Potency

Calibration and Scoring

for the PCCL

September 17, 2003

Purpose

- Examine the distribution of potency values for a set of contaminants that are representative of chemicals likely to be in the CCL Universe
- Utilize the knowledge gained to calibrate one or more approaches to scoring potency for the PCCL

Learning Set Composition

- Regulated chemicals
- Unregulated chemicals with lifetime health advisories
- Nutrients/food additives with toxicity values similar to lifetime health advisories.

Potency Values Collected

- Reference Dose (RfD)
- E-4 risk concentration in water
- NOAEL from the critical study
- LOAEL from the critical study
- Rat Oral LD_{50}

Sources of Information

- Integrated Risk Information system (IRIS)
- Office of Water (OW) Heath Advisories
- Institute of Medicine (IOM) Tolerable Upper Levels (ULs)for Nutrients

Data Set Characteristics

- 216 chemicals
- 185 RfDs
- 51 E-4 risk concentrations
- 149 Critical NOAELs
- 152 Critical LOAELS
- 171 LD_{50}s
- Most potent dioxin
- Least potent dietary phosphorous

Procedure

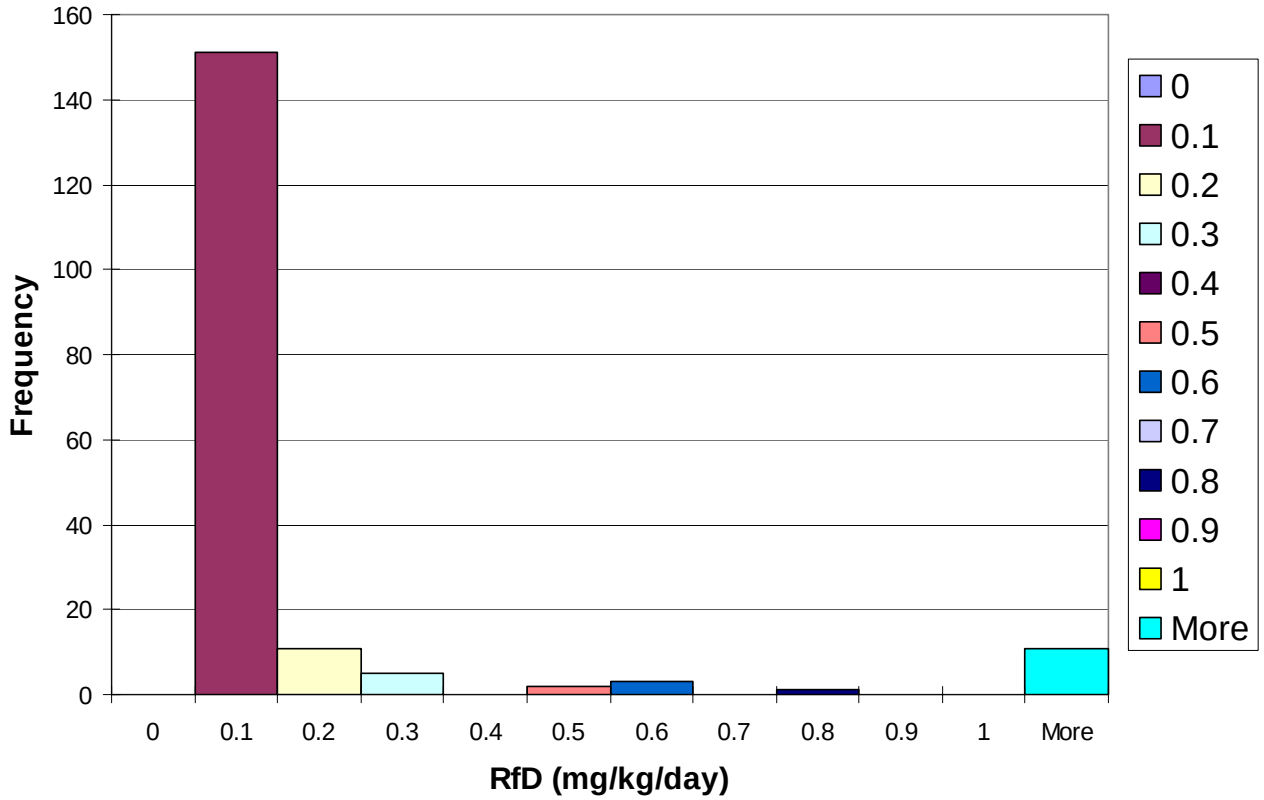
- Enter the potency values into a spread sheet
- Divide the range of potency values into tenths and array the potencies using a histogram
- Take the rounded Log_{10} for each potency value and array the potencies using a histogram

Procedure (contd.)

