

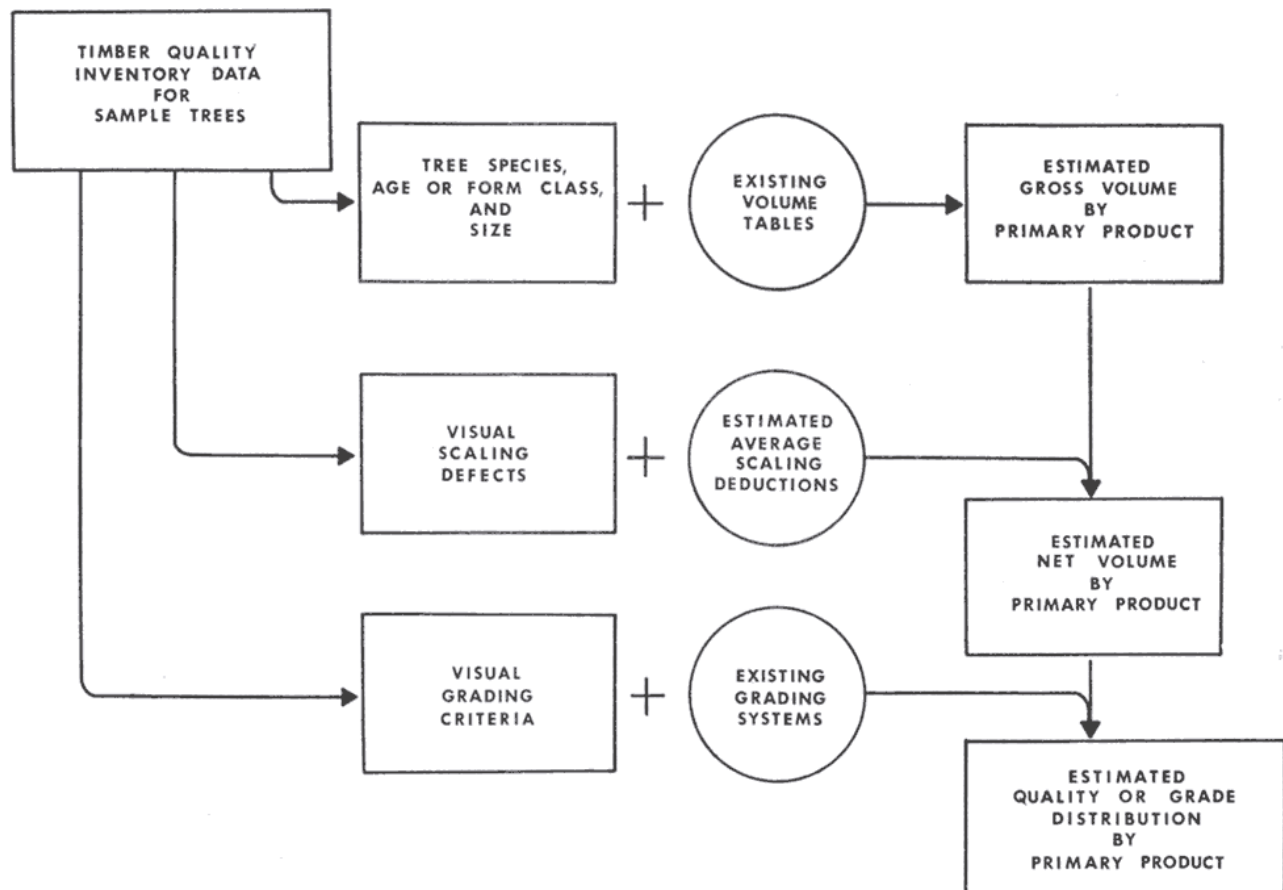
New Approach To Estimating Timber Products

by Peter F. Ffolliott and Roland L. Barger*

Increasing national needs for woodbased products, coupled with a shrinking land base devoted to timber production, requires more efficient utilization of the timber resource. The industry is working toward achieving better allocation of timber to uses for which it is best suited, physically and economically. Too often, however, optimum use is hampered by inadequate characterization of the raw material at hand. As timber utilization practices and technology change, with added emphasis on new products and broad product diversification, improved methods of evaluating timber quality are particularly needed. Required are inventory methods that permit evaluating potential for all products of interest, rather than for a single product. Timber quality inventory is one approach to recognizing and interpreting quality in standing timber.

