Advanced Modeling in R

Non-linear, Bayesian, and mixed effect methods

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Assignments

1. **Fit a linear model with optim**
   - Functions llike.linearmodel, sumsq.linearmodel
   - agb data: log(agb) as a function of log(dbh)
   - Minimize either sum of squares or likelihood
   - How many parameters?
2. **Fit a linear model with variable SD**
   - cecrin data: growth (gr12) as a function of diameter (dbh1)
   - Minimize either sum of squares or likelihood
   - How many parameters?
3. **Fit a non-linear model to quantitative data**
   a) Model types
      - treeheight: ht as a function of dbh (extract one species, eg quaras or tri2tu or pri2co)
      - Use data from a single species to estimate the 3 parameters using maximum likelihood and a Gaussian error.
      - $y = H_{max}\left(1 - e^{-ax^b}\right)$ (it's in teaching.functions.r)
        H_{max}, a, and b are parameters, y is height and x is dbh.
   b) grwfull300: growth as a function of dbh
      - $y \sim x + \log(x)$ (write yourself)
   c) Error functions
      - Try first with Gaussian error
      - For growth rates, then use log-normal or Gamma error (but beware that growth must then be > 0)

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4. **Fit linear and non-linear models with Metropolis method**
   a) Linear
      - Test function linearfit.Bayes in file modelfitBayes.intro.r with any linear model
      - Plot parameter runs
      - Find confidence limits
   b) Adapt linearfit.Bayes to asymptotic (or other model of your preference)
5. **Simulation: Create a simulated correlation and test how well lm fits the parameters**

   The basics
   a) Define x from normal distribution
   b) Define slope and intercept parameters
   c) Define error with *rnorm* and *sd*
   d) Calculate y
   e) Use *lm* to estimate slope and intercept

   More information
   a) Evaluate impact of increasing error
   b) Evaluate impact of error in measuring x
   c) Evaluate impact of highly non-Gaussian x

   Advanced (extra credit)
   a) Test multiple regression, with x_1 and x_2 predictors
   b) Evaluate impact of correlation between x_1 and x_2

6. **Program a Gibbs sampler for tree height model**
    - Adapt survivalGibbs.r to linear model
    - Test hierarchical linear model of growth in growthGibbsHier.r
    - Graph all species responses on top of the forest-wide response
    - Histogram of species responses (slope, intercept of linear model) in hierarchical vs. non-hierarchical model
7. **Run lmer on growth data**
    - Linear model of log(growth) vs. log(dbh) with species a random effect
    - Graph all species responses on top of the forest-wide response
    - Compare results of lmer to Bayesian hierarchical model
8. **Run lmer on full growth data**
    - Linear model of log(growth) vs. log(dbh)
    - Possible random or fixed effects: species, time period
9. **Run lmer on treemass data**
    - Linear model of log(agb) vs. log(dbh), or with rainfall, or dry season months
    - Possible random or fixed effects: species, forest type