

Systems Biology Model Validation & Simulation Tools — Hands-on

Learn how to verify, validate and simulate systems biology models so they are trustworthy and reusable. This module focuses on basic verification checks, validation against data, uncertainty and sensitivity views, and practical use of SBML friendly simulation tools to run time course, steady state and scenario analyses with clear reporting.

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Session 1

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Model Verification & Validation Foundations

What it means for a systems biology model to be “valid”

[concepts of verification vs validation](#) [structural checks and consistency](#) [qualitative vs quantitative agreement](#)

Common issues in models and how to spot them early

[units, parameter ranges and sign errors](#) [mass](#)

balance and conservation ideas **nonphysical trajectories and instability**

Toolchain for basic model checks and documentation

SBML style representations (concept level) **simple scripts for sanity checks** **model metadata and version notes**

Session 2

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Simulation Tools & SBML Workflows

Overview of simulation environments for systems models

visual model editors (concept view) **SBML compatible solvers and GUIs** **scriptable simulation via R / Python**

Setting up time course and steady state simulations

initial conditions and parameter sets **step sizes and solver options overview** **saving trajectories and outputs cleanly**

Implementation toolkit for SBML centric workflows

import / export between editors and code **simple scripts to batch run simulations** **organising simulation projects and files**

Session 3

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Parameter Scans, Sensitivity & Scenarios

Exploring parameter space with scans and grids

one at a time parameter sweeps **coarse grid exploration ideas** **summaries of output ranges and behaviours**

Sensitivity and basic uncertainty views (concept level)

local sensitivity around a reference set **simple global**
style sampling ideas **heatmaps and summary indices**

Implementation toolkit for scans and scenario management

scripts for looped simulations **R / Python plotting of**
parameter vs outputs **scenario naming and**
comparison tables

Session 4

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Mini Capstone: Model Validation & Simulation Report

Design a small validation and simulation plan for a model

Theory + Practical

Run simulations, parameter scans and summarise model
behaviour

baseline and perturbed runs **figures for key**
trajectories **simple validation statements vs**
expectations

Deliverables: notebook, simulation outputs & validation summary

R or Python simulation notebook **CSV/TSV output**
tables and figures **PDF/HTML model validation report**