Compliance Averaging of Soil Contaminant Concentrations

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Under NR 720, Wis. Adm. Code

Point-to-Point Comparison to Standard

NR 720.07 General requirements …

(2) COMPLIANCE WITH SOIL CLEANUP STANDARDS. (a) Contaminant concentrations in soil samples shall be determined using a department–approved and appropriate analytical method and reported on a dry weight basis…

(b) Unless an alternative approach for determining standards exceedances is approved by the department, if a soil contaminant concentration in a sample exceeds the soil cleanup standard at or above the limit of quantitation for that soil contaminant, the soil cleanup standard shall be considered to have been exceeded.

“Soil” Terms

- RCL – Residual Contaminant Level (DNR)
- RSL – Regional Screening Level (U.S. EPA)
- BTV – Background Threshold Value (Statistics)
- UCL – Upper 95% Confidence Limit for the Mean (Statistics)

RR's Spreadsheet of Soil RCLs

Direct-Contact RCLs

1. ***Enter data in yellow cells.*** Numeric-only values under "INPUT Site Data." For ND, use detection limit. Do not type '-', 'NA' nor 'space bar.' Leav
2. ***After completing data entry, click "Get Summary" in*** *Row 892*. Click to go there.

Click to Clear INPUT Site Data Entries (Column H)

(Contaminants not in the provided list can be added starting at Row 880.)

BTV

Find ... Contaminant	CAS Number	NC RCL (mg/kg)	C RCL (mg/kg)	Not-To-Exceed D-C RCL (mg/kg)	Basis	Background Threshold Value (mg/kg)	INPUT Site Data (mg/kg)	Comparison / Flag E = Individual Exceedance!
Benzene	71-43-2	111.	1.49	1.49	ca			
Ethylbenzene	100-41-4	4,220.	7.47	7.47	ca			
Toluene	108-88-3	5,300.	-	818.	Csat			
Xylenes	1330-20-7	890.	-	258.	Csat			
Methyl tert-Butyl Ether (MTBE)	1634-04-4	23,800.	59.4	59.4	ca			
Dichloroethane, 1,2-	107-06-2	46.7	0.608	0.608	ca			
Dibromoethane, 1,2-	106-93-4	107.	0.047	0.047	ca			
Trichloroethylene	79-01-6	6.05	1.26	1.26	ca			
Tetrachloroethylene	127-18-4	115.	30.7	30.7	ca			
Vinyl Chloride	75-01-4	93.3	0.067	0.067	ca			
Dichloroethylene, 1,1-	75-35-4	342.	-	342.	nc			
Dichloroethylene, 1,2-trans-	156-60-5	1,560.	-	1,560.	nc			
Dichloroethylene, 1,2-cis-	156-59-2	156.	-	156.	nc			
Trichloroethane, 1,1,1-	71-55-6	12,300.	-	640.	Csat			
Carbon Tetrachloride	56-23-5	137.	0.854	0.854	ca			
Trimethylbenzene, 1,2,4-	95-63-6	89.8	-	89.8	nc			
Trimethylbenzene, 1,3,5-	108-67-8	782.	-	182.	Csat			
Naphthalene	91-20-3	188.	5.15	5.15	ca			
Benzo[a]pyrene	50-32-8	-	0.015	0.015	ca			
Acenaphthene	83-32-9	3,440.	-	3,440.	nc			
Acenaphthylene	208-96-8	-	-					
Anthracene	120-12-7	17,200.	-	17,200.	nc			
Benz[a]anthracene	56-55-3	-	0.148	0.148	ca			
Benzo(j)fluoranthene	205-82-3	-	0.377	0.377	ca			
Benzo[b]fluoranthene	205-99-2	-	0.148	0.148	ca			
Benzo[g,h,i]perylene	191-24-2	-	-					

Overview | Non-Industrial_DC_RCLs | Industrial_DC_RCLs | Summary_Soil_DC_Data | GW_RCLs

Concentrations from depth of 0 to 4 ft

If concentration < BTV, direct contact is ignored.

Groundwater-Protective RCLs

NOT for Compliance Averaging

Available at RR's "Resources for Environmental Professionals" WebPage

http://dnr.wi.gov/topic/Brownfields/Professionals.html

Where'd the RCLs come from?

1.) **U.S. EPA** RSL Web-Calculator

http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm

2.) **USGS** Report for the BTVs

http://pubs.usgs.gov/sir/2011/5202/

RCLs from EPA RSL Website

Regional Screening Table | Mid-Atlantic Risk Assessment | US EPA

U.S. ENVIRONMENTAL PROTECTION AGENCY

Mid-Atlantic Risk Assessment

EPA Reg. 3 Server

Serving Delaware, District of Columbia, Maryland, Pennsylvania, Virginia, and West Virginia

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- Mid-Atlantic Hazardous Site Cleanup
- Risk Assessment
- Ecological Risk
- Human Health Risk

Regional Screening Table

You will need the free Adobe Reader to view some of the files on this page. See EPA's PDF page to learn more.

For assistance/questions please use the rbc table contact us page

Table of Contents

- Home Page
- User's Guide
- What's New
- FAQ
- Equations
- Calculator
- Generic Tables

Web-Calculator

Welcome to the "Regional Screening Levels for Chemical Contaminants at Superfund Sites" screening level/preliminary remediation goal website. This website was developed with DOE's Oak Ridge National Laboratory (ORNL) under an Interagency Agreement as an update of the EPA Region 3 RBC Table, Region 6 HHMSSL Table and the Region 9 PRG Table. Here you will find tables of risk-based screening levels, calculated using the latest toxicity values, default exposure assumptions and physical and chemical properties, and a calculator where default parameters can be changed to reflect site-specific risks. To ensure proper use of the screening level tables and the calculator, please review the What's New, User's Guide, Frequently Asked Questions, and Download Area links. Below is a general description of screening levels for chemical contaminants. If the calculator is used with non-default inputs in a decision on a Superfund site, it is recommended that the inputs be clearly identified and justified by the user.

