Introduction to Riscue

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Monte Carlo simulation

Given n random variables $X_1, \ldots, X_n$ with known probability distributions.

Let Y be a random variable such that:

$$Y = f(X_1, \ldots, X_n)$$

The distribution of Y can be difficult to calculate analytically.

Instead we run a Monte Carlo simulation where we generate N samples from the distributions of the X_i's, where N is a large number (e.g., $N = 10\,000$).

Monte Carlo simulation (cont.)

Monte Carlo samples:

$$
\begin{aligned}
Y_1 &= f(X_{1,1}, \ldots, X_{n,1}), \\
Y_2 &= f(X_{1,2}, \ldots, X_{n,2}), \\
&\cdots \\
Y_N &= f(X_{1,N}, \ldots, X_{n,N})
\end{aligned}
$$

The distribution of Y is the estimated using the empirical cumulative distribution function, often referred to as the S-curve:

$$\hat{F}(y) = \frac{1}{N} \sum_{j=1}^{N} I(Y_j \leq y)$$

Monte Carlo simulation (cont.)

Note that for a given y we have:

$$E[\hat{F}(y)] = \frac{1}{N}\sum_{j=1}^{N} E[I(Y_j \leq y)] = \frac{1}{N}\sum_{j=1}^{N} P(Y \leq y)$$

$$= P(Y \leq y) = F(y)$$

$$Var[\hat{F}(y)] = \frac{1}{N^2}\sum_{j=1}^{N} Var[I(Y_j \leq y)] = \frac{1}{N^2}\sum_{j=1}^{N} P(Y \leq y)[1 - P(Y \leq y)]$$

$$= \frac{1}{N} P(Y \leq y)[1 - P(Y \leq y)] \leq \frac{1}{4N}$$

Thus, $\hat{F}(y)$ is an unbiased and consistent estimator for $F(y)$.

Monte Carlo simulation (cont.)

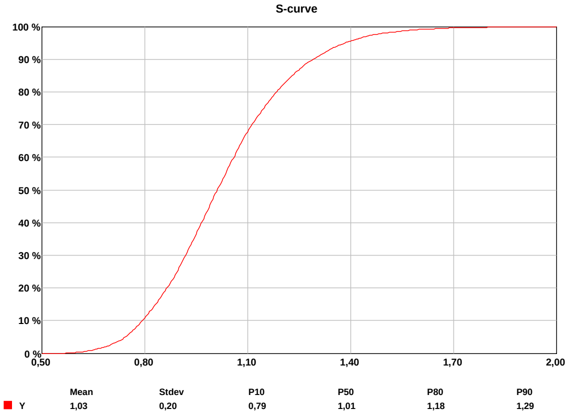

Figure: An empirical distribution curve

Riscue™

Riscue™ is a Monte Carlo simulation program with a graphical user interface where:

- Random variables are represented by nodes in a graph
- Relations between the variables are represented by directed edges
- Large complex models can be structured hierarchically
- Simulations can be run very fast
- Results can be plotted and analyzed
- Sensitivity analysis can be integrated in the models

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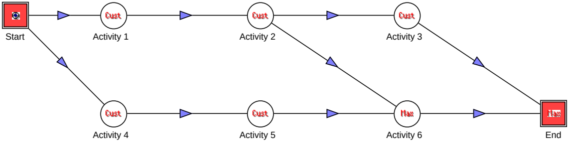

Figure: A Riscue^{TM} model

Riscue^{TM} (cont.)

Application areas

- General risk models
- Cost risk models
- Schedule risk models
- Integrated risk models
- Oil production models
- Reliability models
- Insurance models

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