judgment day

```
library(reticulate)
library(data.table)
library(tidyverse)
```

```
## -- Attaching packages --------------------------------------- tidyverse 1.3.0 --
```

```
## v ggplot2 3.3.3     v purrr   0.3.4
## v tibble  3.1.0     v dplyr   1.0.5
## v tidyr   1.1.3     v stringr 1.4.0
## v readr   1.4.0     v forcats 0.5.1
```

```
## -- Conflicts ------------------------------------------ tidyverse_conflicts() --
## x dplyr::between()   masks data.table::between()
## x dplyr::filter()    masks stats::filter()
## x dplyr::first()     masks data.table::first()
## x dplyr::lag()       masks stats::lag()
## x dplyr::last()      masks data.table::last()
## x purrr::transpose() masks data.table::transpose()
```

```
library(pROC)
```

```
## Type 'citation("pROC")' for a citation.
```

```
##
## Attaching package: 'pROC'
```

```
## The following objects are masked from 'package:stats':
##
##     cov, smooth, var
```

```
use_virtualenv("../venv/", required = TRUE)
source_python("util.py")
source_python("models.py")
```

Functions

```
calculate_yhat_sklearn <- function(model, x) {
  return(model$predict_proba(x)[,2])
}

calculate_yhat_NN <- function(model, x) {
  return(model$predict(x))
}

calculate_TPR <- function(y, yhat) {
  P <- sum(y == 1)
  TP <- sum(((yhat > 0.5) == 1) & (y == 1))
  TPR <- TP / P
```

```
  return(TPR)
}

calculate_FPR <- function(y, yhat) {
  N <- sum(y == 0)
  FP <- sum(((yhat > 0.5) == 1) & (y == 0))
  FPR <- FP / N
  return(FPR)
}

calculate_AUC <- function(y, yhat) {
  df <- data.frame(a=y, p=yhat)
  df <- df[order(df$a),]
  roc_obj <- roc(df$a, df$p)
  AUC <- auc(roc_obj)
  TPR10 <- coords(roc_obj, x=0.9, input="specificity")$sensitivity  # Sensitivity is AKA the FPR
  return(c(AUC=AUC, TPR10=TPR10))
}

calculate_Positivity <- function(yhat) {
  yhat_binary <- (yhat > 0.5)
  positivity <- mean(yhat_binary)
  return(positivity)
}

# This function assumes that the data variables are already defined in the environment.
# E.g. Black_x, AsianPI_y, etc.
calculate_results <- function(model, model_yhat_fn) {
  # (1) Prepare results matrix
  race_eth_all <- c('White', 'Black', 'AsianPI', 'AmeriIndian')
  results <- matrix(nrow = length(race_eth_all), ncol = 6)
  rownames(results) <- race_eth_all
  colnames(results) <- c('TPR', 'FPR',  'AUC', 'TPR10', 'Accuracy', 'Positivity')

  # (2) Calculate TPR, AUC, and TPR10 for each race/ethnicity
  for (i in 1:length(race_eth_all)) {
    race_eth <- race_eth_all[i]
    x <- get(paste0(race_eth, '_x'))  # get() gets a variable in the environment by name
    y <- get(paste0(race_eth, '_y'))
    yhat <- model_yhat_fn(model, x)  # Note this depends on function arguments

    results[i, 1] <- calculate_TPR(y, yhat)
    results[i, 2] <- calculate_FPR(y, yhat)
    results[i, c(3, 4)] <- calculate_AUC(y, yhat)
    results[i, 5] <- mean((yhat > 0.5) == y)
    results[i, 6] <- calculate_Positivity(yhat)
  }

  return(data.frame(results))
}
```

```
read_race_data <- function(file, outome, unaware=FALSE) {
  x <<- fread(file)
  x$outcome <- as.numeric(x$outcome == outcome)
```

```
  AmeriIndian_x <<- x %>% filter(race_AmeriIndian == 1)
  AmeriIndian_y <<- AmeriIndian_x$outcome
  AmeriIndian_x <<- AmeriIndian_x %>% select(-outcome)
  if (unaware)
    AmeriIndian_x <<- AmeriIndian_x %>% select(-race_AmeriIndian, -race_AsianPI, -race_Black, -race_Whi

  AsianPI_x <<- x %>% filter(race_AsianPI == 1)
  AsianPI_y <<- AsianPI_x$outcome
  AsianPI_x <<- AsianPI_x %>% select(-outcome)
  if (unaware)
    AsianPI_x <<- AsianPI_x %>% select(-race_AmeriIndian, -race_AsianPI, -race_Black, -race_White)

  Black_x <<- x %>% filter(race_Black == 1)
  Black_y <<- Black_x$outcome
  Black_x <<- Black_x %>% select(-outcome)
  if (unaware)
    Black_x <<- Black_x %>% select(-race_AmeriIndian, -race_AsianPI, -race_Black, -race_White)

  White_x <<- x %>% filter(race_White == 1)
  White_y <<- White_x$outcome
  White_x <<- White_x %>% select(-outcome)
  if (unaware)
    White_x <<- White_x %>% select(-race_AmeriIndian, -race_AsianPI, -race_Black, -race_White)
}
```

Fairness evaluations

Early Stillbirth

```
file <- '../data/final/stillbirth_test.csv'
outcome <- 'early stillbirth'
```

```
## RACE-AWARE Columns
read_race_data(file, outcome, unaware = FALSE)

# Logistic Regression
lr_early_aware <- load_pickle("../models/lr_early_aware")
lr_early_aware_r <- calculate_results(model = lr_early_aware, model_yhat_fn = calculate_yhat_sklearn)
```

```
## Setting levels: control = 0, case = 1

## Setting direction: controls < cases

## Setting levels: control = 0, case = 1

## Setting direction: controls < cases

## Setting levels: control = 0, case = 1

## Setting direction: controls < cases

## Setting levels: control = 0, case = 1

## Setting direction: controls < cases
```

```
lr_early_aware_r
```

```
##                   TPR       FPR       AUC     TPR10  Accuracy Positivity
## White       0.6319825 0.2004112 0.7740651 0.4769989 0.7993026  0.2011482
## Black       0.8699187 0.4963381 0.8123449 0.5249710 0.5051068  0.4978120
## AsianPI     0.6153846 0.1379786 0.8053245 0.5219780 0.8615667  0.1388588
## AmeriIndian 0.5666667 0.2422029 0.6734812 0.3666667 0.7574205  0.2428421
```

```
# LightGBM
gb_early_aware <- load_pickle("../models/gb_early_aware")
gb_early_aware_r <- calculate_results(model = gb_early_aware, model_yhat_fn = calculate_yhat_sklearn)
```

```
## Setting levels: control = 0, case = 1
## Setting direction: controls < cases
```

```
## Setting levels: control = 0, case = 1
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```
## Setting direction: controls < cases
```

```
