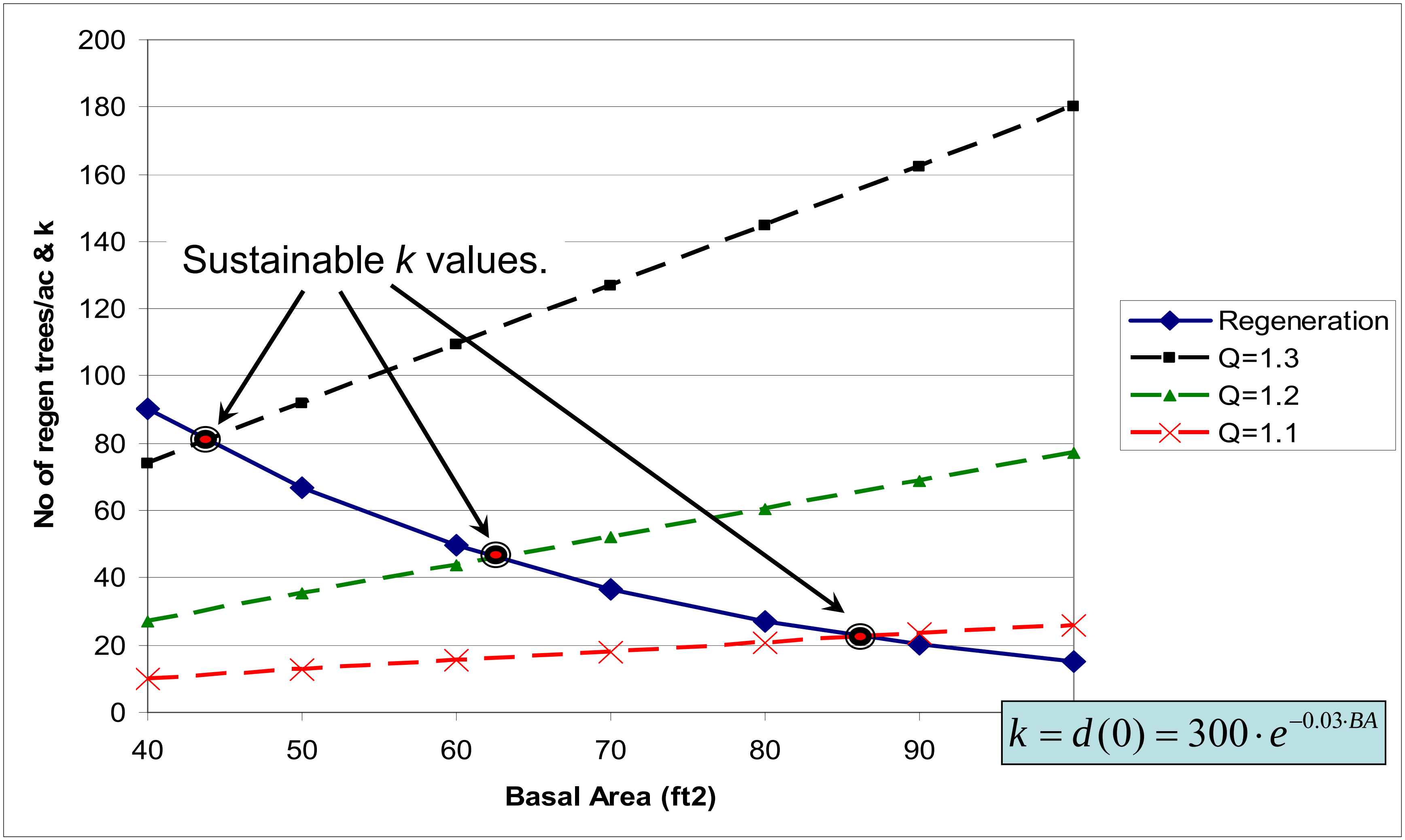
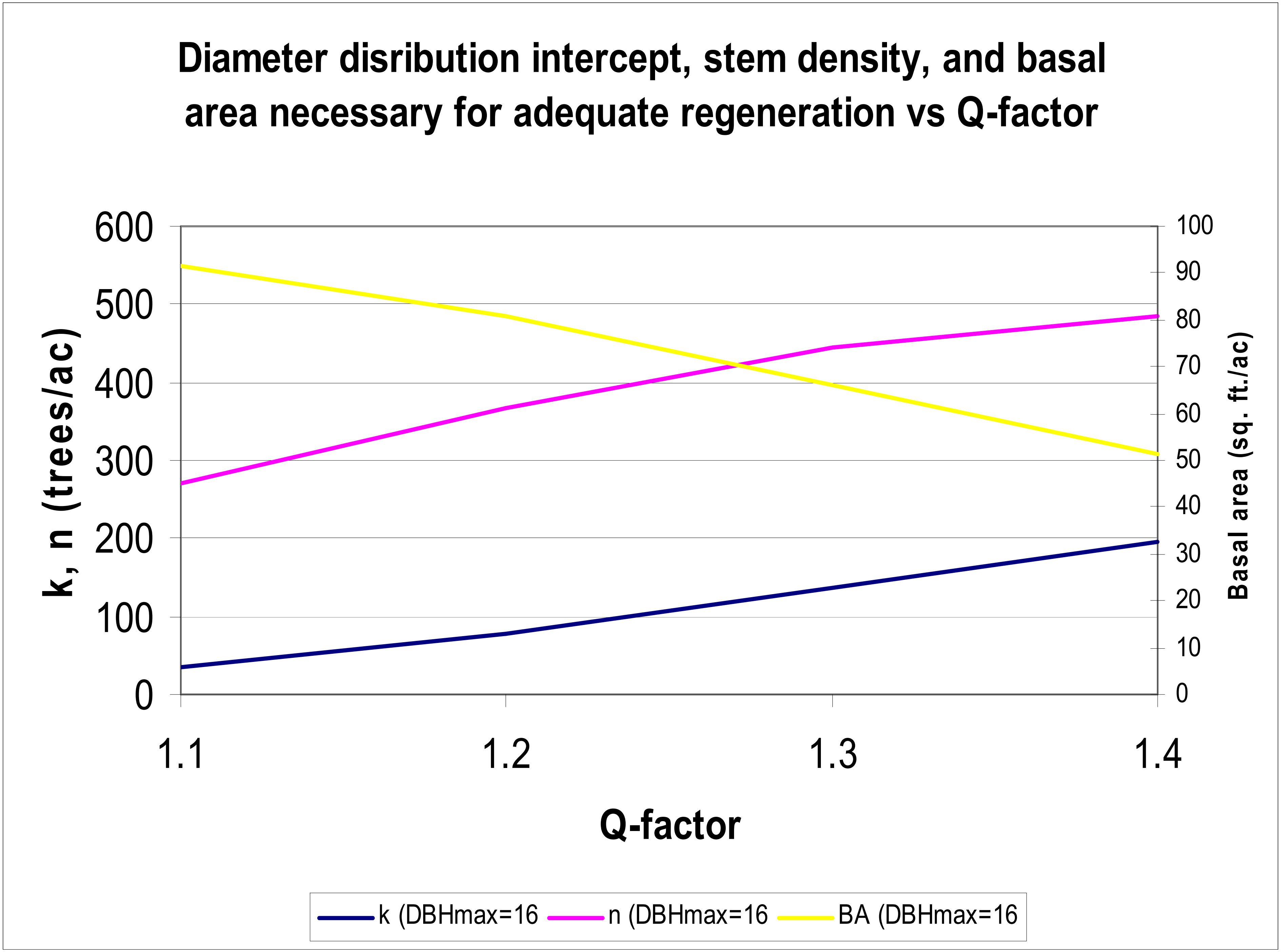
Uneven-aged Management II.

