Statistical modeling of biomass increment

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June 2015

Model overview - data

- Modeling Lyford 13 plots plus HF census data for 1960-2013
- Two data sources and therefore two likelihood terms: census DBH and ring increment
- Trees not in census in a year are assumed < 5 cm dbh

Model overview - growth process

- DBH in a year (end of season) is equal to DBH in previous year plus increment that year
- Unknown true increment assumed to come from a distribution
  - Overall mean increment for all trees varies by year (year effect)
  - Each tree also has a mean increment common to all years (tree effect)
  - Can have increment vary by taxon and with tree size (random taxon effects + regression on size)
  - Playing with having increment be autocorrelated over time via AR process
- Account for when in a season DBH is measured by scaling relative to inferred seasonal growth curve
- Estimated increment is sum across all trees
  - Assume no missing trees given census

Model details

- measured log DBH assumed to follow a t distribution with 3 degrees of freedom, centered on true log DBH
- log increment assumed to follow a normal distribution centered on true log increment, $\log X_{it}$
- $\log X_{it} \sim t_\nu(\alpha_i + \gamma_t + \beta(D_{i,t-1} - 30)I(D_{i,t-1} > 30), \sigma_i^2)$ (increment increases with size only for size > 30 cm)
- $\alpha_i \sim N(\alpha_{\text{taxon}(i)}, \sigma^2_{\text{taxa}})$
- $\gamma_t \sim N(0, \sigma_t^2)$
- Not indicated above, but also can include residual increment process as AR(1) process with AR parameter ρ, estimated in model.

Some results

- Assessment of model fit and raw data has revealed some anomalies in both increment and DBH data and inconsistencies in HF and Neil/Dan's data; some of this resolved based on consultation with Neil/Dan
- Initial fits to all individual trees in Neil/Dan plots: see tree_plots.pdf

Still to be explored

- Can we better pin down distinction between DBH error and increment error
- Increment error may be strongly autocorrelated (because of use of two cores only)
- Not clear how to incorporate long-term trends in increment (or if needed)
- Do increments decline as tree nears death?
- Need to deal with uncertain year of death
- Need to get allometry information
- Would be good to assess impact of not having census data - loss of some larger trees that are decayed and miss many small trees
- How get overall stand estimate from having three plots?
- How incorporate info from nested rings?