UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	8/9/2016 10:46:35 AM
From File	ProUCL input 01-006(n)_a.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Aroclor-1260

General Statistics

Total Number of Observations	10	Number of Distinct Observations	9
Number of Detects	6	Number of Non-Detects	4
Number of Distinct Detects	6	Number of Distinct Non-Detects	3
Minimum Detect	0.011	Minimum Non-Detect	0.033
Maximum Detect	0.52	Maximum Non-Detect	0.035
Variance Detects	0.0387	Percent Non-Detects	40%
Mean Detects	0.145	SD Detects	0.197
Median Detects	0.0775	CV Detects	1.358
Skewness Detects	1.81	Kurtosis Detects	3.428
Mean of Logged Detects	-2.907	SD of Logged Detects	1.646

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.755	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.788	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.282	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.362	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

Mean	0.0921	Standard Error of Mean	0.0531
SD	0.153	95% KM (BCA) UCL	0.182
95% KM (t) UCL	0.19	95% KM (Percentile Bootstrap) UCL	0.18
95% KM (z) UCL	0.18	95% KM Bootstrap t UCL	0.303
90% KM Chebyshev UCL	0.252	95% KM Chebyshev UCL	0.324
97.5% KM Chebyshev UCL	0.424	99% KM Chebyshev UCL	0.621

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.508	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.728	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.305	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.346	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)	0.629	k star (bias corrected MLE)	0.426
Theta hat (MLE)	0.23	Theta star (bias corrected MLE)	0.34
nu hat (MLE)	7.55	nu star (bias corrected)	5.108
MLE Mean (bias corrected)	0.145	MLE Sd (bias corrected)	0.222

Gamma Kaplan-Meier (KM) Statistics

	A	B	C	D	E	F	G	H	I	J	K	L
53					k hat (KM)	0.361					nu hat (KM)	7.211
54			Approximate Chi Square Value (7.21, α)			2.287			Adjusted Chi Square Value (7.21, β)			1.836
55			95% Gamma Approximate KM-UCL (use when n>=50)			0.29			95% Gamma Adjusted KM-UCL (use when n<50)			0.362
56												
57						Gamma ROS Statistics using Imputed Non-Detects						
58					GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs							
59					GROS may not be used when kstar of detected data is small such as < 0.1							
60					For such situations, GROS method tends to yield inflated values of UCLs and BTVs							
61					For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates							
62					Minimum	0.01					Mean	0.0919
63					Maximum	0.52					Median	0.014
64					SD	0.162					CV	1.761
65					k hat (MLE)	0.553				k star (bias corrected MLE)		0.454
66					Theta hat (MLE)	0.166				Theta star (bias corrected MLE)		0.202
67					nu hat (MLE)	11.06				nu star (bias corrected)		9.078
68			MLE Mean (bias corrected)			0.0919				MLE Sd (bias corrected)		0.136
69									Adjusted Level of Significance (β)			0.0267
70			Approximate Chi Square Value (9.08, α)			3.374			Adjusted Chi Square Value (9.08, β)			2.798
71			95% Gamma Approximate UCL (use when n>=50)			0.247			95% Gamma Adjusted UCL (use when n<50)			0.298
72												
73					Lognormal GOF Test on Detected Observations Only							
74				Shapiro Wilk Test Statistic		0.851			Shapiro Wilk GOF Test			
75				5% Shapiro Wilk Critical Value		0.788			Detected Data appear Lognormal at 5% Significance Level			
76				Lilliefors Test Statistic		0.284			Lilliefors GOF Test			
77				5% Lilliefors Critical Value		0.362			Detected Data appear Lognormal at 5% Significance Level			
78					Detected Data appear Lognormal at 5% Significance Level							
79												
80					Lognormal ROS Statistics Using Imputed Non-Detects							
81				Mean in Original Scale		0.0936				Mean in Log Scale		-3.41
82				SD in Original Scale		0.161				SD in Log Scale		1.413
83			95% t UCL (assumes normality of ROS data)			0.187			95% Percentile Bootstrap UCL			0.18
84				95% BCA Bootstrap UCL		0.229				95% Bootstrap t UCL		0.36
85				95% H-UCL (Log ROS)		0.591						
86												
87			UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed									
88				KM Mean (logged)		-3.485			95% H-UCL (KM -Log)			0.457
89				KM SD (logged)		1.364			95% Critical H Value (KM-Log)			3.895
90			KM Standard Error of Mean (logged)			0.475						
91												
92					DL/2 Statistics							
93		DL/2 Normal							DL/2 Log-Transformed			
94				Mean in Original Scale		0.0938				Mean in Log Scale		-3.371
95				SD in Original Scale		0.161				SD in Log Scale		1.366
96			95% t UCL (Assumes normality)			0.187				95% H-Stat UCL		0.514
97			DL/2 is not a recommended method, provided for comparisons and historical reasons									
98												
99					Nonparametric Distribution Free UCL Statistics							
100					Detected Data appear Approximate Normal Distributed at 5% Significance Level							
101												
102					Suggested UCL to Use							
103				95% KM (t) UCL		0.19			95% KM (Percentile Bootstrap) UCL			0.18
104												

