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

Zhao, M.; Klaassen, C.A.J.; Lisovski, S.; Klaassen, M.

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

# Construct a function called basic factor to calculate \( \frac{1}{m\sqrt{l(m)}} \), 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 \( \mu \)
  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 \( K(\mu) \)
```r
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
}
```

---

24 Kup <- L + (1 + 1/c + 1/c^2) * dnorm(c)
25
26 # use the average of the upper and lower limit to represent \( K(\mu) \) in equation 47
27 K <- (Kup + Klow)/2
28
29 Jmu <- 1/(mu^2) - 1 - mu^2 + mu*K # second equation in equation 45
30
31 Im <- (sigma/beta/(1-m))^2*Jmu # equation 38
32
33 mIm <- 1/(sqrt(Im)*m) # \( \frac{1}{m\sqrt{I(m)}} \), the basic factor in equation 44 and plotted in Fig. 1
34 
35 # return \( \frac{1}{m\sqrt{I(m)}} \) in equation 44
36
37 if(is.infinite(mIm)|is.nan(mIm)) {
38  NA # when mu \( \mu > 8 \) the computation is unreliable and thus discarded
39 } else {
40  mIm
41 }
42
43