forestry & natural resources

WOODLAND MANAGEMENT

Financial Maturity: A Guide To When Trees Should Be Harvested

by W. L. Mills, Jr. and John C. Callahan, Department of Forestry and Natural Resources

Financial maturity is a concept which provides for the maximization of monetary returns from an investment in an appreciating asset (one increasing in value over time). The financial maturity calculation requires that the investment opportunity at some point in its life meet the owner's profitability objective. Therefore, it is necessary that the investment be an acceptable one to the investor based on an analysis of its net present worth or internal rate of return.[1]

Financial maturity, then, is the point in the life of an appreciating asset when the owner's cost of keeping an asset exceeds the expected monetary gain. Timber, some wines, bonded distilled liquors, and livestock can be categorized as appreciating assets. All have characteristics which make it difficult to ascertain the age at which financial maturity is reached. In the case of timber, the basic reasons for this difficulty are the inherent nature of the wood production process (a tree is both the production facility and the product) and the changes in quality which occur as trees grow in size.

Since a tree's annual growth cannot be harvested without also destroying the production process itself, financial maturity for trees is approximated when the tree's rate of value increase (value growth percent) is just equal to the owner's implicit cost associated with the capital investment in the tree. This cost is determined by the rate of return which the owner expects from other investments of similar risk and duration. In other words, financial maturity is that point in the life of the tree beyond which the expected value increase no longer equals or exceeds the net return which would be obtained if the tree were sold and the cash value were invested elsewhere. The owner's "expected" rate of return is referred to as his "alternative rate of return" which is discussed in greater detail later. The net effect of cutting financially mature timber is to maximize the net return to the forest enterprise.[2] If the tree is not cut when the point of financial maturity is reached, the investment will not be earning a rate of return greater than or equal to the return expected from the alternative investment. Thus, the cutting of the tree and the reinvestment of the capital funds at the alternative rate of return will provide a greater return than maintaining the investment in the tree. Throughout this discussion, it is assumed that the investor wants to maximize his return on investment and that an alternative investment is always available for reinvestment, e.g., a savings account.

In contrast, the biological maturity of a tree or a stand of trees occurs when the tree or stand achieves maximum merchantable volume. Financial maturity differs from biological maturity by imposing economic and business management constraints on the production process. In determining financial maturity, benefits are weighed against costs. The benefits are

[1]See Chapman, H. H. & W. H. Meyers, 1947. *Forest Valuation*. New York. McGraw-Hill Book Company, Inc. or Johnston, R. W., 1970. *Capital Budgeting*. Belmont, California. Wadsworth Publishing Company, Inc. for a discussion of net present worth and internal rate of return.

[2]Proof of this statement and derivation of formulas used in this publication can be obtained by writing Dr. J. C. Callahan, Department of Forestry and Natural Resources, Purdue University, West Lafayette, IN 47907.

the marketable values, while the costs include capital charges and expenses. If the financial maturity concept is adopted as a management guide, trees and stands are normally harvested at a point in time prior to their biological maturity (Figure 1). Usually the point of financial maturity and biological maturity will be equal only if costs are zero and the owner's alternative rate of return is zero.[3]