Lead

General Statistics

Total Number of Observations	10	Number of Distinct Observations	10
		Number of Missing Observations	0
Minimum	2	Mean	12.12
Maximum	44.1	Median	10.95
SD	12.52	Std. Error of Mean	3.96
Coefficient of Variation	1.033	Skewness	2.083

Normal GOF Test

Shapiro Wilk Test Statistic	0.753	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.25	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.28	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	19.38	95% Adjusted-CLT UCL (Chen-1995)	21.42
		95% Modified-t UCL (Johnson-1978)	19.81

Gamma GOF Test

A-D Test Statistic	0.456	**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	0.182	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.272	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.271	k star (bias corrected MLE)	0.956
Theta hat (MLE)	9.539	Theta star (bias corrected MLE)	12.68
nu hat (MLE)	25.41	nu star (bias corrected)	19.12
MLE Mean (bias corrected)	12.12	MLE Sd (bias corrected)	12.4
		Approximate Chi Square Value (0.05)	10.21
Adjusted Level of Significance	0.0267	Adjusted Chi Square Value	9.095

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	22.71	95% Adjusted Gamma UCL (use when n<50)	25.48

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.916	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.193	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.28	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

	A	B	C	D	E	F	G	H	I	J	K	L
157												
158					**Lognormal Statistics**							
159			Minimum of Logged Data			0.693				Mean of logged Data		2.052
160			Maximum of Logged Data			3.786				SD of logged Data		1.019
161												
162					**Assuming Lognormal Distribution**							
163				95% H-UCL		38.06				90% Chebyshev (MVUE) UCL		24.58
164			95% Chebyshev (MVUE) UCL			30.19				97.5% Chebyshev (MVUE) UCL		37.97
165			99% Chebyshev (MVUE) UCL			53.26						
166												
167					**Nonparametric Distribution Free UCL Statistics**							
168					**Data appear to follow a Discernible Distribution at 5% Significance Level**							
169												
170					**Nonparametric Distribution Free UCLs**							
171				95% CLT UCL		18.63				95% Jackknife UCL		19.38
172			95% Standard Bootstrap UCL			18.35				95% Bootstrap-t UCL		26.08
173			95% Hall's Bootstrap UCL			46.62				95% Percentile Bootstrap UCL		18.86
174			95% BCA Bootstrap UCL			21.25						
175			90% Chebyshev(Mean, Sd) UCL			24				95% Chebyshev(Mean, Sd) UCL		29.38
176			97.5% Chebyshev(Mean, Sd) UCL			36.85				99% Chebyshev(Mean, Sd) UCL		51.53
177												
178					**Suggested UCL to Use**							
179				95% Student's-t UCL		19.38						
180												
181		Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.										
182		These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)										
183		and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.										
184		For additional insight the user may want to consult a statistician.										
185												
186	**Mercury**											
187												
188					**General Statistics**							
189			Total Number of Observations			10				Number of Distinct Observations		10
190			Number of Detects			6				Number of Non-Detects		4
191			Number of Distinct Detects			6				Number of Distinct Non-Detects		4
192			Minimum Detect			0.0479				Minimum Non-Detect		0.0146
193			Maximum Detect			0.555				Maximum Non-Detect		0.0573
194			Variance Detects			0.0364				Percent Non-Detects		40%
195			Mean Detects			0.174				SD Detects		0.191
196			Median Detects			0.123				CV Detects		1.097
197			Skewness Detects			2.213				Kurtosis Detects		5.138
198			Mean of Logged Detects			-2.12				SD of Logged Detects		0.884
199												
200					**Normal GOF Test on Detects Only**							
201			Shapiro Wilk Test Statistic			0.68			**Shapiro Wilk GOF Test**			
202			5% Shapiro Wilk Critical Value			0.788			Detected Data Not Normal at 5% Significance Level			
203			Lilliefors Test Statistic			0.398			**Lilliefors GOF Test**			
204			5% Lilliefors Critical Value			0.362			Detected Data Not Normal at 5% Significance Level			
205					**Detected Data Not Normal at 5% Significance Level**							
206												
207					**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**							
208				Mean		0.112				Standard Error of Mean		0.0538

