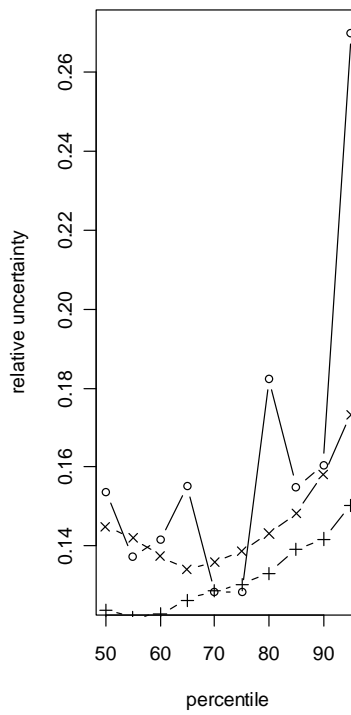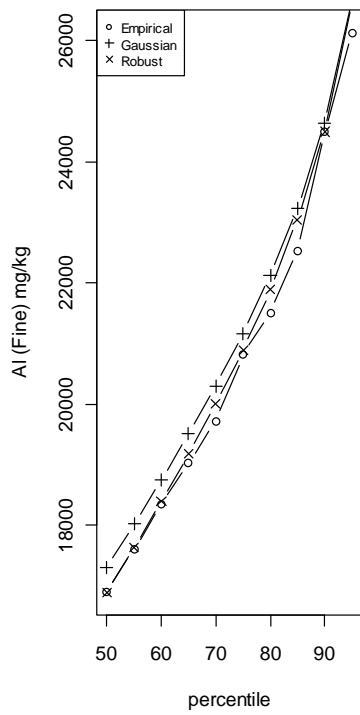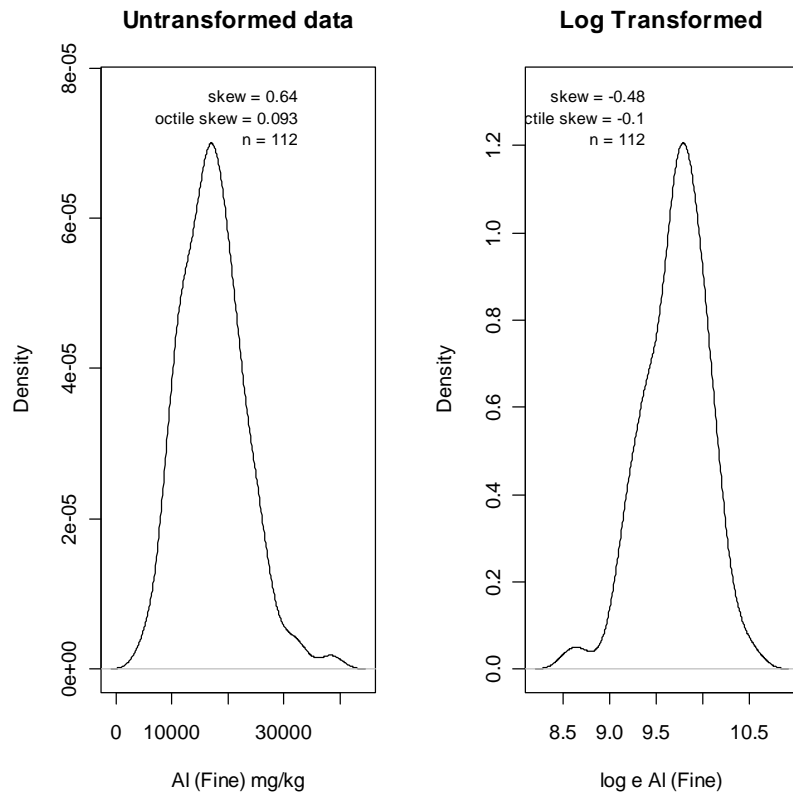# APPENDIX G

BRITISH GEOLOGICAL SURVEY NORMAL BACKGROUND
CONCENTRATION (NBC) CALCULATION RESULTS

Untransformed data

Density

8e-05

6e-05

4e-05

2e-05

0e+00

skew = 0.64
octile skew = 0.093
n = 112

0   10000   30000

Al (Fine) mg/kg

Log Transformed

Density

1.2

1.0

0.8

0.6

0.4

0.2

0.0

skew = -0.48
octile skew = -0.1
n = 112

8.5 9.0 9.5   10.5

log e Al (Fine)

Al (Fine) mg/kg

26000

24000

22000

20000

18000

○ Empirical
+ Gaussian
× Robust

50   60   70   80   90

percentile

relative uncertainty

0.26

0.24

0.22

0.20

0.18

0.16

0.14

50   60   70   80   90

percentile

Aluminum – Page 1

Al (Fine) MT Background domain

NBC= 26000 mg/kg
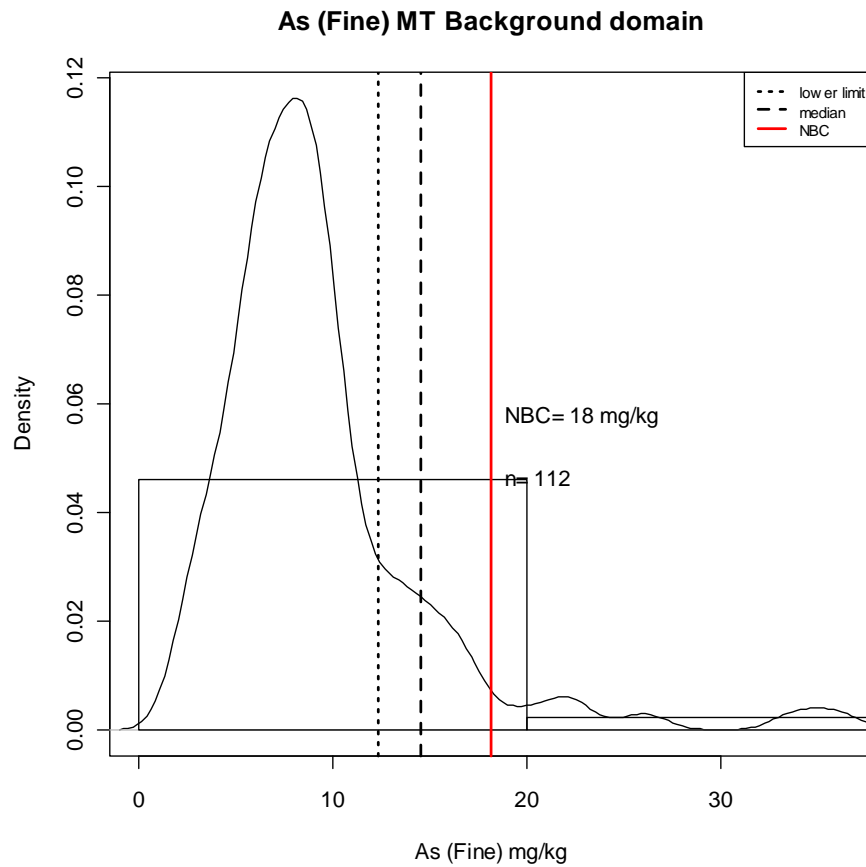
n= 112

NOTE: *R-Script modified to denote upper 95% confidence limit on 90th percentile as NBC*

Percentile	Empirical	E L	E H	Theoretical	T L	T H	Robust	R L	R H
50	16900	15700	18297	17305	16248	18391	16900	15700	18149
55	17600	16400	18820	18024	16937	19136	17645	16361	18869
60	18360	16900	19500	18755	17585	19889	18402	17033	19564
65	19030	17645	20600	19510	18259	20725	19185	17728	20299
70	19710	18470	21000	20306	18984	21599	20010	18443	21165
75	20825	19200	21875	21164	19767	22523	20900	19200	22100
80	21500	19980	23900	22121	20601	23547	21891	20042	23177
85	22540	21105	24600	23235	21569	24804	23046	21003	24422
90	24490	22071	26000	24638	22841	*26335*	24500	22140	26015
95	26135	24446	31500	26716	24628	28643	26655	23816	28433

L = lower confidence limit around given percentile; H = upper confidence limit around given percentile

Untransformed data

Density

skew = 5.2
octile skew = 0.34
n = 112

As (Fine) mg/kg

Log Transformed

Density

skew = 1.2
octile skew = 0.075
n = 112

log e As (Fine)

- ○ Empirical
- + Gaussian
- × Robust

As (Fine) mg/kg

percentile

relative uncertainty

percentile

As (Fine) MT Background domain
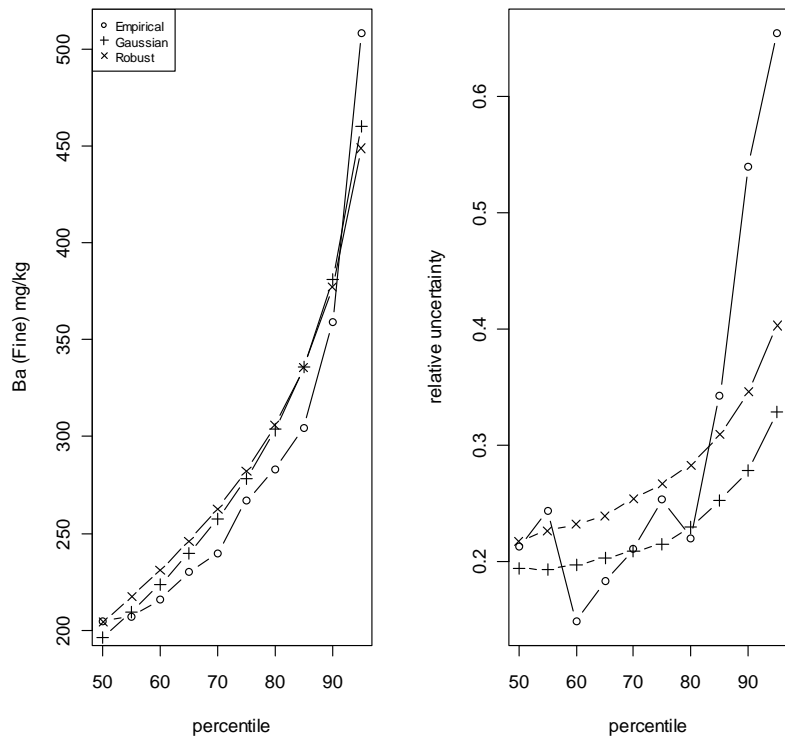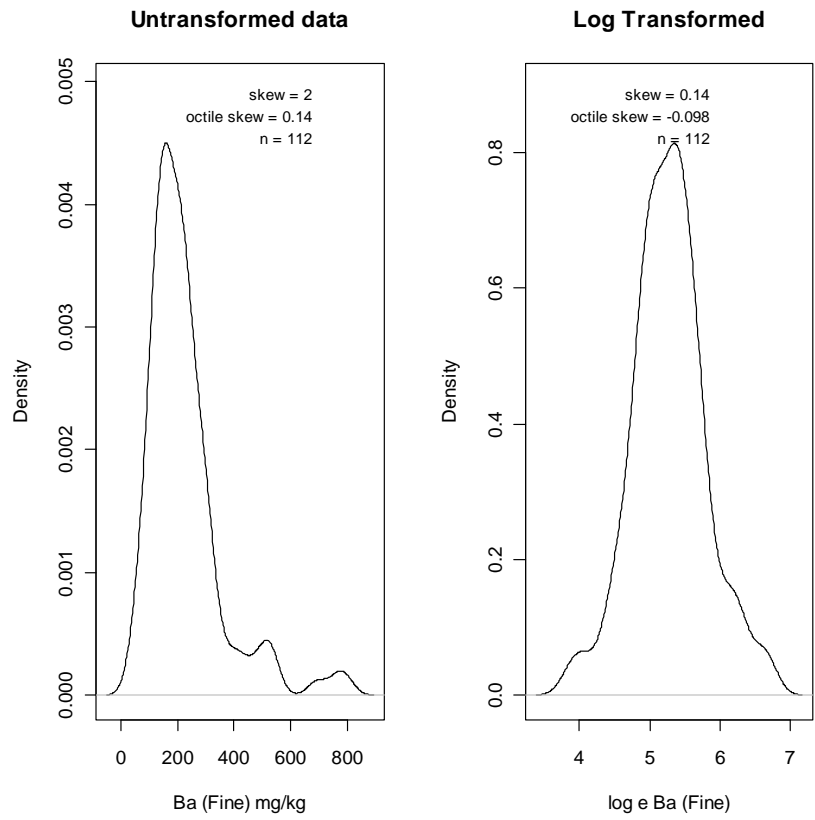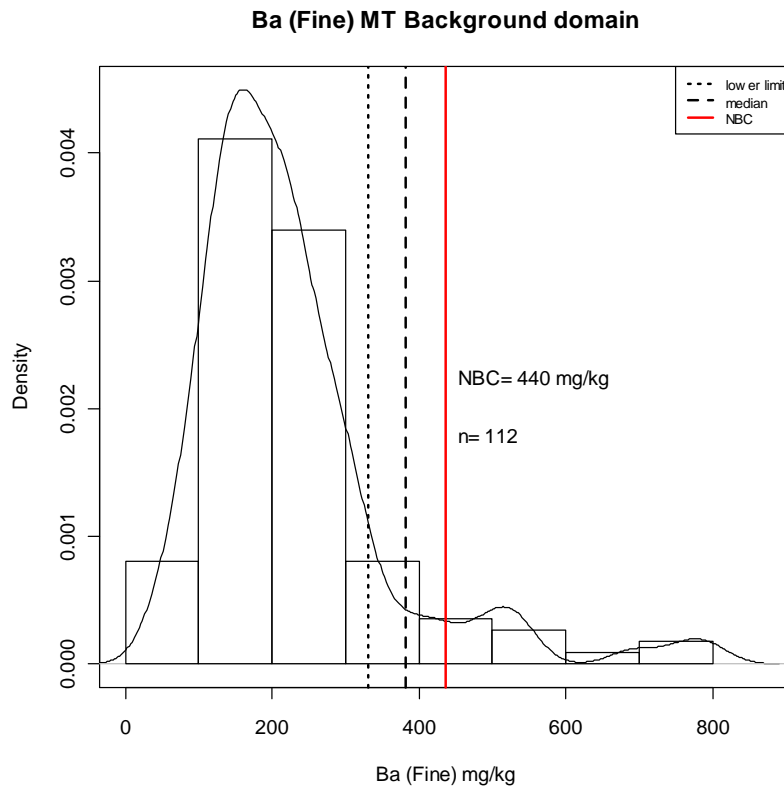