## Setting levels: control = 0, case = 1
```

```
## Setting direction: controls < cases
```

```
## Setting levels: control = 0, case = 1
```

```
## Setting direction: controls < cases
```

```
gb_early_aware_r
```

```
##                   TPR        FPR       AUC     TPR10  Accuracy Positivity
## White       0.6056955 0.08723425 0.8513484 0.6193866 0.9122414 0.08811958
## Black       0.8466899 0.26475324 0.8948861 0.7026713 0.7356864 0.26704913
## AsianPI     0.6813187 0.06106336 0.9000883 0.7417582 0.9384617 0.06220687
## AmeriIndian 0.6666667 0.10343466 0.8369764 0.6666667 0.8961124 0.10454426
```

```
# ReLU Network
relu_early_aware <- load_NN("../models/lrelu_early_aware")
relu_early_aware_r <- calculate_results(relu_early_aware, calculate_yhat_NN)
```

```
## Setting levels: control = 0, case = 1
## Setting direction: controls < cases
```

```
## Setting levels: control = 0, case = 1
```

```
## Setting direction: controls < cases
```

```
## Setting levels: control = 0, case = 1
```

```
## Setting direction: controls < cases
```

```
## Setting levels: control = 0, case = 1
```

```
## Setting direction: controls < cases
```

```
relu_early_aware_r
```

```
##                   TPR         FPR       AUC     TPR10  Accuracy  Positivity
## White       0.2453450 0.009254289 0.7824965 0.5503834 0.9894729 0.009657440
## Black       0.5598142 0.067164728 0.8284422 0.6248548 0.9313636 0.069108355
## AsianPI     0.2857143 0.007296751 0.8209306 0.6593407 0.9913998 0.007810047
## AmeriIndian 0.2000000 0.004211080 0.6968274 0.4000000 0.9942212 0.004596795
```

```
## SELU Network
selu_early_aware <- load_NN("../models/selu_early_aware")
selu_early_aware_r <- calculate_results(selu_early_aware, calculate_yhat_NN)
```

```
## Setting levels: control = 0, case = 1
## Setting direction: controls < cases
```

```
## Setting levels: control = 0, case = 1
```

```
## Setting direction: controls < cases
```

```
## Setting levels: control = 0, case = 1
```

```
## Setting direction: controls < cases
```

```
## Setting levels: control = 0, case = 1
```

```
## Setting direction: controls < cases
```

```
selu_early_aware_r
```

```
##                   TPR        FPR       AUC     TPR10  Accuracy Positivity
## White       0.5788609 0.05859832 0.8434549 0.6314348 0.9407826 0.05948673
## Black       0.8257840 0.23172291 0.8886480 0.7049942 0.7685040 0.23406663
## AsianPI     0.6318681 0.02994814 0.8829801 0.7252747 0.9694284 0.03105785
## AmeriIndian 0.6000000 0.02474010 0.8104433 0.6333333 0.9745206 0.02587339
```

```
## RACE-UNAWARE Columns
read_race_data(file, outcome, unaware = TRUE)

# Logistic Regression
lr_early_unaware <- load_pickle("../models/lr_early_unaware")
lr_early_unaware_r <- calculate_results(model = lr_early_unaware, model_yhat_fn = calculate_yhat_sklearn
```

```
## Setting levels: control = 0, case = 1
```

```
## Setting direction: controls < cases
```

```
## Setting levels: control = 0, case = 1
```

```
## Setting direction: controls < cases
```

```
## Setting levels: control = 0, case = 1
```

```
## Setting direction: controls < cases
```

```
## Setting levels: control = 0, case = 1
```

```
## Setting direction: controls < cases
```

```
lr_early_unaware_r
```

```
##                   TPR       FPR       AUC     TPR10  Accuracy Positivity
## White       0.6911281 0.2591641 0.7719000 0.4720701 0.7407510  0.2599018
## Black       0.7131243 0.2191502 0.8100843 0.5272938 0.7805826  0.2210991
## AsianPI     0.7307692 0.2255802 0.8048593 0.5054945 0.7743393  0.2265116
## AmeriIndian 0.4666667 0.2214107 0.6649186 0.3666667 0.7779748  0.2218939
```

```
# LightGBM
gb_early_unaware <- load_pickle("../models/gb_early_unaware")
gb_early_unaware_r <- calculate_results(model = gb_early_unaware, model_yhat_fn = calculate_yhat_sklearn
```

```
## Setting levels: control = 0, case = 1
```

```
## Setting direction: controls < cases

## Setting levels: control = 0, case = 1

## Setting direction: controls < cases

## Setting levels: control = 0, case = 1

## Setting direction: controls < cases

## Setting levels: control = 0, case = 1

## Setting direction: controls < cases
```

```
gb_early_unaware_r
```

```
##                   TPR       FPR       AUC     TPR10  Accuracy Positivity
## White       0.6434830 0.1193231 0.8488496 0.6171961 0.8802719  0.1202182
## Black       0.7259001 0.1280178 0.8887496 0.6957027 0.8714059  0.1303766
## AsianPI     0.7252747 0.1003582 0.8937432 0.7252747 0.8993203  0.1015103
## AmeriIndian 0.7333333 0.1352810 0.8314340 0.7000000 0.8644602  0.1364592
```

```
# ReLU Network
relu_early_unaware <- load_NN("../models/lrelu_early_unaware")
relu_early_unaware_r <- calculate_results(relu_early_unaware, calculate_yhat_NN)
```

```
## Setting levels: control = 0, case = 1
## Setting direction: controls < cases

## Setting levels: control = 0, case = 1

## Setting direction: controls < cases

## Setting levels: control = 0, case = 1

## Setting direction: controls < cases

## Setting levels: control = 0, case = 1

## Setting direction: controls < cases
```

```
relu_early_unaware_r
```

```
##                    TPR         FPR       AUC     TPR10  Accuracy  Positivity
## White       0.08817087 0.003407947 0.7145190 0.4397590 0.9950408 0.003552689
## Black       0.13008130 0.002493376 0.7427177 0.4878049 0.9940844 0.002996742
## AsianPI     0.13736264 0.012726184 0.7181816 0.4615385 0.9857069 0.012955966
## AmeriIndian 0.03333333 0.002368733 0.6722442 0.2666667 0.9957315 0.002429735
```

```
## SELU Network
selu_early_unaware <- load_NN("../models/selu_early_unaware")
selu_early_unaware_r <- calculate_results(selu_early_unaware, calculate_yhat_NN)
