Overview of Financial Analysis and the Land Expectation Value

Lecture 4 (04/13/2017)

Overview

- Steps in Financial Analysis
- Selecting an Interest Rate
- Net Present Value
- Benefit/Cost Ratio
- Internal Rate of Return
- Discussion: Deep-future discounting

Steps in Financial Analysis

1. <u>Framing the question</u>
   - What is the decision that needs to be made?
   - Who will be affected by the decision?
   - How will the results of the financial analysis be used to make the decision?
2. <u>Establish the scope of the problem</u>
   - What is the spatial and temporal scale?
   - What key factors should be included?
   - Management objectives
3. <u>Identify the schedule of events in the project</u>
   - When do costs and revenues occur?
   - When do activities, services occur?

4. Identify the quantity, value and timing of costs, benefits, services and goods
   – Identify data availabilities and needs;
   – What models to use for predictions;
   – Things that are hard to quantify, value or both.
5. Select an interest rate
6. Calculate Net Present Value (NPV) and other financial indicators;
7. Compare/rank projects.

Guides for Selecting the Interest Rate

1. Alternate Rate of Return (ARR): The rate an investor can earn in his/her best comparable alternative investment. (*Note: An alternative investment must be comparable in terms of risk, liquidity; taxes, transaction costs and time period*)
2. The interest on the loan that is to be used to carry out the project;
3. The rate of return on the investments that the money would be used for if the project was not pursued;
4. Some organizations have set discount rates.

Financial criteria for comparing different projects

- Net Present Value (NPV) is the most widely accepted criterion:

$$NPV = \sum_t \frac{Revenue_t - Cost_t}{(1+i)^t} > 0$$

  - Projects with a + NPV should be pursued;
  - The higher the NPV, the better;
  - Limitation: the NPV does not take the relative size of the investment into account.

- Benefit/Cost Ratio (B/C) measures the size of the benefits of a project relative to the costs of the project:

$$B/C = \sum_t \frac{Revenue_t}{(1+i)^t} / \sum_t \frac{Cost_t}{(1+i)^t} > 1$$

  - Use NPV if NPV and B/C conflict;
  - Use other, non-financial criteria to tip the balance.

- Internal Rate of Return (IRR): is the interest rate at which NPV=0.

