n>=50)	1.127 95% Gamma Adjusted KM-UCL (use when n<50)	1.129

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.842 Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.892 Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.235 Lilliefors GOF Test
5% Lilliefors Critical Value	0.207 Detected Data Not Lognormal at 5% Significance Level
Detected Data Not Lognormal at 5% Significance Level	

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.939 Mean in Log Scale	-0.103
SD in Original Scale	0.273 SD in Log Scale	0.286
95% t UCL (assumes normality of ROS data)	1.014 95% Percentile Bootstrap UCL	1.012
95% BCA Bootstrap UCL	1.017 95% Bootstrap t UCL	1.018
95% H-UCL (Log ROS)	1.022	

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	0.0694 KM Geo Mean	1.072
KM SD (logged)	0.129 95% Critical H Value (KM-Log)	1.707
KM Standard Error of Mean (logged)	0.0215 95% H-UCL (KM -Log)	1.121
KM SD (logged)	0.129 95% Critical H Value (KM-Log)	1.707
KM Standard Error of Mean (logged)	0.0215	

DL/2 Statistics

DL/2 Normal	DL/2 Log-Transformed	
Mean in Original Scale	0.805 Mean in Log Scale	-0.314
SD in Original Scale	0.368 SD in Log Scale	0.44
95% t UCL (Assumes normality)	0.906 95% H-Stat UCL	0.922

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

95% KM (t) UCL	1.126 KM H-UCL	1.121
95% KM (BCA) UCL	1.132	

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.

Fish Tissue ProUCL Output - Sheefish

Antimony (Sb)

General Statistics

Total Number of Observations	38	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	38
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!  
 Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!  
 The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Sb was not processed!

Arsenic (As)

General Statistics

Total Number of Observations	38	Number of Distinct Observations	37
		Number of Missing Observations	0
Minimum	0.036	Mean	3.148
Maximum	6.846	Median	3.175
SD	1.867	Std. Error of Mean	0.303
Coefficient of Variation	0.593	Skewness	-0.14

Normal GOF Test

Shapiro Wilk Test Statistic	0.954	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.938	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.0961	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.142	Data appear Normal at 5% Significance Level	

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	3.659	95% Adjusted-CLT UCL (Chen-1995)	3.639
		95% Modified-t UCL (Johnson-1978)	3.658

Gamma GOF Test

A-D Test Statistic	2.692	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.773	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.222	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.147	Data Not Gamma Distributed at 5% Significance Level	

Gamma Statistics

k hat (MLE)	1.194	k star (bias corrected MLE)	1.117
Theta hat (MLE)	2.637	Theta star (bias corrected MLE)	2.818
nu hat (MLE)	90.75	nu star (bias corrected)	84.92
MLE Mean (bias corrected)	3.148	MLE Sd (bias corrected)	2.979
		Approximate Chi Square Value (0.05)	64.68
Adjusted Level of Significance	0.0434	Adjusted Chi Square Value	63.95

Fish Tissue ProUCL Output - Sheefish

Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	4.134	95% Adjusted Gamma UCL (use when n<50)	4.181
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.713	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.938	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.282	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.142	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-3.324	Mean of logged Data	0.673
Maximum of Logged Data	1.924	SD of logged Data	1.405
Assuming Lognormal Distribution			
95% H-UCL	10.27	90% Chebyshev (MVUE) UCL	9.362
95% Chebyshev (MVUE) UCL	11.33	97.5% Chebyshev (MVUE) UCL	14.07
99% Chebyshev (MVUE) UCL	19.44		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	3.647	95% Jackknife UCL	3.659
95% Standard Bootstrap UCL	3.636	95% Bootstrap-t UCL	3.625
95% Hall's Bootstrap UCL	3.649	95% Percentile Bootstrap UCL	3.637
95% BCA Bootstrap UCL	3.63		
90% Chebyshev(Mean, Sd) UCL	4.057	95% Chebyshev(Mean, Sd) UCL	4.469
97.5% Chebyshev(Mean, Sd) UCL	5.04	99% Chebyshev(Mean, Sd) UCL	6.162
Suggested UCL to Use			
95% Student's-t UCL	3.659		

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.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positively skewed data sets.

Fish Tissue ProUCL Output - Sheefish

Barium (Ba)

General Statistics

Total Number of Observations	38	Number of Distinct Observations	35
		Number of Missing Observations	0
Minimum	0.043	Mean	0.16
Maximum	0.34	Median	0.147
SD	0.0768	Std. Error of Mean	0.0125
Coefficient of Variation	0.482	Skewness	0.677

Normal GOF Test

Shapiro Wilk Test Statistic	0.945	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.938	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.0988	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.142	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.181	95% Adjusted-CLT UCL (Chen-1995)	0.181
		95% Modified-t UCL (Johnson-1978)	0.181

Gamma GOF Test

A-D Test Statistic	0.145	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.752	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.0639	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.144	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			

Gamma Statistics

k hat (MLE)	4.305	k star (bias corrected MLE)	3.983
Theta hat (MLE)	0.037	Theta star (bias corrected MLE)	0.04
nu hat (MLE)	327.2	nu star (bias corrected)	302.7
MLE Mean (bias corrected)	0.16	MLE Sd (bias corrected)	0.0799
		Approximate Chi Square Value (0.05)	263.4
Adjusted Level of Significance	0.0434	Adjusted Chi Square Value	261.9

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	0.183	95% Adjusted Gamma UCL (use when n<50)	0.184
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Fish Tissue ProUCL Output - Sheefish

Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.971	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.938	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.0959	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.142	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-3.147	Mean of logged Data	-1.956
Maximum of Logged Data	-1.079	SD of logged Data	0.516
Assuming Lognormal Distribution			
95% H-UCL	0.19	90% Chebyshev (MVUE) UCL	0.203
95% Chebyshev (MVUE) UCL	0.222	97.5% Chebyshev (MVUE) UCL	0.249
99% Chebyshev (MVUE) UCL	0.301		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	0.18	95% Jackknife UCL	0.181
95% Standard Bootstrap UCL	0.18	95% Bootstrap-t UCL	0.182
95% Hall's Bootstrap UCL	0.182	95% Percentile Bootstrap UCL	0.179
95% BCA Bootstrap UCL	0.182		
90% Chebyshev(Mean, Sd) UCL	0.197	95% Chebyshev(Mean, Sd) UCL	0.214
97.5% Chebyshev(Mean, Sd) UCL	0.237	99% Chebyshev(Mean, Sd) UCL	0.284
Suggested UCL to Use			
95% Student's-t UCL	0.181		

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.

Cadmium (Cd)

General Statistics			
Total Number of Observations	38	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	38
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs! Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit! The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Cd was not processed!

Fish Tissue ProUCL Output - Sheefish

Chromium (Cr)

General Statistics

Total Number of Observations	38	Number of Distinct Observations	3
Number of Detects	2	Number of Non-Detects	36
Number of Distinct Detects	2	Number of Distinct Non-Detects	1
Minimum Detect	0.026	Minimum Non-Detect	0.025
Maximum Detect	0.046	Maximum Non-Detect	0.025
Variance Detects	2.00E-04	Percent Non-Detects	94.74%
Mean Detects	0.036	SD Detects	0.0141
Median Detects	0.036	CV Detects	0.393
Skewness Detects	N/A	Kurtosis Detects	N/A
Mean of Logged Detects	-3.364	SD of Logged Detects	0.403

Warning: Data set has only 2 Detected Values.  
 This is not enough to compute meaningful or reliable statistics and estimates.

Normal GOF Test on Detects Only  
 Not Enough Data to Perform GOF Test

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

KM Mean	0.0256	KM Standard Error of Mean	7.71E-04
KM SD	0.00336	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.0269	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.0268	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.0279	95% KM Chebyshev UCL	0.0289
97.5% KM Chebyshev UCL	0.0304	99% KM Chebyshev UCL	0.0333

Gamma GOF Tests on Detected Observations Only  
 Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	12.62	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.00285	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	50.47	nu star (bias corrected)	N/A
Mean (detects)	0.036		

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0256	SD (KM)	0.00336
Variance (KM)	1.13E-05	SE of Mean (KM)	7.71E-04
k hat (KM)	57.92	k star (KM)	53.36
nu hat (KM)	4402	nu star (KM)	4056
theta hat (KM)	4.42E-04	theta star (KM)	4.79E-04
80% gamma percentile (KM)	0.0285	90% gamma percentile (KM)	0.0302
95% gamma percentile (KM)	0.0316	99% gamma percentile (KM)	0.0344

Fish Tissue ProUCL Output - Sheefish

Gamma Kaplan-Meier (KM) Statistics

	Adjusted Level of Significance ( $\beta$ )	0.0434
Approximate Chi Square Value (N/A, $\alpha$ )	3909 Adjusted Chi Square Value (N/A, $\beta$ )	3903
95% Gamma Approximate KM-UCL (use when n>=50)	0.0265 95% Gamma Adjusted KM-UCL (use when n<50)	0.0266

Lognormal GOF Test on Detected Observations Only  
 Not Enough Data to Perform GOF Test

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.00366	Mean in Log Scale	-7.121
SD in Original Scale	0.0085	SD in Log Scale	1.822
95% t UCL (assumes normality of ROS data)	0.00599	95% Percentile Bootstrap UCL	0.00619
95% BCA Bootstrap UCL	0.00711	95% Bootstrap t UCL	0.01
95% H-UCL (Log ROS)	0.0121		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-3.672	KM Geo Mean	0.0254
KM SD (logged)	0.0976	95% Critical H Value (KM-Log)	N/A
KM Standard Error of Mean (logged)	0.0224	95% H-UCL (KM -Log)	N/A
KM SD (logged)	0.0976	95% Critical H Value (KM-Log)	N/A
KM Standard Error of Mean (logged)	0.0224		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.0137	Mean in Log Scale	-4.328
SD in Original Scale	0.0058	SD in Log Scale	0.24
95% t UCL (Assumes normality)	0.0153	95% H-Stat UCL	0.0145

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

95% KM (t) UCL	0.0269	KM H-UCL	N/A
95% KM (BCA) UCL	N/A		

Warning: One or more Recommended UCL(s) not available!