```

```
## Setting levels: control = 0, case = 1
## Setting direction: controls < cases

## Setting levels: control = 0, case = 1

## Setting direction: controls < cases

## Setting levels: control = 0, case = 1

## Setting direction: controls < cases

## Setting levels: control = 0, case = 1
```

```
## Setting direction: controls < cases
```

```
selu_early_unaware_r
```

```
##                    TPR        FPR       AUC     TPR10  Accuracy Positivity
## White       0.6358160 0.11583271 0.8416660 0.6188390 0.8837432 0.11672064
## Black       0.7166086 0.11468147 0.8869065 0.6922184 0.8846529 0.11705623
## AsianPI     0.7252747 0.09185382 0.8851907 0.7252747 0.9078090 0.09302161
## AmeriIndian 0.6333333 0.13699171 0.8051454 0.6000000 0.8625558 0.13796953
```

Late Stillbirth

```
file <- '../data/final/stillbirth_test.csv'
outcome <- 'late stillbirth'
```

```
## RACE-AWARE Columns
read_race_data(file, outcome, unaware = FALSE)

# Logistic Regression
lr_late_aware <- load_pickle("../models/lr_late_aware")
lr_late_aware_r <- calculate_results(model = lr_late_aware, model_yhat_fn = calculate_yhat_sklearn)
```

```
## Setting levels: control = 0, case = 1
## Setting direction: controls < cases
## Setting levels: control = 0, case = 1
## Setting direction: controls < cases
## Setting levels: control = 0, case = 1
## Setting direction: controls < cases
## Setting levels: control = 0, case = 1
## Setting direction: controls < cases
```

```
lr_late_aware_r
```

```
##                    TPR       FPR       AUC     TPR10  Accuracy Positivity
## White       0.6489770 0.2377429 0.7533796 0.4437340 0.7620914  0.2383443
## Black       0.8432836 0.5172921 0.7727150 0.4421642 0.4835935  0.5180927
## AsianPI     0.5419847 0.1664097 0.7463678 0.4045802 0.8332033  0.1669081
## AmeriIndian 0.8292683 0.4455785 0.8018170 0.5609756 0.5551615  0.4466115
```

```
# LightGBM
gb_late_aware <- load_pickle("../models/gb_late_aware")
gb_late_aware_r <- calculate_results(model = gb_late_aware, model_yhat_fn = calculate_yhat_sklearn)
```

```
## Setting levels: control = 0, case = 1
## Setting direction: controls < cases
## Setting levels: control = 0, case = 1
## Setting direction: controls < cases
## Setting levels: control = 0, case = 1
## Setting direction: controls < cases
## Setting levels: control = 0, case = 1
```

```
## Setting direction: controls < cases
```

```
gb_late_aware_r
```

```
##                    TPR        FPR       AUC     TPR10  Accuracy Positivity
## White       0.6413043 0.11387128 0.8367200 0.6259591 0.8857706 0.11464271
## Black       0.7630597 0.27135383 0.8426006 0.6063433 0.7287307 0.27256148
## AsianPI     0.6641221 0.05710634 0.8848103 0.7022901 0.9425237 0.05791185
## AmeriIndian 0.7073171 0.17633502 0.8677560 0.6341463 0.8233517 0.17776464
```

```
# ReLU Network
relu_late_aware <- load_NN("../models/lrelu_late_aware")
relu_late_aware_r <- calculate_results(relu_late_aware, calculate_yhat_NN)
```

```
## Setting levels: control = 0, case = 1
## Setting direction: controls < cases
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## Setting levels: control = 0, case = 1
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## Setting direction: controls < cases
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## Setting levels: control = 0, case = 1
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```
## Setting direction: controls < cases
```

```
## Setting levels: control = 0, case = 1
```

```
## Setting direction: controls < cases
```

```
relu_late_aware_r
```

```
##                    TPR         FPR       AUC     TPR10  Accuracy  Positivity
## White       0.3305627 0.008663875 0.7088241 0.4993606 0.9903697 0.009134683
## Black       0.4608209 0.033031543 0.7379813 0.5279851 0.9657253 0.034082213
## AsianPI     0.5267176 0.047368848 0.7428498 0.5801527 0.9520660 0.048004943
## AmeriIndian 0.5609756 0.059722131 0.7816313 0.6097561 0.9392566 0.061071710
```

```
## SELU Network
selu_late_aware <- load_NN("../models/selu_late_aware")
selu_late_aware_r <- calculate_results(selu_late_aware, calculate_yhat_NN)
```

```
## Setting levels: control = 0, case = 1
## Setting direction: controls < cases
```

```
## Setting levels: control = 0, case = 1
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## Setting direction: controls < cases
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## Setting levels: control = 0, case = 1
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```
## Setting direction: controls < cases
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```
## Setting levels: control = 0, case = 1
```

```
## Setting direction: controls < cases
```

```
selu_late_aware_r
```

```
##                    TPR        FPR       AUC     TPR10  Accuracy Positivity
## White       0.6329923 0.11765020 0.8328819 0.6150895 0.8819851 0.11840394
## Black       0.8022388 0.33567140 0.8416710 0.6138060 0.6646673 0.33681731
## AsianPI     0.6488550 0.05601087 0.8838119 0.6946565 0.9435975 0.05679758
## AmeriIndian 0.7804878 0.23329163 0.8821023 0.6585366 0.7667455 0.23476491
```

```
## RACE-UNAWARE Columns
read_race_data(file, outcome, unaware = TRUE)

# Logistic Regression
lr_late_unaware <- load_pickle("../models/lr_late_unaware")
lr_late_unaware_r <- calculate_results(model = lr_late_unaware, model_yhat_fn = calculate_yhat_sklearn)
```

```
## Setting levels: control = 0, case = 1
## Setting direction: controls < cases
## Setting levels: control = 0, case = 1
## Setting direction: controls < cases
## Setting levels: control = 0, case = 1
## Setting direction: controls < cases
## Setting levels: control = 0, case = 1
## Setting direction: controls < cases
```

