

	A	B	C	D	E	F	G	H	I	J	K	L
1	UCL Statistics for Data Sets with Non-Detects											
2												
3	User Selected Options											
4	Time of Computation			8/13/2015 3:03:15 PM								
5	From File			ProUCLinput_C-14-006_0-5.xls								
6	Full Precision			OFF								
7	Confidence Coefficient			95%								
8	Bootstrap Operations			2000								
9												
10	Antimony											
11												
12	General Statistics											
13	Total Number of Observations				10		Number of Distinct Observations				10	
14	Number of Detects				8		Number of Non-Detects				2	
15	Number of Distinct Detects				8		Number of Distinct Non-Detects				2	
16	Minimum Detect				0.39		Minimum Non-Detect				1.17	
17	Maximum Detect				1.1		Maximum Non-Detect				1.27	
18	Variance Detects				0.074		Percent Non-Detects				20%	
19	Mean Detects				0.75		SD Detects				0.27	
20	Median Detects				0.73		CV Detects				0.36	
21	Skewness Detects				0.11		Kurtosis Detects				-1.87	
22	Mean of Logged Detects				-0.34		SD of Logged Detects				0.38	
23												
24	Normal GOF Test on Detects Only											
25	Shapiro Wilk Test Statistic				0.9		Shapiro Wilk GOF Test					
26	5% Shapiro Wilk Critical Value				0.81		Detected Data appear Normal at 5% Significance Level					
27	Lilliefors Test Statistic				0.21		Lilliefors GOF Test					
28	5% Lilliefors Critical Value				0.31		Detected Data appear Normal at 5% Significance Level					
29	Detected Data appear Normal at 5% Significance Level											
30												
31	Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs											
32	Mean				0.75		Standard Error of Mean				0.091	
33	SD				0.25		95% KM (BCA) UCL				0.91	
34	95% KM (t) UCL				0.93		95% KM (Percentile Bootstrap) UCL				0.91	
35	95% KM (z) UCL				0.91		95% KM Bootstrap t UCL				0.96	
36	90% KM Chebyshev UCL				1.04		95% KM Chebyshev UCL				1.17	
37	97.5% KM Chebyshev UCL				1.36		99% KM Chebyshev UCL				1.71	
38												
39	Gamma GOF Tests on Detected Observations Only											
40	A-D Test Statistic				0.41		Anderson-Darling GOF Test					
41	5% A-D Critical Value				0.71		Detected data appear Gamma Distributed at 5% Significance Level					
42	K-S Test Statistic				0.20		Kolmogrov-Smirnoff GOF					
43	5% K-S Critical Value				0.29		Detected data appear Gamma Distributed at 5% Significance Level					
44	Detected data appear Gamma Distributed at 5% Significance Level											
45												
46	Gamma Statistics on Detected Data Only											
47	k hat (MLE)				8.33		k star (bias corrected MLE)				5.29	
48	Theta hat (MLE)				0.091		Theta star (bias corrected MLE)				0.14	
49	nu hat (MLE)				133.3		nu star (bias corrected)				84.6	
50	MLE Mean (bias corrected)				0.75		MLE Sd (bias corrected)				0.32	
51												
52	Gamma Kaplan-Meier (KM) Statistics											
53	k hat (KM)				8.74		nu hat (KM)				175	
54	Approximate Chi Square Value (174.97, $\alpha$ )				145.4		Adjusted Chi Square Value (174.97, $\beta$ )				140.7	
55	Approximate KM-UCL (use when n>=50)				0.91		Gamma Adjusted KM-UCL (use when n<50)				0.94	
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	Gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimate											
62	Minimum				0.39		Mean				0.75	
63	Maximum				1.1		Median				0.73	

	A	B	C	D	E	F	G	H	I	J	K	L
64					SD	0.24					CV	0.32
65					k hat (MLE)	10.30					k star (bias corrected MLE)	7.32
66					Theta hat (MLE)	0.072					Theta star (bias corrected MLE)	0.10
67					nu hat (MLE)	207.2					nu star (bias corrected)	146.4
68					MLE Mean (bias corrected)	0.75					MLE Sd (bias corrected)	0.27
69											Adjusted Level of Significance ( $\beta$ )	0.02