	A	B	C	D	E	F	G	H	I	J	K	L
209					SD	0.155				95% KM (BCA) UCL		0.212
210				95% KM (t) UCL		0.21			95% KM (Percentile Bootstrap) UCL			0.205
211				95% KM (z) UCL		0.2				95% KM Bootstrap t UCL		0.343
212				90% KM Chebyshev UCL		0.273				95% KM Chebyshev UCL		0.346
213				97.5% KM Chebyshev UCL		0.448				99% KM Chebyshev UCL		0.647
214												
215					**Gamma GOF Tests on Detected Observations Only**							
216				A-D Test Statistic		0.588			**Anderson-Darling GOF Test**			
217				5% A-D Critical Value		0.708		Detected data appear Gamma Distributed at 5% Significance Level				
218				K-S Test Statistic		0.314			**Kolmogrov-Smirnoff GOF**			
219				5% K-S Critical Value		0.337		Detected data appear Gamma Distributed at 5% Significance Level				
220				**Detected data appear Gamma Distributed at 5% Significance Level**								
221												
222					**Gamma Statistics on Detected Data Only**							
223				k hat (MLE)		1.494				k star (bias corrected MLE)		0.858
224				Theta hat (MLE)		0.116				Theta star (bias corrected MLE)		0.203
225				nu hat (MLE)		17.93				nu star (bias corrected)		10.3
226				MLE Mean (bias corrected)		0.174				MLE Sd (bias corrected)		0.188
227												
228					**Gamma Kaplan-Meier (KM) Statistics**							
229				k hat (KM)		0.517				nu hat (KM)		10.35
230		Approximate Chi Square Value (10.35, α)				4.16			Adjusted Chi Square Value (10.35, β)			3.504
231	95% Gamma Approximate KM-UCL (use when n>=50)					0.278		95% Gamma Adjusted KM-UCL (use when n<50)				0.33
232												
233					**Gamma ROS Statistics using Imputed Non-Detects**							
234				GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs								
235				GROS may not be used when kstar of detected data is small such as < 0.1								
236				For such situations, GROS method tends to yield inflated values of UCLs and BTVs								
237				For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates								
238					Minimum	0.01				Mean		0.108
239					Maximum	0.555				Median		0.0502
240					SD	0.166				CV		1.528
241				k hat (MLE)		0.681				k star (bias corrected MLE)		0.543
242				Theta hat (MLE)		0.159				Theta star (bias corrected MLE)		0.199
243				nu hat (MLE)		13.61				nu star (bias corrected)		10.86
244				MLE Mean (bias corrected)		0.108				MLE Sd (bias corrected)		0.147
245										Adjusted Level of Significance (β)		0.0267
246	Approximate Chi Square Value (10.86, α)					4.487			Adjusted Chi Square Value (10.86, β)			3.801
247	95% Gamma Approximate UCL (use when n>=50)					0.262		95% Gamma Adjusted UCL (use when n<50)				0.31
248												
249					**Lognormal GOF Test on Detected Observations Only**							
250			Shapiro Wilk Test Statistic			0.885			**Shapiro Wilk GOF Test**			
251			5% Shapiro Wilk Critical Value			0.788		Detected Data appear Lognormal at 5% Significance Level				
252			Lilliefors Test Statistic			0.255			**Lilliefors GOF Test**			
253			5% Lilliefors Critical Value			0.362		Detected Data appear Lognormal at 5% Significance Level				
254				**Detected Data appear Lognormal at 5% Significance Level**								
255												
256					**Lognormal ROS Statistics Using Imputed Non-Detects**							
257			Mean in Original Scale			0.111				Mean in Log Scale		-2.926
258			SD in Original Scale			0.164				SD in Log Scale		1.243
259		95% t UCL (assumes normality of ROS data)				0.206			95% Percentile Bootstrap UCL			0.204
260			95% BCA Bootstrap UCL			0.265				95% Bootstrap t UCL		0.361

