The adequacy of aging techniques in vertebrates for rapid estimation of population mortality rates from age distributions

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Appendix S4. Example of R code to simulate data and calculate $\frac{1}{m\sqrt{I(m)}}$, the basic factor in the 95% error percentage plotted in Fig. 1.

```
############### Parameters that will be used in the function #######################
# beta $\beta$ and sigma $\sigma$ is the slope and the standard deviation of the error in equation 19,
# respectively.
# $m$ , assumed mortality rate.
# $c$, constant used in calculation of $K(\mu)$, discussed in Numerical Computation Fisher
# Information in Appendix S2.

# Construct a function called basic factor to calculate $\frac{1}{m\sqrt{I(m)}}$, the basic factor in
# 95% error percentage ($EP(95)$)in equation 44.
basic_factor <- function(beta = 1, sigma, m, c) {
# use  $m$ , beta $\beta$, sigma $\sigma$ to calculate proxy coefficient mu $\mu$
  beta = abs(beta)
  lambda = -log(1-m) # equation is specified in the line below equation
  mu <- sigma*lambda/beta # equation is specified in the line above equation 22
 if(mu > 8) {NA} else { # when mu $\mu$ > 8 the computation is unreliable and thus discarded
  # integral part of equation 46
  int10 <- function(x) (x + dnorm(x)/pnorm(x)) * dnorm(x + mu)
  int1 <- integrate(int10, -mu - c, -mu + c)$value
  # equation 46 to calculate $L(\mu)$, which is also the lower limit of $K(\mu)$
  L <- Klow <- mu + int1
  # right hand of equation 47, which is the upper limit of $K(\mu)$
```

```
    Kup <- L + (1 + 1/c + 1/c^2) * dnorm(c)
  # use the average of the upper and lower limit to represent $K(\mu)$ in equation 47
    K <- (Kup + Klow)/2
    Jmu <- 1/(mu^2) - 1- mu^2 + mu*K # second equation in equation 45
    Im <- (sigma/beta/(1-m))^2*Jmu # equation 38
    mIm <- 1/(sqrt(Im)*m) # $\frac{1}{m\sqrt{I(m)}}$, the basic factor in equation 44 and plotted in Fig. 1

      # return $\frac{1}{m\sqrt{I(m)}}$ in equation 44
if(is.infinite(mIm)|is.nan(mIm)) {
      NA # when mu $\mu$ > 8 the computation is unreliable and thus discarded
    } else {
      mIm
    }
  }
 }
```