updated_senate_model

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```
## -- Attaching packages ---------------------------------------------------------------------------- tidyv
## v ggplot2 3.3.2     v purrr   0.3.4
## v tibble  3.0.3     v dplyr   1.0.2
## v tidyr   1.1.1     v stringr 1.4.0
## v readr   1.3.1     v forcats 0.5.0
## -- Conflicts ------------------------------------------------------------------------------- tidyverse_c
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
## Loading required package: rjags
## Loading required package: coda
## Linked to JAGS 4.3.0
## Loaded modules: basemod,bugs
##
## Attaching package: 'R2jags'
## The following object is masked from 'package:coda':
##
##     traceplot
```

```
s <- read.csv(file='data/senate_polls.csv')
s <- s %>%
  filter(cycle == 2020) %>%
  filter(stage != "general")

senate_polls <- read.csv(file='data/senate_polls.csv')
senate_polls <- senate_polls %>%
  mutate(days_to_election = as.Date(as.character(election_date), format ="%m/%d/%Y")-as.Date(as.charact
  filter(cycle == 2020) %>%
  mutate(race_id = case_when(as.double(race_id) == 7787 ~ 6277,
                   TRUE ~ as.double(race_id))) %>%
  mutate(race_id = case_when(as.double(race_id) == 7781 ~ 7780,
                             TRUE ~ as.double(race_id))) %>%
  filter(stage != "jungle primary") %>%
  filter(stage != "runoff") %>%
  filter(days_to_election <= 365) %>%
  mutate(candidate_party = case_when(candidate_name == "Ricky Dale Harrington" ~ "DEM",
                                     TRUE ~ candidate_party))

polls_republican <- senate_polls %>%
  filter(candidate_party=="REP") %>%
```

```
  mutate(days_to_election = as.numeric(days_to_election))
polls_not_republican <- senate_polls %>%
  filter(candidate_party == "DEM")%>%
  mutate(days_to_election = as.numeric(days_to_election))
```

```
race_id <- polls_republican$race_id %>% unique
y <- polls_republican$pct
r <- match(polls_republican$race_id,race_id)
t <- polls_republican$days_to_election + 1
N_polls <- y %>% length
N_states <- race_id %>% length
N_days <- t %>% max
jags_data_republican <- list(y=y,t=t,r=r,
                  N_polls=N_polls,N_states=N_states,N_days=N_days)
```

```
model <- function(){
  for(k in 1:N_polls){
    y[k] ~ dnorm(p[k],1/sigma2_y[r[k]]) #note no longer binomial
    p[k] = beta[r[k],t[k]]
  }
  for(j in 2:N_days){
    for(i in 1:N_states){
      beta[i,j] ~ dnorm(beta[i,j-1],pow(sigma2_beta[i],-1))
    }
  }

  #EXERCISE: add hierarhciacl prior for sigma2_beta and sigma2_y, i.e. sigma2_beta[j] all come from a c
  for(j in 1:N_states){
      sigma2_y[j] = 1/sigma2_y_inv[j]
      sigma2_y_inv[j] ~ dgamma(nu_y,nu_y*tau_y)

      sigma2_beta[j] = 1/sigma2_beta_inv[j]
      sigma2_beta_inv[j] ~ dgamma(nu_beta,nu_beta*tau_beta)

      beta[j,1] ~ dnorm(mu0,pow(sigma2_0,-1))
  }
  nu_y ~ dunif(0,100)
  tau_y ~ dunif(0,100)

  nu_beta ~ dunif(0,100)
  tau_beta ~ dunif(0,100)

  mu0 ~ dnorm(50,pow(7.5,-2))
  sigma2_0 = 1/sigma2_0_inv
  sigma2_0_inv ~ dgamma(.5,.5)
}
```

```
#be sure to add your added parameters to parameters.to.save
# jags_sims_republican <- jags(data = jags_data_republican,
#                   model.file = model,
#                   parameters.to.save = c("beta","sigma2_beta","p","sigma2_y"),
#                   n.iter = 1000)
```

```
race_id <- polls_not_republican$race_id %>% unique
y <- polls_not_republican$pct
```

```
r <- match(polls_not_republican$race_id,race_id)
t <- polls_not_republican$days_to_election + 1 #WHY PLUS ONE?
N_polls <- y %>% length
N_states <- race_id %>% length
N_days <- t %>% max
jags_data_not_republican <- list(y=y,t=t,r=r,
                  N_polls=N_polls,N_states=N_states,N_days=N_days)

model <- function(){
  for(k in 1:N_polls){
    y[k] ~ dnorm(p[k],1/sigma2_y[r[k]]) #note no longer binomial
    p[k] = beta[r[k],t[k]]
  }
  for(j in 2:N_days){
    for(i in 1:N_states){
      beta[i,j] ~ dnorm(beta[i,j-1],pow(sigma2_beta[i],-1))
    }
  }

