

Week 2 Reading Questions

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Dichotomies

The descriptive vs. predictive dichotomy of models relates to the goal of developing the model and what type of output is expected from the model itself. Descriptive models would aim to describe patterns in the present data and could be used to guide future data collection, prompt the formation of new hypotheses, and/or suggest different analytical approaches. Predictive models would focus less on describing the current data for the sake of understanding current trends, but instead would focus on extrapolating future datapoints using a pattern in the current data.

I could use both endpoints of this dichotomy in my research as frameworks for setting up statistical models. From the descriptive end, I would be able to analyze survival rates of fledglings and correlate survival to other covariates such as contaminant load of that fledgling and developmental growth rate during the nesting period. This would be descriptive because I am not trying to predict how long a chick will survive post-fledge, but instead am looking to correlate data to describe trends and patterns. From the predictive perspective, I could use fledgling survival estimates, band recoveries, and population censuses to predict population dynamics over time, including rate of decline and population size in 10, 20, or even 50 years in the future.

Assumptions and Biases

Assumptions and biases are engrained in every situation where the human perspective is employed. Often in scientific studies, we aim to gain a deeper understanding of the ecology of a species in order to aid that species using management strategies and protective policies. Due to our human nature, however, implicit biases can be identified throughout these studies simply due to our perspective of the issue at hand. In the example provided regarding bird species increasing in elevation in response to climate change, we as human scientists are limited in our perspective and geographic range and forced to assume that birds view the world through our same perspective. The scientist tried to identify a simple correlation between bird spatial distribution and weather patterns, which is likely not a simple interaction at all. Using the present model, the scientist assumed that nutrient availability would be constant across elevational gradients and time (very unlikely) or was not considered when birds were choosing their territories. The scientist also assumed that population dynamics and movement of said bird species would remain constant over the 10 years of the study period, leading to a similar distribution of individuals solely supporting the null hypothesis. The scientist further assumed that habitat quality of the site, including ecosystem-based characteristics such as leaf litter depth, soil quality, vegetation health and suitability, remained constant. All of these assumptions are based on the biases and limitations of our human minds which prevent us from seeing the world in the way our study species might. While we may try to consider different characteristics in our models (like our scientist did in his 4th testimony), it is nearly impossible for us as human researchers to understand how wild birds choose their territories and what habitat features drive these decisions.

Human-based biases in ecological research can have immense effects in the implementation of management strategies and policies. In our bird distribution study, it is very possible that the birds are moving higher in elevation for reasons we are not considering. If we do not understand the underlying factors (shifts in nutrient abundance, changes in vegetation, etc.) behind the animals' decisions (shifting spatial distribution), we may invest resources into a strategy that may not help the species in question at all. If climate change is not driving the shift in elevation (unlikely, but we'll consider it here) and we allocate all of our resources towards that cause while the real issue is an increase in human disturbance via timber-harvest, we now have ignored our true issue while becoming confused as to why our management strategy isn't effective. Similarly, if we are noticing this spatial shift in the White Mountains of NH while the issue is based in a mountain range somewhere else within their native range, we may be completely mis-allocating resources when they could be directed in a better fashion. As wild animals are unaware of our human-made borders (international borders, state borders, etc.), we may also be unable to enforce policies that would help species at all ends of their geographic range and therefore leave some populations (or all populations if a species is dependent on migration) vulnerable.

Dual Model Paradigm

A model is constructed using both a deterministic model and stochastic model. The deterministic portion of the model describes the patterns in data without factoring in randomness or errors. This portion focuses on the data in its most theoretical form to identify innate patterns in the dataset. The stochastic portion of the model focuses solely on the randomness and variability within the data. Within my study system of contaminant loads in kestrel chicks, the deterministic model would include trends between contaminant load and survival post-fledge, looking solely on how the two datasets correlate. The stochastic model might look into variability in contaminant load based on inter-nest variation or even individual variation that may not be evident from a simple contaminant load ~ survival perspective.

Populations

A biological population consists of all organisms of the same species living within a geographically-bounded area. A certain biological population can serve as a statistical population if the entire group is studied, but often a statistical population is different from a biological population. A statistical population is a more general term referring to all observations of interest, whether that be height data on a group of animals or the outcomes of flipping a coin 20 times. The statistical population may vary based on the spatial or temporal scale of the research question as we can refine our population to accommodate the data we need to collect to answer our question (while we wouldn't necessarily change the abundance of organisms in a given area to help us answer a research question). Since statistical populations contain all observations of interest, we can expand or limit our population by changing our question (area of interest).

Model Thinking

In the Snowpacks in the Oregon Cascades scenario, there are many variables at play that may be affecting the system. The height of snowpack accumulation would be a continuous

variable on a ratio scale because the snowpack height can be of any value on a number line (it is only constrained by the precision of the measuring device) and allows a zero measurement to be meaningful (no snow is very different from an amount of snowpack- which may influence melt and erosion rates). The species of trees on the slope would be a categorical nominal variable because the data would be comprised of distinct values (names of species) that cannot be logically organized into any sort of order.