70					Approximate Chi Square Value (146.40, $\alpha$ )	119.4					Adjusted Chi Square Value (146.40, $\beta$ )	115.2
71					Gamma Approximate UCL (use when n>=50)	0.92					Gamma Adjusted UCL (use when n<50)	0.95
72												
73					Lognormal GOF Test on Detected Observations Only							
74					Shapiro Wilk Test Statistic	0.91					Shapiro Wilk GOF Test	
75					5% Shapiro Wilk Critical Value	0.81					Detected Data appear Lognormal at 5% Significance Level	
76					Lilliefors Test Statistic	0.20					Lilliefors GOF Test	
77					5% Lilliefors Critical Value	0.31					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	0.74					Mean in Log Scale	-0.34
82					SD in Original Scale	0.24					SD in Log Scale	0.33
83					95% t UCL (assumes normality of ROS data)	0.88					95% Percentile Bootstrap UCL	0.87
84					95% BCA Bootstrap UCL	0.88					95% Bootstrap t UCL	0.89
85					95% H-UCL (Log ROS)	0.94						
86												
87					UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed							
88					KM Mean (logged)	-0.34					95% H-UCL (KM -Log)	0.96
89					KM SD (logged)	0.35					95% Critical H Value (KM-Log)	2.03
90					KM Standard Error of Mean (logged)	0.13						
91												
92					DL/2 Statistics							
93					DL/2 Normal						DL/2 Log-Transformed	
94					Mean in Original Scale	0.72					Mean in Log Scale	-0.37
95					SD in Original Scale	0.24					SD in Log Scale	0.34
96					95% t UCL (Assumes normality)	0.87					95% H-Stat UCL	0.92
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 Normal Distributed at 5% Significance Level							
101												
102					Suggested UCL to Use							
103					95% KM (t) UCL	0.93					95% KM (Percentile Bootstrap) UCL	0.91
104												
105					Recommendations regarding the selection of a 95% UCL are provided to help the user to select the most appropriate							
106					Recommendations are based upon data size, data distribution, and skewness.							
107					Recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and							
108					Recommendations results will not cover all Real World data sets; for additional insight the user may want to consult							
109												
110												
111					Chromium							
112												
113					General Statistics							
114					Total Number of Observations	10					Number of Distinct Observations	10
115											Number of Missing Observations	0
116					Minimum	9.33					Mean	11.9
117					Maximum	20.7					Median	10.9
118					SD	3.37					Std. Error of Mean	1.06
119					Coefficient of Variation	0.28					Skewness	2.24
120												
121					Normal GOF Test							
122					Shapiro Wilk Test Statistic	0.73					Shapiro Wilk GOF Test	
123					5% Shapiro Wilk Critical Value	0.84					Data Not Normal at 5% Significance Level	
124					Lilliefors Test Statistic	0.23					Lilliefors GOF Test	
125					5% Lilliefors Critical Value	0.28					Data appear Normal at 5% Significance Level	
126					Data appear Approximate Normal at 5% Significance Level							

	A	B	C	D	E	F	G	H	I	J	K	L
127												
128	Assuming Normal Distribution											
129	95% Normal UCL						95% UCLs (Adjusted for Skewness)					
130	95% Student's-t UCL					13.93	95% Adjusted-CLT UCL (Chen-1995)					14.54
131							95% Modified-t UCL (Johnson-1978)					14.04
132												
133	Gamma GOF Test											
134	A-D Test Statistic					0.80	Anderson-Darling Gamma GOF Test					
135	5% A-D Critical Value					0.72	Data Not Gamma Distributed at 5% Significance Level					
136	K-S Test Statistic					0.20	Kolmogrov-Smirnoff Gamma GOF Test					
137	5% K-S Critical Value					0.26	Data appear Gamma Distributed at 5% Significance Level					
138	Detected data follow Appr. Gamma Distribution at 5% Significance Level											
