Homework 4

GEOG 410, Spring 2014

Due Monday, April 7, 2014

Your name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

*NOTE: Where asked for, please cite any sources used in answering the below questions. I will take one point off per question if you don’t.*

Answer the following questions in a different font (**like this**) to help me find your answers. Email me your homework; see last section for instructions about emailing me additional files.

I. General question.

1. Fill out the below table for the two biomes:

|  |  |  |
| --- | --- | --- |
|  | Tropical savanna | Temperate (deciduous) forest |
| climate, including mean annual temperature, mean annual precipitation, and any seasonality of precipitation |  |  |
| causes behind these climate characteristics |  |  |
| general location (distribution among continents and latitudes) |  |  |
| vegetation structure |  |  |
| biomass (low, intermediate, or high?) |  |  |
| biodiversity (low, intermediate, or high?) |  |  |
| major human impacts |  |  |

2. Describe two ways biogeography provided evidence for the theory of plate tectonics. (5 points)

3. Quaternary period.

a. What were the major geologic events that defined the Quaternary period and induced changes to plant and animal distributions? (2 points)

b. What changes to the physical environment did these events cause? Describe three effects. (3 points)

c. Describe three general biogeographical impacts of these changes to the physical environment. (3 points)

II. Location questions.

Remind me of your hometown \_\_\_\_\_\_\_\_\_\_\_\_\_\_ and Location #2 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

a. What biome is associated with each of your locations? (2 points)

Hometown:

Second location:

b. Describe a process that occurred over geologic time that was important for influencing species distributions at your selected locations. (4 points) ***Cite your sources.***

Hometown:

Second location:

c. What was the climate like at your two locations or their regions during the middle of the last glacial period? What was the general vegetation type then and today?(2 points) ***Cite your sources.***

Hometown:

Second location:

d. For your two locations or their regions, describe a biogeographic corridor and a biogeographic barrier.(2 points) ***Cite your sources.***

Hometown:

Second location:

e. For one of your locations, describe an invasive species. How did it arrive? Is it doing any environmental, ecological, or economic damage? (3 points) ***Cite your sources.***

II. Species Distribution Modeling

In this computer exercise, you will run MaxEnt to study the distribution of pikas (*Ochotona princeps*), a small alpine mammal that lives in the western United States. You will:

* ascertain model quality
* identify which explanatory variables are important in describing pika distribution and how those variables influence the distribution
* create a map of current pika potential habitat
* assess the sensitivity of model results to choice of pika presence data
* quantify how climate change will affect the distribution of pikas

Please refer to Homework 3 for instructions on running MaxEnt. NOTE: run MaxEnt on UI computers to avoid issues with permissions, etc.

In the previous homework, MaxEnt not only chose the values of the explanatory variables at the presence locations using the layers (grids) provided, but also chose background points using these layers. In this homework, I provide you with the presence and background locations as well as the values of the explanatory variables at these locations.

1. Download the zip file for Homework 4 from the course web site, homework page, and unzip the file. In this situation, I have provided you with a CSV file that contains both the locations of the presence points as well as the values of the potential explanatory variables at those locations.

1a. Open the pika\_presences.csv file with Excel. How many potential explanatory variables are there (latitude and longitude are not considered explanatory variables here)?

I also provided you with the background points needed by MaxEnt in the file background\_pts\_random.csv. These were randomly selected from the western US.

Run MaxEnt using pika\_presences.csv as the “samples” file and background\_pts\_random.csv as the “environmental layers”; specify the output\_current\_climate output directory. Make sure map (mean annual precipitation), mat (mean annual temperature), mmax (maximum monthly temperature) are checked. Check the “Create response curves” and “Do jackknife…importance” boxes. For the “projection layers directory”, specify layers\_current\_climate. Leave all other settings as defaults. Select the “Run” button, and open the html file in the output directory.

Last time we didn’t assess the quality of the model (how well do the model results fit the observations (data used to develop the model)). Do that now by scrolling to the “Analysis of omission/commission” section and look at the table whose first column is “Cumulative threshold”. Let’s look at the “training omission rate” column. The rows in the table list various ways of converting predictions in continuous format to 0 or 1 for matching the response (independent variable).

1b. What is the greatest omission rate of all the rows? Multiply by 100 to get omission percentage; is this percentage high (a poor model) or low (a good model)? (2 points)

1c. Now (in another section of the HTML file) assess which of the three potential explanatory variables were most important. How did you determine this? (3 points)

1d. For the most importance variable, what is the response of pika presence along a gradient of this variable? Interpret this (explain) with respect to influences on pikas. (3 points)

Inspect the first map that shows the model training and test points and the model prediction. Click on the map to open the larger version.

1e. Where are the training points located? Compare with a map of the western US that shows states and other geographical features. (2 points)

1f. Where does the model predict the highest probability of pika habitat (generally; multiple locations are possible)? (2 points)

2. Now assess the sensitivity of the model predictions to availability of pika observations. Pretend you only have pika observations east of -109º E longitude (in pika\_presences\_east.csv). Rerun MaxEnt with that as your samples file (change the output directory and make sure all explanatory variables are checked) and compare the new map with the old map.

2a. Where on the map (about what state or major geographic feature) is the westernmost pika observation? (2 points)

2b. What are the largest differences between the two maps? (2 points)

2c. Why do these differences occur? Open the Excel file called temperature\_frequency\_distributions.xlsx and view the two charts for MAT (first worksheet) and MMAX (second worksheet). Each chart is a frequency distribution: the y axis indicates how many presence points have values at the x-axis value. Each chart shows the frequency distribution for all points (blue) and for just the eastern points (red). What is the main general difference between the frequency distributions for all versus east (same general patterns occurs for MAT and MMAX)? (2 points)

2d. What are the implications of this sensitivity test for species distribution modelers? (2 points)

3. Now estimate how climate change will affect the modeled distribution of pikas. Rerun MaxEnt with all the presence points (change samples files back), specify a new output directory, and change the projection layers directory to layers\_climch\_projection\_GFDLCM21\_A2. Make sure all explanatory variables are checked. Click on the projection map to open the larger version.

3a. What are the general differences between the current predicted distribution of pikas and the modeled future distribution given warming? (2 points)

3b. If you were employed by the US Fish and Wildlife Service, which was charged to protect the species, how would these maps inform your decision making about where to invest in protection actions (such as creating reserves)? (3 points)

Email me this Word document as well as the three HTML files that resulted from your three MaxEnt runs (in the three output folders).