Software for applied Bayesian inference

FW 891

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Purpose

- Learn the basic syntax of the Stan language
- Write code to elicit simple models and implement Bayesian inference in Stan
- Use the cmdstanr interface
- Develop familiarity with a few packages that make your life easier
- Make sure you have these programs/packages installed

Installing CmdStanR

- See the installation instructions here

```
library(cmdstanr)
# use a built in file that comes with cmdstanr:
file =  file.path(cmdstan_path(), "examples",
                  "bernoulli", "bernoulli.stan")
mod =  cmdstan_model(file)
```

see also CmdStan user's guide

Now let's make sure it works

```
# tagged list where names correspond to the .stan data block
stan_data <- list(N = 10, y = c(0,1,0,0,0,0,0,0,0,1))

fit <- mod$sample(
  data = stan_data,
  seed = 123,
  chains = 4,
  parallel_chains = 4,
  refresh = 500 # print update every 500 iters
)
```

Do the bottom numbers match up?

```
Running MCMC with 4 parallel chains...

Chain 1 Iteration:    1 / 2000 [  0%]  (Warmup)
Chain 1 Iteration: 1001 / 2000 [ 50%]  (Sampling)
Chain 1 Iteration: 2000 / 2000 [100%]  (Sampling)
Chain 2 Iteration:    1 / 2000 [  0%]  (Warmup)
Chain 2 Iteration: 1001 / 2000 [ 50%]  (Sampling)
Chain 2 Iteration: 2000 / 2000 [100%]  (Sampling)
Chain 3 Iteration:    1 / 2000 [  0%]  (Warmup)
Chain 3 Iteration: 1001 / 2000 [ 50%]  (Sampling)
Chain 3 Iteration: 2000 / 2000 [100%]  (Sampling)
Chain 4 Iteration:    1 / 2000 [  0%]  (Warmup)
Chain 4 Iteration: 1001 / 2000 [ 50%]  (Sampling)
Chain 4 Iteration: 2000 / 2000 [100%]  (Sampling)
Chain 1 finished in 0.0 seconds.
Chain 2 finished in 0.0 seconds.
Chain 3 finished in 0.0 seconds.
Chain 4 finished in 0.0 seconds.

All 4 chains finished successfully.
Mean chain execution time: 0.0 seconds.
Total execution time: 0.3 seconds.
```

```
1  fit$summary() # you should get these numbers:
```

```
# A tibble: 2 × 10
  variable   mean median    sd   mad       q5    q95  rhat ess_bulk ess_tail
  <chr>     <num>  <num> <num> <num>    <num>  <num> <num>    <num>    <num>
1 lp__      -7.26  -6.99 0.719 0.329 -8.73    -6.75   1.00    1658.    1861.
2 theta      0.246  0.231 0.118 0.118  0.0811   0.463  1.00    1378.    1236.
```

Presumably this broke someone

image credit