Appendix G

ProUCL Outputs

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.13/14/2017 6:40:29 PM
From File	inputs.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	10000

arsenic_mounds

General Statistics

Total Number of Observations	33	Number of Distinct Observations	26
		Number of Missing Observations	0
Minimum	0.6	Mean	5.195
Maximum	17.3	Median	4.1
SD	3.525	Std. Error of Mean	0.614
Coefficient of Variation	0.679	Skewness	1.511

Normal GOF Test

Shapiro Wilk Test Statistic	0.89	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.931	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.137	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.152	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	6.235	95% Adjusted-CLT UCL (Chen-1995)	6.377
		95% Modified-t UCL (Johnson-1978)	6.262

Gamma GOF Test

A-D Test Statistic	0.194	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.757	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.0821	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.155	Detected data appear Gamma Distributed at 5% Significance Level
	Detected data appear Gamma Distributed at 5% Significance Level	

Gamma Statistics

k hat (MLE)	2.321	k star (bias corrected MLE)	2.13
Theta hat (MLE)	2.239	Theta star (bias corrected MLE)	2.439
nu hat (MLE)	153.2	nu star (bias corrected)	140.6
MLE Mean (bias corrected)	5.195	MLE Sd (bias corrected)	3.56
		Approximate Chi Square Value (0.05)	114.2
Adjusted Level of Significance	0.0419	Adjusted Chi Square Value	112.9

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	6.397	95% Adjusted Gamma UCL (use when n<50)	6.466

	A	B	C	D	E	F	G	H	I	J	K	L
51						Lognormal GOF Test						
52				Shapiro Wilk Test Statistic		0.969		Shapiro Wilk Lognormal GOF Test				
53				5% Shapiro Wilk Critical Value		0.931		Data appear Lognormal at 5% Significance Level				
54				Lilliefors Test Statistic		0.123		Lilliefors Lognormal GOF Test				
55				5% Lilliefors Critical Value		0.152		Data appear Lognormal at 5% Significance Level				
56						Data appear Lognormal at 5% Significance Level						
57												
58						Lognormal Statistics						
59				Minimum of Logged Data		-0.511					Mean of logged Data	1.417
60				Maximum of Logged Data		2.851					SD of logged Data	0.736
61												
62						Assuming Lognormal Distribution						
63				95% H-UCL		7.156					90% Chebyshev (MVUE) UCL	7.604
64				95% Chebyshev (MVUE) UCL		8.623					97.5% Chebyshev (MVUE) UCL	10.04
65				99% Chebyshev (MVUE) UCL		12.82						
66												
67						Nonparametric Distribution Free UCL Statistics						
68						Data appear to follow a Discernible Distribution at 5% Significance Level						
69												
70						Nonparametric Distribution Free UCLs						
71				95% CLT UCL		6.205					95% Jackknife UCL	6.235
72				95% Standard Bootstrap UCL		6.191					95% Bootstrap-t UCL	6.49
73				95% Hall's Bootstrap UCL		6.677					95% Percentile Bootstrap UCL	6.241
74				95% BCA Bootstrap UCL		6.365						
75				90% Chebyshev(Mean, Sd) UCL		7.037					95% Chebyshev(Mean, Sd) UCL	7.87
76				97.5% Chebyshev(Mean, Sd) UCL		9.028					99% Chebyshev(Mean, Sd) UCL	11.3
77												
78						Suggested UCL to Use						
79				95% Student's-t UCL		6.235						
80												
81				When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test								
82				When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL								
83												
84				Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.								
85				Recommendations are based upon data size, data distribution, and skewness.								
86				These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).								
87				However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.								
88												
89	arsenic_SE											
90												
91						General Statistics						
92				Total Number of Observations		10				Number of Distinct Observations		10
93				Number of Detects		9				Number of Non-Detects		1
94				Number of Distinct Detects		9				Number of Distinct Non-Detects		1
95				Minimum Detect		1.5				Minimum Non-Detect		2.1
96				Maximum Detect		5.2				Maximum Non-Detect		2.1
97				Variance Detects		1.073				Percent Non-Detects		10%
98				Mean Detects		3.144				SD Detects		1.036
99				Median Detects		3.2				CV Detects		0.329
100				Skewness Detects		0.531				Kurtosis Detects		1.488