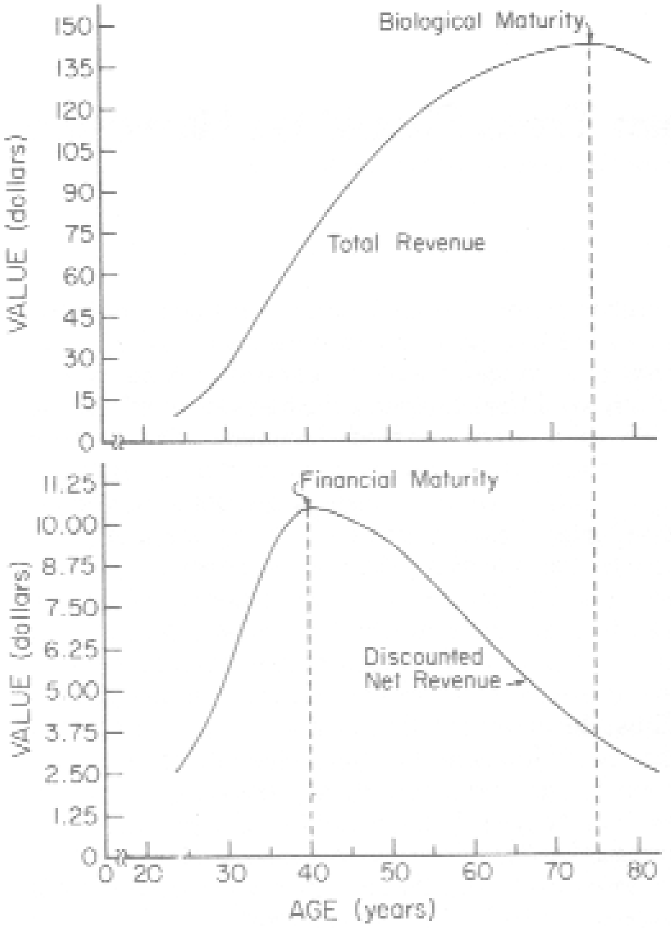

Figure 1. Comparison of financial and biological maturity for a hypothetical tree.

[3]Robert W. Koenig, Indiana Department of Natural Resources, Division of Forestry, suggested the following "unusual" case for a single black walnut tree. In 1959, the Hougham family had a standing offer of $2,500 for a very old and large black walnut tree. The family held the tree until 1965, at which time it sold for $12,600. The tree was 35.5 inches, contained an estimated 2,259 bd. ft. of merchantable volume, and was about 150 years old. The tree had reached biological maturity since a small hole was discovered in the butt log, causing some loss of merchantable volume. If the concept of financial maturity had called for cutting the tree in 1965, the tree might have been both financially and biologically mature with an alternative rate of return greater than zero. The situation surrounding the marketing of this tree was unique. The tree sold at $5.33 per bd. ft., while the average price of the best and largest black walnuts sold in Indiana during 1965 was only $.85 per bd. ft.

Information Requirements

The Alternative Rate of Return

It is necessary that the "proper" alternative rate of return be determined. It is the rate earned by the investor's best alternative investment. One way for a woodland owner to estimate his alternative rate of return is to review present and future investment opportunities. For example, someone investing money in a Certificate of Deposit for 5 years at 10% is providing a guide to his alternative rate of return. If another available investment is the improvement of cropland through drainage, and the expected return is 15%, this would also provide an indication of alternative investment opportunities. Likewise, the cost to an individual in borrowing money provides a similar guide. A tree or stand earning less might be subject to liquidation with the money used to repay a loan or to be reinvested after fully considering the comparable risks, uncertainties, and length of investment period. The rate may vary from time to time in accordance with the owner's appraisal of his financial circumstances.

In summary, the "required" return (the alternative rate of return) is the rate of return a person will need to economically justify an investment in a given type of asset. If the yield from an asset fails to meet this expectation, the rational decision is to liquidate the existing capital asset and to reinvest the proceeds in another form of capital, earning a rate of return equivalent to or greater than the "required" rate.

Expected Incremental Changes in Tree Value

Trees increase in value in three principal ways. As trees grow, they increase in volume and, consequently, in the amount of wood which has merchantable value. They may also improve in quality as the knotty cores are buried under clear layers of annual growth. Changes in quality are reflected in the increased market price per unit volume of standing timber and cut products. The value of trees may also increase over time relative to other goods and services in the economy as a consequence of market scarcity or changing tastes and preferences of the consuming public for wood products or for given species.

The first two types of value increases are direct related to the growth potentials of trees. These are predictable and can be estimated with some reliability by foresters. The relative value changes are more difficult to judge because of the inability to accurately predict future trends and because of the inherent uncertainty associated with any forecast. Assumptions can be made that there will be no change in the relative prices during the investment period being considered (the assumption made in this publication), that relative price changes will follow observable past trends, or that the future price relationships are those anticipated or expected by the investor using perceptive intuition or a crystal ball.

Anticipated Costs

Explicit costs such as property taxes, management expenses, and service fees can be estimated for a given forested property by examining past records of these expenses. Normally, these costs are considered to be out-of-pocket expenses paid annually or periodically during an investment period. Explicit costs which are annual and constant, as is the case of *ad valorem* property taxes, can be ignored in this search for financial maturity.[4]

Implicit costs are sometimes not easily understood since they are not as obvious as out-of-pocket charges. The principal implicit cost in the case of timber production is the cost of holding the standing inventory of timber. During the investment period, trees accumulate wood which has a market value. This is inventory in the same context as stored grain and shelved items in a retail store. The principal cost of holding this inventory is the potential return which *could* have been earned if the value of that inventory had been invested alternatively. This "opportunity" cost forms the basis for determining the individual's alternative rate of return as was indicated previously.