  #EXERCISE: add hierarhciacl prior for sigma2_beta and sigma2_y, i.e. sigma2_beta[j] all come from a c
  for(j in 1:N_states){
      sigma2_y[j] = 1/sigma2_y_inv[j]
      sigma2_y_inv[j] ~ dgamma(nu_y,nu_y*tau_y)

      sigma2_beta[j] = 1/sigma2_beta_inv[j]
      sigma2_beta_inv[j] ~ dgamma(nu_beta,nu_beta*tau_beta)

      beta[j,1] ~ dnorm(mu0,pow(sigma2_0,-1))
  }
  nu_y ~ dunif(0,100)
  tau_y ~ dunif(0,100)

  nu_beta ~ dunif(0,100)
  tau_beta ~ dunif(0,100)

  mu0 ~ dnorm(50,pow(7.5,-2))
  sigma2_0 = 1/sigma2_0_inv
  sigma2_0_inv ~ dgamma(.5,.5)
}

# jags_sims_not_republican <- jags(data = jags_data_not_republican,
#                   model.file = model,
#                   parameters.to.save = c("beta","sigma2_beta","p","sigma2_y"),
#                   n.iter = 1000)
```

```
set.seed(1)
jags_r <- jags(data = jags_data_republican,
                  model.file = model,
                  parameters.to.save = c("beta[1,1]", "beta[2,1]", "beta[3,1]", "beta[4,1]", "beta[5,1]
                                         "beta[6,1]", "beta[7,1]", "beta[8,1]", "beta[9,1]", "beta[10,1
                                         "beta[11,1]", "beta[12,1]", "beta[13,1]", "beta[14,1]", "beta[
                                         "beta[16,1]", "beta[17,1]", "beta[18,1]", "beta[19,1]", "beta[
                                         "beta[21,1]", "beta[22,1]", "beta[23,1]", "beta[24,1]", "beta[
                                         "beta[26,1]", "beta[27,1]", "beta[28,1]", "beta[29,1]"),
```

```
                  n.iter = 1000)
```

```
## module glm loaded
```

```
## Compiling model graph
##    Resolving undeclared variables
##    Allocating nodes
## Graph information:
##    Observed stochastic nodes: 649
##    Unobserved stochastic nodes: 10533
##    Total graph size: 12613
##
## Initializing model
```

```
b1r <- jags_r$BUGSoutput$sims.array[1:1500]
b10r <- jags_r$BUGSoutput$sims.array[1501:3000]
b11r <- jags_r$BUGSoutput$sims.array[3001:4500]
b12r <- jags_r$BUGSoutput$sims.array[4501:6000]
b13r <- jags_r$BUGSoutput$sims.array[6001:7500]
b14r <- jags_r$BUGSoutput$sims.array[7501:9000]
b15r <- jags_r$BUGSoutput$sims.array[9001:10500]
b16r <- jags_r$BUGSoutput$sims.array[10501:12000]
b17r <- jags_r$BUGSoutput$sims.array[12001:13500]
b18r <- jags_r$BUGSoutput$sims.array[13501:15000]
b19r <- jags_r$BUGSoutput$sims.array[15001:16500]
b2r <- jags_r$BUGSoutput$sims.array[16501:18000]
b20r <- jags_r$BUGSoutput$sims.array[18001:19500]
b21r <- jags_r$BUGSoutput$sims.array[19501:21000]
b22r <- jags_r$BUGSoutput$sims.array[21001:22500]
b23r <- jags_r$BUGSoutput$sims.array[22501:24000]
b24r <- jags_r$BUGSoutput$sims.array[24001:25500]
b25r <- jags_r$BUGSoutput$sims.array[25501:27000]
b26r <- jags_r$BUGSoutput$sims.array[27001:28500]
b27r <- jags_r$BUGSoutput$sims.array[28501:30000]
b28r <- jags_r$BUGSoutput$sims.array[30001:31500]
b29r <- jags_r$BUGSoutput$sims.array[31501:33000]
b3r <- jags_r$BUGSoutput$sims.array[33001:34500]
b4r <- jags_r$BUGSoutput$sims.array[34501:36000]
b5r <- jags_r$BUGSoutput$sims.array[36001:37500]
b6r <- jags_r$BUGSoutput$sims.array[37501:39000]
b7r <- jags_r$BUGSoutput$sims.array[39001:40500]
b8r <- jags_r$BUGSoutput$sims.array[40501:42000]
b9r <- jags_r$BUGSoutput$sims.array[42001:43500]