	A	B	C	D	E	F	G	H	I	J	K	L
101				Mean of Logged Detects		1.095				SD of Logged Detects		0.349
102												
103					Normal GOF Test on Detects Only							
104				Shapiro Wilk Test Statistic		0.954			Shapiro Wilk GOF Test			
105				5% Shapiro Wilk Critical Value		0.829			Detected Data appear Normal at 5% Significance Level			
106				Lilliefors Test Statistic		0.18			Lilliefors GOF Test			
107				5% Lilliefors Critical Value		0.274			Detected Data appear Normal at 5% Significance Level			
108					Detected Data appear Normal at 5% Significance Level							
109												
110					Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs							
111					KM Mean	2.98				KM Standard Error of Mean		0.352
112					KM SD	1.05				95% KM (BCA) UCL		3.6
113				95% KM (t) UCL		3.625			95% KM (Percentile Bootstrap) UCL			3.56
114				95% KM (z) UCL		3.559				95% KM Bootstrap t UCL		3.67
115				90% KM Chebyshev UCL		4.036				95% KM Chebyshev UCL		4.514
116				97.5% KM Chebyshev UCL		5.178				99% KM Chebyshev UCL		6.483
117												
118					Gamma GOF Tests on Detected Observations Only							
119					A-D Test Statistic	0.285			Anderson-Darling GOF Test			
120				5% A-D Critical Value		0.722			Detected data appear Gamma Distributed at 5% Significance Level			
121					K-S Test Statistic	0.191			Kolmogorov-Smirnov GOF			
122				5% K-S Critical Value		0.279			Detected data appear Gamma Distributed at 5% Significance Level			
123					Detected data appear Gamma Distributed at 5% Significance Level							
124												
125					Gamma Statistics on Detected Data Only							
126					k hat (MLE)	9.943				k star (bias corrected MLE)		6.703
127					Theta hat (MLE)	0.316				Theta star (bias corrected MLE)		0.469
128					nu hat (MLE)	179				nu star (bias corrected)		120.6
129					Mean (detects)	3.144						
130												
131					Gamma ROS Statistics using Imputed Non-Detects							
132				GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs								
133			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)										
134				For such situations, GROS method may yield incorrect values of UCLs and BTVs								
135					This is especially true when the sample size is small.							
136			For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates										
137					Minimum	1.5					Mean	2.984
138					Maximum	5.2					Median	3.15
139					SD	1.101					CV	0.369
140					k hat (MLE)	7.836				k star (bias corrected MLE)		5.552
141					Theta hat (MLE)	0.381				Theta star (bias corrected MLE)		0.537
142					nu hat (MLE)	156.7				nu star (bias corrected)		111
143				Adjusted Level of Significance (β)		0.0267						
144				Approximate Chi Square Value (111.03, α)		87.71			Adjusted Chi Square Value (111.03, β)			84.11
145				95% Gamma Approximate UCL (use when n>=50)		3.777			95% Gamma Adjusted UCL (use when n<50)			3.938
146												
147					Estimates of Gamma Parameters using KM Estimates							
148					Mean (KM)	2.98					SD (KM)	1.05
149					Variance (KM)	1.102					SE of Mean (KM)	0.352
150					k hat (KM)	8.061					k star (KM)	5.71

	A	B	C	D	E	F	G	H	I	J	K	L
151				nu hat (KM)		161.2					nu star (KM)	114.2
152				theta hat (KM)		0.37					theta star (KM)	0.522
153			80% gamma percentile (KM)			3.948				90% gamma percentile (KM)		4.648
154			95% gamma percentile (KM)			5.283				99% gamma percentile (KM)		6.616
155												
156					Gamma Kaplan-Meier (KM) Statistics							
157			Approximate Chi Square Value (114.19, α)			90.52				Adjusted Chi Square Value (114.19, β)		86.87
158			95% Gamma Approximate KM-UCL (use when n>=50)			3.759				95% Gamma Adjusted KM-UCL (use when n<50)		3.917
159												
160					Lognormal GOF Test on Detected Observations Only							
161			Shapiro Wilk Test Statistic			0.951			Shapiro Wilk GOF Test			
162			5% Shapiro Wilk Critical Value			0.829		Detected Data appear Lognormal at 5% Significance Level				
163			Lilliefors Test Statistic			0.209			Lilliefors GOF Test			
164			5% Lilliefors Critical Value			0.274		Detected Data appear Lognormal at 5% Significance Level				
165				Detected Data appear Lognormal at 5% Significance Level								
166												
167					Lognormal ROS Statistics Using Imputed Non-Detects							
168			Mean in Original Scale			2.994				Mean in Log Scale		1.034
169			SD in Original Scale			1.086				SD in Log Scale		0.38
170			95% t UCL (assumes normality of ROS data)			3.624				95% Percentile Bootstrap UCL		3.54
171			95% BCA Bootstrap UCL			3.59				95% Bootstrap t UCL		3.684
172			95% H-UCL (Log ROS)			3.927						
173												
174				Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution								
175			KM Mean (logged)			1.026				KM Geo Mean		2.789
176			KM SD (logged)			0.374				95% Critical H Value (KM-Log)		2.059
177			KM Standard Error of Mean (logged)			0.125				95% H-UCL (KM -Log)		3.866
178			KM SD (logged)			0.374				95% Critical H Value (KM-Log)		2.059
179			KM Standard Error of Mean (logged)			0.125						
180												
181					DL/2 Statistics							
182			DL/2 Normal						DL/2 Log-Transformed			
183			Mean in Original Scale			2.935				Mean in Log Scale		0.99
184			SD in Original Scale			1.18				SD in Log Scale		0.466
185			95% t UCL (Assumes normality)			3.619				95% H-Stat UCL		4.206
186				DL/2 is not a recommended method, provided for comparisons and historical reasons								
187												
188					Nonparametric Distribution Free UCL Statistics							
189				Detected Data appear Normal Distributed at 5% Significance Level								
190												
191					Suggested UCL to Use							
192			95% KM (t) UCL			3.625						
193												
194		Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.										
195		Recommendations are based upon data size, data distribution, and skewness.										
196		These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).										
197		However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.										
198												
199												
200	lead_SE											

