

SRA 2011 Annual Meeting Workshops

Sunday, December 4th

Full Day Workshops, 8:30 am – 5:30 pm

WS 1

Benchmark Dose Modeling (BMD) Analysis – an Introduction to BMD Methods and Application of EPA's Benchmark Dose Software

Organizer: J. Allen Davis

\$300.00/\$350 after 11/4/2011

This workshop will provide participants with interactive training on the use of the U.S. EPA's Benchmark Dose Software (BMDS) and its application to risk assessment. The course will provide an overview of the BMD process, including determination of data adequacy, model fitting and comparison, and selection of a benchmark response level. This workshop will cover all BMD models available in BMDS 2.2—including the new MS-COMBO model, which calculates multi-tumor composite risk values. Instruction will also be given in regard to new features that have been implemented in version 2.2. This interactive training workshop will consist of morning and afternoon sessions. The morning session will include instructor presentations covering the basic science and theory of BMD modeling, and is intended for those with no prior experience in BMD modeling. The afternoon session will expand upon the morning session and will consist of a demonstration of EPA's BMDS 2.2 through individual and group class modeling exercises. Questions and critical discussions of presentation material and class activities are highly encouraged. Participants planning to attend the afternoon session need to bring their own laptops to the workshop with BMDS 2.2 installed (with necessary administrative rights). The latest version of the software can be found at: <http://epa.gov/ncea/bmds/>. To ensure students receive the maximum benefit from participating in the workshop, it is recommended that they examine the online training and tutorial materials prior to the workshop. Training and tutorial materials can be found at: <http://www.epa.gov/ncea/bmds/training/index.html>.

WS 2

Advancing Mechanisms of Gut Interactions Informing Microbial Risk Assessment

Organizer: Peg Coleman

\$300/\$350 after 11/4/2011

In the decade since the first SRA workshop on mechanistic modeling of host-pathogen interactions in the gastrointestinal tract, a paradigm shift arose that complicates microbial dose-response assessment for enteric pathogens: expansion of knowledge of the gut ecosystem to include not just human mucosal cells, but the indigenous microbiota and its collective genome, the microbiome. The goal of the workshop is to promote a paradigm shift to an ecosystem approach for microbial risk assessment that incorporates data on human microbiome interactions linked to stable pathways (health) or perturbed systems (disease). International experts will introduce new concepts and supporting evidence from metagenomic studies using high throughput sequencing methods rather than pure culture methods of past generations of medical microbiologists. Microbial risk analysts will be challenged to identify not just the two traditional metrics (pathogen dose and host response) as in simple empirical dose-response models of disease outcomes, but also the underlying interactions of the complex gut ecosystems that cause health and disease. Participants will consider how to scale data across spatial scales (genetic, molecular, tissue, organ, individual, subpopulation, population) for more coherent microbial dose-response assessment that incorporates innate and adaptive immune interactions of healthy ecosystems and immunomodulation by the microbiota in health and disease.

WS 3

Risk, Robustness and Info-Gaps

Organizer: Yakov Ben-Haim

\$325 / \$375 after 11/4/2011

Risk analysts use measurements and science-based models to design systems, evaluate reliability, and make plans and policies. However, models may be simpler than reality, causal factors may be unknown, measurements may err or be incomplete, and systems may change over time in unknown ways. Probability is useful for modeling and managing some of these uncertainties. However some uncertainties are info-gaps: disparities between what is known and what needs to be known in order to make good decisions. For instance, we sometimes do not know the correct probability distribution or all of the relevant physical mechanisms such as non-linearities or time dependencies. This course studies info-gap theory for modeling and managing uncertainties in risk analysis and related decision problems. The course emphasizes the added value of an info-gap analysis as well as its limitations, and the integration of info-gap theory with probabilistic analysis. This course is built around lectures presenting a series of simple examples taken from a wide range of applications in the field of risk analysis, reliability assessment and policy selection. The examples illustrate the integration of info-gap robustness analysis in a variety of other decision strategies. The end of the workshop is devoted to exercises which help the participants get a hands-on feel for info-gap analysis. Students, researchers, and analysts involved in risk analysis, reliability assessment and policy selection will find this workshop useful.