NBC= 18 mg/kg

n= 112

As (Fine) mg/kg
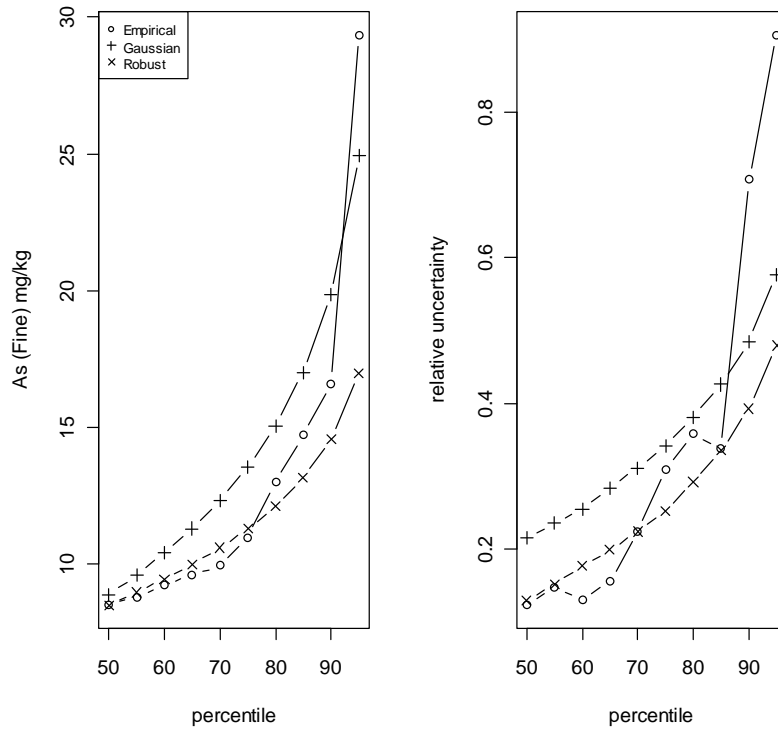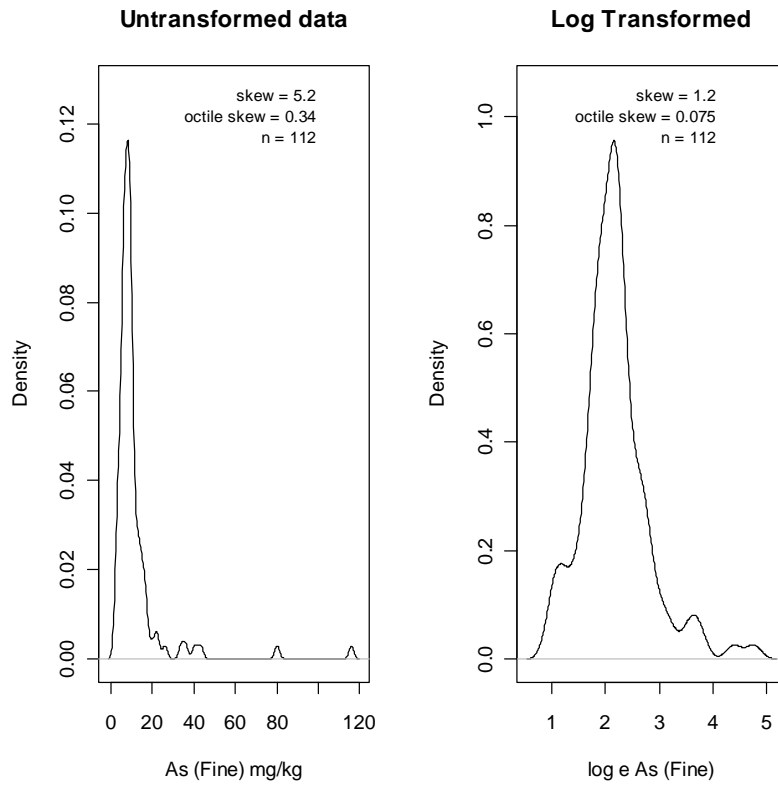
NOTE: R-Script modified to denote upper 95% confidence limit on 90th percentile as NBC

Percentile	Empirical	E L	E H	Theoretical	T L	T H	Robust	R L	R H
50	8.5	8.0	9.0	8.9	7.9	10.1	8.5	8.0	9.2
55	8.8	8.2	9.5	9.6	8.4	11.0	9.0	8.4	9.7
60	9.2	8.5	9.8	10.4	9.1	12.0	9.5	8.8	10.4
65	9.6	8.8	10.8	11.3	9.7	13.2	10.0	9.2	11.2
70	9.9	9.4	12.2	12.3	10.5	14.6	10.6	9.6	12.0
75	11.0	9.6	13.7	13.6	11.3	16.3	11.3	10.0	13.0
80	13.0	10.0	15.3	15.1	12.3	18.4	12.1	10.7	14.2
85	14.7	11.6	17.1	17.0	13.7	21.4	13.1	11.4	15.9
90	16.6	13.6	25.7	19.8	15.5	25.8	14.6	12.4	***18.2***
95	29.4	16.6	43.3	24.9	18.7	34.1	17.0	13.9	22.2

L = lower confidence limit around given percentile; H = upper confidence limit around given percentile

Untransformed data

Density

skew = 2
octile skew = 0.14
n = 112

Ba (Fine) mg/kg

Log Transformed

Density

skew = 0.14
octile skew = -0.098
n = 112

log e Ba (Fine)

Ba (Fine) mg/kg

o Empirical
+ Gaussian
x Robust

percentile

relative uncertainty

percentile

Ba (Fine) MT Background domain
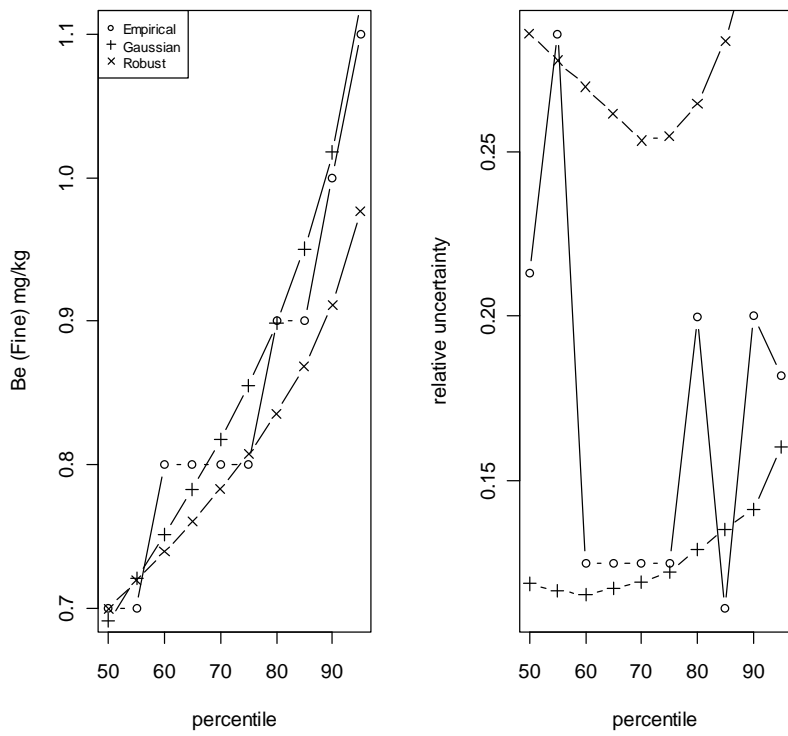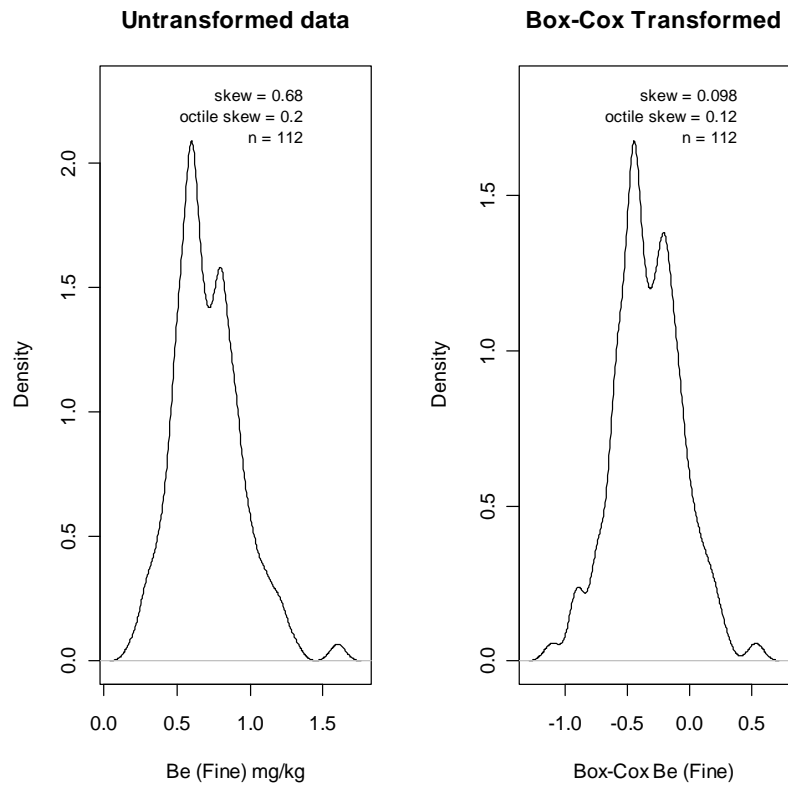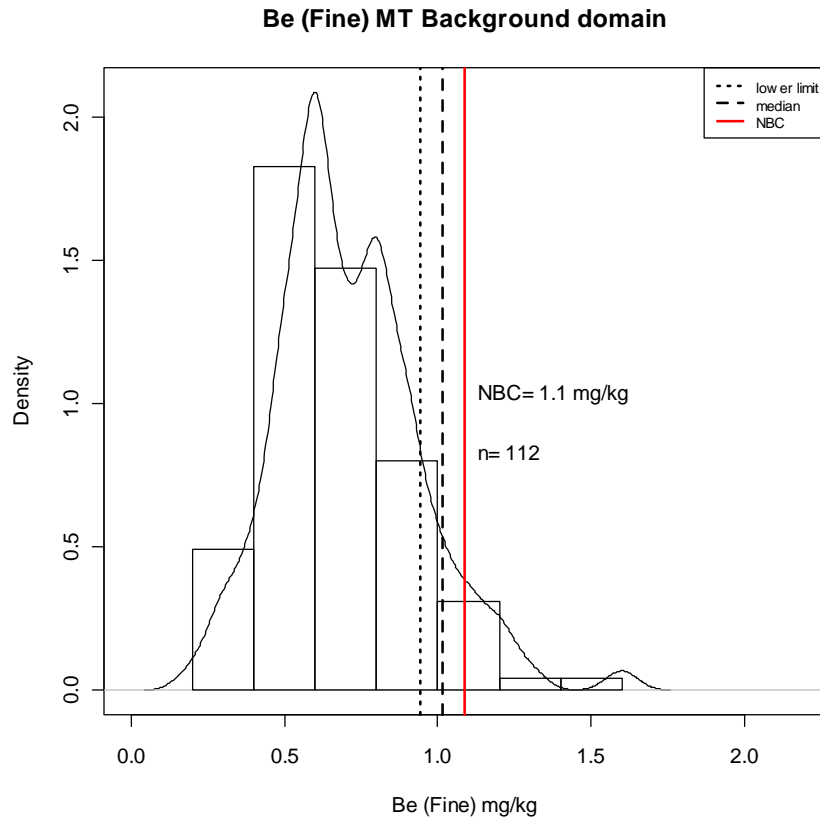

NBC= 440 mg/kg

n= 112

NOTE: R-Script modified to denote upper 95% confidence limit on 90th percentile as NBC

Percentile	Empirical	E L	E H	Theoretical	T L	T H	Robust	R L	R H
50	204	169	213	196	179	216	204	169	213
55	207	179	229	209	191	230	217	179	227
60	216	205	236	224	203	246	231	189	242
65	230	208	255	240	217	264	246	200	259
70	240	224	275	258	232	286	263	212	279
75	267	230	297	278	250	310	282	225	303
80	283	247	308	304	270	340	306	242	331
85	304	274	373	336	295	379	336	262	366
90	359	302	494	381	330	***437***	377	288	416
95	508	354	693	460	391	539	449	332	506

L = lower confidence limit around given percentile; H = upper confidence limit around given percentile

Untransformed data

skew = 0.68
octile skew = 0.2
n = 112

Density

Be (Fine) mg/kg

Box-Cox Transformed

skew = 0.098
octile skew = 0.12
n = 112

Density

Box-Cox Be (Fine)