	A	B	C	D	E	F	G	H	I	J	K	L
261				95% H-UCL (Log ROS)		0.52						
262												
263			UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed									
264				KM Mean (logged)		-2.913				95% H-UCL (KM -Log)		0.427
265				KM SD (logged)		1.179				95% Critical H Value (KM-Log)		3.481
266			KM Standard Error of Mean (logged)			0.415						
267												
268					DL/2 Statistics							
269			DL/2 Normal						DL/2 Log-Transformed			
270				Mean in Original Scale		0.111				Mean in Log Scale		-2.932
271				SD in Original Scale		0.164				SD in Log Scale		1.284
272			95% t UCL (Assumes normality)			0.206				95% H-Stat UCL		0.596
273			DL/2 is not a recommended method, provided for comparisons and historical reasons									
274												
275				Nonparametric Distribution Free UCL Statistics								
276				Detected Data appear Gamma Distributed at 5% Significance Level								
277												
278					Suggested UCL to Use							
279				95% KM (BCA) UCL		0.212				95% GROS Adjusted Gamma UCL		0.31
280			95% Adjusted Gamma KM-UCL			0.33						
281												
282			Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.									
283			Recommendations are based upon data size, data distribution, and skewness.									
284			These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).									
285			However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.									
286												
287												
288	Nickel											
289												
290					General Statistics							
291			Total Number of Observations			10			Number of Distinct Observations			10
292									Number of Missing Observations			0
293				Minimum		3.5				Mean		5.58
294				Maximum		10.1				Median		4.85
295				SD		2.293				Std. Error of Mean		0.725
296			Coefficient of Variation			0.411				Skewness		1.404
297												
298					Normal GOF Test							
299			Shapiro Wilk Test Statistic			0.795			Shapiro Wilk GOF Test			
300			5% Shapiro Wilk Critical Value			0.842			Data Not Normal at 5% Significance Level			
301			Lilliefors Test Statistic			0.266			Lilliefors GOF Test			
302			5% Lilliefors Critical Value			0.28			Data appear Normal at 5% Significance Level			
303				Data appear Approximate Normal at 5% Significance Level								
304												
305					Assuming Normal Distribution							
306			95% Normal UCL						95% UCLs (Adjusted for Skewness)			
307				95% Student's-t UCL		6.909			95% Adjusted-CLT UCL (Chen-1995)			7.117
308									95% Modified-t UCL (Johnson-1978)			6.963
309												
310					Gamma GOF Test							
311				A-D Test Statistic		0.688			Anderson-Darling Gamma GOF Test			
312				5% A-D Critical Value		0.727			Detected data appear Gamma Distributed at 5% Significance Level			