WS 4

Cumulative Risk Assessment: Grouping and Analyzing Combined Chemical, Biological, Physical and Socio-Economic Stressors

Organizer: Linda K. Teuschler

\$349/\$399 after 11/4/2011

Public interest has been growing regarding the health effects of environmental exposures and cumulative impacts from multiple chemical and nonchemical (e.g., microbes, noise) stressors on communities. Initiating factors for a cumulative risk assessment (CRA) could include: contaminants in environmental media from multiple pollutant sources; environmental quality metrics, e.g., pollution levels; exposure metrics, including biomonitoring; public health effect metrics; and ecosystem impacts. CRA can be defined as an analysis, characterization, and possible quantification of the combined risks to human health or the environment from multiple agents or stressors. In addition, population and individual vulnerability factors are being recognized as important to CRA, such as diet/nutritional status, behaviors, genetic traits, socio-economic status, sensitivities, and psychosocial stress. To meet this challenge, research efforts are ongoing to characterize exposure, health effects and risks from combinations of chemical, physical, biological and socio-economic stressors. This workshop highlights concepts, methods, and resources for scoping and conducting a population-based CRA. A central theme is integrating exposure information and population characteristics during CRA planning and scoping based on initiating factors. In the exercises, chemical, biological and physical stressor groups are formed using exposure and toxicity factors and are linked with vulnerability factors characteristic of the exposed population, including socio-economic stressors; these groups are used to develop risk characterization information. Methods for estimating human health risks are discussed and applied, including epidemiologic approaches and methods based on existing chemical mixtures risk assessment guidance and toxicological data. Teaching methods include lectures and hands-on exercises. Participants are asked to bring a calculator.

WS 5

Get More from Your Models- Use Sensitivity Analysis

Organizer: Amir Mokhtari

\$245/\$295 after 11/4/2011

This workshop will answer key questions faced by those who conduct, manage, or review probabilistic and sensitivity analysis of risk models. When should you perform sensitivity analysis? What are the typical simulation techniques and software packages? What are the roles of uncertainty and sensitivity analyses as value added techniques in risk assessment? How do you prepare a model to facilitate sensitivity analysis? What are key considerations in the development of scenarios that are the basis for sensitivity analysis? What are some typical sensitivity analysis methods and how can you select among them? How should particular sensitivity analysis methods be applied? How should the results of sensitivity analysis be presented and interpreted? This workshop will answer these questions. The methods and case studies presented are based upon several years of research at NC State University (Dr. Frey) and RTI regarding developing quantitative risk assessment models for environmental and microbial systems and research regarding transferring, applying, and adapting sensitivity analysis methods developed in other disciplines to quantitative exposure and risk assessment models. This workshop helps practitioners select specific sensitivity analysis methods relevant to the particular case study and model characteristics. The workshop will also aid in interpreting results from a sensitivity analysis in response to a particular modeling objective. The basic concepts of probabilistic risk assessment will be illustrated using practical case studies. This workshop is aimed at practitioners, managers, or reviewers who wish to refine their knowledge regarding approaches in risk assessment and sensitivity analysis methods.

WS 6

Probabilistic risk analysis with hardly any data

Organizer: Scott Ferson

\$250/\$300 after 11/4/2011

This full-day tutorial introduces and compares methods for developing a probabilistic risk analysis when little or no empirical data are available to inform the risk model. The talks are organized around the basic problems that risk analysts face: not knowing the input distributions, not knowing their correlations, not being sure about the model itself, or even which variables should be considered. Possible strategies include traditional approximative methods and recent robust and bounding methods. Numerical examples are given that illustrate the use of various methods including traditional moment propagation, PERT, maximum entropy, uniformity principle, probability bounds analysis, Bayesian model averaging and the old work horse, sensitivity analysis. All of the approaches can be used to develop a fully probabilistic estimate useful for screening decisions and other planning. The advantages and drawbacks of the various approaches are examined. Essentially, the drawbacks are that bounding approaches may say too little about risks, and the rough and ready approximate methods may say too much. The discussion addresses how defensible decisions can be made even when little information is available, and when one should break down and collect some data and, in that case, what data to look for. The presentation style will be casual and interactive. Participants will receive a CD of the illustrations and numerical examples used during the tutorial.

