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

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

3 ##### Parameters that will be used in the function #####

4 # beta β and sigma σ is the slope and the standard deviation of the error in equation 19,
5 # respectively.

6 # m , assumed mortality rate.

7 # c , constant used in calculation of $K(\mu)$, discussed in Numerical Computation Fisher
8 # Information in Appendix S2.

9

10 # Construct a function called basic factor to calculate $\frac{1}{m\sqrt{I(m)}}$, the basic factor in

11 # 95% error percentage ($EP(95)$) in equation 44.

12 basic_factor <- function(beta = 1, sigma, m, c) {

13 # use m , beta β , sigma σ to calculate proxy coefficient μ

14 beta = abs(beta)

15 lambda = -log(1-m) # equation is specified in the line below equation

16 mu <- sigma*lambda/beta # equation is specified in the line above equation 22

17 if(mu > 8) {NA} else { # when $\mu > 8$ the computation is unreliable and thus discarded

18 # integral part of equation 46

19 int10 <- function(x) (x + dnorm(x)/pnorm(x)) * dnorm(x + mu)

20 int1 <- integrate(int10, -mu - c, -mu + c)\$value

21 # equation 46 to calculate $L(\mu)$, which is also the lower limit of $K(\mu)$

22 L <- Klow <- mu + int1

23 # right hand of equation 47, which is the upper limit of $K(\mu)$

```

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

```