	A	B	C	D	E	F	G	H	I	J	K	L
313					K-S Test Statistic	0.231		**Kolmogrov-Smirnoff Gamma GOF Test**				
314					5% K-S Critical Value	0.267		Detected data appear Gamma Distributed at 5% Significance Level				
315				**Detected data appear Gamma Distributed at 5% Significance Level**								
316												
317							**Gamma Statistics**					
318				k hat (MLE)		7.995			k star (bias corrected MLE)			5.663
319				Theta hat (MLE)		0.698			Theta star (bias corrected MLE)			0.985
320				nu hat (MLE)		159.9			nu star (bias corrected)			113.3
321				MLE Mean (bias corrected)		5.58			MLE Sd (bias corrected)			2.345
322									Approximate Chi Square Value (0.05)			89.7
323				Adjusted Level of Significance		0.0267			Adjusted Chi Square Value			86.06
324												
325							**Assuming Gamma Distribution**					
326		95% Approximate Gamma UCL (use when n>=50))				7.046			95% Adjusted Gamma UCL (use when n<50)			7.344
327												
328							**Lognormal GOF Test**					
329				Shapiro Wilk Test Statistic		0.878		**Shapiro Wilk Lognormal GOF Test**				
330				5% Shapiro Wilk Critical Value		0.842		Data appear Lognormal at 5% Significance Level				
331				Lilliefors Test Statistic		0.207		**Lilliefors Lognormal GOF Test**				
332				5% Lilliefors Critical Value		0.28		Data appear Lognormal at 5% Significance Level				
333				**Data appear Lognormal at 5% Significance Level**								
334												
335							**Lognormal Statistics**					
336				Minimum of Logged Data		1.253			Mean of logged Data			1.655
337				Maximum of Logged Data		2.313			SD of logged Data			0.361
338												
339							**Assuming Lognormal Distribution**					
340				95% H-UCL		7.143			90% Chebyshev (MVUE) UCL			7.467
341				95% Chebyshev (MVUE) UCL		8.336			97.5% Chebyshev (MVUE) UCL			9.542
342				99% Chebyshev (MVUE) UCL		11.91						
343												
344						**Nonparametric Distribution Free UCL Statistics**						
345				**Data appear to follow a Discernible Distribution at 5% Significance Level**								
346												
347							**Nonparametric Distribution Free UCLs**					
348				95% CLT UCL		6.773			95% Jackknife UCL			6.909
349				95% Standard Bootstrap UCL		6.705			95% Bootstrap-t UCL			8.731
350				95% Hall's Bootstrap UCL		14.35			95% Percentile Bootstrap UCL			6.74
351				95% BCA Bootstrap UCL		7.02						
352				90% Chebyshev(Mean, Sd) UCL		7.756			95% Chebyshev(Mean, Sd) UCL			8.741
353				97.5% Chebyshev(Mean, Sd) UCL		10.11			99% Chebyshev(Mean, Sd) UCL			12.8
354												
355							**Suggested UCL to Use**					
356				95% Student's-t UCL		6.909						
357												
358		Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.										
359		These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)										
360		and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.										
361		For additional insight the user may want to consult a statistician.										
362												
363	**Nitrate**											
364												