$$NPV = \sum_t \frac{Revenue_t - Cost_t}{(1+i)^t} = 0$$

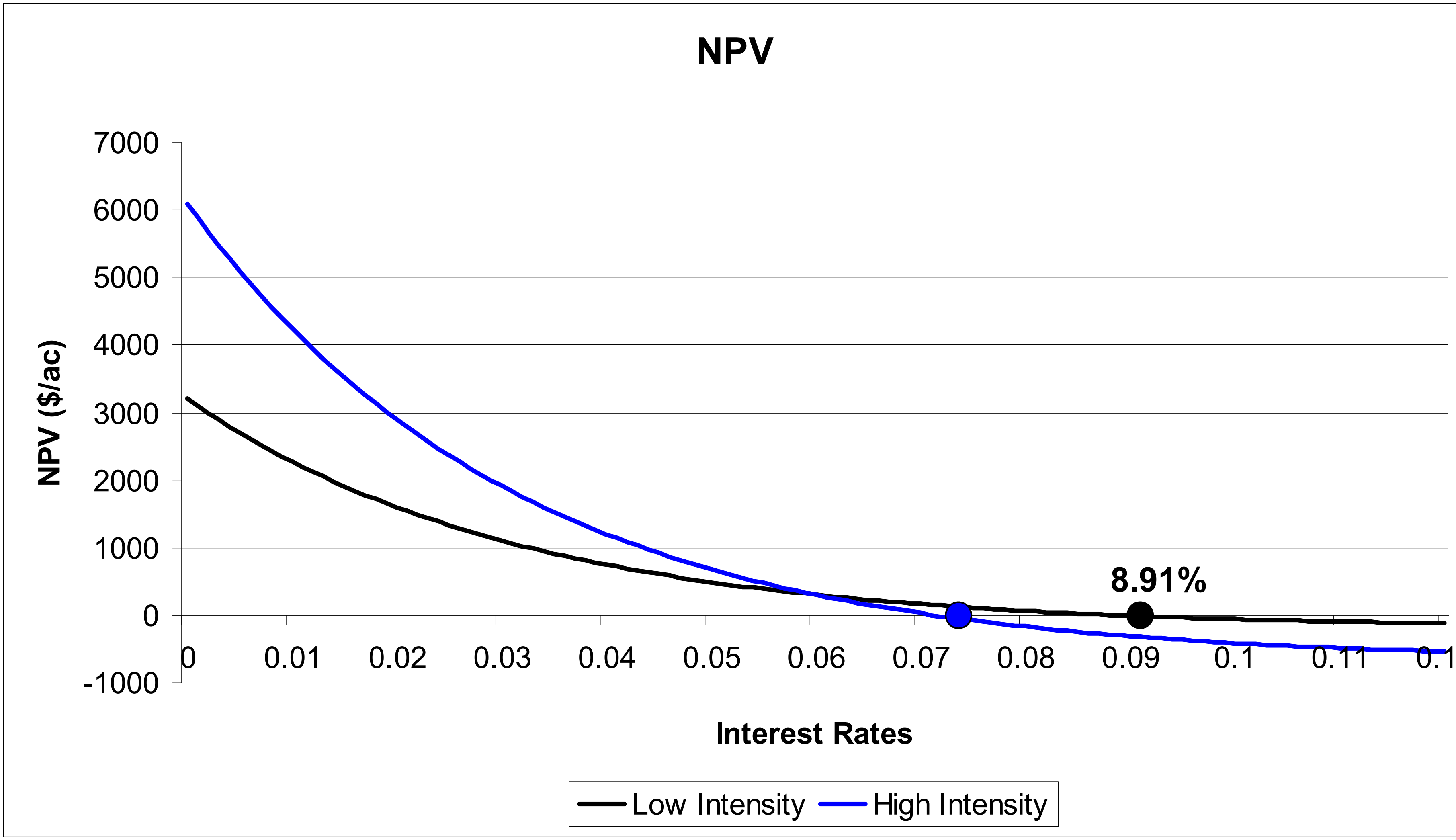
  - Project acceptability criterion: IRR>ARR;
  - Unique to the project;
  - Investors with different minimum acceptable rates of return can look at one IRR;
  - NPV and IRR guidelines are sometimes inconsistent;
  - IRR is “hard” to calculate.