139												
140	Gamma Statistics											
141	k hat (MLE)					17.74	k star (bias corrected MLE)					12.53
142	Theta hat (MLE)					0.67	Theta star (bias corrected MLE)					0.95
143	nu hat (MLE)					355.7	nu star (bias corrected)					250.3
144	MLE Mean (bias corrected)					11.91	MLE Sd (bias corrected)					3.38
145							Approximate Chi Square Value (0.05)					214.7
146	Adjusted Level of Significance					0.024	Adjusted Chi Square Value					208.9
147												
148	Assuming Gamma Distribution											
149	Approximate Gamma UCL (use when n>=50))					13.93	Adjusted Gamma UCL (use when n<50)					14.34
150												
151	Lognormal GOF Test											
152	Shapiro Wilk Test Statistic					0.82	Shapiro Wilk Lognormal GOF Test					
153	5% Shapiro Wilk Critical Value					0.84	Data Not Lognormal at 5% Significance Level					
154	Lilliefors Test Statistic					0.19	Lilliefors Lognormal GOF Test					
155	5% Lilliefors Critical Value					0.28	Data appear Lognormal at 5% Significance Level					
156	Data appear Approximate Lognormal at 5% Significance Level											
157												
158	Lognormal Statistics											
159	Minimum of Logged Data					2.23	Mean of logged Data					2.45
160	Maximum of Logged Data					3.03	SD of logged Data					0.23
161												
162	Assuming Lognormal Distribution											
163	95% H-UCL					13.93	90% Chebyshev (MVUE) UCL					14.64
164	95% Chebyshev (MVUE) UCL					15.86	97.5% Chebyshev (MVUE) UCL					17.54
165	99% Chebyshev (MVUE) UCL					20.93						
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					13.73	95% Jackknife UCL					13.93
172	95% Standard Bootstrap UCL					13.66	95% Bootstrap-t UCL					16.64
173	95% Hall's Bootstrap UCL					21	95% Percentile Bootstrap UCL					13.73
174	95% BCA Bootstrap UCL					14.36						
175	90% Chebyshev(Mean, Sd) UCL					15.11	95% Chebyshev(Mean, Sd) UCL					16.64
176	97.5% Chebyshev(Mean, Sd) UCL					18.64	99% Chebyshev(Mean, Sd) UCL					22.64
177												
178	Suggested UCL to Use											
179	95% Student's-t UCL					13.93						
180												
181	Recommendations regarding the selection of a 95% UCL are provided to help the user to select the most appropriate											
182	Recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and											
183	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	TATB											
187												
188	General Statistics											
189	Total Number of Observations					10	Number of Distinct Observations					6

	A	B	C	D	E	F	G	H	I	J	K	L
190	Number of Detects					5	Number of Non-Detects					5
191	Number of Distinct Detects					5	Number of Distinct Non-Detects					1
192	Minimum Detect					0.40	Minimum Non-Detect					1
193	Maximum Detect					11.3	Maximum Non-Detect					1
194	Variance Detects					21.8	Percent Non-Detects					50%
195	Mean Detects					4.27	SD Detects					4.67
196	Median Detects					1.61	CV Detects					1.09
197	Skewness Detects					1.05	Kurtosis Detects					-0.55
198	Mean of Logged Detects					0.82	SD of Logged Detects					1.35
199												
200	Normal GOF Test on Detects Only											
201	Shapiro Wilk Test Statistic					0.84	Shapiro Wilk GOF Test					
202	5% Shapiro Wilk Critical Value					0.76	Detected Data appear Normal at 5% Significance Level					
203	Lilliefors Test Statistic					0.31	Lilliefors GOF Test					
204	5% Lilliefors Critical Value					0.39	Detected Data appear Normal at 5% Significance Level					
205	Detected Data appear Normal at 5% Significance Level											
206												
207	Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs											
208	Mean					2.33	Standard Error of Mean					1.24
209	SD					3.53	95% KM (BCA) UCL					4.63
