Statistical Modeling of a Non-Parametric Data Distribution to Determine an Exposure Point Concentration during Risk Assessment

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In order to quantify a risk assessment exposure point concentration (EPC), the sample data distribution is determined first. If a data set distribution is determined as either normal or lognormal, the 95% upper confidence limit (UCL) can be calculated using t-test and Land method respectively. However, if the data distribution is neither normal nor lognormal, the sample distribution is assumed unknown and considered non-parametric. There are no well-defined methods to estimate the 95% UCL for the mean of a non-parametric sample except using two very primitive and conservative approaches: (1) maximum value, and (2) 95th percentile. Nevertheless, using these two methods to estimate 95% UCL of the EPC are always too conservative and consequently the risk will be overestimated.

In this paper, two additional options (approximate 95% UCL and resampling technique) to estimate 95% UCL mean of a non-parametric sample are explored. In the first option, the 95% UCL for the mean is based upon approximation. That is, the distribution of data set is assumed to be approximately normal even though the mean is a function of observed data from a distribution other than a normal distribution. In the second option, estimating 95% UCL for mean was no longer dependent on central limit theorem and normal approximation. Instead, the resampling method is used to derive inferential results for either normal or non-normal distributions. The only fundamental assumption of resampling is that the observed data are representative of the underlying population.

In addition to the stipulation of these two methods, an effort is made to compare the methods based upon numerous field data sets in terms of accuracy and validity. It is found that there is no a significant difference between these two methods especially that the estimated 95% UCL for mean is not very sensitive to the size of sample.
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