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Learning to Learn

The Art of Doing Science and Engineering

Session 19: Simulation II

Topic Outline

- Simulation Reliability
- Domain Experts
- Problem
- Simulation in the Soft Sciences
- Method of Scenarios
- Realistic Estimates of Reliability
- Responsibility

Simulation Reliability

"Computer based simulation is now in wide spread use to analyse system models and evaluate theoretical solutions to observed problems. Since important decisions must rely on simulation, it is essential that its validity be tested, and that its advocates be able to describe the level of authentic representation which they achieved."

-- 1975 Summer Simulation Conference

Simulation Reliability

Why should anyone believe the simulation is relevant?

- Accuracy of the modeling
- Accuracy of the computations

Are you measuring reliability of the real-world event or reliability of the simulation?

Domain Experts

Simulation experts **are concerned with the simulation and have little or no regard for reality, or even "observed reality."**

Domain experts **are essential to answer questions like:**

- Are all the essentials incorporated correctly into the model?
- How relevant to reality are these models:

Problem

Relevant accuracy and reliability of simulations are a serious problem.

There is no silver bullet, no magic incantation, no panacea – only yourself.

Sloppy simulation involves design, implementation and test without regard to real world observations.

Simulation in the Soft Sciences

Necessary to understand the underlying laws of whatever field your are simulating.

Not possible with the "soft sciences" – economics, literature, history, drama, sociology, etc.

- *Combining of data can create effects not there in detail*
- *Be wary when agreeing to do a simulation – seek mathematically expressed rules for every possible interaction*

Method of Scenarios

Do not predict what will actually happen, just give a number of possible projections.

- Consider typical patterns with ranges of behavior rather than predictions of the behavior of a specific subject.

Realistic Estimates of Reliability

Consider the following questions:

- Does the background field support the assumed laws to a high degree?
- How sure are you some small, but vital, effect is not missing?
- Is the input data reliable?
- Is the simulation stable or unstable?
- What cross checks against known past experience have you available for checking things?
- Can you produce any internal checks?

Responsibility

Reliability of simulation is becoming increasingly important as the use of simulation in decision making increases.

YOU are responsible for your decisions, and cannot blame them on those who do the simulations.

Reliability is a central question with no easy answers.

Related topics

Simulation in the Soft Sciences

- Santa Fe Institute and Studies in Complexity Theory (complex interactions among constituent parts)

  http://www.santafe.edu/sfi/research/indexResearchAreas.html