210	95% KM (t) UCL					4.62	95% KM (Percentile Bootstrap) UCL					4.55
211	95% KM (z) UCL					4.39	95% KM Bootstrap t UCL					13.7
212	90% KM Chebyshev UCL					6.08	95% KM Chebyshev UCL					7.78
213	97.5% KM Chebyshev UCL					10.14	99% KM Chebyshev UCL					14.7
214												
215	Gamma GOF Tests on Detected Observations Only											
216	A-D Test Statistic					0.31	Anderson-Darling GOF Test					
217	5% A-D Critical Value					0.69	data appear Gamma Distributed at 5% Significance Level					
218	K-S Test Statistic					0.26	Kolmogrov-Smirnoff GOF					
219	5% K-S Critical Value					0.36	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)					0.92	k star (bias corrected MLE)					0.50
224	Theta hat (MLE)					4.63	Theta star (bias corrected MLE)					8.50
225	nu hat (MLE)					9.22	nu star (bias corrected)					5.02
226	MLE Mean (bias corrected)					4.27	MLE Sd (bias corrected)					6.02
227												
228	Gamma Kaplan-Meier (KM) Statistics											
229	k hat (KM)					0.43	nu hat (KM)					8.75
230	Approximate Chi Square Value (8.75, $\alpha$ )					3.17	Adjusted Chi Square Value (8.75, $\beta$ )					2.62
231	Approximate KM-UCL (use when n>=50)					6.43	Gamma Adjusted KM-UCL (use when n<50)					7.8
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	Gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimate											
238	Minimum					0.01	Mean					2.15
239	Maximum					11.3	Median					0.29
240	SD					3.83	CV					1.77
241	k hat (MLE)					0.29	k star (bias corrected MLE)					0.27
242	Theta hat (MLE)					7.38	Theta star (bias corrected MLE)					7.95
243	nu hat (MLE)					5.85	nu star (bias corrected)					5.42
244	MLE Mean (bias corrected)					2.15	MLE Sd (bias corrected)					4.14
245							Adjusted Level of Significance ( $\beta$ )					0.02
246	Approximate Chi Square Value (5.43, $\alpha$ )					1.35	Adjusted Chi Square Value (5.43, $\beta$ )					1.03
247	Gamma Approximate UCL (use when n>=50)					8.64	Gamma Adjusted UCL (use when n<50)					11.3
248												
249	Lognormal GOF Test on Detected Observations Only											
250	Shapiro Wilk Test Statistic					0.95	Shapiro Wilk GOF Test					
251	5% Shapiro Wilk Critical Value					0.76	Detected Data appear Lognormal at 5% Significance Level					
252	Lilliefors Test Statistic					0.2	Lilliefors GOF Test					

	A	B	C	D	E	F	G	H	I	J	K	L
253	5% Lilliefors Critical Value				0.39	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				2.31	Mean in Log Scale				-0.23		
258	SD in Original Scale				3.74	SD in Log Scale				1.54		
259	95% t UCL (assumes normality of ROS data)				4.48	95% Percentile Bootstrap UCL				4.35		
260	95% BCA Bootstrap UCL				5.03	95% Bootstrap t UCL				14.9		
261	95% H-UCL (Log ROS)				24.39							
262												
263	DLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed											
264	KM Mean (logged)				-0.043	95% H-UCL (KM -Log)				8.45		
265	KM SD (logged)				1.21	95% Critical H Value (KM-Log)				3.56		
266	KM Standard Error of Mean (logged)				0.42							
267												
268	DL/2 Statistics											
269	DL/2 Normal					DL/2 Log-Transformed						
270	Mean in Original Scale				2.38	Mean in Log Scale				0.06		
271	SD in Original Scale				3.69	SD in Log Scale				1.20		
272	95% t UCL (Assumes normality)				4.52	95% H-Stat UCL				9.05		
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 Normal Distributed at 5% Significance Level											
277												
278	Suggested UCL to Use											
279	95% KM (t) UCL				4.62	95% KM (Percentile Bootstrap) UCL				4.55		
280												
281	Recommendations regarding the selection of a 95% UCL are provided to help the user to select the most appropriate UCL.											