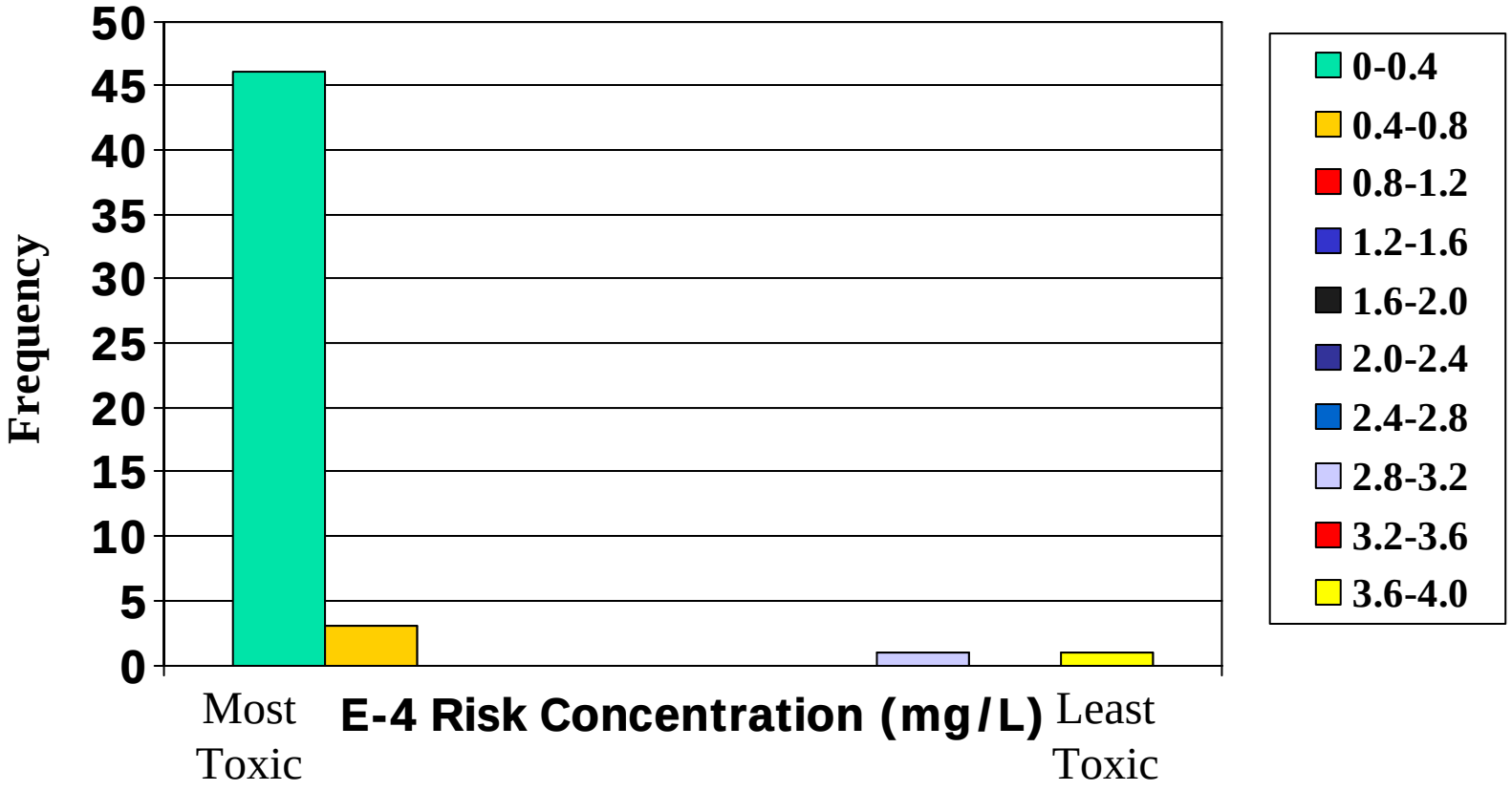
- Calibrate scoring equations for each data set that equates the modal Log_{10} of the potency value to a score of 5 on a 1-10 potency scale.
  - This was the process used for the March, 2003 algorithm exercise
- Test the scoring equations for each type of potency value and examine whether or not the scores agree.

