Trace Elements in Ground Water Of the United States

Lopaka (Rob) Lee and Dennis Helsel

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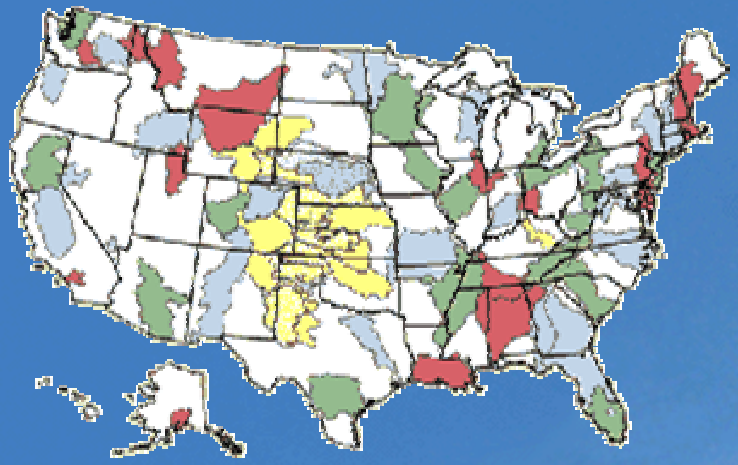

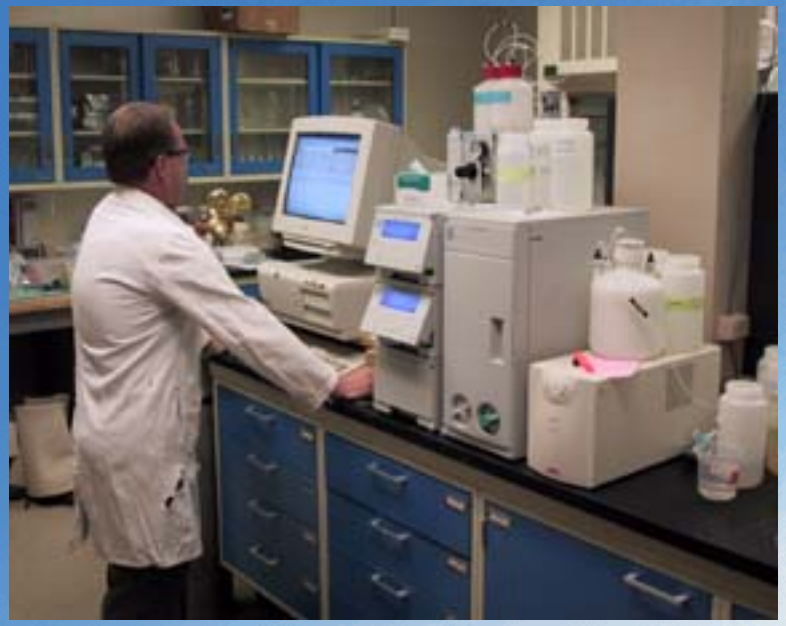