```
lr_late_unaware_r
```

```
##                   TPR       FPR       AUC     TPR10  Accuracy Positivity
## White       0.6918159 0.2901270 0.7523553 0.4405371 0.7098466  0.2907145
## Black       0.6958955 0.2606097 0.7721206 0.4328358 0.7392834  0.2616788
## AsianPI     0.6793893 0.2577799 0.7446469 0.3893130 0.7421368  0.2583393
## AmeriIndian 0.7317073 0.2771449 0.8041441 0.5853659 0.7228789  0.2783688
```

```
# LightGBM
gb_late_unaware <- load_pickle("../models/gb_late_unaware")
gb_late_unaware_r <- calculate_results(model = gb_late_unaware, model_yhat_fn = calculate_yhat_sklearn)
```

```
## Setting levels: control = 0, case = 1
## Setting direction: controls < cases
## Setting levels: control = 0, case = 1
## Setting direction: controls < cases
## Setting levels: control = 0, case = 1
## Setting direction: controls < cases
## Setting levels: control = 0, case = 1
## Setting direction: controls < cases
```

```
gb_late_unaware_r
```

```
##                   TPR        FPR       AUC     TPR10  Accuracy Positivity
## White       0.6560102 0.12645643 0.8359212 0.6285166 0.8732254  0.1272310
## Black       0.6604478 0.14055976 0.8478981 0.6268657 0.8589515  0.1418366
## AsianPI     0.6946565 0.09968759 0.8692809 0.6946565 0.9000395  0.1004771
## AmeriIndian 0.7560976 0.16691908 0.8840311 0.7073171 0.8328737  0.1685054
```

```
# ReLU Network
relu_late_unaware <- load_NN("../models/lrelu_late_unaware")
relu_late_unaware_r <- calculate_results(relu_late_unaware, calculate_yhat_NN)
```

```
## Setting levels: control = 0, case = 1
```

```
## Setting direction: controls < cases
## Setting levels: control = 0, case = 1
## Setting direction: controls < cases
## Setting levels: control = 0, case = 1
## Setting direction: controls < cases
## Setting levels: control = 0, case = 1
## Setting direction: controls < cases
```

```
relu_late_unaware_r
```

```
##                   TPR       FPR       AUC     TPR10  Accuracy Positivity
## White       0.5997442 0.1468925 0.7652594 0.5537084 0.8527369  0.1475549
## Black       0.5895522 0.1270137 0.7826470 0.5597015 0.8722902  0.1281497
## AsianPI     0.6793893 0.1565403 0.7828417 0.6335878 0.8432419  0.1572342
## AmeriIndian 0.6829268 0.1208929 0.8170370 0.6829268 0.8785789  0.1224061
```

```
## SELU Network
selu_late_unaware <- load_NN("../models/selu_late_unaware")
selu_late_unaware_r <- calculate_results(selu_late_unaware, calculate_yhat_NN)
```

```
## Setting levels: control = 0, case = 1
## Setting direction: controls < cases
## Setting levels: control = 0, case = 1
## Setting direction: controls < cases
## Setting levels: control = 0, case = 1
## Setting direction: controls < cases
## Setting levels: control = 0, case = 1
## Setting direction: controls < cases
```

```
selu_late_unaware_r
```

```
##                   TPR       FPR       AUC     TPR10  Accuracy Positivity
## White       0.6630435 0.1419589 0.8307014 0.6202046 0.8577559  0.1427210
## Black       0.6380597 0.1421996 0.8408769 0.6044776 0.8572607  0.1434175
## AsianPI     0.6793893 0.1131882 0.8698050 0.6717557 0.8865365  0.1139396
## AmeriIndian 0.7560976 0.1724501 0.8766500 0.6829268 0.8273575  0.1740215
```

Preterm Birth

```
file <- '../data/final/preterm_test.csv'
outcome <- 'preterm'
```

```
## RACE-AWARE Columns
read_race_data(file, outcome, unaware = FALSE)

# Logistic Regression
lr_preterm_aware <- load_pickle("../models/lr_preterm_aware")
lr_preterm_aware_r <- calculate_results(model = lr_preterm_aware, model_yhat_fn = calculate_yhat_sklearn
```

```
## Setting levels: control = 0, case = 1
```

```
## Setting direction: controls < cases
## Setting levels: control = 0, case = 1
## Setting direction: controls < cases
## Setting levels: control = 0, case = 1
## Setting direction: controls < cases
## Setting levels: control = 0, case = 1
## Setting direction: controls < cases
```

```
lr_preterm_aware_r
```

```
##                   TPR       FPR       AUC     TPR10  Accuracy Positivity
## White       0.6681098 0.5215287 0.6020178 0.1668847 0.4978167  0.5364817
## Black       0.3973039 0.2730820 0.5866214 0.1518569 0.6758403  0.2923317
## AsianPI     0.4551074 0.3109044 0.5977047 0.1634364 0.6662576  0.3249790
## AmeriIndian 0.8035176 0.7010949 0.5919673 0.1618090 0.3656235  0.7146369
```

```
# LightGBM
gb_preterm_aware <- load_pickle("../models/gb_preterm_aware")
gb_preterm_aware_r <- calculate_results(model = gb_preterm_aware, model_yhat_fn = calculate_yhat_sklearn
```

```
## Setting levels: control = 0, case = 1
## Setting direction: controls < cases
## Setting levels: control = 0, case = 1
## Setting direction: controls < cases
## Setting levels: control = 0, case = 1
## Setting direction: controls < cases
## Setting levels: control = 0, case = 1
## Setting direction: controls < cases
```

```
gb_preterm_aware_r
```

```
##                   TPR       FPR       AUC     TPR10  Accuracy Positivity
## White       0.7745026 0.6568927 0.6119690 0.2266581 0.3871147  0.6688903
## Black       0.5699619 0.4346981 0.5957807 0.2109868 0.5660240  0.4556589
## AsianPI     0.5102148 0.3596981 0.6111286 0.2344683 0.6276050  0.3743890
## AmeriIndian 0.9256281 0.8549116 0.5942295 0.2130653 0.2482892  0.8642615
```

```
# ReLU Network
relu_preterm_aware <- load_NN("../models/lrelu_preterm_aware")
relu_preterm_aware_r <- calculate_results(relu_preterm_aware, calculate_yhat_NN)
```

```
## Setting levels: control = 0, case = 1
## Setting direction: controls < cases
## Setting levels: control = 0, case = 1
## Setting direction: controls < cases
## Setting levels: control = 0, case = 1
## Setting direction: controls < cases
## Setting levels: control = 0, case = 1
```