Introduction

Superfund sites are addressed under the authority of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980, which was amended by the 1986 Superfund Amendments and Reauthorization Act. The purpose of this website is to provide a screening level

BTVs from USGS Report

Title: Distribution and Variation of Arsenic in Wisconsin Surface Soils, With Data on Other Trace Elements

Table 1–2. Statistical summary, including 95-percent upper confidence limit of the mean (95% UCL), of trace elem
Wisconsin. Summaries are for the entire dataset after outliers were removed. (*For the element molybdenum, the p
for the censored-data methods that were used in this report. None of the summary statistics were calculated for th

[Statistics are for concentrations in milligrams per kilogram]

BTV

Trace element	Number of samples	Non-detects (%)	Minimum detected value	Maximum detected value	Median	Mean	95% UCL of the mean
Aluminum	662	0	610	28,721	8,282	9,147	9,479
Arsenic	654	32.3	1.0	8.3	1.8	2.3	2.4
Barium	658	0	3.53	364	92.0	101	105
Calcium	607	0	22.9	14,536	1,931	2,831	3,025
Cadmium	642	38	0.10	1.07	0.15	0.23	0.25
Cobalt	661	1.5	0.51	22.0	6.34	6.61	6.87
Chromium	659	0	0.95	43.5	12.5	13.7	14.2

Page 41 of Report

“Soil” Terms

- ~~RCL – Cleanup level in soil (mostly calculated)~~
- ~~RSL – Has algorithm for RCL calculation~~
- ~~BTV – Background that may become RCL~~
- UCL – Statistic For Comparison to DC-RCL

UCL

- Upper 95% Confidence Limit for the Mean
- Applies to a single population
- Can be compared to DC-RCL
- U.S. EPA's ProUCL software

Multiple Populations?

ProUCL 5.0 Capabilities

A summary of statistical methods available in the ProUCL software is provided as follows.

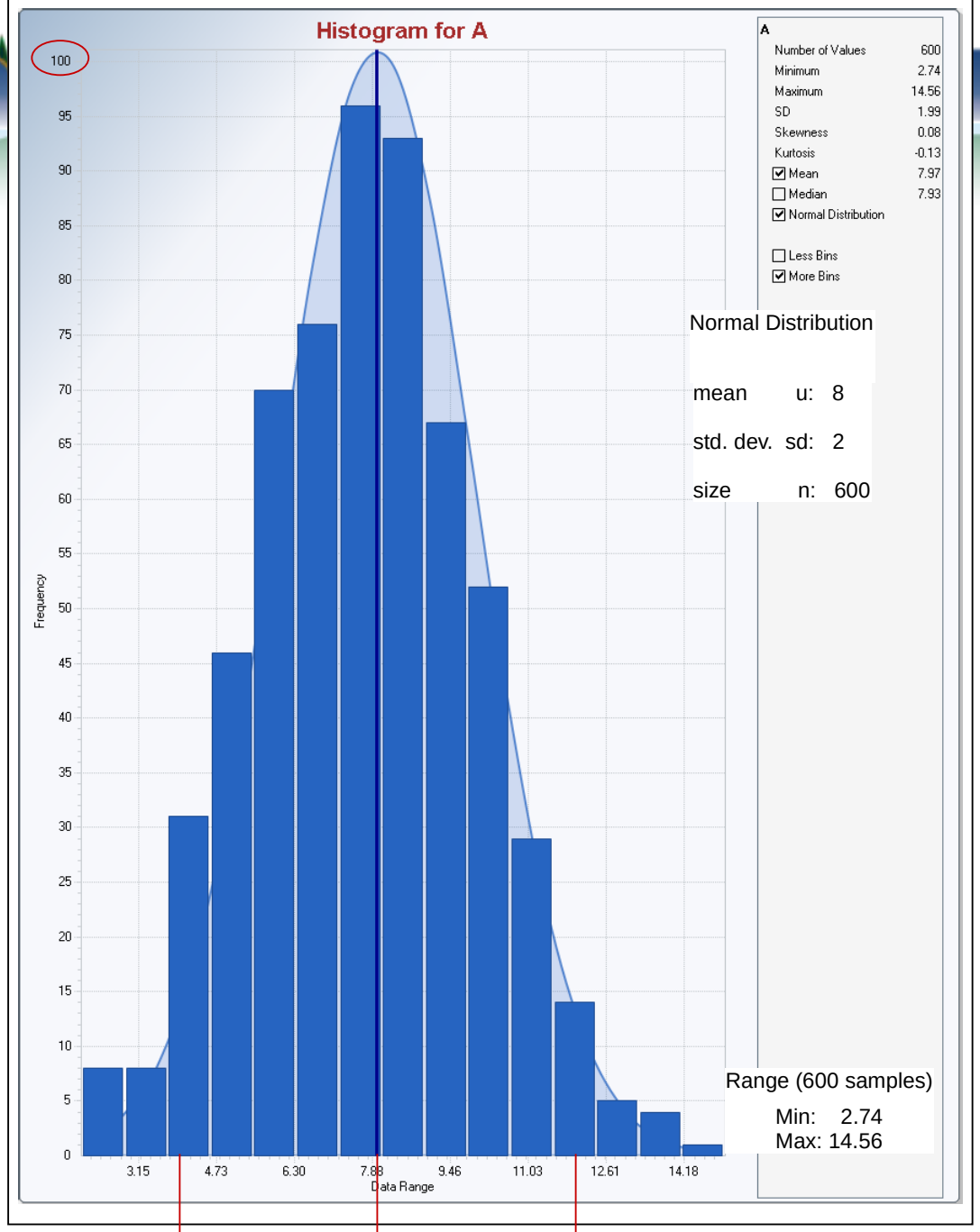
Assumptions: Like most statistical methods, statistical methods to compute upper limits (e.g., UCLs UPLs, UTLs) are also based upon certain assumptions including the availability of a randomly collecte data set consisting of independently and identically distributed (*i.i.d*) observations representing th population (e.g., site area, reference area) under investigation. A UCL of the mean (of a population) an BTV estimates (UPL, UTL) should be computed using a randomly collected (simple random o systematic random) data set representing a single statistical population (e.g., site population o background population). If multiple populations (e.g., background and site data mixed together) ar present in a data set, it is recommended to separate them out first by using the population partitioning techniques (e.g., Singh, Singh, and Flatman 1994), and then compute appropriate decision statistics (e.g. 95% UCLs) separately for each identified population. The topic of population partitioning and th extraction of a valid site-specific background data set from a broader mixture data set potentially consisting of both onsite and offsite data are beyond the scope of ProUCL 5.0 and this guidanc document. Parametric estimation and hypotheses testing methods (e.g., t-test, UCLs, UTLs) are base upon distributional (e.g., normal distribution, gamma) assumptions. ProUCL has GOF tests for normal gamma, and lognormal distributions.

Separate populations, then use ProUCL on each population.