jags_d <- jags(data = jags_data_not_republican,
                  model.file = model,
                  parameters.to.save = c("beta[1,1]", "beta[2,1]", "beta[3,1]", "beta[4,1]", "beta[5,1]
                                         "beta[6,1]", "beta[7,1]", "beta[8,1]", "beta[9,1]", "beta[10,1
                                         "beta[11,1]", "beta[12,1]", "beta[13,1]", "beta[14,1]", "beta[
                                         "beta[16,1]", "beta[17,1]", "beta[18,1]", "beta[19,1]", "beta[
                                         "beta[21,1]", "beta[22,1]", "beta[23,1]", "beta[24,1]", "beta[
                                         "beta[26,1]", "beta[27,1]", "beta[28,1]", "beta[29,1]"),
                  n.iter = 1000)
```

```
## Compiling model graph
##    Resolving undeclared variables
##    Allocating nodes
## Graph information:
##    Observed stochastic nodes: 649
##    Unobserved stochastic nodes: 10533
##    Total graph size: 12613
##
## Initializing model
```

```
b1d <- jags_d$BUGSoutput$sims.array[1:1500]
b10d <- jags_d$BUGSoutput$sims.array[1501:3000]
b11d <- jags_d$BUGSoutput$sims.array[3001:4500]
b12d <- jags_d$BUGSoutput$sims.array[4501:6000]
b13d <- jags_d$BUGSoutput$sims.array[6001:7500]
b14d <- jags_d$BUGSoutput$sims.array[7501:9000]
b15d <- jags_d$BUGSoutput$sims.array[9001:10500]
b16d <- jags_d$BUGSoutput$sims.array[10501:12000]
b17d <- jags_d$BUGSoutput$sims.array[12001:13500]
b18d <- jags_d$BUGSoutput$sims.array[13501:15000]
b19d <- jags_d$BUGSoutput$sims.array[15001:16500]
b2d <- jags_d$BUGSoutput$sims.array[16501:18000]
b20d <- jags_d$BUGSoutput$sims.array[18001:19500]
b21d <- jags_d$BUGSoutput$sims.array[19501:21000]
b22d <- jags_d$BUGSoutput$sims.array[21001:22500]
b23d <- jags_d$BUGSoutput$sims.array[22501:24000]
b24d <- jags_d$BUGSoutput$sims.array[24001:25500]
b25d <- jags_d$BUGSoutput$sims.array[25501:27000]
b26d <- jags_d$BUGSoutput$sims.array[27001:28500]
b27d <- jags_d$BUGSoutput$sims.array[28501:30000]
b28d <- jags_d$BUGSoutput$sims.array[30001:31500]
b29d <- jags_d$BUGSoutput$sims.array[31501:33000]
b3d <- jags_d$BUGSoutput$sims.array[33001:34500]
b4d <- jags_d$BUGSoutput$sims.array[34501:36000]
b5d <- jags_d$BUGSoutput$sims.array[36001:37500]
b6d <- jags_d$BUGSoutput$sims.array[37501:39000]
b7d <- jags_d$BUGSoutput$sims.array[39001:40500]
b8d <- jags_d$BUGSoutput$sims.array[40501:42000]
b9d <- jags_d$BUGSoutput$sims.array[42001:43500]
```

```
w1 = ifelse(b1r > b1d, 1, 0)
w2 = ifelse(b2r > b2d, 1, 0)
w3 = ifelse(b3r > b3d, 1, 0)
w4 = ifelse(b4r > b4d, 1, 0)
w5 = ifelse(b5r > b5d, 1, 0)
w6 = ifelse(b6r > b6d, 1, 0)
w7 = ifelse(b7r > b7d, 1, 0)
w8 = ifelse(b8r > b8d, 1, 0)
w9 = ifelse(b9r > b9d, 1, 0)
w10 = ifelse(b10r > b10d, 1, 0)
w11 = ifelse(b11r > b11d, 1, 0)
w12 = ifelse(b12r > b12d, 1, 0)
w13 = ifelse(b13r > b13d, 1, 0)
w14 = ifelse(b14r > b14d, 1, 0)
w15 = ifelse(b15r > b15d, 1, 0)
```

```
w16 = ifelse(b16r > b16d, 1, 0)
w17 = ifelse(b17r > b17d, 1, 0)
w18 = ifelse(b18r > b18d, 1, 0)
w19 = ifelse(b19r > b19d, 1, 0)
w20 = ifelse(b20r > b20d, 1, 0)
w21 = ifelse(b21r > b21d, 1, 0)
w22 = ifelse(b22r > b22d, 1, 0)
w23 = ifelse(b23r > b23d, 1, 0)
w24 = ifelse(b24r > b24d, 1, 0)
w25 = ifelse(b25r > b25d, 1, 0)
w26 = ifelse(b26r > b26d, 1, 0)
w27 = ifelse(b27r > b27d, 1, 0)
w28 = ifelse(b28r > b28d, 1, 0)
w29 = ifelse(b29r > b29d, 1, 0)
w30 = ifelse(b2r > b2d, 1, 0)

r_wins <- data.frame(cbind(w1, w2, w3, w4, w5, w6, w7, w8, w9, w10, w11, w12, w13, w14, w15, w16, w17, w

n = nrow(r_wins)

