

Evaluating Reasonable Potential with Large Datasets

- Step 1.

If n>10, transform the data to lognormal.
- Step 2.

Find the average of the lognormal data (μ_y) and the variance (σ_y^2), where $\mu_y = \text{sum of } y_i/k$ and $\sigma_y^2 = \text{sum}(y_i - \mu)^2 / k - 1$
- Step 3.

When data are lognormally distributed, these values from the normal distribution can then be used to calculate the coefficient of variation for the random variable X that is lognormally distributed. The mean, variance and coefficient of variation of the random variable X may be estimated by E(X), V(X), and cv(X), respectively.

$E(X) = \exp(\mu_y + \sigma_y^2 / 2)$
 $V(X) = \exp(2\mu_y + \sigma_y^2)[(\exp \sigma_y^2) - 1]$
 $cv(X) = [(\exp \sigma_y^2) - 1]^{1/2}$
- Step 4.

From page 52 of the TSD, find the highest measured effluent concentration based on the desired confidence level as follows:
 $P_n = (1 - \text{confidence level})^{1/n}$
EXAMPLE: $P_n = (1 - 0.99)^{1/38} = 0.88$
- Step 5.

Using a cumulative probability distribution function for the standard normal distribution, find the value of "z" for your calculated Pn.
- Step 6.

Find the relationship between the 99th percentile and the upper bound of the lognormal effluent distribution: C_{99} / C_n

For example:
 $C_{99} = \exp(2.326\sigma - 0.5\sigma^2)$ and 2.326 is the normal distribution z value for the 99th percentile
 $C_{79} = \exp(1.175\sigma - 0.5\sigma^2)$ and 1.175 is the normal distribution z value for the 88th percentile

INPUT AND CALCULATIONS

n	38	Entered value
μ_y	2.52	Entered value. The average of your data transformed to lognormal.
σ_y^2	1.66	Entered value. The variance of your data transformed to lognormal.
σ_y	1.288409873	Square root of the variance
Confidence Level	0.99	Entered value
Z upper bound	2.326347874	Using the NORMSINV function, input your probability (i.e. 0.99)
CV	2.063809789	Square root (exp(variance-1))
P _n	0.8859	(1-confidence level) ^{1/n}
Z _{Pn}	1.204836518	Function that calculates inverse of the standard normal cumulative distribution

SPREADSHEET WILL CALCULATE C₉₉ AND C_n

C ₉₉	8.734577451	
C _n	2.059211753	
C ₉₉ /C _n **	4.241709207	**This value becomes the "multiplying factor in the reasonable potential calculation.

Raw Data	Ln (raw data)
0.09	2.407945609
0.11	2.207274913
0.05	2.995732274
0.05	2.995732274
0.07	2.659260037
0	
0.012	4.422848629
0	
0.005	5.298317367
0.017	4.074541935
0.132	2.024953356
0.14	1.966112856
0	
0.212	1.551169004
0.245	1.406497068
0.172	1.760260802
0.078	2.551046452
0.047	3.057607677
0.76	0.274436846
0.022	3.816712826
0.027	3.611918413
0.01	4.605170186
0.012	4.422848629
0.022	3.816712826
0.164	1.807888851
0.192	1.650259907
0.18	1.714798428
0.08	2.525728644
0.33	1.108662625
0.082	2.501036032
0	
0.065	2.733368009
0.317	1.148853505
0.452	0.794073099
0	
0.022	3.816712826
0.35	1.049822124
0.015	4.199705078
0.362	1.016111067
0.16	1.832581464
0	
0.132	2.024953356
0.924	0.079043207
0.022	3.816712826
0	
0	
0	
0	

Ave 0.139364 2.519668711

Variance

1.664725965

CALCULATED MULTIPLYING FACTOR FOR REASONABLE POTENTIAL CALCS

n	Pn	Z value	σ^2	C _{.99}	Cn	C ₉₉ /C _n (Multiplying Factor)
21	0.8031	0.852695	0.307485	3.114457	1.37587246	2.263623641
22	0.8111	0.882071			1.398468332	2.227048947
23	0.8185	0.909841			1.420169401	2.19301826
24	0.8254	0.936158			1.44104665	2.161246777
25	0.8318	0.961159			1.461162841	2.131492356
26	0.8377	0.984958			1.480573739	2.103547662
27	0.8432	1.007659			1.499329122	2.077233999
28	0.8483	1.029352			1.517473613	2.052396431
29	0.8532	1.050117			1.535047374	2.028899876
30	0.8577	1.070025			1.552086684	2.006625957
31	0.8620	1.089138			1.568624425	1.98547044
32	0.8660	1.107515			1.584690498	1.965341138
33	0.8697	1.125205			1.600312174	1.94615618
34	0.8733	1.142256			1.615514396	1.927842571
35	0.8767	1.158708			1.630320038	1.910334998
36	0.8799	1.1746			1.644750128	1.89357482
37	0.8830	1.189965			1.658824045	1.877509214
38	0.8859	1.204837			1.672559684	1.862090458
39	0.8886	1.219242			1.68597361	1.847275312
40	0.8913	1.233208			1.699081184	1.833024494
41	0.8938	1.246759			1.711896677	1.819302221
42	0.8962	1.259918			1.724433374	1.806075824
43	0.8984	1.272704			1.736703662	1.793315403
44	0.9006	1.285138			1.748719109	1.780993534
45	0.9027	1.297237			1.760490536	1.769085015
46	0.9047	1.309017			1.772028081	1.757566633
47	0.9067	1.320494			1.783341253	1.74641697
48	0.9085	1.331682			1.794438986	1.73561623
49	0.9103	1.342593			1.805329684	1.72514608