Using AgenaRisk to visualise risk and model uncertainty

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What is AgenaRisk?

- Helps you model risk, analyse uncertainty and make better decisions
- Combines the benefits of Bayesian networks, statistical simulation and spreadsheet-like analysis
- Is visual, easy to use, intuitive and powerful
Who should use AgenaRisk?

- Risk and quantitative analysts
  Currently using spreadsheets wishing to model uncertain variables using probability distributions

- Bayesian network researchers and designers
  Looking to handle continuous variables for diagnosis in object-based and dynamic models

- AI researchers and practitioners
  Interested in expert systems and machine learning

- Statisticians
  Wishing to estimate unknown parameters, from data, using Bayesian inference

- Engineers and scientists
  Interested in incorporating risk and uncertainty into their models

- Quality and reliability engineers
  Looking to calculate system or process reliability using fault trees, expert judgement and failure data

- Academics
  Probability theory, Statistical simulation, Bayesian networks and AI, Risk assessment, Decision analysis, Quality and Six Sigma and Reliability Engineering
AgenaRisk
Modelling Spectrum

“Mind” Mapping
Causal modelling

Simulation

Probabilistic Expert Systems

Dynamic Modelling

Statistical Learning from data

Accessible And Simple

Expert-led And Difficult
Risk Map*

- Nodes represent
  - variables
  - events
  - quantities
- Links represent relationships
  - relevance
  - causality
- Easy to support and understand

* Also know as causal model or Bayesian network
Measuring Scales

• Risk Node Types
  – Boolean (Yes/No, True/False)
  – Labelled (Red, Blue, Green)
  – Numeric (Integer, Continuous, Discrete)
  – Ranked (High, Medium, Low)
Discrete Probabilities

- Prior probabilities
  - No: 0.9
  - Yes: 0.1

- Conditional Probabilities

- Result viewed as marginal probability distribution
Town Flood Example

**Trigger**
- Dam bursts upstream

**Control**
- Flood Barrier Falls

**Risk Event**
- Flood?

**Consequence**
- Loss of Life

**Mitigant**
- Rapid Emergency Response
Calculation of Town Flood Risk

- **Dam bursts upstream**
  - No: 0.0
  - Yes: 0.0

- **Flood Barrier Fails**
  - No: 0.0
  - Yes: 0.0

- **Flood?**
  - No: 0.0
  - Yes: 0.0

- **Rapid Emergency**
  - No: 0.0
  - Yes: 0.0

- **Loss of Life**
  - No: 0.0
  - Yes: 0.0
Backwards Reasoning

- Estimate causes from effects!
- Useful way to model uncertain indicators
Continuous Probabilities by Simulation

Model Statistical Distributions E.g. Normal

\[ p(X) = \frac{1}{\sigma \sqrt{2\pi}} e^{-(x-\mu)^2/(2\sigma^2)} \]
Simulation Model Example
Beta-Binomial Example

Beta prior = belief in fairness of coin

Number of trials = (10, 100)

Probability of head

Number of heads observed

Trials
Sensitivity analysis and fast comparison using scenarios
Statistical Learning Example
Connecting Risk Maps using Building Blocks

• Connect risk maps via input/output risk nodes

• Create complex time based or complex structural models
Dynamic Flood Example
“Risky” Applications

- Aircraft Mid-air collision
- Software defects
- Systems reliability
- Warranty return rates of electronic parts
- Operational risk in financial institutions
- Predict hazards in petrochemical industry
- Project portfolio risk profiling
Six Sigma Quality Control
Mid Air Collision Prediction
Final Remarks

- **Structured Method**
  - Based on 300 year old proven Bayes’ theorem
  - Enabled by modern computer power & technology
  - Beyond current statistical & Monte Carlo techniques
  - Combines subjective judgements with data

- **Risk Maps enable Visual Communication**
  - Managing risk through pictures
  - Useable by risk novices as well as experts
  - Makes complex risk problems easily communicable

- **AgenaRisk is Industrial Strength**
  - Enables scalable, reusable & auditable risk models
  - Integrates easily with DBMS & Excel
  - Enables professional developers to build end-user applications