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 \( \frac{1}{m \sqrt{\hat{I}(m)}} \), the basic factor in the 95\% error percentage plotted in Fig. 1.

Parameters that will be used in the function

\[
\beta \quad \text{and} \quad \sigma \quad \text{is the slope and the standard deviation of the error in equation 19, respectively.}
\]

\( m \), 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 \( \frac{1}{m \sqrt{\hat{I}(m)}} \), the basic factor in 95\% error percentage (\( EP(95) \)) in equation 44.

```r
basic_factor <- function(beta = 1, sigma, m, c) {
  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 {
    # 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 \( K(\mu) \)
  }
}
```

# beta \( \beta \) and sigma \( \sigma \) is the slope and the standard deviation of the error in equation 19,

# respectively.

# Construct a function called basic factor to calculate \( \frac{1}{m \sqrt{\hat{I}(m)}} \), the basic factor in 95\% error percentage (\( EP(95) \)) in equation 44.

# 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.
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
}