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.

Fish Tissue ProUCL Output - Sheefish

Copper (Cu)

General Statistics

Total Number of Observations	39	Number of Distinct Observations	39
		Number of Missing Observations	0
Minimum	0.161	Mean	0.564
Maximum	1.459	Median	0.559
SD	0.239	Std. Error of Mean	0.0382
Coefficient of Variation	0.424	Skewness	1.303

Normal GOF Test

Shapiro Wilk Test Statistic	0.923	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.939	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.105	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.14	Data appear 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	0.628	95% Adjusted-CLT UCL (Chen-1995)	0.635
		95% Modified-t UCL (Johnson-1978)	0.629

Gamma GOF Test

A-D Test Statistic	0.261	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.751	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.0866	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.142	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			

Gamma Statistics

k hat (MLE)	5.948	k star (bias corrected MLE)	5.508
Theta hat (MLE)	0.0947	Theta star (bias corrected MLE)	0.102
nu hat (MLE)	463.9	nu star (bias corrected)	429.6
MLE Mean (bias corrected)	0.564	MLE Sd (bias corrected)	0.24
		Approximate Chi Square Value (0.05)	382.5
Adjusted Level of Significance	0.0437	Adjusted Chi Square Value	380.8

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	0.633	95% Adjusted Gamma UCL (use when n<50)	0.636
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Lognormal GOF Test

Shapiro Wilk Test Statistic	0.975	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.939	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.113	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.14	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			



Fish Tissue ProUCL Output - Sheefish

Lognormal Statistics

Minimum of Logged Data	-1.826	Mean of logged Data	-0.66
Maximum of Logged Data	0.378	SD of logged Data	0.433

Assuming Lognormal Distribution

95% H-UCL	0.647	90% Chebyshev (MVUE) UCL	0.688
95% Chebyshev (MVUE) UCL	0.743	97.5% Chebyshev (MVUE) UCL	0.82
99% Chebyshev (MVUE) UCL	0.971		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	0.626	95% Jackknife UCL	0.628
95% Standard Bootstrap UCL	0.625	95% Bootstrap-t UCL	0.642
95% Hall's Bootstrap UCL	0.651	95% Percentile Bootstrap UCL	0.626
95% BCA Bootstrap UCL	0.628		
90% Chebyshev(Mean, Sd) UCL	0.678	95% Chebyshev(Mean, Sd) UCL	0.73
97.5% Chebyshev(Mean, Sd) UCL	0.802	99% Chebyshev(Mean, Sd) UCL	0.944

Suggested UCL to Use

95% Student's-t UCL	0.628
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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.

Fish Tissue ProUCL Output - Sheefish

Iron (Fe)

General Statistics

Total Number of Observations	38	Number of Distinct Observations	31
		Number of Missing Observations	0
Minimum	2.3	Mean	7.529
Maximum	16.4	Median	7.35
SD	3.075	Std. Error of Mean	0.499
Coefficient of Variation	0.408	Skewness	0.9

Normal GOF Test

Shapiro Wilk Test Statistic	0.94	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.938	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.166	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.142	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	8.371	95% Adjusted-CLT UCL (Chen-1995)	8.427
		95% Modified-t UCL (Johnson-1978)	8.383

Gamma GOF Test

A-D Test Statistic	0.397	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.75	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.119	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.143	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			

Gamma Statistics

k hat (MLE)	6.138	k star (bias corrected MLE)	5.671
Theta hat (MLE)	1.227	Theta star (bias corrected MLE)	1.328
nu hat (MLE)	466.5	nu star (bias corrected)	431
MLE Mean (bias corrected)	7.529	MLE Sd (bias corrected)	3.162
		Approximate Chi Square Value (0.05)	383.9
Adjusted Level of Significance	0.0434	Adjusted Chi Square Value	382.1

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	8.453	95% Adjusted Gamma UCL (use when n<50)	8.494
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Fish Tissue ProUCL Output - Sheefish

Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.965	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.938	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.14	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.142	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	0.833	Mean of logged Data	1.935
Maximum of Logged Data	2.797	SD of logged Data	0.428
Assuming Lognormal Distribution			
95% H-UCL	8.651	90% Chebyshev (MVUE) UCL	9.2
95% Chebyshev (MVUE) UCL	9.939	97.5% Chebyshev (MVUE) UCL	10.96
99% Chebyshev (MVUE) UCL	12.98		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	8.35	95% Jackknife UCL	8.371
95% Standard Bootstrap UCL	8.327	95% Bootstrap-t UCL	8.48
95% Hall's Bootstrap UCL	8.575	95% Percentile Bootstrap UCL	8.342
95% BCA Bootstrap UCL	8.429		
90% Chebyshev(Mean, Sd) UCL	9.026	95% Chebyshev(Mean, Sd) UCL	9.703
97.5% Chebyshev(Mean, Sd) UCL	10.64	99% Chebyshev(Mean, Sd) UCL	12.49
Suggested UCL to Use			
95% Student's-t UCL	8.371		

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.

Fish Tissue ProUCL Output - Sheefish

Manganese (Mn)

General Statistics

Total Number of Observations	38	Number of Distinct Observations	30
		Number of Missing Observations	0
Minimum	0.092	Mean	0.134
Maximum	0.169	Median	0.136
SD	0.0175	Std. Error of Mean	0.00284
Coefficient of Variation	0.13	Skewness	-0.172

Normal GOF Test

Shapiro Wilk Test Statistic	0.985	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.938	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.0754	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.142	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.139	95% Adjusted-CLT UCL (Chen-1995)	0.139
		95% Modified-t UCL (Johnson-1978)	0.139

Gamma GOF Test

A-D Test Statistic	0.261	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.746	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.0927	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.143	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			

Gamma Statistics

k hat (MLE)	58.36	k star (bias corrected MLE)	53.77
Theta hat (MLE)	0.0023	Theta star (bias corrected MLE)	0.00249
nu hat (MLE)	4435	nu star (bias corrected)	4086
MLE Mean (bias corrected)	0.134	MLE Sd (bias corrected)	0.0183
		Approximate Chi Square Value (0.05)	3939
Adjusted Level of Significance	0.0434	Adjusted Chi Square Value	3933

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	0.139	95% Adjusted Gamma UCL (use when n<50)	0.139
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Lognormal GOF Test

Shapiro Wilk Test Statistic	0.974	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.938	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.1	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.142	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			

Lognormal Statistics

Minimum of Logged Data	-2.386	Mean of logged Data	-2.019
Maximum of Logged Data	-1.778	SD of logged Data	0.134

Fish Tissue ProUCL Output - Sheefish

Assuming Lognormal Distribution

95% H-UCL	0.139	90% Chebyshev (MVUE) UCL	0.143
95% Chebyshev (MVUE) UCL	0.147	97.5% Chebyshev (MVUE) UCL	0.152
99% Chebyshev (MVUE) UCL	0.163		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	0.139	95% Jackknife UCL	0.139
95% Standard Bootstrap UCL	0.139	95% Bootstrap-t UCL	0.139
95% Hall's Bootstrap UCL	0.138	95% Percentile Bootstrap UCL	0.139
95% BCA Bootstrap UCL	0.139		
90% Chebyshev(Mean, Sd) UCL	0.143	95% Chebyshev(Mean, Sd) UCL	0.146
97.5% Chebyshev(Mean, Sd) UCL	0.152	99% Chebyshev(Mean, Sd) UCL	0.162

Suggested UCL to Use

95% Student's-t UCL	0.139
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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.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positively skewed data sets.

