Case Study 4
Bald Eagle Flight Patterns

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The Client's Interest

- The client is interested in how bald eagle flight patterns are associated with weather patterns.
- Specifically, how are the number of wing flaps associated with temperature?

The Client's Data

- Weekly one hour visits to a local nature preserve to observe bald eagles over a six month period.
- The temperature is recorded each visit.
- Each bald eagle observed in flight is tracked for 30 seconds.
- The number of wing beats is counted over that 30 seconds.
- ~25% of the birds only soar while observed. The remaining eagles flap 10-40 times.

What is There to Flap about?

- Bald eagles are apex avian predators and conserve energy. As such, they prefer to soar.
- Bald eagles flap their wings to adjust/maintain altitude.
- Bald eagles flap their wings to fly with purpose in a chosen direction.
- Bald eagles flap their wings to engage in aerial combat or mating rituals.

Questions for the Client

1. How will the results of this study be used?
2. Are there other studies that we can refer to?
3. How are flight patterns being defined, and how does wing flapping indicate a pattern?
4. What other weather related data was collected? For example, wind speed, cloud cover, precipitation, etc.
5. Was the altitude of the eagle, time of day, or ground terrain relevant to the research question? If so, was it collected?
6. Is the intent of an eagle relevant? For example, hunting, travel, take off, landing, patrolling, etc.

Further Questions for the Client

7. Was it possible to individually identify the eagles? If so, were they recorded as individuals?
8. Was the gender of the eagle recorded?

   (females are ~25% larger than males)
9. Were eagles ever observed simultaneously? If so, which one was chosen and why?
10. Were multiple observers used?
11. If an eagle was observed less than 30 seconds, what was done with that observation?
12. Is it possible to categorize the collected data?

Possible Concerns with the Design or Data Collection

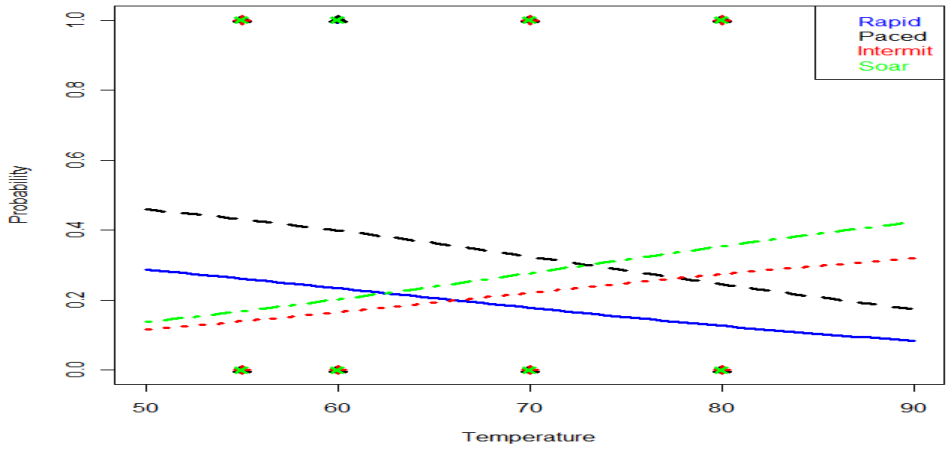
- Does the data collected address the underlying research question?
- How accurate is the data? Would video have provided a more accurate measure of several parameters?

http://www.youtube.com/watch?feature=player_detailpage&v=AbN5m5F3DYE#t=58s

- Would it have made more sense to choose collection visit times based on the predictors of interest?
- How are periodic changes in behavior such as rearing of chicks addressed by this collection?