	A	B	C	D	E	F	G	H	I	J	K	L
365							General Statistics					
366			Total Number of Observations			10			Number of Distinct Observations			10
367			Number of Detects			9			Number of Non-Detects			1
368			Number of Distinct Detects			9			Number of Distinct Non-Detects			1
369			Minimum Detect			0.085			Minimum Non-Detect			0.2
370			Maximum Detect			26			Maximum Non-Detect			0.2
371			Variance Detects			73.25			Percent Non-Detects			10%
372			Mean Detects			3.184			SD Detects			8.559
373			Median Detects			0.38			CV Detects			2.688
374			Skewness Detects			2.996			Kurtosis Detects			8.983
375			Mean of Logged Detects			-0.849			SD of Logged Detects			1.715
376												
377						Normal GOF Test on Detects Only						
378			Shapiro Wilk Test Statistic			0.413		Shapiro Wilk GOF Test				
379			5% Shapiro Wilk Critical Value			0.829		Detected Data Not Normal at 5% Significance Level				
380			Lilliefors Test Statistic			0.505		Lilliefors GOF Test				
381			5% Lilliefors Critical Value			0.295		Detected Data Not Normal at 5% Significance Level				
382						Detected Data Not Normal at 5% Significance Level						
383												
384					Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs							
385					Mean	2.879			Standard Error of Mean			2.586
386					SD	7.71			95% KM (BCA) UCL			8.019
387			95% KM (t) UCL			7.619			95% KM (Percentile Bootstrap) UCL			8.001
388			95% KM (z) UCL			7.132			95% KM Bootstrap t UCL			121.5
389			90% KM Chebyshev UCL			10.64			95% KM Chebyshev UCL			14.15
390			97.5% KM Chebyshev UCL			19.03			99% KM Chebyshev UCL			28.61
391												
392						Gamma GOF Tests on Detected Observations Only						
393			A-D Test Statistic			1.689		Anderson-Darling GOF Test				
394			5% A-D Critical Value			0.801		Detected Data Not Gamma Distributed at 5% Significance Level				
395			K-S Test Statistic			0.44		Kolmogrov-Smirnoff GOF				
396			5% K-S Critical Value			0.3		Detected Data Not Gamma Distributed at 5% Significance Level				
397						Detected Data Not Gamma Distributed at 5% Significance Level						
398												
399						Gamma Statistics on Detected Data Only						
400			k hat (MLE)			0.337			k star (bias corrected MLE)			0.299
401			Theta hat (MLE)			9.447			Theta star (bias corrected MLE)			10.66
402			nu hat (MLE)			6.067			nu star (bias corrected)			5.378
403			MLE Mean (bias corrected)			3.184			MLE Sd (bias corrected)			5.825
404												
405						Gamma Kaplan-Meier (KM) Statistics						
406			k hat (KM)			0.139			nu hat (KM)			2.788
407			Approximate Chi Square Value (2.79, α)			0.313			Adjusted Chi Square Value (2.79, β)			0.214
408		95% Gamma Approximate KM-UCL (use when n>=50)				25.68		95% Gamma Adjusted KM-UCL (use when n<50)				37.56
409												
410						Gamma ROS Statistics using Imputed Non-Detects						
411				GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs								
412				GROS may not be used when kstar of detected data is small such as < 0.1								
413				For such situations, GROS method tends to yield inflated values of UCLs and BTVs								
414		For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates										
415					Minimum	0.01			Mean			2.867
416					Maximum	26			Median			0.285

