Bayesian Evidence Synthesis for OUD Prevalence Estimate

```
## -- Attaching core tidyverse packages ------------------------ tidyverse 2.0.0 --
## v dplyr     1.1.3     v readr     2.1.4
## v forcats   1.0.0     v stringr   1.5.0
## v ggplot2   3.4.1     v tibble    3.2.1
## v lubridate 1.9.2     v tidyr     1.3.0
## v purrr     1.0.2
## -- Conflicts ------------------------------------------ tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
## i Use the conflicted package (<http://conflicted.r-lib.org/>) to force all conflicts to become errors
## Loading required package: coda
##
## Linked to JAGS 4.3.1
##
## Loaded modules: basemod,bugs
##
##
## Attaching package: 'kableExtra'
##
##
## The following object is masked from 'package:dplyr':
##
##     group_rows
```

simulation function

bayesian evidence sythesis model

data simulation

```
# loading population and strata information
data_df <- readRDS(file="sim_fake_data.rds")
set.seed(1234)
lambda <- 0.005 # same between strata within the same county
data_df$lambda <- lambda

len <- dim(data_df)[1]
output_df <- data.frame()
mpsrf <- rep(NA,len)
inits <- list(tau=c(0.3,0.07,0.63), p_DNM = 0.03, p_U=0.05) # initialization of parameters

for(i in 1:len){
```

```
  input <- data_df[i,]
  # simulate ground truth values
  N <- input$Population
  p_DNM <- rbeta(1,1.1,55)
  p_U <- rbeta(1,1.1,55)
  tau <- rdirichlet(1,c(3.3,1.1,5.5)) # [tau_DMTb, tau_DMTo, tau_NT]
  tau_DMTb <- tau[1]
  tau_DMT <- tau[1]+tau[2]
  p_OUD <- p_DNM+p_U+rbeta(1,1,150)

  # generate "data" for bayesian modeling
  data_sim <- DataSim(N=N,p_OUD = p_OUD,p_DNM=p_DNM,p_U=p_U,tau_DMTb=tau_DMTb,
                tau_DMT=tau_DMT,lambda = lambda)
  samps1 <- bayes_modeling(N=N,lambda=lambda,data_sim,inits,
                n.chains=2,n.adapt=5000,n.iter=20000)
  a <- summary(samps1)
  res <- gelman.diag(samps1)
  mpsrf[i] <- res$mpsrf
  # multivariate convergence statistics: if the chain converges, mpsrf should be less than 1.1

  op <- cbind(input,"p_DNM"=p_DNM,"p_U"=p_U,"p_OUD"=p_OUD,
              "p_DM"=data_sim$p_DM,"p_DMTb"=data_sim$p_DMTb,"p_DMT"=data_sim$p_DMT,
              "p_Tb"=data_sim$p_Tb,"n_ODF"=data_sim$n_ODF,
              "psrf_DNM"=res$psrf[1,1],"psrf_U"=res$psrf[2,1],
              # partial convergence diagnosis statistics; if converging, psrf should be less than 1.1
              "p_DNM_mean"=a$statistics[1,1],"p_DNM_sd"=a$statistics[1,2],
              "p_DNM_lb"=a$quantiles[1,1],"p_DNM_ub"=a$quantiles[1,5],
              "p_U_mean"=a$statistics[2,1],"p_U_sd"=a$statistics[2,2],
              "p_U_lb"=a$quantiles[2,1],"p_U_ub"=a$quantiles[2,5])
  output_df <- rbind(output_df,op)

}
```

```
## Compiling model graph
##    Resolving undeclared variables
##    Allocating nodes
## Graph information:
##    Observed stochastic nodes: 4
##    Unobserved stochastic nodes: 4
##    Total graph size: 31
##
## Initializing model
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```
# compute overall OUD prevalence estimate
output_df <- output_df %>%
  mutate(p_OUD_mean = p_DM+p_U_mean+p_DNM_mean,
         p_OUD_lb = p_DM+p_U_lb+p_DNM_lb,
         p_OUD_ub = p_DM+p_U_ub+p_DNM_lb)
```

```
head(output_df)
```

```
##     Age    Sex Population lambda       p_DNM         p_U      p_OUD
## 1 18-34 Female      43334  0.005 0.003058236 0.029130558 0.05032659
## 2 18-34   Male      42710  0.005 0.030531076 0.019748568 0.05304159
## 3 35-54 Female      37413  0.005 0.012837209 0.009976237 0.02981107
## 4 35-54   Male      35900  0.005 0.018341558 0.031190073 0.06049289
```

```
## 5 55-64 Female      20978  0.005 0.015058618 0.053961486 0.06932690
## 6 55-64   Male      19586  0.005 0.008387174 0.053692696 0.07514984
##           p_DM    p_DMTb     p_DMT        p_Tb n_ODF psrf_DNM   psrf_U
## 1 0.0181378002 0.2926270 0.4745436 0.006092214     7 1.002019 1.000464
## 2 0.0027619435 0.2373633 0.4150689 0.008452353     8 1.002062 1.000511
## 3 0.0069976218 0.3361319 0.4079496 0.006601983     5 1.005197 1.000072
## 4 0.0109612607 0.4142215 0.5527424 0.012172702     9 1.004853 1.000144
## 5 0.0003067938 0.6215118 0.6892441 0.005910954     7 1.009340 1.000046
## 6 0.0130699722 0.4023619 0.4999775 0.008934954     4 1.005370 1.000084
##    p_DNM_mean     p_DNM_sd    p_DNM_lb    p_DNM_ub   p_U_mean      p_U_sd
## 1 0.002738687 0.0004946018 0.001866411 0.003808805 0.01923516 0.010285472
## 2 0.030743875 0.0053195677 0.021840150 0.042573752 0.01634718 0.010618833
## 3 0.012747851 0.0015871400 0.010008909 0.016183658 0.01496038 0.009718861
## 4 0.018384592 0.0017770207 0.015168991 0.022082315 0.02976044 0.013253623
## 5 0.015205505 0.0050724018 0.008508569 0.028174584 0.04228768 0.017714720
## 6 0.009263797 0.0013834661 0.006849938 0.012262847 0.02327056 0.014369752
##        p_U_lb     p_U_ub p_OUD_mean   p_OUD_lb   p_OUD_ub
## 1 0.003191711 0.04272861 0.04011164 0.02319592 0.06273282
## 2 0.001251169 0.04130407 0.04985300 0.02585326 0.06590617
## 3 0.001303599 0.03784661 0.03470585 0.01831013 0.05485314
## 4 0.007929082 0.05958849 0.05910629 0.03405933 0.08571874
## 5 0.012816539 0.08202445 0.05779998 0.02163190 0.09083981
## 6 0.002538964 0.05722620 0.04560433 0.02245887 0.07714611
```