Fish Tissue ProUCL Output - Sheefish

Mercury (Hg)

General Statistics

Total Number of Observations	38	Number of Distinct Observations	21
		Number of Missing Observations	0
Minimum	0.11	Mean	0.212
Maximum	0.32	Median	0.21
SD	0.0584	Std. Error of Mean	0.00947
Coefficient of Variation	0.275	Skewness	0.138

Normal GOF Test

Shapiro Wilk Test Statistic	0.957	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.938	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.0946	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.142	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.228	95% Adjusted-CLT UCL (Chen-1995)	0.228
		95% Modified-t UCL (Johnson-1978)	0.228

Gamma GOF Test

A-D Test Statistic	0.365	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.748	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.0999	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.143	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			

Gamma Statistics

k hat (MLE)	13.06	k star (bias corrected MLE)	12.04
Theta hat (MLE)	0.0163	Theta star (bias corrected MLE)	0.0176
nu hat (MLE)	992.3	nu star (bias corrected)	915.3
MLE Mean (bias corrected)	0.212	MLE Sd (bias corrected)	0.0612
		Approximate Chi Square Value (0.05)	846
Adjusted Level of Significance	0.0434	Adjusted Chi Square Value	843.3

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	0.23	95% Adjusted Gamma UCL (use when n<50)	0.231
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Fish Tissue ProUCL Output - Sheefish

Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.954	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.938	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.0962	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.142	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-2.207	Mean of logged Data	-1.588
Maximum of Logged Data	-1.139	SD of logged Data	0.287
Assuming Lognormal Distribution			
95% H-UCL	0.232	90% Chebyshev (MVUE) UCL	0.243
95% Chebyshev (MVUE) UCL	0.257	97.5% Chebyshev (MVUE) UCL	0.276
99% Chebyshev (MVUE) UCL	0.313		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	0.228	95% Jackknife UCL	0.228
95% Standard Bootstrap UCL	0.228	95% Bootstrap-t UCL	0.229
95% Hall's Bootstrap UCL	0.229	95% Percentile Bootstrap UCL	0.228
95% BCA Bootstrap UCL	0.228		
90% Chebyshev(Mean, Sd) UCL	0.241	95% Chebyshev(Mean, Sd) UCL	0.254
97.5% Chebyshev(Mean, Sd) UCL	0.272	99% Chebyshev(Mean, Sd) UCL	0.307
Suggested UCL to Use			
95% Student's-t UCL	0.228		

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.

Fish Tissue ProUCL Output - Sheefish

Nickel (Ni)

General Statistics

Total Number of Observations	38	Number of Distinct Observations	4
Number of Detects	3	Number of Non-Detects	35
Number of Distinct Detects	3	Number of Distinct Non-Detects	1
Minimum Detect	0.05	Minimum Non-Detect	0.025
Maximum Detect	0.347	Maximum Non-Detect	0.025
Variance Detects	0.0226	Percent Non-Detects	92.11%
Mean Detects	0.185	SD Detects	0.15
Median Detects	0.158	CV Detects	0.813
Skewness Detects	0.782	Kurtosis Detects	N/A
Mean of Logged Detects	-1.966	SD of Logged Detects	0.974

Warning: Data set has only 3 Detected Values.

This is not enough to compute meaningful or reliable statistics and estimates.

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.976	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.238	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.425	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	0.0376	KM Standard Error of Mean	0.011
KM SD	0.0552	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.0561	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.0557	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.0706	95% KM Chebyshev UCL	0.0855
97.5% KM Chebyshev UCL	0.106	99% KM Chebyshev UCL	0.147

Gamma GOF Tests on Detected Observations Only

Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	1.942	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.0953	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	11.65	nu star (bias corrected)	N/A
Mean (detects)	0.185		

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	0.0238
Maximum	0.347	Median	0.01
SD	0.0592	CV	2.487
k hat (MLE)	0.888	k star (bias corrected MLE)	0.835
Theta hat (MLE)	0.0268	Theta star (bias corrected MLE)	0.0285
nu hat (MLE)	67.49	nu star (bias corrected)	63.49
Adjusted Level of Significance ( $\beta$ )	0.0434		
Approximate Chi Square Value (63.49, $\alpha$ )	46.16	Adjusted Chi Square Value (63.49, $\beta$ )	45.55
95% Gamma Approximate UCL (use when n>=50)	0.0328	95% Gamma Adjusted UCL (use when n<50)	N/A



Fish Tissue ProUCL Output - Sheefish

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0376 SD (KM)	0.0552
Variance (KM)	0.00305 SE of Mean (KM)	0.011
k hat (KM)	0.464 k star (KM)	0.445
nu hat (KM)	35.28 nu star (KM)	33.83
theta hat (KM)	0.0811 theta star (KM)	0.0846
80% gamma percentile (KM)	0.0614 90% gamma percentile (KM)	0.104
95% gamma percentile (KM)	0.151 99% gamma percentile (KM)	0.266

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (33.83, $\alpha$ )	21.52 Adjusted Chi Square Value (33.83, $\beta$ )	21.12
95% Gamma Approximate KM-UCL (use when n>=50)	0.0591 95% Gamma Adjusted KM-UCL (use when n<50)	0.0603

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.988 Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.767 Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.216 Lilliefors GOF Test	
5% Lilliefors Critical Value	0.425 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	0.0161 Mean in Log Scale	-8.719
SD in Original Scale	0.0612 SD in Log Scale	3.581
95% t UCL (assumes normality of ROS data)	0.0328 95% Percentile Bootstrap UCL	0.0345
95% BCA Bootstrap UCL	0.0474 95% Bootstrap t UCL	0.119
95% H-UCL (Log ROS)	3.841	

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-3.553 KM Geo Mean	0.0286
KM SD (logged)	0.515 95% Critical H Value (KM-Log)	1.927
KM Standard Error of Mean (logged)	0.102 95% H-UCL (KM -Log)	0.0385
KM SD (logged)	0.515 95% Critical H Value (KM-Log)	1.927
KM Standard Error of Mean (logged)	0.102	

DL/2 Statistics

DL/2 Normal	DL/2 Log-Transformed	
Mean in Original Scale	0.0261 Mean in Log Scale	-4.191
SD in Original Scale	0.0587 SD in Log Scale	0.698
95% t UCL (Assumes normality)	0.0422 95% H-Stat UCL	0.0245
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	0.0561
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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.

Fish Tissue ProUCL Output - Sheefish

Selenium (Se)

General Statistics

Total Number of Observations	38	Number of Distinct Observations	37
		Number of Missing Observations	0
Minimum	0.445	Mean	0.595
Maximum	0.776	Median	0.595
SD	0.0876	Std. Error of Mean	0.0142
Coefficient of Variation	0.147	Skewness	0.256

Normal GOF Test

Shapiro Wilk Test Statistic	0.946	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.938	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.135	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.142	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.619	95% Adjusted-CLT UCL (Chen-1995)	0.619
		95% Modified-t UCL (Johnson-1978)	0.619

Gamma GOF Test

A-D Test Statistic	0.612	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.746	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.117	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.143	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			

Gamma Statistics

k hat (MLE)	47.44	k star (bias corrected MLE)	43.71
Theta hat (MLE)	0.0126	Theta star (bias corrected MLE)	0.0136
nu hat (MLE)	3605	nu star (bias corrected)	3322
MLE Mean (bias corrected)	0.595	MLE Sd (bias corrected)	0.0901
		Approximate Chi Square Value (0.05)	3189
Adjusted Level of Significance	0.0434	Adjusted Chi Square Value	3184

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	0.62	95% Adjusted Gamma UCL (use when n<50)	0.621
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Fish Tissue ProUCL Output - Sheefish

Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.949	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.938	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.112	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.142	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-0.81	Mean of logged Data	-0.529
Maximum of Logged Data	-0.254	SD of logged Data	0.148
Assuming Lognormal Distribution			
95% H-UCL	0.621	90% Chebyshev (MVUE) UCL	0.638
95% Chebyshev (MVUE) UCL	0.658	97.5% Chebyshev (MVUE) UCL	0.685
99% Chebyshev (MVUE) UCL	0.738		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	0.619	95% Jackknife UCL	0.619
95% Standard Bootstrap UCL	0.619	95% Bootstrap-t UCL	0.621
95% Hall's Bootstrap UCL	0.618	95% Percentile Bootstrap UCL	0.618
95% BCA Bootstrap UCL	0.618		
90% Chebyshev(Mean, Sd) UCL	0.638	95% Chebyshev(Mean, Sd) UCL	0.657
97.5% Chebyshev(Mean, Sd) UCL	0.684	99% Chebyshev(Mean, Sd) UCL	0.737
Suggested UCL to Use			
95% Student's-t UCL	0.619		

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.

Vanadium (V)

General Statistics			
Total Number of Observations	38	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	38
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs! Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit! The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable V was not processed!

