

# Population and ODE-based models using Stan and Torsten

*with applications in pharmacometrics*

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*Length:* 1/2 - 1 day

## **Prerequisite:**

Participants should be familiar with Bayesian statistics and basic Stan. The requisite material is covered in the introductory tutorial and the tutorial on hierarchical modeling. The short length of the workshop is meant to give participants (and the instructor) a chance to attend these tutorials and other workshops of interest.

This workshop focuses on examples from pharmacometrics, so familiarity in the subject is helpful. In addition, we will use Torsten, a specialized extension of Stan, which participants should install. That said, the methods discussed apply to other fields: e.g. epidemiology, geology, econometrics, so I will keep the core concepts general. I will review basic notions of pharmacometrics, so that participants from all field can do the exercises.

## **Outline:**

### 1. Introduction

- Modeling framework: build, fit, and criticize
- Review: diagnosing inference
- Review: criticizing the model

### 2. Pharmacometrics models

- Compartment models
- The event schedule
- *Exercise 1: build, fit, and diagnose a two compartment model*

3. Ordinary differential equation based models
  - Arsenal of tools to solve ODEs
  - *Exercise 2: write, fit, and diagnose a two compartment model with the ODE integrator*
  - The mixed solver: combining analytical and numerical methods
  - *Exercise 3: write, fit, and diagnose a Friberg-Karlsson model*
4. Population models
  - Review of hierarchical models
  - *Exercise 4: write, fit, and diagnose a population two compartment model*
  - Divergent transitions and where they come from
  - *Exercise 5: re-parametrize the population two compartment model*
  - Within-chain parallelization
5. Open discussion and concluding remarks