Example

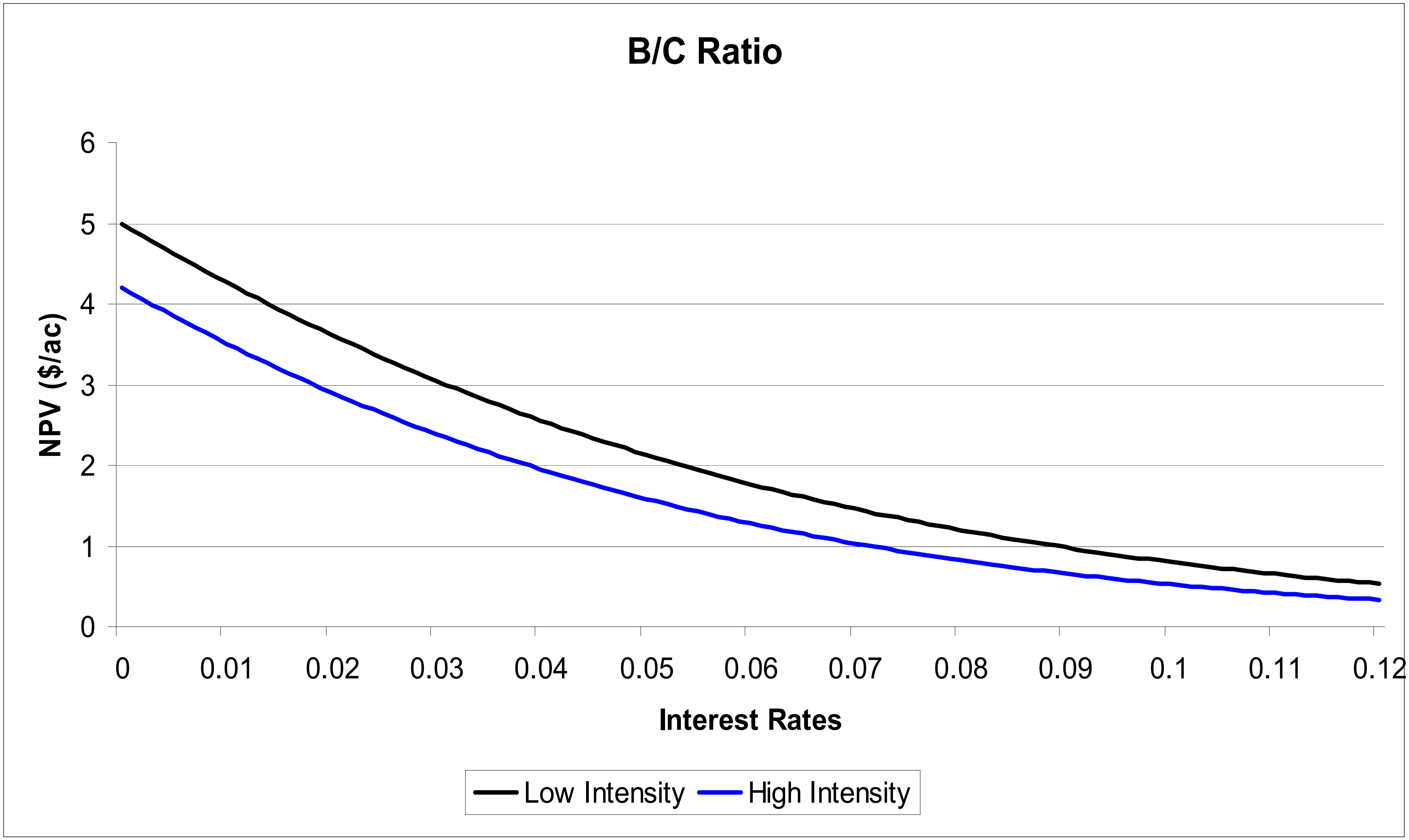
- Consider two alternative forest management regimes:

	Year	Low Intensity Option	High Intensity Option
Establishment cost	0	$50	$400
Annual management cost	All	$25	$50
Final revenue	30	$4,000	$8,000

The NPV and IRR



Benefit/Cost Ratios



The Land Expectation Value (LEV)

Financial Analysis of Stand-Level Forest Management Decisions

- Even-aged stands:
  - One age-class with ages ranging no more than 20% of a rotation;
  - Most or all of the stand is removed at harvest;
  - No generational overlap on a given site;
  - Favors shade-intolerant species: oaks, pines, Douglas fir, etc;
  - Low harvesting costs;
  - Most industrial forests are even-aged.
- Uneven-aged stands