	A	B	C	D	E	F	G	H	I	J	K	L
417					SD	8.132					CV	2.837
418					k hat (MLE)	0.302				k star (bias corrected MLE)		0.278
419					Theta hat (MLE)	9.482				Theta star (bias corrected MLE)		10.3
420					nu hat (MLE)	6.046				nu star (bias corrected)		5.566
421			MLE Mean (bias corrected)			2.867				MLE Sd (bias corrected)		5.434
422										Adjusted Level of Significance (β)		0.0267
423			Approximate Chi Square Value (5.57, α)			1.422				Adjusted Chi Square Value (5.57, β)		1.092
424			95% Gamma Approximate UCL (use when n>=50)			11.22			95% Gamma Adjusted UCL (use when n<50)			14.61
425												
426						Lognormal GOF Test on Detected Observations Only						
427			Shapiro Wilk Test Statistic			0.792			Shapiro Wilk GOF Test			
428			5% Shapiro Wilk Critical Value			0.829			Detected Data Not Lognormal at 5% Significance Level			
429			Lilliefors Test Statistic			0.289			Lilliefors GOF Test			
430			5% Lilliefors Critical Value			0.295			Detected Data appear Lognormal at 5% Significance Level			
431				Detected Data appear Approximate Lognormal at 5% Significance Level								
432												
433						Lognormal ROS Statistics Using Imputed Non-Detects						
434			Mean in Original Scale			2.877				Mean in Log Scale		-0.977
435			SD in Original Scale			8.127				SD in Log Scale		1.666
436			95% t UCL (assumes normality of ROS data)			7.589			95% Percentile Bootstrap UCL			7.984
437			95% BCA Bootstrap UCL			10.62				95% Bootstrap t UCL		118.9
438			95% H-UCL (Log ROS)			19.37						
439												
440			UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed									
441			KM Mean (logged)			-0.972				95% H-UCL (KM -Log)		13.31
442			KM SD (logged)			1.58				95% Critical H Value (KM-Log)		4.392
443			KM Standard Error of Mean (logged)			0.531						
444												
445						DL/2 Statistics						
446			DL/2 Normal						DL/2 Log-Transformed			
447			Mean in Original Scale			2.876				Mean in Log Scale		-0.995
448			SD in Original Scale			8.128				SD in Log Scale		1.681
449			95% t UCL (Assumes normality)			7.587				95% H-Stat UCL		20.32
450			DL/2 is not a recommended method, provided for comparisons and historical reasons									
451												
452						Nonparametric Distribution Free UCL Statistics						
453			Detected Data appear Approximate Lognormal Distributed at 5% Significance Level									
454												
455						Suggested UCL to Use						
456			99% KM (Chebyshev) UCL			28.61						
457					Warning: Recommended UCL exceeds the maximum observation							
458												
459			Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.									
460			Recommendations are based upon data size, data distribution, and skewness.									
461			These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).									
462			However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.									
463												
464	Plutonium-239/240											
465												
466						General Statistics						
467			Total Number of Observations			14				Number of Distinct Observations		14
468			Number of Detects			12				Number of Non-Detects		2

	A	B	C	D	E	F	G	H	I	J	K	L
469				Number of Distinct Detects		12				Number of Distinct Non-Detects		2
470				Minimum Detect		0.0169				Minimum Non-Detect		0.002
471				Maximum Detect		8.22				Maximum Non-Detect		0.013
472				Variance Detects		8.789				Percent Non-Detects		14.29%
473				Mean Detects		1.854				SD Detects		2.965
474				Median Detects		0.638				CV Detects		1.599
475				Skewness Detects		1.92				Kurtosis Detects		2.287
476				Mean of Logged Detects		-0.581				SD of Logged Detects		1.777
477												
478					Normal GOF Test on Detects Only							
479			Shapiro Wilk Test Statistic			0.617		Shapiro Wilk GOF Test				
480			5% Shapiro Wilk Critical Value			0.859		Detected Data Not Normal at 5% Significance Level				
481			Lilliefors Test Statistic			0.343		Lilliefors GOF Test				
482			5% Lilliefors Critical Value			0.256		Detected Data Not Normal at 5% Significance Level				
483				Detected Data Not Normal at 5% Significance Level								
484												
485				Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs								
486					Mean	1.589				Standard Error of Mean		0.756
487					SD	2.707				95% KM (BCA) UCL		2.876
488				95% KM (t) UCL		2.927				95% KM (Percentile Bootstrap) UCL		2.803
489				95% KM (z) UCL		2.832				95% KM Bootstrap t UCL		7.542
490				90% KM Chebyshev UCL		3.856				95% KM Chebyshev UCL		4.883
491				97.5% KM Chebyshev UCL		6.308				99% KM Chebyshev UCL		9.107
492												
493					Gamma GOF Tests on Detected Observations Only							
494				A-D Test Statistic		0.512		Anderson-Darling GOF Test				
495				5% A-D Critical Value		0.783		Detected data appear Gamma Distributed at 5% Significance Level				
496				K-S Test Statistic		0.175		Kolmogrov-Smirnoff GOF				
497				5% K-S Critical Value		0.258		Detected data appear Gamma Distributed at 5% Significance Level				
498				Detected data appear Gamma Distributed at 5% Significance Level								
499												
500					Gamma Statistics on Detected Data Only							
501				k hat (MLE)		0.526				k star (bias corrected MLE)		0.45
502				Theta hat (MLE)		3.524				Theta star (bias corrected MLE)		4.119
503				nu hat (MLE)		12.63				nu star (bias corrected)		10.8
504				MLE Mean (bias corrected)		1.854				MLE Sd (bias corrected)		2.763
505												
506					Gamma Kaplan-Meier (KM) Statistics							
507				k hat (KM)		0.345				nu hat (KM)		9.653
508			Approximate Chi Square Value (9.65, α)			3.726				Adjusted Chi Square Value (9.65, β)		3.253
509		95% Gamma Approximate KM-UCL (use when n>=50)				4.117			95% Gamma Adjusted KM-UCL (use when n<50)			4.716
510												
511					Gamma ROS Statistics using Imputed Non-Detects							
512			GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs									
513			GROS may not be used when kstar of detected data is small such as < 0.1									
514			For such situations, GROS method tends to yield inflated values of UCLs and BTVs									
515		For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates										
516					Minimum	0.01				Mean		1.59
517					Maximum	8.22				Median		0.439
518					SD	2.808				CV		1.766
519					k hat (MLE)	0.405				k star (bias corrected MLE)		0.366
520				Theta hat (MLE)		3.923				Theta star (bias corrected MLE)		4.343