```
## Setting direction: controls < cases
```

```
relu_preterm_aware_r
```

```
##                   TPR       FPR       AUC     TPR10  Accuracy Positivity
## White       0.8119013 0.7201619 0.5983944 0.1808585 0.3341148  0.7295204
## Black       0.4592608 0.3332788 0.5821708 0.1716760 0.6345727  0.3528012
## AsianPI     0.6833944 0.5504765 0.5950278 0.1716082 0.4723500  0.5634497
## AmeriIndian 0.9994975 0.9987750 0.5905584 0.1793970 0.1332137  0.9988705
```

```
## SELU Network
selu_preterm_aware <- load_NN("../models/selu_preterm_aware")
selu_preterm_aware_r <- calculate_results(selu_preterm_aware, calculate_yhat_NN)
```

```
## Setting levels: control = 0, case = 1
## Setting direction: controls < cases
```

```
## Setting levels: control = 0, case = 1
```

```
## Setting direction: controls < cases
```

```
## Setting levels: control = 0, case = 1
```

```
## Setting direction: controls < cases
```

```
## Setting levels: control = 0, case = 1
```

```
## Setting direction: controls < cases
```

```
selu_preterm_aware_r
```

```
##                   TPR       FPR       AUC     TPR10  Accuracy Positivity
## White       0.7198324 0.5877049 0.6136892 0.2421242 0.4436675  0.6011834
## Black       0.4934234 0.3580374 0.5962230 0.2214915 0.6189446  0.3790171
## AsianPI     0.4885280 0.3433467 0.6092433 0.2430592 0.6402438  0.3575168
## AmeriIndian 0.9301508 0.8817855 0.5977927 0.2170854 0.2255664  0.8881802
```

```
## RACE-UNAWARE Columns
read_race_data(file, outcome, unaware = TRUE)

# Logistic Regression
lr_preterm_unaware <- load_pickle("../models/lr_preterm_unaware")
lr_preterm_unaware_r <- calculate_results(model = lr_preterm_unaware, model_yhat_fn = calculate_yhat_sk
```

```
## Setting levels: control = 0, case = 1
```

```
## Setting direction: controls < cases
```

```
## Setting levels: control = 0, case = 1
```

```
## Setting direction: controls < cases
```

```
## Setting levels: control = 0, case = 1
```

```
## Setting direction: controls < cases
```

```
## Setting levels: control = 0, case = 1
```

```
## Setting direction: controls < cases
```

```
lr_preterm_unaware_r
```

```
##                   TPR       FPR       AUC     TPR10  Accuracy Positivity
## White       0.4065954 0.2595531 0.6027899 0.1717944 0.7063901  0.2745532
```

```
## Black       0.4292049 0.2991503 0.5855553 0.1517081 0.6587550  0.3193039
## AsianPI     0.3937140 0.2594817 0.5997616 0.1738083 0.7066691  0.2725832
## AmeriIndian 0.4301508 0.3105428 0.5906192 0.1567839 0.6551724  0.3263571
```

```
# LightGBM
gb_preterm_unaware <- load_pickle("../models/gb_preterm_unaware")
gb_preterm_unaware_r <- calculate_results(model = gb_preterm_unaware, model_yhat_fn = calculate_yhat_sk
```

```
## Setting levels: control = 0, case = 1
## Setting direction: controls < cases
```

```
## Setting levels: control = 0, case = 1
```

```
## Setting direction: controls < cases
```

```
## Setting levels: control = 0, case = 1
```

```
## Setting direction: controls < cases
```

```
## Setting levels: control = 0, case = 1
```

```
## Setting direction: controls < cases
```

```
gb_preterm_unaware_r
```

```
##                   TPR       FPR       AUC     TPR10  Accuracy Positivity
## White       0.5315125 0.3699849 0.6141063 0.2306651 0.6199667  0.3864626
## Black       0.5918343 0.4582290 0.5975279 0.2125640 0.5495289  0.4789327
## AsianPI     0.5137768 0.3626557 0.6107634 0.2376113 0.6252838  0.3774056
## AmeriIndian 0.5773869 0.4607610 0.5942215 0.2241206 0.5442828  0.4761810
```

```
# ReLU Network
relu_preterm_unaware <- load_NN("../models/lrelu_preterm_unaware")
relu_preterm_unaware_r <- calculate_results(relu_preterm_unaware, calculate_yhat_NN)
```

```
## Setting levels: control = 0, case = 1
## Setting direction: controls < cases
```

```
## Setting levels: control = 0, case = 1
```

```
## Setting direction: controls < cases
```

```
## Setting levels: control = 0, case = 1
```

```
## Setting direction: controls < cases
```

```
## Setting levels: control = 0, case = 1
```

```
## Setting direction: controls < cases
```

```
relu_preterm_unaware_r
```

```
##                   TPR       FPR       AUC     TPR10  Accuracy Positivity
## White       0.7275884 0.6092362 0.5977678 0.1930914 0.4251239  0.6213095
## Black       0.8121652 0.7387162 0.5820333 0.1798000 0.3466496  0.7500980
## AsianPI     0.7334730 0.6273725 0.5883298 0.1839130 0.4078471  0.6377283
## AmeriIndian 0.8211055 0.7304954 0.5908944 0.1884422 0.3424357  0.7424756
```

```
## SELU Network
selu_preterm_unaware <- load_NN("../models/selu_preterm_unaware")
selu_preterm_unaware_r <- calculate_results(selu_preterm_unaware, calculate_yhat_NN)
```

```
## Setting levels: control = 0, case = 1
## Setting direction: controls < cases
```

```
## Setting levels: control = 0, case = 1
## Setting direction: controls < cases
## Setting levels: control = 0, case = 1
## Setting direction: controls < cases
## Setting levels: control = 0, case = 1
## Setting direction: controls < cases
```

```
selu_preterm_unaware_r
```

```
##                   TPR       FPR       AUC     TPR10  Accuracy Positivity
## White       0.6659451 0.5255648 0.6088366 0.2285464 0.4939715  0.5398852
## Black       0.7403880 0.6370567 0.5937883 0.2106892 0.4214330  0.6530691
## AsianPI     0.6565741 0.5198133 0.6062929 0.2367732 0.4974027  0.5331615
## AmeriIndian 0.7492462 0.6497205 0.5910312 0.2150754 0.4030297  0.6628795
```

Save results

```
# AWARE RESULTS
lr_early_aware_r$model <- 'lr'
lr_early_aware_r$task <- 'early'
lr_early_aware_r$raceeth <- rownames(lr_early_aware_r)
