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Related or not

Terminology and definitions for model validation and uncertainty analysis

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The modeling cycle.

- A model can never be called valid, but:
 - A model can be invalidated
 - Passing any validation test increases credibility
- It is a cyclic proces
- Uncertainty analysis is part of it:
 - Experimentation
 - hence: programming and data-analysis

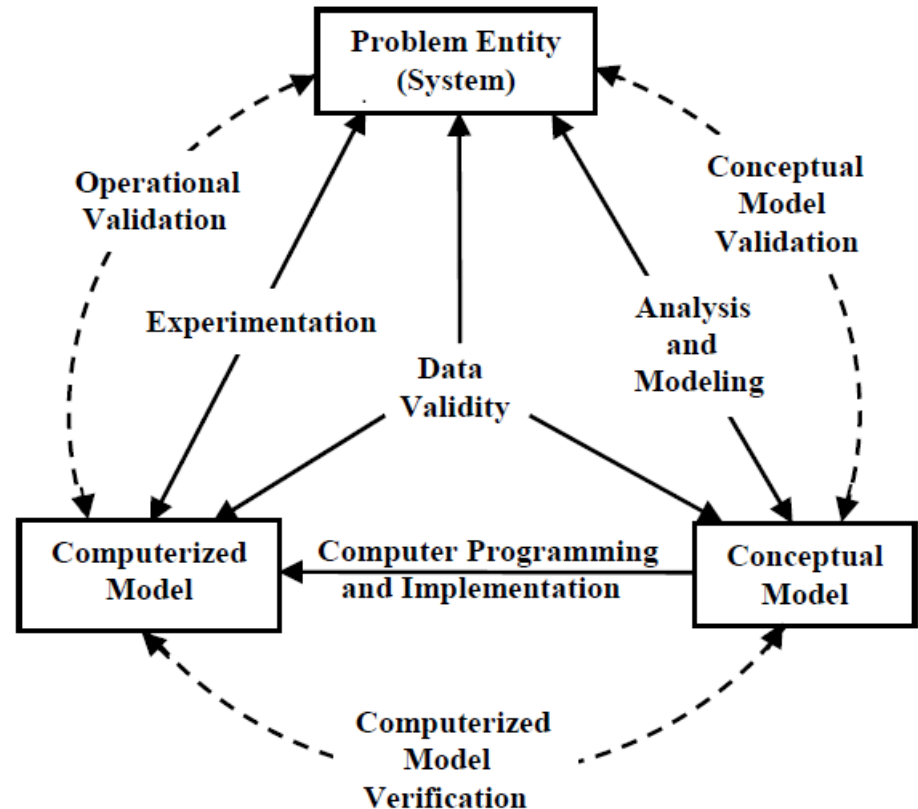


Figure 2: Simplified version of the modeling process

Source: R.G. Sargent in Proceedings of the 2011 winter simulation conference.

Model validation

VALID MODEL

- “A proper and sufficient representation of the system it is intended to represent, in view of a specific application”

“proper” = in line with what is known about the system

“sufficient” = the results can serve as a solid basis for decision making

Different types of model validation

- Linked to the modeling cycle
- Types of validation versus types of tests
- Conceptual validation
- Input data validation
- Code verification
- Operational validation

Conceptual validation

1. Face validity testing

- Who? Why experts? What did they conclude?

2. Cross-model validation

- If so, where?
- If not, why not?

- Linked to structural uncertainty: model structure

Input data validation

First indicate description and justification of: search strategy, choice of sources (inclusion/exclusion), assumptions, uncertainty, data adjustments/choice of methods.

1. Face validity testing
 - Who? Why experts? What did they conclude?
2. Statistical model fit testing
 - Description, justification, outcomes
- Linked to parameter uncertainty
 - Distributions around parameters based on input data
 - Valid input data analyses → Valid distributions → proper uncertainty analysis

