Lecture 17: Variable Probability Plots
• Horizontal Point Samples
• BAF Calculations
• Measuring BAF

Variable Probability Plots: Overview
In fixed area plots: probability of selecting a tree is constant regardless of tree size

Source: Husch Beers and Kershaw

Variable Probability Plots: Overview
In variable probability (or variable area) plots: probability of selecting a tree depends on the size of the tree

Source: Husch Beers and Kershaw
Variable Probability Plots: Horizontal Point Sampling

Horizontal Point Sampling: probability of selecting a tree is proportional to its basal area

The Method:
• Observed stands at plot center at DBH
• Projects an angle horizontally to each tree
• All trees with diameters > angle are counted
• Then scale all measures to per unit area using expansion factors

Expansion Factors: The Tree Factor

In forestry we summarize data in terms of the measure per unit area

To convert from per plot to per unit area we scale the measures by a factor:

Factor = Unit Area (e.g., acre) / Plot Area

This factor is sometimes called a tree factor as factor = number of trees/unit area that EACH tree represents

Expansion Factors: The Tree Factor (TF)

TF = Unit Area / Plot Area

If constant factor is used, then per plot of FIXED area:
Trees counted * TF = trees/unit area

Similarly:
Summed volume * TF = volume / unit area
The Tree Factor: Horizontal Point Sampling

Plot radius is proportional to tree diameter. For trees right at edge the ratio of tree diameter to radius = a constant, $k$

$$k = \frac{D}{r} \quad \text{(where D is in inches)}$$

$$r = \frac{D}{k} \quad \text{(divide D by 12 to get feet)}$$

Plot Area = $\pi r^2 = \pi \left(\frac{D}{12k}\right)^2$

$$TF = \frac{\text{Acre (sq ft)}}{\text{Plot Area}} = \frac{43,560k^2}{\pi/144 \cdot D^2} = \frac{10,890k^2}{\text{Basal Area}}$$

Expansion Factors: The Basal Area Factor (BAF)

$$\text{BAF} = \text{Basal Area} \cdot \text{Tree Factor (TF)}$$

$$\text{BAF} = \text{Basal Area} \cdot \left(\frac{10,890k^2}{\text{Basal Area}}\right)$$

$$\text{BAF} = 10,890k^2 \quad \text{where} \quad k = 2 \sin \left(\frac{\theta}{2}\right)$$

The BAF does not depend on tree size but is constant for each horizontal angle selected

BAF Example 1: Calculating BAF from angle

For an object of fixed width, held a fixed distance away from your eye you can work out the angle $\theta$:

Thumb: 2/3 " held at 24" away

$$\theta = \tan^{-1}\left(\frac{\text{half width}}{\text{distance}}\right) = 0.3333/24 = 0.3333$$

$$\theta = 0.79^\circ$$

$$k = 2 \sin \left(\frac{0.79}{2}\right) = 0.014$$

$$\text{BAF} = 10,890k^2 = 2.13$$
BAF Example 2: Calculating Whether Trees are In

For a known BAF, say 10, we can work out \( k \):

\[
10 = 10,890 \, k^2
\]

\[k = 0.0303\]

For known tree diameters: We can work out the maximum (or limiting) distance a tree can be at to be “in” the plot:

\[r = D/k\]

For example a 10” tree will be “in” if within:

\[r = 10/0.0303 = 330” = 27.5 \text{ feet}\]

Thinking About Measurements: Basal Area

Basal Area: What is it ???

66 Feet (1 chain)

16 sq feet per plot

BA = 160 sq feet
Basal Area: The Angle Gauge

- Select BA Factor (5, 10, 20, 40) to ensure tally of 5-12 trees
- Center eye over Plot Center
- Hold chain 'like an archer' and aim the gauge at the target trees' breast height
- Circle around plot center and aim gauge at tree's DBH
- If tree DBH > Angle Gauge Width ADD to tally

BA/unit area = BAF * Tally

Angle Gauge Example: BAF = 10