#rowSums(r_wins)
r_wins$total = rowSums(r_wins)

#missing a few states, but these races aren't predicted to be close
#ARKANSAS(R) #RHODE ISLAND(D) #SOUTH DAKOTA(R) #WEST VIRGINIA(R) #WYOMING(R) #LOUISIANA(R)
# double Georgia
# R + 5, need 21 total for split
#16

repub_senate <- r_wins%>%
  filter(total > 16) %>%
  summarise(perc = n()/nrow(r_wins)) %>%
  pull()

repub_senate
```

```
## [1] 0.15
```

Validation on 2018 senate race

```
# 35 seats up

s <- read.csv(file='data/senate_polls.csv')
s <- s %>%
  filter(cycle == 2018) %>%
  filter(stage != "general")

senate_polls <- read.csv(file='data/senate_polls.csv')
senate_polls <- senate_polls %>%
  mutate(days_to_election = as.Date(as.character(election_date), format ="%m/%d/%Y")-as.Date(as.charact
  filter(cycle == 2018) %>%
  filter(race_id != 97) %>% # 2 democrats running?
```

```
  mutate(candidate_party = case_when(candidate_name == "Bernard Sanders" ~ "DEM",
                                     candidate_name == "Angus S. King Jr." ~ "DEM",
                                     TRUE ~ candidate_party)) %>% # made them democrat so numbers would
  filter(stage != "jungle primary") %>%
  filter(stage != "runoff") %>%
  filter(days_to_election <= 365)

polls_republican <- senate_polls %>%
  filter(candidate_party=="REP") %>%
  mutate(days_to_election = as.numeric(days_to_election))
polls_not_republican <- senate_polls %>%
  filter(candidate_party == "DEM")%>%
  mutate(days_to_election = as.numeric(days_to_election))
```

```
race_id <- polls_republican$race_id %>% unique
y <- polls_republican$pct
r <- match(polls_republican$race_id,race_id)
t <- polls_republican$days_to_election + 1
N_polls <- y %>% length
N_states <- race_id %>% length
N_days <- t %>% max

jags_data_republican <- list(y=y,t=t,r=r,
                  N_polls=N_polls,N_states=N_states,N_days=N_days)
```

```
model <- function(){
  for(k in 1:N_polls){
    y[k] ~ dnorm(p[k],1/sigma2_y[r[k]]) #note no longer binomial
    p[k] = beta[r[k],t[k]]
  }
  for(j in 2:N_days){
    for(i in 1:N_states){
      beta[i,j] ~ dnorm(beta[i,j-1],pow(sigma2_beta[i],-1))
    }
  }

  #EXERCISE: add hierarhciacl prior for sigma2_beta and sigma2_y, i.e. sigma2_beta[j] all come from a c
  for(j in 1:N_states){
      sigma2_y[j] = 1/sigma2_y_inv[j]
      sigma2_y_inv[j] ~ dgamma(nu_y,nu_y*tau_y)

      sigma2_beta[j] = 1/sigma2_beta_inv[j]
      sigma2_beta_inv[j] ~ dgamma(nu_beta,nu_beta*tau_beta)

      beta[j,1] ~ dnorm(mu0,pow(sigma2_0,-1))
  }
  nu_y ~ dunif(0,100)
  tau_y ~ dunif(0,100)

  nu_beta ~ dunif(0,100)
  tau_beta ~ dunif(0,100)

  mu0 ~ dnorm(50,pow(7.5,-2))
  sigma2_0 = 1/sigma2_0_inv
```

```
  sigma2_0_inv ~ dgamma(.5,.5)
}
```

```
race_id <- polls_not_republican$race_id %>% unique
y <- polls_not_republican$pct
r <- match(polls_not_republican$race_id,race_id)
t <- polls_not_republican$days_to_election + 1 #WHY PLUS ONE?
N_polls <- y %>% length
N_states <- race_id %>% length
N_days <- t %>% max

jags_data_not_republican <- list(y=y,t=t,r=r,
                  N_polls=N_polls,N_states=N_states,N_days=N_days)

model <- function(){
  for(k in 1:N_polls){
    y[k] ~ dnorm(p[k],1/sigma2_y[r[k]]) #note no longer binomial
    p[k] = beta[r[k],t[k]]
  }
  for(j in 2:N_days){
    for(i in 1:N_states){
      beta[i,j] ~ dnorm(beta[i,j-1],pow(sigma2_beta[i],-1))
    }
  }