Financial Maturity of an Individual Tree

The General Case

In uneven-aged stands managed for timber production, individual trees should be selected for harvest as they become mature. The financial maturity concept is ideally suited for the purpose of determining "maturity" if maximization of net revenues is the decision-making criterion. Figure 2[5] represents the typical value growth percent (VGP)[6] pattern for an individual tree. VGP measures the rate of value increase in the discounted net revenue curve (Figure 1); however, the VGP may be calculated without drawing such a graph. The value growth percent is modest when the tree is small in diameter because the value per unit of wood is low, and the volume is small. In the diameter range of 12 to 16 inches, the VGP initially rises sharply because unit values increase rapidly as the tree increases in volume and quality. The VGP then falls as the implicit costs associated with holding the tree increase. Implicit cost increases as tree value increases. There may be a second rise in VGP which frequently occurs because of the development of prime sawlogs and veneer quality logs. Once the prime and veneer quality standard has been achieved, VGP again begins to fall as the implicit costs of holding the asset offsets the value growth in these higher quality trees. When the alternative rate of return is 8%, financial maturity occurs at Point B. The tree's dbh (diameter at breast height) at this point is between 14 and 15 inches. Note that the point of financial maturity is not determined at A since the owner's alternative rate of return has just been reached, and higher VGP's are realized beyond this point.[7] If the alternative rate of return were 6%, the point of financial maturity is at point C where the decreasing VGP equals the alternative rate of return, and tree diameter is between 20 and 21 inches (dbh).

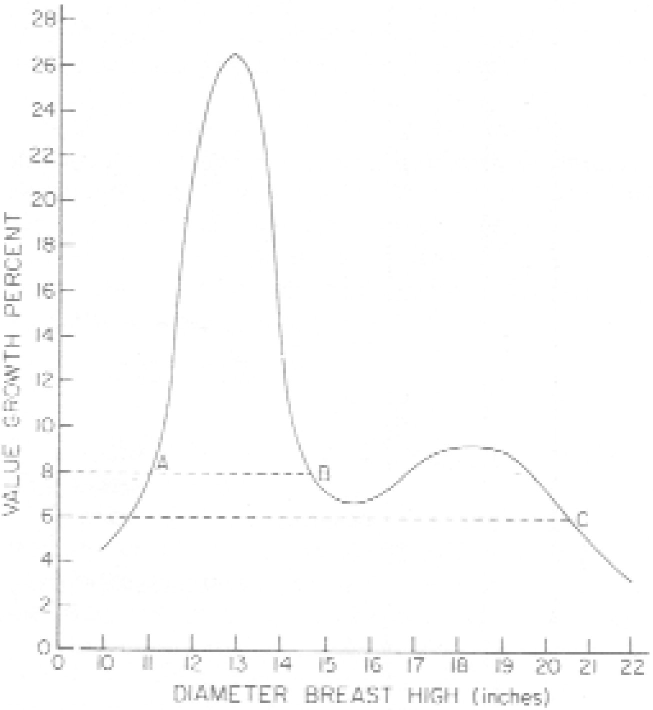

Figure 2. Value Growth Percent track for a hypothetical tree composited from 145 tuliptrees and red and white oak trees.

Source: Data on file in Purdue University Department of Forestry and Natural Resources.

[4]Refer to Footnote 2.

[5]For the mathematically inclined, the graph in Figure 2 represents a bimodal discounted net revenue distribution. The assumption made is that the first mode or maximum is the global maximum.

[6]Value growth percent is explained in detail in the next section.

[7]Value growth percent is analogous to calculating the marginal revenues for any productive process. Equating VGP and the alternative rate of return is analogous to equating marginal cost to marginal revenue.

Table 1. Present and future size and value of the sample white oak.