A timber quality inventory system attempts to identify and measure in standing timber the basic stem characteristics related to quality. This information may then be interpreted in terms of basic product requirements and existing grading and quality classification systems to estimate suitability of the timber for a variety of primary products. The system should estimate both quantity and quality of timber suited to each primary product of interest. *Timber quality* refers to degree of suitability for one or more primary products. Primary product refers to products harvested from the woods, e.g., saw logs, veneer logs, poles and pulpwood.

Figure 1. -Inventory data for sample trees are used in combination with standard procedures for estimating volume, scaling, and grading to evaluate primary product potential.



The inventory system described here has been developed in southwestern ponderosa pine (*Pinus ponderosa* Laws.) stands. The basic methodology may be applied with little difficulty to other area and other species.

The Inventory System

Quality for most primary products is determined by stem features stem form defects, scar defects, and knot or limb occurrence. Stem form and scar defects are also the major visual scaling in log products.

In developing the quality inventory methods used, design considerations were: (1) to recognize and observe or measure basic stem characteristics that are common scaling and grading criteria for primary products; (2) to minimize quality interpretations (i.e., minimize observer bias) by avoiding field use of conventional tree or log grading systems; (3) to strike a compromise between information desired and time and effort required to conduct an inventory.

A system designed to recognize occurrence and severity of fundamental stem defect features affords several advantages. Basic stem features can be observed and classified objectively by field crews who may not be sufficiently experienced to make valid judgments of grade for several primary products. Basic stem quality data permit flexibility in interpretation for a range of products and grading systems. The method avoids "dating" inventory information by tying it to grading systems that may be revised or replaced.

The inventory system relies upon observations or measurements of visual stem characteristics, all directly related to timber suitability, grade, or volume for one or more primary products. Specific stem characteristics and classifications or measurement used in evaluating product potential in ponderosa pine are below:

<i>Stem characteristics</i>	<i>Implications for use, quality, quantity</i>	<i>Classification or measurements</i>
Species	Indicates potential range of primary products.	Species
Size	Indicator of merchantability for primary products.	D.b.h. <i>Total height</i> (required for volume determination) <i>Pole height</i> (where applicable) as maximum 5-foot height class.
Sweep	Determines gross volume for all primary products. Limits use for products requiring straight stem. Scaling defect in log products.	<i>Minor:</i> Deviation of merchantable stem less than tree d.b.h. <i>Major:</i> Deviation of merchantable stem equal to or greater than tree d.b.h.
Crook	Limits use for products requiring straight stem. Scaling defect in log products.	<i>Minor:</i> Deviation of stem less than ½ diameter of stem at crook. <i>Major:</i> Deviation of stem equal to or greater than ¾ diameter of stem at crook <i>Location:</i> Half-log (8-foot section) height in tree
Fork	Inadmissible in primary products. Associated crotch and distorted grain in scaling defect in log products.	<i>Location:</i> Half-log (8-foot section) height in tree
Lean	Indicator of reaction wood, limiting use for some products.	<i>Class:</i> 5-degree classes
Basal scar	Limits use of portion	<i>Minor:</i> contained in

	of stem. Scaling and grading defect in log products.	(1/4 circumference) <i>Major</i> : extends to two or more stem faces
Lightning scar	Limits use for some products. Scaling and grading defect in log products.	<i>Minor</i> : contained in one stem face <i>Major</i> : extends to two or more stem faces
Knots	Use for some products limited by knot size. Primary grading criteria for all log products.	For each of first three merchantable half-logs (8-foot stem sections) <i>Number</i> of knots in face, <i>Size</i> of largest live knot (limb) to nearest inch, <i>Size</i> of largest dead knot to nearest inch. For fourth merchantable half-log (24 to 32 feet) <i>Occurrence</i> of clear half-log (8-foot) faces

Using Inventory Data

The timber inventory data obtained provide a means of estimating stand potential for a variety of primary products. The data are used with standard methods of volume estimation, scaling, and grading to estimate: (1) gross volume suitable for a primary product; (2) probable volume reduction due to visual scaling defects, and remaining net volume suited to the products; (3) quality of the timber in terms of existing grading or quality classification systems. The manner in which inventory data are combined with existing methods of estimating volume and grade is illustrated in figure 1.

