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Information Science and Technology Seminar Speaker Series

Scott Ferson
Applied Biomathematics

Accounting for Doubt about the Model in Risk and Uncertainty Analyses

Wednesday, September 3, 2014

3:00 - 4:00 PM

TA-3, Bldg. 1690, Room 102 (CNLS Conference Room)

Abstract: Analysts usually construct a model and then act as though it correctly represents the state of the world. This understates the uncertainty associated with the model's predictions, because it fails to express the analyst's uncertainty that the model itself might be in error. Several approaches have been proposed to account for model uncertainty within a probabilistic assessment, including what-if studies, stochastic mixtures, Bayesian model averaging, generalized method of moments, probability bounds analysis, robust Bayes analyses, and imprecise probabilities. Although each approach has advantages that make it attractive in some situations, each also has serious limitations. For example, several approaches require the analyst to explicitly enumerate all the possible competing models. This might sometimes be reasonable, but the uncertainty will often be more profound and there might be possible models of which the analyst is not even aware. Although Bayesian model averaging and stochastic mixture strategies are considered by many to be the state of the art in accounting for model uncertainty in probabilistic assessments, numerical examples show that both approaches actually tend to erase model uncertainty rather than truly propagate it through calculations. In contrast, probability bounds analysis, robust Bayes methods, and imprecise probability methods can be used even if the possible models cannot be explicitly enumerated and, moreover, they do not average away the uncertainty but propagate it fully through calculations. In the context of risk analysis and uncertainty modeling, it is often possible to project uncertainty about X (which may be aleatory, epistemic or both) through a function f to characterize the uncertainty about Y = f (X) even though f itself has not been precisely characterized. Although the general strategies for quantitatively expressing and projecting model uncertainty though mathematical calculations seem either dubious or quite crude, there are a variety of special cases where methods to handle model uncertainty are rather well developed and available solutions are both comprehensive and subtle.

Biography: Scott Ferson is a senior scientist at Applied Biomathematics (www.ramas.com) and adjunct professor at the School of Marine and Atmospheric Sciences at Stony Brook University. He holds a Ph.D. in Ecology and Evolution from the State University of New York (SUNY) and an A.B. in biology from Wabash College. His professional interests include statistical methods when empirical information is very sparse, medical risks and population biology, and risk analysis which he teaches at Stony Brook. Ferson has five published books, ten commercially distributed software packages, and over a hundred scholarly publications, in environmental risk analysis, uncertainty propagation, and conservation biology. He is a fellow of the Society for Risk Analysis. His research over the last decade, funded primarily by the National Institutes of Health, NASA, and Sandia National Laboratories, has focused on developing reliable mathematical and statistical tools for risk assessments and on methods for uncertainty analysis when empirical information is very sparse, including methods for quality assurance for Monte Carlo assessments, exact methods for detecting clusters in very small data sets, backcalculation methods for use in remediation planning, and distribution-free methods of risk analysis.

For more information contact the technical host Kari Sentz, ksentz@lanl.gov, 667-3320.

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