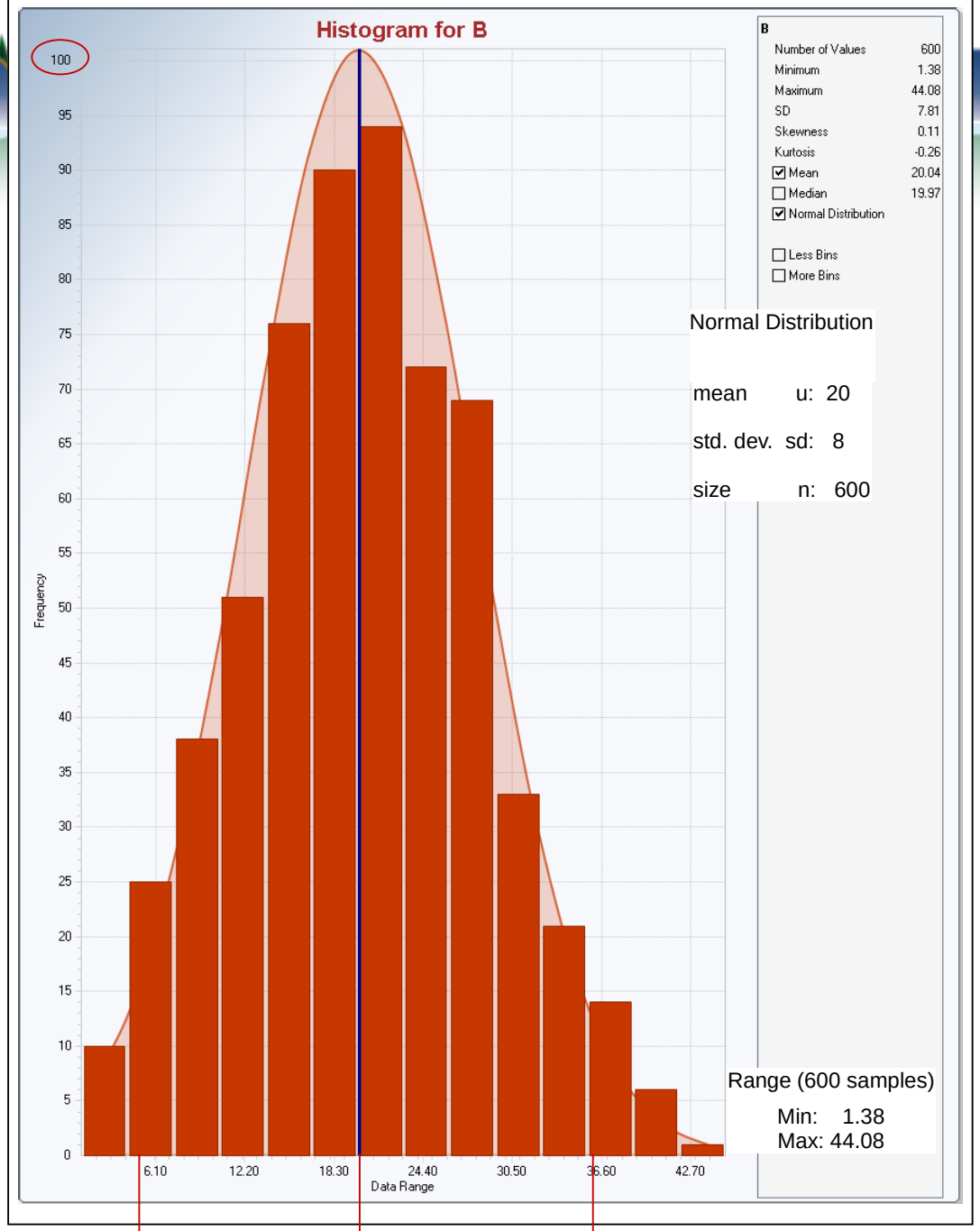
How to Recognize Multiple Populations?

- Histogram
- Q-Q Plot

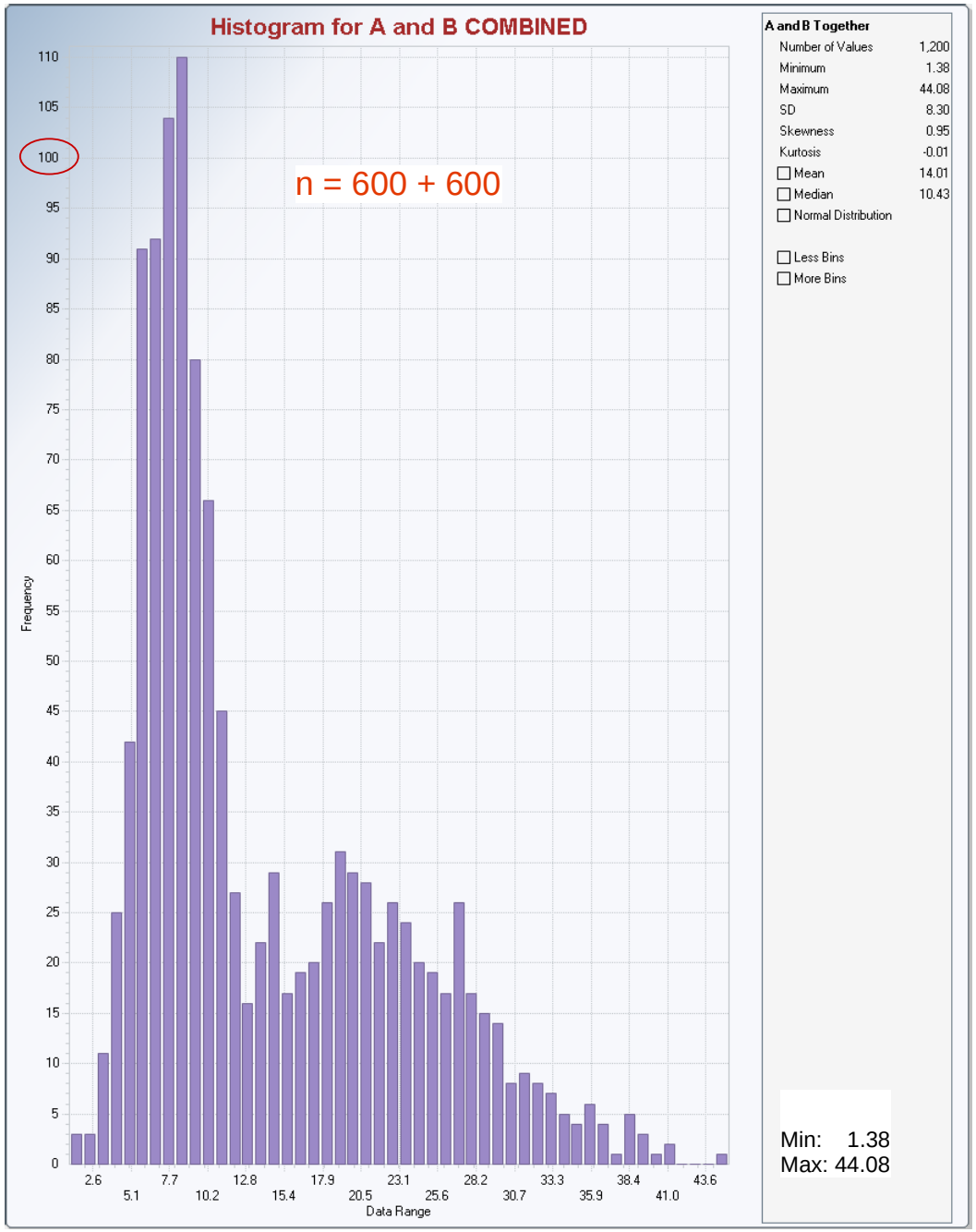
(Exploratory Data Analysis)