The value of forest land

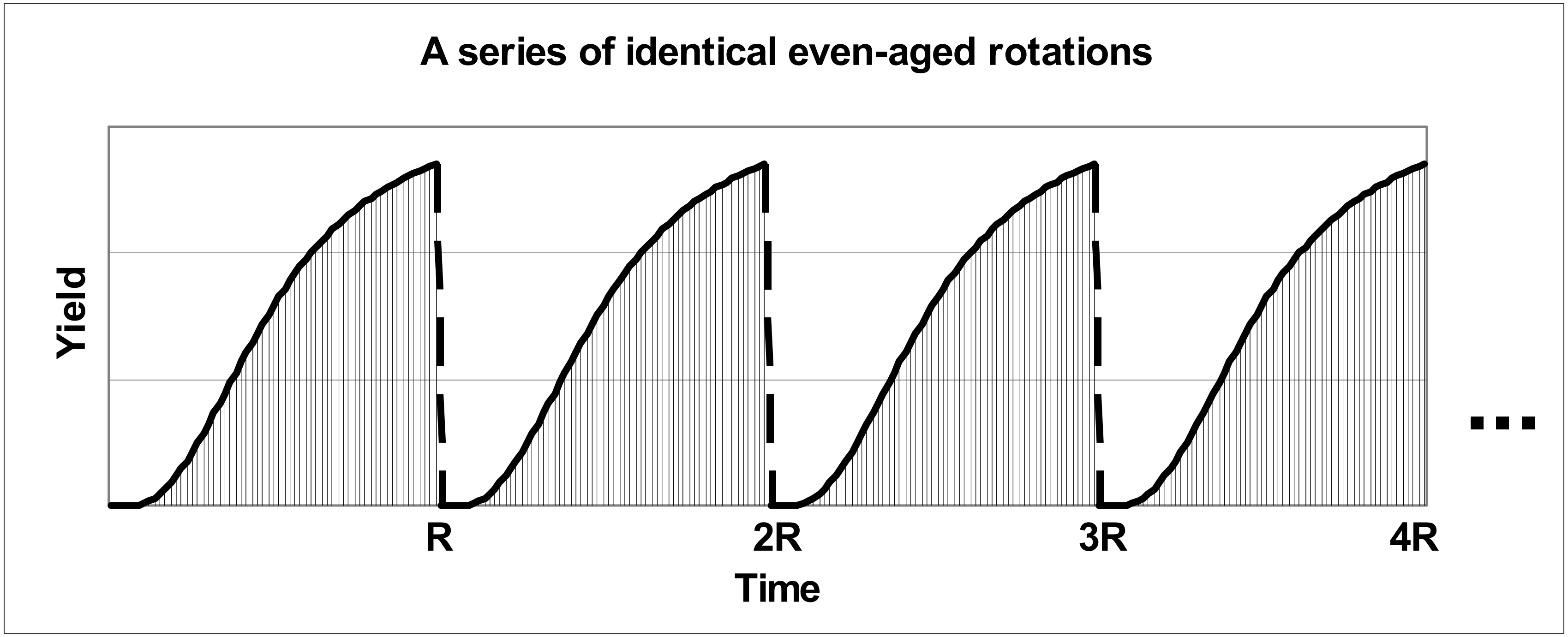
- The Land Expectation Value:* considers the value of bare land at the start of an even-aged forest rotation;
- The Forest Value: considers the value of land and trees at any stage of stand development;
- Transaction Evidence Approach: is based on identifying recent sales with similar properties.

*Note: LEV is also known as the Soil Expectation Value, Willingness to Pay for Land or Bare Land Value

Definition of LEV

<u>The Land Expectation Value (LEV)</u> is the net present value of an infinite series of identical, even-aged forest rotations, starting from bare land.

<u>Major Assumption of LEV:</u> the rotations are identical



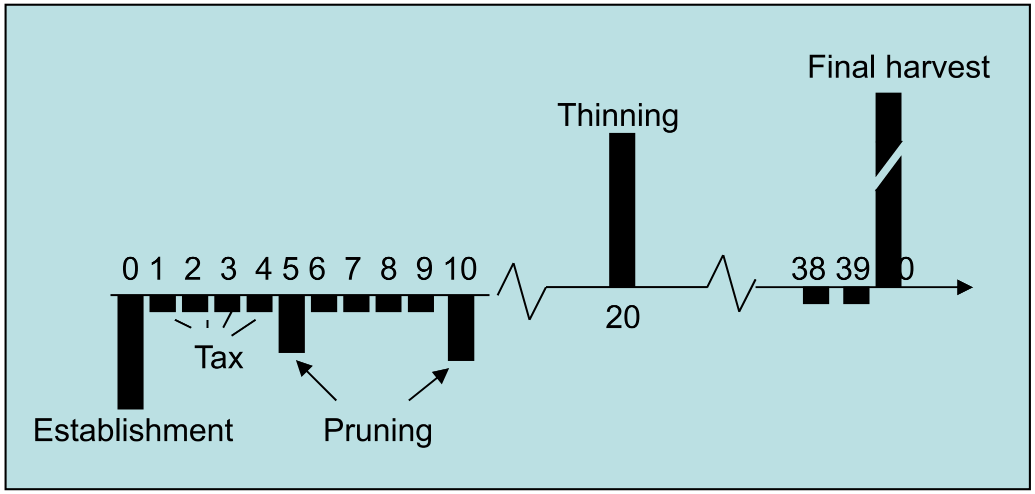
The LEV can be used:

