stan examples

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This file contains examples of 'Stan'.
The first example is for Gaussian model.
The second example is for Beta-binomial model.

Set up

Ex_1 Gaussian

The mock data is 1,000 i.i.d. X ~ Normal(μ=5,σ=1).

Template Result:

```
## Inference for Stan model: my_model_norm.
## 4 chains, each with iter=2000; warmup=1000; thin=1;
## post-warmup draws per chain=1000, total post-warmup draws=4000.
##
##           mean se_mean   sd    2.5%     25%     50%     75%   97.5% n_eff Rhat
## mu        4.98    0.00 0.03    4.92    4.96    4.98    5.00    5.04  3319    1
## sigma     1.04    0.00 0.02    0.99    1.02    1.04    1.05    1.08  3017    1
## lp__   -535.51    0.03 1.03 -538.40 -535.88 -535.20 -534.78 -534.52  1678    1
##
## Samples were drawn using NUTS(diag_e) at Wed Jan  5 00:19:58 2022.
## For each parameter, n_eff is a crude measure of effective sample size,
## and Rhat is the potential scale reduction factor on split chains (at
## convergence, Rhat=1).
```

Pair plots:

Try to extract sample results

```
##  [1] 4.98610 4.97626 5.00561 4.91539 4.87870 4.90267 5.01703 4.94508 4.97180
## [10] 4.98501
```

Ex_2 Beta-binomial

Parameters and set up:

The number of sampling times is 1000;
Prior distribution θ~$Beta(1,1)$, Y~$Bin(100,\theta)$;
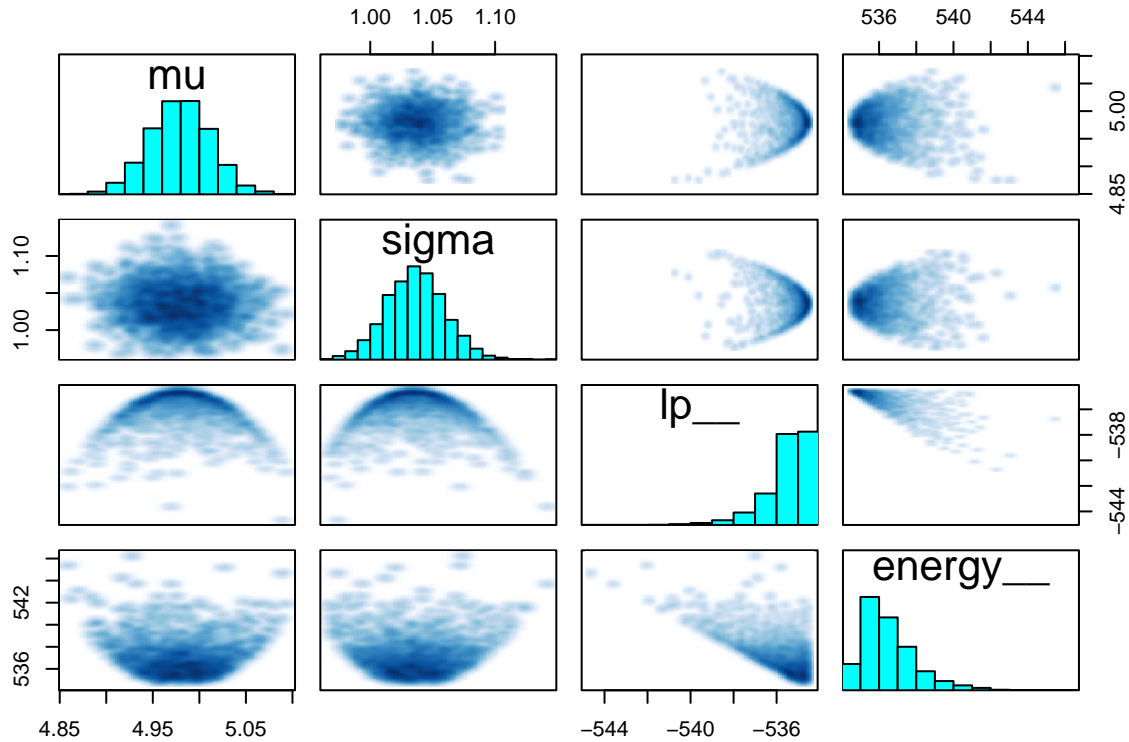
Figure 1: Pair plots for Gaussian model

Observed data is 82 responses in the first cohort of 100 patients;

Posterior distribution for θ:

```
## Inference for the input samples (4 chains: each with iter = 1000; warmup = 0):
##
##          Q5    Q50    Q95  Mean  SD  Rhat Bulk_ESS Tail_ESS
## theta   0.7    0.8    0.9   0.8 0.0  1.01      581      705
## lp__  -51.1  -49.3  -49.0 -49.6 0.8  1.01      805      725
##
## For each parameter, Bulk_ESS and Tail_ESS are crude measures of
## effective sample size for bulk and tail quantities respectively (an ESS > 100
## per chain is considered good), and Rhat is the potential scale reduction
## factor on rank normalized split chains (at convergence, Rhat <= 1.05).
```