  #EXERCISE: add hierarhciacl prior for sigma2_beta and sigma2_y, i.e. sigma2_beta[j] all come from a c
  for(j in 1:N_states){
      sigma2_y[j] = 1/sigma2_y_inv[j]
      sigma2_y_inv[j] ~ dgamma(nu_y,nu_y*tau_y)

      sigma2_beta[j] = 1/sigma2_beta_inv[j]
      sigma2_beta_inv[j] ~ dgamma(nu_beta,nu_beta*tau_beta)

      beta[j,1] ~ dnorm(mu0,pow(sigma2_0,-1))
  }
  nu_y ~ dunif(0,100)
  tau_y ~ dunif(0,100)

  nu_beta ~ dunif(0,100)
  tau_beta ~ dunif(0,100)

  mu0 ~ dnorm(50,pow(7.5,-2))
  sigma2_0 = 1/sigma2_0_inv
  sigma2_0_inv ~ dgamma(.5,.5)
}
```

```
set.seed(1)
jags_r <- jags(data = jags_data_republican,
                  model.file = model,
                  parameters.to.save = c("beta[1,1]", "beta[2,1]", "beta[3,1]", "beta[4,1]", "beta[5,1]
                                         "beta[6,1]", "beta[7,1]", "beta[8,1]", "beta[9,1]", "beta[10,1
                                         "beta[11,1]", "beta[12,1]", "beta[13,1]", "beta[14,1]", "beta[
                                         "beta[16,1]", "beta[17,1]", "beta[18,1]", "beta[19,1]", "beta[
                                         "beta[21,1]", "beta[22,1]", "beta[23,1]", "beta[24,1]", "beta[
```

```
                                          "beta[26,1]", "beta[27,1]", "beta[28,1]", "beta[29,1]", "beta[3
                                          "beta[31,1]", "beta[32,1]"),
                 n.iter = 1000)
```

```
## Compiling model graph
##    Resolving undeclared variables
##    Allocating nodes
## Graph information:
##    Observed stochastic nodes: 791
##    Unobserved stochastic nodes: 11686
##    Total graph size: 14204
##
## Initializing model
```

```
b1r <- jags_r$BUGSoutput$sims.array[1:1500]
b10r <- jags_r$BUGSoutput$sims.array[1501:3000]
b11r <- jags_r$BUGSoutput$sims.array[3001:4500]
b12r <- jags_r$BUGSoutput$sims.array[4501:6000]
b13r <- jags_r$BUGSoutput$sims.array[6001:7500]
b14r <- jags_r$BUGSoutput$sims.array[7501:9000]
b15r <- jags_r$BUGSoutput$sims.array[9001:10500]
b16r <- jags_r$BUGSoutput$sims.array[10501:12000]
b17r <- jags_r$BUGSoutput$sims.array[12001:13500]
b18r <- jags_r$BUGSoutput$sims.array[13501:15000]
b19r <- jags_r$BUGSoutput$sims.array[15001:16500]
b2r <- jags_r$BUGSoutput$sims.array[16501:18000]
b20r <- jags_r$BUGSoutput$sims.array[18001:19500]
b21r <- jags_r$BUGSoutput$sims.array[19501:21000]
b22r <- jags_r$BUGSoutput$sims.array[21001:22500]
b23r <- jags_r$BUGSoutput$sims.array[22501:24000]
b24r <- jags_r$BUGSoutput$sims.array[24001:25500]
b25r <- jags_r$BUGSoutput$sims.array[25501:27000]
b26r <- jags_r$BUGSoutput$sims.array[27001:28500]
b27r <- jags_r$BUGSoutput$sims.array[28501:30000]
b28r <- jags_r$BUGSoutput$sims.array[30001:31500]
b29r <- jags_r$BUGSoutput$sims.array[31501:33000]
b3r <- jags_r$BUGSoutput$sims.array[33001:34500]
b30r <- jags_r$BUGSoutput$sims.array[34501:36000]
b31r <- jags_r$BUGSoutput$sims.array[36001:37500]
b32r <- jags_r$BUGSoutput$sims.array[37501:39000]
b4r <- jags_r$BUGSoutput$sims.array[39001:40500]
b5r <- jags_r$BUGSoutput$sims.array[40501:42000]
b6r <- jags_r$BUGSoutput$sims.array[42001:43500]
b7r <- jags_r$BUGSoutput$sims.array[43501:45000]
b8r <- jags_r$BUGSoutput$sims.array[45001:46500]
b9r <- jags_r$BUGSoutput$sims.array[46501:48000]