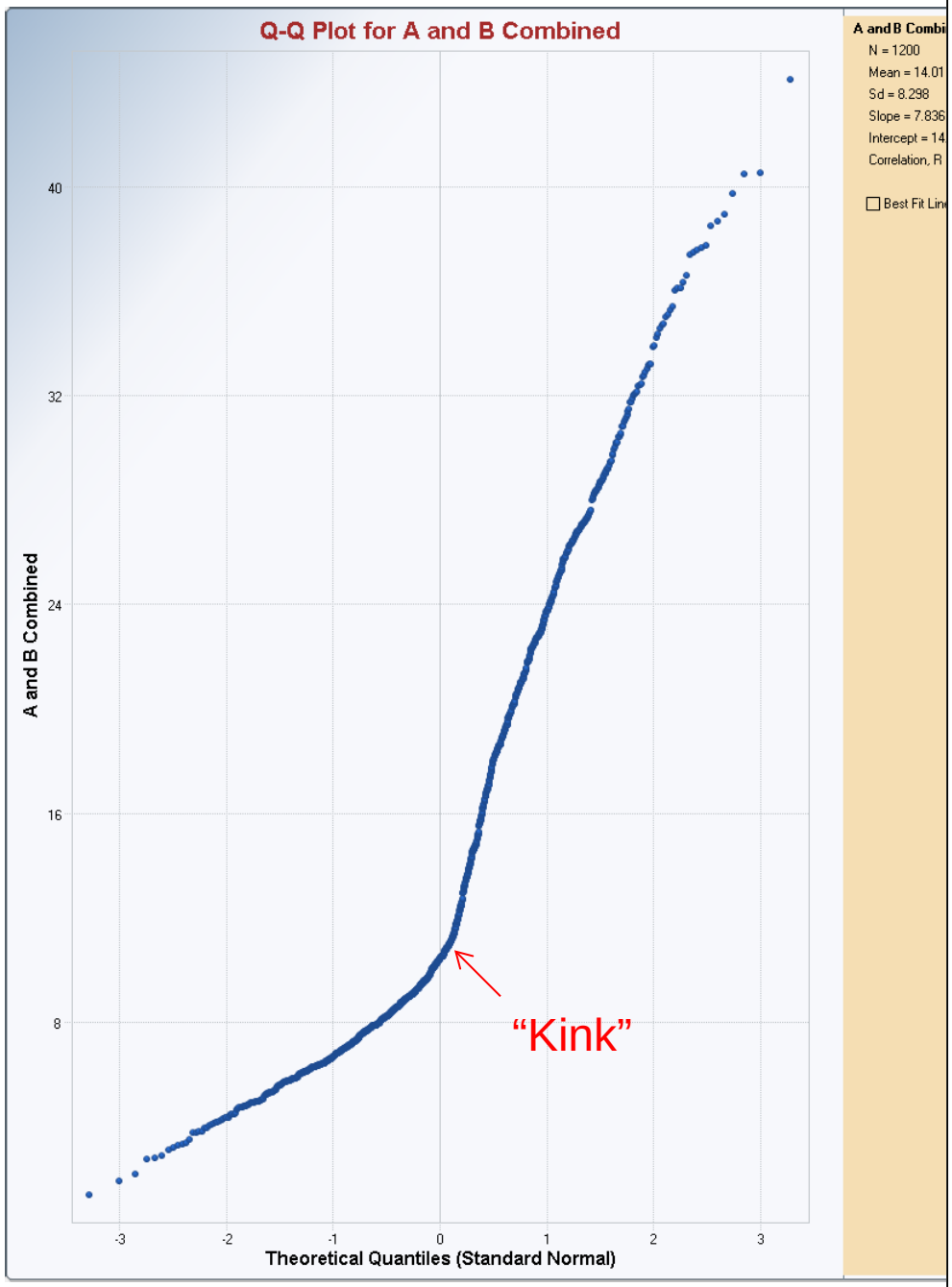

Histogram for A
A
Number of Values 600
Minimum 2.74
Maximum 14.56
SD 1.99
Skewness 0.08
Kurtosis -0.13
Mean 7.97
Median 7.93
Normal Distribution
Less Bins
More Bins
Frequency
Data Range
Normal Distribution
mean u: 8
std. dev. sd: 2
size n: 600
Range (600 samples)
Min: 2.74
Max: 14.56

