Prior Sensitivity Analysis

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This document contains the prior sensitivity analysis conducted to assess the impact of different settings for the priors. The posterior probabilities obtained from the different settings are compared to the one from the original model. The difference in posterior probabilities are listed after every model.

Package Installation

```
library(rethinking)
library(reshape2)
```

Original Model

```
#Message type as fixed effect
set.seed(4)
m2 <- ulam(
  alist(
    motivation ~ dstudent(v, mu, sigma),
    #model
    mu <- a + (a_person[pid] * sigma_p) + (b * messageType),
    #adaptive prior
    a_person[pid] ~ dnorm(0, 1),
    #hyper prior
    sigma_p ~ dexp(1),
    #fixed priors
    v ~ gamma(2, 0.1),
    a ~ dnorm(0, 5),
    b ~ dnorm(0, 10),
    sigma ~ dexp(1)
  ), data = combinedMotivation, iter = 10000, chains = 4, cores = 4, log_lik = TRUE,
  control=list(adapt_delta=.99, max_treedepth = 15)
)

post <- extract.samples(m2, 10000)
```

```
originalPosteriorProbability <- length(post[which(post$b>0)])/length(post$b)
cat("Calculated posterior probability value is ",  originalPosteriorProbability)
```

```
## Calculated posterior probability value is  1
```

Prior Sensitivity Analysis with mu = 1, sigma = 5

```
#Message type as fixed effect
set.seed(4)
```

```
m2 <- ulam(
alist(
  motivation ~ dstudent(v, mu, sigma),
  #model
  mu <- a + (a_person[pid] * sigma_p) + (b * messageType),
  #adaptive prior
  a_person[pid] ~ dnorm(0, 1),
  #hyper prior
  sigma_p ~ dexp(1),
  #fixed priors
  v ~ gamma(2, 0.1),
  a ~ dnorm(0, 5),
  b ~ dnorm(1, 5),
  sigma ~ dexp(1)
), data = combinedMotivation, iter = 10000, chains = 4, cores = 4, log_lik = TRUE,
control=list(adapt_delta=.99, max_treedepth = 15)
)

post_mu_1_sigma_5 <- extract.samples(m2, 10000)
```

```
pp_mu_1_sigma_5 <- length(post_mu_1_sigma_5[which(post_mu_1_sigma_5$b>0)])/length(post_mu_1_sigma_5$b)
cat("Calculated posterior probability value is ",  pp_mu_1_sigma_5)
```

```
## Calculated posterior probability value is  1
```

```
cat("Difference in posterior probability value = ", pp_mu_1_sigma_5 - originalPosteriorProbability)
```

```
## Difference in posterior probability value =  0
```

Prior Sensitivity Analysis with mu = -2, sigma = 10

```
#Message type as fixed effect
set.seed(4)

m2 <- ulam(
alist(
  motivation ~ dstudent(v, mu, sigma),
  #model
  mu <- a + (a_person[pid] * sigma_p) + (b * messageType),
  #adaptive prior
  a_person[pid] ~ dnorm(0, 1),
  #hyper prior
  sigma_p ~ dexp(1),
  #fixed priors
  v ~ gamma(2, 0.1),
  a ~ dnorm(0, 5),
  b ~ dnorm(-2, 10),
  sigma ~ dexp(1)
), data = combinedMotivation, iter = 10000, chains = 4, cores = 4, log_lik = TRUE,
control=list(adapt_delta=.99, max_treedepth = 15)
)

post_mu_2_sigma_10 <- extract.samples(m2, 10000)
```

```
pp_mu_2_sigma_10 <- length(post_mu_2_sigma_10[which(post_mu_2_sigma_10$b>0)])/length(post_mu_2_sigma_10$
cat("Calculated posterior probability value is ",  pp_mu_2_sigma_10)
```

```
## Calculated posterior probability value is  1
```

```
cat("Difference in posterior probability value = ", pp_mu_2_sigma_10 - originalPosteriorProbability)
```

```
## Difference in posterior probability value =  0
```

Prior Sensitivity Analysis with mu = -5, sigma = 5 for normal priors, sigma = 5 for exponential priors

```
#Message type as fixed effect
set.seed(4)

m2 <- ulam(
alist(
  motivation ~ dstudent(v, mu, sigma),
  #model
  mu <- a + (a_person[pid] * sigma_p) + (b * messageType),
  #adaptive prior
  a_person[pid] ~ dnorm(0, 1),
  #hyper prior
  sigma_p ~ dexp(5), #Changed to 5 from 1
  #fixed priors
  v ~ gamma(2, 0.1),
  a ~ dnorm(0, 5),
  b ~ dnorm(-5, 5),
  sigma ~ dexp(1)
), data = combinedMotivation, iter = 10000, chains = 4, cores = 4, log_lik = TRUE,
control=list(adapt_delta=.99, max_treedepth = 15)
)
post_mu_5_sigma_5 <- extract.samples(m2, 10000)
```

```
pp_mu_5_sigma_5 <- length(post_mu_5_sigma_5[which(post_mu_5_sigma_5$b>0)])/length(post_mu_5_sigma_5$b)
cat("Calculated posterior probability value is ",  pp_mu_5_sigma_5)
```

```
## Calculated posterior probability value is  1
```

```
cat("Difference in posterior probability value = ", pp_mu_5_sigma_5 - originalPosteriorProbability)
```

```
## Difference in posterior probability value =  0
```

Prior Sensitivity Analysis with mu = 2, sigma = 10, sigma = 2 for exponential priors

```
#Message type as fixed effect
set.seed(4)

m2 <- ulam(
alist(
  motivation ~ dstudent(v, mu, sigma),
  #model
  mu <- a + (a_person[pid] * sigma_p) + (b * messageType),
  #adaptive prior
```

```
  a_person[pid] ~ dnorm(0, 1),
  #hyper prior
  sigma_p ~ dexp(2),
  #fixed priors
  v ~ gamma(2, 0.1),
  a ~ dnorm(0, 5),
  b ~ dnorm(2, 10),
  sigma ~ dexp(1)
), data = combinedMotivation, iter = 10000, chains = 4, cores = 4, log_lik = TRUE,
control=list(adapt_delta=.99, max_treedepth = 15)
)

post_mu_2_sigma_10 <- extract.samples(m2, 10000)
```

```
pp_mu_2_sigma_10 <- length(post_mu_2_sigma_10[which(post_mu_2_sigma_10$b>0)])/length(post_mu_2_sigma_10$
cat("Calculated posterior probability value is ",  pp_mu_2_sigma_10)
```

```
## Calculated posterior probability value is  1
```

```
cat("Difference in posterior probability value = ", pp_mu_2_sigma_10 - originalPosteriorProbability)
```

```
## Difference in posterior probability value =  0
```

The difference in the posterior probabilities when compared to the original model is 0. Consequently, it can be said that the different prior settings have no impact on the posterior probability. Thus, the results obtained would not change under different prior settings.