lr_early_aware_r$aware <- TRUE
gb_early_aware_r$model <- 'gb'
gb_early_aware_r$task <- 'early'
gb_early_aware_r$raceeth <- rownames(gb_early_aware_r)
gb_early_aware_r$aware <- TRUE
relu_early_aware_r$model <- 'lrelu'
relu_early_aware_r$task <- 'early'
relu_early_aware_r$raceeth <- rownames(relu_early_aware_r)
relu_early_aware_r$aware <- TRUE
selu_early_aware_r$model <- 'selu'
selu_early_aware_r$task <- 'early'
selu_early_aware_r$raceeth <- rownames(selu_early_aware_r)
selu_early_aware_r$aware <- TRUE

lr_late_aware_r$model <- 'lr'
lr_late_aware_r$task <- 'late'
lr_late_aware_r$raceeth <- rownames(lr_late_aware_r)
lr_late_aware_r$aware <- TRUE
gb_late_aware_r$model <- 'gb'
gb_late_aware_r$task <- 'late'
gb_late_aware_r$raceeth <- rownames(gb_late_aware_r)
gb_late_aware_r$aware <- TRUE
relu_late_aware_r$model <- 'lrelu'
relu_late_aware_r$task <- 'late'
relu_late_aware_r$raceeth <- rownames(relu_late_aware_r)
relu_late_aware_r$aware <- TRUE
selu_late_aware_r$model <- 'selu'
selu_late_aware_r$task <- 'late'
selu_late_aware_r$raceeth <- rownames(selu_late_aware_r)
selu_late_aware_r$aware <- TRUE
```

```
lr_preterm_aware_r$model <- 'lr'
lr_preterm_aware_r$task <- 'preterm'
lr_preterm_aware_r$raceeth <- rownames(lr_preterm_aware_r)
lr_preterm_aware_r$aware <- TRUE
gb_preterm_aware_r$model <- 'gb'
gb_preterm_aware_r$task <- 'preterm'
gb_preterm_aware_r$raceeth <- rownames(gb_preterm_aware_r)
gb_preterm_aware_r$aware <- TRUE
relu_preterm_aware_r$model <- 'lrelu'
relu_preterm_aware_r$task <- 'preterm'
relu_preterm_aware_r$raceeth <- rownames(relu_preterm_aware_r)
relu_preterm_aware_r$aware <- TRUE
selu_preterm_aware_r$model <- 'selu'
selu_preterm_aware_r$task <- 'preterm'
selu_preterm_aware_r$raceeth <- rownames(selu_preterm_aware_r)
selu_preterm_aware_r$aware <- TRUE
```

```
# UNAWARE RESULTS
lr_early_unaware_r$model <- 'lr'
lr_early_unaware_r$task <- 'early'
lr_early_unaware_r$raceeth <- rownames(lr_early_unaware_r)
lr_early_unaware_r$aware <- FALSE
gb_early_unaware_r$model <- 'gb'
gb_early_unaware_r$task <- 'early'
gb_early_unaware_r$raceeth <- rownames(gb_early_unaware_r)
gb_early_unaware_r$aware <- FALSE
relu_early_unaware_r$model <- 'lrelu'
relu_early_unaware_r$task <- 'early'
relu_early_unaware_r$raceeth <- rownames(relu_early_unaware_r)
relu_early_unaware_r$aware <- FALSE
selu_early_unaware_r$model <- 'selu'
selu_early_unaware_r$task <- 'early'
selu_early_unaware_r$raceeth <- rownames(selu_early_unaware_r)
selu_early_unaware_r$aware <- FALSE

lr_late_unaware_r$model <- 'lr'
lr_late_unaware_r$task <- 'late'
lr_late_unaware_r$raceeth <- rownames(lr_late_unaware_r)
lr_late_unaware_r$aware <- FALSE
gb_late_unaware_r$model <- 'gb'
gb_late_unaware_r$task <- 'late'
gb_late_unaware_r$raceeth <- rownames(gb_late_unaware_r)
gb_late_unaware_r$aware <- FALSE
relu_late_unaware_r$model <- 'lrelu'
relu_late_unaware_r$task <- 'late'
relu_late_unaware_r$raceeth <- rownames(relu_late_unaware_r)
relu_late_unaware_r$aware <- FALSE
selu_late_unaware_r$model <- 'selu'
selu_late_unaware_r$task <- 'late'
selu_late_unaware_r$raceeth <- rownames(selu_late_unaware_r)
selu_late_unaware_r$aware <- FALSE

lr_preterm_unaware_r$model <- 'lr'
```

```
lr_preterm_unaware_r$task <- 'preterm'
lr_preterm_unaware_r$raceeth <- rownames(lr_preterm_unaware_r)
lr_preterm_unaware_r$aware <- FALSE
gb_preterm_unaware_r$model <- 'gb'
gb_preterm_unaware_r$task <- 'preterm'
gb_preterm_unaware_r$raceeth <- rownames(gb_preterm_unaware_r)
gb_preterm_unaware_r$aware <- FALSE
relu_preterm_unaware_r$model <- 'lrelu'
relu_preterm_unaware_r$task <- 'preterm'
relu_preterm_unaware_r$raceeth <- rownames(relu_preterm_unaware_r)
relu_preterm_unaware_r$aware <- FALSE
selu_preterm_unaware_r$model <- 'selu'
selu_preterm_unaware_r$task <- 'preterm'
selu_preterm_unaware_r$raceeth <- rownames(selu_preterm_unaware_r)
selu_preterm_unaware_r$aware <- FALSE
```

```
results_varnames <- ls(pattern = '.+_r$')
results_combined <- mget(results_varnames) %>%
  bind_rows(.id = 'varname') %>%
  remove_rownames()
results_combined
```

```
##                   varname        TPR          FPR       AUC     TPR10  Accuracy
## 1        gb_early_aware_r 0.60569551 0.087234252 0.8513484 0.6193866 0.9122414
## 2        gb_early_aware_r 0.84668990 0.264753239 0.8948861 0.7026713 0.7356864
## 3        gb_early_aware_r 0.68131868 0.061063357 0.9000883 0.7417582 0.9384617
## 4        gb_early_aware_r 0.66666667 0.103434662 0.8369764 0.6666667 0.8961124
## 5      gb_early_unaware_r 0.64348302 0.119323095 0.8488496 0.6171961 0.8802719
## 6      gb_early_unaware_r 0.72590012 0.128017812 0.8887496 0.6957027 0.8714059
## 7      gb_early_unaware_r 0.72527473 0.100358241 0.8937432 0.7252747 0.8993203
## 8      gb_early_unaware_r 0.73333333 0.135280958 0.8314340 0.7000000 0.8644602
## 9         gb_late_aware_r 0.64130435 0.113871285 0.8367200 0.6259591 0.8857706
## 10        gb_late_aware_r 0.76305970 0.271353829 0.8426006 0.6063433 0.7287307
## 11        gb_late_aware_r 0.66412214 0.057106342 0.8848103 0.7022901 0.9425237
## 12        gb_late_aware_r 0.70731707 0.176335023 0.8677560 0.6341463 0.8233517
## 13      gb_late_unaware_r 0.65601023 0.126456427 0.8359212 0.6285166 0.8732254
## 14      gb_late_unaware_r 0.66044776 0.140559759 0.8478981 0.6268657 0.8589515
## 15      gb_late_unaware_r 0.69465649 0.099687589 0.8692809 0.6946565 0.9000395
## 16      gb_late_unaware_r 0.75609756 0.166919076 0.8840311 0.7073171 0.8328737
## 17     gb_preterm_aware_r 0.77450258 0.656892671 0.6119690 0.2266581 0.3871147
## 18     gb_preterm_aware_r 0.56996191 0.434698143 0.5957807 0.2109868 0.5660240
## 19     gb_preterm_aware_r 0.51021477 