**R code for quadratic stand diameter (18august2025)**

can you explain the variables "expansion", "sum\_weighted" and "sum\_treearea" in the calculation of "quad\_dbh"? mutate( baf = 9.1, ba = baf, expansion = ba / (.005454 \* dbh^2), # (I'm not sure what this is doing) use this to back calculate the 9.1BAF value of 2.75\*dbh=radius tpa = baf / ((0.005454 \* dbh ^ 2)), reserve\_tpa = (43560 / (pi \* (16^2))) \* within16 # the number of potential reserve trees per acre ) %>% #tpa = 43560 / (threshold distance^2 \* pi) arrange(stand, as.numeric(point), spp, dbh) overstory <- overstory\_prep %>% group\_by(stand, point, spp) %>% # values for each point summarize( growingseason = first(growingseason), tree\_count = n(), sum\_weighted = sum(dbh^2 \* expansion), sum\_treearea = sum(expansion), ba\_sqft = sum(ba), stems\_acre = sum(tpa), reserve\_acre = sum(reserve\_tpa), .groups = "drop" ) %>% mutate( quad\_dbh = sqrt(sum\_weighted/sum\_treearea)

**ChatGPT said:**

Great question 👍 — let’s break down what’s happening in your code and why those variables are needed for **quadratic mean diameter (QMD, or "quad\_dbh")**.

**Background**

The **quadratic mean diameter (QMD or Dq)** is defined as:

QMD=∑dbh2NQMD = \sqrt{\frac{\sum dbh^2}{N}}QMD=N∑dbh2​​

where:

* dbhdbhdbh = tree diameter (inches),
* NNN = number of trees (or the total expansion factor if using variable radius plots).

In other words, QMD is the diameter of the “average” tree weighted by basal area.

**Your Code Variables**

**1. expansion = ba / (.005454 \* dbh^2)**

* This is the **tree expansion factor (tpa per tree)** for variable-radius plots.
* Formula:

TPA=BAFBAtreeTPA = \frac{BAF}{BA\_{tree}}TPA=BAtree​BAF​

where

BAtree=0.005454×dbh2BA\_{tree} = 0.005454 \times dbh^2BAtree​=0.005454×dbh2

* So each tally tree represents some number of trees per acre. Larger trees represent fewer trees per acre (smaller expansion), and smaller trees represent more trees per acre (larger expansion).

**2. sum\_weighted = sum(dbh^2 \* expansion)**

* This is the **weighted sum of squared diameters**, where each tree’s dbh2dbh^2dbh2 is multiplied by its expansion factor (TPA it represents).
* Formula:

∑(dbh2×expansion)\sum (dbh^2 \times expansion)∑(dbh2×expansion)

* This ensures that the contribution of each tree is scaled correctly by how many trees per acre it represents in the plot.

**3. sum\_treearea = sum(expansion)**

* This is essentially the **total trees per acre (TPA)** represented in the plot.
* It’s the denominator in the QMD calculation.

**4. quad\_dbh = sqrt(sum\_weighted / sum\_treearea)**

* This gives the **quadratic mean diameter**:

QMD=∑(dbh2×expansion)∑(expansion)QMD = \sqrt{\frac{\sum(dbh^2 \times expansion)}{\sum(expansion)}}QMD=∑(expansion)∑(dbh2×expansion)​​

Which is exactly the formula for QMD, but scaled correctly for variable-radius samples (using expansion instead of raw counts).

✅ So in plain English:

* **expansion** = how many trees per acre each tallied tree represents.
* **sum\_weighted** = the total “weight” of diameters squared, scaled to trees/acre.
* **sum\_treearea** = the total number of trees/acre (from expansion).
* **quad\_dbh** = the weighted average diameter (by basal area), i.e. the size of the “typical” tree.

Would it help if I rewrote your function into a **short clean block of R code** that calculates QMD step-by-step for one stand/point so you can see the math unfold clearly?

Perfect 👍 — let’s strip it down and walk step by step with some **clean R code**. I’ll show it for one stand/point, then generalize with group\_by.

**Example Code**

r

CopyEdit

library(dplyr)

# Example: overstory\_prep already has stand, point, spp, dbh, etc.

qmd\_calc <- overstory\_prep %>%

mutate(

baf = 9.1, # basal area factor (ft²/acre)

ba\_tree = 0.005454 \* dbh^2, # basal area per tree (ft²)

expansion = baf / ba\_tree # how many trees/acre this tree represents

) %>%

group\_by(stand, point) %>% # or stand, growingseason, etc. as needed

summarize(

n\_trees = n(), # tally count

sum\_weighted = sum(dbh^2 \* expansion), # weighted dbh²

sum\_expansion = sum(expansion), # total trees/acre represented

quad\_dbh = sqrt(sum\_weighted / sum\_expansion), # quadratic mean diameter

.groups = "drop"

)

qmd\_calc

**How It Works**

1. **ba\_tree** = per-tree basal area (ft²).
2. **expansion** = trees per acre each tally tree represents.
3. **sum\_weighted** = ∑dbh2×expansion\sum dbh^2 \times expansion∑dbh2×expansion.
4. **sum\_expansion** = total trees/acre represented in that plot.
5. **quad\_dbh** = weighted mean diameter (QMD).

**Output Example (fake numbers)**

| **stand** | **point** | **n\_trees** | **sum\_weighted** | **sum\_expansion** | **quad\_dbh** |
| --- | --- | --- | --- | --- | --- |
| A | 1 | 8 | 56500 | 150 | 19.4 |

👉 This produces the exact same quad\_dbh you had before, but the variables are shown explicitly so you can verify the math at each step.