EPIX ANALYTICS
Sound answers for complex decisions
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Course program: Quantitative Risk Analysis and Disease Modeling in Epidemiology

EpiX Analytics

The course runs from 09:00 to 17:00 each day. Registrations on the first day begin at 8:30am.

Day 1	**Introduction to risk analysis**
Morning	**Welcome and general Introduction** **Introduction to risk analysis in epidemiology and food safety** • Definitions & History • Frameworks (OIE, Codex) • Principles and main steps of risk analysis • Qualitative, semi-quantitative and quantitative approaches • Risk management and risk communication **Statistical foundations for quantitative risk analysis** • Mean, mode, standard deviation, skewness, kurtosis, percentiles • Probability vs. population distributions, relative vs. cumulative, discrete vs. continuous
Afternoon	**Statistical foundations for quantitative risk analysis (cont.)** • Probability theory refresher • The use of distributions: heterogeneity, randomness, uncertainty • Graphical representations of risk events **Risk modeling** • Monte Carlo simulation, Excel add-ons (@RISK®) and script-based simulation tools (e.g. R®, Matlab®) • Calculation vs. simulation • Typical risk analysis results, their presentation and interpretation • Practical problems to solve ***Optional social event - microbrewery tasting tour***
Day 2	**Fundamental stochastic processes**
Morning	**Binomial process** • Binomial, beta, BetaBinomial, negative binomial, and geometric distributions • Practical problems to solve
Afternoon	**Poisson process** • Poisson, gamma, exponential distributions - optional: Erlang, Polya, and Delaporte • Practical problems to solve

Day 3	**Fundamental stochastic processes (cont.)**
Morning	**Hypergeometric process, identities, and aggregate modeling** • Sampling from finite populations: Hypergeometric and inverse Hypergeometric distributions • Using distribution identities • Aggregate modeling: compound distributions, central limit theorem • Practical problems to solve **Model design and validation** • Good practices in risk modeling: how to build and maintain a model • Risk analysis checklist: avoiding mistakes and creating useful models
Afternoon	**Determining distributions from data/distribution fitting** • Introduction to statistical methods to fit distributions to data: frequentist (standard tests, Bootstrap, non-parametric) and Bayesian (MCMC, MC, analytical, BMA) • Examples of estimation of population parameters using data: location, shape, and scale parameters • Combining data sources and/or expert opinion: meta-analysis, Bayesian Model Averaging, and mixture distributions • Problems to solve
Day 4	**Modeling uncertainty**
Morning	**Modeling uncertainty** • Meaning of uncertainty and variability, the value of their distinction, modeling techniques • Sensitivity and scenario analyses to evaluate uncertainty and variability (optional) **Bayesian statistics** • Theory and derivation, comparison with classical statistical and Bootstrap methods • Posterior construction and simulation: Conjugate priors, discrete approximations, Bayesian Monte Carlo, MCMC, Likelihood-free methods (ABC) • Practical problems to solve
Afternoon	**Classical statistics** • Using classical statistical inference and tests to model uncertainty about population parameters • Limitations **The bootstrap** • Non-parametric and parametric Bootstrap techniques • Using the bootstrap to model correlations ***Optional social event - group dinner***
Day 5	**Disease spread (epidemic) simulation modeling**
Morning	**Introduction to disease spread modeling**

	• The dynamics of infectious diseases in populations, state transition diagrams, and basic disease parameters • The simple SIR and SEIR models • Extensions to the simple models: stochastic, spatially explicit models, multiple species/epidemiological populations • How to use disease spread models within a risk assessment • Applications and case studies
Afternoon	**Hands-on development of a stochastic model using Excel and @RISK and/or R** **Review of published risk analyses** (optional) **Discussion of participants' modeling problems** (optional) **Delivery of certificates of attendance and adjourn**