# b33r <- jags_r$BUGSoutput$sims.array[39001:40500]
# b34r <- jags_r$BUGSoutput$sims.array[40501:42000]
# b4r <- jags_r$BUGSoutput$sims.array[42001:43500]
# b5r <- jags_r$BUGSoutput$sims.array[43501:45000]
# b6r <- jags_r$BUGSoutput$sims.array[45001:46500]
# b7r <- jags_r$BUGSoutput$sims.array[46501:48000]
# b8r <- jags_r$BUGSoutput$sims.array[48001:49500]
```

```
# b9r <- jags_r$BUGSoutput$sims.array[49501:51000]

jags_d <- jags(data = jags_data_not_republican,
                  model.file = model,
                  parameters.to.save = c("beta[1,1]", "beta[2,1]", "beta[3,1]", "beta[4,1]", "beta[5,1]
                                         "beta[6,1]", "beta[7,1]", "beta[8,1]", "beta[9,1]", "beta[10,1
                                         "beta[11,1]", "beta[12,1]", "beta[13,1]", "beta[14,1]", "beta[
                                         "beta[16,1]", "beta[17,1]", "beta[18,1]", "beta[19,1]", "beta[
                                         "beta[21,1]", "beta[22,1]", "beta[23,1]", "beta[24,1]", "beta[
                                         "beta[26,1]", "beta[27,1]", "beta[28,1]", "beta[29,1]", "beta[
                                         "beta[31,1]", "beta[32,1]"),
                  n.iter = 1000)
```

```
## Compiling model graph
##    Resolving undeclared variables
##    Allocating nodes
## Graph information:
##    Observed stochastic nodes: 797
##    Unobserved stochastic nodes: 11686
##    Total graph size: 14222
##
## Initializing model
```

```
b1d <- jags_d$BUGSoutput$sims.array[1:1500]
b10d <- jags_d$BUGSoutput$sims.array[1501:3000]
b11d <- jags_d$BUGSoutput$sims.array[3001:4500]
b12d <- jags_d$BUGSoutput$sims.array[4501:6000]
b13d <- jags_d$BUGSoutput$sims.array[6001:7500]
b14d <- jags_d$BUGSoutput$sims.array[7501:9000]
b15d <- jags_d$BUGSoutput$sims.array[9001:10500]
b16d <- jags_d$BUGSoutput$sims.array[10501:12000]
b17d <- jags_d$BUGSoutput$sims.array[12001:13500]
b18d <- jags_d$BUGSoutput$sims.array[13501:15000]
b19d <- jags_d$BUGSoutput$sims.array[15001:16500]
b2d <- jags_d$BUGSoutput$sims.array[16501:18000]
b20d <- jags_d$BUGSoutput$sims.array[18001:19500]
b21d <- jags_d$BUGSoutput$sims.array[19501:21000]
b22d <- jags_d$BUGSoutput$sims.array[21001:22500]
b23d <- jags_d$BUGSoutput$sims.array[22501:24000]
b24d <- jags_d$BUGSoutput$sims.array[24001:25500]
b25d <- jags_d$BUGSoutput$sims.array[25501:27000]
b26d <- jags_d$BUGSoutput$sims.array[27001:28500]
b27d <- jags_d$BUGSoutput$sims.array[28501:30000]
b28d <- jags_d$BUGSoutput$sims.array[30001:31500]
b29d <- jags_d$BUGSoutput$sims.array[31501:33000]
b3d <- jags_d$BUGSoutput$sims.array[33001:34500]
b30d <- jags_d$BUGSoutput$sims.array[34501:36000]
b31d <- jags_d$BUGSoutput$sims.array[36001:37500]
b32d <- jags_d$BUGSoutput$sims.array[37501:39000]
b4d <- jags_d$BUGSoutput$sims.array[39001:40500]
b5d <- jags_d$BUGSoutput$sims.array[40501:42000]
b6d <- jags_d$BUGSoutput$sims.array[42001:43500]
b7d <- jags_d$BUGSoutput$sims.array[43501:45000]
b8d <- jags_d$BUGSoutput$sims.array[45001:46500]
```

```r
b9d <- jags_d$BUGSoutput$sims.array[46501:48000]

# b33d <- jags_d$BUGSoutput$sims.array[39001:40500]
# b34d <- jags_d$BUGSoutput$sims.array[40501:42000]
# b4d <- jags_d$BUGSoutput$sims.array[42001:43500]
# b5d <- jags_d$BUGSoutput$sims.array[43501:45000]
# b6d <- jags_d$BUGSoutput$sims.array[45001:46500]
# b7d <- jags_d$BUGSoutput$sims.array[46501:48000]
# b8d <- jags_d$BUGSoutput$sims.array[48001:49500]
# b9d <- jags_d$BUGSoutput$sims.array[49501:51000]
```

