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Eco 602

Week 2 Reading Questions

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**Q1**. Bolker CH. 1: Explain one modeling dichotomy example and how you might approach one of your research interests from each of the dichotomy endpoints.

**Theoretical vs Applied**

Theoretical models can often be very difficult mathematically and seem complex. It seems theoretical models may be adjusting or refuting previously developed theories related to particular ecological phenomena, rather than being applied to a real-world problem. Theoretical models can also be ecologically over-simplified, meaning that they may not apply precisely to a specific data set, rather they work better to describe a particular general phenomenon as a whole. Applied modeling, on the other hand, aims at finding a solution to a real, practical problem. This type of modeling may be to answer a particular question in your research, with a specific set of data. It takes on a problem-solving technique, and may be simpler than theoretical models which have a lot of background information and mathematical formulas and derivations.

My research is based on aquatic remote sensing and GIS methods in tidal marshes and coastal environments. There is a lot of theory related to optics in water and associate reflectance and absorbance values for various aquatic constituents. My thesis research focuses on using remote sensing models to estimate suspended sediment concentration (SSC) in estuaries. Theoretical and Applied models have both been used to estimate remotely sensed SSC. Theoretical models rely on the basis of understanding all of the theory and mathematical derivations for optical properties of water and sediment constituents and how they absorb and reflect light. On the other hand, applied models for estimating SSC are rather simple and use a single empirical relationship which is validated to a particular in situ dataset. Both types of models have their advantages and disadvantages, but so far, I hope to tackle an applied model in my research, focused on a marsh site in New England, as this is most feasible for me, it will save some time and allow me to perform other GIS-related analyses.

**Q2.** McGarigal CH. 1/Bang et. al: Identify at least one source of bias or assumption (cultural, scientific, other) in the three quotes, or in the description of the four testimonials regarding climate change and bird nesting habitat. Hypothesize a practical impact these biases or assumptions might have on scientific communication and the effectiveness of management efforts.

There is implicit cultural bias in the quotes presented. This bias is that Western science is the only way to properly conduct science, and any relevant science must be conducted in the form of the scientific method and be presented in a statistically significant way, or else it will not be considered. Here we are making cultural biases because we are not allowing room to consider other culture’s representation and processes of science. For example, Indigenous science as mentioned in the Bang et al article may take on a form and process much different from the well-known ‘Scientific Method’. Western science in relation to ecology is typically seen in a competitive way, whereas Indigenous science may recognize the same ecology as a cooperative situation between two species or populations.

There are also several assumptions made in the testimonies for climate change and bird nesting habitat in McGarigal CH 1. For instance, in testimony 1, only a simple scatter plot is presented and the assumption is made that this data could follow a linear regression and be statistically significant. There is also the assumption that bird nesting habitat is shifting to higher elevations due to climate change rather than some other cause. Other causes should be considered… Testimony 1 is also assuming that only one small dataset is enough to prove that moving habitat to higher elevations is due to climate change. This is surely not enough data or a big enough sample size to persuade an important management decision or to encourage a large monetary grant awarded for additional research to be done. There may also be bias in selecting a particular area for the bird nesting observations. Perhaps it is an area that has a generally higher elevation range in the mountains, rather than a lower elevation range in a valley region. The results of the model could be drastically different based on the study area chosen. To eliminate that type of scientific bias, you would want to select and represent several study areas that range in elevation, climate, temperature, etc. Upon leaving these assumptions and biases as is, it would spark seeds of doubt when communicating this science. This could lead to poor support and misinterpretations of the data presented. For example, if the assumption was made that climate change is responsible for bird habitat shifting to higher elevations, and a large grant was awarded to further study this, you might find that other locations do not conform to this original hypothesis and maybe climate change is really not the main factor causing the shift at all. These biases and assumptions could also represent your analysis as a lazy attempt and not gain approval of policy makers or other stakeholders.

**Q3.** McGarigal Chapter 1/Bolker Chapter 1: Identify and briefly describe the two primary components of a model constructed in the dual model paradigm? Give an example of the two components in the context of a system you are interested in studying.

