Nest survival custom interval model – updated **4/26/2023**

Assume $Y = 0$ if the nest failed and $Y = 1$ if the nest succeeded. Let J be the number of intervals observed, for $j = 1, 2, \ldots, J$ intervals, and let T_j be the length (days) of interval j.

<u>Nests with only one interval:</u>

If only one interval is observed ($J = 1$), then:

$$\begin{aligned} P(Y=1) &= p_{s,1}{}^{T_1} \\ P(Y=0) &= 1-p_{s,1}{}^{T_1} \end{aligned} \tag{1.1}$$

Where $p_{s,1}$ is the daily probability of nest survival (success) during the first (and only) observed interval, and T_1 is the length of that interval. $P(Y = 1)$ in Eqn (1.1) is the probability supplied to the Bernoulli likelihood for the nests with only one observed interval.

<u>Nests with more than one interval:</u>

If more than one interval is observed ($J > 1$), then the ***unnormalized*** probabilities of observing a 0 or 1 during the ***last*** interval are:

$$\begin{aligned} Q(Y=1) &= \prod_{j=1}^{J} p_{s,j}{}^{T_j} \\ Q(Y=0) &= \left(\prod_{j=1}^{J-1} p_{s,j}{}^{T_j}\right)\left(1-p_{s,J}{}^{T_J}\right) \end{aligned} \tag{1.2}$$

Where $p_{s,j}$ is the daily probability of nest survival during interval j, and T_j is the length of interval j. (We are currently using some form of the above probabilities in the current custom model.)

The **normalized** probabilities, which are the correct probabilities to use with the Bernoulli likelihood, are:

$$\begin{aligned} P(Y=1) &= \frac{Q(Y=1)}{Q(Y=1)+Q(Y=0)} \\ P(Y=0) &= \frac{Q(Y=0)}{Q(Y=1)+Q(Y=0)} \end{aligned} \tag{1.3}$$

Where $Q(Y=1)$ and $Q(Y = 0)$ are given in Eqn (1.2). The probability, $P(Y = 1)$, in Eqn (1.3), is the correct probability to input to the Bernoulli likelihood for the nests associated with more than one observed interval.