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Dendrometry

1. Introduction

Dendrometry is the science of measuring trees and forest stands. It allows us to estimate:

- The **volume** of trees and forests.
- The **biomass** and **carbon stock**.
- The **structure** and **composition** of forest stands.

It is essential for forest management, inventories, commercial exploitation, and ecological studies.

2. Main Dendrometric Parameters

2.1 Diameter at Breast Height (DBH)

- Measured at 1.3 m above the ground. - Symbol: D or $D_{1.3}$ (in cm). - Key indicator of tree growth and volume.

2.2 Total Height (H)

- Vertical distance from ground to top of the tree (m). - Measured using clinometer, laser rangefinder, or hypsometer.

2.3 Circumference (C)

- Measured at 1.3 m above the ground. - Relation with diameter:

$$D = \frac{C}{\pi}$$

2.4 Tree Volume (V)

- Volume of wood (m³). - General formula for a cylindrical trunk:

$$V = \frac{\pi D^2}{4} \times H$$

- More precise formulas use **cone**, **paraboloid**, or **Smalian** models.

3. Common Volume Formulas

3.1 Smalian Formula

$$V = \frac{S_b + S_h}{2} \times H$$

- S_b = base area - S_h = top area - H = height of the log segment

3.2 Huber Formula

$$V = S_m \times H$$

- S_m = area at the middle of the trunk

3.3 Newton Formula

$$V = \frac{H}{6}(S_b + 4S_m + S_h)$$

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4. Wood Density and Biomass

- Wood density (ρ): mass per unit volume (kg/m^3) - Total biomass:

$$B = \rho \times V$$

- Carbon stock estimate:

$$C \approx 0.5 \times B$$

5. Forest Inventory Calculations

1. Number of trees per hectare:

$$N = \frac{n}{a} \times 10\,000$$

- n = number of trees measured in the plot - a = plot area in m^2

2. Basal area (G):

$$G = \sum \frac{\pi D^2}{4} \quad [\text{m}^2/\text{ha}]$$

3. Total stand volume:

$$V_{total} = \sum V_i \quad [\text{m}^3/\text{ha}]$$

6. Measurement Methods

- **Direct**: measure all trees individually. - **Indirect / sampling**: use plots or random sampling methods. - **Remote sensing**: LiDAR, satellite images for large-scale inventories.

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7. Summary Table

Parameter	Symbol	Unit	Measurement Method
Diameter at 1.3 m	D / DBH	cm	Tape or caliper
Circumference	C	cm	Tape
Total height	H	m	Clinometer, hypsometer
Volume	V	m ³	Smalian, Huber formulas
Basal area	G	m ² /ha	Sum of tree cross-sections
Biomass	B	kg	Density × Volume

8. Conclusion

- Dendrometry provides essential quantitative data for forest management. - Main parameters include DBH, height, circumference, volume, basal area, and biomass. - Measurement accuracy depends on method and tree shape.