- To identify optimal even-aged management regimes for forest stands where the primary objective is to maximize financial returns;
- To estimate the value of forestland without standing timber that is used for growing timber.

Limitations of LEV

- LEV is a poor predictor of forestland value if the main value of land is not timber related;
- LEV can be used to estimate the opportunity costs of various management regimes;
- Prices and costs are assumed to be constant (use real rate).

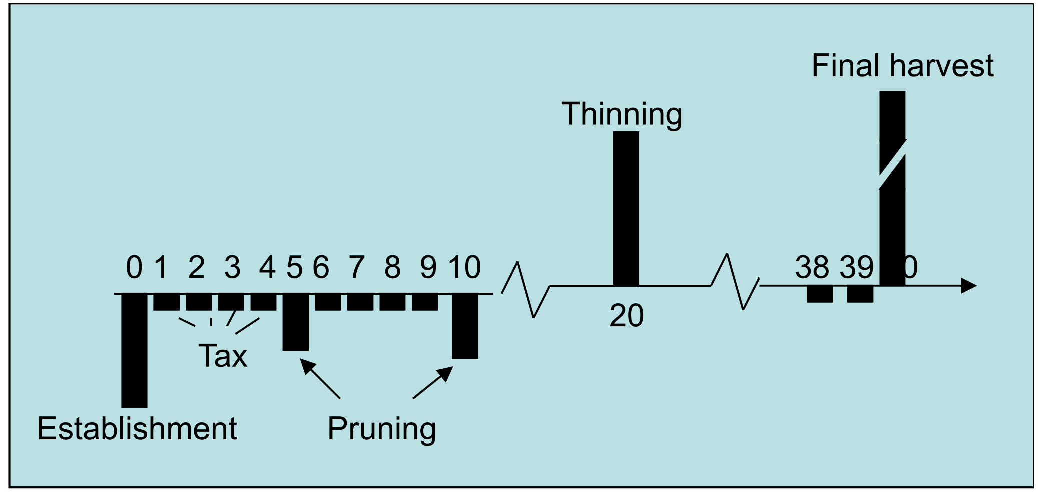
Calculation of LEV



Basic types of costs & revenues:

1. Establishment costs (e.g., site prep., planting)
2. Annual costs and revenues (e.g., property tax, hunting leases)
3. Intermediate costs and revenues (thinnings, pruning, etc.)
4. Final net revenue

Calculation of LEV



- <u>Method 1:</u>

1. Calculate the present value of the first rotation;

$$PV_{R_1} = -E + \sum_{t=1}^{R-1} \frac{I_t}{(1+r)^t} + \frac{A[(1+r)^R - 1]}{r(1+r)^R} + \frac{\sum_{p=1}^{n} P_p \cdot Y_{p,R} - C_h}{(1+r)^R}$$

