

Generalized Additive Models: Allowing for some wiggle room in your models

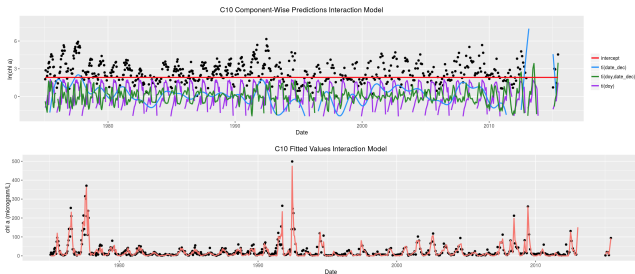
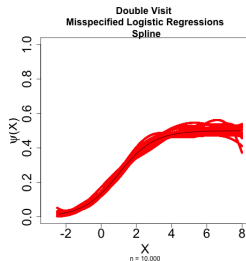
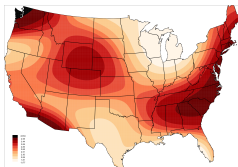
Sara Stoudt

March 17, 2021

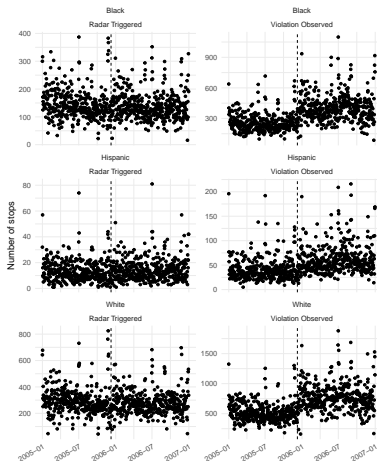
About Me

- currently teaching in the Statistical and Data Sciences Program at Smith College
- PhD in Statistics at Berkeley
 - ecology: evaluating fitness for purpose of a variety of data collection protocols for species distribution and abundance models
 - ecology: evaluating model fit in terms of community metrics for joint species distribution models
 - statistics communication: co-authored a book *Communicating with Data: The Art of Writing for Data Science* with Deborah Nolan

GAMs in my work



Setting the Scene



- “Using change in a seat belt law to study racially-biased policing in South Carolina” by Corinne A Riddell, Jay S Kaufman, Jacqueline M Torres, and Sam Harper
- <https://github.com/corinne-riddell/SCarolinaTrafficStops>

Linear Model

$$Y = X\beta + \epsilon$$

Choices:

- which covariates X to use

Generalized Linear Model

$$E[Y] \sim g^{-1}(X\beta)$$

$$g(E[Y]) \sim X\beta$$

Choices:

- which covariates X to use
- response distribution and link function g

Generalized Additive Models: Intuition

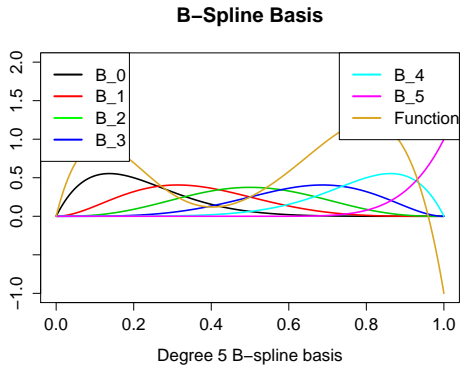
$$g(E[Y]) = X\beta + f_1(x_{1i}) + f_2(x_{2i}) + f_3(x_{3i}, x_{4i}) + \dots$$

Choices:

- which covariates X to use
- response distribution and link function g
- type of basis that defines f_i
- dimension of basis
- smoothing parameter

*Simon N. Wood. *Generalized Additive Models: An Introduction with R*. Chapman and Hall/CRC, 2006.

GAM: Parameter Intuition

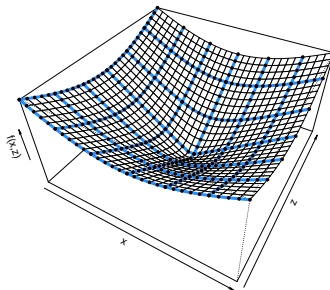


GAM: Parameter Intuition

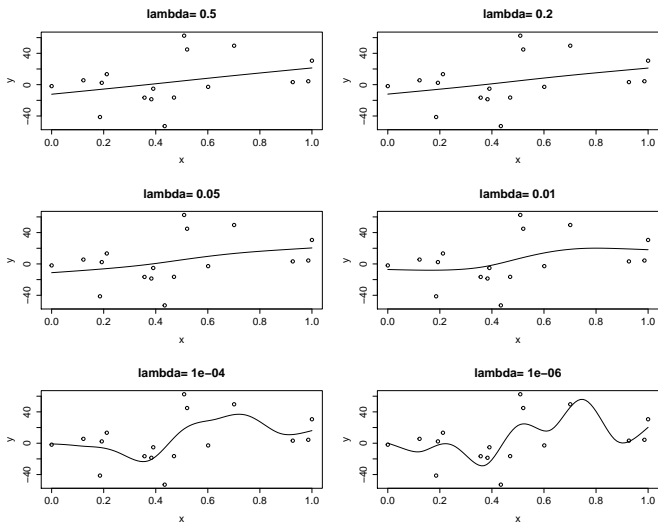
$$f(x) = \sum_{i=1}^q a_i(x) \alpha_k$$

$$f(x, z) = \sum_i \beta_i(z) a_i(x) = \sum_i \sum_j \beta_{ij} b_j(z) a_i(x)$$

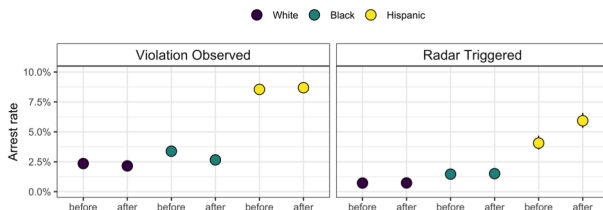
Visualize Tensor Product Smooth



GAM: Parameter Intuition



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