	A	B	C	D	E	F	G	H	I	J	K	L
201												
202					General Statistics							
203			Total Number of Observations			10			Number of Distinct Observations			10
204									Number of Missing Observations			0
205					Minimum	3.3					Mean	139.9
206					Maximum	563					Median	23.55
207					SD	205.9					Std. Error of Mean	65.11
208					Coefficient of Variation	1.472					Skewness	1.431
209												
210					Normal GOF Test							
211			Shapiro Wilk Test Statistic			0.706			Shapiro Wilk GOF Test			
212			5% Shapiro Wilk Critical Value			0.842			Data Not Normal at 5% Significance Level			
213			Lilliefors Test Statistic			0.361			Lilliefors GOF Test			
214			5% Lilliefors Critical Value			0.262			Data Not Normal at 5% Significance Level			
215					Data Not Normal at 5% Significance Level							
216												
217					Assuming Normal Distribution							
218			95% Normal UCL						95% UCLs (Adjusted for Skewness)			
219					95% Student's-t UCL	259.3			95% Adjusted-CLT UCL (Chen-1995)			278.5
220									95% Modified-t UCL (Johnson-1978)			264.2
221												
222					Gamma GOF Test							
223					A-D Test Statistic	0.755			Anderson-Darling Gamma GOF Test			
224					5% A-D Critical Value	0.776			Detected data appear Gamma Distributed at 5% Significance Level			
225					K-S Test Statistic	0.274			Kolmogorov-Smirnov Gamma GOF Test			
226					5% K-S Critical Value	0.281			Detected data appear Gamma Distributed at 5% Significance Level			
227					Detected data appear Gamma Distributed at 5% Significance Level							
228												
229					Gamma Statistics							
230					k hat (MLE)	0.507			k star (bias corrected MLE)			0.422
231					Theta hat (MLE)	276			Theta star (bias corrected MLE)			331.9
232					nu hat (MLE)	10.14			nu star (bias corrected)			8.431
233			MLE Mean (bias corrected)			139.9			MLE Sd (bias corrected)			215.5
234									Approximate Chi Square Value (0.05)			2.987
235			Adjusted Level of Significance			0.0267			Adjusted Chi Square Value			2.453
236												
237					Assuming Gamma Distribution							
238		95% Approximate Gamma UCL (use when n>=50)				394.9			95% Adjusted Gamma UCL (use when n<50)			481
239												
240					Lognormal GOF Test							
241			Shapiro Wilk Test Statistic			0.915			Shapiro Wilk Lognormal GOF Test			
242			5% Shapiro Wilk Critical Value			0.842			Data appear Lognormal at 5% Significance Level			
243			Lilliefors Test Statistic			0.203			Lilliefors Lognormal GOF Test			
244			5% Lilliefors Critical Value			0.262			Data appear Lognormal at 5% Significance Level			
245					Data appear Lognormal at 5% Significance Level							
246												
247					Lognormal Statistics							
248			Minimum of Logged Data			1.194			Mean of logged Data			3.691
249			Maximum of Logged Data			6.333			SD of logged Data			1.751
250												

Assuming Lognormal Distribution

95% H-UCL	3059		90% Chebyshev (MVUE) UCL	380.6
95% Chebyshev (MVUE) UCL	490		97.5% Chebyshev (MVUE) UCL	641.9
99% Chebyshev (MVUE) UCL	940.2			

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	247	95% Jackknife UCL	259.3
95% Standard Bootstrap UCL	242.1	95% Bootstrap-t UCL	389
95% Hall's Bootstrap UCL	263.2	95% Percentile Bootstrap UCL	249.2
95% BCA Bootstrap UCL	271.7		
90% Chebyshev(Mean, Sd) UCL	335.3	95% Chebyshev(Mean, Sd) UCL	423.7
97.5% Chebyshev(Mean, Sd) UCL	546.5	99% Chebyshev(Mean, Sd) UCL	787.8

Suggested UCL to Use

95% Adjusted Gamma UCL	481	

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.