WS 7

The transformation of energy policies: Implications for risk governance, communication and stakeholder participation

Organizer: Ortwin Renn

\$300/\$350 after 11/4/2011

The workshop will be focusing on risks from the generation and use of energy. This is a problem that has high popularity for risk professionals worldwide and includes typical risk components such as uncertainty, complexity and ambiguity. With the nuclear accident in Fukushima, the role of energy production is again in the forefront of public debate. The workshop will use this topic to explore the best means to communicate different types of risks and to involve stakeholders in the process of risk management and public communication. The basic core of this workshop is formed by a broad conceptual framework for risk governance developed by the International Risk Governance Council (IRGC), a private, non-profit foundation in Geneva, Switzerland. The workshop will be a combination of lecture and interactive case studies, including role-playing exercises and feedback discussions. It is designed to help workshop participants think through the issues involved in dealing with risk communication about energy risks.

WS 8

ECETOC TRA, ESIG Consumer Generic Exposure Scenario and PetroRisk Exposure Tools

Organizer: Rosemary Zaleski

\$275/\$325 after 11/4/2011

A number of exposure and risk characterization tools have been developed to meet requirements of the European Union's Registration Evaluation and Authorization of Chemicals (REACH) regulation; this workshop will focus on three tools developed and used by the petroleum and petrochemical sectors that have applicability to other sectors and chemicals. The morning session will include an overview of REACH exposure requirements and an overview and working session with two tools.

- The European Center for Ecotoxicology and Toxicology of Chemicals Targeted Risk Assessment (ECETOC TRA) is a preferred screening tool listed within European Chemical Agency guidance documents that provides occupational, environmental and consumer exposure estimates.
- The European Solvents Industry Group Consumer Generic Exposure Scenario Tool (ESIG Consumer GES) is based upon the consumer portion of the ECETOC TRA, but implements refinements described within the TRA annex and autopopulates output in REACH format. The afternoon session will focus on:
 - PETRORISK estimates exposures arising from environmental release of complex substances and can be used to quantify risks to human and wildlife receptors.

These freely available tools apply REACH exposure assessment guidance and demonstrate approaches developed to enable efficient and consistent implementation for meeting REACH requirements. Their design reflects parameters and defaults appropriate for hydrocarbon substances. Participants are encouraged to bring laptops for the working sessions. Participants will gain a general understanding of REACH exposure requirements, as well as the scientific basis of the tools being discussed. They will learn how to use these three tools and develop an understanding of their strengths, limitations, and application boundaries.

WS 9

Eliciting Judgments to Inform Decisionmaking

Organizer: Christina McLaughlin

\$300/\$350 after 11/4/2011

Decision makers must frequently rely on data or information that is incomplete or inadequate in one way or another. Judgment, often from experts and occasionally from non-experts, then plays a critical role in the interpretation and characterization of those data as well as in the completion of information gaps. But how experts or other stakeholders are selected and their judgments elicited matters – they can also strongly influence the opinions obtained and the analysis on which they rely. Several approaches to eliciting judgments have evolved. The workshop will cover topics ranging from recruitment, elicitation protocol design, different elicitation techniques (e.g., individual elicitations, Delphi method, nominal group technique, etc.) to aggregation methods for combining opinions of multiple individuals. The role of judgment elicitation and its limitations, problems, and risks in policy analysis will also be addressed. The workshop will include presentation of two case studies that will include a discussion of the selection process; elicitation protocol development, elicitation technique utilized, and the various issues that arose before, during, and after the elicitation process and the manner in which they were resolved. The class will conclude with a hands-on exercise where participants will apply different elicitation techniques to a given problem and compare/contrast elicitation results across the techniques.

WS 10

Biological Interactions between Social Stressors and Environmental Hazards

Organizer: O. Nweke/ A. Kadry

\$50

In the United States, historical social and economic forces have segregated certain segments of the population into communities with high indices of urban poverty, material deprivation and adverse physical and social environmental conditions. Emerging research suggests that this confluence of risk factors can modify the relationship between exposure to pollution and the resultant adverse health effects. The evidence from this research underlies hypotheses that these types of interactions may explain persistent environmental health inequities across population groups defined by race/ethnicity and income in the United States, and has driven proposals for paradigm shifts in our traditional understanding of the relationship between environmental exposure and disease. However, much remains unknown about the pathways through which social context interacts with environmental health risk. These advancements in knowledge are requisite to facilitate comprehensive integration of the emerging research in environmental policy making. Specifically, such data can help to more accurately define exposure-response relationships used in risk assessments, aid the development of robust and sensitive methods to identify vulnerable population groups, and inform standards setting and other policy actions to ensure the protection of populations that are more vulnerable as a result of co-exposure to both social and chemical stressors. The objectives of this workshop are to: share knowledge on biological pathways through which psychosocial stress and social context may influence health risk; highlight and discuss emerging toxicological and epidemiological data on the interactions between social context, psychosocial stress and exposures to environmental hazards, and

stimulate discussion on research to advance the practical application of this type of information in risk assessment.