## Fish Tissue ProUCL Output - Sheefish

Zinc (Zn)

## General Statistics

Total Number of Observations	38	Number of Distinct Observations	38
		Number of Missing Observations	0
Minimum	3.199	Mean	4.696
Maximum	6.57	Median	4.616
SD	0.72	Std. Error of Mean	0.117
Coefficient of Variation	0.153	Skewness	0.281

## Normal GOF Test

Shapiro Wilk Test Statistic	0.98	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.938	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.0952	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.142	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			

## Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	4.894	95% Adjusted-CLT UCL (Chen-1995)	4.894
		95% Modified-t UCL (Johnson-1978)	4.894

## Gamma GOF Test

A-D Test Statistic	0.281	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.746	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.095	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.143	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			

## Gamma Statistics

k hat (MLE)	43.4	k star (bias corrected MLE)	39.99
Theta hat (MLE)	0.108	Theta star (bias corrected MLE)	0.117
nu hat (MLE)	3299	nu star (bias corrected)	3039
MLE Mean (bias corrected)	4.696	MLE Sd (bias corrected)	0.743
		Approximate Chi Square Value (0.05)	2912
Adjusted Level of Significance	0.0434	Adjusted Chi Square Value	2907

## Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	4.901	95% Adjusted Gamma UCL (use when n<50)	4.91
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## Lognormal GOF Test

Shapiro Wilk Test Statistic	0.979	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.938	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.103	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.142	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			

## Lognormal Statistics

Minimum of Logged Data	1.163	Mean of logged Data	1.535
Maximum of Logged Data	1.883	SD of logged Data	0.155

Fish Tissue ProUCL Output - Sheefish

Assuming Lognormal Distribution

95% H-UCL	4.909	90% Chebyshev (MVUE) UCL	5.053
95% Chebyshev (MVUE) UCL	5.214	97.5% Chebyshev (MVUE) UCL	5.438
99% Chebyshev (MVUE) UCL	5.878		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	4.889	95% Jackknife UCL	4.894
95% Standard Bootstrap UCL	4.89	95% Bootstrap-t UCL	4.9
95% Hall's Bootstrap UCL	4.908	95% Percentile Bootstrap UCL	4.884
95% BCA Bootstrap UCL	4.892		
90% Chebyshev(Mean, Sd) UCL	5.047	95% Chebyshev(Mean, Sd) UCL	5.206
97.5% Chebyshev(Mean, Sd) UCL	5.426	99% Chebyshev(Mean, Sd) UCL	5.859

Suggested UCL to Use

95% Student's-t UCL	4.894
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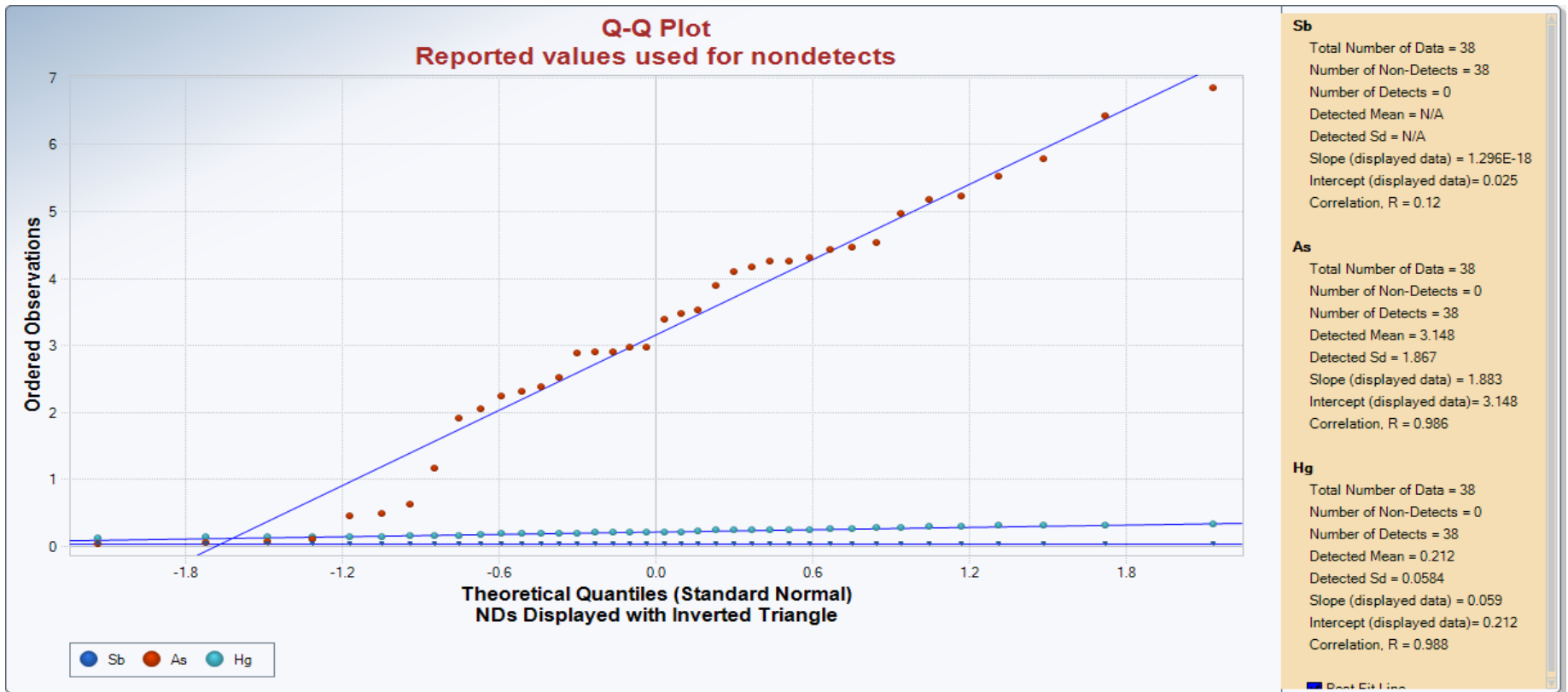
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

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.

Figure D-3. Q-Q Plot - Sheefish



## Sheefish Outlier Test

Outlier Tests for Selected Variables replacing nondetects with 1/2 the Detection Limit

User Selected Options

Date/Time of Computation ProUCL 5.17/24/2017 2:33:12 PM

From File WorkSheet.xls

Full Precision OFF

Rosner's Outlier Test for 1 Outliers in Sb

Total N	38
Number NDs	38
Number Detects	38
Mean with NDs=DL/2	0.0125
SD with NDs=DL/2	5.27E-18

Rosner's Outlier Test for 1 Outliers in As

Total N	38
Number NDs	0
Number Detects	38
Mean with NDs=DL/2	3.148
SD with NDs=DL/2	1.867
Number of data	38
Number of suspected outliers	1

NDs replaced with half value.

#	Mean	sd	Potential outlier	Obs. Number	Test value	Critical value (5%)	Critical value (1%)
1	3.148	1.842	6.846	26	2.007	3.01	3.36

## Sheefish Outlier Test

For 5% Significance Level, there is no Potential Outlier

For 1% Significance Level, there is no Potential Outlier

Rosner's Outlier Test for 1 Outliers in Hg

Total N	38
Number NDs	0
Number Detects	38
Mean with NDs=DL/2	0.212
SD with NDs=DL/2	0.0584
Number of data	38
Number of suspected outliers	1

NDs replaced with half value.

#	Mean	sd	Potential outlier	Obs. Number	Test value	Critical value (5%)	Critical value (1%)
1	0.212	0.0576	0.32	29	1.867	3.01	3.36

For 5% Significance Level, there is no Potential Outlier

For 1% Significance Level, there is no Potential Outlier





## UCL Statistics for Data Sets with Non-Detects

## User Selected Options

Date/Time of Computation ProUCL 5.16/19/2017 10:05:48 PM  
 From File WorkSheet.xls  
 Full Precision OFF  
 Confidence Coefficient 95%  
 Number of Bootstrap Operations 2000

## Aluminum (Al)

## General Statistics

Total Number of Observations	25	Number of Distinct Observations	3
Number of Detects	3	Number of Non-Detects	22
Number of Distinct Detects	2	Number of Distinct Non-Detects	1
Minimum Detect	1.1	Minimum Non-Detect	1
Maximum Detect	1.2	Maximum Non-Detect	1
Variance Detects	0.00333	Percent Non-Detects	88%
Mean Detects	1.133	SD Detects	0.0577
Median Detects	1.1	CV Detects	0.0509
Skewness Detects	1.732	Kurtosis Detects	N/A
Mean of Logged Detects	0.124	SD of Logged Detects	0.0502

Warning: Data set has only 3 Detected Values.

This is not enough to compute meaningful or reliable statistics and estimates.

## Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.75	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.767	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.385	Lilliefors GOF Test
5% Lilliefors Critical Value	0.425	Detected Data appear Normal at 5% Significance Level

Detected Data appear Approximate Normal at 5% Significance Level

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

KM Mean	1.016	KM Standard Error of Mean	0.0113
KM SD	0.0463	95% KM (BCA) UCL	N/A
95% KM (t) UCL	1.035	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	1.035	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	1.05	95% KM Chebyshev UCL	1.065
97.5% KM Chebyshev UCL	1.087	99% KM Chebyshev UCL	1.129

## Gamma GOF Tests on Detected Observations Only

Not Enough Data to Perform GOF Test

## Gamma Statistics on Detected Data Only

k hat (MLE)	589	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.00192	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	3534	nu star (bias corrected)	N/A
Mean (detects)	1.133		

## 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	0.506	Mean	0.833
Maximum	1.2	Median	0.828
SD	0.174	CV	0.21
k hat (MLE)	23.18	k star (bias corrected MLE)	20.42
Theta hat (MLE)	0.0359	Theta star (bias corrected MLE)	0.0408
nu hat (MLE)	1159	nu star (bias corrected)	1021
Adjusted Level of Significance ( $\beta$ )	0.0395		
Approximate Chi Square Value (N/A, $\alpha$ )	948	Adjusted Chi Square Value (N/A, $\beta$ )	943.2
95% Gamma Approximate UCL (use when $n \geq 50$ )	0.897	95% Gamma Adjusted UCL (use when $n < 50$ )	N/A

Estimates of Gamma Parameters using KM Estimates		
Mean (KM)	1.016 SD (KM)	0.0463
Variance (KM)	0.00214 SE of Mean (KM)	0.0113
k hat (KM)	481.5 k star (KM)	423.7
nu hat (KM)	24073 nu star (KM)	21186
theta hat (KM)	0.00211 theta star (KM)	0.0024
80% gamma percentile (KM)	1.057 90% gamma percentile (KM)	1.08
95% gamma percentile (KM)	1.099 99% gamma percentile (KM)	1.134

Gamma Kaplan-Meier (KM) Statistics		
Approximate Chi Square Value (N/A, $\alpha$ )	20848 Adjusted Chi Square Value (N/A, $\beta$ )	20826
95% Gamma Approximate KM-UCL (use when $n \geq 50$ )	1.032 95% Gamma Adjusted KM-UCL (use when $n < 50$ )	1.034

Lognormal GOF Test on Detected Observations Only		
Shapiro Wilk Test Statistic	0.75 Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.767 Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.385 Lilliefors GOF Test	
5% Lilliefors Critical Value	0.425 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	0.876 Mean in Log Scale	-0.145
SD in Original Scale	0.14 SD in Log Scale	0.158
95% t UCL (assumes normality of ROS data)	0.924 95% Percentile Bootstrap UCL	0.923
95% BCA Bootstrap UCL	0.925 95% Bootstrap t UCL	0.925
95% H-UCL (Log ROS)	0.927	

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution		
KM Mean (logged)	0.0149 KM Geo Mean	1.015
KM SD (logged)	0.0428 95% Critical H Value (KM-Log)	N/A
KM Standard Error of Mean (logged)	0.0105 95% H-UCL (KM-Log)	N/A
KM SD (logged)	0.0428 95% Critical H Value (KM-Log)	N/A
KM Standard Error of Mean (logged)	0.0105	

DL/2 Statistics		
DL/2 Normal	DL/2 Log-Transformed	
Mean in Original Scale	0.576 Mean in Log Scale	-0.595
SD in Original Scale	0.211 SD in Log Scale	0.272
95% t UCL (Assumes normality)	0.648 95% H-Stat UCL	0.632
DL/2 is not a recommended method, provided for comparisons and historical reasons		

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

Suggested UCL to Use		
95% KM (t) UCL	1.035	

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.

Antimony (Sb)

General Statistics		
Total Number of Observations	25 Number of Distinct Observations	1
Number of Detects	0 Number of Non-Detects	25
Number of Distinct Detects	0 Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!  
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!  
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Sb was not processed!

## Arsenic (As)

## General Statistics

Total Number of Observations	25	Number of Distinct Observations	13
Number of Detects	17	Number of Non-Detects	8
Number of Distinct Detects	13	Number of Distinct Non-Detects	1
Minimum Detect	0.025	Minimum Non-Detect	0.025
Maximum Detect	0.064	Maximum Non-Detect	0.025
Variance Detects	1.38E-04	Percent Non-Detects	32%
Mean Detects	0.0374	SD Detects	0.0118
Median Detects	0.036	CV Detects	0.315
Skewness Detects	1.075	Kurtosis Detects	0.734
Mean of Logged Detects	-3.33	SD of Logged Detects	0.295

## Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.881	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.892	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.147	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.207	Detected Data appear Normal at 5% Significance Level	
Detected Data appear Approximate Normal at 5% Significance Level			

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

KM Mean	0.0334	KM Standard Error of Mean	0.00228
KM SD	0.011	95% KM (BCA) UCL	0.0371
95% KM (t) UCL	0.0373	95% KM (Percentile Bootstrap) UCL	0.0372
95% KM (z) UCL	0.0371	95% KM Bootstrap t UCL	0.0385
90% KM Chebyshev UCL	0.0402	95% KM Chebyshev UCL	0.0433
97.5% KM Chebyshev UCL	0.0476	99% KM Chebyshev UCL	0.056

## Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.444	Anderson-Darling GOF Test	
5% A-D Critical Value	0.739	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.127	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.209	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)	11.94	k star (bias corrected MLE)	9.868
Theta hat (MLE)	0.00313	Theta star (bias corrected MLE)	0.00379
nu hat (MLE)	405.8	nu star (bias corrected)	335.5
Mean (detects)	0.0374		

## 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	0.0298
Maximum	0.064	Median	0.027
SD	0.0149	CV	0.502
k hat (MLE)	3.901	k star (bias corrected MLE)	3.459
Theta hat (MLE)	0.00763	Theta star (bias corrected MLE)	0.00861
nu hat (MLE)	195	nu star (bias corrected)	173
Adjusted Level of Significance ( $\beta$ )	0.0395		
Approximate Chi Square Value (172.97, $\alpha$ )	143.6	Adjusted Chi Square Value (172.97, $\beta$ )	141.7
95% Gamma Approximate UCL (use when $n \geq 50$ )	0.0359	95% Gamma Adjusted UCL (use when $n < 50$ )	0.0363

Fish Tissue ProUCL Output - Arctic Grayling

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0334 SD (KM)	0.011
Variance (KM)	1.22E-04 SE of Mean (KM)	0.00228
k hat (KM)	9.156 k star (KM)	8.084
nu hat (KM)	457.8 nu star (KM)	404.2
theta hat (KM)	0.00365 theta star (KM)	0.00413
80% gamma percentile (KM)	0.0427 90% gamma percentile (KM)	0.0491
95% gamma percentile (KM)	0.0548 99% gamma percentile (KM)	0.0666

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (404.19, $\alpha$ )	358.6 Adjusted Chi Square Value (404.19, $\beta$ )	355.7
95% Gamma Approximate KM-UCL (use when n>=50)	0.0376 95% Gamma Adjusted KM-UCL (use when n<50)	0.038

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.928 Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.892 Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.125 Lilliefors GOF Test	
5% Lilliefors Critical Value	0.207 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	0.031 Mean in Log Scale	-3.566
SD in Original Scale	0.0136 SD in Log Scale	0.438
95% t UCL (assumes normality of ROS data)	0.0356 95% Percentile Bootstrap UCL	0.0356
95% BCA Bootstrap UCL	0.0357 95% Bootstrap t UCL	0.0363
95% H-UCL (Log ROS)	0.0369	

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-3.445 KM Geo Mean	0.0319
KM SD (logged)	0.289 95% Critical H Value (KM-Log)	1.806
KM Standard Error of Mean (logged)	0.0596 95% H-UCL (KM -Log)	0.037
KM SD (logged)	0.289 95% Critical H Value (KM-Log)	1.806
KM Standard Error of Mean (logged)	0.0596	

DL/2 Statistics

DL/2 Normal	DL/2 Log-Transformed	
Mean in Original Scale	0.0294 Mean in Log Scale	-3.667
SD in Original Scale	0.0152 SD in Log Scale	0.556
95% t UCL (Assumes normality)	0.0346 95% H-Stat UCL	0.0375
DL/2 is not a recommended method, provided for comparisons and historical reasons		

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	0.0373
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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.

## Barium (Ba)

## General Statistics

Total Number of Observations	25	Number of Distinct Observations	22
		Number of Missing Observations	0
Minimum	0.064	Mean	0.13
Maximum	0.202	Median	0.131
SD	0.0333	Std. Error of Mean	0.00666
Coefficient of Variation	0.255	Skewness	0.349

## Normal GOF Test

Shapiro Wilk Test Statistic	0.947	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.918	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.15	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.173	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			

## Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.142	95% Adjusted-CLT UCL (Chen-1995)	0.142
		95% Modified-t UCL (Johnson-1978)	0.142

## Gamma GOF Test

A-D Test Statistic	0.528	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.744	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.133	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.174	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			

## Gamma Statistics

k hat (MLE)	15.37	k star (bias corrected MLE)	13.55
Theta hat (MLE)	0.00849	Theta star (bias corrected MLE)	0.00963
nu hat (MLE)	768.3	nu star (bias corrected)	677.4
MLE Mean (bias corrected)	0.13	MLE Sd (bias corrected)	0.0354
		Approximate Chi Square Value (0.05)	618
Adjusted Level of Significance	0.0395	Adjusted Chi Square Value	614.2

## Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	0.143	95% Adjusted Gamma UCL (use when n<50)	0.144
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## Lognormal GOF Test

Shapiro Wilk Test Statistic	0.943	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.918	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.152	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.173	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			

Lognormal Statistics		
Minimum of Logged Data	-2.749	Mean of logged Data
Maximum of Logged Data	-1.599	SD of logged Data

Assuming Lognormal Distribution		
95% H-UCL	0.144	90% Chebyshev (MVUE) UCL
95% Chebyshev (MVUE) UCL	0.162	97.5% Chebyshev (MVUE) UCL
99% Chebyshev (MVUE) UCL	0.201	

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

Nonparametric Distribution Free UCLs		
95% CLT UCL	0.141	95% Jackknife UCL
95% Standard Bootstrap UCL	0.141	95% Bootstrap-t UCL
95% Hall's Bootstrap UCL	0.143	95% Percentile Bootstrap UCL
95% BCA Bootstrap UCL	0.142	
90% Chebyshev(Mean, Sd) UCL	0.15	95% Chebyshev(Mean, Sd) UCL
97.5% Chebyshev(Mean, Sd) UCL	0.172	99% Chebyshev(Mean, Sd) UCL

Suggested UCL to Use	
95% Student's-t UCL	0.142

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.