BaP_SE

General Statistics

Total Number of Observations	10		Number of Distinct Observations	10
			Number of Missing Observations	0
Minimum	8.1		Mean	42.68
Maximum	224		Median	14.5
SD	66.17		Std. Error of Mean	20.93
Coefficient of Variation	1.55		Skewness	2.771

Normal GOF Test

Shapiro Wilk Test Statistic	0.577	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.325	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.262	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	81.04	95% Adjusted-CLT UCL (Chen-1995)	96.69
		95% Modified-t UCL (Johnson-1978)	84.1

Gamma GOF Test

A-D Test Statistic	0.932	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.752	Data Not Gamma Distributed at 5% Significance Level

	A	B	C	D	E	F	G	H	I	J	K	L

301 | K-S Test Statistic | 0.286 | Kolmogorov-Smirnov Gamma GOF Test

302 | 5% K-S Critical Value | 0.275 | Data Not Gamma Distributed at 5% Significance Level

303 | Data Not Gamma Distributed at 5% Significance Level

304

305 | Gamma Statistics

306 | k hat (MLE) | 0.907 | k star (bias corrected MLE) | 0.701

307 | Theta hat (MLE) | 47.07 | Theta star (bias corrected MLE) | 60.85

308 | nu hat (MLE) | 18.13 | nu star (bias corrected) | 14.03

309 | MLE Mean (bias corrected) | 42.68 | MLE Sd (bias corrected) | 50.96

310 | | | Approximate Chi Square Value (0.05) | 6.59

311 | Adjusted Level of Significance | 0.0267 | Adjusted Chi Square Value | 5.728

312

313 | Assuming Gamma Distribution

314 | 95% Approximate Gamma UCL (use when n>=50)) | 90.85 | 95% Adjusted Gamma UCL (use when n<50) | 104.5

315

316 | Lognormal GOF Test

317 | Shapiro Wilk Test Statistic | 0.869 | Shapiro Wilk Lognormal GOF Test

318 | 5% Shapiro Wilk Critical Value | 0.842 | Data appear Lognormal at 5% Significance Level

319 | Lilliefors Test Statistic | 0.252 | Lilliefors Lognormal GOF Test

320 | 5% Lilliefors Critical Value | 0.262 | Data appear Lognormal at 5% Significance Level

321 | Data appear Lognormal at 5% Significance Level

322

323 | Lognormal Statistics

324 | Minimum of Logged Data | 2.092 | Mean of logged Data | 3.11

325 | Maximum of Logged Data | 5.412 | SD of logged Data | 1.063

326

327 | Assuming Lognormal Distribution

328 | 95% H-UCL | 124.1 | 90% Chebyshev (MVUE) UCL | 75.18

329 | 95% Chebyshev (MVUE) UCL | 92.71 | 97.5% Chebyshev (MVUE) UCL | 117

330 | 99% Chebyshev (MVUE) UCL | 164.8

331

332 | Nonparametric Distribution Free UCL Statistics

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

334

335 | Nonparametric Distribution Free UCLs

336 | 95% CLT UCL | 77.1 | 95% Jackknife UCL | 81.04

337 | 95% Standard Bootstrap UCL | 75.29 | 95% Bootstrap-t UCL | 209.1

338 | 95% Hall's Bootstrap UCL | 209.4 | 95% Percentile Bootstrap UCL | 80.77

339 | 95% BCA Bootstrap UCL | 102.9

340 | 90% Chebyshev(Mean, Sd) UCL | 105.5 | 95% Chebyshev(Mean, Sd) UCL | 133.9

341 | 97.5% Chebyshev(Mean, Sd) UCL | 173.4 | 99% Chebyshev(Mean, Sd) UCL | 250.9

342

343 | Suggested UCL to Use

344 | 95% Chebyshev (Mean, Sd) UCL | 133.9

345

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

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

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

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

350

BbF_SE

General Statistics

Total Number of Observations	10	Number of Distinct Observations	10
		Number of Missing Observations	0
Minimum	9.9	Mean	78.7
Maximum	492	Median	22
SD	148.2	Std. Error of Mean	46.86
Coefficient of Variation	1.883	Skewness	2.943

