Environmental Statistics

RTI International has been providing model- and design-based solutions to environmental problems for over 50 years in support of government and industry. RTI's environmental statisticians collaborate with scientists and engineers from other disciplines to form a team that has a deep understanding of environmental problems and policies.

Our scientists have a wide range of statistical skills; extensive experience in data collection, manipulation, management, and transmission; and project management and report preparation experience. Our geographic information systems (GIS) experts often support our projects by combining data from different sources, manipulating data, geocoding, and producing graphical displays of analysis results.

Environmental Sampling Design

RTI develops probability-based sampling designs to make robust inferences regarding environmental variables that evolve in space and time. We also have developed sampling designs for collecting data on water and air quality and on human exposure to contaminants.

To provide our clients with the best services, RTI researchers apply

- environmental sampling design
- experimental design, analysis, and modeling
- geostatistical, spatial, and spatio-temporal analysis
- risk assessment and exposure analyses
- exposure modeling
- environmental monitoring systems design
- response surface analysis
- uncertainty analysis

In addition to using standard methods, such as stratified, cluster, systematic, multistage, and double or two-phased sampling, RTI statisticians can apply

- capture-recapture designs
- ranked-set sampling
- line transects and variable circular plot sampling
- area sampling
- grid sampling

Experimental Design, Analysis, and Modeling

RTI researchers have extensive experience analyzing data sets in accordance with different experimental and survey designs used to collect the data. We use model- and design-based solutions to answer research questions and address project objectives.

Environmental phenomena often exhibit strong spatial, temporal, and exogenous variability, so we use model-based approaches based on hierarchical modeling:

- Simple conditional models are developed at each level of the hierarchy. The result is a joint model that, while complex, can feasibly provide regional analysis results.
- Depending on the complexity of the problem or the expert opinions available, we apply likelihood-based or Bayesian approaches to estimate model parameters.

RTI's SUDAAN® software can be used to obtain design-based estimates (estimates of total counts, medians, percentiles, percentages, rates, and model parameter estimates), while accounting for features of the sampling design, such as stratification, clustering, and unequal sampling rates. When novel design-based estimators are proposed, we use SAS, R, WinBUGS, GeoBUGS, and S-plus.

Geostatistical, Spatial, and Spatio-Temporal Analysis

We use geostatistical, spatial, and spatio-temporal models to characterize environmental processes and to reliably produce predictions at locations where no measurements are available. In some circumstances, our proposed models may combine information from different geo-databases and field survey data, in which case we explore various approaches for combining information, change of support (upscale or downscale), and spatial resolution issues in the different data sets.

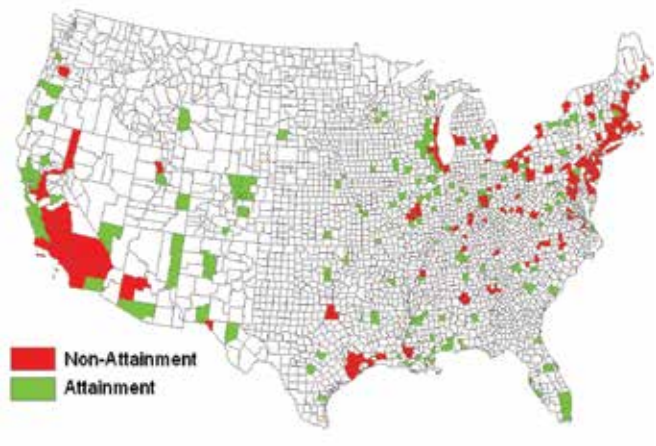
These models allow us to produce national, regional, county, state, and small-scale inferences to meet our clients' needs. We have used geostatistical models to determine the contribution of certain industries to air pollution in specific regions.

Risk Assessment and Exposure Analysis

Using environmental exposure data, RTI statisticians apply parametric, nonparametric, and simulation techniques to evaluate whether ambient concentrations of a chemical are sufficiently high to cause health concerns. We use statistical models to characterize contaminant levels and Monte Carlo, Jackknife, and bootstrap simulation techniques to assess the uncertainties in current risk assessment practices and emission factors:

- Working with risk experts, we have applied response surface regression and categorical regression techniques to identify data inputs and collapse categories of site characteristics to help the U.S. EPA evaluate regulatory and nonregulatory options for fossil fuel waste management.
- We can apply a variety of tools (e.g., Monte Carlo techniques, response-surface sensitivity analysis) to characterize risk from probabilistic simulations.

Attainment Status, 1988–1990



Exposure Monitoring

RTI pioneered the use of probability-based surveys as a basis for field studies involving direct exposure measurements, including the Total Exposure Assessment Methodology (TEAM) studies and the National Human Exposure Assessment Survey (NHEXAS) in EPA Region 5. We can apply statistical modeling techniques to develop models of human exposure pathways and routes.

RTI has participated in more than 30 exposure field studies involving multimedia, multipathway, and multichemical components. Activities have included

- sample survey design
- estimation
- modeling
- database development
- protocol development
- field studies

More Information

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