51	**Gamma Statistics on Detected Data Only**											
52					k hat (MLE)	1.23			k star (bias corrected MLE)			0.625
53					Theta hat (MLE)	9.023			Theta star (bias corrected MLE)			17.75
54					nu hat (MLE)	12.3			nu star (bias corrected)			6.254
55					MLE Mean (bias corrected)	11.1			MLE Sd (bias corrected)			14.04
56												
57	**Gamma Kaplan-Meier (KM) Statistics**											
58					k hat (KM)	0.701			nu hat (KM)			8.409
59					Approximate Chi Square Value (8.41, α)	2.974			Adjusted Chi Square Value (8.41, β)			1.937
60					95% Gamma Approximate KM-UCL (use when n>=50)	26.62			95% Gamma Adjusted KM-UCL (use when n<50)			40.88
61												
62	**Gamma ROS Statistics using Imputed Non-Detects**											
63	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											
64	GROS may not be used when kstar of detected data is small such as < 0.1											
65	For such situations, GROS method tends to yield inflated values of UCLs and BTVs											
66	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
67					Minimum	0.01			Mean			9.252
68					Maximum	34			Median			6.05
69					SD	12.46			CV			1.347
70					k hat (MLE)	0.469			k star (bias corrected MLE)			0.345
71					Theta hat (MLE)	19.74			Theta star (bias corrected MLE)			26.78
72					nu hat (MLE)	5.625			nu star (bias corrected)			4.146
73					MLE Mean (bias corrected)	9.252			MLE Sd (bias corrected)			15.74
74									Adjusted Level of Significance (β)			0.0122
75					Approximate Chi Square Value (4.15, α)	0.78			Adjusted Chi Square Value (4.15, β)			0.386
76					95% Gamma Approximate UCL (use when n>=50)	49.16			95% Gamma Adjusted UCL (use when n<50)			99.3
77												
78	**Lognormal GOF Test on Detected Observations Only**											
79					Shapiro Wilk Test Statistic	0.923			**Shapiro Wilk GOF Test**			
80					5% Shapiro Wilk Critical Value	0.762			Detected Data appear Lognormal at 5% Significance Level			
81					Lilliefors Test Statistic	0.27			**Lilliefors GOF Test**			
82					5% Lilliefors Critical Value	0.396			Detected Data appear Lognormal at 5% Significance Level			
83	**Detected Data appear Lognormal at 5% Significance Level**											
84												
85	**Lognormal ROS Statistics Using Imputed Non-Detects**											
86					Mean in Original Scale	9.338			Mean in Log Scale			1.517
87					SD in Original Scale	12.39			SD in Log Scale			1.413
88					95% t UCL (assumes normality of ROS data)	19.53			95% Percentile Bootstrap UCL			18.37
89					95% BCA Bootstrap UCL	20.28			95% Bootstrap t UCL			36.62
90					95% H-UCL (Log ROS)	417.4						
91												
92	**UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed**											
93					KM Mean (logged)	1.624			95% H-UCL (KM -Log)			93.62
94					KM SD (logged)	1.122			95% Critical H Value (KM-Log)			4.555
95					KM Standard Error of Mean (logged)	0.512						
96												
97	**DL/2 Statistics**											
98	**DL/2 Normal**								**DL/2 Log-Transformed**			
99					Mean in Original Scale	9.333			Mean in Log Scale			1.508
100					SD in Original Scale	12.39			SD in Log Scale			1.429

	A	B	C	D	E	F	G	H	I	J	K	L
101	95% t UCL (Assumes normality)					19.53	95% H-Stat UCL					456
102	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
103												
104	**Nonparametric Distribution Free UCL Statistics**											
105	**Detected Data appear Gamma Distributed at 5% Significance Level**											
106												
107	**Suggested UCL to Use**											
108	95% KM (Chebyshev) UCL					31.8	95% GROS Adjusted Gamma UCL					99.3
109	95% Adjusted Gamma KM-UCL					40.88						
110	**Warning: Recommended UCL exceeds the maximum observation**											
111												
112	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
113	Recommendations are based upon data size, data distribution, and skewness.											
114	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
115	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
116												

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	12/22/2015 10:35:01 AM
From File	Metals.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Cr

General Statistics

Total Number of Observations	6	Number of Distinct Observations	6
		Number of Missing Observations	0
Minimum	2.1	Mean	28.52
Maximum	47	Median	32.5
SD	18.31	Std. Error of Mean	7.475
Coefficient of Variation	0.642	Skewness	-0.552

Note: Sample size is small (e.g., <10), If data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.912	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.788	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.198	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.362	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	43.58	95% Adjusted-CLT UCL (Chen-1995)	39.01
		95% Modified-t UCL (Johnson-1978)	43.3

Gamma GOF Test

A-D Test Statistic	0.507	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.708	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.252	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.338	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.457	k star (bias corrected MLE)	0.839
Theta hat (MLE)	19.58	Theta star (bias corrected MLE)	33.97
nu hat (MLE)	17.48	nu star (bias corrected)	10.07
MLE Mean (bias corrected)	28.52	MLE Sd (bias corrected)	31.12
		Approximate Chi Square Value (0.05)	3.988