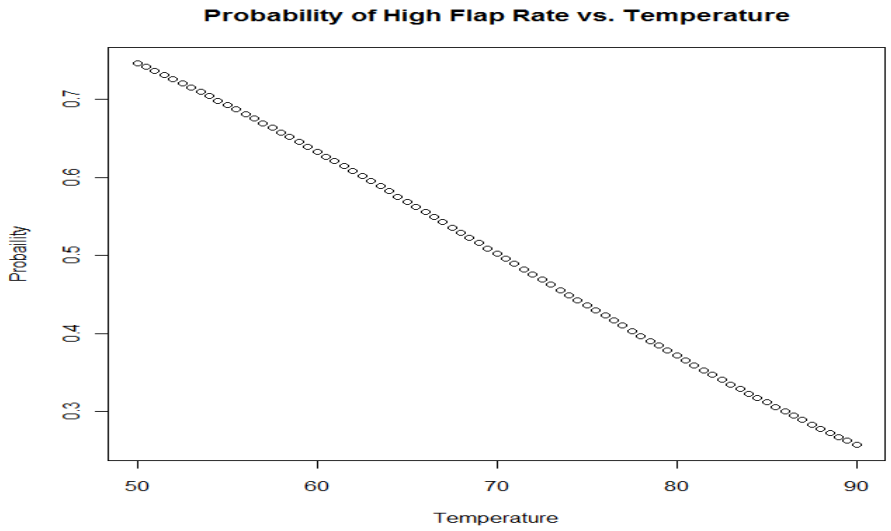
Analysis by Multinomial Logit

- Categorize flapping frequency into Rapid (30-40), Paced (20-29), Intermittent (10-19), and Soar (0). The multinomial logistic regression will fit a model for the probabilities of all categories versus temperature.
- flap<-multinom(cbind(Rapid,Paced,Intermit,Soar)~Temp, data=bird)
- Assumes an underlying multinomial population.
- With the ordinal response, you could also consider a proportional odds model.



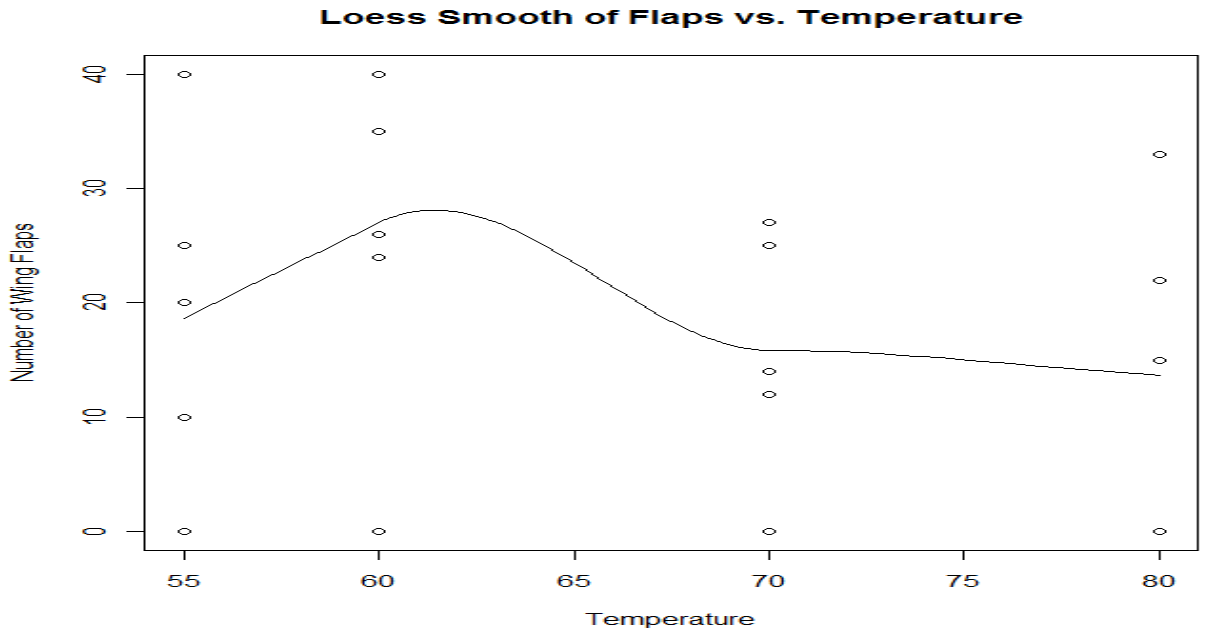
Analysis by Logistic Regression

- Categorize the flapping frequency into two responses. For example, high frequency (20-40) and low frequency (0-19). Use a logistic regression model to calculate the probability of each category at a given temperature.
- flap1 <- glm(cbind(High,Low)~Temp, family=binomial, data=bird)
- Assumes underlying Bernouli probabilities yielding binomial samples.