Results - Histograms

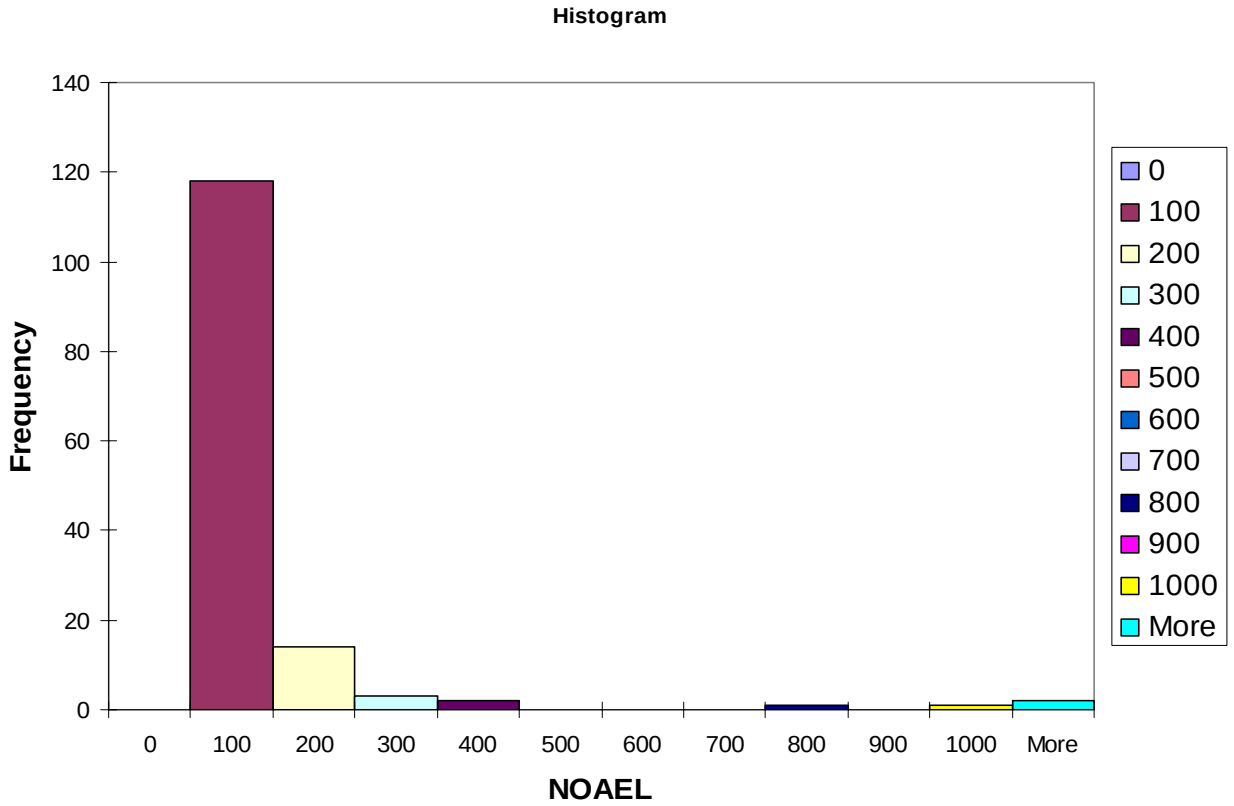
RfD Distribution by Deciles



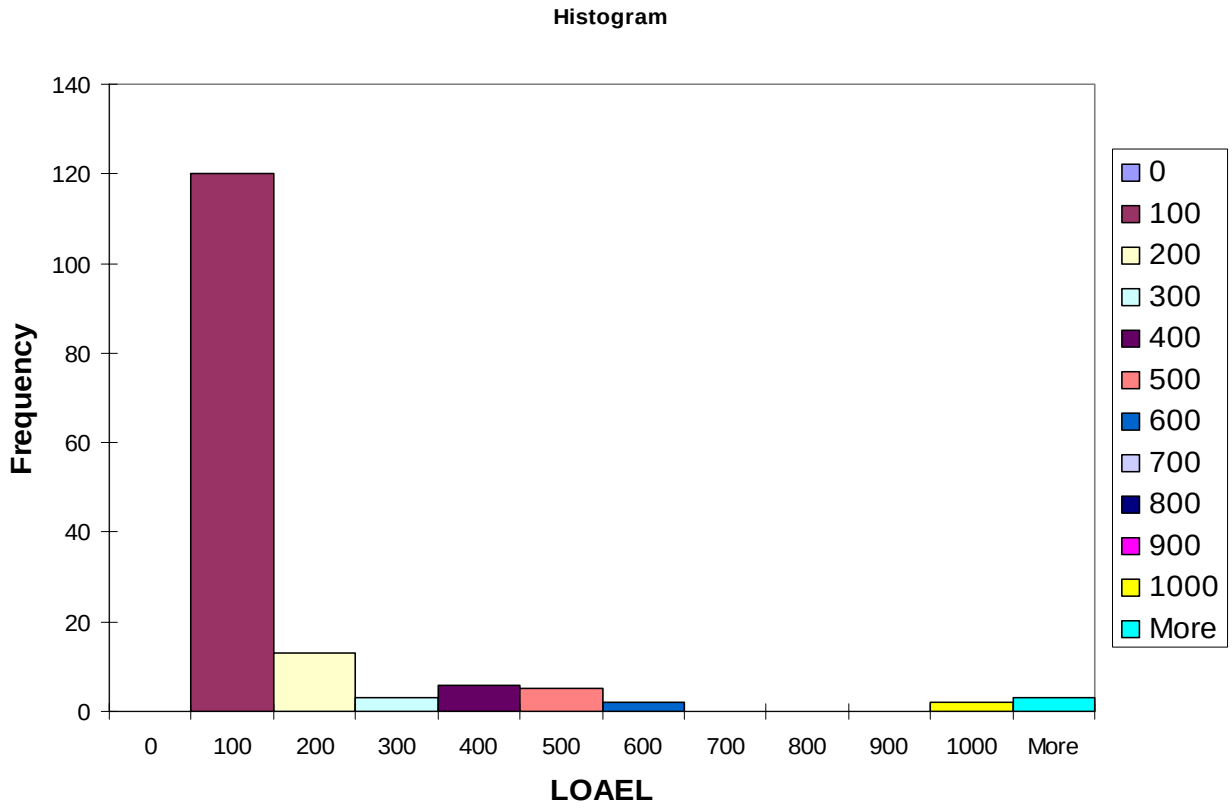
Distribution of Concentration for E^{-4} risk by Deciles