Half Day AM Workshops, 8:00 am – 12:00 pm

WS 1A

Benchmark Dose Modeling (BMD) Analysis – an Introduction to BMD Methods and Application of EPA’s Benchmark Dose Software

Organizer: J. Allen Davis

\$175/\$225 after 11/4/2011

This workshop will provide participants with interactive training on the use of the U.S. EPA’s Benchmark Dose Software (BMDS) and its application to risk assessment. The course will provide an overview of the BMD process, including determination of data adequacy, model fitting and comparison, and selection of a benchmark response level. This workshop will cover all BMD models available in BMDS 2.2 —including the new MS-COMBO model, which calculates multi-tumor composite risk values. Instruction will also be given in regard to new features that have been implemented in version 2.2. This interactive training workshop will consist of morning and afternoon sessions. The morning session will include instructor presentations covering the basic science and theory of BMD modeling, and is intended for those with no prior experience in BMD modeling. To ensure students receive the maximum benefit from participating in the workshop, it is recommended that they examine the online training and tutorial materials prior to the workshop. Training and tutorial materials can be found at:
<http://www.epa.gov/ncea/bmids/training/index.html>.

WS 8A

ECETOC TRA, ESIG Consumer Generic Exposure Scenario and PetroRisk Exposure Tools

Organizer: Rosemary Zaleski

\$275/\$325 after 11/4/2011

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WS 11

Dosimetric Adjustment Methods and Application in Chemical Risk Assessment

Organizer: Jay Zhao

\$250/\$300 after 11/4/2011

This half-day workshop is designed to provide basic training in methods used for the dosimetric adjustments required for completing dose-response assessments derived from animal toxicology data. The topics will include interspecies oral dose adjustment for noncancer and cancer assessment, cancer unit risk or slope factor conversion, inhalation exposure concentration unit conversion and human equivalent concentration (HEC) calculation for particle and vapor exposure using various modeling approaches. Applications of physiologically-based pharmacokinetic (PBPK) modeling and Chemical Specific Adjustment Factors in dose-response assessment will also be introduced. Participants will be provided with sufficient working knowledge of the various techniques to conduct all the necessary dosimetric adjustment(s) in typical noncancer and cancer risk assessments. It is recommended that participants bring a calculator and a laptop computer for class exercises.

WS 12

Synthesizing Evidence: An Introduction to Systematic Reviews, Meta-Analysis, and Expert Elicitation

Organizer: Lisa Robinson

\$225/\$275 after 11/4/2011

Risk analysis often requires making inferences or estimating parameter values from studies that contain inconsistent or conflicting results or address dissimilar contexts. Such inferences or estimates should be consistent with the weight of evidence. Deciding whether and how to combine information from multiple studies requires thinking carefully about the nature of the problem to be addressed and the characteristics of the available evidence. In this workshop, we will investigate the advantages and limitations of alternative approaches to research synthesis from a cross-disciplinary perspective. We will introduce the range of methods for evaluating and combining evidence and explore three prominent approaches in detail: systematic review, meta-analysis, and expert elicitation. These methods are used widely in the social sciences and medicine as well as in risk assessment. Each begins with a careful review of the research literature, but then the approaches diverge. Systematic review involves a largely qualitative evaluation of available studies against established criteria to identify those that are most appropriate for use in a particular context. Meta-analysis involves selecting studies from the available literature using formal criteria and then using statistical models to calculate summary estimates and explore sources of variation across studies. Expert elicitation uses a structured process to select experts who provide subjective probability distributions that characterize their knowledge about a quantity. The workshop will conclude with a panel discussion focused on questions raised by attendees, including the appropriate application of each method to the problems they face to support evidence-based decisionmaking.

Note: This workshop is intended for those who are interested in exploring the advantages and limitations of alternative approaches for synthesizing evidence. Those interested in exploring expert elicitation techniques in more detail should instead register for the workshop, "Eliciting Judgments to Inform Decisionmaking."

