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.

```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 $K(\mu)$
  }
}
```

# The function is defined with the specified parameters and calculates the basic factor using the provided equations.
Kup <- L + \((1 + 1/c + 1/c^2) * \text{dnorm}(c)\)

# use the average of the upper and lower limit to represent \(K(\mu)\) in equation 47
K <- (Kup + Klow)/2

\(Jmu \leftarrow \frac{1}{\mu^2} - 1 - \mu^2 + \mu K\) \# second equation in equation 45

\(Im \leftarrow (\text{sigma/\beta/(1-m)})^2 \cdot Jmu\) \# equation 38

\(mIm \leftarrow \frac{1}{\sqrt{Im} \cdot \mu}\) \# \(\frac{1}{m\sqrt{I(m)}}\), the basic factor in equation 44 and plotted in Fig. 1

if(is.infinite(mIm) | is.nan(mIm)) {
    NA \# when \(\mu > 8\) the computation is unreliable and thus discarded
} else {
    mIm
}

if(is.infinite(mIm) | is.nan(mIm)) {
    NA \# when \(\mu > 8\) the computation is unreliable and thus discarded
} else {
    mIm
}