Analysis by Scatterplot and Loess

- Plot the raw data of wing flaps per 30 seconds versus temperature and see if there is a pattern for least squares regression. Run such a regression if the plot suggests it is reasonable.



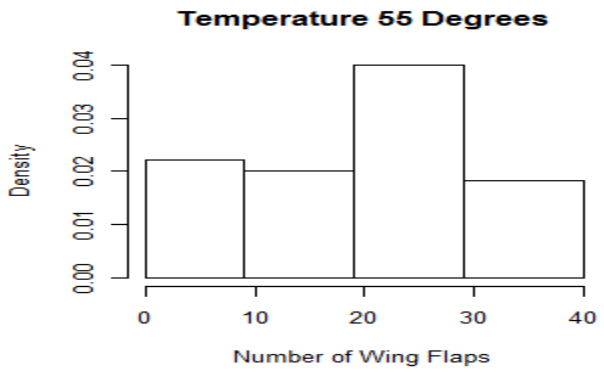
Analysis as Longitudinal Data

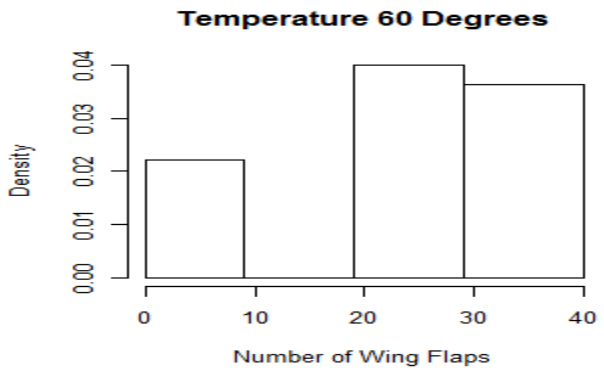
- This method relies on having multiple observations on recorded individual birds.
- "The goal is to estimate the (effects) of variables while controlling for unmeasured covariates and adjusting for lack of independence among the multiple observations for each (eagle)." [1]
- Helpful for analyzing observational data where many characteristics go unrecorded.
- It is possible to use a "hurdle" (Binomial based) that requires that an eagle actually have wing flaps prior to analysis of the number of wing flaps (Poisson based). The temperature covariate can be in both phases of this approach.
- Such a model reduces the bias, but can yield unwieldy variances.

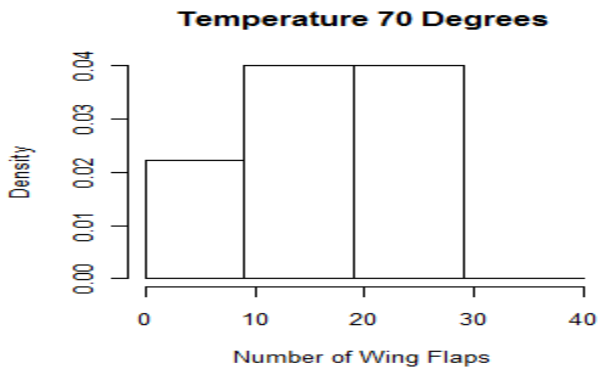
[1] http://support.sas.com/publishing/pubcat/chaps/58348.pdf , p. 4

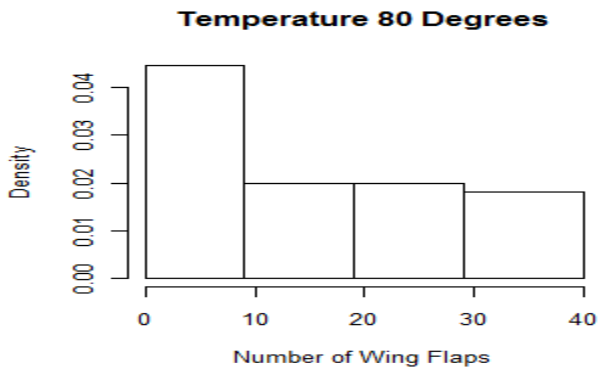
Graphical Analysis by Temperature

- Something as simple as histograms can help to visualize possible trends against the predictor of interest.









Thank You