51	Adjusted Level of Significance					0.0122	Adjusted Chi Square Value					2.732
52												
53	**Assuming Gamma Distribution**											
54	95% Approximate Gamma UCL (use when n>=50))					72.04	95% Adjusted Gamma UCL (use when n<50)					105.2
55												
56	**Lognormal GOF Test**											
57	Shapiro Wilk Test Statistic					0.797	**Shapiro Wilk Lognormal GOF Test**					
58	5% Shapiro Wilk Critical Value					0.788	Data appear Lognormal at 5% Significance Level					
59	Lilliefors Test Statistic					0.274	**Lilliefors Lognormal GOF Test**					
60	5% Lilliefors Critical Value					0.362	Data appear Lognormal at 5% Significance Level					
61	**Data appear Lognormal at 5% Significance Level**											
62												
63	**Lognormal Statistics**											
64	Minimum of Logged Data					0.742	Mean of logged Data					2.97
65	Maximum of Logged Data					3.85	SD of logged Data					1.202
66												
67	**Assuming Lognormal Distribution**											
68	95% H-UCL					538.1	90% Chebyshev (MVUE) UCL					82.64
69	95% Chebyshev (MVUE) UCL					104.7	97.5% Chebyshev (MVUE) UCL					135.2
70	99% Chebyshev (MVUE) UCL					195.2						
71												
72	**Nonparametric Distribution Free UCL Statistics**											
73	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
74												
75	**Nonparametric Distribution Free UCLs**											
76	95% CLT UCL					40.81	95% Jackknife UCL					43.58
77	95% Standard Bootstrap UCL					39.75	95% Bootstrap-t UCL					41.44
78	95% Hall's Bootstrap UCL					37.04	95% Percentile Bootstrap UCL					39.33
79	95% BCA Bootstrap UCL					38.17						
80	90% Chebyshev(Mean, Sd) UCL					50.94	95% Chebyshev(Mean, Sd) UCL					61.1
81	97.5% Chebyshev(Mean, Sd) UCL					75.2	99% Chebyshev(Mean, Sd) UCL					102.9
82												
83	**Suggested UCL to Use**											
84	95% Student's-t UCL					43.58						
85												
86	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
87	These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)											
88	and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.											
89	For additional insight the user may want to consult a statistician.											
90												
91	**Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be**											
92	**reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.**											
93												

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	12/22/2015 10:35:42 AM
From File	Metals.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Cu

General Statistics

Total Number of Observations	6	Number of Distinct Observations	6
		Number of Missing Observations	0
Minimum	5.5	Mean	20.42
Maximum	30	Median	23.5
SD	9.861	Std. Error of Mean	4.026
Coefficient of Variation	0.483	Skewness	-0.724

Note: Sample size is small (e.g., <10), If data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.895	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.788	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.248	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.362	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	28.53	95% Adjusted-CLT UCL (Chen-1995)	25.77
		95% Modified-t UCL (Johnson-1978)	28.33

Gamma GOF Test

A-D Test Statistic	0.487	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.701	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.266	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.334	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.554	k star (bias corrected MLE)	1.888
Theta hat (MLE)	5.745	Theta star (bias corrected MLE)	10.81
nu hat (MLE)	42.64	nu star (bias corrected)	22.66
MLE Mean (bias corrected)	20.42	MLE Sd (bias corrected)	14.86
		Approximate Chi Square Value (0.05)	12.83

Adjusted Level of Significance	0.0122	Adjusted Chi Square Value 10.27
Assuming Gamma Distribution		
95% Approximate Gamma UCL (use when n>=50))	36.05	95% Adjusted Gamma UCL (use when n<50) 45.06
Lognormal GOF Test		
Shapiro Wilk Test Statistic	0.835	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.788	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.242	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.362	Data appear Lognormal at 5% Significance Level
Data appear Lognormal at 5% Significance Level		
Lognormal Statistics		
Minimum of Logged Data	1.705	Mean of logged Data 2.869
Maximum of Logged Data	3.401	SD of logged Data 0.663
Assuming Lognormal Distribution		
95% H-UCL	54.51	90% Chebyshev (MVUE) UCL 38.12
95% Chebyshev (MVUE) UCL	45.84	97.5% Chebyshev (MVUE) UCL 56.55
99% Chebyshev (MVUE) UCL	77.6	
Nonparametric Distribution Free UCL Statistics		
Data appear to follow a Discernible Distribution at 5% Significance Level		
Nonparametric Distribution Free UCLs		
95% CLT UCL	27.04	95% Jackknife UCL 28.53
95% Standard Bootstrap UCL	26.44	95% Bootstrap-t UCL 27.29
95% Hall's Bootstrap UCL	25.11	95% Percentile Bootstrap UCL 26.5
95% BCA Bootstrap UCL	25.83	
90% Chebyshev(Mean, Sd) UCL	32.49	95% Chebyshev(Mean, Sd) UCL 37.96
97.5% Chebyshev(Mean, Sd) UCL	45.56	99% Chebyshev(Mean, Sd) UCL 60.47
Suggested UCL to Use		
95% Student's-t UCL	28.53	
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.		
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)		
and Singh and Singh (2003). 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 positvely skewed data sets.		

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	12/22/2015 10:36:23 AM
From File	Metals.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Ni

General Statistics

Total Number of Observations	6	Number of Distinct Observations	6
		Number of Missing Observations	0
Minimum	8.5	Mean	36.92
Maximum	56	Median	46
SD	20.03	Std. Error of Mean	8.178
Coefficient of Variation	0.543	Skewness	-0.832

Note: Sample size is small (e.g., <10), If data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.834	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.788	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.286	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.362	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	53.39	95% Adjusted-CLT UCL (Chen-1995)	47.4
		95% Modified-t UCL (Johnson-1978)	52.93

Gamma GOF Test

A-D Test Statistic	0.709	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.702	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.343	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.335	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.627	k star (bias corrected MLE)	1.425
Theta hat (MLE)	14.05	Theta star (bias corrected MLE)	25.91
nu hat (MLE)	31.52	nu star (bias corrected)	17.1
MLE Mean (bias corrected)	36.92	MLE Sd (bias corrected)	30.93
		Approximate Chi Square Value (0.05)	8.74