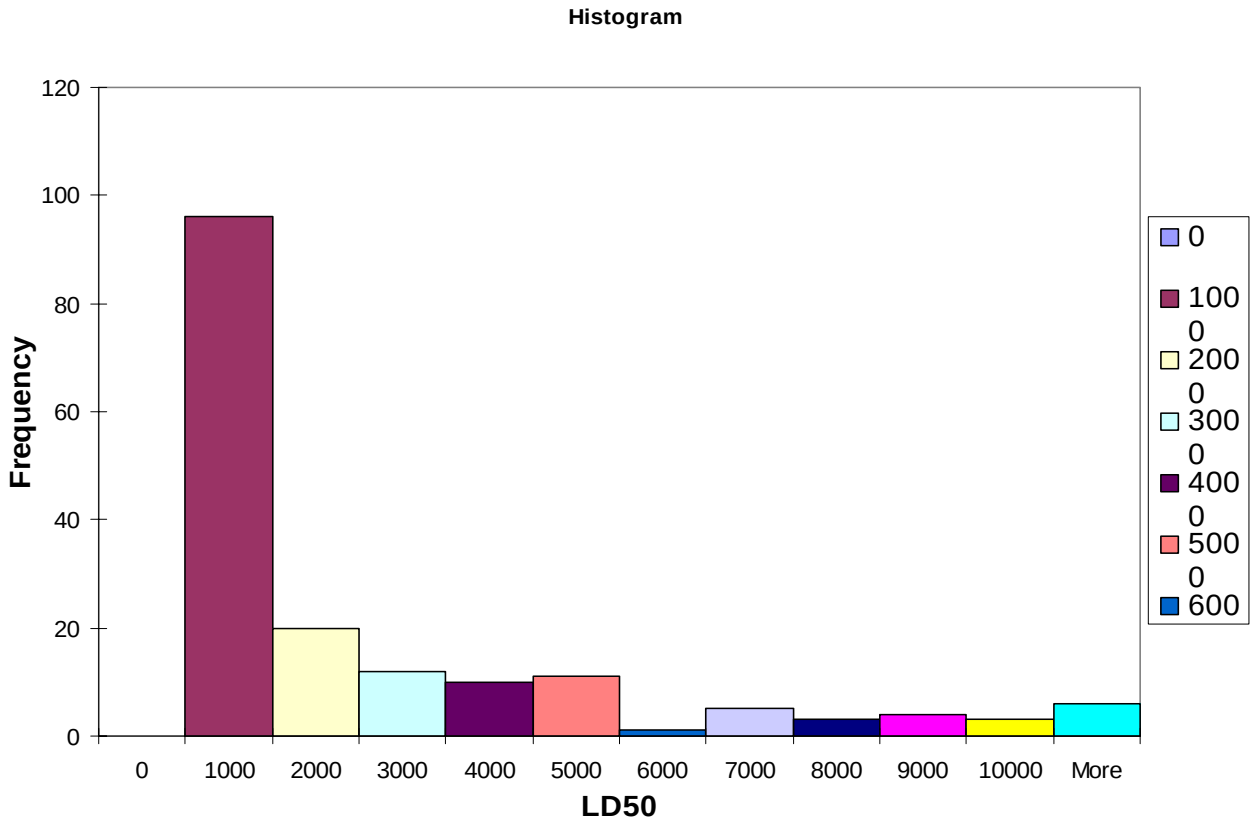
NOAEL Distribution by Deciles



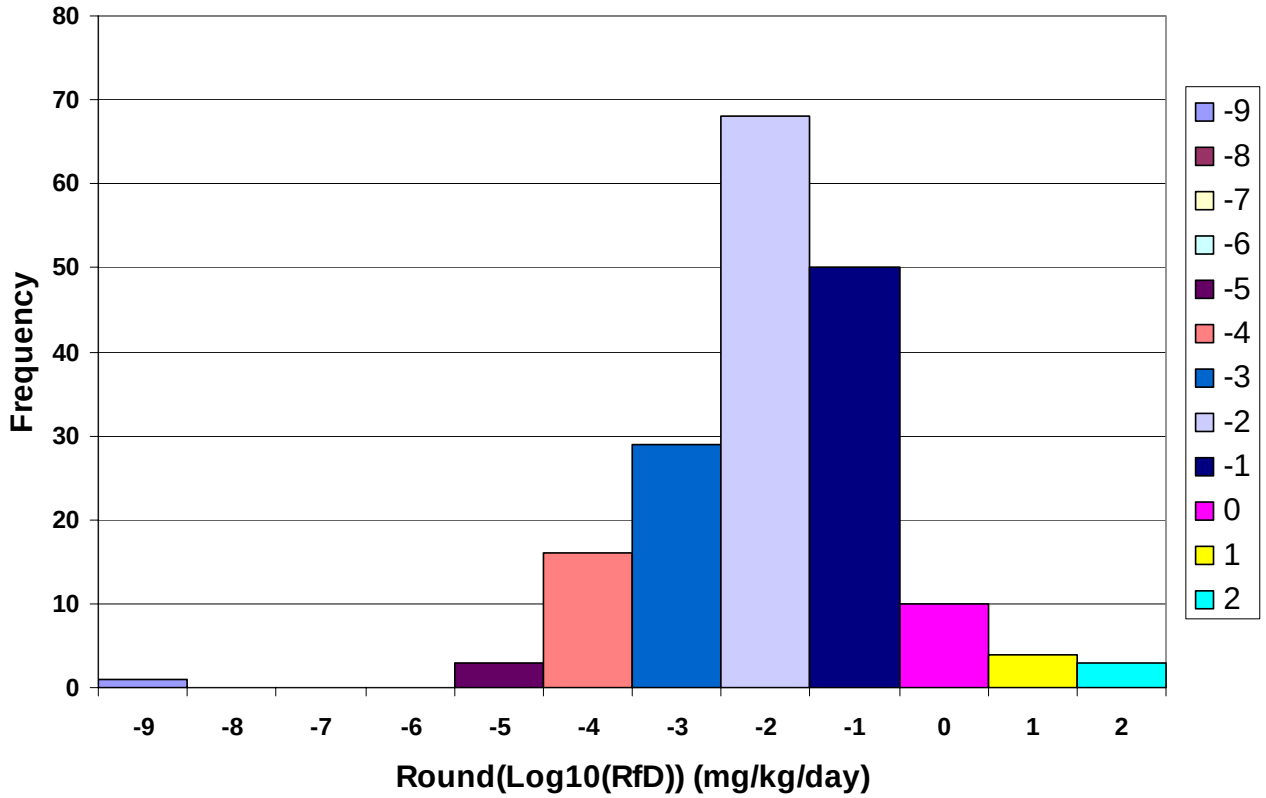