○ Empirical
+ Gaussian
× Robust

Be (Fine) mg/kg

percentile

relative uncertainty

percentile

Be (Fine) MT Background domain

- - - - lower limit
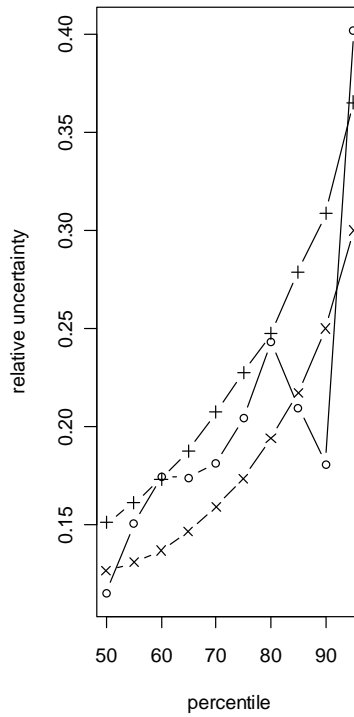- - - median
—— NBC

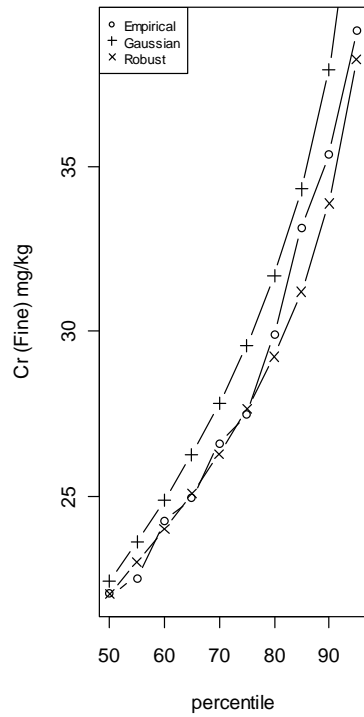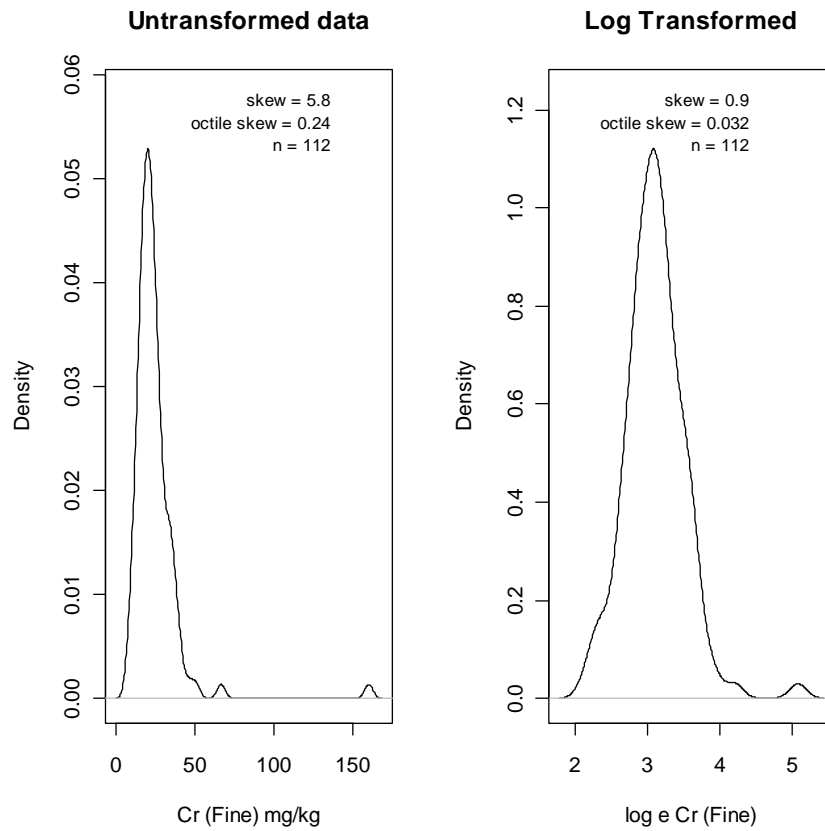NBC= 1.1 mg/kg

n= 112

Density

Be (Fine) mg/kg

NOTE: R-Script modified to denote upper 95% confidence limit on 90th percentile as NBC

Percentile	Empirical	E L	E H	Theoretical	T L	T H	Robust	R L	R H
50	0.7	0.6	0.7	0.7	0.7	0.7	0.7	0.6	0.8
55	0.7	0.6	0.8	0.7	0.7	0.8	0.7	0.6	0.8
60	0.8	0.7	0.8	0.8	0.7	0.8	0.7	0.6	0.8
65	0.8	0.7	0.8	0.8	0.7	0.8	0.8	0.7	0.9
70	0.8	0.8	0.9	0.8	0.8	0.9	0.8	0.7	0.9
75	0.8	0.8	0.9	0.9	0.8	0.9	0.8	0.7	0.9
80	0.9	0.8	1.0	0.9	0.8	1.0	0.8	0.7	1.0
85	0.9	0.9	1.0	1.0	0.9	1.0	0.9	0.8	1.0
90	1.0	0.9	1.1	1.0	0.9	*1.1*	0.9	0.8	1.1
95	1.1	1.0	1.2	1.1	1.0	1.2	1.0	0.9	1.2

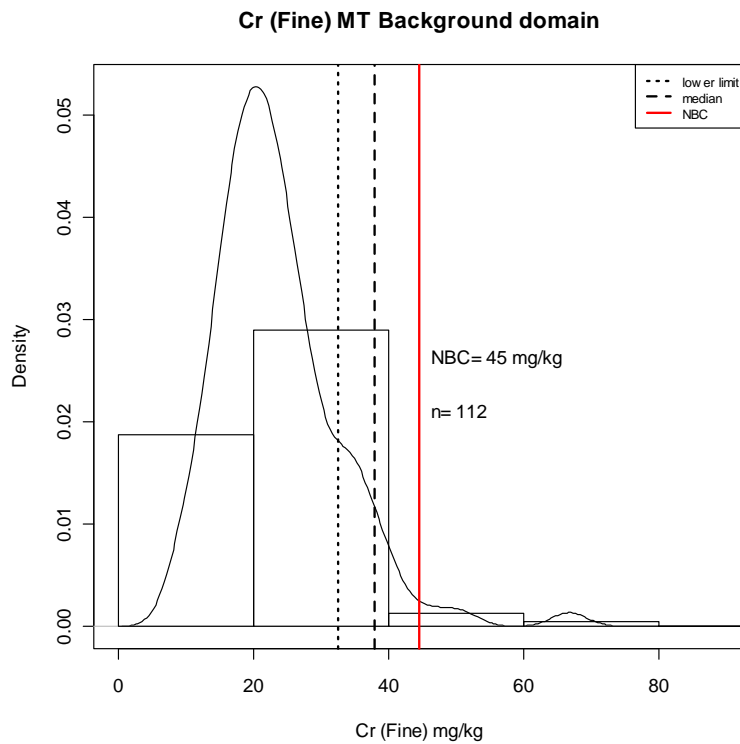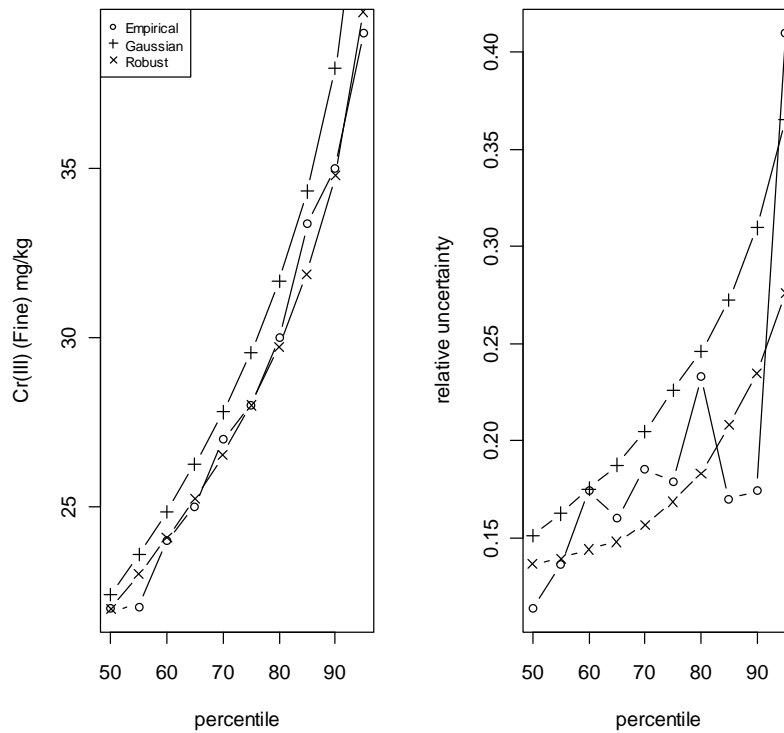L = lower confidence limit around given percentile; H = upper confidence limit around given percentile

Beryllium - 2

Untransformed data

skew = 5.8
octile skew = 0.24
n = 112

Density

Cr (Fine) mg/kg

Log Transformed

skew = 0.9
octile skew = 0.032
n = 112

Density

log e Cr (Fine)

○ Empirical
+ Gaussian
× Robust

Cr (Fine) mg/kg

percentile

relative uncertainty

percentile

Chromium - 1

Cr (Fine) MT Background domain
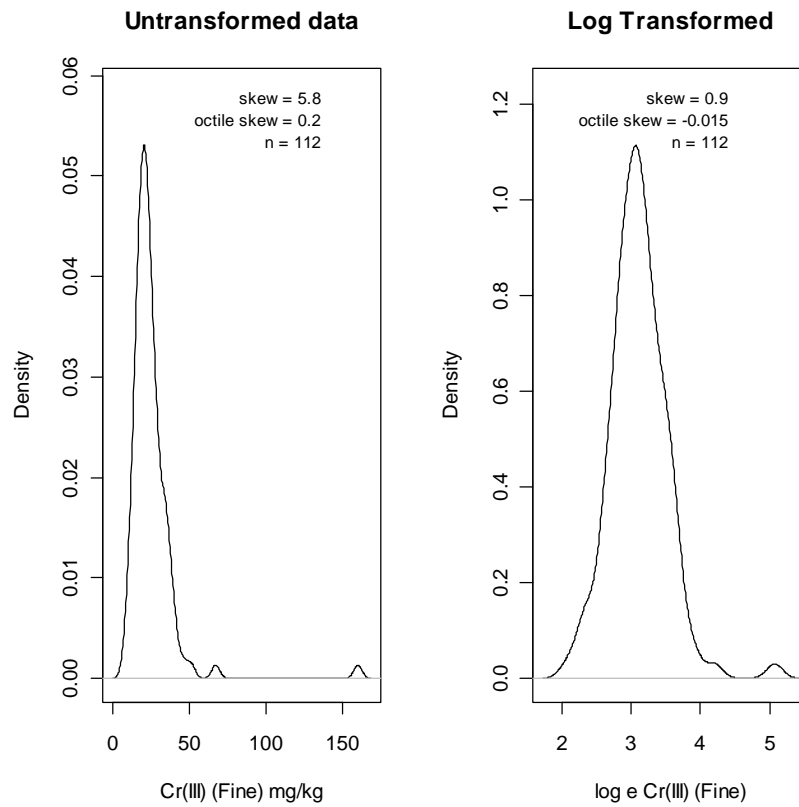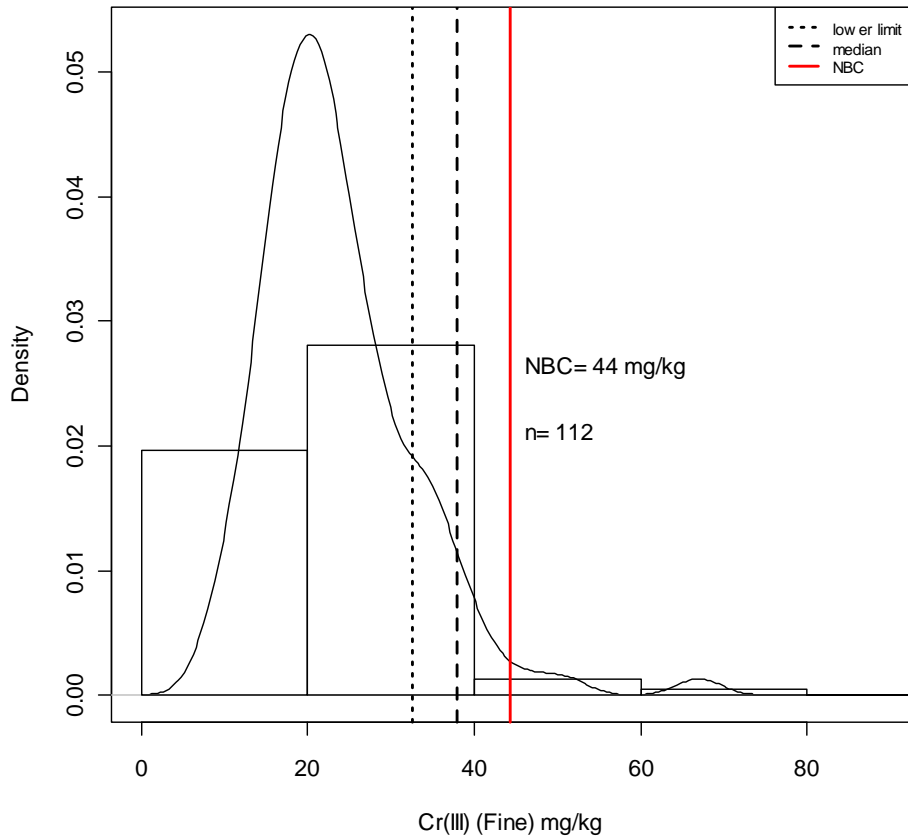

NBC= 45 mg/kg

n= 112

NOTE: R-Script modified to denote upper 95% confidence limit on 90th percentile as NBC

Percentile	Empirical	E L	E H	Theoretical	T L	T H	Robust	R L	R H
50	22.0	20.9	23.8	22.4	20.7	24.2	22.0	20.9	23.6
55	22.5	21.4	24.8	23.6	21.7	25.5	23.0	21.8	24.7
60	24.2	22.1	26.4	24.9	22.7	27.1	24.0	22.6	25.9
65	24.9	22.5	27.1	26.3	23.8	28.9	25.1	23.5	27.2
70	26.6	24.3	29.2	27.8	25.1	30.9	26.3	24.5	28.7
75	27.5	25.3	31.7	29.6	26.5	33.3	27.6	25.6	30.3
80	29.9	26.9	34.3	31.7	28.1	36.0	29.2	26.9	32.3
85	33.1	28.3	35.4	34.3	30.1	39.6	31.2	28.5	35.1
90	35.4	31.7	39.0	37.9	32.6	***44.6***	33.9	30.5	39.0
95	39.1	35.2	50.8	44.0	36.8	53.2	38.3	33.8	45.5