Time from present	dbh	Log length	Purdue log grade	Log volume Doyle rule	Value per board ft.	Value per log	Value per tree	Value growth percent
years	inches	feet	designation	board ft.	dollars	dollars	dollars	percent
(1)	(2)	(3)	(4)	(5)	(6)	(5x6=7)	Sum 7=8	(9)
0	14.2	16	2	48	.109	5.23		
		16	3	27	.088	2.38	7.61	2,52
5	14.6	16	2	54	.109	5.89		
		16	3	31	.088	2.73	8.62	2.41
10	15.1	16	2	60	.109	6.54		
		16	3	36	.088	3.17	9.71	8.32
15	16.0	8	1	46	.159	7.31		
		16	2	48	.109	5.23		
		8	3	22	.088	1.94	14.48	3.85
20	16.8	8	1	56	.159	8.90		
		16	2	57	.109	6.21		
		8	3	27	.088	2.38	17.49	3.39
25	17.6	16	1	93	.159	14.79		
		8	2	32	.109	3.49		
		8	3	27	.088	2.38	20.66	2.06
30	18.0	16	1	100	.159	15.90		
		16	2	64	.109	6.98	22.88	

A Specific Case

- When should a white oak tree, presently 14.2" dbh, be harvested if the owner's alternative rate of return is 7%?
- Should the tree be cut now or allowed to grow?
- Is the tree paying its way compared to other investments available to the owner?

To respond to these questions, the tree's prospects for growth and changes in quality must be appraised. Such an assessment for a hypothetical tree covering the next 30 years is shown in Table 1. To simplify the analysis, only the implicit cost of holding inventory is considered. Property taxes, management, and other explicit costs chargeable to an individual tree are minimal and can be safely ignored.

The calculated value growth percents (Table 1, Column 9) are the compound interest rates which equate the beginning tree values with the future tree values in the five-year time periods indicated. Since all other costs except holding costs have been assumed to be negligible, a relatively simple formula can be used to calculate the value growth percent:[8]

$$VGP = \left[\frac{FV}{PV}\right]^{\frac{1}{t}} - 1$$

where VGP = Value Growth Percent
PV = Beginning Tree Value
FV = Ending Tree Value
t = Number of Years Between Estimated Tree Values

As an example, to calculate the VGP between 10 and 15 years:

$$VGP = \frac{14.48}{9.71}^{\frac{1}{5}} - 1$$

$$VGP = 1.49124^{\frac{1}{5}} - 1$$

$$VGP = 1.0832 - 1$$

$$VGP = .0832 \text{ or } 8.32\%$$[9]

Since the owner's alternative rate of return is 7%, the point of financial maturity would occur later, and the decision to cut would be postponed until that time when the VGP declines to the owner's alternative rate of return. If the owner's alternative rate of return is greater than 8.32%, test the next time interval to see if VGP is increasing or decreasing. If it is decreasing, then the tree should be harvested unless there are non-economic factors that need to be considered.

Application

The concepts and procedures outlined above can assist landowners in deciding whether or not to cut target trees. The example which was used analyzed prospective returns and implicit costs during five-year periods. The principles can also be applied on a year-to-year basis. In other words, it is not necessary to make growth and value projections over extended periods of time. However, the assistance of a forester in estimating values and prospective growth may be desirable whatever the owner's planning horizon. Guidance in obtaining the help of foresters is found in Purdue University Extension publication FNR-87 "Forestry and Wildlife Management Assistance Available to Indiana Woodland Owners: Providers and Programs." Guidelines based on the financial maturity concept published by Trimble, et al. (1974) provide the basic elements for selecting trees that should be harvested (Table 2). These guidelines are influenced by both silvicultural and financial maturity concepts and provide a good balance between the two. Note that at lower alternative rates of return (2 to 5%), trees growing on good sites[10], e.g., Site 80, may have larger diameters (dbh) at financial maturity than those trees growing on poorer sites..

Financial Maturity of Even-Aged Stand

The General Case

In even-aged stands managed for timber production, the length of rotation (number of years between planting and harvesting) may be determined by using the financial maturity concept. The basic value growth percent method used in the case of an individual tree will be employed again. Since stands are groups of individual trees, determining financial maturity for a stand involves the same factors used in the analysis of individual trees; however, these factors are aggregated into one average value for the stand. Figure 2 also characterizes stand growth and the phenomena which were described earlier for individual trees also occur in stands.

A Specific Case

- When should a 40 year-old, even-aged stand of upland oaks be harvested if the owner's alternative rate of return is 6%?
- Should the stand be cut or allowed to grow?
- Is the stand paying its way compared to other investments available to the owner?

---

[8]Refer to Footnote 2.

[9]Many pocket calculators are now "programmed" to provide nth root calculations. Logarithmic tables can also be used to obtain nth roots.

[10]Site is a measure of productivity which includes climatic, soil, and topographic factors. It is commonly measured as the height of the dominant and co-dominant trees on a site at age 50 or 100 years.