LOAEL Distribution by Deciles



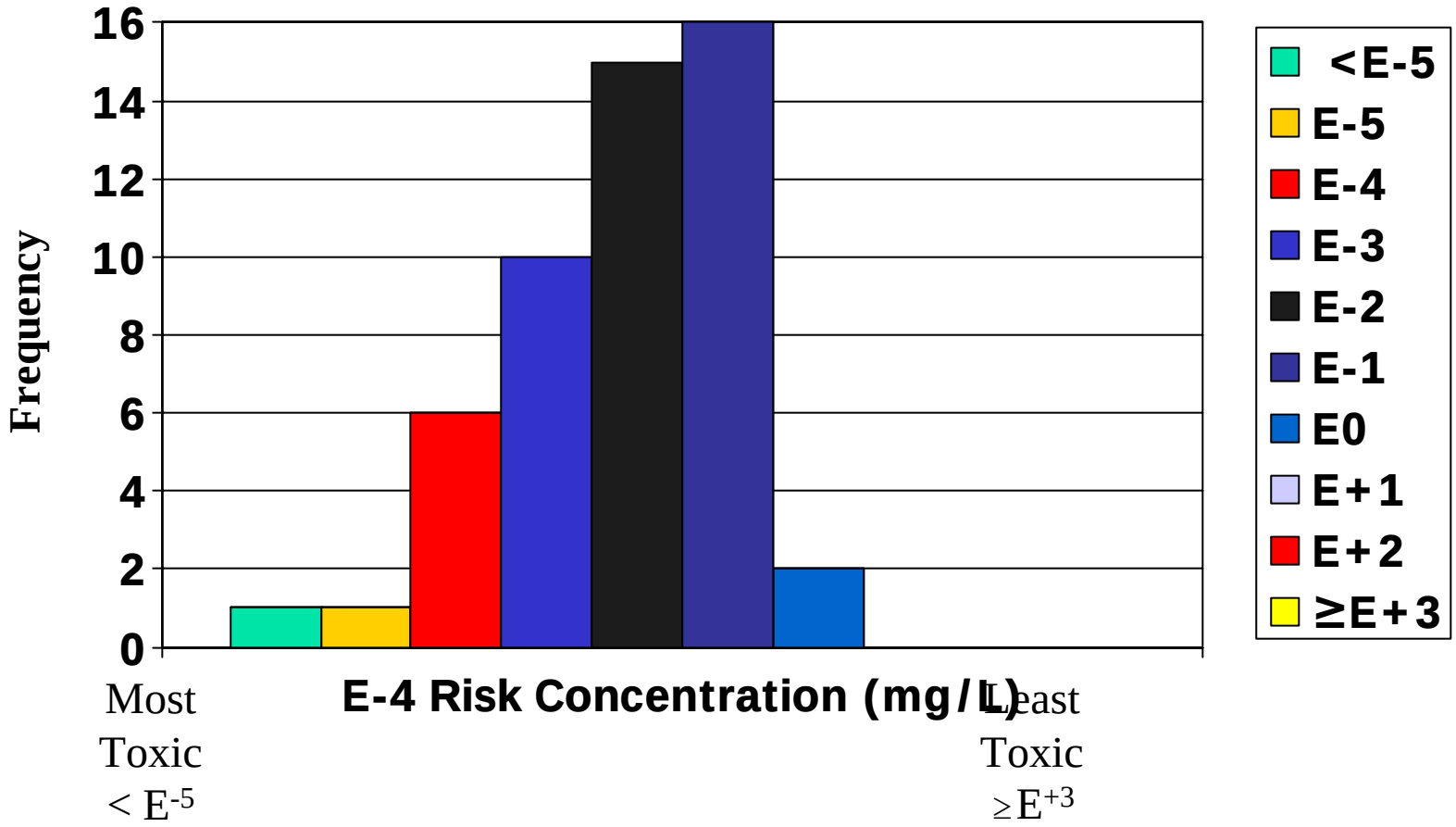
LD50 Distribution