Histogram of draws[, "theta"]
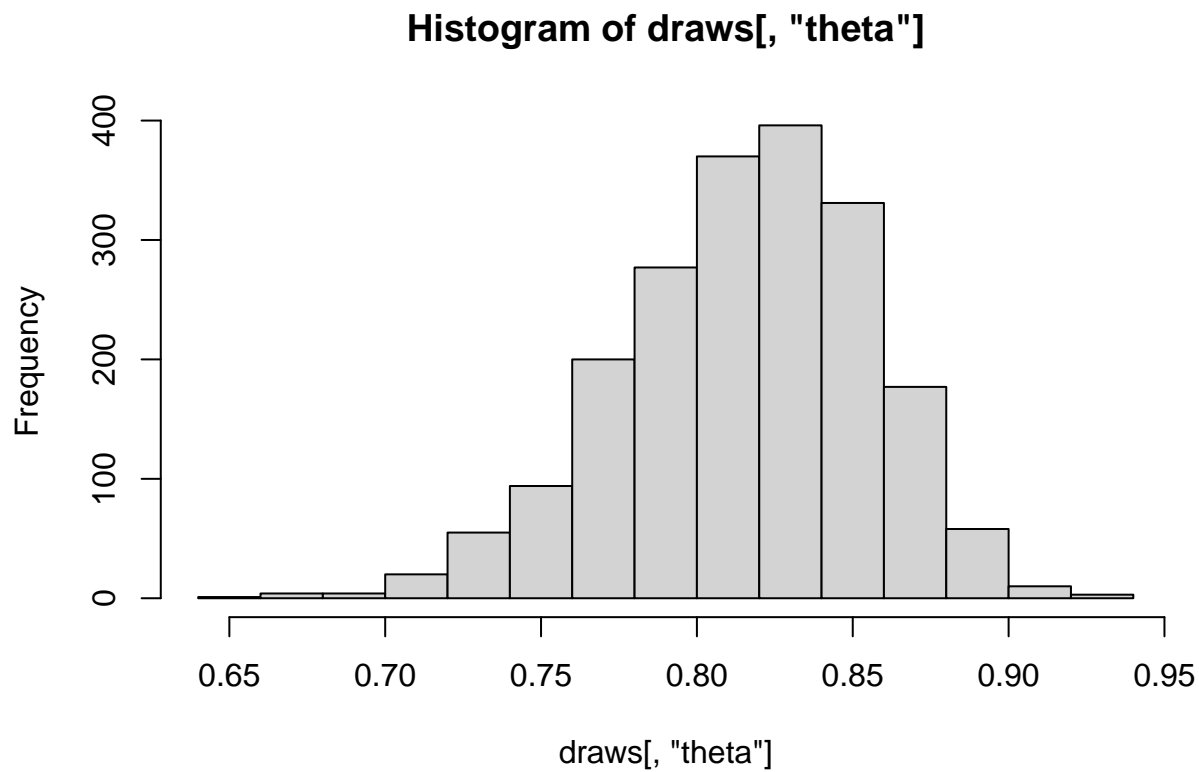
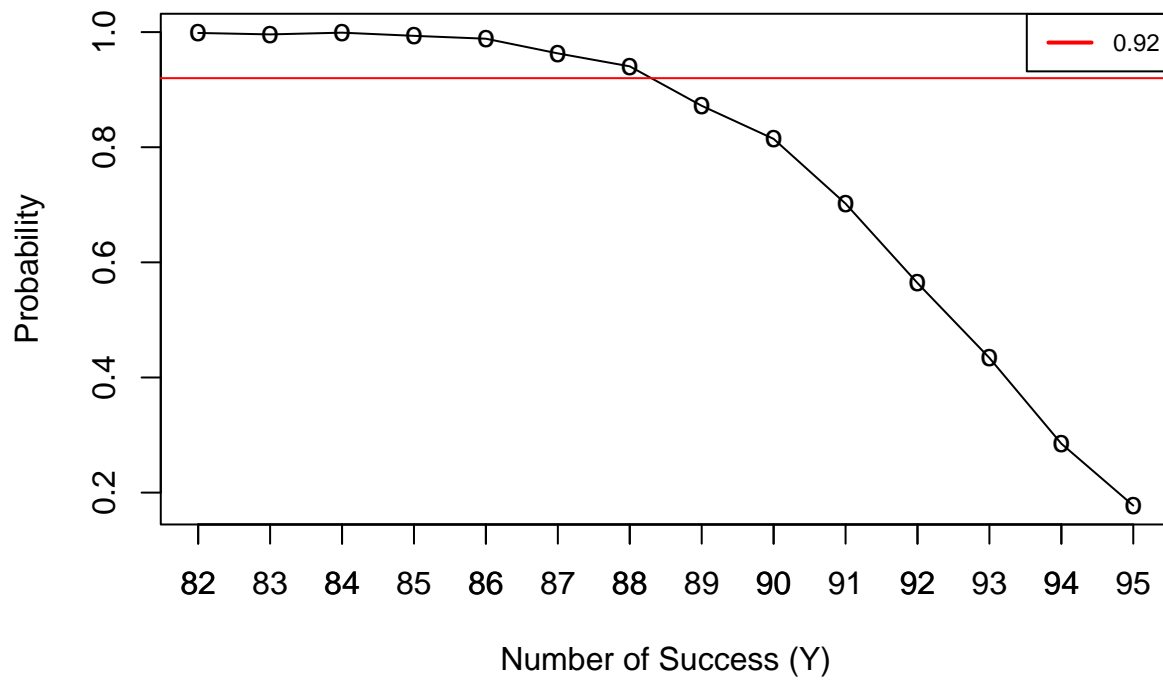
For $P(\theta \leq 0.92 | Y = 82)$

```
## [1] 0.9985
```

As $P(\theta \leq 0.92 | Y = 82) = 0.9985 > 0.9$, we stop the trial at the first interim analysis for observing 82 responses in the first 100 patients.

```
## [1] 0.1775
```

Posterior distribution of theta


```
## [1] "P|Y=88: 0.9405"
## [1] "P|Y=89: 0.872"
```