```r
jags_r$BUGSoutput
```

```
## Inference for Bugs model at "/var/folders/bl/kdxqftsj6xj9mm8fpxmrv6qr0000gn/T//RtmpLzQcTe/modelac8c5
##  3 chains, each with 1000 iterations (first 500 discarded)
##  n.sims = 1500 iterations saved
##              mean   sd   2.5%    25%    50%    75%  97.5% Rhat n.eff
## beta[1,1]    44.2  2.1   40.1   42.9   44.2   45.6   48.3  1.0   220
## beta[10,1]   49.7  4.0   42.3   46.7   49.7   52.7   57.2  1.0    75
## beta[11,1]   42.9  3.0   36.6   41.0   43.0   44.8   48.9  1.1    20
## beta[12,1]   40.1  3.1   34.5   37.8   39.9   42.2   46.6  1.1    43
## beta[13,1]   41.7  2.4   36.9   40.3   41.9   43.3   46.3  1.2    18
## beta[14,1]   46.9  3.2   40.8   44.6   47.0   49.1   52.7  1.2    13
## beta[15,1]   42.4  3.0   35.9   40.6   42.5   44.4   47.9  1.0    66
## beta[16,1]   39.2  3.9   31.8   36.4   39.3   42.1   46.5  1.5     7
## beta[17,1]   40.4  3.9   31.6   37.9   40.7   43.1   47.3  1.2    17
## beta[18,1]   42.7  2.7   37.2   40.9   42.8   44.5   47.4  1.4     8
## beta[19,1]   40.8  3.5   34.1   38.4   40.8   43.3   47.1  1.2    16
## beta[2,1]    47.1  1.8   43.5   45.9   47.0   48.3   50.6  1.1    56
## beta[20,1]   39.2  4.1   30.7   36.3   39.4   42.2   46.5  1.5     8
## beta[21,1]   42.5  2.8   36.8   40.6   42.6   44.6   47.4  1.4     9
## beta[22,1]   47.6  3.0   41.2   45.8   47.6   49.5   54.3  1.0   540
## beta[23,1]   45.5  3.2   39.4   43.5   45.5   47.5   52.2  1.0   120
## beta[24,1]   40.7  4.0   33.1   38.0   40.8   43.4   48.5  1.4     8
## beta[25,1]   41.7  4.4   31.1   39.5   42.3   44.6   48.9  1.3    11
## beta[26,1]   46.9  3.9   39.7   44.2   46.9   49.6   54.5  1.0    50
## beta[27,1]   40.7  3.6   33.8   38.3   40.8   43.3   47.3  1.2    13
## beta[28,1]   41.8  4.4   33.5   38.7   41.9   44.7   50.6  1.5     7
## beta[29,1]   45.2  3.6   38.6   42.8   45.2   47.5   52.7  1.6     7
## beta[3,1]    45.7  2.1   41.8   44.3   45.7   47.2   50.1  1.0   520
## beta[30,1]   41.2  3.9   33.3   38.6   41.3   43.9   48.2  1.1    26
## beta[31,1]   42.1  4.9   30.8   39.6   42.7   45.3   50.4  1.7     7
## beta[32,1]   42.8  4.2   34.0   40.3   43.1   45.6   50.6  1.3    11
## beta[4,1]    48.3  2.3   43.6   46.8   48.4   49.9   52.5  1.0   150
## beta[5,1]    44.8  2.1   40.4   43.5   44.9   46.1   48.8  1.0   330
## beta[6,1]    43.0  2.2   38.8   41.7   43.1   44.4   47.3  1.0    59
## beta[7,1]    45.6  1.8   42.0   44.4   45.6   46.9   48.9  1.0    46
## beta[8,1]    45.1  2.3   40.5   43.6   45.2   46.7   49.7  1.0   460
## beta[9,1]    42.3  3.4   34.9   40.0   42.4   44.7   48.6  1.0   300
## deviance   4050.0 52.5 3965.3 4012.5 4040.8 4082.5 4162.1  2.4     4
##
## For each parameter, n.eff is a crude measure of effective sample size,
## and Rhat is the potential scale reduction factor (at convergence, Rhat=1).
##
```

