APPENDIX J.5

ProUCL Exposure Point Concentration Calculation

User Selected Options

Date/Time of Computation	ProUCL 5.12/6/2020 2:04:15 PM
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
mber of Bootstrap Operations	2000

Manganese (mg/kg)

General Statistics

Total Number of Observations	13	Number of Distinct Observations	13
		Number of Missing Observations	1
Minimum	155	Mean	1723
Maximum	7010	Median	573
SD	2436	Std. Error of Mean	675.5
Coefficient of Variation	1.414	Skewness	1.78

Normal GOF Test

Shapiro Wilk Test Statistic	0.665	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.866	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.303	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.234	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	2927	95% Adjusted-CLT UCL (Chen-1995)	3190
		95% Modified-t UCL (Johnson-1978)	2982

Gamma GOF Test

A-D Test Statistic	0.879	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.773	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.208	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.246	)etected data appear Gamma Distributed at 5% Significance Lev(

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

Gamma Statistics

k hat (MLE)	0.72	k star (bias corrected MLE)	0.605
Theta hat (MLE)	2392	Theta star (bias corrected MLE)	2846
nu hat (MLE)	18.73	nu star (bias corrected)	15.74
MLE Mean (bias corrected)	1723	MLE Sd (bias corrected)	2214
		Approximate Chi Square Value (0.05)	7.778
Adjusted Level of Significance	0.0301	Adjusted Chi Square Value	6.994

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	3485	95% Adjusted Gamma UCL (use when n<50)	3876

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.903	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.866	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.186	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.234	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	5.043	Mean of logged Data	6.616
Maximum of Logged Data	8.855	SD of logged Data	1.314

Assuming Lognormal Distribution

95% H-UCL	6485	90% Chebyshev (MVUE) UCL	3513
95% Chebyshev (MVUE) UCL	4383	97.5% Chebyshev (MVUE) UCL	5590
99% Chebyshev (MVUE) UCL	7963		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	2834	95% Jackknife UCL	2927
95% Standard Bootstrap UCL	2774	95% Bootstrap-t UCL	4847
95% Hall's Bootstrap UCL	5302	95% Percentile Bootstrap UCL	2832
95% BCA Bootstrap UCL	3238		
90% Chebyshev(Mean, Sd) UCL	3749	95% Chebyshev(Mean, Sd) UCL	4667
97.5% Chebyshev(Mean, Sd) UCL	5941	99% Chebyshev(Mean, Sd) UCL	8444

Suggested UCL to Use

95% Adjusted Gamma UCL	3876

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

User Selected Options

Date/Time of Computation	ProUCL 5.12/9/2020 4:27:35 PM
From File	Whitehead Kplant Sel.xls
Full Precision	OFF
Confidence Coefficient	95%
mber of Bootstrap Operations	2000

Whitehead Kplant Sel

General Statistics

Total Number of Observations	18	Number of Distinct Observations	18
		Number of Missing Observations	0
Minimum	0.0194	Mean	0.117
Maximum	0.491	Median	0.0996
SD	0.119	Std. Error of Mean	0.0281
Coefficient of Variation	1.016	Skewness	2.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.754	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.897	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.23	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.202	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	0.166	95% Adjusted-CLT UCL (Chen-1995)	0.178
		95% Modified-t UCL (Johnson-1978)	0.169

Gamma GOF Test

A-D Test Statistic	0.669	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.76	)etected data appear Gamma Distributed at 5% Significance Lev
K-S Test Statistic	0.179	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.208	)etected data appear Gamma Distributed at 5% Significance Lev
	Detected data appear Gamma Distributed at 5% Significance Level	

Gamma Statistics

k hat (MLE)	1.324	k star (bias corrected MLE)	1.14
Theta hat (MLE)	0.0887	Theta star (bias corrected MLE)	0.103
nu hat (MLE)	47.65	nu star (bias corrected)	41.04
MLE Mean (bias corrected)	0.117	MLE Sd (bias corrected)	0.11
		Approximate Chi Square Value (0.05)	27.36
Adjusted Level of Significance	0.0357	Adjusted Chi Square Value	26.29

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	0.176	95% Adjusted Gamma UCL (use when n<50)	0.183

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.925	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.897	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.168	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.202	Data appear Lognormal at 5% Significance Level
	Data appear Lognormal at 5% Significance Level	

Lognormal Statistics

Minimum of Logged Data	-3.942	Mean of logged Data	-2.566
Maximum of Logged Data	-0.711	SD of logged Data	0.954

Assuming Lognormal Distribution

95% H-UCL	0.22	90% Chebyshev (MVUE) UCL	0.204
95% Chebyshev (MVUE) UCL	0.244	97.5% Chebyshev (MVUE) UCL	0.298
99% Chebyshev (MVUE) UCL	0.406		

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

Nonparametric Distribution Free UCLs

95% CLT UCL	0.164	95% Jackknife UCL	0.166
95% Standard Bootstrap UCL	0.163	95% Bootstrap-t UCL	0.197
95% Hall's Bootstrap UCL	0.408	95% Percentile Bootstrap UCL	0.163
95% BCA Bootstrap UCL	0.18		
90% Chebyshev(Mean, Sd) UCL	0.202	95% Chebyshev(Mean, Sd) UCL	0.24
97.5% Chebyshev(Mean, Sd) UCL	0.293	99% Chebyshev(Mean, Sd) UCL	0.397

Suggested UCL to Use

95% Adjusted Gamma 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.
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These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
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