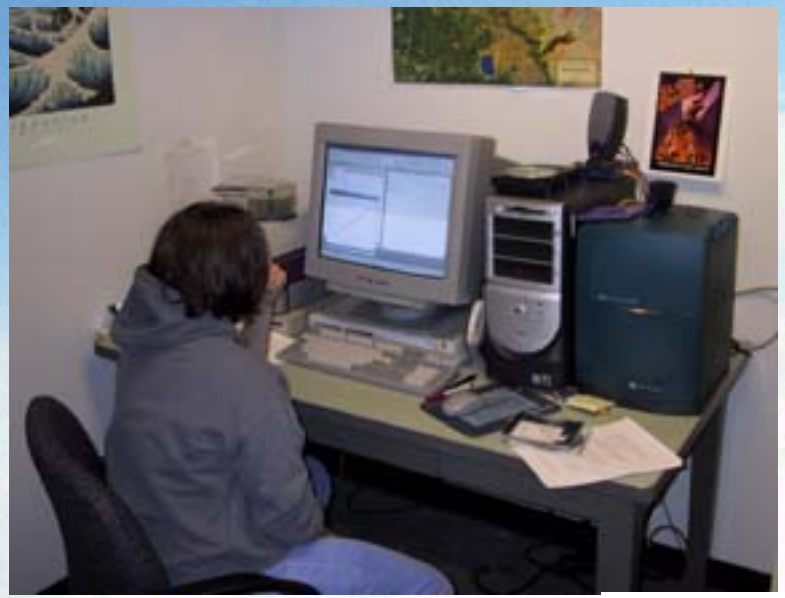

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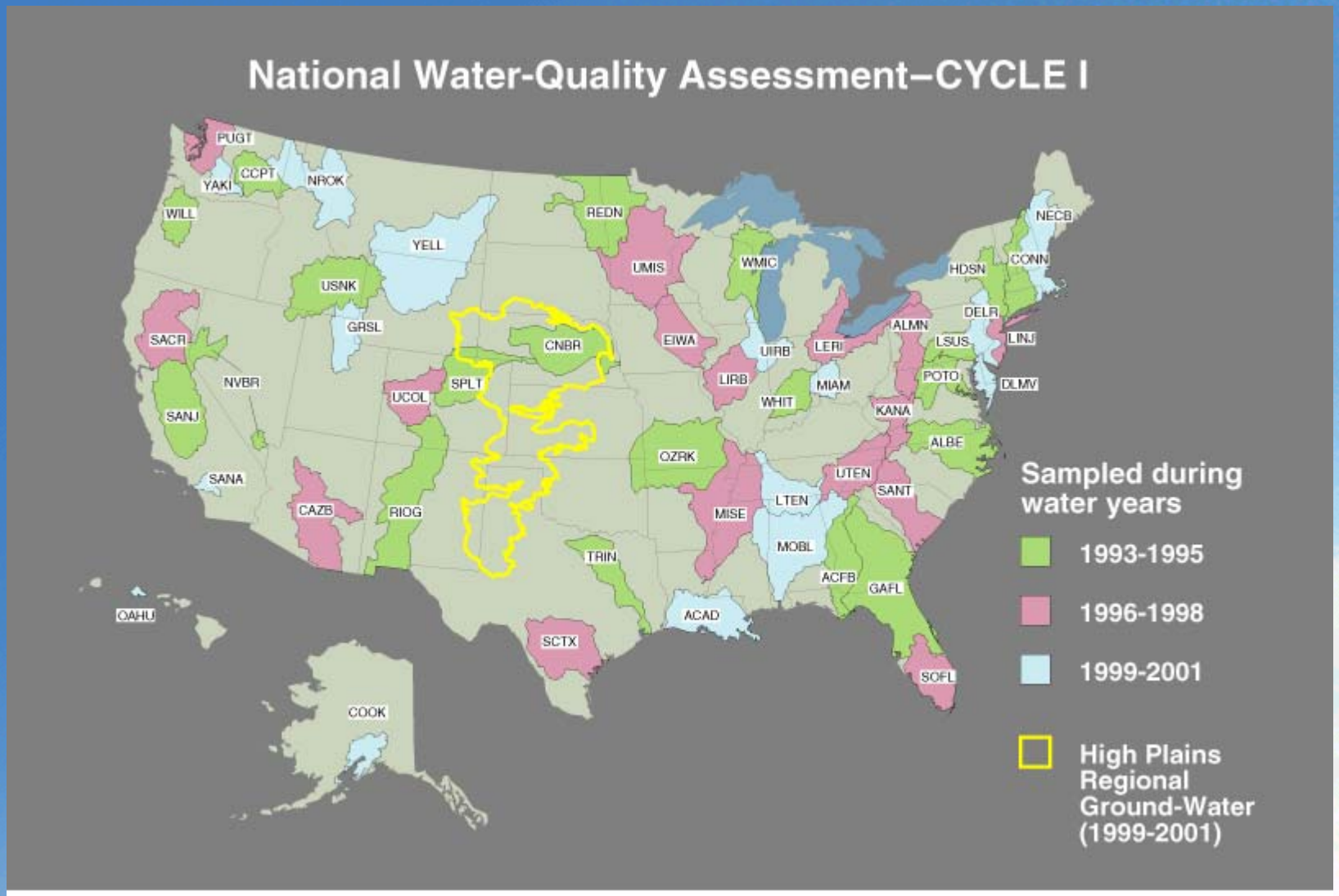

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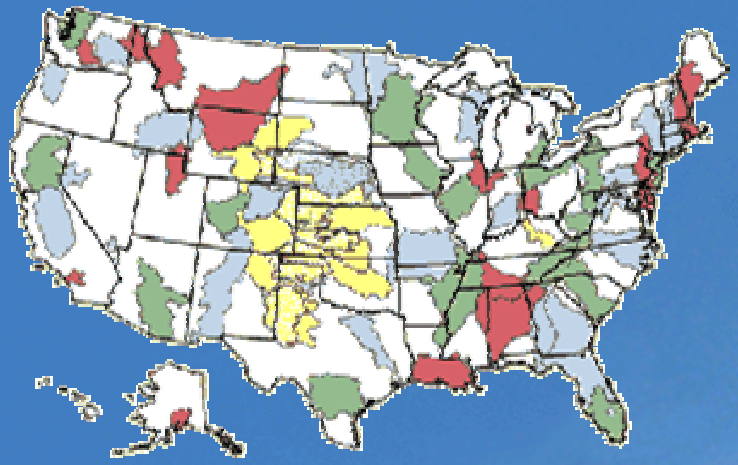