WS 13

Introduction to Environmental and Health Aspects of Nanotechnology

Organizer: Jo Ann Shatkin

\$350/\$400 after 11/4/2011

This course will provide participants with an overview of the emerging concerns regarding nanotechnology and nanomaterials and impacts for occupational and public health and the environment. The course introduces the topics of nanotechnology, nanotoxicology, environmental aspects of nanotechnology, and addresses ethical, legal, societal and regulatory perspectives. Through lectures and interactive sessions, participants will obtain a knowledge base for understanding the exposure, human health, and safety issues for

nanomaterials and nanotechnologies and the potential impacts for workers, consumers, stakeholders, and the environment. Nanotechnology is the understanding and control of matter at dimensions of roughly 1 to 100 nanometers, where unique phenomena enable novel applications. Nanotechnology is emerging in all economic sectors, including: energy, medicine, food technology, imaging, manufacturing, electronics and air and water purification. Some of the current and potential future materials and technologies have the potential for significant impacts on health and the environment. This course introduces participants to the technological basis of nanoscale phenomena, the current and potential future uses of nanotechnology, explores the breadth of issues raised for health and the environment, and implications of current research and gaps on regulatory policy and societal impacts. At the conclusion of this course, the participants will have gained insights into (1) Key concerns regarding nanotechnology risks for employees, the public, and the environment; (2) Characteristics and properties of nanomaterials and nanotechnologies; (3) Nanotoxicology: state-of-the-science regarding the toxicity of nanomaterials and nanotechnologies; (4) Environmental aspects of nanotechnology; and (5) Risk assessment and risk management issues for nanomaterials and nanotechnologies.

WS 14

Use of PBPK modeling to evaluate risks to sensitive population and early ages

Organizer: Harvey J. Clewell/ Miyoung Yoon

\$200/\$250

A major challenge in addressing concerns on early life sensitivity to environmental chemicals is obtaining the dosimetry information in the target tissue during development and growth. In this course, the value of physiologically based pharmacokinetic (PBPK) modeling in quantitative health risk assessments for early life is demonstrated by providing a scientifically sound tool to predict the target tissue dose in different life stages. Early life dosimetry is the result of a complex interplay of changing physiological and biochemical factors during dynamic development. Such factors include ontogeny in metabolizing enzymes, changes in transporter expression, maturation of biological barriers such as the blood brain barrier, differential growth of tissues, and distinct exposure patterns in children compared to adults. These factors contribute to pharmacokinetic differences between the young and adult and may be responsible for potential differences in susceptibility to chemicals across ages. PBPK modeling provides a means to integrate these factors in proper context and thus contributes to reducing uncertainty in conducting risk/safety assessment for early life and related sensitive life stages including pregnancy and lactation. The presentations will provide an overview of pharmacokinetic factors affecting early life dosimetry and two case studies of PBPK approaches for gestation/lactation and childhood exposures, plus a demonstration of how PBPK modeling of development can be used to evaluate neonatal epidemiological results. The course participants will get in depth understanding of the value of PBPK modeling in addressing issues of potential sensitivity in sensitive population/infants and children and the possible application scenarios of this valuable tool.

Half Day PM Workshops, 1:00 pm – 5:00 pm

WS 1B

Benchmark Dose Modeling (BMD) Analysis – an Introduction to BMD Methods and Application of EPA's Benchmark Dose Software

Organizer: J. Allen Davis

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given in regard to new features that have been implemented in version 2.2. This interactive training workshop will consist of morning and afternoon sessions. The afternoon session will expand upon the morning session and will consist of a demonstration of EPA's BMDS 2.2 through individual and group class modeling exercises. Questions and critical discussions of presentation material and class activities are highly encouraged. Participants planning to attend the afternoon session need to bring their own laptops to the workshop with BMDS 2.2 installed (with necessary administrative rights). The latest version of the software can be found at: <http://epa.gov/ncea/bmds/>. To ensure students receive the maximum benefit from participating in the workshop, it is recommended that they examine the online training and tutorial materials prior to the workshop. Training and tutorial materials can be found at: <http://www.epa.gov/ncea/bmds/training/index.html>.

WS 8B

ECETOC TRA, ESIG Consumer Generic Exposure Scenario and PetroRisk Exposure Tools

Organizer: Rosemary Zaleski

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WS 15

Enterprise & Project Risks from a Systems Perspective

Organizer: C. Ariel Pinto

\$275/\$325 after 11/4/2011

This workshop has the objective to develop understanding and skills on the basic framework for the modeling, assessment, analysis, and management of risks in the context of project and engineering enterprises. Topics to be discussed include, but are not limited to introductions to risk and project management, engineering enterprise systems, a systems perspective on project goals and anti-goals, identifying and estimating project risks, and using expert evidence in risk estimation. Also will be discussed are generalized processes for project risk management and engineering enterprise risk management, including the characterization of enterprise problem space and capability approach. There will be several case studies for workshop participants to develop fundamental skills and generate insights.