L = lower confidence limit around given percentile; H = upper confidence limit around given percentile

Untransformed data

Density

skew = 5.8
octile skew = 0.2
n = 112

Cr(III) (Fine) mg/kg

Log Transformed

Density

skew = 0.9
octile skew = -0.015
n = 112

log e Cr(III) (Fine)

Cr(III) (Fine) mg/kg

- o Empirical
- + Gaussian
- × Robust

percentile

relative uncertainty

percentile

Chromium (III) - 1

Cr(III) (Fine) MT Background domain

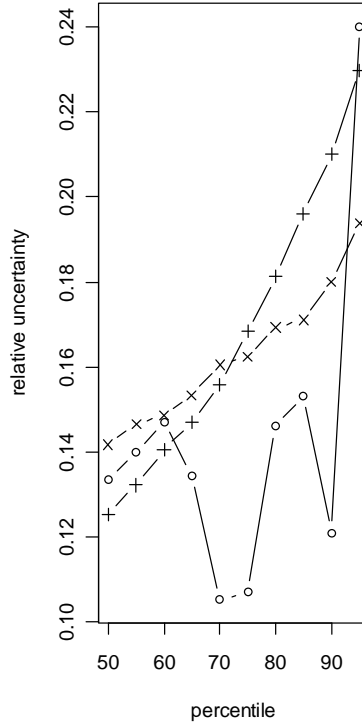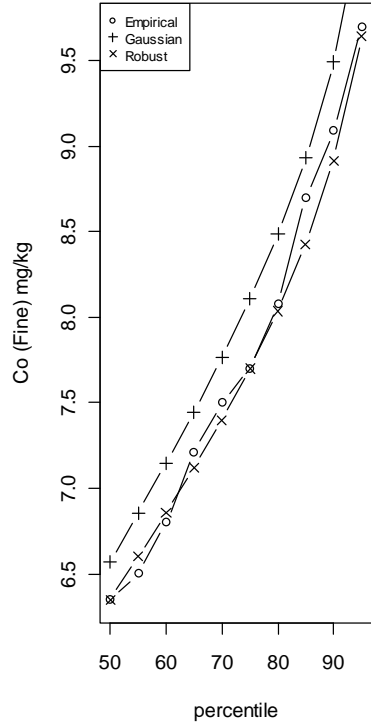NOTE: R-Script modified to denote upper 95% confidence limit on 90th percentile as NBC
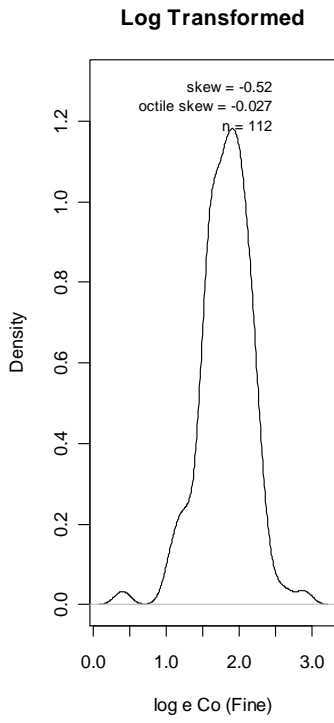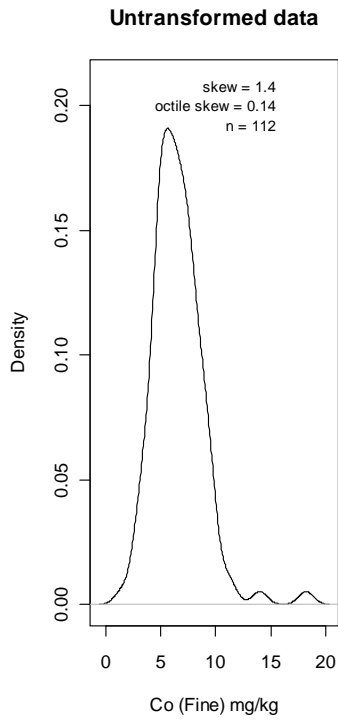
NOTE: R-Script modified to denote upper 95% confidence limit on 90th percentile as NBC

Percentile	Empirical	E L	E H	Theoretical	T L	T H	Robust	R L	R H
50	22.0	21.0	23.5	22.4	20.8	24.2	22.0	21.0	24.0
55	22.0	21.0	24.0	23.6	21.8	25.6	23.0	21.8	25.0
60	24.0	22.0	26.2	24.9	22.9	27.2	24.1	22.7	26.2
65	25.0	23.0	27.0	26.3	24.0	28.9	25.2	23.7	27.4
70	27.0	24.0	29.0	27.8	25.2	30.9	26.5	24.7	28.9
75	28.0	26.0	31.0	29.6	26.6	33.3	28.0	25.9	30.7
80	30.0	27.0	34.0	31.7	28.2	36.0	29.7	27.3	32.7
85	33.3	29.3	35.0	34.3	30.1	39.4	31.9	28.8	35.4
90	35.0	32.9	39.0	37.9	32.6	***44.4***	34.8	30.9	39.0
95	39.0	35.0	51.0	44.1	36.8	52.9	39.6	34.5	45.4

L = lower confidence limit around given percentile; H = upper confidence limit around given percentile

Untransformed data

skew = 1.4
octile skew = 0.14
n = 112

Density

Co (Fine) mg/kg

Log Transformed

skew = -0.52
octile skew = -0.027
n = 112

Density

log e Co (Fine)

o Empirical
+ Gaussian
× Robust

Co (Fine) mg/kg

percentile

relative uncertainty

percentile

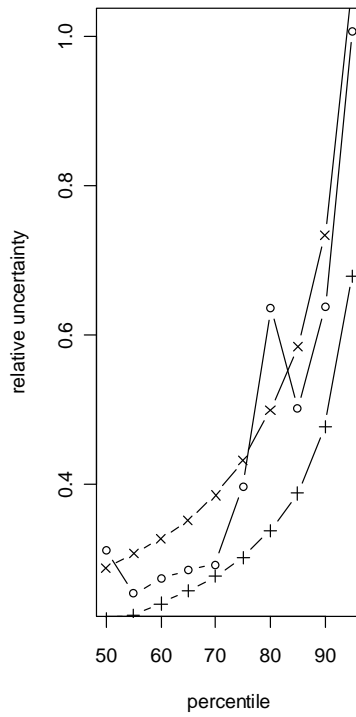**Co (Fine) MT Background domain**
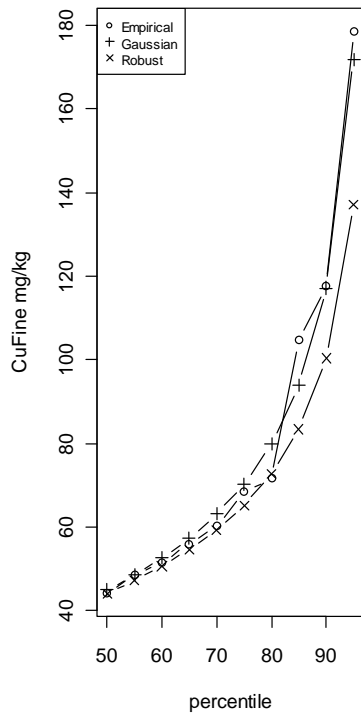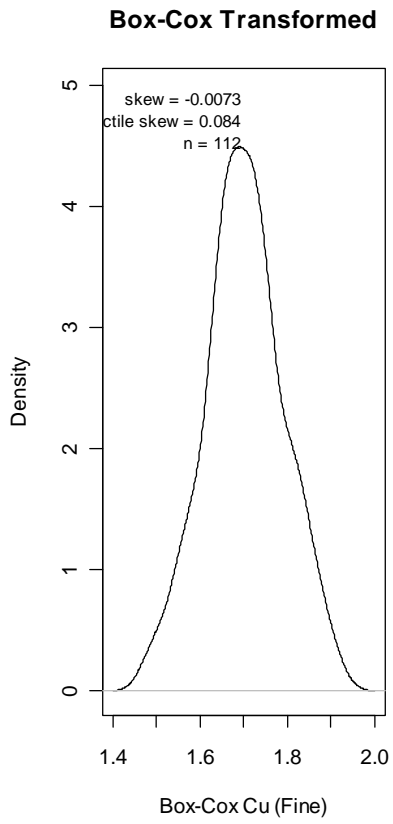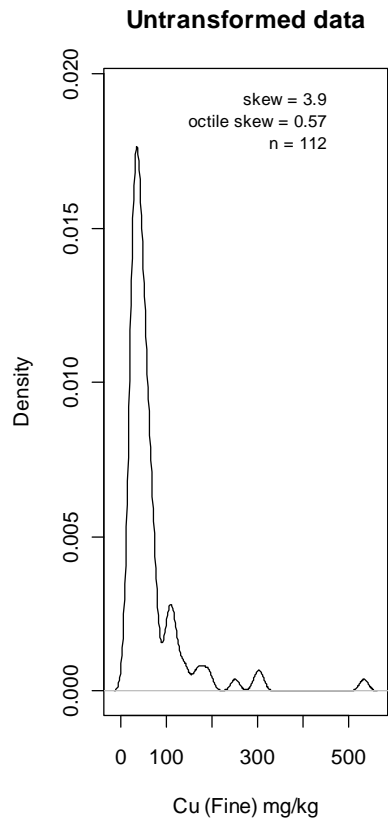

NBC= 9.7 mg/kg

n= 112

Co (Fine) mg/kg
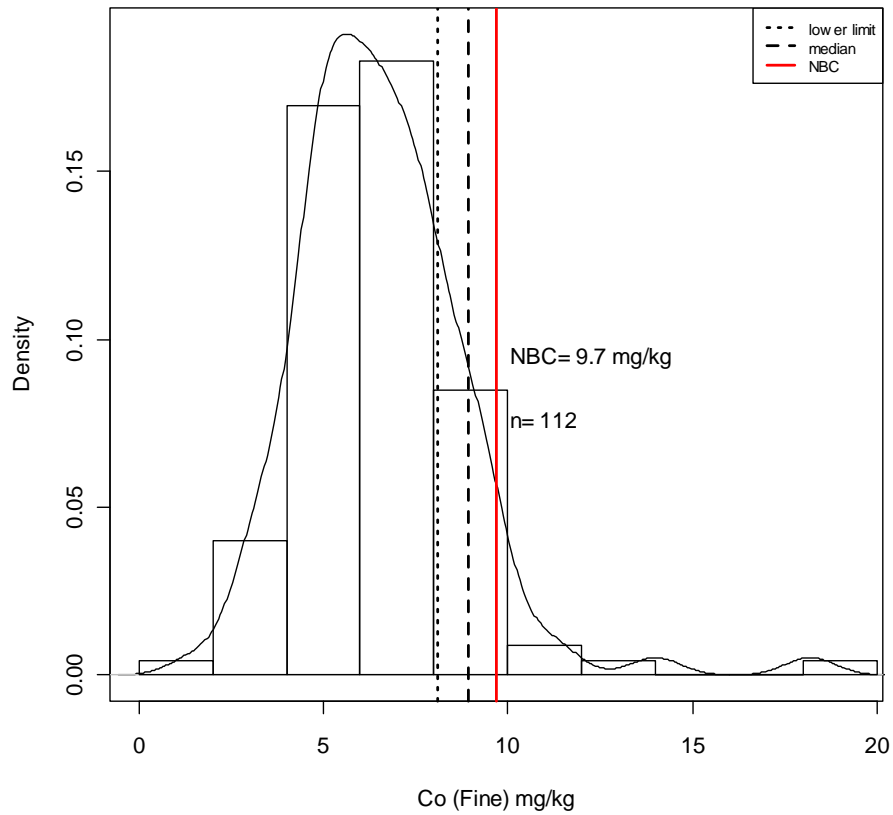
NOTE: R-Script modified to denote upper 95% confidence limit on 90th percentile as NBC

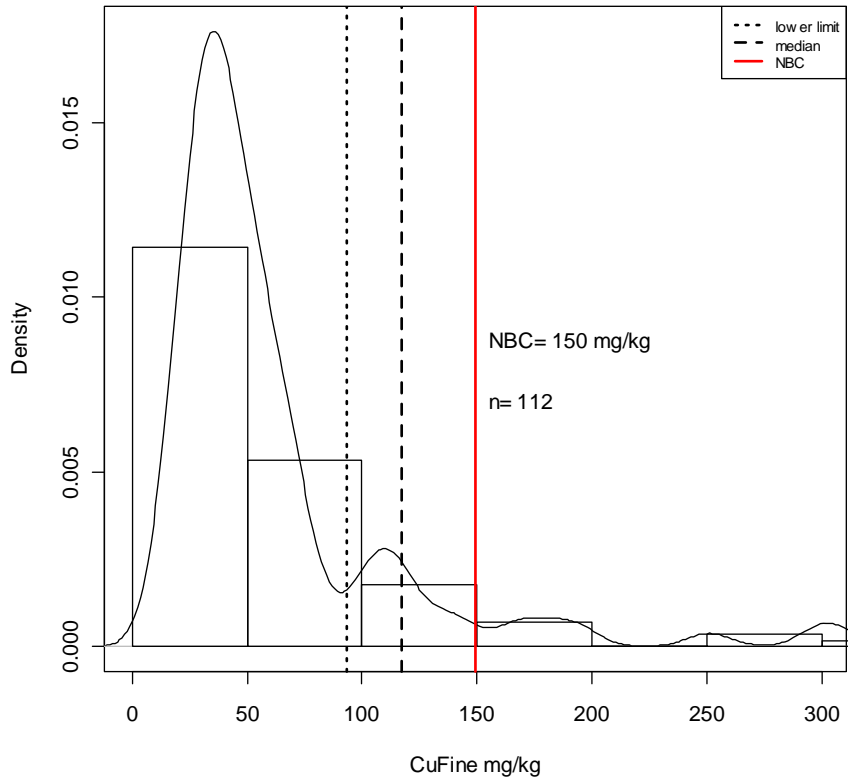| Percentile	Empirical	E L	E H	Theoretical	T L	T H	Robust	R L	R H
50	6.4	6.0	6.8	6.6	6.2	7.0	6.4	5.9	6.8
55	6.5	6.2	7.1	6.9	6.4	7.3	6.6	6.1	7.1
60	6.8	6.4	7.4	7.1	6.7	7.7	6.9	6.3	7.3
65	7.2	6.6	7.6	7.4	6.9	8.0	7.1	6.5	7.6
70	7.5	7.0	7.8	7.8	7.2	8.4	7.4	6.8	8.0
75	7.7	7.4	8.2	8.1	7.5	8.8	7.7	7.0	8.3
80	8.1	7.6	8.8	8.5	7.8	9.3	8.0	7.3	8.7
85	8.7	7.9	9.2	8.9	8.1	9.8	8.4	7.7	9.1
90	9.1	8.6	9.7	9.5	8.6	10.5	8.9	8.1	*9.7*
95	9.7	9.1	11.4	10.3	9.2	11.6	9.6	8.7	10.5