0.359698127 0.6111286 0.2344683 0.6276050
## 20     gb_preterm_aware_r 0.92562814 0.854911569 0.5942295 0.2130653 0.2482892
## 21   gb_preterm_unaware_r 0.53151253 0.369984858 0.6141063 0.2306651 0.6199667
## 22   gb_preterm_unaware_r 0.59183431 0.458228967 0.5975279 0.2125640 0.5495289
## 23   gb_preterm_unaware_r 0.51377685 0.362655667 0.6107634 0.2376113 0.6252838
## 24   gb_preterm_unaware_r 0.57738693 0.460761044 0.5942215 0.2241206 0.5442828
## 25        lr_early_aware_r 0.63198248 0.200411239 0.7740651 0.4769989 0.7993026
## 26        lr_early_aware_r 0.86991870 0.496338142 0.8123449 0.5249710 0.5051068
## 27        lr_early_aware_r 0.61538462 0.137978627 0.8053245 0.5219780 0.8615667
## 28        lr_early_aware_r 0.56666667 0.242202921 0.6734812 0.3666667 0.7574205
## 29      lr_early_unaware_r 0.69112815 0.259164126 0.7719000 0.4720701 0.7407510
## 30      lr_early_unaware_r 0.71312427 0.219150228 0.8100843 0.5272938 0.7805826
## 31      lr_early_unaware_r 0.73076923 0.225580239 0.8048593 0.5054945 0.7743393
```

```
## 32     lr_early_unaware_r 0.46666667 0.221410712 0.6649186 0.3666667 0.7779748
## 33        lr_late_aware_r 0.64897698 0.237742878 0.7533796 0.4437340 0.7620914
## 34        lr_late_aware_r 0.84328358 0.517292066 0.7727150 0.4421642 0.4835935
## 35        lr_late_aware_r 0.54198473 0.166409705 0.7463678 0.4045802 0.8332033
## 36        lr_late_aware_r 0.82926829 0.445578455 0.8018170 0.5609756 0.5551615
## 37      lr_late_unaware_r 0.69181586 0.290126966 0.7523553 0.4405371 0.7098466
## 38      lr_late_unaware_r 0.69589552 0.260609735 0.7721206 0.4328358 0.7392834
## 39      lr_late_unaware_r 0.67938931 0.257779852 0.7446469 0.3893130 0.7421368
## 40      lr_late_unaware_r 0.73170732 0.277144927 0.8041441 0.5853659 0.7228789
## 41     lr_preterm_aware_r 0.66810980 0.521528707 0.6020178 0.1668847 0.4978167
## 42     lr_preterm_aware_r 0.39730389 0.273081981 0.5866214 0.1518569 0.6758403
## 43     lr_preterm_aware_r 0.45510739 0.310904373 0.5977047 0.1634364 0.6662576
## 44     lr_preterm_aware_r 0.80351759 0.701094863 0.5919673 0.1618090 0.3656235
## 45   lr_preterm_unaware_r 0.40659543 0.259553112 0.6027899 0.1717944 0.7063901
## 46   lr_preterm_unaware_r 0.42920486 0.299150336 0.5855553 0.1517081 0.6587550
## 47   lr_preterm_unaware_r 0.39371399 0.259481694 0.5997616 0.1738083 0.7066691
## 48   lr_preterm_unaware_r 0.43015075 0.310542837 0.5906192 0.1567839 0.6551724
## 49     relu_early_aware_r 0.24534502 0.009254289 0.7824965 0.5503834 0.9894729
## 50     relu_early_aware_r 0.55981417 0.067164728 0.8284422 0.6248548 0.9313636
## 51     relu_early_aware_r 0.28571429 0.007296751 0.8209306 0.6593407 0.9913998
## 52     relu_early_aware_r 0.20000000 0.004211080 0.6968274 0.4000000 0.9942212
## 53   relu_early_unaware_r 0.08817087 0.003407947 0.7145190 0.4397590 0.9950408
## 54   relu_early_unaware_r 0.13008130 0.002493376 0.7427177 0.4878049 0.9940844
## 55   relu_early_unaware_r 0.13736264 0.012726184 0.7181816 0.4615385 0.9857069
## 56   relu_early_unaware_r 0.03333333 0.002368733 0.6722442 0.2666667 0.9957315
## 57      relu_late_aware_r 0.33056266 0.008663875 0.7088241 0.4993606 0.9903697
## 58      relu_late_aware_r 0.46082090 0.033031543 0.7379813 0.5279851 0.9657253
## 59      relu_late_aware_r 0.52671756 0.047368848 0.7428498 0.5801527 0.9520660
## 60      relu_late_aware_r 0.56097561 0.059722131 0.7816313 0.6097561 0.9392566
## 61    relu_late_unaware_r 0.59974425 0.146892534 0.7652594 0.5537084 0.8527369
## 62    relu_late_unaware_r 0.58955224 0.127013656 0.7826470 0.5597015 0.8722902
## 63    relu_late_unaware_r 0.67938931 0.156540350 0.7828417 0.6335878 0.8432419
## 64    relu_late_unaware_r 0.68292683 0.120892869 0.8170370 0.6829268 0.8785789
## 65   relu_preterm_aware_r 0.81190125 0.720161862 0.5983944 0.1808585 0.3341148
## 66   relu_preterm_aware_r 0.45926080 0.333278763 0.5821708 0.1716760 0.6345727
## 67   relu_preterm_aware_r 0.68339445 0.550476493 0.5950278 0.1716082 0.4723500
## 68   relu_preterm_aware_r 0.99949749 0.998774979 0.5905584 0.1793970 0.1332137
## 69 relu_preterm_unaware_r 0.72758843 0.609236201 0.5977678 0.1930914 0.4251239
## 70 relu_preterm_unaware_r 0.81216522 0.738716173 0.5820333 0.1798000 0.3466496
## 71 relu_preterm_unaware_r 0.73347302 0.627372548 0.5883298 0.1839130 0.4078471
## 72 relu_preterm_unaware_r 0.82110553 0.730495368 0.5908944 0.1884422 0.3424357
## 73     selu_early_aware_r 0.57886090 0.058598320 0.8434549 0.6314348 0.9407826
## 74     selu_early_aware_r 0.82578397 0.231722913 0.8886480 0.7049942 0.7685040
## 75     selu_early_aware_r 0.63186813 0.029948141 0.8829801 0.7252747 0.9694284
## 76     selu_early_aware_r 0.60000000 0.024740097 0.8104433 0.6333333 0.9745206
## 77   selu_early_unaware_r 0.63581599 0.115832713 0.8416660 0.6188390 0.8837432
## 78   selu_early_unaware_r 0.71660859 0.114681474 0.8869065 0.6922184 0.8846529
## 79   selu_early_unaware_r 0.72527473 0.091853821 0.8851907 0.7252747 0.9078090
## 80   selu_early_unaware_r 0.63333333 0.136991709 0.8051454 0.6000000 0.8625558
## 81      selu_late_aware_r 0.63299233 0.117650199 0.8328819 0.6150895 0.8819851
## 82      selu_late_aware_r 0.80223881 0.335671403 0.8416710 0.6138060 0.6646673
## 83      selu_late_aware_r 0.64885496 0.056010874 0.8838119 0.6946565 0.9435975
## 84      selu_late_aware_r 0.78048780 0.233291631 0.8821023 0.6585366 0.7667455
## 85    selu_late_unaware_r 0.66304348 0.141958873 0.8307014 0.6202046 0.8577559
```

```