Table 2. Diameter limits for harvesting sawlog trees at different alternative rates of return.

Species	Mark trees of these dbh classes and larger:														
	Low						Medium						High		
	2%			3%			4%			5%			6%		
	80	70	60	80	70	60	80	70	60	80	70	60	80	70	60
Yellow poplar	26	26	24	24	22	22	20	18	18	20	18	18	18	18	18
Beech	24	22	22	22	20	20	20	18	18	20	18	18	18	18	18
Black cherry	32	30	30	28	26	24	22	20	18	20	20	18	18	18	18
Red maple	32	30	30	28	26	24	22	22	18	20	20	18	18	18	18
White ash	30	28	28	26	24	24	22	20	18	20	20	18	18	18	18
Sugar maple	32	32	30	28	28	24	22	22	18	20	20	18	18	18	18
Red oak	26	26	24	24	24	22	22	22	20	22	20	20	20	18	18
White oak	24	22	20	22	20	20	20	18	18	20	18	18	18	18	18
Chestnut oak	24	24	22	22	22	20	20	18	18	20	18	18	18	18	18
Other long-lived species	26	26	24	24	24	22	20	20	18	20	20	18	18	18	18

Trees to mark--sawlog sizes
(above 11.0 inches dbh)

For All Rate-of-Return Classes, Mark:

1. Culls and near culls.
2. Trees with significant rot in the butt log.
3. Very low-vigor trees (vigor 4).
4. Extremely rough trees with butt-log grade 5.
5. Any trees over 15 inches with butt-log grade 4.
6. Any short-lived species, such as black locust, sassafras, and butternut, unless they are unusually vigorous.

In addition, trees above a certain dbh class are marked under certain conditions. This dbh varies with the rate of return desired, by species, and, in the case of oak, by site quality. It also varies by crown or vigor class and is additionally affected by the likelihood of log-grade improvement. The trees to mark are those of the indicated dbh's and larger. These will be marked unless a potential grade improvement can be foreseen in the next 10 years.

Source: Trimble *et al.* (1974), p. 12.

To respond to these questions, the stand's prospects for growth and impending changes in quality must be appraised. The stand's future expenses must be estimated, also. Estimates of these items covering the next 25 years are shown in Table 3.

The VGP is calculated similarly to the VGP for individual trees, except that intermediate revenues and periodic explicit costs will enter into the calculation. The value growth percents, including the intermediate values, are calculated by the formula:[11]

$$VGP = \left[\frac{FV - PV}{PV - (c_n \times DF^n) + (r_m \times DF^m)} + 1\right]^{\frac{1}{t}} - 1$$

where FV = the future value of the stand (column 9)
PV = the present value of the stand (column 10)
c_n = intermediate costs at r^n years from present year
r_m = intermediate revenues at m years from present year
t = number of years between FV and PV
DF^i = discounting factors i = n or m (From Table 1, Appendix A)

For example, to calculate the VGP for the period 5 to 10 years in the future using data from Table 3 and a 6% alternative rate of return:

where $FV = 242.58$
$PV = 78.58$
$c_2 = 10$ (column 5)
$r_3 = 15$ (column 6)
$DF^2 = 0.8900$ from Table 1, Appendix A., column 0.06, n=2
$DF^3 = 0.8396$ from Table 1, Appendix B, column 0.06, m=3
$n = 2$
$m = 3$

Substituting these values into the formula, the formula reads:

$$VGP = \left[\frac{242.58 - 78.58}{78.58 - 10(0.8900) + 15(0.8396)} + 1\right]^{\frac{1}{5}} - 1$$

Completing the operations:

$$VGP = \left[\frac{164.00}{87.77} + 1\right]^{\frac{1}{5}} - 1$$

$$VGP = (2.993)^{\frac{1}{5}} - 1$$

$$VGP = 1.2452 - 1$$

$$VGP = .2452 \text{ or } 24.52\%$$

[11]Refer to Footnote 2.

In the example given, the point of financial maturity comes in the 20 to 25 year period because the VGP equals and then falls below 6% in this period. In other words, to maintain a rate of return of 6% on assets, it is necessary to harvest the stand in this period and re-invest in an alternative investment, such as savings accounts, or re-establish a new stand of trees.