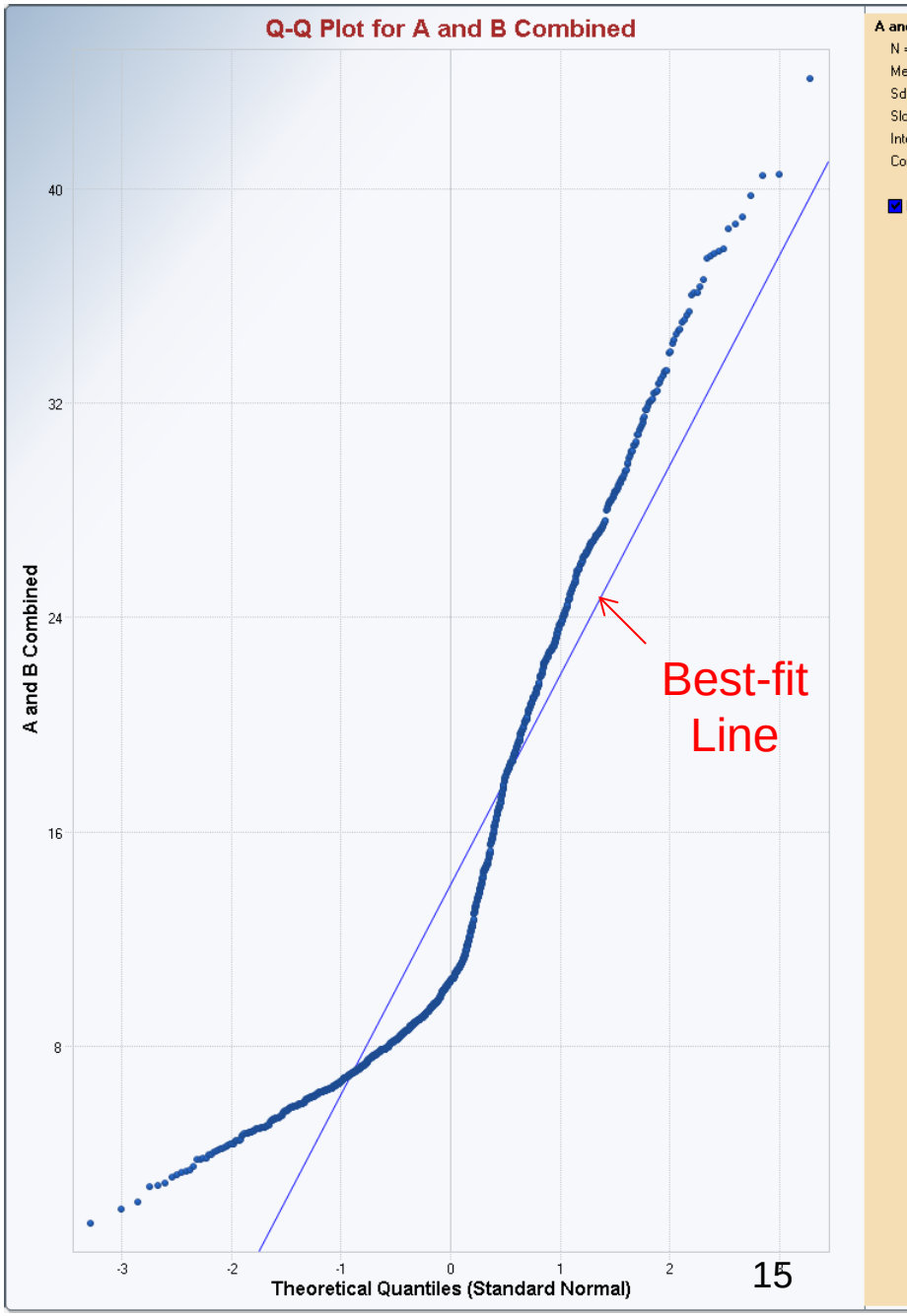
4 8 12

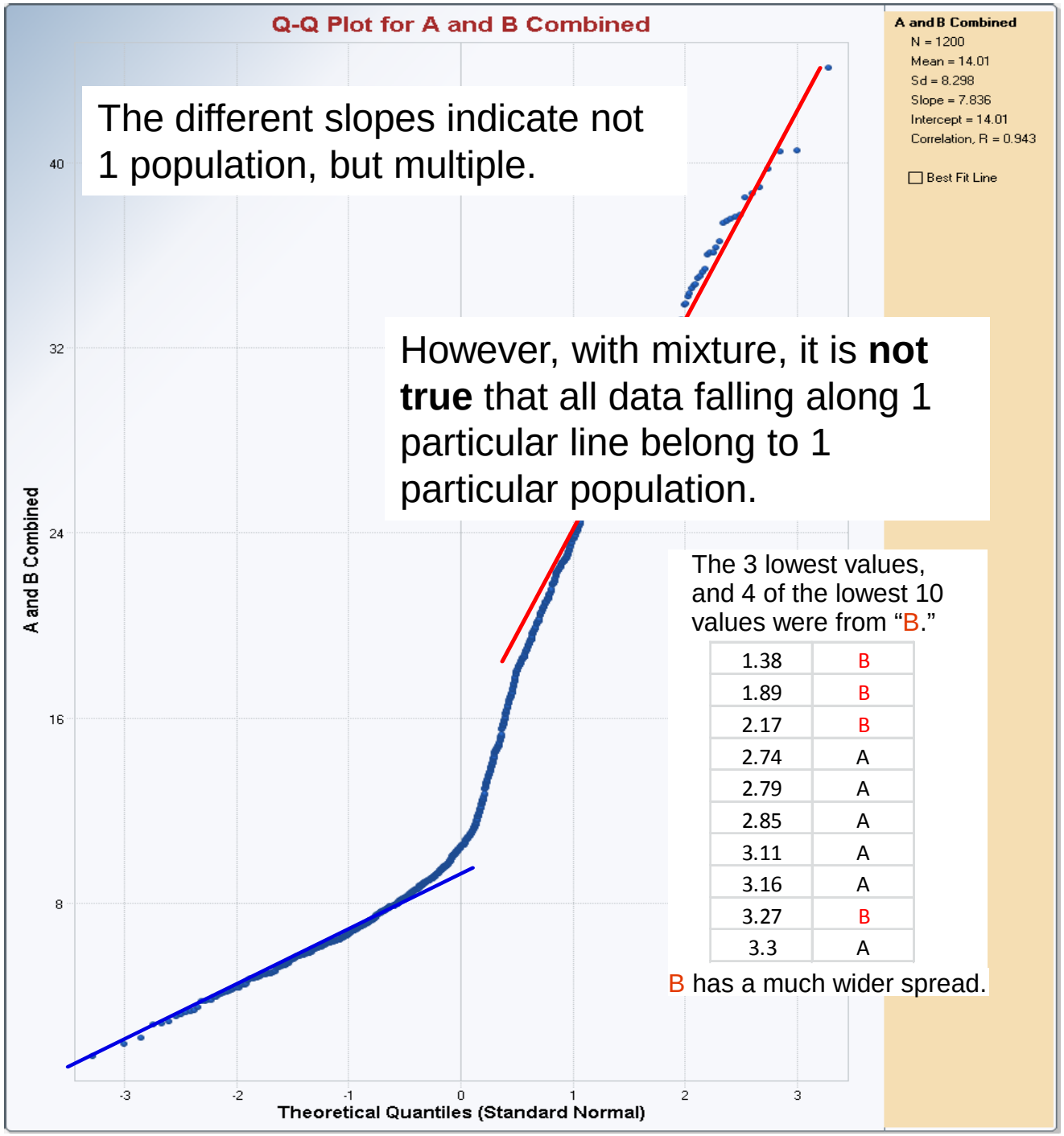

Histogram for B
B
Number of Values 600
Minimum 1.38
Maximum 44.08
SD 7.81
Skewness 0.11
Kurtosis -0.26
Mean 20.04
Median 19.97
Normal Distribution
Less Bins
More Bins
Frequency
Data Range
6.10
12.20
18.30
24.40
30.50
36.60
42.70
Normal Distribution
mean u: 20
std. dev. sd: 8
size n: 600
Range (600 samples)
Min: 1.38
Max: 44.08

