# Fundamentals of Stan

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mc-stan.org

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## Course description

This half-a-day course serves as a rigorous introduction to Stan and can be used as a stepping stone to then take more advanced tutorials.

We will discuss the tenants of the *Bayesian workflow*, i.e. the iterative process through which we build, fit, and criticize models, with the latter step often motivating useful revisions to our model. We will see how Stan supports each of the steps and apply them to several illustrative examples. In an effort to thoroughly understand the outputs returned by Stan, we will also delve a little bit under-the-hood, and review Stan's Hamiltonian Monte Carlo sampler—currently one of the most successful Markov chain Monte Carlo (MCMC) methods—and cover essential diagnostics for running MCMC. This will be a hands-on workshop: participants are expected to code and attempt several exercises.

### Goals:

- Learn the Stan language
- Understand how to do Bayesian inference with MCMC
- Learn the fundamentals of the Bayesian workflow
- Apply these principles to some illustrative examples

**Helpful pre-requisites:**

- Familiarity with probability (i.e. different types of distributions; conditional distributions; definitions of expectation values, variance, quantiles, etc.)
- Familiarity in a coding language, e.g. R or Python. The focus will be on coding in Stan. Participants are not expected to know Stan.

**About the instructor:** *Charles is research fellow at the Flatiron Institute, Center for Computational Mathematics. He holds a PhD in Statistics from Columbia university, where he worked with Andrew Gelman. For 7 years, he has been a member of the Stan development team. His contributions include support for several implicit functions (e.g. matrix exponentials, algebraic solvers, hidden Markov models), and the co-creation of Torsten, an extension of Stan for pharmacometrics. His research interests include Bayesian hierarchical models, Markov chains Monte Carlo, variational inference and automatic differentiation.*