Inventory data can be analyzed by computer procedures or by hand. For computer analysis, all inventory data for each sample tree are punched on a data card; analysis for each product can then be programmed. If hand analysis is used, the inventory data are aggregated into stand tables, showing number of trees per acre and frequency of occurrence of each type of stem defect, by tree diameter classes.

Gross volume for most primary products is the total volume contained in trees of acceptable size and form. Gross volume is obtained by a plying volume tables to the stand tale developed from inventory data. Size limitations for a product will initially determine the timber to be included in gross volume. Other stem characteristics may also define gross product potential, e.g., commercial pole potential may include stems of a particular form class in addition to size limits.

Net volume is obtained by estimating reductions in usable material resulting from visual stem defects. Depending upon the primary products being evaluated, recorded stem defects may prohibit use for the product, or may reduce usable volume for the product. For defects prohibiting use for the products, gross volume (or count) is reduced by the volume (or count) contained in trees or tree sections having the defect. Examples are removal of trees with recorded sweep from gross stem count for pole potential, and removal of 8-foot stem sections with major crook from gross volume for veneer logs.

For defects reducing usable volume for products (i.e., scaling defects), average scaling deductions are applied to gross volume. Average scaling deductions for each type of defect may be estimated by referring to standard scaling procedures and methods.

Computer techniques include the capability to scan defect data by individual tree and stem sections, and to make specific corrections to gross volume for each product. If calculations are performed by hand, it is convenient to start with tables showing gross product volume by log position and tree diameter class. Scaling deductions can be applied by log position (where applicable) and tree diameter class. For a particular scalable defect and tree diameter class, corrections to gross volume are calculated as follows:

$$\begin{aligned} & (\text{Percent occurrence of defect}) \times \\ & (\text{Percent scaling deduction}) = \\ & (\text{Percent correction to gross volume}) \end{aligned}$$

Diameter class information can be combined to show total deductions by defect type and total net volume for the primary product considered.

Quality or grade of the net volume for each primary product is also important. Choices between alternative products will frequently be based upon the grade of the timber for each potential product. For some primary products, such as poles, quality may be expressed by height and diameter class. For others, such as saw logs and veneer logs, an estimate of log grade is needed. Grade or quality class is estimated by interpreting recorded stem quality information in terms of existing grading systems.

Grading systems for conversion products, such as saw logs and veneer logs, include only visible stem characteristics as grading criteria. Most are based on size, number, and distribution of log knots. Consequently, the grade of a log can be estimated by comparing recorded stem defect data with grade specifications. Depending upon the grading system used, this may involve scanning knot data only, or may require consideration of scars and stem form defects.

Estimated grade or quality class distribution can be combined with net volume information for each primary product to form a multiproduct schedule (Table 1). The schedule shows estimated net product potential, by grade or quality class, for each diameter class of trees. Maximum product potential is shown for each product individually. A similar schedule can be developed for selective allocation of the resource to products in order of preference. Allocation of a log for one product would then preclude its consideration for others. The latter type of schedule requires ranking of products to establish the order of preference. Schedules such as these provide the kind of resource information needed to improve timber utilization efficiency, and to guide both utilization and management planning and decision making.

Table 1. An Example of a Multiproduct Schedule, Indicating Estimated Net Volumes of Primary Products, By Grade or Quality Class, That Could Be Obtained From a Timber Stand.¹

Tree diameter class	Net product potential per acre													
	Saw log volume				Stud log volume			Veneer log volume			Commercial poles			Pulpwood
	grade				grade			grade			height class			
	1	2	3	5	1	2	3	1	2	3	20-30	35-40	45+	
	Board feet				Scribner						Number			Cu. ft.
10	—	—	—	—	4	16	120	—	—	—	4	—	—	49
12	—	4	13	186	6	10	102	—	12	65	2	1	—	51
14	3	5	20	262	3	8	174	3	10	165	1	2	—	68
16	ETC.				ETC.			ETC.			ETC.			ETC.
18														
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Total (±)	195	305	890	4125	22	101	874	240	675	2835	9	6	2	1,016

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¹Grading systems used in evaluating log products are those developed for ponderosa pine.