L = lower confidence limit around given percentile; H = upper confidence limit around given percentile

Untransformed data

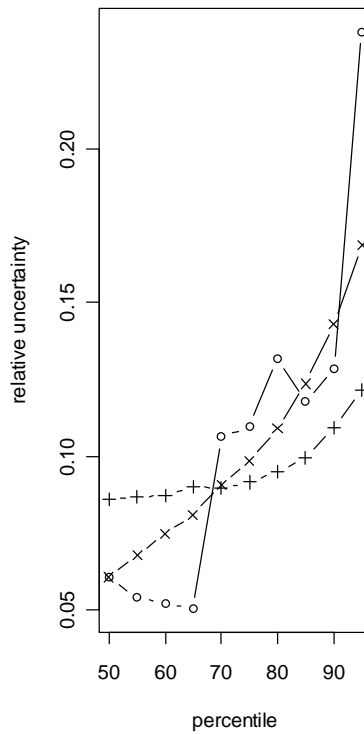skew = 3.9
octile skew = 0.57
n = 112

Density

Cu (Fine) mg/kg

Box-Cox Transformed

skew = -0.0073
ctile skew = 0.084
n = 112

Density

Box-Cox Cu (Fine)

o Empirical
+ Gaussian
x Robust

CuFine mg/kg

percentile

relative uncertainty

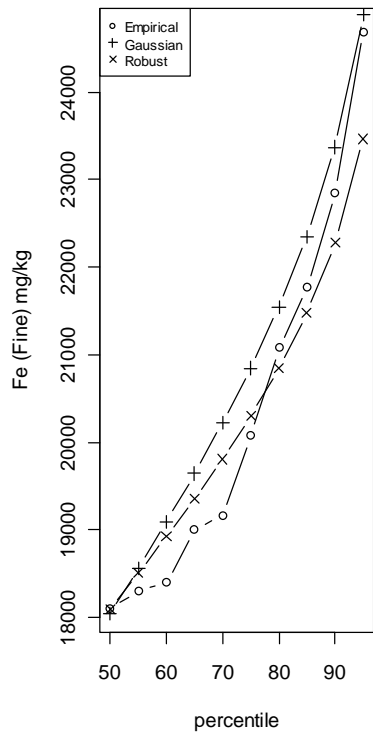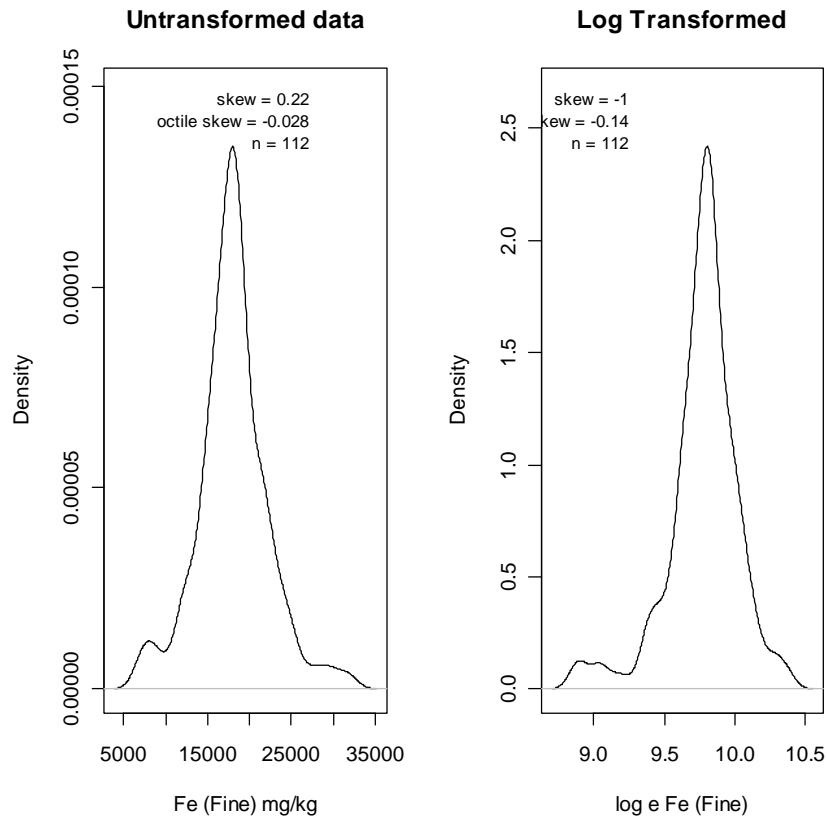percentile

CuFine MT Background domain
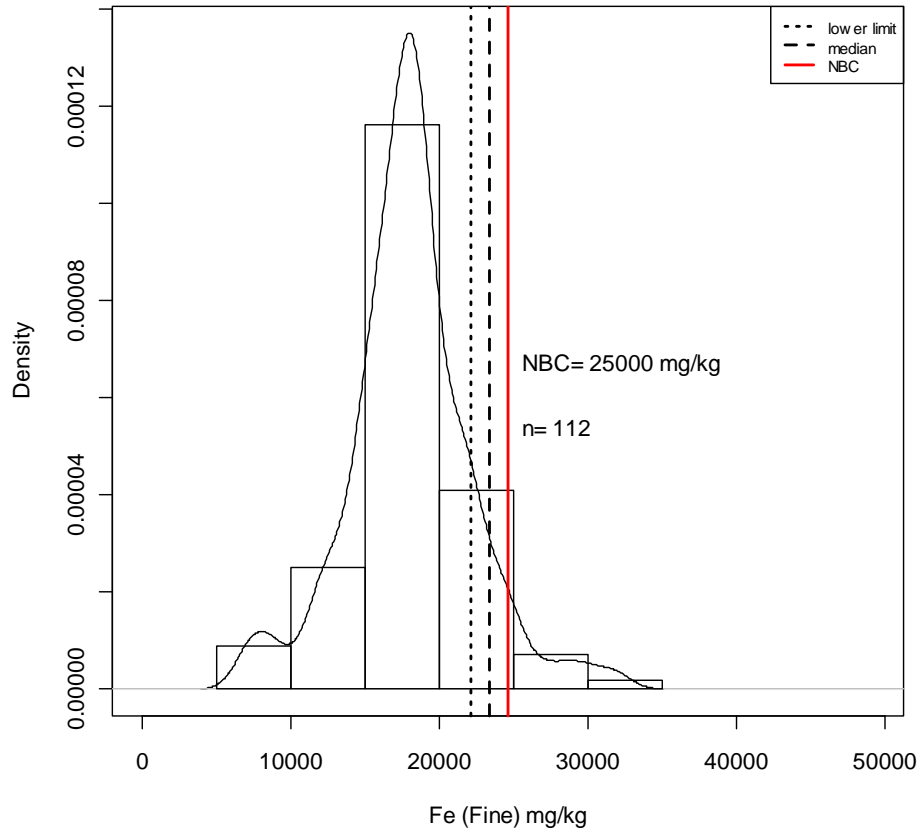

NBC= 150 mg/kg

n= 112

CuFine mg/kg

NOTE: R-Script modified to denote upper 95% confidence limit on 90th percentile as NBC

Percentile	Empirical	E L	E H	Theoretical	T L	T H	Robust	R L	R H
50	44.1	37.5	51.2	45.0	40.5	50.4	44.1	37.7	50.4
55	48.7	42.9	55.2	48.6	43.6	54.4	47.2	40.2	54.7
60	51.4	44.9	58.9	52.6	46.8	59.4	50.7	43.1	59.7
65	55.9	49.0	64.9	57.4	50.7	65.4	54.7	46.3	65.5
70	60.3	52.4	70.0	63.1	55.3	72.7	59.4	50.0	72.8
75	68.5	56.4	83.6	70.4	60.7	81.9	65.2	54.5	82.6
80	71.6	62.5	108.0	80.0	67.9	94.9	72.8	59.6	95.9
85	104.7	69.9	122.3	93.9	78.0	114.4	83.4	66.7	115.5
90	117.7	97.2	172.2	117.2	93.5	***149.4***	100.4	76.6	150.2
95	178.7	118.0	298.0	171.8	126.0	242.6	137.0	97.0	244.0

L = lower confidence limit around given percentile; H = upper confidence limit around given percentile

Untransformed data

skew = 0.22
octile skew = -0.028
n = 112

Density

5000   15000   25000   35000

Fe (Fine) mg/kg

Log Transformed

skew = -1
kew = -0.14
n = 112

Density

9.0   9.5   10.0   10.5

log e Fe (Fine)

○ Empirical
+ Gaussian
× Robust

Fe (Fine) mg/kg

18000   19000   20000   21000   22000   23000   24000

50   60   70   80   90

percentile

relative uncertainty

0.05   0.10   0.15   0.20

50   60   70   80   90

percentile

Iron - 1

Fe (Fine) MT Background domain

NBC= 25000 mg/kg

n= 112

Fe (Fine) mg/kg

NOTE: R-Script modified to denote upper 95% confidence limit on 90th percentile as NBC

Percentile	Empirical	E L	E H	Theoretical	T L	T H	Robust	R L	R H
50	18100	17300	18400	18043	17312	18866	18100	17300	18400
55	18305	17810	18800	18566	17809	19422	18510	17636	18894
60	18400	18100	19060	19097	18300	19967	18926	17989	19408
65	19000	18400	19360	19645	18788	20562	19357	18365	19935
70	19170	18470	20510	20224	19349	21161	19810	18700	20499
75	20075	19000	21200	20848	19917	21828	20300	19100	21100
80	21080	19200	21980	21543	20550	22596	20845	19497	21769
85	21770	20405	22970	22353	21231	23459	21481	19921	22575
90	22850	21640	24580	23372	22084	***24640***	22280	20425	23609
95	24690	22625	28500	24883	23348	26372	23465	21164	25122

L = lower confidence limit around given percentile; H = upper confidence limit around given percentile

Untransformed data

skew = 1
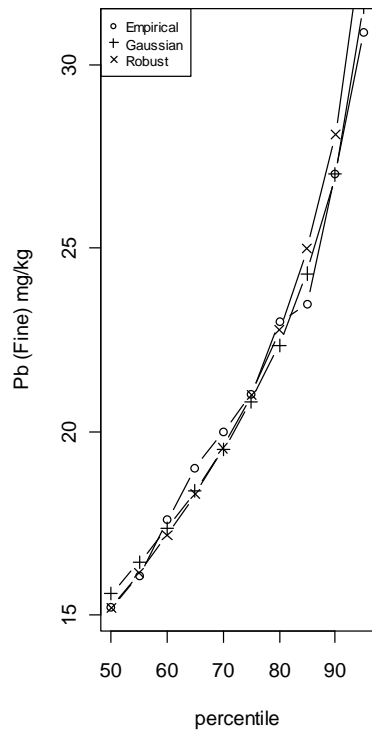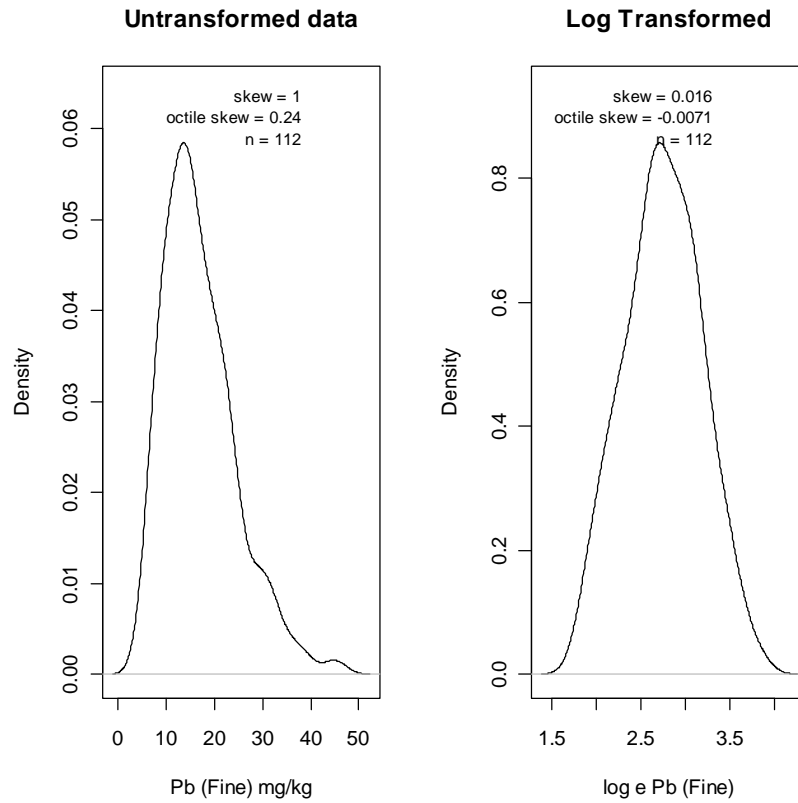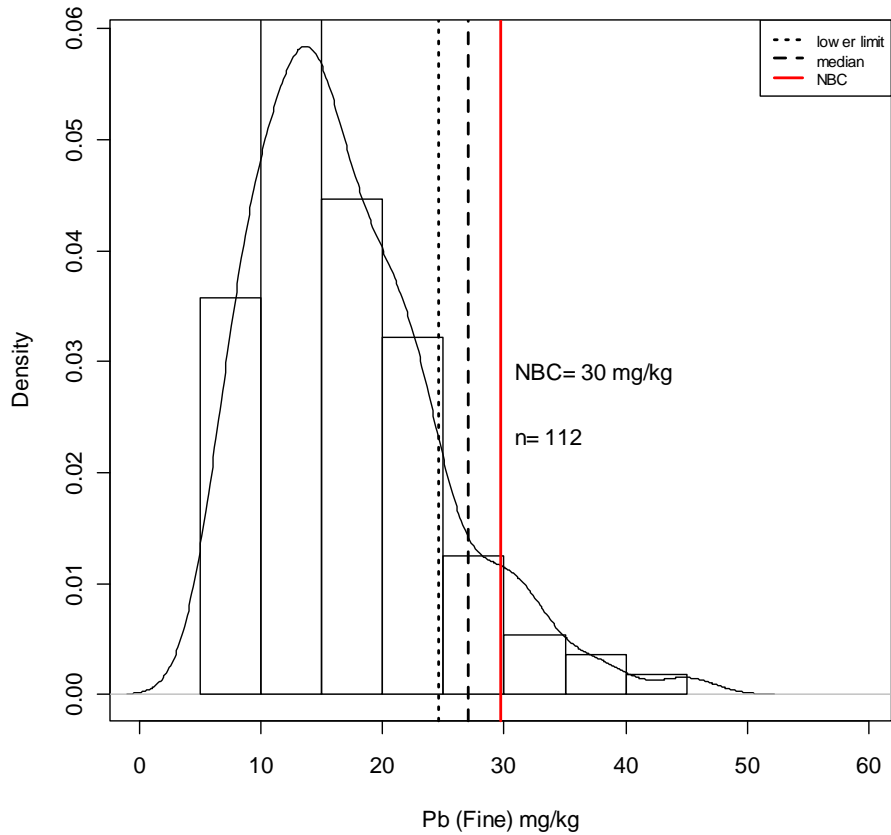octile skew = 0.24
n = 112