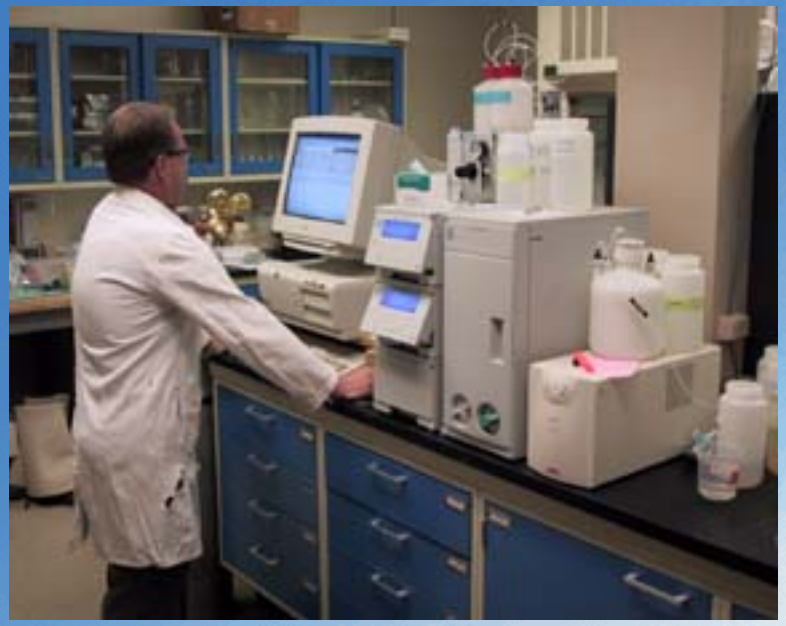

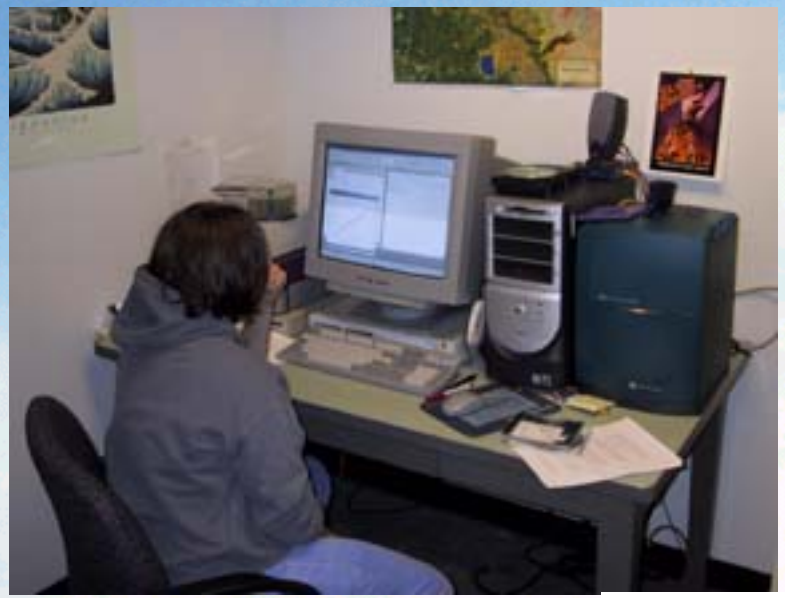

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