The presentation of the “dual model paradigm” was not clear in either of the McGarigal or Bolker CH 1 readings. What I think is meant by “dual model paradigm” is Deterministic vs. stochastic models, so that is what I’m going to write about. In deterministic models, the output of the model is fully determined by the parameter values and the initial conditions and data. Stochastic models on the other hand, possess inherent randomness and the same set of parameter values and initial conditions will lead to a combination of different outputs. A stochastic model has the capacity to handle the uncertainty in the inputs built into it, but in a deterministic model, the uncertainties are external to the model. It is clear that the natural world is typically stochastic and random in nature, but both deterministic and stochastic modeling can be useful. Deterministic models will always have the same outputs based on the known inputs that go into the model, therefore this model is more repeatable and perhaps easier to visualize and explain. Stochastic models introduce more randomness and therefore may have different output each time but might better represent a more realistic representation of the natural world.

Regarding my own research, an example of a deterministic model would be fitting a multi-variate model to a particular set of marsh sediment organic carbon data from a marsh site in Scituate, MA. This deterministic model would be particular to that set of data and result in the same output each time it’s run. The model is based on the mean high water elevation and marsh platform elevation, which in this case we would assume are static values. In a stochastic model, a degree of randomness might be added. For instance, the height of marsh vegetation varies somewhat randomly across the marsh platform and if we want to account for this realistic variable, it will also affect the elevation values that are inputs to the model. Therefore, different model outputs would result if the input values for marsh vegetation height and elevation were selected stochastically.

**Q4.** McGarigal CH 2: Describe the difference between a statistical and biological (or ecological) population. Which of these populations may vary depending on the spatial or temporal scale of the research question?

A biological (or ecological) population is all the individuals of a particular species in a particular place that will sustain the group through time. A statistical population is a target group that you wish to make statistical inferences from about the biological population group as a whole. The statistical population is typically a sub-set of the whole biological population. However, at times the statistical population can encompass the entire biological population in an area. For example, if you wish to know the density of a particular plant species, Arrowhead, in a watershed, you might choose to examine the number of Arrowhead plants in 200 plots distributed throughout the study area. This selection of plots will not include the entire biological population of that Arrowhead plant species in the watershed, but it will allow you to make statistical inferences about the biological population of Arrowhead in that area.

I think both statistical and biological populations vary depending on the spatial and temporal scale of the research question. Biological populations are dynamic over space and through time. Individuals of a particular species that make up a population are born and die through time; therefore, you must define the temporal period in question. There may also be different populations of the same species across a geographic area. The populations could have become fragmented by a natural divide so therefore it is also important to define the boundaries of the study area to which the biological population in question belongs. The statistical population by definition also depends on the spatial and temporal scope of the desired inferences you would like to make about the whole biological population. You might want to choose your statistical population based on a particular geographic area in question. That geographic area could be the magnitude of a whole continent, or as small as a single municipality or watershed area. You could wish to make statistical inferences about a population over several decades or over just one growing season. It’s important to define the temporal and spatial scale in order to select the proper statistical population and to answer your research question.

**Q5.** McGarigal CH 2 and in-class group model thinking activity (Cattails): For each of the following two data types, propose an entity and/or variable in your (Cattails) scenario that you could measure using the data type/scale. Explain why the data type or scale is appropriate for the entity/variable chosen.

1. A categorical, nominal variable

Cattail species name would be an example of a categorical nominal variable. There are several species of cattail common in North America including *T. latifolia, T. domingensis, and T. angustifolia*. You could choose these three cattail species names themselves to be categorical, nominal variables. This works because there is no particular order to the three species names listed above, rather they are just scientific species names. Some of these species also fall into the categories of native to North America, native to Eurasia, and hybrid invasive species. These could also become nominal categorical variables since they are simply a qualitative measure and hold no rank or order. It could even be as simple as ‘native’ or ‘invasive’ for the nominal categories. Once the nominal categories are established, you could perform a count of how many of each ‘native’ or ‘invasive’ individuals there are in a particular defined area. This data type, categorical nominal, is appropriate for the variable of cattail species (or invasive/native designation) because it categorizes the plants and gives us a first glance at whether or not they might be harmful to the surrounding ecosystem or not. This would be a good basis for a first count of the cattail population and to spark further study questions.

1. A discrete variable

Cattail presence and abundance is thought to be influenced by human activity. One example of a discrete variable would be the number of people (human population) living in a particular watershed of study where cattail habitat might exist. The human population in the watershed area could be based on the U.S. Census Bureau’s statistics and be made up of several municipalities. You could even focus on ‘population of a single city or town’ which is a discrete variable. These human population values could vary from city to city in the study area and have some affect on the cattail abundance or count of invasive versus native versus hybrid species present. The number of people living in a town or city would hypothetically not change during a population count of cattail plants.

I worked alone on these reading questions.