

## ST440/540 – Mid-term exam – Due 4/26

THIS IS AN EXAM - DO NOT DISCUSS THE PROBLEM WITH ANYONE (INCLUDING OTHER STUDENTS OR THE TA)! If you have questions, please email me.

The data<sup>1</sup> come from the iNaturalist database, described at

<https://www.inaturalist.org/>.

This website allows citizen scientists to upload their observations to share with the scientific community. In this exam, you will use these data to study the spatial distribution of the American black bear. The dataset consists of a randomly-selected set of  $n = 927$  50 km<sup>2</sup> regions from Western North America. The variables are:

Variable	Description
Y	Number of black bear reports, $Y \in \{0, \dots, N\}$
N	Number of surveys submitted
forest	Proportion of the region that is forest
grassland	Proportion of the region that is grassland
cropland	Proportion of the region that is cropland
temp	Annual average temperature
precip	Annual average precipitation
humanPop	Human population
protected	Indicator of whether the region includes protected lands
ecoregion	Either “MARINE WEST COAST FOREST”, “MEDITERRANEAN CALIFORNIA”, “NORTH AMERICAN DESERTS” or “NORTHWESTERN FORESTED MOUNTAINS”

The objective is to build a statistical model for the ecological niche of black bears and test for local adaptation by ecoregion. As an example, if they have higher average counts in protected than unprotected areas of the marine ecoregion, but lower expected counts in protected than unprotected areas of the Mediterranean CA ecoregion, then their preference/niche would vary by ecoregion and this evidence of local adaptation.

Summarize your analysis in a 3-5 page report (double spaced, 11pt, one-inch margins). Papers longer than five pages will be penalized. To avoid penalty, your report MUST have the following sections and contents:

1. Introduction: Briefly describe the problem and your objectives
2. Models and hypotheses: Describe the Bayesian model you propose and how you will summarize the models to address the primary objective of the study
3. Computation: Give the details of the Bayesian computational algorithms you use and the verify the algorithms were successful
4. Model comparisons: Fit 3-5 models to the data, select a best fitting model, and verify that the model fits well
5. Results: Present and interpret your final results

---

<sup>1</sup>Thanks to Brent Pease of the Department of Forestry and Environmental Resources for providing the data

6. Discussion: Summarize your results and discuss limitations to the data and study design that might affect your conclusions

Your paper should be written as a professional document with full paragraphs, clearly labeled and numbered figures and/or tables, and few spelling/grammar errors. You should include sufficient detail that another student in class could reproduce your results. Summarize your analysis in a PDF document submitted on moodle. Append your code to the end of this document and submit a single PDF document on moodle (code does not count towards the page limit). You do not need to turn in all of your code, but please include commented JAGS code for your final model.

Have fun!