4 20 36


Histogram for A and B COMBINED
n = 600 + 600
Frequency
Data Range
A and B Together
Number of Values 1,200
Minimum 1.38
Maximum 44.08
SD 8.30
Skewness 0.95
Kurtosis -0.01
Mean 14.01
Median 10.43
Normal Distribution
Less Bins
More Bins
Min: 1.38
Max: 44.08


Q-Q Plot for A and B Combined
A and B Combi
N = 1200
Mean = 14.01
Sd = 8.298
Slope = 7.836
Intercept = 14
Correlation, R
Best Fit Lin
A and B Combined
Theoretical Quantiles (Standard Normal)
"Kink"


Q-Q Plot for A and B Combined
A and B Combined
Theoretical Quantiles (Standard Normal)
Best-fit Line



The different slopes indicate not 1 population, but multiple.

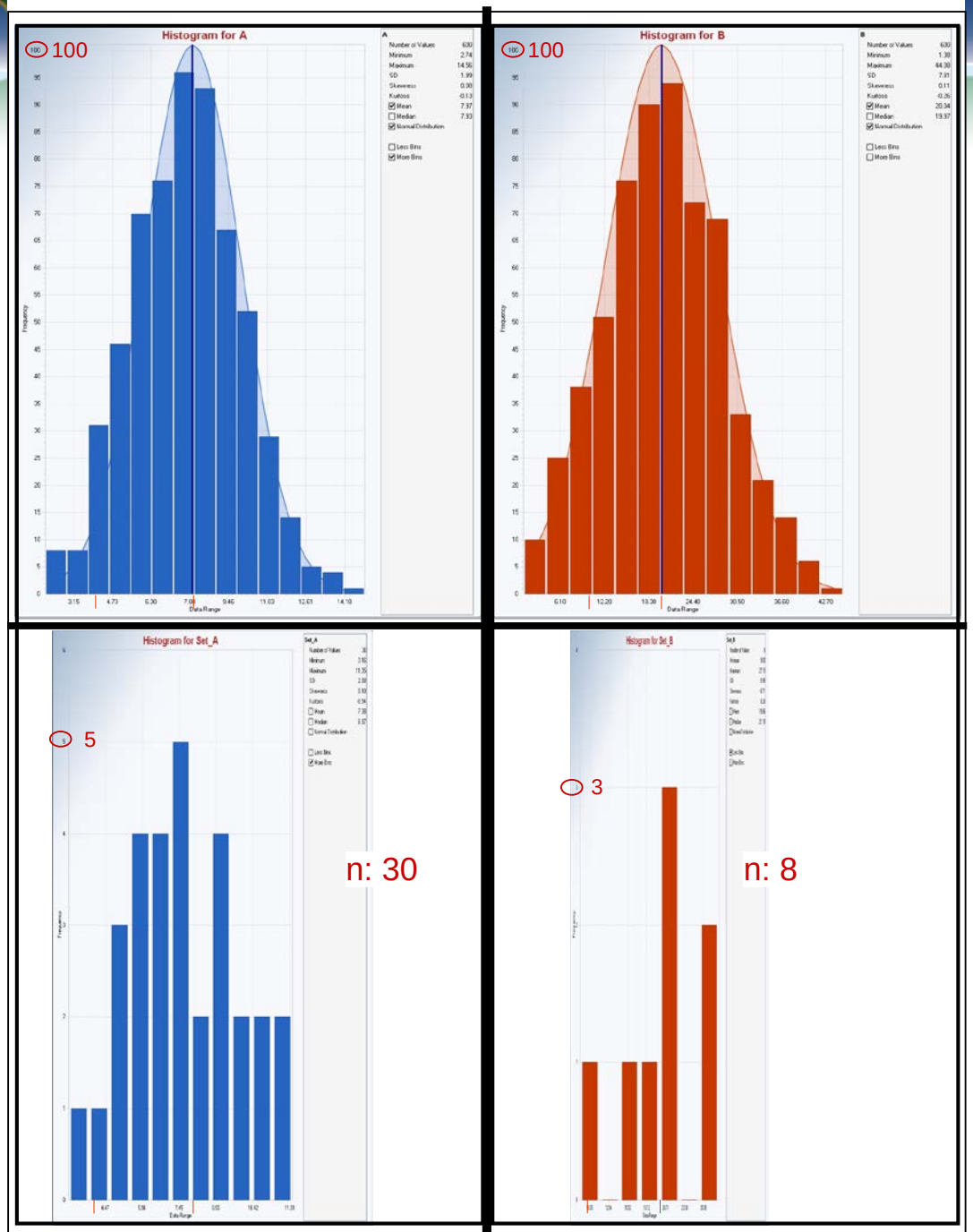
However, with mixture, it is **not true** that all data falling along 1 particular line belong to 1 particular population.

The 3 lowest values, and 4 of the lowest 10 values were from "B."