Normal GOF Test

Shapiro Wilk Test Statistic	0.522	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.35	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.262	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	164.6	95% Adjusted-CLT UCL (Chen-1995)	202.4
		95% Modified-t UCL (Johnson-1978)	171.9

Gamma GOF Test

A-D Test Statistic	1.021	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.764	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.238	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.278	Detected data appear Gamma Distributed at 5% Significance Level

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

Gamma Statistics

k hat (MLE)	0.667	k star (bias corrected MLE)	0.534
Theta hat (MLE)	118	Theta star (bias corrected MLE)	147.5
nu hat (MLE)	13.34	nu star (bias corrected)	10.67
MLE Mean (bias corrected)	78.7	MLE Sd (bias corrected)	107.7
		Approximate Chi Square Value (0.05)	4.366
Adjusted Level of Significance	0.0267	Adjusted Chi Square Value	3.691

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	192.4	95% Adjusted Gamma UCL (use when n<50)	227.5

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.867	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.176	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.262	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	2.293	Mean of logged Data	3.453

	A	B	C	D	E	F	G	H	I	J	K	L
401				Maximum of Logged Data		6.198				SD of logged Data		1.249
402												
403						Assuming Lognormal Distribution						
404				95% H-UCL		313.1				90% Chebyshev (MVUE) UCL		138
405			95% Chebyshev (MVUE) UCL			172.8				97.5% Chebyshev (MVUE) UCL		221
406			99% Chebyshev (MVUE) UCL			315.8						
407												
408						Nonparametric Distribution Free UCL Statistics						
409					Data appear to follow a Discernible Distribution at 5% Significance Level							
410												
411						Nonparametric Distribution Free UCLs						
412				95% CLT UCL		155.8				95% Jackknife UCL		164.6
413			95% Standard Bootstrap UCL			151.3				95% Bootstrap-t UCL		578
414			95% Hall's Bootstrap UCL			455.8				95% Percentile Bootstrap UCL		167.4
415			95% BCA Bootstrap UCL			216.4						
416			90% Chebyshev(Mean, Sd) UCL			219.3				95% Chebyshev(Mean, Sd) UCL		283
417			97.5% Chebyshev(Mean, Sd) UCL			371.4				99% Chebyshev(Mean, Sd) UCL		545
418												
419						Suggested UCL to Use						
420				95% Adjusted Gamma UCL		227.5						
421												
422			When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test									
423			When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL									
424												
425			Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.									
426			Recommendations are based upon data size, data distribution, and skewness.									
427			These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).									
428			However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.									
429												
430												
431	arsenic_discrete											
432												
433						General Statistics						
434				Total Number of Observations		8				Number of Distinct Observations		7
435										Number of Missing Observations		0
436				Minimum		1.3				Mean		4.563
437				Maximum		7.7				Median		4.7
438				SD		1.915				Std. Error of Mean		0.677
439				Coefficient of Variation		0.42				Skewness		-0.24
440												
441			Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use									
442			guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.									
443			For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).									
444			Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1									
445												
446						Normal GOF Test						
447				Shapiro Wilk Test Statistic		0.951			Shapiro Wilk GOF Test			
448				5% Shapiro Wilk Critical Value		0.818			Data appear Normal at 5% Significance Level			
449				Lilliefors Test Statistic		0.237			Lilliefors GOF Test			
450				5% Lilliefors Critical Value		0.283			Data appear Normal at 5% Significance Level			