Code verification

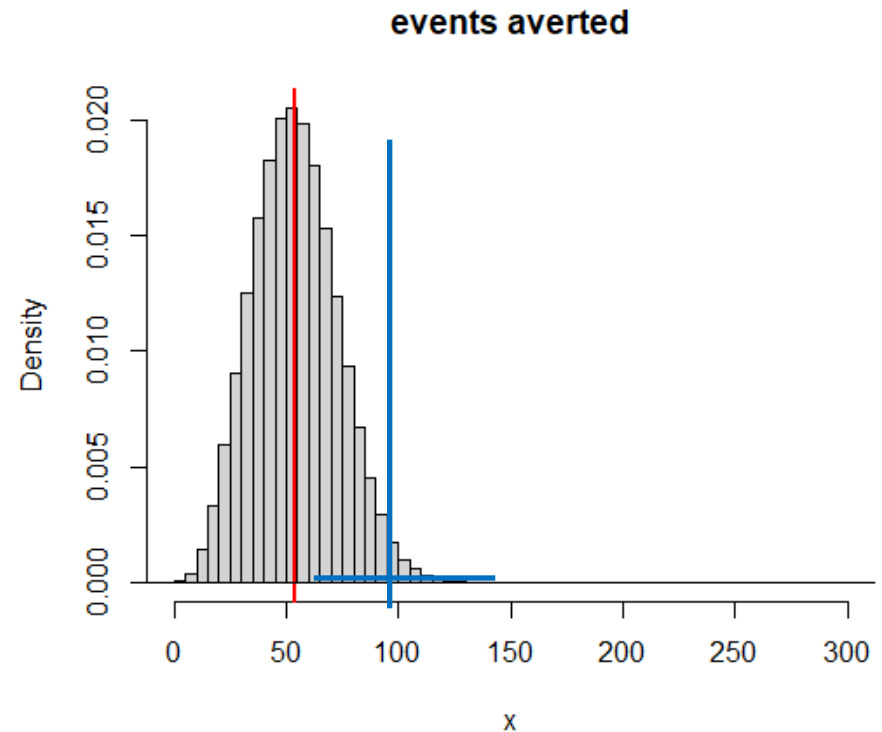
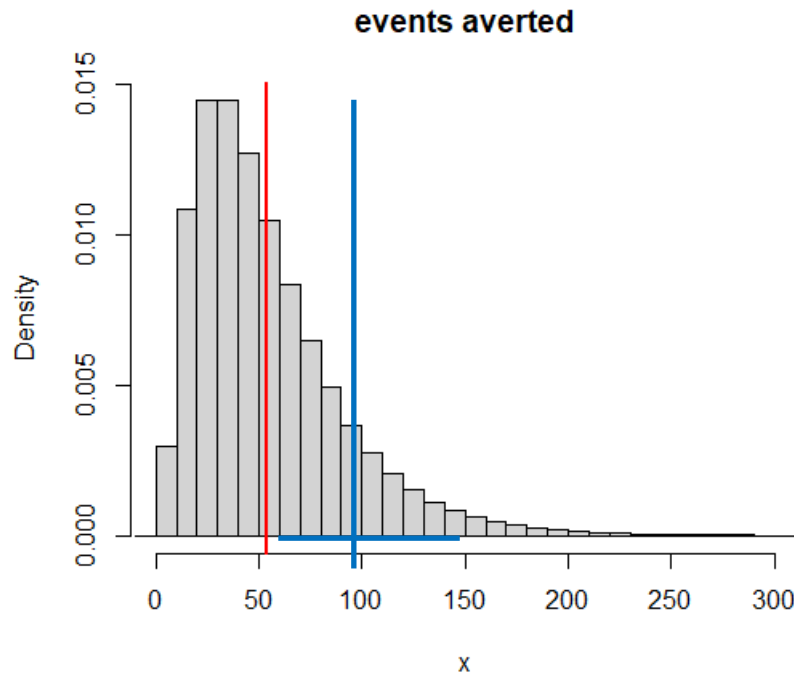
Indicate differences between conceptual model and final computerized model

1. External review
 2. Extreme value testing
 3. Testing of traces
 4. Unit testing
 - Sub-Modules
- Linked to all types of uncertainty analysis:
 - Valid code → proper analysis possible
 - Code should allow for efficient analysis and sufficient loops

Operational validation

- Assess validity of model outcomes
 - Face validity (experts)
 - Internal validation/dependent validation
 - External validation/independent validation
 - Cross-model validation
 - Prospective validation
- Closely linked to uncertainty analysis
 - Variability and uncertainty imply model outcomes to vary
 - How to compare range of model outcomes to external data
 - Little research so far. Different approaches in practice.

Link uncertainty and operational validity



Link uncertainty and operational validity

- Large uncertainty in model outcomes
 - Always a valid model?
 - Not very useful. Trade-off. (Corro-Ramos, VIH 2017)
 - Could decision makers a priori set required accuracy?