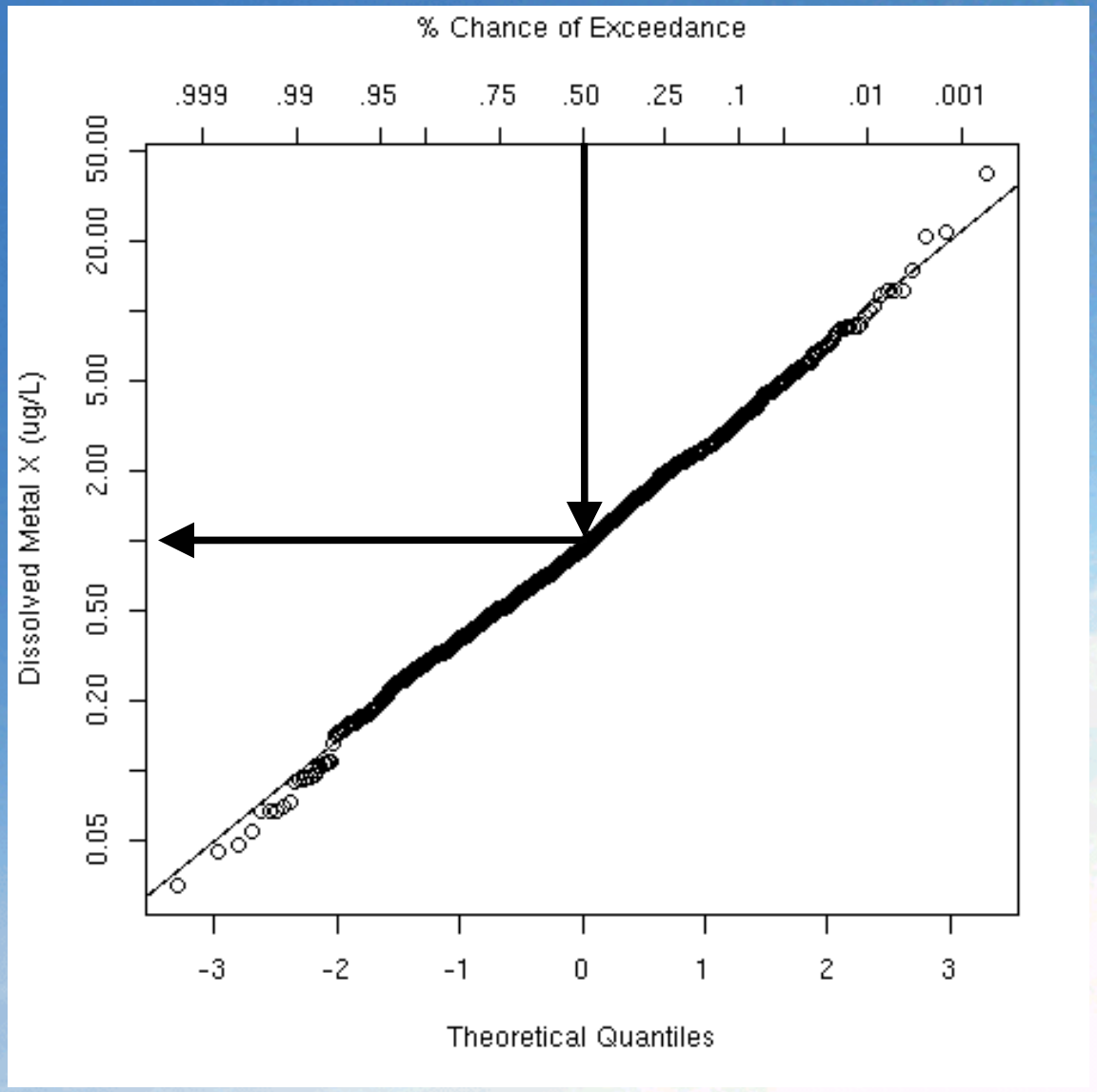
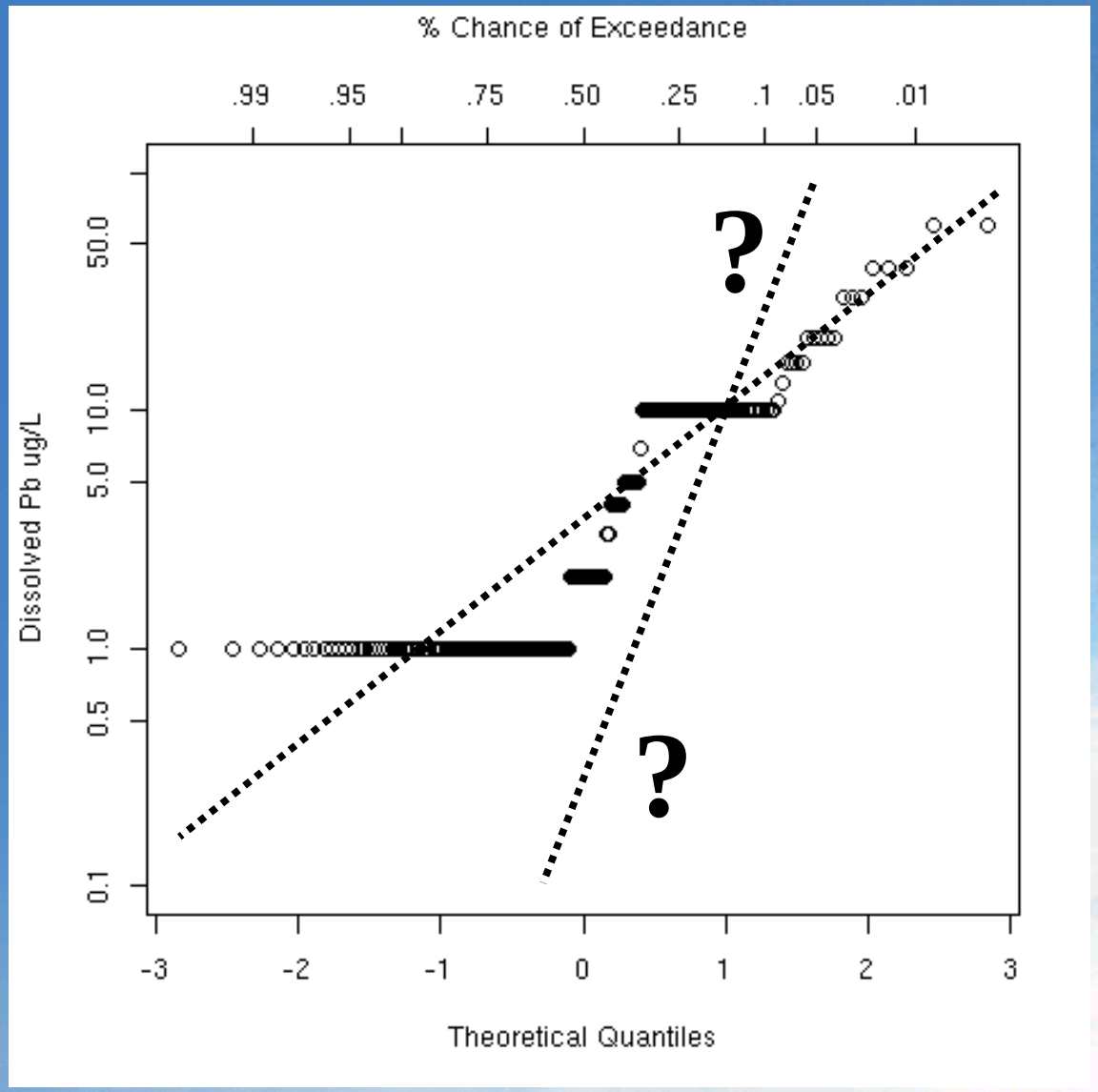
Trace Element Distributions – *The **Ideal** World*