	A	B	C	D	E	F	G	H	I	J	K	L
451	Data appear Normal at 5% Significance Level											
452												
453	Assuming Normal Distribution											
454	95% Normal UCL						95% UCLs (Adjusted for Skewness)					
455	95% Student's-t UCL					5.845	95% Adjusted-CLT UCL (Chen-1995)					5.614
456							95% Modified-t UCL (Johnson-1978)					5.835
457												
458	Gamma GOF Test											
459	A-D Test Statistic					0.511	Anderson-Darling Gamma GOF Test					
460	5% A-D Critical Value					0.719	Detected data appear Gamma Distributed at 5% Significance Level					
461	K-S Test Statistic					0.299	Kolmogorov-Smirnov Gamma GOF Test					
462	5% K-S Critical Value					0.295	Data Not Gamma Distributed at 5% Significance Level					
463	Detected data follow Appr. Gamma Distribution at 5% Significance Level											
464												
465	Gamma Statistics											
466	k hat (MLE)					4.825	k star (bias corrected MLE)					3.099
467	Theta hat (MLE)					0.946	Theta star (bias corrected MLE)					1.472
468	nu hat (MLE)					77.19	nu star (bias corrected)					49.58
469	MLE Mean (bias corrected)					4.563	MLE Sd (bias corrected)					2.592
470							Approximate Chi Square Value (0.05)					34.41
471	Adjusted Level of Significance					0.0195	Adjusted Chi Square Value					31.25
472												
473	Assuming Gamma Distribution											
474	95% Approximate Gamma UCL (use when n>=50))					6.573	95% Adjusted Gamma UCL (use when n<50)					7.239
475												
476	Lognormal GOF Test											
477	Shapiro Wilk Test Statistic					0.852	Shapiro Wilk Lognormal GOF Test					
478	5% Shapiro Wilk Critical Value					0.818	Data appear Lognormal at 5% Significance Level					
479	Lilliefors Test Statistic					0.318	Lilliefors Lognormal GOF Test					
480	5% Lilliefors Critical Value					0.283	Data Not Lognormal at 5% Significance Level					
481	Data appear Approximate Lognormal at 5% Significance Level											
482												
483	Lognormal Statistics											
484	Minimum of Logged Data					0.262	Mean of logged Data					1.411
485	Maximum of Logged Data					2.041	SD of logged Data					0.548
486												
487	Assuming Lognormal Distribution											
488	95% H-UCL					7.891	90% Chebyshev (MVUE) UCL					7.409
489	95% Chebyshev (MVUE) UCL					8.651	97.5% Chebyshev (MVUE) UCL					10.38
490	99% Chebyshev (MVUE) UCL					13.76						
491												
492	Nonparametric Distribution Free UCL Statistics											
493	Data appear to follow a Discernible Distribution at 5% Significance Level											
494												
495	Nonparametric Distribution Free UCLs											
496	95% CLT UCL					5.676	95% Jackknife UCL					5.845
497	95% Standard Bootstrap UCL					5.62	95% Bootstrap-t UCL					5.731
498	95% Hall's Bootstrap UCL					5.746	95% Percentile Bootstrap UCL					5.575
499	95% BCA Bootstrap UCL					5.55						
500	90% Chebyshev(Mean, Sd) UCL					6.593	95% Chebyshev(Mean, Sd) UCL					7.513

	A	B	C	D	E	F	G	H	I	J	K	L
501			97.5% Chebyshev(Mean, Sd) UCL			8.79			99% Chebyshev(Mean, Sd) UCL			11.3
502												
503					Suggested UCL to Use							
504				95% Student's-t UCL		5.845						
505												
506		Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.										
507		Recommendations are based upon data size, data distribution, and skewness.										
508		These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).										
509		However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.										
510												
511		Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be										
512		reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.										
513												
514												
515	lead_discrete											
516												
517					General Statistics							
518			Total Number of Observations			8			Number of Distinct Observations			8
519									Number of Missing Observations			0
520					Minimum	20.8					Mean	135.5
521					Maximum	543					Median	81
522					SD	174.9					Std. Error of Mean	61.84
523				Coefficient of Variation		1.29					Skewness	2.225
524												
525		Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use										
526		guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.										
527		For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).										
528		Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1										
529												
530					Normal GOF Test							
531			Shapiro Wilk Test Statistic			0.691			Shapiro Wilk GOF Test			
532			5% Shapiro Wilk Critical Value			0.818			Data Not Normal at 5% Significance Level			
533			Lilliefors Test Statistic			0.319			Lilliefors GOF Test			
534			5% Lilliefors Critical Value			0.283			Data Not Normal at 5% Significance Level			
535					Data Not Normal at 5% Significance Level							
536												
537					Assuming Normal Distribution							
538			95% Normal UCL						95% UCLs (Adjusted for Skewness)			
539				95% Student's-t UCL		252.7			95% Adjusted-CLT UCL (Chen-1995)			289.2
540									95% Modified-t UCL (Johnson-1978)			260.8
541												
542					Gamma GOF Test							
543			A-D Test Statistic			0.582			Anderson-Darling Gamma GOF Test			
544			5% A-D Critical Value			0.738		Detected data appear Gamma Distributed at 5% Significance Level				
545			K-S Test Statistic			0.269			Kolmogorov-Smirnov Gamma GOF Test			
546			5% K-S Critical Value			0.302		Detected data appear Gamma Distributed at 5% Significance Level				
547				Detected data appear Gamma Distributed at 5% Significance Level								
548												
549					Gamma Statistics							
550					k hat (MLE)	0.936			k star (bias corrected MLE)			0.668