282	Recommendations are based upon data size, data distribution, and skewness.											
283	Recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and											
284	Singh. Recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and											
285	Singh. Recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and											
286												
287	Uranium											
288												
289	General Statistics											
290	Total Number of Observations				10	Number of Distinct Observations				9		
291						Number of Missing Observations				0		
292	Minimum				0.52	Mean				1.11		
293	Maximum				1.94	Median				1.12		
294	SD				0.37	Std. Error of Mean				0.12		
295	Coefficient of Variation				0.33	Skewness				0.75		
296												
297	Normal GOF Test											
298	Shapiro Wilk Test Statistic				0.92	Shapiro Wilk GOF Test						
299	5% Shapiro Wilk Critical Value				0.84	Data appear Normal at 5% Significance Level						
300	Lilliefors Test Statistic				0.23	Lilliefors GOF Test						
301	5% Lilliefors Critical Value				0.28	Data appear Normal at 5% Significance Level						
302	Data appear Normal at 5% Significance Level											
303												
304	Assuming Normal Distribution											
305	95% Normal UCL					95% UCLs (Adjusted for Skewness)						
306	95% Student's-t UCL				1.33	95% Adjusted-CLT UCL (Chen-1995)				1.34		
307						95% Modified-t UCL (Johnson-1978)				1.34		
308												
309	Gamma GOF Test											
310	A-D Test Statistic				0.34	Anderson-Darling Gamma GOF Test						
311	5% A-D Critical Value				0.72	Data appear Gamma Distributed at 5% Significance Level						
312	K-S Test Statistic				0.19	Kolmogorov-Smirnov Gamma GOF Test						
313	5% K-S Critical Value				0.26	Data appear Gamma Distributed at 5% Significance Level						
314	Detected data appear Gamma Distributed at 5% Significance Level											
315												

	A	B	C	D	E	F	G	H	I	J	K	L
316	<b>Gamma Statistics</b>											
317	k hat (MLE)				9.51	k star (bias corrected MLE)				6.72		
318	Theta hat (MLE)				0.11	Theta star (bias corrected MLE)				0.16		
319	nu hat (MLE)				190.4	nu star (bias corrected)				134.6		
320	MLE Mean (bias corrected)				1.11	MLE Sd (bias corrected)				0.43		
321						Approximate Chi Square Value (0.05)				108.8		
322	Adjusted Level of Significance				0.02	Adjusted Chi Square Value				104.8		
323												
324	<b>Assuming Gamma Distribution</b>											
325	Approximate Gamma UCL (use when n>=50))				1.38	Adjusted Gamma UCL (use when n<50)				1.43		
326												
327	<b>Lognormal GOF Test</b>											
328	Shapiro Wilk Test Statistic				0.94	<b>Shapiro Wilk Lognormal GOF Test</b>						
329	5% Shapiro Wilk Critical Value				0.84	Data appear Lognormal at 5% Significance Level						
330	Lilliefors Test Statistic				0.19	<b>Lilliefors Lognormal GOF Test</b>						
331	5% Lilliefors Critical Value				0.28	Data appear Lognormal at 5% Significance Level						
332	<b>Data appear Lognormal at 5% Significance Level</b>											
333												
334	<b>Lognormal Statistics</b>											
335	Minimum of Logged Data				-0.64	Mean of logged Data				0.05		
336	Maximum of Logged Data				0.66	SD of logged Data				0.35		
337												
338	<b>Assuming Lognormal Distribution</b>											
339	95% H-UCL				1.43	90% Chebyshev (MVUE) UCL				1.49		
340	95% Chebyshev (MVUE) UCL				1.66	97.5% Chebyshev (MVUE) UCL				1.90		
341	99% Chebyshev (MVUE) UCL				2.37							
342												
343	<b>Nonparametric Distribution Free UCL Statistics</b>											
344	<b>Data appear to follow a Discernible Distribution at 5% Significance Level</b>											
345												
346	<b>Nonparametric Distribution Free UCLs</b>											
347	95% CLT UCL				1.31	95% Jackknife UCL				1.33		
348	95% Standard Bootstrap UCL				1.30	95% Bootstrap-t UCL				1.37		
349	95% Hall's Bootstrap UCL				1.47	95% Percentile Bootstrap UCL				1.31		
350	95% BCA Bootstrap UCL				1.33							
351	90% Chebyshev(Mean, Sd) UCL				1.47	95% Chebyshev(Mean, Sd) UCL				1.63		
352	97.5% Chebyshev(Mean, Sd) UCL				1.86	99% Chebyshev(Mean, Sd) UCL				2.30		
353												
354	<b>Suggested UCL to Use</b>											
355	95% Student's-t UCL				1.33							
356												
357	ptions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate											
358	ommendations are based upon the results of the simulation studies summarized in Singh, Singh, and											
359	and Singh and Singh (2003). However, simulations results will not cover all Real World data sets											
360	For additional insight the user may want to consult a statistician.											
361												