#### Cadmium (Cd)

General Statistics		
Total Number of Observations	25	Number of Distinct Observations
Number of Detects	0	Number of Non-Detects
Number of Distinct Detects	0	Number of Distinct Non-Detects

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs! Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit! The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Cd was not processed!

## Chromium (Cr)

## General Statistics

Total Number of Observations	25	Number of Distinct Observations	6
Number of Detects	7	Number of Non-Detects	18
Number of Distinct Detects	6	Number of Distinct Non-Detects	1
Minimum Detect	0.025	Minimum Non-Detect	0.025
Maximum Detect	0.225	Maximum Non-Detect	0.025
Variance Detects	0.00582	Percent Non-Detects	72%
Mean Detects	0.0756	SD Detects	0.0763
Median Detects	0.033	CV Detects	1.009
Skewness Detects	1.653	Kurtosis Detects	1.896
Mean of Logged Detects	-2.937	SD of Logged Detects	0.85

## Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.721	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.803	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.35	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	0.0392	KM Standard Error of Mean	0.00945
KM SD	0.0437	95% KM (BCA) UCL	0.055
95% KM (t) UCL	0.0553	95% KM (Percentile Bootstrap) UCL	0.0551
95% KM (z) UCL	0.0547	95% KM Bootstrap t UCL	0.143
90% KM Chebyshev UCL	0.0675	95% KM Chebyshev UCL	0.0803
97.5% KM Chebyshev UCL	0.0981	99% KM Chebyshev UCL	0.133

## Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.829	Anderson-Darling GOF Test	
5% A-D Critical Value	0.721	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.306	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.317	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)	1.558	k star (bias corrected MLE)	0.985
Theta hat (MLE)	0.0485	Theta star (bias corrected MLE)	0.0767
nu hat (MLE)	21.81	nu star (bias corrected)	13.79
Mean (detects)	0.0756		

## 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	0.0284
Maximum	0.225	Median	0.01
SD	0.0486	CV	1.712
k hat (MLE)	1.003	k star (bias corrected MLE)	0.909
Theta hat (MLE)	0.0283	Theta star (bias corrected MLE)	0.0312
nu hat (MLE)	50.15	nu star (bias corrected)	45.47
Adjusted Level of Significance ( $\beta$ )	0.0395		
Approximate Chi Square Value (45.47, $\alpha$ )	31	Adjusted Chi Square Value (45.47, $\beta$ )	30.18
95% Gamma Approximate UCL (use when $n \geq 50$ )	0.0416	95% Gamma Adjusted UCL (use when $n < 50$ )	0.0427



## Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0392 SD (KM)	0.0437
Variance (KM)	0.00191 SE of Mean (KM)	0.00945
k hat (KM)	0.802 k star (KM)	0.732
nu hat (KM)	40.1 nu star (KM)	36.62
theta hat (KM)	0.0488 theta star (KM)	0.0535
80% gamma percentile (KM)	0.0643 90% gamma percentile (KM)	0.0973
95% gamma percentile (KM)	0.131 99% gamma percentile (KM)	0.212

## Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (36.62, $\alpha$ )	23.77 Adjusted Chi Square Value (36.62, $\beta$ )	23.06
95% Gamma Approximate KM-UCL (use when $n \geq 50$ )	0.0603 95% Gamma Adjusted KM-UCL (use when $n < 50$ )	0.0622

## Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.815 Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.803 Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.283 Lilliefors GOF Test	
5% Lilliefors Critical Value	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	0.0239 Mean in Log Scale	-5.301
SD in Original Scale	0.0505 SD in Log Scale	1.922
95% t UCL (assumes normality of ROS data)	0.0411 95% Percentile Bootstrap UCL	0.0417
95% BCA Bootstrap UCL	0.0485 95% Bootstrap t UCL	0.0778
95% H-UCL (Log ROS)	0.143	

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

KM Mean (logged)	-3.478 KM Geo Mean	0.0309
KM SD (logged)	0.536 95% Critical H Value (KM-Log)	1.99
KM Standard Error of Mean (logged)	0.116 95% H-UCL (KM -Log)	0.0443
KM SD (logged)	0.536 95% Critical H Value (KM-Log)	1.99
KM Standard Error of Mean (logged)	0.116	

## DL/2 Statistics

DL/2 Normal	DL/2 Log-Transformed	
Mean in Original Scale	0.0302 Mean in Log Scale	-3.977
SD in Original Scale	0.0479 SD in Log Scale	0.787
95% t UCL (Assumes normality)	0.0465 95% H-Stat UCL	0.0366
DL/2 is not a recommended method, provided for comparisons and historical reasons		

## Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Gamma Distributed at 5% Significance Level

## Suggested UCL to Use

Gamma Adjusted KM-UCL (use when  $k \leq 1$  and  $15 < n < 5$ ) 0.0622

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.

## Copper (Cu)

## General Statistics

Total Number of Observations	26	Number of Distinct Observations	25
		Number of Missing Observations	0
Minimum	0.281	Mean	0.701
Maximum	3.47	Median	0.577
SD	0.589	Std. Error of Mean	0.115
Coefficient of Variation	0.84	Skewness	4.457

## Normal GOF Test

Shapiro Wilk Test Statistic	0.457	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.92	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.319	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.17	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			

## Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.898	95% Adjusted-CLT UCL (Chen-1995)	0.999
		95% Modified-t UCL (Johnson-1978)	0.915

## Gamma GOF Test

A-D Test Statistic	2.172	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.749	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.213	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.172	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			

## Gamma Statistics

k hat (MLE)	3.613	k star (bias corrected MLE)	3.222
Theta hat (MLE)	0.194	Theta star (bias corrected MLE)	0.218
nu hat (MLE)	187.9	nu star (bias corrected)	167.5
MLE Mean (bias corrected)	0.701	MLE Sd (bias corrected)	0.39
		Approximate Chi Square Value (0.05)	138.6
Adjusted Level of Significance	0.0398	Adjusted Chi Square Value	136.9

## Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	0.847	95% Adjusted Gamma UCL (use when n<50)	0.858
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Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.821	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.92	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.162	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.17	Data appear Lognormal at 5% Significance Level	
Data appear Approximate Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-1.269	Mean of logged Data	-0.5
Maximum of Logged Data	1.244	SD of logged Data	0.465
Assuming Lognormal Distribution			
95% H-UCL	0.809	90% Chebyshev (MVUE) UCL	0.863
95% Chebyshev (MVUE) UCL	0.949	97.5% Chebyshev (MVUE) UCL	1.069
99% Chebyshev (MVUE) UCL	1.304		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	0.891	95% Jackknife UCL	0.898
95% Standard Bootstrap UCL	0.892	95% Bootstrap-t UCL	1.246
95% Hall's Bootstrap UCL	1.655	95% Percentile Bootstrap UCL	0.92
95% BCA Bootstrap UCL	1.062		
90% Chebyshev(Mean, Sd) UCL	1.047	95% Chebyshev(Mean, Sd) UCL	1.204
97.5% Chebyshev(Mean, Sd) UCL	1.422	99% Chebyshev(Mean, Sd) UCL	1.85
Suggested UCL to Use			
95% Student's-t UCL	0.898	or 95% Modified-t UCL	0.915
or 95% H-UCL	0.809		

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

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

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

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

ProUCL computes and outputs H-statistic based UCLs for historical reasons only.

H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.

It is therefore recommended to avoid the use of H-statistic based 95% UCLs.

Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.