	A	B	C	D	E	F	G	H	I	J	K	L
551				Theta hat (MLE)		144.9			Theta star (bias corrected MLE)			202.9
552				nu hat (MLE)		14.97			nu star (bias corrected)			10.69
553				MLE Mean (bias corrected)		135.5			MLE Sd (bias corrected)			165.8
554									Approximate Chi Square Value (0.05)			4.377
555				Adjusted Level of Significance		0.0195			Adjusted Chi Square Value			3.415
556												
557					Assuming Gamma Distribution							
558			95% Approximate Gamma UCL (use when n>=50)			331			95% Adjusted Gamma UCL (use when n<50)			424.3
559												
560					Lognormal GOF Test							
561				Shapiro Wilk Test Statistic		0.884			Shapiro Wilk Lognormal GOF Test			
562				5% Shapiro Wilk Critical Value		0.818			Data appear Lognormal at 5% Significance Level			
563				Lilliefors Test Statistic		0.249			Lilliefors Lognormal GOF Test			
564				5% Lilliefors Critical Value		0.283			Data appear Lognormal at 5% Significance Level			
565					Data appear Lognormal at 5% Significance Level							
566												
567					Lognormal Statistics							
568				Minimum of Logged Data		3.035			Mean of logged Data			4.287
569				Maximum of Logged Data		6.297			SD of logged Data			1.178
570												
571					Assuming Lognormal Distribution							
572				95% H-UCL		819.2			90% Chebyshev (MVUE) UCL			293.1
573			95% Chebyshev (MVUE) UCL			367.4			97.5% Chebyshev (MVUE) UCL			470.7
574			99% Chebyshev (MVUE) UCL			673.5						
575												
576					Nonparametric Distribution Free UCL Statistics							
577				Data appear to follow a Discernible Distribution at 5% Significance Level								
578												
579					Nonparametric Distribution Free UCLs							
580				95% CLT UCL		237.2			95% Jackknife UCL			252.7
581			95% Standard Bootstrap UCL			230.9			95% Bootstrap-t UCL			387.7
582			95% Hall's Bootstrap UCL			608.6			95% Percentile Bootstrap UCL			238.6
583			95% BCA Bootstrap UCL			284						
584			90% Chebyshev(Mean, Sd) UCL			321			95% Chebyshev(Mean, Sd) UCL			405.1
585			97.5% Chebyshev(Mean, Sd) UCL			521.7			99% Chebyshev(Mean, Sd) UCL			750.8
586												
587					Suggested UCL to Use							
588				95% Adjusted Gamma UCL		424.3						
589												
590			Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.									
591				Recommendations are based upon data size, data distribution, and skewness.								
592			These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).									
593			However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.									
594												
595	BaP_discrete											
596												
597					General Statistics							
598				Total Number of Observations		8			Number of Distinct Observations			8
599				Number of Detects		7			Number of Non-Detects			1
600				Number of Distinct Detects		7			Number of Distinct Non-Detects			1

	A	B	C	D	E	F	G	H	I	J	K	L
601					Minimum Detect		11				Minimum Non-Detect	57.1
602					Maximum Detect		37				Maximum Non-Detect	57.1
603					Variance Detects		91.15				Percent Non-Detects	12.5%
604					Mean Detects		24.91				SD Detects	9.548
605					Median Detects		22.7				CV Detects	0.383
606					Skewness Detects		-0.11				Kurtosis Detects	-1.452
607					Mean of Logged Detects		3.142				SD of Logged Detects	0.431
608												
609					Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use							
610					guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.							
611					For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).							
612					Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1							
613												
614					Normal GOF Test on Detects Only							
615					Shapiro Wilk Test Statistic		0.936		Shapiro Wilk GOF Test			
616					5% Shapiro Wilk Critical Value		0.803		Detected Data appear Normal at 5% Significance Level			
617					Lilliefors Test Statistic		0.224		Lilliefors GOF Test			
618					5% Lilliefors Critical Value		0.304		Detected Data appear Normal at 5% Significance Level			
619					Detected Data appear Normal at 5% Significance Level							
620												
621					Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs							
622					KM Mean		24.91			KM Standard Error of Mean		3.609
623					KM SD		8.839			95% KM (BCA) UCL		30.47
624					95% KM (t) UCL		31.75			95% KM (Percentile Bootstrap) UCL		30.41
625					95% KM (z) UCL		30.85			95% KM Bootstrap t UCL		31.94
626					90% KM Chebyshev UCL		35.74			95% KM Chebyshev UCL		40.64
627					97.5% KM Chebyshev UCL		47.45			99% KM Chebyshev UCL		60.82
628												
629					Gamma GOF Tests on Detected Observations Only							
630					A-D Test Statistic		0.315		Anderson-Darling GOF Test			
631					5% A-D Critical Value		0.709		Detected data appear Gamma Distributed at 5% Significance Level			
632					K-S Test Statistic		0.241		Kolmogorov-Smirnov GOF			
633					5% K-S Critical Value		0.313		Detected data appear Gamma Distributed at 5% Significance Level			
634					Detected data appear Gamma Distributed at 5% Significance Level							
635												
636					Gamma Statistics on Detected Data Only							
637					k hat (MLE)		7.006			k star (bias corrected MLE)		4.098
638					Theta hat (MLE)		3.556			Theta star (bias corrected MLE)		6.079
639					nu hat (MLE)		98.08			nu star (bias corrected)		57.38
640					Mean (detects)		24.91					
641												
642					Gamma ROS Statistics using Imputed Non-Detects							
643					GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs							
644					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)							
645					For such situations, GROS method may yield incorrect values of UCLs and BTVs							
646					This is especially true when the sample size is small.							
647					For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates							
648					Minimum		11				Mean	24.81
649					Maximum		37				Median	23.41
650					SD		8.844				CV	0.356