Density

Pb (Fine) mg/kg

Log Transformed

skew = 0.016
octile skew = -0.0071
n = 112

Density

log e Pb (Fine)

○ Empirical
+ Gaussian
× Robust

Pb (Fine) mg/kg

percentile

relative uncertainty

percentile

Pb (Fine) MT Background domain

NBC= 30 mg/kg

n= 112
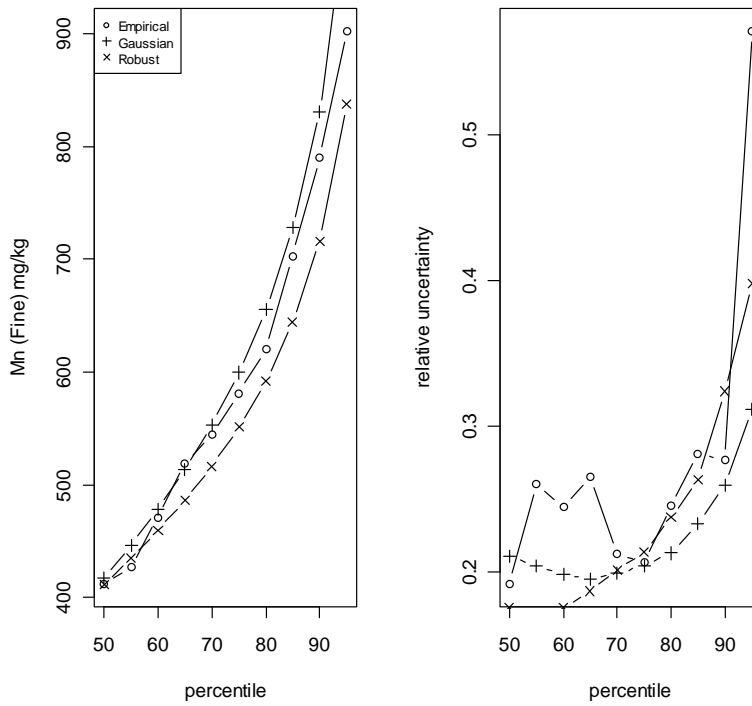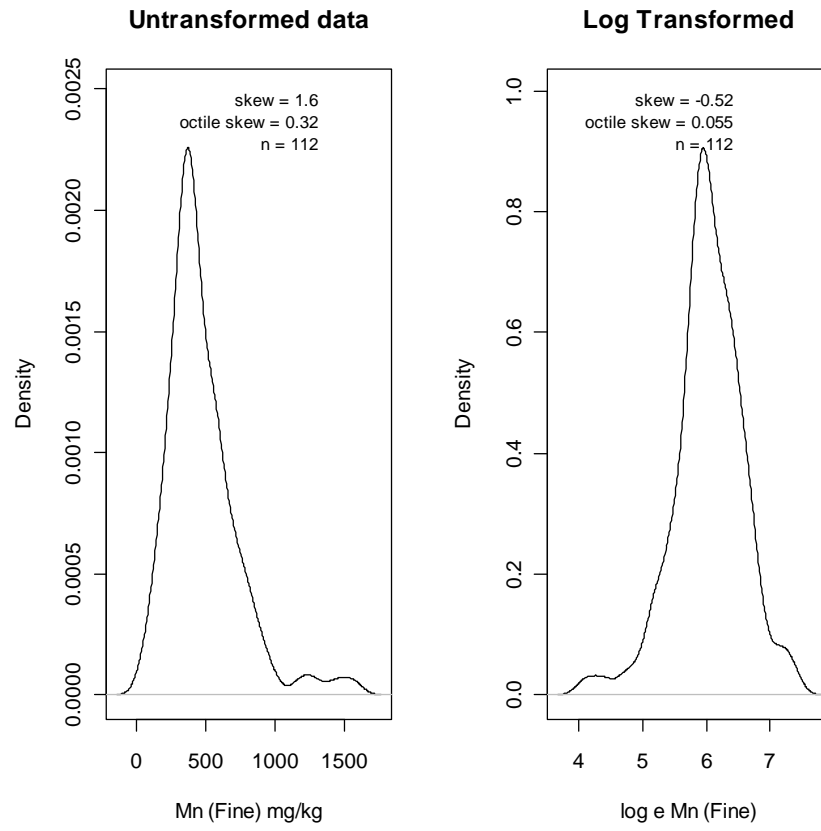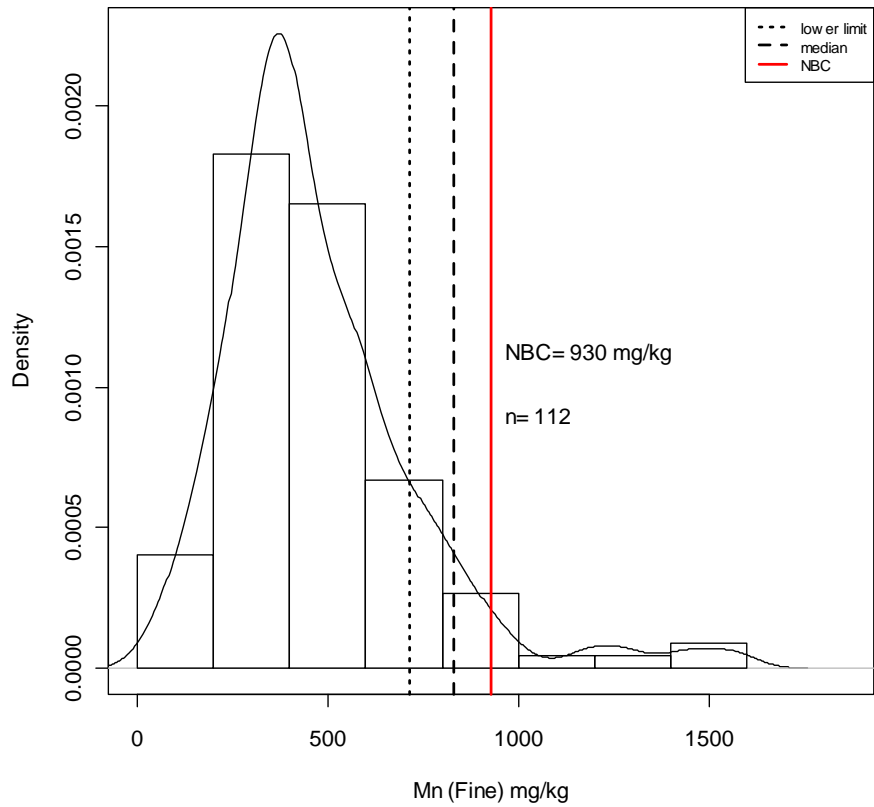
Pb (Fine) mg/kg
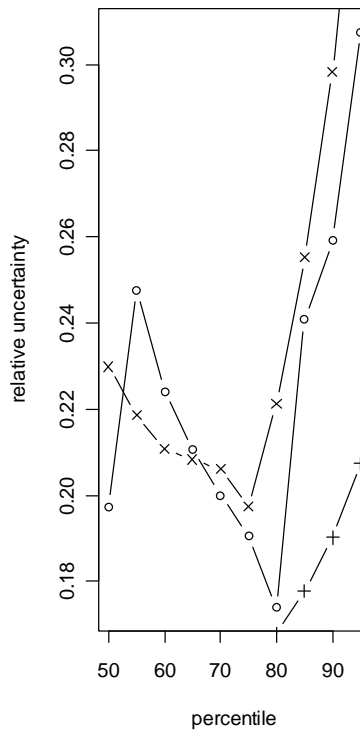
NOTE: R-Script modified to denote upper 95% confidence limit on 90th percentile as NBC

Percentile	Empirical	E L	E H	Theoretical	T L	T H	Robust	R L	R H
50	15.2	14.0	17.0	15.6	14.5	16.8	15.2	14.0	17.5
55	16.0	15.0	19.0	16.4	15.3	17.8	16.1	14.9	18.4
60	17.6	15.6	19.6	17.4	16.1	18.8	17.2	15.8	19.4
65	19.0	17.0	21.0	18.4	17.0	19.9	18.3	16.7	20.5
70	20.0	18.0	22.0	19.5	18.1	21.2	19.5	17.8	21.8
75	21.0	19.0	23.0	20.8	19.2	22.6	21.0	19.0	23.1
80	23.0	20.0	24.0	22.3	20.6	24.3	22.8	20.1	25.2
85	23.5	22.3	28.0	24.3	22.3	26.6	25.0	21.6	27.9
90	27.0	23.0	30.0	27.0	24.6	***29.7***	28.1	23.5	31.9
95	30.9	27.0	36.5	31.6	28.5	35.0	33.4	26.7	38.8

L = lower confidence limit around given percentile; H = upper confidence limit around given percentile

Untransformed data

skew = 1.6
octile skew = 0.32
n = 112

Density

Mn (Fine) mg/kg

Log Transformed

skew = -0.52
octile skew = 0.055
n = 112

Density

log e Mn (Fine)

Mn (Fine) mg/kg

○ Empirical
+ Gaussian
× Robust

percentile

relative uncertainty

percentile

Manganese - 1
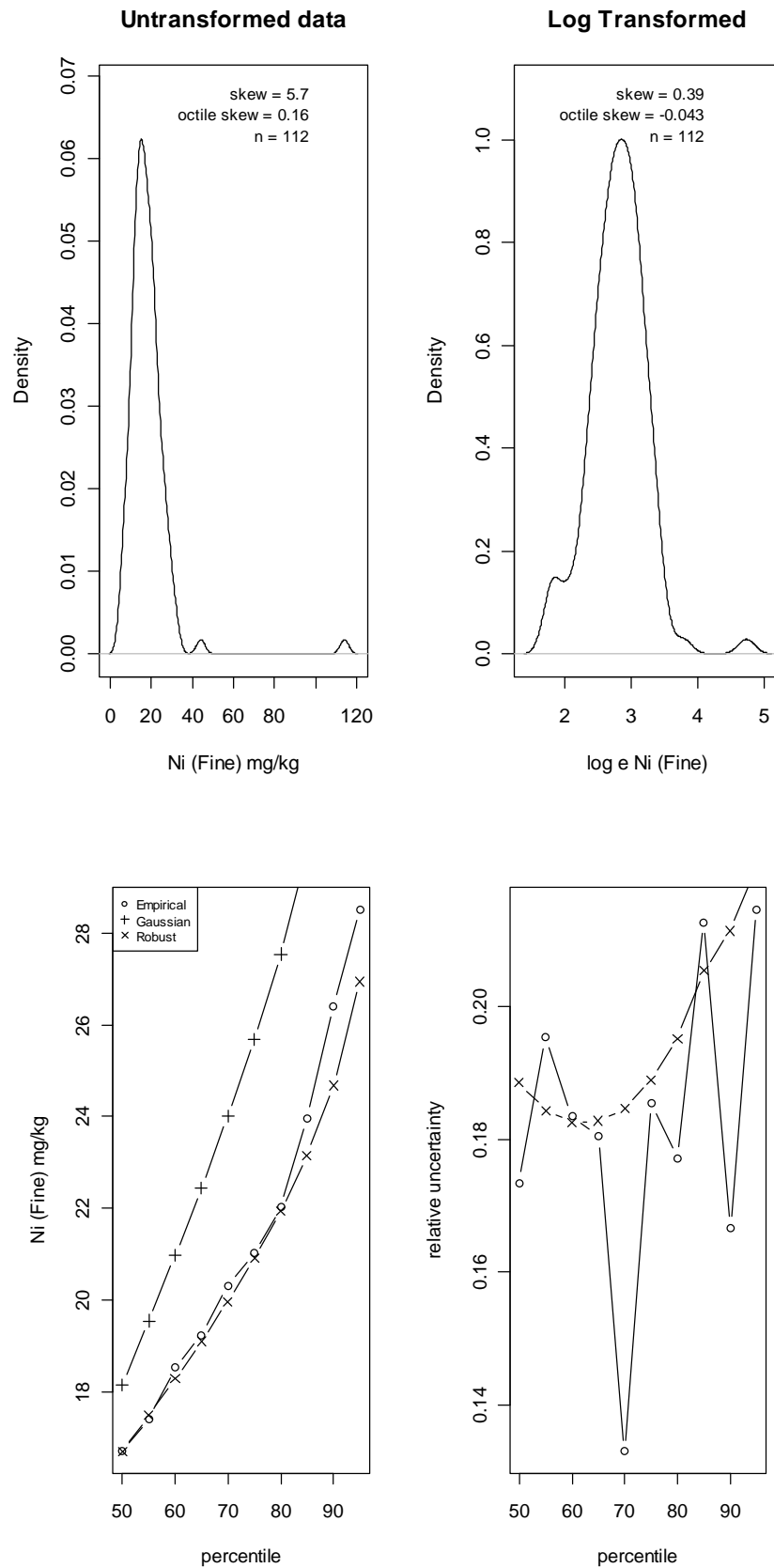
Mn (Fine) MT Background domain