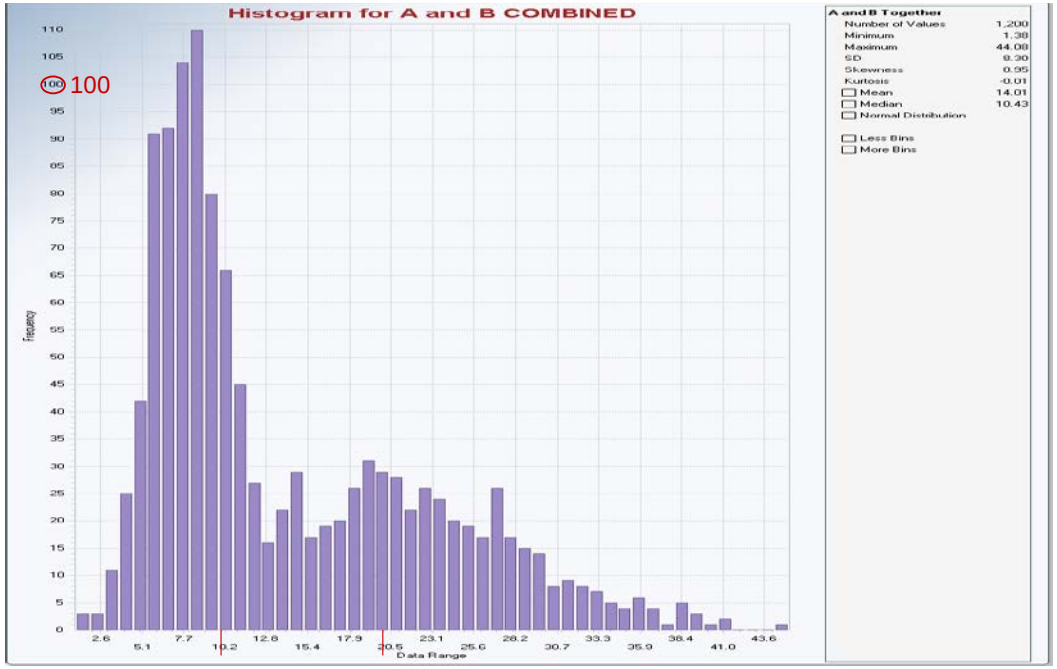
1.38	B
1.89	B
2.17	B
2.74	A
2.79	A
2.85	A
3.11	A
3.16	A
3.27	B
3.3	A

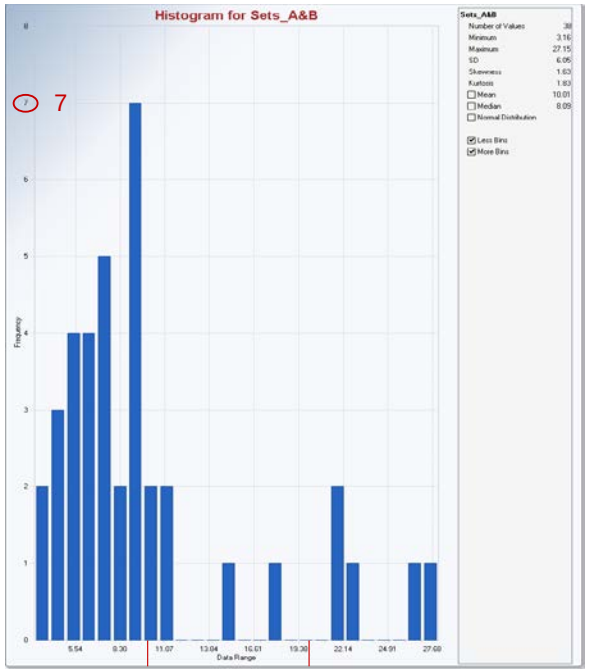
B has a much wider spread.

Sampling Size Matters!