	A	B	C	D	E	F	G	H	I	J	K	L
651					k hat (MLE)	7.977					k star (bias corrected MLE)	5.069
652					Theta hat (MLE)	3.111					Theta star (bias corrected MLE)	4.895
653					nu hat (MLE)	127.6					nu star (bias corrected)	81.1
654				Adjusted Level of Significance (β)		0.0195						
655			Approximate Chi Square Value (81.10, α)			61.35				Adjusted Chi Square Value (81.10, β)		57.02
656		Approximate Chi Square Value (81.10, α) 95% Gamma Approximate UCL (use when n>=50)				32.8				95% Gamma Adjusted UCL (use when n<50)		35.29
657												
658					Estimates of Gamma Parameters using KM Estimates							
659					Mean (KM)	24.91					SD (KM)	8.839
660					Variance (KM)	78.13					SE of Mean (KM)	3.609
661					k hat (KM)	7.944					k star (KM)	5.049
662					nu hat (KM)	127.1					nu star (KM)	80.78
663					theta hat (KM)	3.136					theta star (KM)	4.935
664				80% gamma percentile (KM)		33.45					90% gamma percentile (KM)	39.76
665				95% gamma percentile (KM)		45.5					99% gamma percentile (KM)	57.63
666												
667					Gamma Kaplan-Meier (KM) Statistics							
668			Approximate Chi Square Value (80.78, α)			61.07				Adjusted Chi Square Value (80.78, β)		56.75
669		95% Gamma Approximate KM-UCL (use when n>=50)				32.96				95% Gamma Adjusted KM-UCL (use when n<50)		35.46
670												
671					Lognormal GOF Test on Detected Observations Only							
672				Shapiro Wilk Test Statistic		0.923			Shapiro Wilk GOF Test			
673				5% Shapiro Wilk Critical Value		0.803			Detected Data appear Lognormal at 5% Significance Level			
674				Lilliefors Test Statistic		0.219			Lilliefors GOF Test			
675				5% Lilliefors Critical Value		0.304			Detected Data appear Lognormal at 5% Significance Level			
676				Detected Data appear Lognormal at 5% Significance Level								
677												
678					Lognormal ROS Statistics Using Imputed Non-Detects							
679					Mean in Original Scale	24.69					Mean in Log Scale	3.142
680					SD in Original Scale	8.861					SD in Log Scale	0.399
681				95% t UCL (assumes normality of ROS data)		30.63					95% Percentile Bootstrap UCL	29.54
682					95% BCA Bootstrap UCL	29.54					95% Bootstrap t UCL	30.73
683					95% H-UCL (Log ROS)	34.9						
684												
685				Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution								
686					KM Mean (logged)	3.142					KM Geo Mean	23.16
687					KM SD (logged)	0.399				95% Critical H Value (KM-Log)		2.193
688				KM Standard Error of Mean (logged)		0.163					95% H-UCL (KM -Log)	34.9
689					KM SD (logged)	0.399				95% Critical H Value (KM-Log)		2.193
690				KM Standard Error of Mean (logged)		0.163						
691												
692					DL/2 Statistics							
693		DL/2 Normal							DL/2 Log-Transformed			
694					Mean in Original Scale	25.37					Mean in Log Scale	3.169
695					SD in Original Scale	8.932					SD in Log Scale	0.406
696				95% t UCL (Assumes normality)		31.35					95% H-Stat UCL	36.18
697				DL/2 is not a recommended method, provided for comparisons and historical reasons								
698												
699					Nonparametric Distribution Free UCL Statistics							
700					Detected Data appear Normal Distributed at 5% Significance Level							

	A	B	C	D	E	F	G	H	I	J	K	L
701												
702					Suggested UCL to Use							
703				95% KM (t) UCL		31.75						
704												
705		Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.										
706		Recommendations are based upon data size, data distribution, and skewness.										
707		These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).										
708		However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.										
709												