**Flow chart for Knowledge Transfer IBM**

For a given year (T):

For each individual at year T:

1. If animal is uninformed, assess whether the naïve individual learns by itself.
   * + Determined by a binomial distribution that is informed by the naïve learning probability (nl) and the age of the animal. Here, older animals have an increased probability of naïve learning.
       - Binomial distribution with probability of success = nl × ageClass/maxAgeClass
2. Determine the number of interactions the individual will have with every other living animal in the population, and then whether or not information is transferred socially.

* Number of interactions is determined by a poisson distribution of the max number of interactions termed si, modified by the boldness of each individual and a given partner and the density of the population.
* Positive density dependence, when populations are more dense (i.e., closer to K, there are more interactions). The equation below calculates the interactions for all available partners of an individual
* Poisson distribution with lambda = (si × BoldnessFocalID × ifelse(N>=K, 1, N/K) × BoldnessInteractingID))

Note: 3rd term, density or alive/k, is capped at 1

* Neutral density dependence, density is not considered. The equation below calculates the interactions for all available partners of an individual
* Poisson distribution with lambda = (si × BoldnessFocalID)
* Negative density dependence, when populations are more dense (i.e., closer to K, there are less interactions). The equation below calculates the interactions for all available partners of an individual
* Poisson distribution with lambda = (si × BoldnessFocalID × ifelse(N>=K, 1, 1+(1-N/K))

\*Note: Given that memory of past interactions is selected, the above equations will be modified by the number of interactions 2 individuals had the previous year multipled by the bias for familiar individuals.

Example:

Poisson distribution with lambda = (si × BoldnessFocalID) + (pastInteractions \* familiarBias)

* Given that 1 of the 2 individuals in a pair is knowledgeable, whether or not information is transferred is determined by the number of interactions between the pair and the information transfer probability
* Binomial distribution with probability of success = P(information transfer)

Note: the above equation is repeated for the number of times a given pair interacts, and information is transferred if at least one of the interactions results in a success.

1. Given the individual is a female, determine whether she gives birth and transfers her knowledge.

* Probability of giving birth is determined by birth rate of the individual’s age class and population density Distribution: probability
* Binomial distribution with probability of success = birthRate × (1 – N/K))
* If successful birth, create new individual and if VertTransmission = 1, give the new individual the informational status and interactions of mother.
* Interactions between mother and offspring is equal to the total number of interactions with other individuals in the first year of the offspring

1. Determine whether the animal dies.

* Whether or not an animal dies is determined based on survival rate of individual’s age class, population density, and the informational status of the animal (i.e., uninformed animals will suffer decrease in survival based on parameter h).
  + - Binomial distribution with probability of success =
      * If informed: 1- (survivalRate × (1 - (N/K))
      * If uninformed: 1- (survivalRate × (1 - (N/K)) - h)