Trace Element Distributions – *The **Real** World*



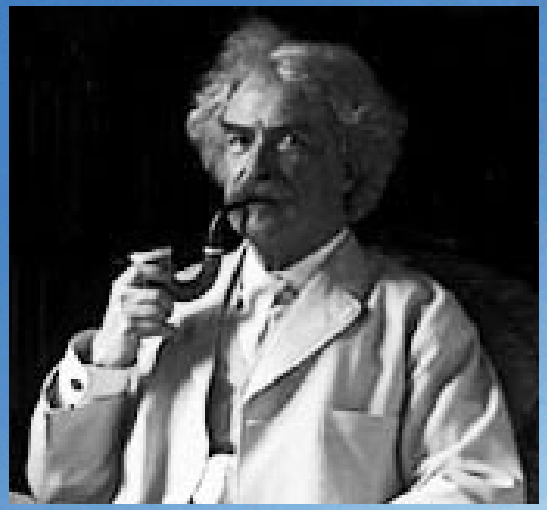
Problems:

Censored Data

***Multiple* Censoring Levels**

Mark Twain Misquoted:

Lies, Damn Lies, and Statistics.



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Statistical Methods for Dealing with Nondetects

- Simple Substitution
- Parametric Methods (MLE, …)
- Nonparametric Methods