by Deciles



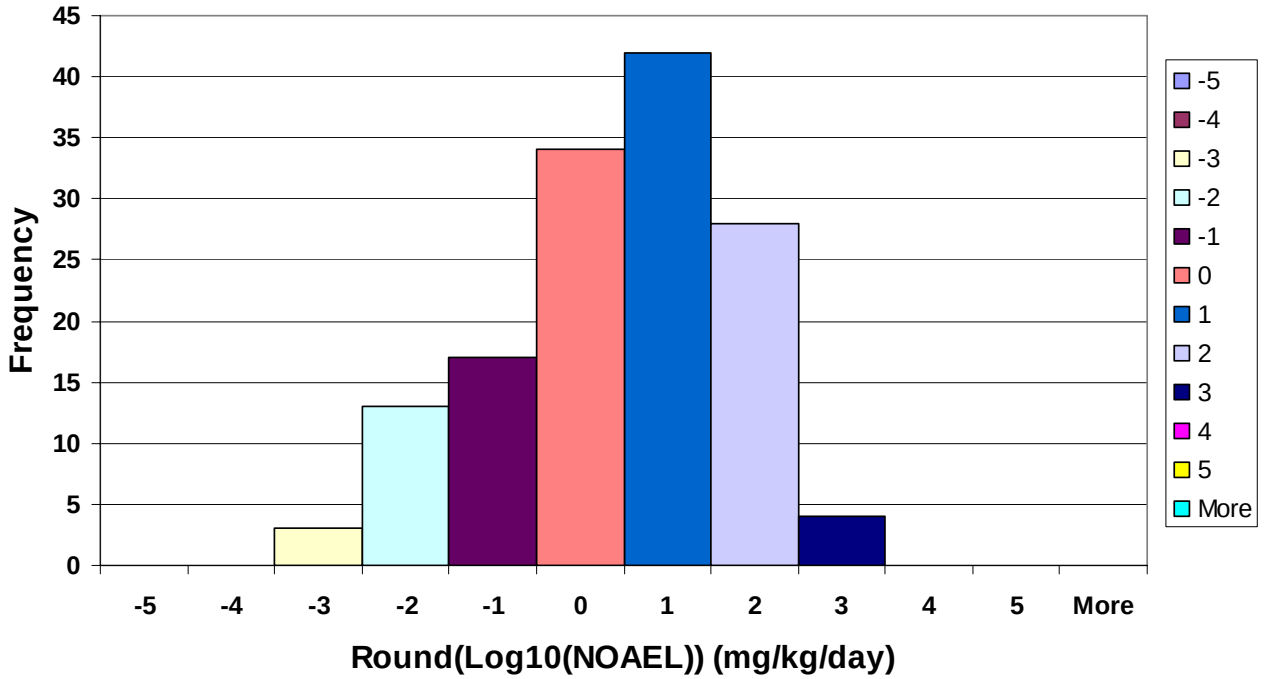
RfD Distribution – Rounded Log_{10}