## Iron (Fe)

## General Statistics

Total Number of Observations	25	Number of Distinct Observations	22
		Number of Missing Observations	0
Minimum	3.8	Mean	7.444
Maximum	12.7	Median	6.9
SD	2.283	Std. Error of Mean	0.457
Coefficient of Variation	0.307	Skewness	0.722

## Normal GOF Test

Shapiro Wilk Test Statistic	0.94	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.918	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.153	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.173	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			

## Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	8.225	95% Adjusted-CLT UCL (Chen-1995)	8.266
		95% Modified-t UCL (Johnson-1978)	8.236

## Gamma GOF Test

A-D Test Statistic	0.342	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.745	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.113	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.174	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			

## Gamma Statistics

k hat (MLE)	11.49	k star (bias corrected MLE)	10.14
Theta hat (MLE)	0.648	Theta star (bias corrected MLE)	0.734
nu hat (MLE)	574.5	nu star (bias corrected)	506.9
MLE Mean (bias corrected)	7.444	MLE Sd (bias corrected)	2.338
		Approximate Chi Square Value (0.05)	455.6
Adjusted Level of Significance	0.0395	Adjusted Chi Square Value	452.3

## Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	8.281	95% Adjusted Gamma UCL (use when n<50)	8.341
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## Lognormal GOF Test

Shapiro Wilk Test Statistic	0.972	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.918	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.105	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.173	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			

Lognormal Statistics			
Minimum of Logged Data	1.335	Mean of logged Data	1.963
Maximum of Logged Data	2.542	SD of logged Data	0.304
Assuming Lognormal Distribution			
95% H-UCL	8.349	90% Chebyshev (MVUE) UCL	8.825
95% Chebyshev (MVUE) UCL	9.45	97.5% Chebyshev (MVUE) UCL	10.32
99% Chebyshev (MVUE) UCL	12.02		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	8.195	95% Jackknife UCL	8.225
95% Standard Bootstrap UCL	8.175	95% Bootstrap-t UCL	8.31
95% Hall's Bootstrap UCL	8.326	95% Percentile Bootstrap UCL	8.196
95% BCA Bootstrap UCL	8.244		
90% Chebyshev(Mean, Sd) UCL	8.814	95% Chebyshev(Mean, Sd) UCL	9.435
97.5% Chebyshev(Mean, Sd) UCL	10.3	99% Chebyshev(Mean, Sd) UCL	11.99
Suggested UCL to Use			
95% Student's-t UCL	8.225		

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.

## Manganese (Mn)

## General Statistics

Total Number of Observations	25	Number of Distinct Observations	22
		Number of Missing Observations	0
Minimum	0.147	Mean	0.24
Maximum	0.567	Median	0.2
SD	0.111	Std. Error of Mean	0.0223
Coefficient of Variation	0.463	Skewness	2.136

## Normal GOF Test

Shapiro Wilk Test Statistic	0.675	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.918	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.29	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.173	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			

## Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.279	95% Adjusted-CLT UCL (Chen-1995)	0.287
		95% Modified-t UCL (Johnson-1978)	0.28

## Gamma GOF Test

A-D Test Statistic	2.25	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.746	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.248	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.175	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			

## Gamma Statistics

k hat (MLE)	7.066	k star (bias corrected MLE)	6.245
Theta hat (MLE)	0.034	Theta star (bias corrected MLE)	0.0385
nu hat (MLE)	353.3	nu star (bias corrected)	312.2
MLE Mean (bias corrected)	0.24	MLE Sd (bias corrected)	0.0962
		Approximate Chi Square Value (0.05)	272.3
Adjusted Level of Significance	0.0395	Adjusted Chi Square Value	269.8

## Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	0.276	95% Adjusted Gamma UCL (use when n<50)	0.278
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## Lognormal GOF Test

Shapiro Wilk Test Statistic	0.81	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.918	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.219	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.173	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			

## Lognormal Statistics

Minimum of Logged Data	-1.917	Mean of logged Data	-1.498
Maximum of Logged Data	-0.567	SD of logged Data	0.357

## Assuming Lognormal Distribution

95% H-UCL	0.273	90% Chebyshev (MVUE) UCL	0.29
95% Chebyshev (MVUE) UCL	0.313	97.5% Chebyshev (MVUE) UCL	0.346
99% Chebyshev (MVUE) UCL	0.41		

## Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

## Nonparametric Distribution Free UCLs

95% CLT UCL	0.277	95% Jackknife UCL	0.279
95% Standard Bootstrap UCL	0.276	95% Bootstrap-t UCL	0.3
95% Hall's Bootstrap UCL	0.277	95% Percentile Bootstrap UCL	0.28
95% BCA Bootstrap UCL	0.289		
90% Chebyshev(Mean, Sd) UCL	0.307	95% Chebyshev(Mean, Sd) UCL	0.338
97.5% Chebyshev(Mean, Sd) UCL	0.38	99% Chebyshev(Mean, Sd) UCL	0.462

## Suggested UCL to Use

95% Student's-t UCL	0.279	or 95% Modified-t UCL	0.28
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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.

## Mercury (Hg)

## General Statistics

Total Number of Observations	25	Number of Distinct Observations	18
		Number of Missing Observations	0
Minimum	0.08	Mean	0.22
Maximum	0.486	Median	0.18
SD	0.127	Std. Error of Mean	0.0253
Coefficient of Variation	0.577	Skewness	0.951

## Normal GOF Test

Shapiro Wilk Test Statistic	0.859	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.918	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.17	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.173	Data appear 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	0.263	95% Adjusted-CLT UCL (Chen-1995)	0.266
		95% Modified-t UCL (Johnson-1978)	0.264

## Gamma GOF Test

A-D Test Statistic	0.627	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.75	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.129	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.176	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

## Gamma Statistics

k hat (MLE)	3.483	k star (bias corrected MLE)	3.091
Theta hat (MLE)	0.063	Theta star (bias corrected MLE)	0.071
nu hat (MLE)	174.1	nu star (bias corrected)	154.6
MLE Mean (bias corrected)	0.22	MLE Sd (bias corrected)	0.125
		Approximate Chi Square Value (0.05)	126.8
Adjusted Level of Significance	0.0395	Adjusted Chi Square Value	125.1

## Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	0.268	95% Adjusted Gamma UCL (use when n<50)	0.271
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## Lognormal GOF Test

Shapiro Wilk Test Statistic	0.942	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.918	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.118	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.173	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

## Lognormal Statistics

Minimum of Logged Data	-2.526	Mean of logged Data	-1.667
Maximum of Logged Data	-0.722	SD of logged Data	0.556

## Assuming Lognormal Distribution

95% H-UCL	0.277	90% Chebyshev (MVUE) UCL	0.295
95% Chebyshev (MVUE) UCL	0.33	97.5% Chebyshev (MVUE) UCL	0.378
99% Chebyshev (MVUE) UCL	0.473		

## Nonparametric Distribution Free UCL Statistics

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

## Nonparametric Distribution Free UCLs

95% CLT UCL	0.261	95% Jackknife UCL	0.263
95% Standard Bootstrap UCL	0.259	95% Bootstrap-t UCL	0.271
95% Hall's Bootstrap UCL	0.265	95% Percentile Bootstrap UCL	0.261
95% BCA Bootstrap UCL	0.267		
90% Chebyshev(Mean, Sd) UCL	0.296	95% Chebyshev(Mean, Sd) UCL	0.33
97.5% Chebyshev(Mean, Sd) UCL	0.378	99% Chebyshev(Mean, Sd) UCL	0.472

## Suggested UCL to Use

95% Student's-t UCL	0.263
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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.

## Nickel (Ni)

## General Statistics

Total Number of Observations	25	Number of Distinct Observations	2
Number of Detects	2	Number of Non-Detects	23
Number of Distinct Detects	1	Number of Distinct Non-Detects	1

Warning: Only one distinct data value was detected! ProUCL (or any other software) should not be used on such a data set!  
It is suggested to use alternative site specific values determined by the Project Team to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Ni was not processed!

## Selenium (Se)

## General Statistics

Total Number of Observations	25	Number of Distinct Observations	25
		Number of Missing Observations	0
Minimum	0.802	Mean	1.139
Maximum	1.547	Median	1.145
SD	0.2	Std. Error of Mean	0.04
Coefficient of Variation	0.176	Skewness	0.364

## Normal GOF Test

Shapiro Wilk Test Statistic	0.96	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.918	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.119	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.173	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			

## Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	1.207	95% Adjusted-CLT UCL (Chen-1995)	1.208
		95% Modified-t UCL (Johnson-1978)	1.208

## Gamma GOF Test

A-D Test Statistic	0.267	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.743	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.105	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.174	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			

## Gamma Statistics

k hat (MLE)	34.03	k star (bias corrected MLE)	29.97
Theta hat (MLE)	0.0335	Theta star (bias corrected MLE)	0.038
nu hat (MLE)	1702	nu star (bias corrected)	1499
MLE Mean (bias corrected)	1.139	MLE Sd (bias corrected)	0.208
		Approximate Chi Square Value (0.05)	1410
Adjusted Level of Significance	0.0395	Adjusted Chi Square Value	1404

## Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	1.211	95% Adjusted Gamma UCL (use when n<50)	1.216
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## Lognormal GOF Test

Shapiro Wilk Test Statistic	0.97	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.918	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.105	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.173	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			

## Lognormal Statistics

Minimum of Logged Data	-0.221	Mean of logged Data	0.115
Maximum of Logged Data	0.436	SD of logged Data	0.176

## Assuming Lognormal Distribution

95% H-UCL	1.213	90% Chebyshev (MVUE) UCL	1.259
95% Chebyshev (MVUE) UCL	1.314	97.5% Chebyshev (MVUE) UCL	1.39
99% Chebyshev (MVUE) UCL	1.539		

## Nonparametric Distribution Free UCL Statistics

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

## Nonparametric Distribution Free UCLs

95% CLT UCL	1.205	95% Jackknife UCL	1.207
95% Standard Bootstrap UCL	1.204	95% Bootstrap-t UCL	1.21
95% Hall's Bootstrap UCL	1.213	95% Percentile Bootstrap UCL	1.205
95% BCA Bootstrap UCL	1.206		
90% Chebyshev(Mean, Sd) UCL	1.259	95% Chebyshev(Mean, Sd) UCL	1.313
97.5% Chebyshev(Mean, Sd) UCL	1.389	99% Chebyshev(Mean, Sd) UCL	1.537

## Suggested UCL to Use

95% Student's-t UCL	1.207
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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.