<u>Linear Regression on Order Statistics (LROS)</u>

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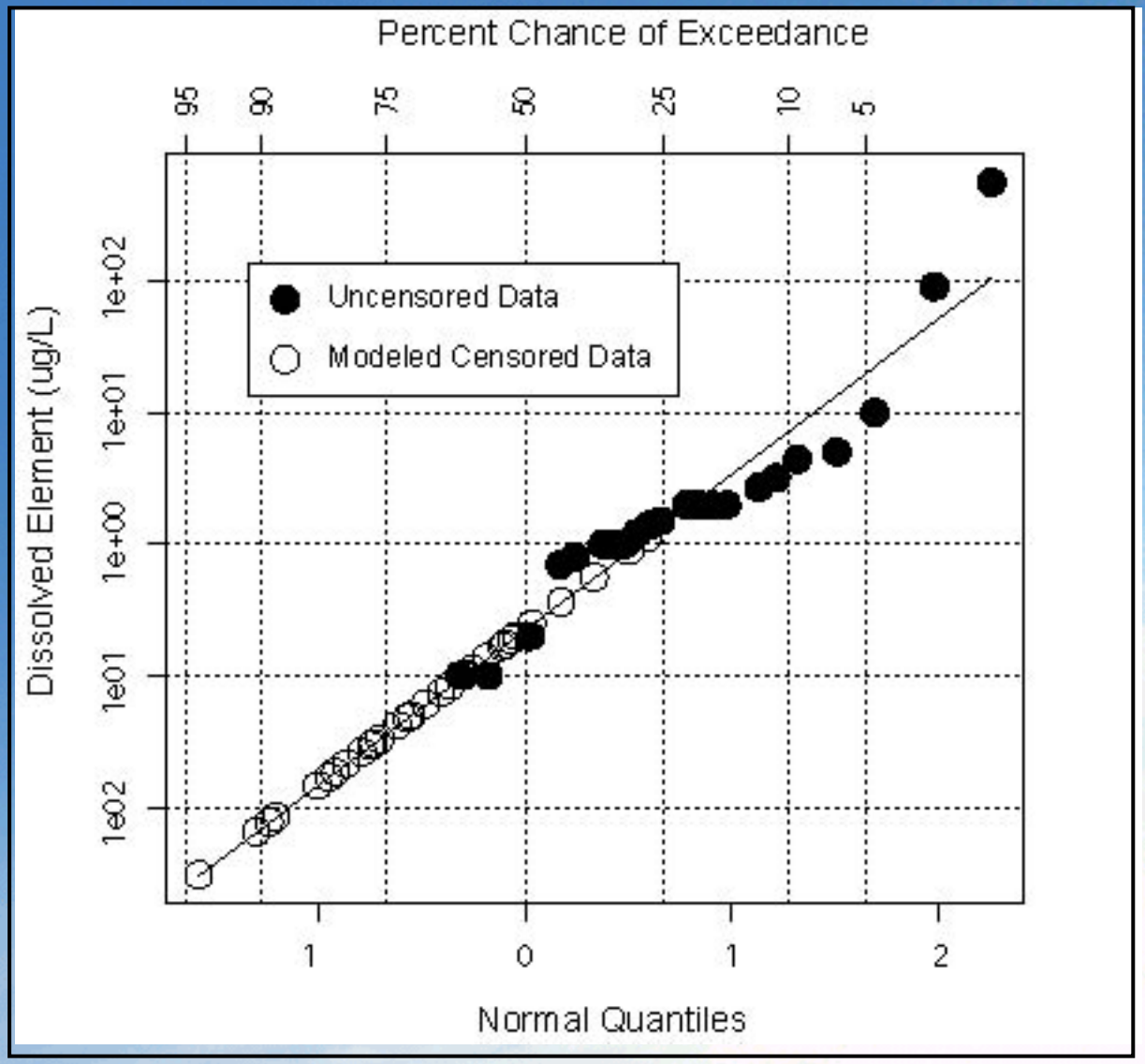
Robust LROS (Helsel-Cohn Method)



National Medians for Dissolved Elements (Ground Water)

Element	**Median** (ug/L)
Zinc	8
Copper	1
Arsenic	0.7
Nickel	0.7
Selenium	0.2
Lead	0.1

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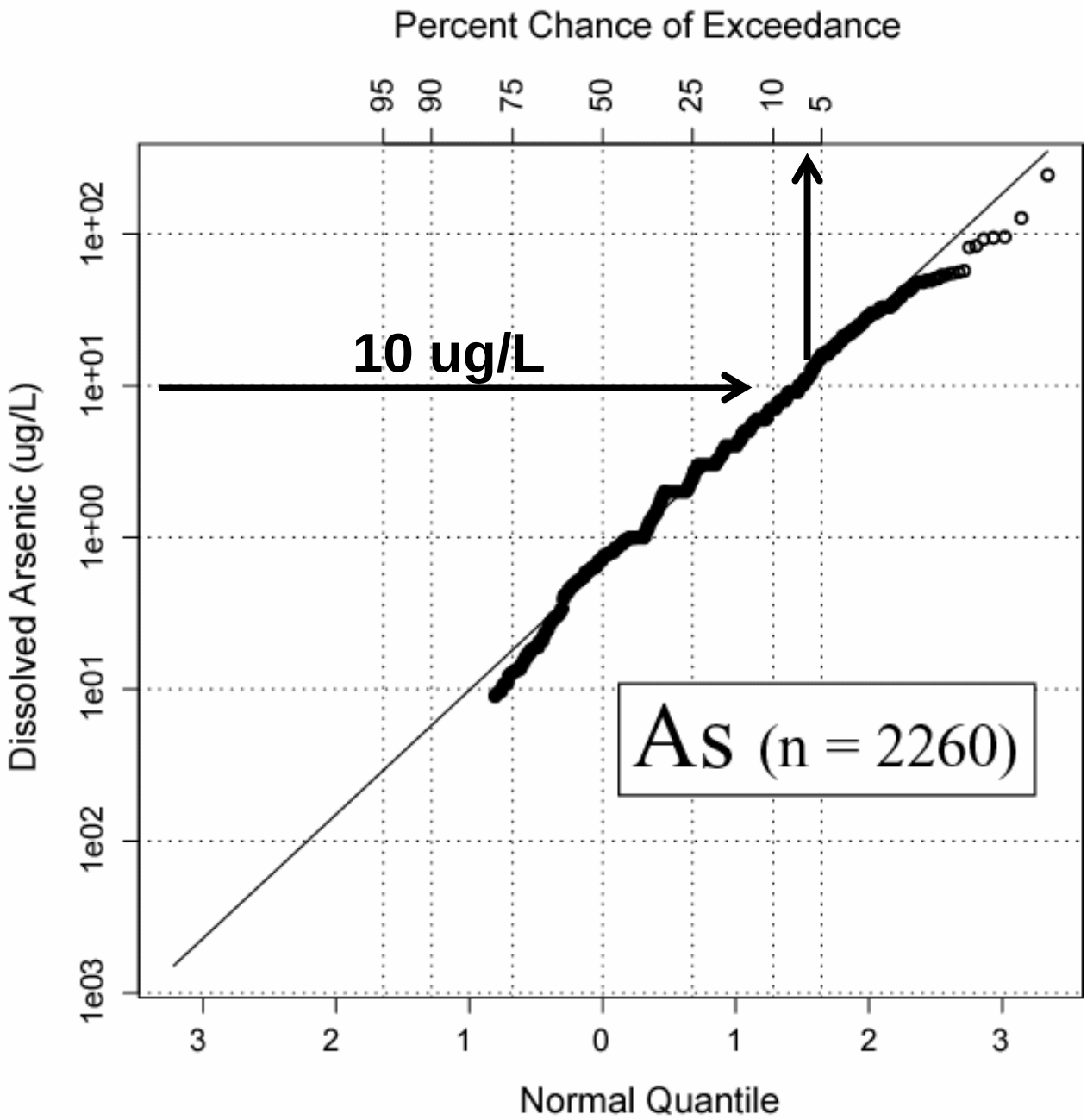

