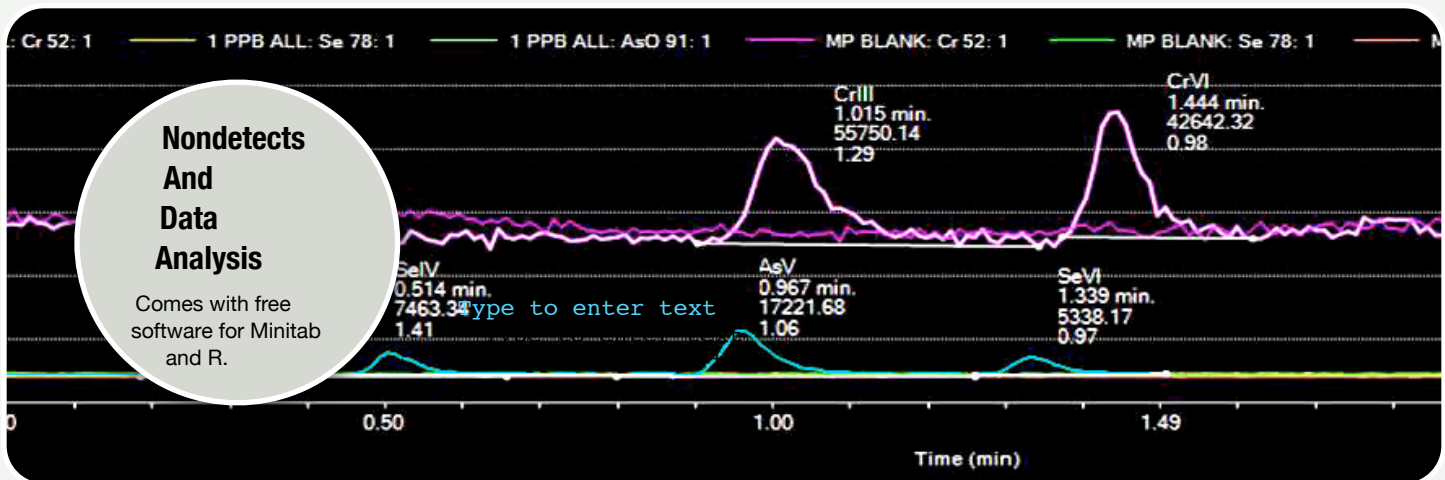


# = Practical Stats

[www.practicalstats.com](http://www.practicalstats.com)



## Nondetects And Data Analysis

Comes with free software for Minitab and R.

## Nondetects And Data Analysis

Statistical methods for data with nondetects. Correctly handle data below detection limits without fabrication of data values (such as one-half the detection limit).

For most environmental professionals, the way to deal with "nondetects" is less than obvious. Values below detection or quantitation limits result from measuring trace amounts of a variety of organic and inorganic chemicals. Inadequate methods such as substitution of one-half the detection limit, Cohen's approximate MLE, or Aitchison's DLOG methods are still being used and recommended even though they produce inaccurate results. This course presents up-to-date (maximum likelihood and survival analysis) methods for computing summary statistics, performing hypothesis tests, regression modeling and trend analysis for data with one or more detection limits. Example problems are worked in class, so students can confidently take these methods back to their office.

Routines in commercial software as well as the free R statistical system are highlighted. A full course outline is available on the Practical Stats website. This course assumes a knowledge of basic statistics, including some familiarity with t-tests, linear regression, and simple nonparametric tests like the rank-sum test.

### INSTRUCTOR

Dr. Dennis Helsel has 30 years experience in applying statistical methods to environmental sciences. He is author of the course textbook *Nondetects And Data Analysis* (Wiley, 2005). He was awarded the Distinguished Achievement Award by the Section on Statistics and Environment of the American Statistical Association in 2003.



### Free Information

Copies of eleven articles on handling of nondetects for low-level contaminant data are available upon request through our website.

## Nondetects And Data Analysis

### Course Outline

#### Day 1

##### Types of Reporting Limits

- detection and quantitation limits
- implications for data analysis

##### Storing Nondetects in a Database

- three standard formats

##### Plotting Data with Nondetects

- censored boxplots
- censored probability plots
- scatterplots with nondetects
- survival curves

##### Overview: The Three Approaches

- ROS (probability plotting)
- maximum likelihood
- nonparametric methods
- why not to substitute (fabricate) data

##### Estimating Descriptive Statistics

- what's the mean of  $<1$ ,  $5 <10$  and  $17$ ?
- parametric methods
- Kaplan–Meier and other nonparametric methods
- why Cohen and Delta–lognormal are “old technology”

##### Computing Interval Estimates

- how to compute confidence intervals with nondetects
- UCLs for censored data
- bootstrapping

##### Tests for paired data

- paired Prentice–Wilcoxon test
- paired “t–test” for censored data

#### Day 2

##### Comparing Two Groups

- Generalized Wilcoxon (nonparametric) test
- MLE “t–test”
- what to do with multiple reporting limits

##### Comparing Three or More Groups

- Generalized Wilcoxon (nonparametric) test
- MLE version of ANOVA
- familiar tests for one reporting limit

##### Correlation Methods

- censored correlation coefficients
- what to do when one or both have multiple detection limits?
- Kendall's tau
- likelihood correlation coefficient

##### Regression and Trends

- how to compute a line with nondetects?
- what to do with multiple reporting limits?
- Akritis–Sen–Theil line
- MLE for regression
- logistic regression

##### Free Software

- All of the software and data sets used in this class are available on the NADA website (address below)