## 86    selu_late_unaware_r 0.63805970 0.142199622 0.8408769 0.6044776 0.8572607
## 87    selu_late_unaware_r 0.67938931 0.113188218 0.8698050 0.6717557 0.8865365
## 88    selu_late_unaware_r 0.75609756 0.172450122 0.8766500 0.6829268 0.8273575
## 89   selu_preterm_aware_r 0.71983235 0.587704878 0.6136892 0.2421242 0.4436675
## 90   selu_preterm_aware_r 0.49342340 0.358037424 0.5962230 0.2214915 0.6189446
## 91   selu_preterm_aware_r 0.48852803 0.343346667 0.6092433 0.2430592 0.6402438
## 92   selu_preterm_aware_r 0.93015075 0.881785468 0.5977927 0.2170854 0.2255664
## 93 selu_preterm_unaware_r 0.66594510 0.525564784 0.6088366 0.2285464 0.4939715
## 94 selu_preterm_unaware_r 0.74038805 0.637056682 0.5937883 0.2106892 0.4214330
## 95 selu_preterm_unaware_r 0.65657412 0.519813256 0.6062929 0.2367732 0.4974027
## 96 selu_preterm_unaware_r 0.74924623 0.649720542 0.5910312 0.2150754 0.4030297
##     Positivity model    task     raceeth aware
## 1  0.088119581    gb   early       White  TRUE
## 2  0.267049125    gb   early       Black  TRUE
## 3  0.062206870    gb   early     AsianPI  TRUE
## 4  0.104544261    gb   early AmeriIndian  TRUE
## 5  0.120218155    gb   early       White FALSE
## 6  0.130376609    gb   early       Black FALSE
## 7  0.101510348    gb   early     AsianPI FALSE
## 8  0.136459154    gb   early AmeriIndian FALSE
## 9  0.114642707    gb    late       White  TRUE
## 10 0.272561481    gb    late       Black  TRUE
## 11 0.057911851    gb    late     AsianPI  TRUE
## 12 0.177764644    gb    late AmeriIndian  TRUE
## 13 0.127230951    gb    late       White FALSE
## 14 0.141836627    gb    late       Black FALSE
## 15 0.100477112    gb    late     AsianPI FALSE
## 16 0.168505385    gb    late AmeriIndian FALSE
## 17 0.668890265    gb preterm       White  TRUE
## 18 0.455658903    gb preterm       Black  TRUE
## 19 0.374389022    gb preterm     AsianPI  TRUE
## 20 0.864261511    gb preterm AmeriIndian  TRUE
## 21 0.386462580    gb preterm       White FALSE
## 22 0.478932733    gb preterm       Black FALSE
## 23 0.377405567    gb preterm     AsianPI FALSE
## 24 0.476180985    gb preterm AmeriIndian FALSE
## 25 0.201148195    lr   early       White  TRUE
## 26 0.497812012    lr   early       Black  TRUE
## 27 0.138858781    lr   early     AsianPI  TRUE
## 28 0.242842133    lr   early AmeriIndian  TRUE
## 29 0.259901752    lr   early       White FALSE
## 30 0.221099080    lr   early       Black FALSE
## 31 0.226511614    lr   early     AsianPI FALSE
## 32 0.221893880    lr   early AmeriIndian FALSE
## 33 0.238344348    lr    late       White  TRUE
## 34 0.518092716    lr    late       Black  TRUE
## 35 0.166908093    lr    late     AsianPI  TRUE
## 36 0.446611505    lr    late AmeriIndian  TRUE
## 37 0.290714475    lr    late       White FALSE
## 38 0.261678817    lr    late       Black FALSE
## 39 0.258339327    lr    late     AsianPI FALSE
## 40 0.278368794    lr    late AmeriIndian FALSE
## 41 0.536481703    lr preterm       White  TRUE
## 42 0.292331672    lr preterm       Black  TRUE
```

```
## 43 0.324979038    lr preterm     AsianPI  TRUE
## 44 0.714636901    lr preterm AmeriIndian  TRUE
## 45 0.274553158    lr preterm       White FALSE
## 46 0.319303860    lr preterm       Black FALSE
## 47 0.272583185    lr preterm     AsianPI FALSE
## 48 0.326357053    lr preterm AmeriIndian FALSE
## 49 0.009657440 lrelu   early       White  TRUE
## 50 0.069108355 lrelu   early       Black  TRUE
## 51 0.007810047 lrelu   early     AsianPI  TRUE
## 52 0.004596795 lrelu   early AmeriIndian  TRUE
## 53 0.003552689 lrelu   early       White FALSE
## 54 0.002996742 lrelu   early       Black FALSE
## 55 0.012955966 lrelu   early     AsianPI FALSE
## 56 0.002429735 lrelu   early AmeriIndian FALSE
## 57 0.009134683 lrelu    late       White  TRUE
## 58 0.034082213 lrelu    late       Black  TRUE
## 59 0.048004943 lrelu    late     AsianPI  TRUE
## 60 0.061071710 lrelu    late AmeriIndian  TRUE
## 61 0.147554873 lrelu    late       White FALSE
## 62 0.128149672 lrelu    late       Black FALSE
## 63 0.157234170 lrelu    late     AsianPI FALSE
## 64 0.122406094 lrelu    late AmeriIndian FALSE
## 65 0.729520359 lrelu preterm       White  TRUE
## 66 0.352801206 lrelu preterm       Black  TRUE
## 67 0.563449700 lrelu preterm     AsianPI  TRUE
## 68 0.998870507 lrelu preterm AmeriIndian  TRUE
## 69 0.621309521 lrelu preterm       White FALSE
## 70 0.750097993 lrelu preterm       Black FALSE
## 71 0.637728286 lrelu preterm     AsianPI FALSE
## 72 0.742475583 lrelu preterm AmeriIndian FALSE
## 73 0.059486726  selu   early       White  TRUE
## 74 0.234066634  selu   early       Black  TRUE
## 75 0.031057851  selu   early     AsianPI  TRUE
## 76 0.025873391  selu   early AmeriIndian  TRUE
## 77 0.116720641  selu   early       White FALSE
## 78 0.117056228  selu   early       Black FALSE
## 79 0.093021607  selu   early     AsianPI FALSE
## 80 0.137969530  selu   early AmeriIndian FALSE
## 81 0.118403937  selu    late       White  TRUE
## 82 0.336817313  selu    late       Black  TRUE
## 83 0.056797577  selu    late     AsianPI  TRUE
## 84 0.234764907  selu    late AmeriIndian  TRUE
## 85 0.142721010  selu    late       White FALSE
## 86 0.143417477  selu    late       Black FALSE
## 87 0.113939566  selu    late     AsianPI FALSE
## 88 0.174021539  selu    late AmeriIndian FALSE
## 89 0.601183434  selu preterm       White  TRUE
## 90 0.379017122  selu preterm       Black  TRUE
## 91 0.357516821  selu preterm     AsianPI  TRUE
## 92 0.888180187  selu preterm AmeriIndian  TRUE
## 93 0.539885227  selu preterm       White FALSE
## 94 0.653069130  selu preterm       Black FALSE
## 95 0.533161544  selu preterm     AsianPI FALSE
## 96 0.662879543  selu preterm AmeriIndian FALSE
```

```
fwrite(results_combined, '../data/results.csv')
```