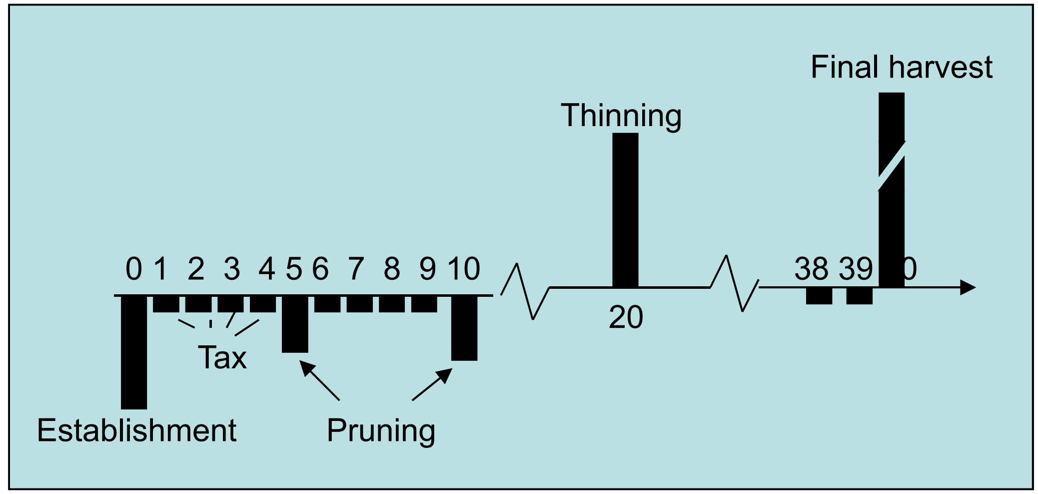
2. Convert the present value to a future value;

$$FV_{R_1} = (1+r)^R \cdot PV_{R_1}$$

3. Apply the infinite periodic payment formula

$$LEV = \frac{FV_{R_1}}{(1+r)^R - 1} =$$

Calculation of LEV



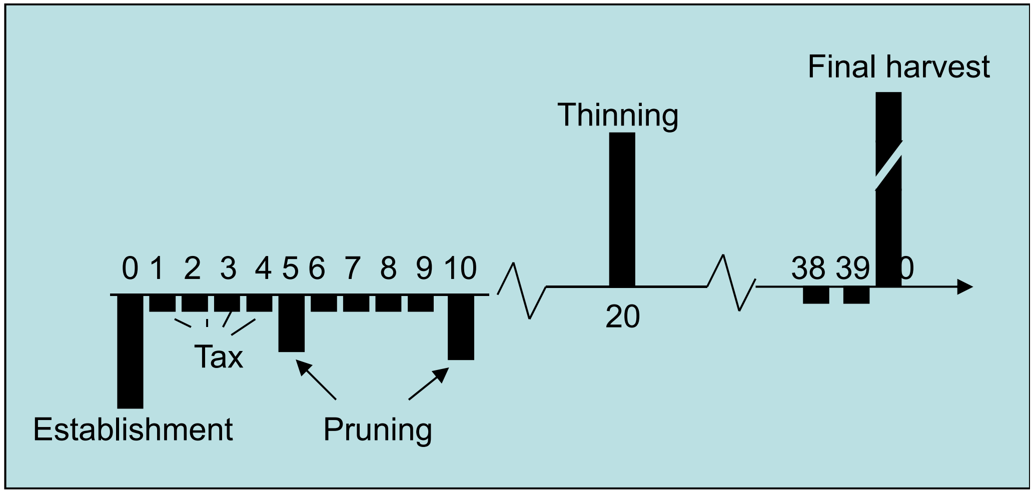
- <u>Method 2:</u>
  1. Calculate the future value of the first rotation;

$$FV_{R_1} = -E(1+r)^R + \sum_{t=1}^{R-1} I_t (1+r)^{(R-t)} + \frac{A[(1+r)^R - 1]}{r} + \\ + \sum_{p=1}^{n} P_p \cdot Y_{p,R} - C_h$$

  2. Apply the infinite periodic payment formula

$$LEV = \frac{FV_{R_1}}{(1+r)^R - 1} =$$

Calculation of LEV



- <u>Method 3:</u>
  1. Calculate the future value of the first rotation, ignoring the annual costs and revenues:

$$FV'_{R_1} = -E(1+r)^R + \sum_{t=1}^{R-1} I_t(1+r)^{(R-t)} + \sum_{p=1}^{n} P_p \cdot Y_{p,R} - C_h$$

