



Introduction to rstan: workshop

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What is Stan?

- Stan is, among other things, a modeling language:
 - Bayesian inference with MCMC samplings via NUTS, HMC
 - Approximate Bayesian inference with variational inference
 - Penalized maximum likelihood estimation with optimization
- Similar to BUGS
- Rstan is just a way to run Stan using R code
 - The same files can be run in python

What will we cover?

- Packages we need and initialization
- How to use rstan directly
- How to check diagnostics
- How to handle rstan objects
- How to avoid using rstan
 - brms (my favorite)
 - rstanarm (pretty good)

Downloading packages

- Need:
 - rstan
 - parallel
- Want:
 - rstanarm
 - brms
 - shinystan

Getting Started

- `options(mc.cores = parallel::detectCores())`
 - This tells rstan to use as many cores as your computer has available
- `rstan_options(auto_write = TRUE)`
 - Don't have to recompile stan files
- `Sys.setenv(LOCAL_CPPFLAGS = '-march=native')`
 - Allows faster executive time, must may cause problems

rstan package

- “User-facing R functions are provided to parse, compile, test, estimate, and analyze Stan models by accessing the header-only Stan library provided by the 'StanHeaders' package.”
1. Write your log posterior density in a .stan file
 2. Prepare the data
 3. Call stan
 4. Diagnose non-convergence
 5. Conduct posterior inference

Rules/Common Problems

- Stan files must always end with a blank line
- Stan files need to have a “data”, “parameters”, and “model” chunk
 - Can also have “transformed parameters”, “functions”, and “generated quantities”, “transformed data”, and maybe a few others
- Always declare the dimensions and support for variables
 - Ex: `real<lower=L, upper=U> y[N]`

rstan package

- Rstan does a lot of things that we won't cover
 - Solving Algebraic Equations
 - Ordinary Differential Equations
 - One Dimensional Integrals

brms package

- “Fit Bayesian generalized (non-)linear multivariate multilevel models using ‘Stan’ for full Bayesian inference.”
- Uses familiar R notation for models (lm, glm, lmer, etc)
- Nicer output formatting
- Note: data argument must always be supplied

rstanarm package

- “Estimates previously compiled regression models using the 'rstan' package.”
- Uses familiar R notation for models, but not as familiar
- Plays a little nicer with rstan functions

Where to go for help

- Stan User's Guide: https://mc-stan.org/docs/2_19/stan-users-guide/index.html
- Initialization: <https://github.com/stan-dev/rstan/wiki/RStan-Getting-Started>
- Reference Manual: https://mc-stan.org/docs/2_19/reference-manual/index.html#overview
- rstanarm vignettes: <http://mc-stan.org/rstanarm/articles/index.html>