```r
#####################################################################
########
## Program Name: Estimated Fetal Growth Velocity Calculator
## Authors: Daniel He, Zhen Chen, Katherine Grantz
## Date: 01/23/2026

################################### Inputs
#################################

# Gestational Age
# cat("Please enter Gestational Age\n")
# GA= scan(n=2)
# if(length(GA)==0|length(GA)==1){
#   cat("Please enter Gestational Age\n")
#   GA= scan(n=2)
#   if(length(GA)==0|length(GA)==1){
#     cat("If you have your Gestational Age information, please enter
Gestational Age
#         \nIf you do not have your Please enter Gestational Age, please
hit any button to continue\n")
#     GA=scan(n=2)
#     if(length(GA)==0){
#       GA=40
#     }#set default value for GA
#   }
# }

## Race
race_index= c("White", "Black" ,"Hispanic", "Asian")
# cat("Please enter # of race\nRace Index: 1-White 2-Black 3-Hispanic 4-
Asian\n")
# Race= scan(n=1)
# if(length(Race)==0){
#   cat("Please enter # of race\nRace Index: 1-White 2-Black 3-Hispanic
4-Asian\n")
#   Race= scan(n=1)
#   if(length(Race)==0){
#     cat("If you have your race information, please enter # of race
#         \nIf you do not have your race information, please hit any
button to continue
#         \nRace Index: 1-White 2-Black 3-Hispanic 4-Asian\n")
#     Race= scan(n=1)
#     if(length(Race)==0){
#       Race=1
#       }#set default value for race
#   }
# }

## Ultrasonograpy TypeUltrasonograpy
ultra_index= c("EFW1" , "EFW2" , "EFW3" , "EFW4" , "AC" , "BPD" , "FL",
"HC","HUMERUS")
# cat("Please enter # of ultrasonograpy typeUltrasonograpy
#     \nUltra Index: 1-EFW1, 2-EFW2, 3-EFW3, 4-EFW4, 5-AC, 6-BPD, 7-FL,
8-HC, 9-HUMERUS")
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# Ultra= scan(n=1)
# if(length(Ultra)==0){
#   cat("Please enter # of ultrasonograpy typeUltrasonograpy
#       \nUltra Index: 1-EFW1, 2-EFW2, 3-EFW3, 4-EFW4, 5-AC, 6-BPD, 7-FL,
8-HC, 9-HUMERUS\n")
#   Ultra= scan(n=1)
#   if(length(Ultra)==0){
#     cat("If you have your Ultra information\nPlease enter # of Ultra
#         \nIf you do not have your Ultra information, please hit any
button to continue
#         \nUltra Index: 1-EFW1, 2-EFW2, 3-EFW3, 4-EFW4, 5-AC, 6-BPD, 7-
FL, 8-HC, 9-HUMERUS\n")
#     Ultra=scan(n=1)
#     if(length(Ultra)==0){
#       Ultra=1
#     }#set default value for Ultra
#   }
# }

# cat("Please enter value of the ultrasonograpy\n")

# Ultra_value= scan(n=2)
# if(length(Ultra_value)==0|length(Ultra_value)==1){
#   cat("Please enter value of the ultrasonograpy\n")
#   Ultra_value= scan(n=2)
#   if(length(Ultra_value)==0|length(Ultra_value)==1){
#     cat("If you have your value of the ultrasonograpy
information,Please enter value of the ultrasonograpy
#         \nIf you do not have your Ultra_value information, please find
your value of ultrasonograpy and come back later :)")
#
#   }
# }
# input any two values here: e.g. 99

GA= scan(n=2)
99
99
Ultra_value= scan(n=2)
99
99

#set values at here
# # 1-White 2-Black 3-Hispanic 4-Asian
Race=2

meas1=  c(
  13,
  25.1,
  92,
  73.1,
  12
```

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)
meas2=  c(
   25,
   65.8,
   240.4,
   215.7,
   50


)

  #########
# calculate EFW1-4 and EFW measurement 1 and 2
GA[1]= meas1[1]
BPD1=  meas1[2]
HC1=   meas1[3]
AC1=   meas1[4]
FL1=   meas1[5]

GA[2]= meas2[1]
BPD2= meas2[2]
HC2=  meas2[3]
AC2=  meas2[4]
FL2=  meas2[5]

 EFW1_1 = 10 ** (1.304 + (0.05281*0.1*AC1) + (0.1938*0.1*FL1)-
(0.004*0.1*0.1*AC1*FL1))
 EFW2_1 = 10 ** (1.335-
0.0034*0.1*0.1*AC1*FL1+0.0316*0.1*BPD1+0.0457*0.1*AC1+0.1623*0.1*FL1)
 EFW3_1 = 10 ** (1.326-
0.00326*0.1*0.1*AC1*FL1+0.0107*0.1*HC1+0.0438*0.1*AC1+0.158*0.1*FL1)
 EFW4_1 = 10 ** (1.3596-
0.00386*0.1*0.1*AC1*FL1+0.0064*0.1*HC1+0.00061*0.1*0.1*BPD1*AC1+0.0424*0.
1*AC1+0.174*0.1*FL1)