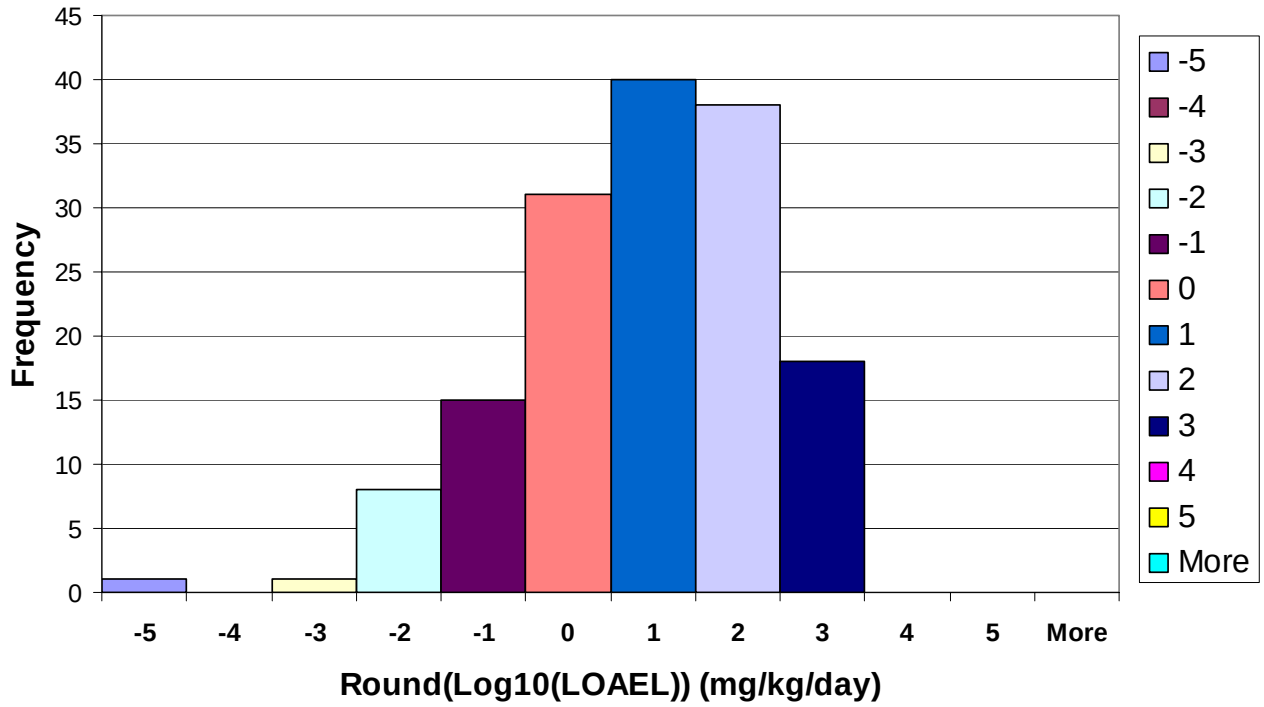
E^{-4} Risk Concentration Distribution - Rounded Log_{10} Scale