  2. Apply the infinite periodic payment formula

$$LEV = \frac{FV'_{R_1}}{(1+r)^R - 1} + \frac{A}{r} =$$

A Loblolly Pine Example

Management Activity	Cost/Revenue ($/acre)	Timing	Present Value of First Rotation	Future Value of First Rotation
Reforestation	125.00	0	-$125.00	-$1,285.71
Brush control	50.00	5	-$37.36	-$384.30
Thinning cost	75.00	10	-$41.88	-$430.76
Thinning revenue	200.00	20	$62.36	$641.43
Property tax	3.00	annual	-$45.14	-$464.29
Hunting lease	1.00	annual	$15.05	$154.76
Final harvest	3,000.00	40	$291.67	$3,000.00
Total			**$119.69**	**$1,231.12**

Calculate the per acre LEV using a 6% real alternative rate of return.

- Method 1:
  1. Convert PV of 1st rotation to FV:

$$FV_{R_1} = PV_{R_1}(1+r)^{40} = \$119.69 \cdot (1.06)^{40} = \underline{\$1,231.12}$$

  2. Apply the infinite periodic payment formula for this future value:

$$LEV = \frac{FV_{R_1}}{(1+r)^R - 1} = \frac{\$1,231.12}{9.28571} = \underline{\underline{\$132.58}}$$

- Method 2: is identical to Step 2 in Method 1;

- <u>Method 3</u>:

1. Calculate FV of 1st rotation without annual costs/revenues :

$$FV'_{R_1} = -\$1,285.71 - \$384,30 - \$430.76 +$$
$$+ \$641.43 + \$3,000 = \underline{\$1,540.66}$$

2. Apply the infinite periodic payment formula for this future value:

$$LEV' = \frac{\$1,540.66}{(1.06)^{40} - 1} = \underline{\$165.9172}$$

3. Apply and deduct the infinite annual series of net revenues:

$$LEV = LEV' + \frac{A}{r} = \$165.9172 + \frac{-\$2}{0.06} = \underline{\underline{\$132.58}}$$

$$LEV = \frac{\left[-E + \sum_{t=1}^{R-1} \frac{I_t}{(1+r)^t} + \frac{A[(1+r)^R - 1]}{r(1+r)^R} + \frac{\sum_{p=1}^{n} P_p \cdot Y_{p,R} - C_h}{(1+r)^R} \right] (1+r)^R}{(1+r)^R - 1}$$

$$LEV = \frac{-E(1+r)^R + \sum_{t=1}^{R-1} I_t (1+r)^{(R-t)} + \frac{A[(1+r)^R - 1]}{r} + \sum_{p=1}^{n} P_p \cdot Y_{p,R} - C_h}{(1+r)^R - 1}$$

$$LEV = \frac{-E(1+r)^{R} + \sum_{t=1}^{R-1} I_t (1+r)^{(R-t)} + \sum_{p=1}^{n} P_p \cdot Y_{p,R} - C_h}{(1+r)^{R} - 1} + \frac{A}{r}$$

$$FV_{reforestation} = -E(1+r)^{R} = -\$125.00 \cdot (1.06)^{40} = \underline{-\$1,285.71}$$

$$PV_{brush} = I_5(1+r)^{-5} = -\$50.00 \cdot (1.06)^{-5} = \underline{-\$37.36}$$

$$FV_{brush} = I_5(1+r)^{(R-5)} = -\$50.00 \cdot (1.06)^{35} = \underline{-\$384.30}$$

$$PV_{tax} = \frac{A_{tax}[(1+r)^R - 1]}{r(1+r)^R} = \frac{-\$3.00[(1.06)^{40} - 1]}{0.06(1.06)^{40}} =$$

$$= \frac{-\$27.8571}{0.61714} = \underline{-\$45.14}$$

$$FV_{tax} = \frac{A_{tax}[(1+r)^R - 1]}{r} = \frac{-\$3.00[(1.06)^{40} - 1]}{0.06} =$$

$$= \frac{-\$27.8571}{0.06} = \underline{-\$464.29}$$

$$PV_{harvest} = \frac{\sum_{p=1}^{n} P_p Y_{p,R} - C_h}{(1+r)^R} = \frac{\$3000.00}{1.06^{40}} = \underline{-\$291.67}$$