Application

To estimate financial maturity for a stand, estimate present and future stand values in 5 or 10 years. Next estimate any intermediate periodic costs or revenues which will be associated with the woodlands during this period. Annual constant or almost constant cost may be ignored.[12] An example of periodic revenues may be from the selling of firewood or from a commercial thinning. Select your alternative rate of return. Now enter the estimated values and intermediate costs and revenues into the formula for VGP for even-aged stands, and calculate the VGP. If it is greater than the alternative rate of return, maintain the stand for the number of years in the period examined. If the VGP is less than the alternative rate of return and the trees to be harvested are of sawlog size, harvest the stand. Calculations of VGP for young, non-merchantable stands will not yield acceptable rates of return just as new businesses or manufacturing processes take time to begin operating on a profitable basis. Therefore, harvesting a stand before mechantability is reached may reduce the total wealth of the owner.

Income Tax Implication

Up to now the effect of income taxes has been ignored so as to not complicate the basic idea of financial maturity. In general, the inclusion of income tax expenses in the calculation of value growth percent *for individual trees* as described herein will not materially change financial maturity. It is, therefore, recommended that income taxes be ignored along with other explicit costs in these cases. However, the same is *not always true* when considering the financial maturity of *tree stands*. Because some expenses may be reduced by itemized deductions, the effect of income taxes is to shorten the time a stand will be held when all other things are held constant.

As the number of periodic deductable expenses increases and as your personal income tax rises, the influence of income taxes becomes more significant. For example, if you are in a low-income bracket or have few expenses, the calculation of after-tax finan-

[12]Refer to Footnote 2.

Table 3. Values, costs and revenues for a forty-year-old even-aged stand of upland oaks.

Time from present	Volume per acre	Value per bd. ft.	Gross total value	Intermediate Costs	Intermediate Revenues	Discounted Costs ($C_n x DF^n$)	Discounted Revenues ($R_m x DF^m$)	Future value	Present value	Value growth percent
years	bd. ft.				dollars					percent
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
0	611	.0965	58.96						58.96	
4				10		7.92				6.72
5	717	.1096	78.58					78.58	78.58	
7				10		8.90				24.52
8					15		12.59			
10	2061	.1177	242.58					242.58	242.58	
12					30		26.70			8.73
15	3041	.1258	382.56					382.56	382.56	
20	4087	.1353	552.97					552.97	552.97	7.65
25	5115	.1400	716.10					716.10		5.31

cial maturity is not recommended. If your tax rate is high and many expenses are incurred in the woodlands, after-tax analysis may be worthwhile.

Summary

Procedures and guidelines are presented which will assist woodland owners in determining whether or not to harvest individual trees or stands if income maximization is an objective. These procedures and guidelines are based on the individual owner's investment alternatives. The suggested methods help insure that the woodland owner will receive his expected and desired rate of return on the investments. If not, the owner should cut the timber and either reestablish new woods or convert the land to another more profitable investment.

The VGP method recommended will provide reliable estimates of financial maturity if accurate estimates of present and future tree value are made. These estimates of tree value will be influenced by site, species, and the tree's unique growth rate. The guidelines in Table 2 must be used with the knowledge that the individual tree's unique growth rate has been considered only by averaging the growth of many trees. Therefore, some trees may have diameters at financial maturity which are lower or higher than the diameters suggested.

Finally, if tree prices are expected to rise or fall relative to all other commodities, the point of financial maturity will lengthen or shorten, respectively. This may be incorporated in the VGP method by increasing or decreasing the relative prices used to evaluate the volume of timber and proceeding to calculate VGP as described.

Sources of Additional Information

Estimating Tree Volume and Log Quality

FNR 4, *How to Make and Use the Tree Measuring Stick*, W. L. Fix, Purdue University Cooperative Extension Service Publication.

Financial Maturity Concepts

Bentley, William R. and Dennis E. Teegarden. 1965. "Financial Maturity: A Theoretical Review," *Forest Science*, Volume 11:76-87.

DeBald, Paul S. and Joseph Mendel. 1976. *An Individual-tree Approach to Making Stand Evaluation.* USDA Forest Service Research Paper NE-336, 13 p.

Duerr, William A., John Fedkiw, and Sam Guttenburg. 1956. *Financial Maturity: A Guide to Profitable Timber Growing.* USDA Agricultural Technical Bulletin 1146, 75 p. illus.

Gaffney, M. Mason. 1957. *Concepts of financial maturity of timber and other assets.* A.E. Information Series No. 62, North Carolina State College. Raleigh. 105 p.

