Estimating the probability of success from multiple binomial trials

When to use this

Use this program when your data consists of the results of a number of binomial experiments, each with a known but possibly different number of trials n_i. y_i is the number of successes observed in trial i. It is assumed that the probability of success p in each independent Bernoulli trial is the same. You want to estimate the parameter p (the probability of success in a single Bernoulli trial).

The likelihood for this model is binomial,

$$f(y|p) = \prod_{i=1}^{N} \binom{n_i}{y_i} p^{y_i} (1-p)^{n_i - y_i}$$

The number of binomial experiments N, the vector of the number of trials in each experiment $n_1, n_2, \ldots n_N$ and the vector containing the number of successes $y_1, y_2, \ldots, y_N$ are passed to Stan.

The prior for p

The default model file `binomial.stan` is set up with a uniform prior for p, coded as `beta(1,1)`, which is equivalent.

If you have better information about p, you might consider using a $\beta(a, b)$ prior. The mean of a $\beta(a, b)$ distribution is $a/(a + b)$, and the higher a and b are, the more the probability mass concentrates near 0.5.

The default Stan model file

The name of the model file in the example code is `binomial_single_trial.stan`

```
//Estimate the probability of success from a single binomial experiment with n trials
data {
int N;
//number of trials
int<lower=0> y;
//number of successes
}
parameters {
real<lower=0, upper=1> p;
//probability of success p
}
model {
```

```
p ~ beta(1,1);
//uniform prior for p
y ~ binomial(N,p);
//binomial likelihood given p
}
```