

## • Quantitative Aspects of Transuranic and Other Radionuclide Field Studies

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The purpose of this project is to identify, develop and communicate statistical methodology for environmental actinide studies. Significant accomplishments of FY 1980 were continued publication of TRAN-STAT (a periodical specializing in the statistical aspects of environmental contaminant studies), acquisition of preliminary results from our computer simulation study for evaluating estimators of average ratios (e.g., transfer coefficients, isotopic ratios), and the review of statistical estimation methods for data near detection limits. Related work under separate DOE funding includes writing the statistics portion of a radiological guide for DOE decommissioning operations, expanding our expertise in the application of Kriging in two and three-dimensions for estimating spatial patterns of contaminants in the environment to evaluate potential hazards, continuing our statistical design and analysis work for the Nevada Applied Ecology Group, and providing statistical assistance to PNL's environmental radiological monitoring effort.

### TRAN-STAT: Statistics for Environmental Contaminant Studies

TRAN-STAT, a periodical distributed to DOE and DOE-contractor personnel engaged in environmental actinide studies, is a tool for communicating statistical design and analysis techniques applicable to environmental studies. This fills a need to stimulate the use of better statistical methodology in evaluating potential health hazards to man from the presence of radionuclides and other contaminants in the environment. Twelve issues have been distributed since September 1977, four of which were published during the past year. Topics discussed in Issues 9 through 12 were a description of our ratio simulation study, announcement of a new three-stage mass spectrometer developed at the Savannah River Laboratory for analysis of environmental samples, discussion of a bias problem with linear calibration lines, a statistical study to evaluate the computer pseudo-random number generator used in our ratio study, and the design of radionuclide field studies including specification of statistical criteria for deciding on the number of measurements required to meet study objectives. TRAN-STAT will continue to be published in FY 1981.

### Ratio Computer Simulation Study

We are studying the statistical properties of 11 estimators of average ratios to evaluate which are best suited for estimating transfers of radionuclides from one

ecosystem component to another, e.g., from soil to plants via root uptake. The rationale and methodology for this study are discussed in Issue 9 of TRAN-STAT (PNL-SA-8074). Models with additive or multiplicative errors, and statistical distributions for data believed to represent real world situations are being used. Ratios are used in many areas of research and our results should be applicable to other than radionuclide studies. Preliminary results indicate several of the estimators perform poorly compared with commonly used estimators such as the familiar mean of ratios  $(1/n) \sum_{i=1}^n (y_i/x_i)$  and the median ratio. Our final results will be reported in TRAN-STAT and the open literature.

### Data Near Detection Limits

Radionuclide concentrations at or below detection limits may be reported by analytical laboratories as zero, less-than values, or negative concentrations. We have reviewed statistical methodologies for estimating the mean and standard deviation of such data. Results have been accepted for publication in Health Physics. Details can be found in TRAN-STAT, Issue 7 (PNL-SA-7585).

### Other Activities

We are writing the statistics portion of a radiological guide for DOE decommissioning operations. Statistical assistance is also being provided to DOE, CORO, on the decommissioning of the New Brunswick Laboratory

in New Brunswick, New Jersey. Expanded efforts of BNW statisticians in the application of statistics to decommissioning are expected during FY 1981.

During FY 1980 DOE purchased a three-dimensional version of BLUEPACK, a computer code for estimating spatial patterns of contaminants in environmental media (e.g., soil, air). Currently we are gaining experience in using this new code. With adequate data BLUEPACK can be used to estimate average concentrations of any spatial variable over areas or volumes. During FY 1980 we applied Kriging to estimate the spatial distribution of radionuclides and the soil tonnage removal for a hypothetical cleanup of a test area on the Nevada Test Site. This work was primarily funded by the Nevada Applied Ecology Group (NAEG).

Statistical assistance in the design and analysis of environmental radionuclide studies is supplied to NAEG, as we have done continuously since 1971. Advice is given on the type, quantity and location of environmental samples at nuclear test areas and the resulting data analyzed using Kriging and other methods to evaluate potential hazards to man.

We are also providing assistance to PNL's environmental monitoring effort regarding statistical quality control at analytical laboratories, improved statistical data display and analysis in environmental monitoring reports, and the design and analysis of various environmental sampling efforts. We continue to provide statistical input to a study of the environmental effects of a prototype 1200 kV transmission line near Lyons, Oregon; work that is funded by the Bonneville Power Administration.