Grisez, Ted J. and Joseph Mendel. 1972. *The Rate of Value Increase for Black Cherry, Red Maple, and White Ash.* USDA Forest Service Research Paper NE-231, 26 p.

Mendel, Joseph J., Ted J. Grisez and G. R. Trimble, Jr. 1973. *The Rate of Value Increase for Sugar Maple.* USDA Forest Service Research Paper NE-250, 19 p.

———, Paul S. DeBald and Martin W. Dale. 1976. *Tree Value Conversion Standards for Hardwood Sawtimber.* USDA Forest Service Research Paper NE-337. 74 p. illus.

Trimble, George R., Jr., Joseph J. Mendel and Richard A. Kennell. 1974. *A Procedure for Selection Marking in Hardwoods Combining Silvicultural Considerations with Economic Guidelines.* USDA Forest Service Research Paper NE-292. 13 p.

Appendix A: Discounting Factors

TABLE 1. PRESENT VALUE OF $1.00 RECIEVED IN YEAR N (DISCOUNTING)

	INTEREST RATES									
N	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09	0.10
1	.9901	.9804	.9709	.9615	.9524	.9434	.9346	.9259	.9174	.9091
2	.9803	.9612	.9426	.9246	.9070	.8900	.8734	.8573	.8417	.8264
3	.9706	.9423	.9151	.8890	.8638	.8396	.8163	.7938	.7722	.7513
4	.9610	.9238	.8885	.8548	.8227	.7921	.7629	.7350	.7084	.6830
5	.9515	.9057	.8626	.8219	.7835	.7473	.7130	.6806	.6499	.6209
6	.9420	.8880	.8375	.7903	.7462	.7050	.6663	.6302	.5963	.5645
7	.9327	.8706	.8131	.7599	.7107	.6651	.6227	.5835	.5470	.5132
8	.9235	.8535	.7894	.7307	.6768	.6274	.5820	.5403	.5019	.4665
9	.9143	.8368	.7664	.7026	.6446	.5919	.5439	.5002	.4604	.4241
10	.9053	.8203	.7441	.6756	.6139	.5584	.5083	.4632	.4224	.3855
11	.8963	.8043	.7224	.6496	.5847	.5268	.4751	.4289	.3875	.3505
12	.8874	.7885	.7014	.6246	.5568	.4970	.4440	.3971	.3555	.3186
13	.8787	.7730	.6810	.6006	.5303	.4688	.4150	.3677	.3262	.2897
14	.8700	.7579	.6611	.5775	.5051	.4423	.3878	.3405	.2992	.2633
15	.8613	.7430	.6419	.5553	.4810	.4173	.3624	.3152	.2745	.2394
16	.8528	.7284	.6232	.5339	.4581	.3936	.3387	.2919	.2519	.2176
17	.8444	.7142	.6050	.5134	.4363	.3714	.3166	.2703	.2311	.1978
18	.8360	.7002	.5874	.4936	.4155	.3503	.2959	.2502	.2120	.1799
19	.8277	.6864	.5703	.4746	.3957	.3305	.2765	.2317	.1945	.1635
20	.8195	.6730	.5537	.4564	.3769	.3118	.2584	.2145	.1784	.1486
25	.7798	.6095	.4776	.3751	.2953	.2330	.1842	.1460	.1160	.0923
30	.7419	.5521	.4120	.3083	.2314	.1741	.1314	.0994	.0754	.0573
35	.7059	.5000	.3554	.2534	.1813	.1301	.0937	.0676	.0490	.0356
40	.6717	.4529	.3066	.2083	.1420	.0972	.0668	.0460	.0318	.0221
45	.6391	.4102	.2644	.1712	.1113	.0727	.0476	.0313	.0207	.0137
50	.6080	.3715	.2281	.1407	.0872	.0543	.0339	.0213	.0134	.0085
55	.5785	.3365	.1968	.1157	.0653	.0406	.0242	.0145	.0087	.0053
60	.5504	.3048	.1697	.0951	.0535	.0303	.0173	.0099	.0057	.0033

RR 9/93 (2M)

Cooperative Extension work in Agriculture and Home Economics, state of Indiana, Purdue University and U.S. Department of Agriculture cooperating. H.A. Wadsworth, Director, West Lafayette, IN. Issued in furtherance of the acts of May 8 and June 30, 1914. The Purdue University Cooperative Extension Service is an affirmative action/equal opportunity institution.