```
## DIC info (using the rule, pD = var(deviance)/2)
## pD = 563.1 and DIC = 4613.1
## DIC is an estimate of expected predictive error (lower deviance is better).
```

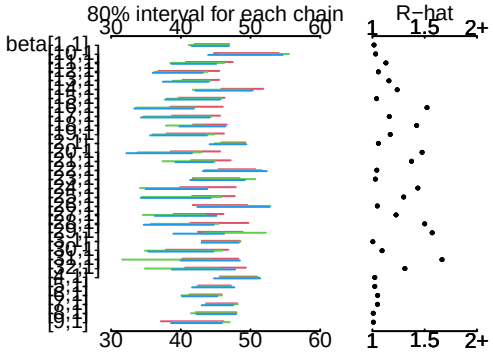
```
w1 = ifelse(b1r > b1d, 1, 0)
w2 = ifelse(b2r > b2d, 1, 0)
w3 = ifelse(b3r > b3d, 1, 0)
w4 = ifelse(b4r > b4d, 1, 0)
w5 = ifelse(b5r > b5d, 1, 0)
w6 = ifelse(b6r > b6d, 1, 0)
w7 = ifelse(b7r > b7d, 1, 0)
w8 = ifelse(b8r > b8d, 1, 0)
w9 = ifelse(b9r > b9d, 1, 0)
w10 = ifelse(b10r > b10d, 1, 0)
w11 = ifelse(b11r > b11d, 1, 0)
w12 = ifelse(b12r > b12d, 1, 0)
w13 = ifelse(b13r > b13d, 1, 0)
w14 = ifelse(b14r > b14d, 1, 0)
w15 = ifelse(b15r > b15d, 1, 0)
w16 = ifelse(b16r > b16d, 1, 0)
w17 = ifelse(b17r > b17d, 1, 0)
w18 = ifelse(b18r > b18d, 1, 0)
w19 = ifelse(b19r > b19d, 1, 0)
w20 = ifelse(b20r > b20d, 1, 0)
w21 = ifelse(b21r > b21d, 1, 0)
w22 = ifelse(b22r > b22d, 1, 0)
w23 = ifelse(b23r > b23d, 1, 0)
w24 = ifelse(b24r > b24d, 1, 0)
w25 = ifelse(b25r > b25d, 1, 0)
w26 = ifelse(b26r > b26d, 1, 0)
w27 = ifelse(b27r > b27d, 1, 0)
w28 = ifelse(b28r > b28d, 1, 0)
w29 = ifelse(b29r > b29d, 1, 0)
w30 = ifelse(b30r > b30d, 1, 0)
w31 = ifelse(b31r > b31d, 1, 0)
w32 = ifelse(b32r > b32d, 1, 0)
#w33 = ifelse(b33r > b33d, 1, 0)
#w34 = ifelse(b34r > b34d, 1, 0)


r_wins <- data.frame(cbind(w1, w2, w3, w4, w5, w6, w7, w8, w9, w10, w11, w12, w13, w14, w15, w16, w17, w

n = nrow(r_wins)

#rowSums(r_wins)
r_wins$total = rowSums(r_wins)

#missing a few states, but these races aren't predicted to be close
#CALIFORNIA (D) MISSISSIPI (R) MISSISSIPPI Special (R)
# 51 R 49 D split before
# 9 R up, 26 D up
# R+6 needed more than 8 seats to keep majority

repub_senate <- r_wins%>%
```

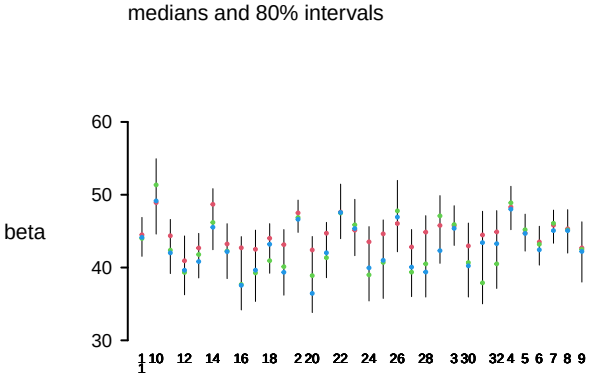
```
  filter(total > 6) %>%
  summarise(perc = n()/nrow(r_wins)) %>%
  pull()

repub_senate
```

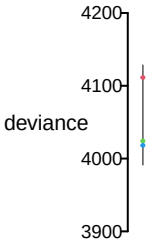
```
## [1] 0.63
```

```
plot(jags_r,ask = FALSE)
```

```
lders/bl/kdxqftsj6xj9mm8fpxmrv6qr0000gn/T//RtmpLzQcTe/modelac8c59fec128.txt", fit using jags, 3 chains, each with 1000 iteration
```








```
plot(jags_d,ask = FALSE)
```

lders/bl/kdxqftsj6xj9mm8fpxmrv6qr0000gn/T//RtmpLzQcTe/modelac8c643b5740.txt", fit using jags, 3 chains, each with 1000 iteration