Vose Consulting
Veterinary Training Research Initiative (VTRI) - 0101

Applied quantitative risk analysis in agriculture

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Location: Premier Travel Inn, Glasgow
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Course overview

The course is split into two self-contained modules. The first module will be useful for analysts who have some basic knowledge of simulation modelling and to risk managers in general. This is a key module that should be taken before attending Module 2.

Module 2 provides an in-depth knowledge of the modelling techniques necessary for international level risk assessments. We critically look at risk models, and the participants are encouraged to bring along modelling problems they are currently faced with. Attendance of Module 1 or prior knowledge of the material covered in Module 1 will be needed. Participants considering only attending Module 2, should run through the short self-test in the following site http://www.voseconsulting.com/quiz.htm to make sure they have the knowledge provided in Module 1.

Module 1 lasts five days and provides the basic principles of risk assessment and where it fits in to the risk analysis process. It also looks at resource, strategy and communication issues that management face in risk assessment. It covers essential modelling principles, and gets the participants used to the risk analysis modelling environment (in this case @RISK with Excel and the statistical software R, but the lessons apply equally well to other modelling environments). We will also look at essential probability and statistics theory and various stochastic processes. This module covers material that is essential for Module 2.

Module 2 also lasts five days and has been greatly revised and should appeal to those who have already attended one of Vose Consulting's previous courses. The focus is less on the predictive microbiology and dose-response models, and more on producing models that risk managers can put their faith in. Thus, we introduce a framework for model construction that we developed for the United States Department of Agriculture to help find the simplest model that will adequately solve the manager's problem.

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This module is suited to those already familiar with spreadsheets, who have some modelling experience and who are interested in developing these abilities further. The module content will enable the participants to produce realistic, professional quality models. It is designed to encourage the modeller to develop creative problem solving skills through plenty of problem exercises.

MODULE 1: INTRODUCTION TO RISK ANALYSIS, SOFTWARE, STOCHASTIC PROCESSES AND THEIR MODELLING

Day 1

- Introduction to risk analysis
  - The partition of risk assessment and risk analysis in the management of risk
  - Establishing a risk policy
  - The roles of risk managers and risk assessors
  - Risk communication
- Introduction to risk assessment:
  - Moving from an intellectual exercise to a useful decision tool
  - Identification of a risk
  - Establishing risk assessment objectives
  - Creating and managing a risk assessment team
- Difficulties in modelling biological systems

Day 2

- Introduction to risk analysis modelling methods
  - Monte Carlo simulation, @RISK/Crystal Ball and Excel, R
  - Calculation vs. simulation
  - Uncertainty, variability and inter-individual variability
- Typical modelling results, their presentation and interpretation
- Introduction to descriptive statistics
  - Mean, standard deviation, skewness, kurtosis, percentiles
- Introduction to probability theory
  - Probability concepts
  - Graphical representations of risk events: Venn diagrams, fault trees and event trees
  - Probability vs. population distributions, relative vs. cumulative, discrete vs. continuous

Day 3

- Binomial Process
  - Binomial, beta, negative binomial and geometric distributions
- Problems to solve

- Nested binomials

Day 4

- Poisson process
  - Poisson, gamma, m-Erlang and exponential distributions.
- Mixed Poisson and binomial processes
- Problems to solve

- Hypergeometric process
  - Hypergeometric and inverse Hypergeometric distributions
- Central Limit Theorem
  - Normal and lognormal distributions

Day 5

- Disease spread (epidemic) simulation modelling:
  - Introduction to disease spread modelling
  - The dynamics of infectious diseases in populations, state transition diagrams, and basic disease parameters
  - Difference and differential equations, "agent-based" simulation models
  - The simple SIR and SEIR models
  - Extensions to the simple models: stochastic, spatially explicit models, multiple species/epidemiological populations
  - Hands-on development of stochastic models using Excel and @Risk and/or R

MODULE 2: ADVANCED RISK ANALYSIS MODELLING

Day 1

- Modelling dependencies
  - Rank order correlation, conditional logic and indexing, envelope method, copulas, bootstrap
  - Problems to solve
- Predictive microbiology and dose-response modelling
- A new hierarchal framework for building risk analysis models
  - Establishing consistency between models and defending their theoretical basis
  - Making models more efficient and valid
  - Building self-updating predictive models with MCMC

Day 2

- Reviewing published models within the new framework
  - Could the models be simplified?
  - How would simplification affect the results and assumptions?
- Uncertainty and variability

  - Meaning of uncertainty and variability, the value of their distinction, modelling techniques
  - Examples of modelling problems where they are usefully separated
  - Structures of two-dimensional (second order) risk analysis models
- Classical statistics
  - Estimation of population mean and standard deviation
  - Estimation of population prevalence and Poisson mean

Day 3

- Bayes' Theorem
  - Theory and derivation
  - Construction and simulation solutions
  - WinBUGS modelling

Note: Bayesian methods of statistics is used here considerably as an intuitive means of helping participants understand the connection between data and knowledge

Day 4

- The Bootstrap
  - Non-parametric and parametric Bootstrap techniques
  - Use of Jack-knife for gauging robustness
  - Applications and problems to solve
- Analysing and using data:
  - Checking quality and appropriateness
  - How to accept and reject different data sets
  - Spotting the traps and filling the gaps in reported data
- Determining distributions from data
  - Assessing validity of data
  - First order distribution fitting
    - Fitting to parametric and non-parametric distributions
    - MLE and goodness of fit statistics
    - Using optimizers with gof statistics for best fit
  - Second order distribution fitting
  - Parametric and non-parametric distributions
  - Likelihood estimating, Bootstrapping, other methods
  - Problems to solve

Day 5

- Presenting risk analysis quantitative results
  - Statistical and graphical outputs from a risk assessment
- Report writing
- A new method for validating models and their results
  - Reviewing assumptions, knowledge and data quality
  - Integrating the model's vulnerabilities into a validity score
  - Graphical representation of validity