



INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

The Southwest Indianapolis Air Toxics Study

The Effects of Non-detects

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Introduction:

The Indiana Department of Environmental Management (IDEM) recently concluded a two-year study of air toxics in the Southwest quadrant of Indianapolis. IDEM studied one-hundred-sixty-eight (168) pollutants to determine whether any of them were present in the air in concentrations that would warrant further attention to reduce potential health risks.

IDEM collected samples of the air at two (2) monitor site locations once every six (6) days between October 2006 and October 2008. In all, IDEM recorded the levels of eighty (80) different pollutants in the area over the two (2) year period.

Description:

The result of any sample where there is not enough of the pollutant in the sample to see it is commonly referred to as “non-detects.” A constant problem with any environmental sampling project is non-detects. Sampling equipment is not perfect, so we can never say that the concentration is zero (0). Any sampling procedure has a detection limit associated with it. In reality any sampling procedure has many detection limits associated with it; each with a different name and a slightly different meaning. For the purposes of this paper the generic term, “detection limit,” means the lowest concentration of a pollutant in a sample at which we can assign a number.

Importance:

Any concentration represented as a non-detect effectively represents a range of possible values. If the detection limit of a pollutant is 1 ppbv (parts per billion by volume) and a sample is reported as ND (non-detect) that means the true concentration could be anything below 1 ppbv; it could be 0 ppbv or it could be 0.999 ppbv, we have no way of knowing for sure. Ignoring non-detects is not an acceptable thing to do so environmental scientists have to figure out what to do with non-detects.

Substitution:

Historically, the most common thing done with non-detects is called “substitution.” This means that you would replace any non-detect with a numeric value, usually $\frac{1}{2}$ of the detection limit. So in the previous example with the detection limit of 1 ppbv, a non-detect would get replaced with 0.5 ppbv ($\frac{1}{2}$ of 1 ppbv). You could replace non-detects with any value you wanted (e.g., 0, $\frac{1}{4}$ of the detection limit, $\frac{1}{2}$ the detection limit, the whole detection limit) so long as you were consistent. Half the detection limit was by far the most common and accepted value.

This worked reasonably well, but as computers became more common, scientists realized there might be a better way of doing things. One of these better ways of doing things is called the “Kaplan-Meier Product Limit Estimate” or simply, Kaplan-Meier.

Kaplan-Meier:

Kaplan-Meier is a method that compares the number of non-detects you have to the number of detects you have, and uses that comparison, along with the detection limit and some other aspects of the data to estimate what the average of the data would be if you had known the true values of all the non-detects. Through extensive studies, it has been shown to introduce less bias and provide more accurate results than any of the substitution methods used in the past. Because of this, IDEM chose the Kaplan-Meier method to handle non-detects in the Southwest Indianapolis Air Toxics Study.



More Information:

- For more information on the Southwest Indianapolis Air Toxics Study, please visit the study's Web site at <http://www.idem.IN.gov/programs/air/workgroups/swindyairtox>.
- For questions and concerns, please call IDEM's Office of Air Quality Project Management Section at (317) 234-3499.