NBC= 930 mg/kg

n= 112

Mn (Fine) mg/kg

NOTE: R-Script modified to denote upper 95% confidence limit on 90th percentile as NBC

Percentile	Empirical	E L	E H	Theoretical	T L	T H	Robust	R L	R H
50	412	387	466	417	375	463	412	388	460
55	427	401	512	446	402	493	435	410	484
60	471	415	530	478	431	526	460	432	513
65	519	431	569	513	461	562	486	455	545
70	544	485	601	553	494	604	517	478	582
75	581	522	642	600	534	657	551	506	623
80	621	564	716	656	580	720	592	538	678
85	703	599	797	728	636	805	644	579	749
90	790	672	891	831	713	*929*	716	631	863
95	903	764	1280	1010	843	1158	837	713	1047

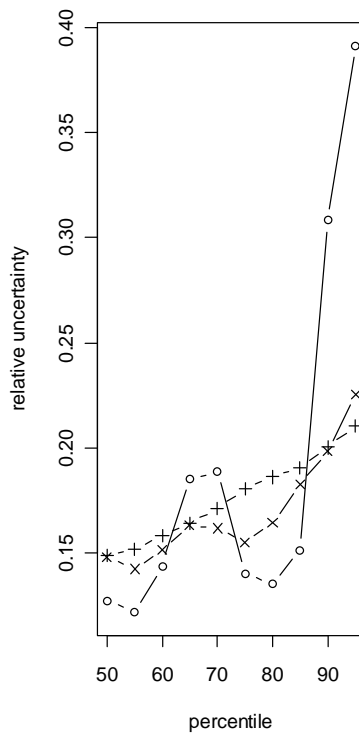L = lower confidence limit around given percentile; H = upper confidence limit around given percentile

Manganese - 2

Untransformed data

skew = 5.7
octile skew = 0.16
n = 112

Density

Ni (Fine) mg/kg

Log Transformed

skew = 0.39
octile skew = -0.043
n = 112

Density

log e Ni (Fine)

Ni (Fine) mg/kg

- ○ Empirical
- + Gaussian
- × Robust

percentile

relative uncertainty

percentile

Ni (Fine) MT Background domain
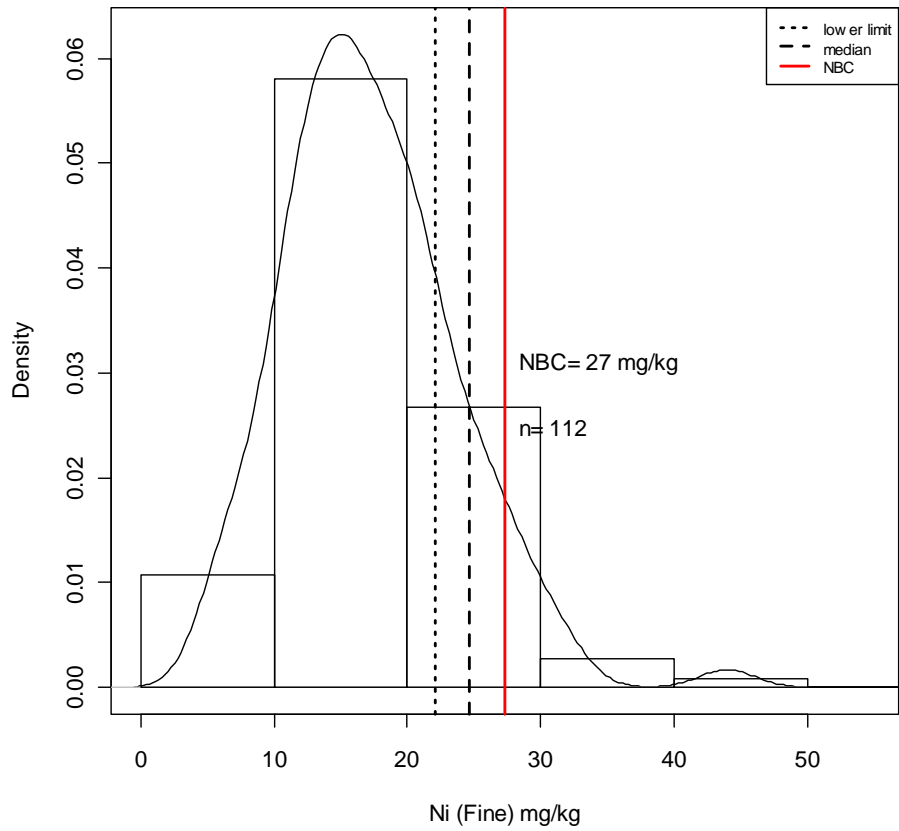
NBC= 27 mg/kg

n= 112

Ni (Fine) mg/kg

NOTE: R-Script modified to denote upper 95% confidence limit on 90th percentile as NBC

Percentile	Empirical	E L	E H	Theoretical	T L	T H	Robust	R L	R H
50	16.7	15.4	18.2	18.1	16.4	20.7	16.7	15.3	18.4
55	17.4	15.8	19.2	19.5	17.1	22.8	17.5	16.0	19.3
60	18.5	16.7	20.1	21.0	17.8	24.9	18.3	16.7	20.1
65	19.2	17.4	20.9	22.4	18.6	27.1	19.1	17.5	21.0
70	20.3	18.8	21.5	24.0	19.4	29.5	20.0	18.2	21.9
75	21.0	19.6	23.5	25.7	20.3	32.0	20.9	19.0	22.9
80	22.0	20.8	24.7	27.5	21.2	34.9	21.9	19.9	24.2
85	24.0	21.4	26.5	29.7	22.3	38.2	23.2	20.9	25.6
90	26.4	23.4	27.8	32.5	23.7	42.4	24.7	22.1	***27.3***
95	28.5	26.0	32.1	36.5	25.8	48.5	26.9	24.0	30.0

L = lower confidence limit around given percentile; H = upper confidence limit around given percentile

Untransformed data

skew = 1.1
octile skew = 0.11
n = 112

Log Transformed

skew = -0.19
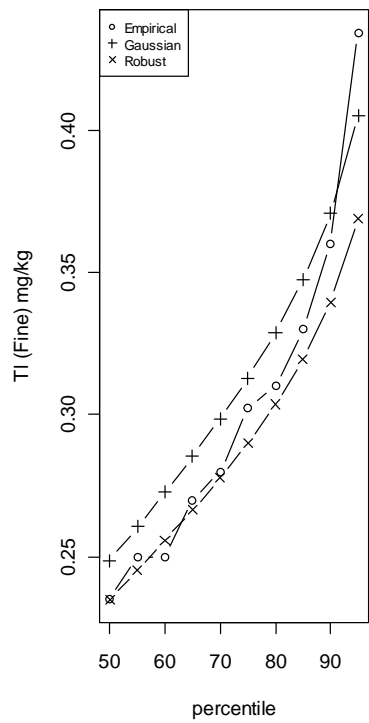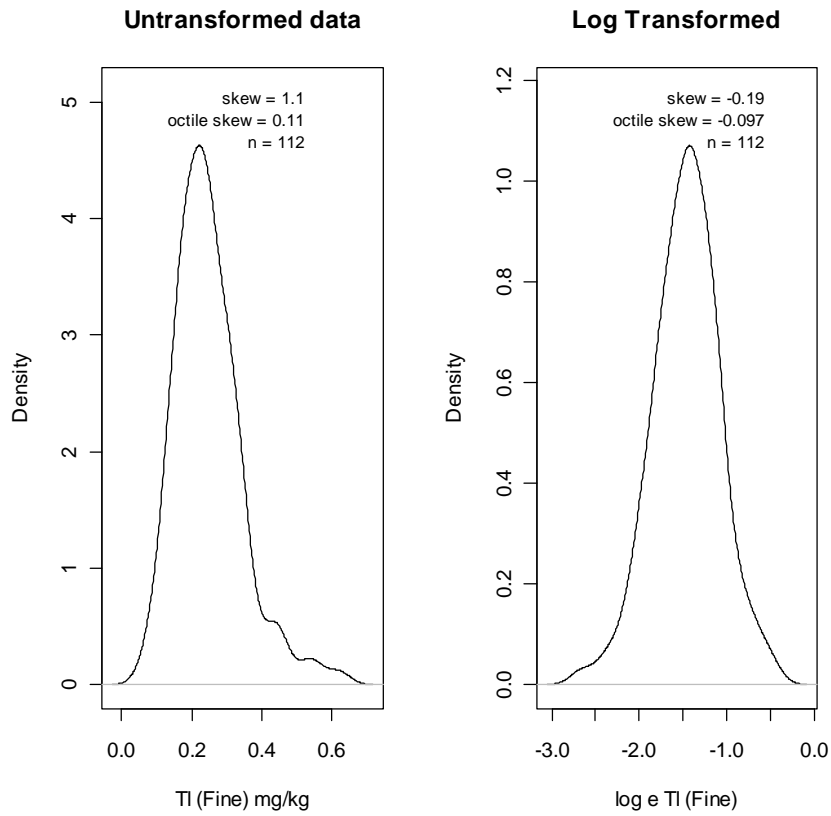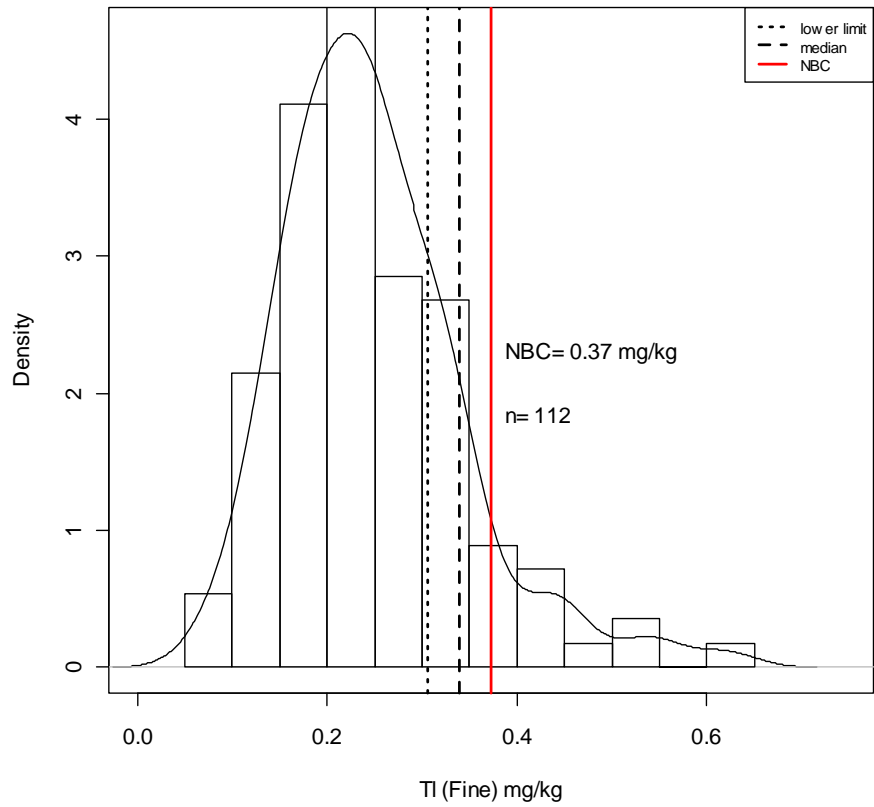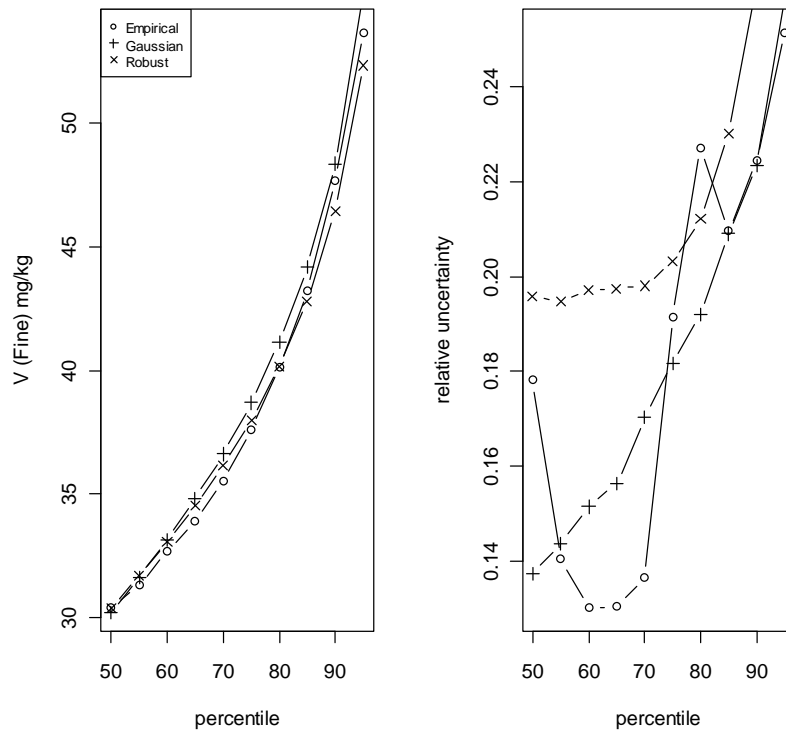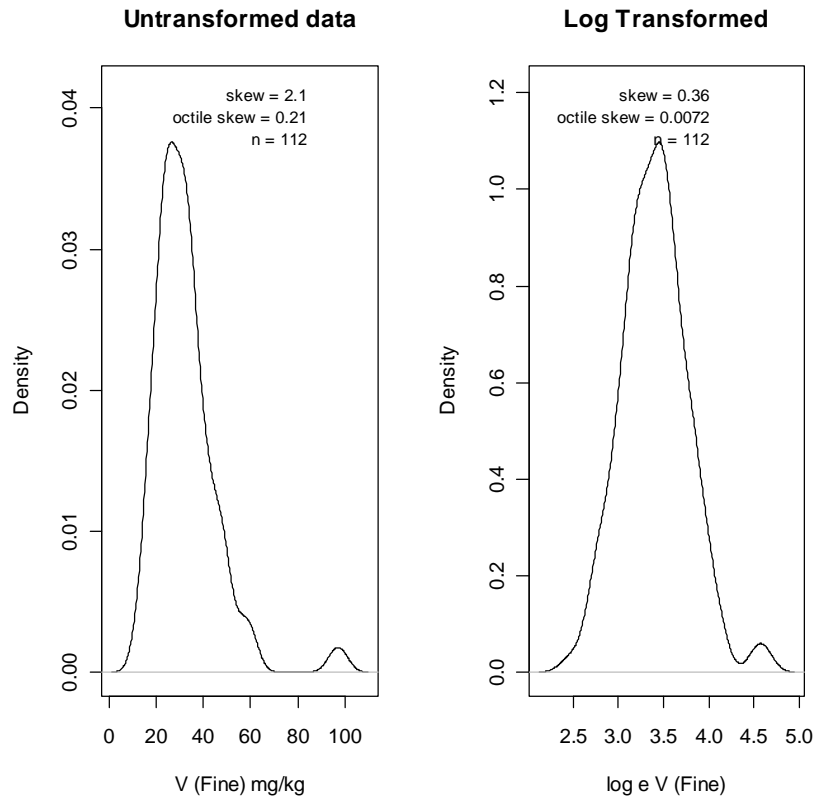octile skew = -0.097
n = 112