 EFW1_2 = 10 ** (1.304 + (0.05281*0.1*AC2) + (0.1938*0.1*FL2)-
(0.004*0.1*0.1*AC2*FL2))
 EFW2_2 = 10 ** (1.335-
0.0034*0.1*0.1*AC2*FL2+0.0316*0.1*BPD2+0.0457*0.1*AC2+0.1623*0.1*FL2)
 EFW3_2 = 10 ** (1.326-
0.00326*0.1*0.1*AC2*FL2+0.0107*0.1*HC2+0.0438*0.1*AC2+0.158*0.1*FL2)
 EFW4_2 = 10 ** (1.3596-
0.00386*0.1*0.1*AC2*FL2+0.0064*0.1*HC2+0.00061*0.1*0.1*BPD2*AC2+0.0424*0.
1*AC2+0.174*0.1*FL2)

 uv1=c(EFW1_1,EFW2_1,EFW3_1,EFW4_1,AC1,BPD1,FL1,HC1,9)
 uv2=c(EFW1_2,EFW2_2,EFW3_2,EFW4_2,AC2,BPD2,FL2,HC2,9)

 for (ulr in c(6,8,5,7,1,2,3,4)) {
   # # 1-EFW1, 2-EFW2, 3-EFW3, 4-EFW4, 5-AC, 6-BPD, 7-FL, 8-HC, 9-HUMERUS
   Ultra=ulr

 Ultra_value[1]=uv1[Ultra]
 Ultra_value[2]=uv2[Ultra]
```

```r
    #########

 # generate the results
for (w in 1) {

  Ultra_value=log(Ultra_value)*w

  ################################## call files
################################
  # call the parameter estimates file
  # call the percentile calculator file
  #source("FetalGrowth_PE_012219.R")
  PE=c(1,1,2.70216590950516000000E+00,-1.09423627116649000000E-
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  )
  PE= matrix(PE,nrow=36,byrow = T)
  index= (Race-1)*9+Ultra; #Changed from 10 to 9 for number of ultrasound
measurements.
  info= PE[index,]#/1e8
  fcoef=info[3:9]; sigma=info[10];Sigmab=
matrix(info[11:26],4,4);Zeta=info[27:29];varfixed=
matrix(info[30:78],7,7)

  ################# Velocity calculator

  i = GA[1]
  j = GA[2]

  int <- 1
  t1 <- i
  t2 <- i**2
  t3 <- i**3
  tt1 <- (i - Zeta[1])**3 * (i > Zeta[1])
  tt2 <- (i - Zeta[2])**3 * (i > Zeta[2])
  tt3 <- (i - Zeta[3])**3 * (i > Zeta[3])

  Fxxi = cbind(int, t1, t2, t3, tt1, tt2, tt3)
  Rxxi = cbind(int, t1, t2, t3)
```

```r
  int <- 1
  t1 <- j
  t2 <- j**2
  t3 <- j**3
  tt1 <- (j - Zeta[1])**3 * (j > Zeta[1])
  tt2 <- (j - Zeta[2])**3 * (j > Zeta[2])
  tt3 <- (j - Zeta[3])**3 * (j > Zeta[3])

  Fxxj = cbind(int, t1, t2, t3, tt1, tt2, tt3)
  Rxxj = cbind(int, t1, t2, t3)

  dFxx = Fxxj - Fxxi
  dRxx = Rxxj - Rxxi

  mean <- dFxx%*%fcoef
  var <- 2*sigma**2 + dRxx%*%Sigmab%*%t(dRxx) + dFxx%*%varfixed%*%t(dFxx)
  std <- sqrt(var)

  percentile = round (pnorm(Ultra_value[2]-Ultra_value[1], mean = mean,
sd = std, lower.tail = TRUE, log.p = FALSE),3)

  # please compute percentile instead of median

  #
  mean1=Fxxi%*%fcoef
  mean2=Fxxj%*%fcoef
  std1=sqrt(sigma**2 + Rxxi%*%Sigmab%*%t(Rxxi) +
Fxxi%*%varfixed%*%t(Fxxi))
  std2=sqrt(sigma**2 + Rxxj%*%Sigmab%*%t(Rxxj) +
Fxxj%*%varfixed%*%t(Fxxj))

  percentile1 = round  (pnorm(Ultra_value[1], mean = mean1, sd = std1,
lower.tail = TRUE, log.p = FALSE),3)
  percentile2 = round  (pnorm(Ultra_value[2], mean = mean2, sd = std2,
lower.tail = TRUE, log.p = FALSE),3)

  if (percentile1<0.03 ) {percentile1="<3" }
  if (percentile1>0.97 ) {percentile1=">97" }
  if (percentile1<=0.97 & percentile1>=0.03 )
{percentile1=percentile1*100}

  if (percentile2<0.03 ) {percentile2="<3" }
  if (percentile2>0.97 ) {percentile2=">97" }
  if (percentile2<=0.97 & percentile2>=0.03 )
{percentile2=percentile2*100}

  if (percentile<0.03 ) {percentile="<3" }
  if (percentile>0.97 ) {percentile=">97" }
  if (percentile<=0.97 & percentile>=0.03 ) {percentile=percentile*100}

  # ################################################
  #
  #
```

```
  ################################## Ourputs
##################################
  options(digits=3)
  # cat("m1, m2 and velocity are respectively",100*percentile1,"%
","," ,100*percentile2,"% "," ," ,100*percentile,"% ",
"(",race_index[Race],", ",ultra_index[Ultra],":",
  #     exp(Ultra_value)[1]," ",exp(Ultra_value)[2],", ","GA:",GA[1],"
",GA[2],")",sep="","            ")

  cat("when (",ultra_index[Ultra],":",
     exp(Ultra_value)[1]," ",exp(Ultra_value)[2],")","; ","m1, m2 and
velocity are respectively",percentile1,"% "," ," ,percentile2,"%
","," ,percentile,"% ", sep="","            ")
}
 }
```