

Spatial smoothing of zero-inflated abundance data

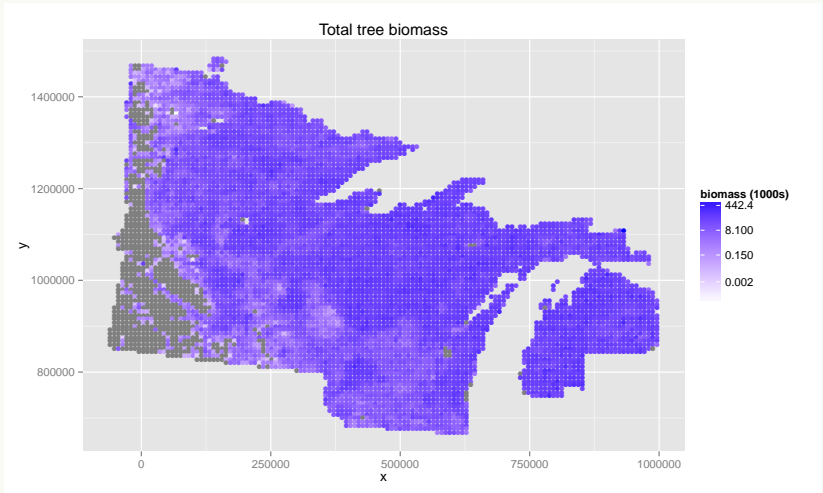
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Motivation

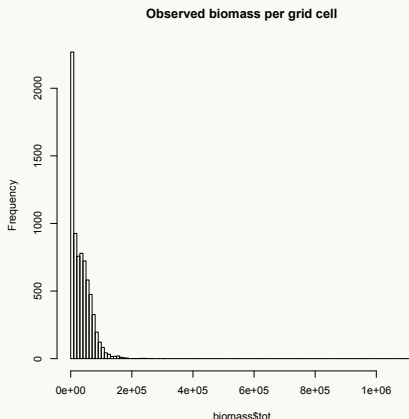
Take a look at some data



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The data is non-negative with a long right tail, suggesting a log transformation or a gamma model.



Motivation

Take a look at some data

The data is the total tree biomass per grid cell from the Public Land Survey of the upper midwest.

- ▶ Observations are at corner points (90 per grid cell)
- ▶ Want to know the actual biomass on the grid cell from these local samples
- ▶ Goal is to calculate the total biomass of each taxon across the upper midwest
- ▶ Many grid cells have zero observed biomass

Motivation

Take a look at some data

Want a model for which power-law variation (long right tail) and exact zeroes are handled naturally, not as an exception.

- ▶ We use the Tweedie family of distribution
- ▶ Tweedie distribution has a tuning parameter that slides smoothly from Poisson to Gamma distribution
- ▶ Estimating that tuning parameter is difficult, and current state of the art is a priori specification
- ▶ A better solution may be to estimate the parameter by matching the theoretical and observed mean-variance relationship.

Title

Tweedie distribution

- Exponential dispersion model:

$$f(y; \theta; \phi) = a(y, \phi) \exp [\phi^{-1} \{y\theta - \kappa(\theta)\}]$$

Title

Tweedie distribution

- Tweedie model's parameters:

$$\lambda = \frac{\mu^{(2-p)}}{\phi(2-p)}$$

$$\alpha = \frac{2-p}{1-p}$$

$$\gamma = \phi(p-1)\mu^{p-1}$$

Title

Tweedie distribution

- Probability of exact zero:

$$P(Y = 0) = \exp \left\{ -\frac{\mu^{2-p}}{\phi(2-p)} \right\}$$

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