# R code for working with LMS files, from Urlacher et al., “Physical Growth of the Shuar: Height, Weight, and BMI References for an Indigenous Amazonian Population”

# This function produces centile values for given ages and LMS values.
centilesLMS <- function(Age, Sex, LMSlookuptable, cent = c(0.02, 0.05, 0.25, 0.50, 0.75, 0.95, 0.98)){
  useLMS <- apply(data.frame(Age, Sex), 1, function(x)
    which.min(abs(LMSlookuptable$Age-as.numeric(x[1]))+(x[2]!=LMSlookuptable$Sex)*999))
  LMS <- LMSlookuptable[useLMS,]
  getcent <- function(la, mu, si){
    sapply(cent, function(x)
      exp(log(qnorm(x)*la*si+1)/la+log(mu)), simplify=TRUE)
  }
  if(length(cent)==1) o <- cbind(Age, apply(LMS, 1, function(x)
    getcent(x[1], x[2], x[3])))
  else o <- cbind(Age, t(apply(LMS, 1, function(x) getcent(x[1], x[2], x[3]))))
  o <- data.frame(o)
  names(o) <- c("Age", cent)
  o
}

# This function calculates a z-score from a measure and the appropriate LMS values.
ZfromLMS <- function(measure, la, mu, si){
  zs <- ((measure / mu)^la - 1)/(la * si)
  zs
}

# function to get z-scores for a given age and value. Sex, age, and value need to be in the same units or with the same coding scheme as is used in the LMS table.
getZ <- function(Age, Sex, Value, LMSlookuptable){
  useLMS <- apply(data.frame(Age, Sex), 1, function(x)
    which.min(abs(LMSlookuptable$Age-as.numeric(x[1]))+(x[2]!=LMSlookuptable$Sex)*999))
  LMSmatches <- LMSlookuptable[useLMS,]
  ZfromLMS(Value, LMSmatches$Lambda, LMSmatches$Mu, LMSmatches$Sigma)
}
#just a wrapper. Uses pnorm to get centiles from the Z-scores in getZ
getCentile <- function(Age, Sex, Value, LMSlookuptable) {
  zs <- getZ(Age, Sex, Value, LMSlookuptable)
  cent <- pnorm(zs)
  cent
}

#example usage

#read in LMS files
HT.LMS <- read.csv("ShuarHeightByageLMS.csv")
WT.LMS <- read.csv("ShuarWeightByAgeLMS.csv")
BMI.LMS <- read.csv("ShuarBMIByAgeLMS.csv")

#get a z-score for an 5 year-old male, 97cm tall
getZ(5, "Male", 97, HT.LMS)

#get a Centile value
getCentile(5, "Male", 97, HT.LMS)

#get z-scores for three individuals
growthdat <-
data.frame(Age=c(5, 5, 15), Sex=c("Male", "Female", "Male"), Weights<-c(15, 15, 40))
getZ(growthdat$Age, growthdat$Sex, growthdat$Weights, WT.LMS)

#what are the 5th, 50th, and 95th centiles for males at age 5 and age 10?
centilesLMS(c(5, 10), "Male", HT.LMS, cent=c(0.05, 0.50, 0.95))