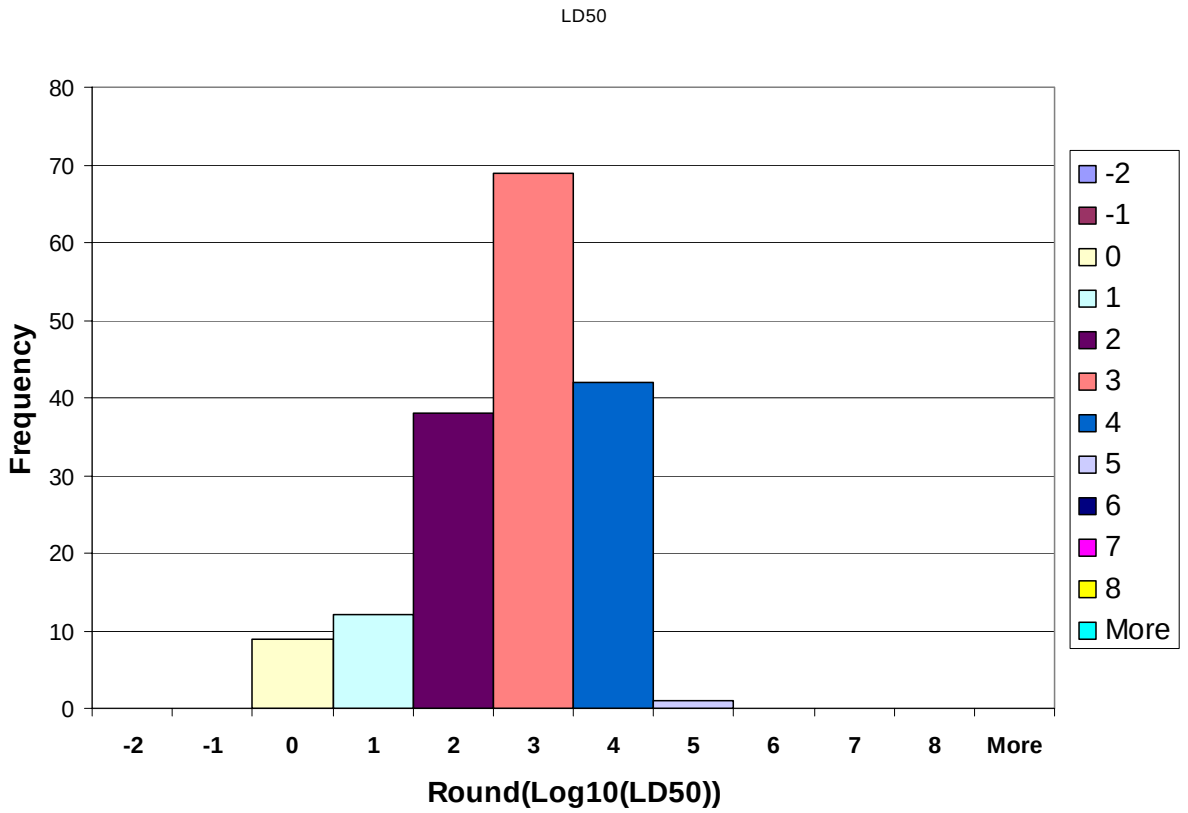
NOAEL Distribution – Rounded Log_{10}



LOAEL Distribution – Rounded Log_{10}



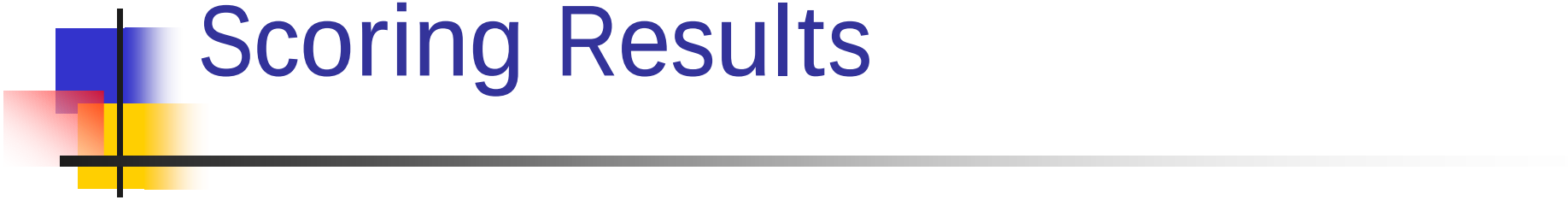
LD50 Distribution – Rounded Log_{10}



Scoring Equations

Method

- Base Equation
  - 5 =10 - (modal $\log_{10}$ of potency value + X)
- Derivation of RfD equation
  - 5 = 10 - (-2 + X) X = +7
  - RfD-based Score = 10 –(Log_{10} of RfD + 7)
- Other values of X
  - E-4 risk concentration: X = +6
  - NOAEL: X = +4
  - LOAEL: X = +4
  - LD50: X = +2



Scoring Results

Examples of Scoring (contd)

Chemical	RfD	NOAEL	LOAEL	LD50
Dioxin	10		10	4
Phosphorous	1	4		7
Methyl ethyl ketone	3	3	3	5
Phenol	4	4	4	5
Hexazinone	4	5	4	5
Iodine	5	8	8	4

Examples of Scoring

Chemical	RfD	NOAEL	LOAEL	LD50
Baygon	5	-	6	6
Dacthal	5	6	5	5
Ethylene Glycol	3	4	3	4
Silver	5	-	8	4
Paraquat	5	6	6	6
Calcium	1	-	4	-

Conclusions

- Scores are fairly consistent for a given chemical.
- Low uncertainty factors increase the spread of scores between RfD, NOAEL and LOAEL
- LD50s for inorganics must be for a relevant form of the chemical
- Options exist for refining the process

Options for Refinement

- Looking at other distributions of the learning set data.
- Expanding the learning set
- Centering the scoring scale on the median unrounded $Log_{10.}$value.
- Examining other approaches to using the learning set distributions to calibrate scoring and comparing the results.