WS 16

Chemical-Specific Adjustment Factors: Application of Data to Reduce Uncertainty in Inter- and Intraspecies Extrapolation for Chemical Risk Assessment

Organizer: John Lipscomb

\$250/\$300 after 11/4/2011

The World Health Organization, through the International Programme on Chemical Safety (IPCS), has established guidance on the use of mechanistic data to replace default uncertainty factors for interspecies extrapolation and intraspecies variability in deriving risk values such as Reference Doses (RfDs) and Tolerable Concentrations (TCs). This guidance informs the choice and application of data that can be used to replace defaults with chemical specific adjustment factors (CSAFs), resulting in values that better reflect the data for the chemical of interest. Under this approach, the uncertainty factors for interspecies differences (UFA) and human variability (UFH) are first subdivided into toxicokinetic (TK) and toxicodynamic (TD) components. The data relevant for each subcomponent is then evaluated to determine whether chemical-specific data can be used in place of the default. Use of the CSAF framework allows the improved use of available data in deriving risk values, and can assist in targeting new studies to address uncertainties and lead to more accurate risk values, including kinetic and dynamic data in *in vitro* systems. CSAFs have been used by the U.S. EPA in deriving an RfD for boron and by Health Canada in deriving a TC for 2-butoxyethanol. This half-day workshop will provide a brief review of the use of uncertainty factors and historical perspective on the reliance on quantitative data to develop values for inter- and intraspecies extrapolation. The course will focus on the IPCS methodology for CSAF development, including the thinking process and steps used for evaluating data. Examples and classroom activities will be used as instructional aides.

WS 17

Risk Analysis: Fundamental Concepts, Applications and Controversies

Organizer: Branden B. Johnson

\$250/\$300 after 11/4/2011

Meetings and publications of the Society for Risk Analysis can be daunting to newcomers. More generally, risk analysis incorporates and spans many disciplines. It is often difficult for people, even those who work on some topic within risk analysis—be it toxicology, terrorist threat assessment or human behavior—to understand how their work fits into the risk analysis “big picture.” Likewise, disciplinary training does not prepare people to understand, much less converse with, fellow practitioners. This workshop, taught by two experts with extensive histories in practice, government and academia, is designed to fill that gap. We introduce fundamental risk analysis concepts, terminology, applications and calculations. The workshop is suitable for first time Society for Risk Analysis Annual Meeting attendees, as well as all individuals new to risk analysis and those who have been involved in only a limited aspect of risk analysis. Participants should have an undergraduate degree in an area relevant to risk analysis, and / or relevant work experience. Upon completion of this course, students will understand the origins, applications and controversies surrounding risk analysis. They will be prepared to evaluate risk analysis reports and presentations. Most importantly, they will be prepared to engage comfortably in the range of conversations that distinguish Society for Risk Analysis Annual Conferences.

Full Day Thursday, December 8th Workshop, 8:30 am – 5:30 pm

WS 18

Probabilistic risk analysis with hardly any data

Organizer: Scott Ferson

\$250/\$300 after 11/4/2011

This full-day tutorial introduces and compares methods for developing a probabilistic risk analysis when little or no empirical data are available to inform the risk model. The talks are organized around the basic problems that risk analysts face: not knowing the input distributions, not knowing their correlations, not being sure about the model itself, or even which variables should be considered. Possible strategies include traditional approximative methods and recent robust and bounding methods. Numerical examples are given that illustrate the use of various methods including traditional moment propagation, PERT, maximum entropy, uniformity principle, probability bounds analysis, Bayesian model averaging and the old work horse, sensitivity analysis. All of the approaches can be used to develop a fully probabilistic estimate useful for screening decisions and other planning. The advantages and drawbacks of the various approaches are examined. Essentially, the drawbacks are that bounding approaches may say too little about risks, and the rough and ready approximate methods may say too much. The discussion addresses how defensible decisions can be made even when little information is available, and when one should break down and collect some data and, in that case, what data to look for. The presentation style will be casual and interactive. Participants will receive a CD of the illustrations and numerical examples used during the tutorial.