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National Exceedance Probabilities for EPA Standards (Groundwater)

Element	EPA MCL (ug/L)	Exceed. Prob. (%)
Arsenic	10	7
Molybdenum	40	1.5
Lead	15	0.5
Selenium	50	0.2
Nickel	100	0.05

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NAWQA

Data Warehouse

http://water.usgs.gov/nawqa

But what about STORET? …

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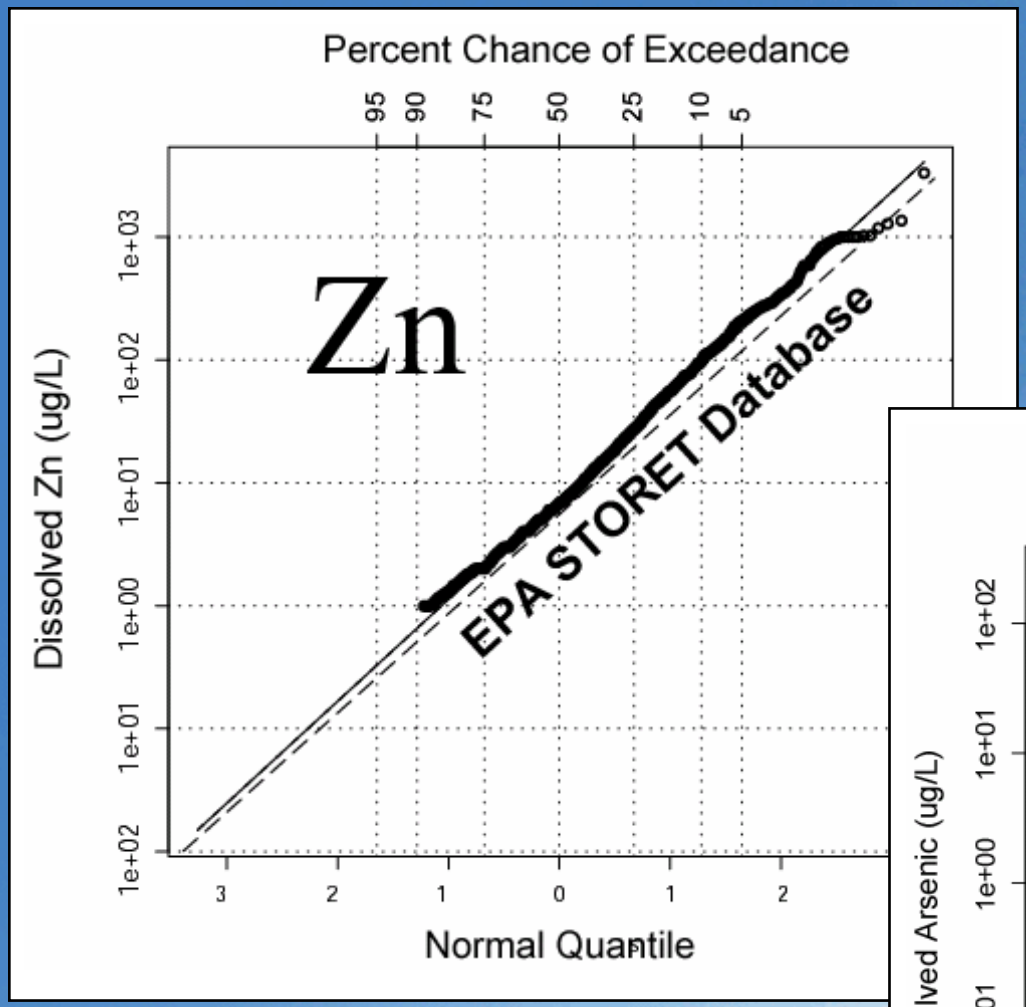
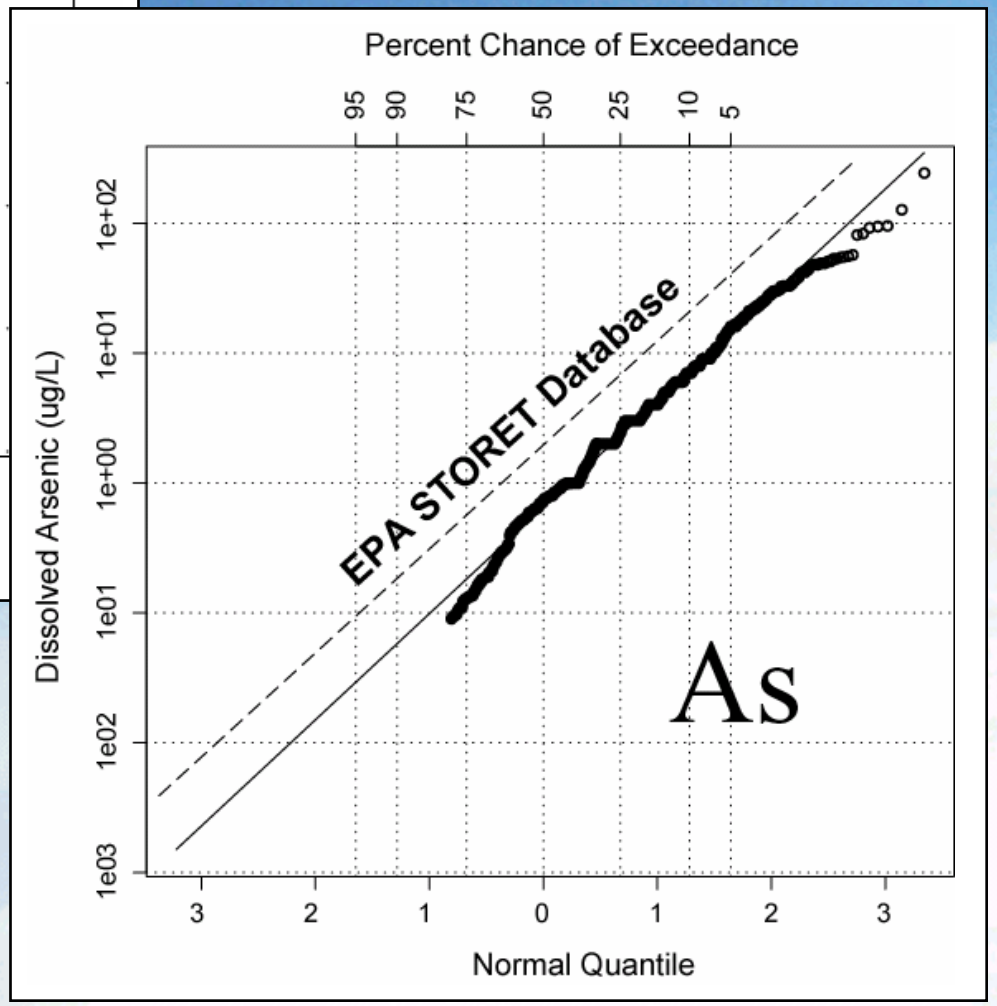

Percent Chance of Exceedance
95
90
75
50
25
10
5
Zn
EPA STORET Database
Dissolved Zn (ug/L)
1e+03
1e+02
1e+01
1e+00
1e+01
1e+02
3
2
1
0
1
2
Normal Quantile


Percent Chance of Exceedance
95
90
75
50
25
10
5
EPA STORET Database
As
Dissolved Arsenic (ug/L)
1e+02
1e+01
1e+00
1e01
1e02
1e03
3
2
1
0
1
2
3
Normal Quantile

Nondetects
And
Data
Analysis

Statistics for Censored Environmental Data

by Dennis R. Helsel

NADA for R and S-Plus

Statistics Software for Censored Data

by Lopaka Lee

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