## Vanadium (V)

## General Statistics

Total Number of Observations	25	Number of Distinct Observations	1
Number of Detects	0	Number of Non-Detects	25
Number of Distinct Detects	0	Number of Distinct Non-Detects	1

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!  
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!  
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable V was not processed!

## Zinc (Zn)

## General Statistics

Total Number of Observations	25	Number of Distinct Observations	25
		Number of Missing Observations	0
Minimum	4.194	Mean	6.547
Maximum	9.2	Median	6.522
SD	1.175	Std. Error of Mean	0.235
Coefficient of Variation	0.179	Skewness	0.223

## Normal GOF Test

Shapiro Wilk Test Statistic	0.984	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.918	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.0777	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.173	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			

## Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	6.949	95% Adjusted-CLT UCL (Chen-1995)	6.945
		95% Modified-t UCL (Johnson-1978)	6.951

## Gamma GOF Test

A-D Test Statistic	0.169	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.743	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.0949	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.174	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			

## Gamma Statistics

k hat (MLE)	31.8	k star (bias corrected MLE)	28.01
Theta hat (MLE)	0.206	Theta star (bias corrected MLE)	0.234
nu hat (MLE)	1590	nu star (bias corrected)	1401
MLE Mean (bias corrected)	6.547	MLE Sd (bias corrected)	1.237
		Approximate Chi Square Value (0.05)	1315
Adjusted Level of Significance	0.0395	Adjusted Chi Square Value	1309

## Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	6.975	95% Adjusted Gamma UCL (use when n<50)	7.005
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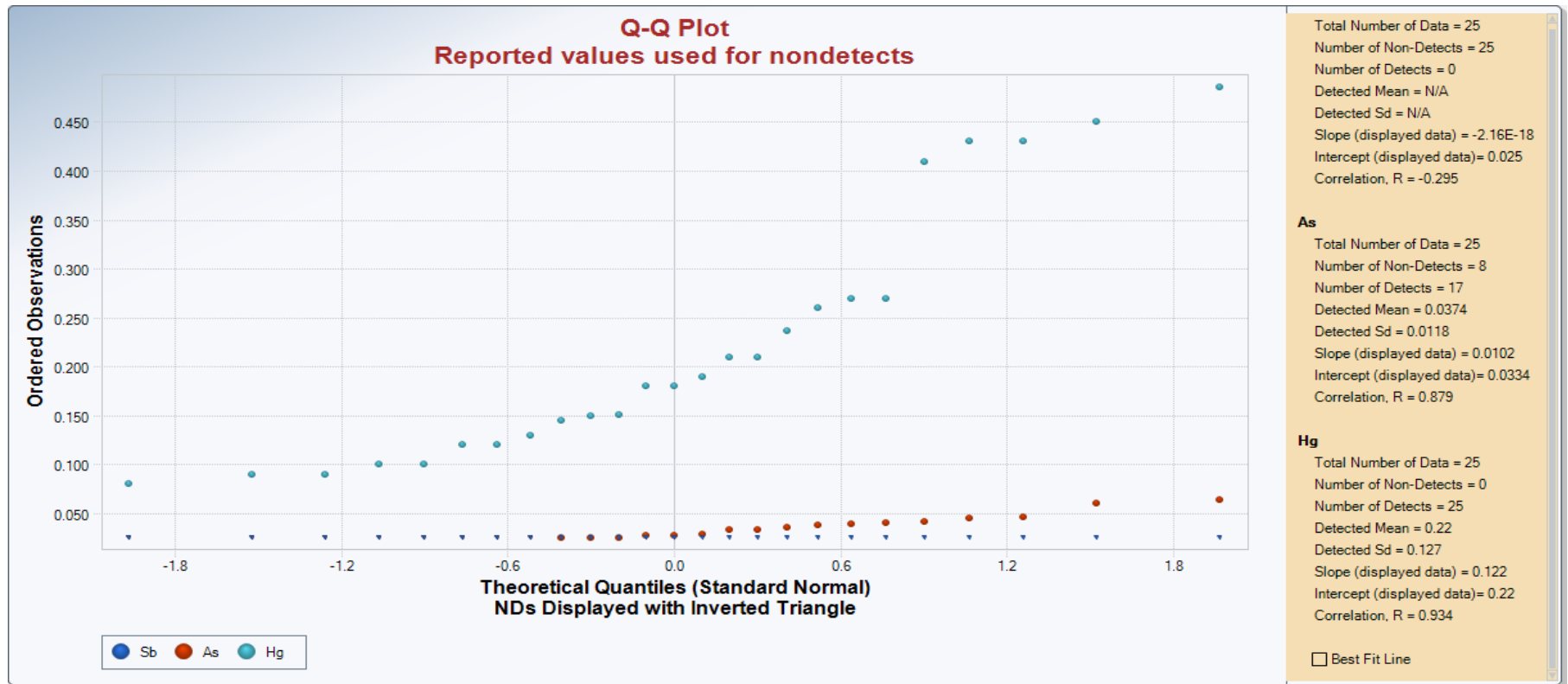
Lognormal GOF Test		
Shapiro Wilk Test Statistic	0.981	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.918	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.108	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.173	Data appear Lognormal at 5% Significance Level
Data appear Lognormal at 5% Significance Level		
Lognormal Statistics		
Minimum of Logged Data	1.434	Mean of logged Data
Maximum of Logged Data	2.219	SD of logged Data
Assuming Lognormal Distribution		
95% H-UCL	6.996	90% Chebyshev (MVUE) UCL
95% Chebyshev (MVUE) UCL	7.601	97.5% Chebyshev (MVUE) UCL
99% Chebyshev (MVUE) UCL	8.951	
Nonparametric Distribution Free UCL Statistics		
Data appear to follow a Discernible Distribution at 5% Significance Level		
Nonparametric Distribution Free UCLs		
95% CLT UCL	6.934	95% Jackknife UCL
95% Standard Bootstrap UCL	6.941	95% Bootstrap-t UCL
95% Hall's Bootstrap UCL	6.985	95% Percentile Bootstrap UCL
95% BCA Bootstrap UCL	6.928	
90% Chebyshev(Mean, Sd) UCL	7.252	95% Chebyshev(Mean, Sd) UCL
97.5% Chebyshev(Mean, Sd) UCL	8.015	99% Chebyshev(Mean, Sd) UCL
Suggested UCL to Use		
95% Student's-t UCL	6.949	

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.

Figure D-4. Q-Q Plot - Arctic Grayling



## Arctic Grayling Outlier Test

Outlier Tests for Selected Variables replacing nondetects with 1/2 the Detection Limit

User Selected Options

Date/Time of Computation      ProUCL 5.17/24/2017 2:37:24 PM

From File                                      WorkSheet.xls

Full Precision                                OFF

Rosner's Outlier Test for 1 Outliers in Sb

Total N	25
Number NDs	25
Number Detects	25
Mean with NDs=DL/2	0.0125
SD with NDs=DL/2	3.54E-18

Rosner's Outlier Test for 1 Outliers in As

Total N	25
Number NDs	8
Number Detects	25
Mean with NDs=DL/2	0.0294
SD with NDs=DL/2	0.0152
Number of data	25
Number of suspected outliers	1

NDs replaced with half value.

#	Mean	sd	Potential outlier	Obs. Number	Test value	Critical value (5%)	Critical value (1%)
1	0.0294	0.0149	0.064	4	2.317	2.82	3.14

## Arctic Grayling Outlier Test

For 5% Significance Level, there is no Potential Outlier

For 1% Significance Level, there is no Potential Outlier

Rosner's Outlier Test for 1 Outliers in Hg

Total N	25
Number NDs	0
Number Detects	25
Mean with NDs=DL/2	0.22
SD with NDs=DL/2	0.127
Number of data	25
Number of suspected outliers	1

NDs replaced with half value.

#	Mean	sd	Potential outlier	Obs. Number	Test value	Critical value (5%)	Critical value (1%)
1	0.22	0.124	0.486	21	2.148	2.82	3.14

For 5% Significance Level, there is no Potential Outlier

For 1% Significance Level, there is no Potential Outlier