Empirical
Gaussian
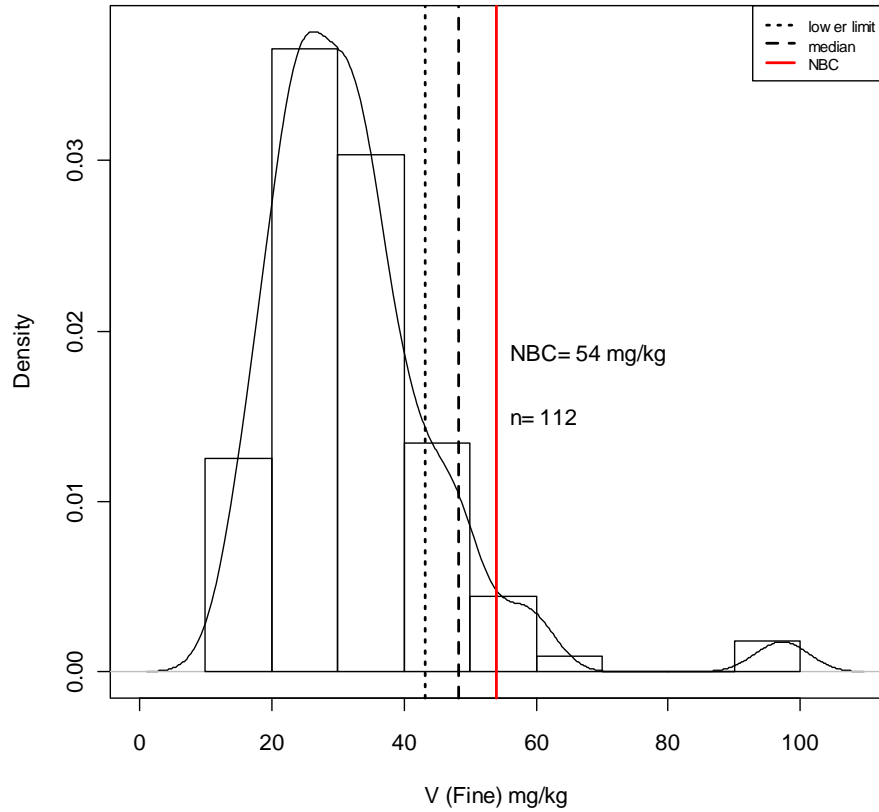Robust

TI (Fine) MT Background domain

NOTE: R-Script modified to denote upper 95% confidence limit on 90th percentile as NBC

Percentile	Empirical	E L	E H	Theoretical	T L	T H	Robust	R L	R H
50	0.24	0.22	0.25	0.25	0.23	0.27	0.24	0.22	0.25
55	0.25	0.23	0.26	0.26	0.24	0.28	0.25	0.23	0.26
60	0.25	0.24	0.28	0.27	0.25	0.29	0.26	0.24	0.27
65	0.27	0.25	0.30	0.29	0.26	0.31	0.27	0.24	0.29
70	0.28	0.26	0.31	0.30	0.27	0.32	0.28	0.25	0.30
75	0.30	0.27	0.31	0.31	0.28	0.34	0.29	0.26	0.31
80	0.31	0.29	0.33	0.33	0.30	0.36	0.30	0.28	0.33
85	0.33	0.31	0.36	0.35	0.31	0.38	0.32	0.29	0.35
90	0.36	0.32	0.43	0.37	0.33	0.41	0.34	0.31	*0.37*
95	0.43	0.36	0.53	0.41	0.36	0.45	0.37	0.33	0.41

L = lower confidence limit around given percentile; H = upper confidence limit around given percentile

Untransformed data

Density

skew = 2.1
octile skew = 0.21
n = 112

V (Fine) mg/kg

Log Transformed

Density

skew = 0.36
octile skew = 0.0072
n = 112

log e V (Fine)

V (Fine) mg/kg

○ Empirical
+ Gaussian
× Robust

percentile

relative uncertainty

percentile

Vanadium - 1

V (Fine) MT Background domain

NBC= 54 mg/kg

n= 112

V (Fine) mg/kg

NOTE: R-Script modified to denote upper 95% confidence limit on 90th percentile as NBC

Percentile	Empirical	E L	E H	Theoretical	T L	T H	Robust	R L	R H
50	30.4	27.3	32.7	30.2	28.2	32.3	30.4	26.5	32.4
55	31.3	29.5	33.9	31.6	29.4	34.0	31.7	27.8	34.0
60	32.7	30.6	34.8	33.1	30.7	35.7	33.1	29.2	35.7
65	33.9	31.6	36.0	34.8	32.2	37.6	34.5	30.6	37.5
70	35.5	33.5	38.4	36.6	33.7	39.9	36.1	32.2	39.4
75	37.6	34.1	41.3	38.7	35.4	42.4	38.0	33.9	41.6
80	40.2	35.7	44.8	41.1	37.4	45.3	40.1	35.8	44.3
85	43.2	38.7	47.8	44.2	39.9	49.1	42.8	38.1	47.9
90	47.7	41.3	52.0	48.4	43.2	***54.0***	46.4	40.9	53.1
95	53.7	47.7	61.2	55.3	48.4	62.8	52.3	45.6	61.6

L = lower confidence limit around given percentile; H = upper confidence limit around given percentile

Untransformed data

skew = 1.3
octile skew = 0.43
n = 112

Density

Zn (Fine) mg/kg

Log Transformed

skew = -0.25
octile skew = 0.28
n = 112

Density

log e Zn (Fine)

Zn (Fine) mg/kg

Empirical

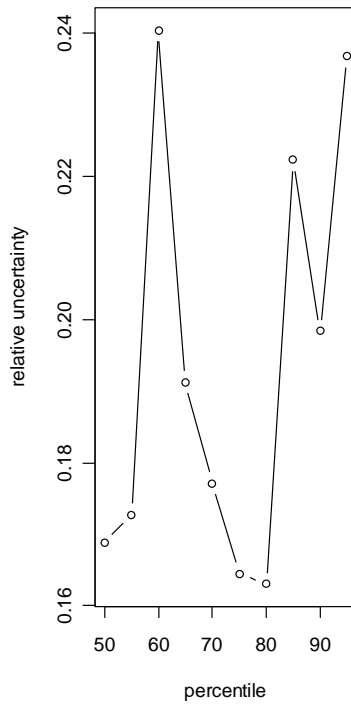percentile

relative uncertainty
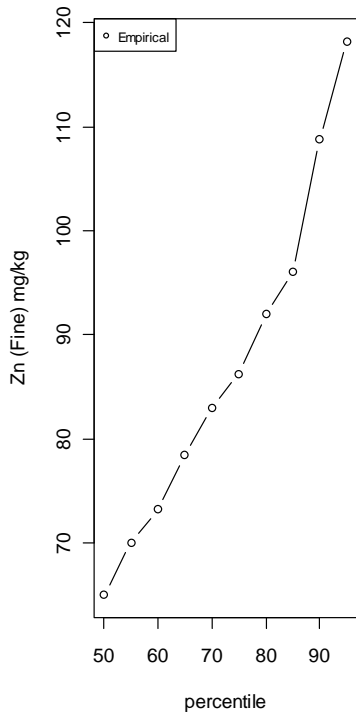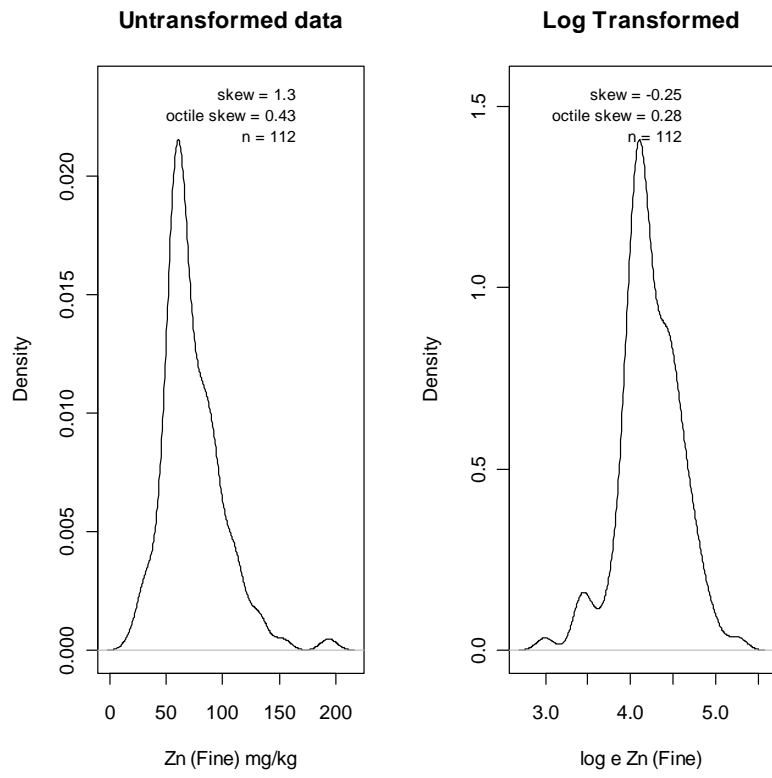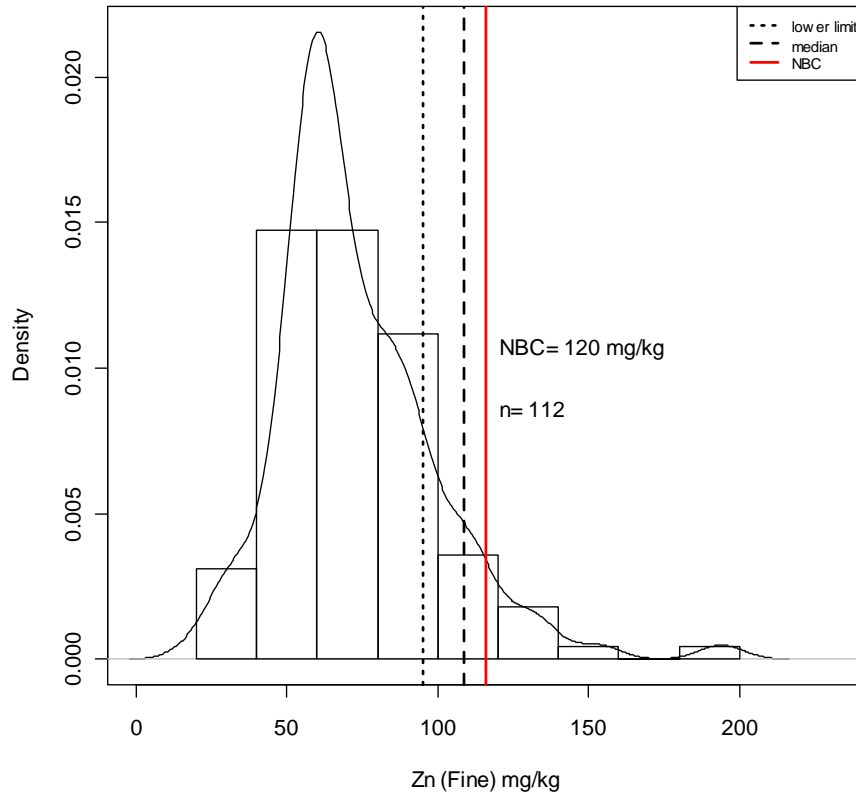
percentile

Zinc - 1

Zn (Fine) MT Background domain

NOTE: *R-Script modified to denote upper 95% confidence limit on 90th percentile as NBC*

Percentile	Empirical	E L	E H
50	65	62	72
55	70	64	76
60	73	66	83
65	78	71	86
70	83	74	89
75	86	81	93
80	92	83	100
85	96	88	110
90	109	95	*116*
95	118	108	135

L = lower confidence limit around given percentile; H = upper confidence limit around given percentile