	A	B	C	D	E	F	G	H	I	J	K	L
521					nu hat (MLE)	11.35				nu star (bias corrected)		10.25
522				MLE Mean (bias corrected)		1.59				MLE Sd (bias corrected)		2.628
523										Adjusted Level of Significance (β)		0.0312
524				Approximate Chi Square Value (10.25, α)		4.1				Adjusted Chi Square Value (10.25, β)		3.598
525				95% Gamma Approximate UCL (use when n>=50)		3.977				95% Gamma Adjusted UCL (use when n<50)		4.531
526												
527				Lognormal GOF Test on Detected Observations Only								
528				Shapiro Wilk Test Statistic		0.968		Shapiro Wilk GOF Test				
529				5% Shapiro Wilk Critical Value		0.859		Detected Data appear Lognormal at 5% Significance Level				
530				Lilliefors Test Statistic		0.102		Lilliefors GOF Test				
531				5% Lilliefors Critical Value		0.256		Detected Data appear Lognormal at 5% Significance Level				
532				Detected Data appear Lognormal at 5% Significance Level								
533												
534				Lognormal ROS Statistics Using Imputed Non-Detects								
535				Mean in Original Scale		1.59				Mean in Log Scale		-1.173
536				SD in Original Scale		2.808				SD in Log Scale		2.222
537				95% t UCL (assumes normality of ROS data)		2.919				95% Percentile Bootstrap UCL		2.909
538				95% BCA Bootstrap UCL		3.378				95% Bootstrap t UCL		7.408
539				95% H-UCL (Log ROS)		85.83						
540												
541				UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed								
542				KM Mean (logged)		-1.386				95% H-UCL (KM -Log)		337.2
543				KM SD (logged)		2.524				95% Critical H Value (KM-Log)		5.747
544				KM Standard Error of Mean (logged)		0.704						
545												
546				DL/2 Statistics								
547			DL/2 Normal					DL/2 Log-Transformed				
548				Mean in Original Scale		1.589				Mean in Log Scale		-1.351
549				SD in Original Scale		2.809				SD in Log Scale		2.577
550				95% t UCL (Assumes normality)		2.919				95% H-Stat UCL		471
551				DL/2 is not a recommended method, provided for comparisons and historical reasons								
552												
553				Nonparametric Distribution Free UCL Statistics								
554				Detected Data appear Gamma Distributed at 5% Significance Level								
555												
556				Suggested UCL to Use								
557				95% KM (Chebyshev) UCL		4.883			95% GROS Adjusted Gamma UCL			4.531
558				95% Adjusted Gamma KM-UCL		4.716						
559												
560			Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.									
561			Recommendations are based upon data size, data distribution, and skewness.									
562			These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).									
563			However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.									
564												