

# Birds

*Stat 241 – Spring 2017*

## The Data

```
data(birdextinct, package = "LearnBayes")
head(birdextinct, 3)
```

```
##      species  time nesting size status
## 1 Sparrowhawk 3.030    1.00    0      1
## 2 Buzzard    5.464    2.00    0      1
## 3 Kestrel    4.098    1.21    0      1
```

Measurements on breedings pairs of landbird species were collected from 16 islands about Britain over several decades.

- **species** – name of bird species
- **time** – average time of extinction on the islands
- **nesting** – average number of nesting pairs
- **size** – size of the species: 1 or 0 if large or small
- **status** – status of the species: 1 or 0 if resident or migrant

Let's do a bit of renaming to make it easier to remember the coding.

```
Birds <- birdextinct %>%
  mutate(large = size, resident = status,
         size = ifelse(large, "large", "small"),
         status = ifelse(resident, "resident", "migratory"),
         combo = paste(size, status),
         logtime = log(time))
```

## A model

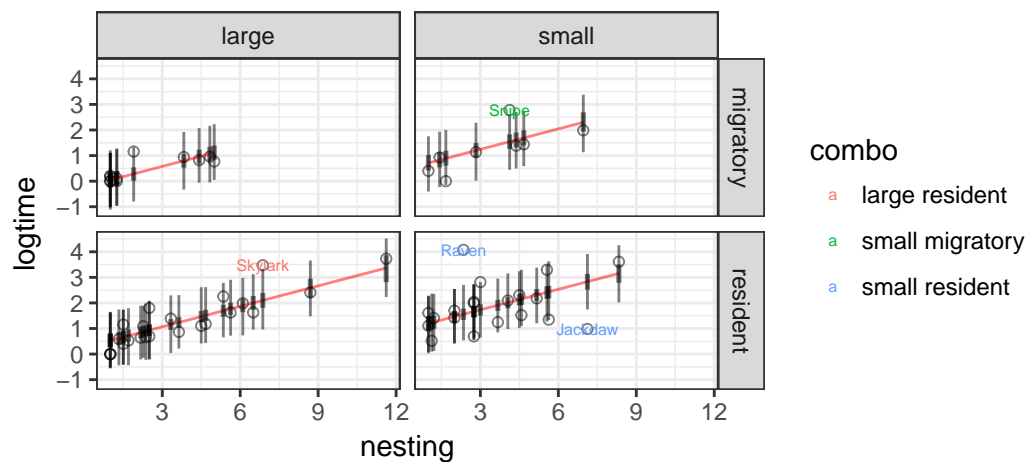
```
mBirds <-
  map2stan(
    alist(
      logtime ~ dnorm( mu , sigma ),
      mu <- Intercept + b_nesting * nesting +
        b_large * large + b_resident * resident,
      Intercept ~ dnorm(0,10),
      b_nesting ~ dnorm(0,10),
      b_large ~ dnorm(0,10),
      b_resident ~ dnorm(0,10),
      sigma ~ dcauchy(0,2)
    ),
    data = Birds)
```

```
precis(mBirds)
```

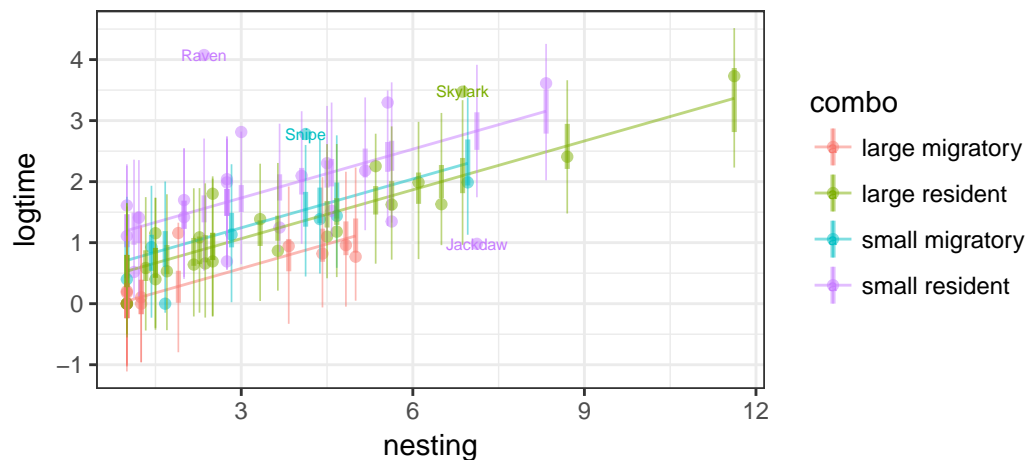
```
##      Mean StdDev lower 0.89 upper 0.89 n_eff Rhat
## Intercept  0.44  0.20    0.13    0.78   512    1
## b_nesting  0.27  0.04    0.20    0.32   814    1
## b_large   -0.67  0.17   -0.94   -0.42   840    1
## b_resident 0.49  0.18    0.20    0.76   806    1
## sigma      0.67  0.06    0.57    0.76  1000    1
```

## Model Predictions

1. What does this model predict for the mean log extinction time for a species that currently has 4 nesting pairs? That depends, of course, on the covariates (four combinations of size and status). Compute these four estimates several ways:
  - “by hand” from the output above
  - using `link()`
  - using `extract.samples()` but not `link()`
2. How is what `link()` does different from what you did “by hand”? Does it matter? Why or why not? Is the answer the same for all types of models?
3. How is `sim()` different from `link()`? Explain how to obtain the output from `sim()` using the output from `extract.samples()`.
4. How do you create this plot and what does it tell us about the model?



5. Do you like this plot better or worse? Why?



6. What would it mean to add **interaction** to this model? How might the plots above change if we used a model with interaction?
7. (Describe how to) fit this model using the grid method.
8. Why did we abandon the grid method in favor of `map()` and then `map2stan()`?