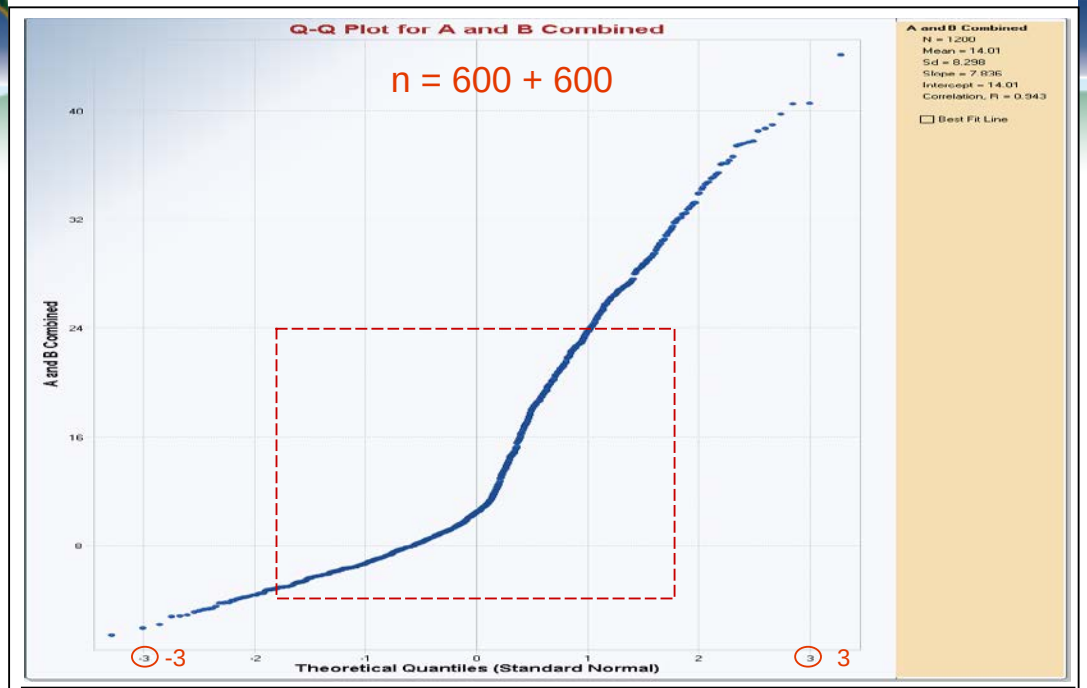
Mixture of Populations

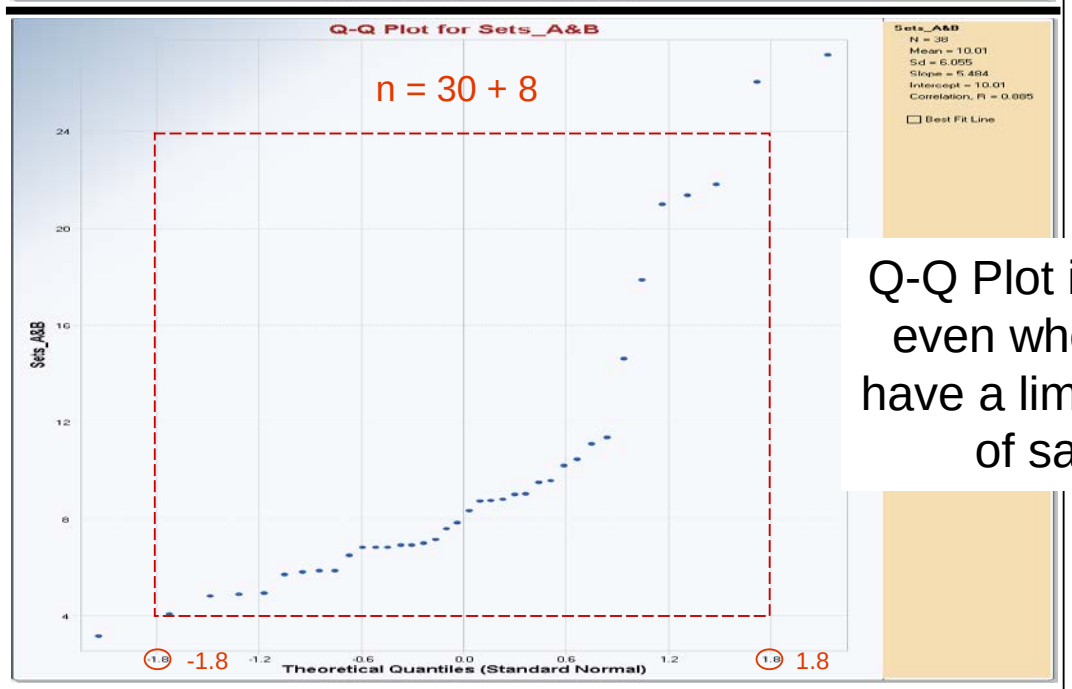




We can't distinguish mixture with histogram alone.

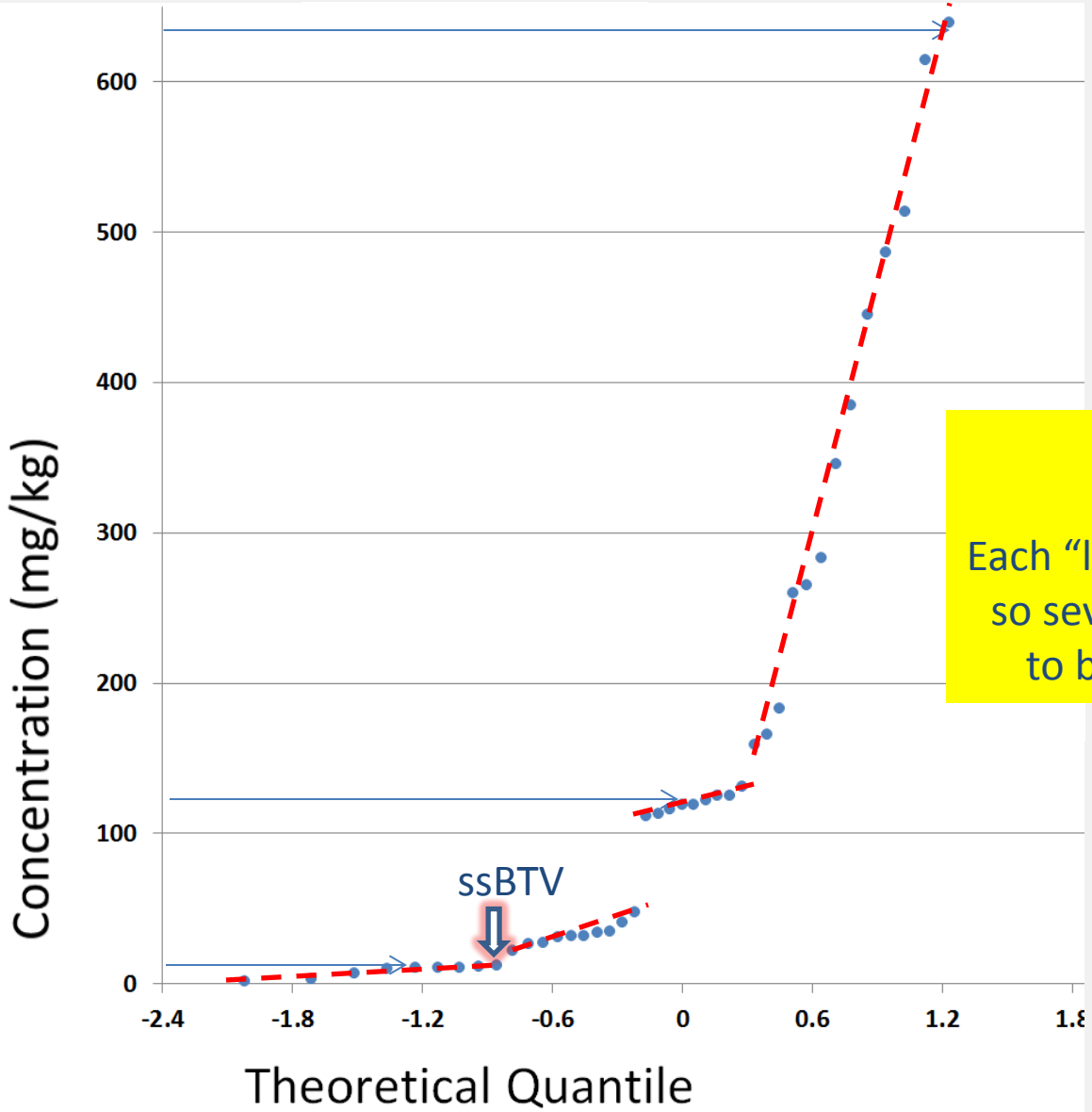
Q-Q Plot of Mixture





Q-Q Plot is still useful even when we may have a limited number of samples!

Multiple Populations?



Yes.

Each "line" has its UCL, so several UCLs need to be calculated.

UCL – DC-RCL Comparison

Data for Contaminant **X**
(RCL for X is **10** mg/kg.)
Red font indicates RCL exceedance.

Sample#	Soil-**X** (mg/kg)
1	8.5
2	9.7
3	10.
4	9.
5	8.
6	10.
7	9.1
8	10.5
9	11.
10	10.2
11	9.4
12	9.6
13	9.4

Soil-X (mg/kg)

General Statistics

Total Number of Observations	13	Number of Distinct Observations	11
		Number of Missing Observations	0
Minimum	8	Mean	9.569
Maximum	11	Median	9.6
SD	0.812	Std. Error of Mean	0.225
Coefficient of Variation	0.0848	Skewness	-0.227

Normal GOF Test

Shapiro Wilk Test Statistic	0.99	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.866	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.11	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.246	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	9.971	95% Adjusted-CLT UCL (Chen-1995)	9.924
		95% Modified-t UCL (Johnson-1978)	9.968

Suggested UCL to Use

95% Student's-t UCL	9.971

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

RCL Summary

- RSL – Regional Screening Level
- BTV – Statewide (unless site-specific)
- UCL – Site-specific for comparison to DC-RCL

Upcoming RR Program ***Issues & Trends*** Webinars

July 29

New EPA VI Guidance and WI sub-slab VRSL

Terry Evanson

August 5

Navigating VPLE (Voluntary Party Liability Exemption)

Michael Prager