Course: Data Carpentry

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Project Description: Taper correction for diameter estimation at a reference height of 1.3 metres for biomass calculation from long term forest dynamics plot data.

**Problem**

 Long term forest dynamics studies that include multiple censuses of the same individual tree usually have several reference heights for diameter measurements which are greater than the standard 1.3 m reference height (diameter at breast height – DBH). These higher reference heights for diameter measurements result from the upward growth of tree buttress and deformities at 1.3 m above the ground. Diameters recorded above the standard 1.3 m may under estimate biomass as allometric equations developed from destructive sampling of trees are based on a reference height of 1.3m to establish a diameter ~ biomass relationship (see Chave et al., 2014).

Figure 1: Distribution of reference heights for diameter measurements (POM) from several forest censuses conducted in permanent sample plots. The vertical red line indicates the standard reference height of 1.3 m for diameter assessments. The percentages indicate the number of stems that had a diameter measured at a point of measurement greater than 1.3 m.

**Analysis protocol**

*Step 1:* We simulate diameter ~ height measurements to estimate parameters *a* and *b* based on Metcalf et al. (2009) and Cushman et al. (2014) taper correction model:

*h* is the height at which the diameter was recorded and *d* is the diameter measurements. The simulated data includes species and individual level random effects. The r code to simulate the data is stored in the file “sim\_taper\_data.R”.

*Step 2:* We build a hierarchical Bayesian model in JAGS to estimate parameters *a* and *b* at the species level and then apply the taper correction to the simulated diameters. The r code is stored as “taper\_species\_model.R”. Note that functions used in the analysis are stored in a separate file (“functions.R”) and are sourced in the model file as is the simulated data.



Figure 2: Density plot of posterior draws for species level parameter a. The green vertical lines indicates the simulated species level value.

*Step 3:* We apply the Chave et al. (2014) biomass allometry to diameters estimated at 1.3 m



Figure 3: Biomass calculated from diameters estimated at 1.3m reference height above the ground. The black line represents mean values, and the grey lines (not clearly visible as they are close to the mean values) are the 95% credible intervals (propagates uncertainty associated with the diameter measurements).