Lecture 10 (5/4/2017)

Review: Sustainable Regeneration





Diameter disribution intercept, stem density, and basal area necessary for adequate regeneration vs Q-factor
k, n (trees/ac)
Basal area (sq. ft./ac)
600
500
400
300
200
100
0
100
90
80
70
60
50
40
30
20
10
0
1.1
1.2
1.3
1.4
Q-factor
k (DBHmax=16
n (DBHmax=16
BA (DBHmax=16

Selecting the optimal cutting cycle and residual basal area

- Longer cutting cycles require lower residual BAs after the harvest (thus, the cutting cycle and BA decisions cannot be separated);
- Identical harvests at the end of each cutting cycles;

Forest Value = Present Value of all costs and revenues from the uneven-aged management regime

The Forest Value of Uneven-aged Management Regimes

$$ForVal = Net\,\mathrm{Re}v_1 + \frac{Net\,\mathrm{Re}v_{cc}}{(1+r)^t - 1} + \frac{A}{r}$$

where : NetRev$_1$ = *the net* revenue of the initial harvest,

NetRev$_{cc}$ = *the* net harvest revenue at the end of each cutting cycle,

A = annual net revenue (negative for costs),

t = the cutting cycle, and

r = real interest rate.

Example 1: A 200-ac Uneven-aged Stand

Determine best cutting cycle and residual basal area. Consider three residual basal areas (50,60 and 70 ft^2) and three cutting cycles: 5, 10 and 15 years. Stumpage Price is $220/mbf and there is a fixed harvesting cost of $2,000 for the entire stand. The property taxes are $5/ac/yr. Use a 4% real alternate rate of return.

Residual Basal Area	Volume Harvested (mbf/ac) in Initial Harvest	Volume Harvested (mbf/ac) in Future Harvests		
		5-year Cycle	10-year Cycle	15-year Cycle
50	1.98	0.88	2.42	3.00
60	1.76	1.10	2.53	3.10
70	1.21	1.30	2.64	3.63

Solution:

$$NetRev_1 = \$220/mbf \cdot 1.98 mbf/ac - \$10/ac = \underline{\$425.60/ac}$$

$$NetRev_{cc} = \$220/mbf \cdot 0.88 mbf/ac - \$10/ac = \underline{\$183.60/ac}$$

$$ForVal_{BA=50,cc=5} = \$425.60 + \frac{\$183.60}{(1.04)^5 - 1} - \frac{5}{0.04} = \underline{\underline{\$1,148.04/ac}}$$

Residual Basal Area	Forest Value (per acre)		
	5-year Cycle	10-year Cycle	15-year Cycle
50	$1,148.00	$1,388.40	$1,112.10
60	$1,323.00	$1,390.40	$1,091.20
70	**$1,405.10**	$1,319.80	$1,115.80

What if the stand is 80 instead of 200 ac?

$$NetRev_1 = \$220/mbf \cdot 1.98 mbf/ac - \$25/ac = \underline{\$410.60/ac}$$

$$NetRev_{cc} = \$220/mbf \cdot 0.88 mbf/ac - \$25/ac = \underline{\$168.60/ac}$$

$$ForVal_{BA=50,cc=5} = \$410.60 + \frac{\$168.60}{(1.04)^5 - 1} - \frac{5}{0.04} = \underline{\underline{\$1,063.80/ac}}$$

Residual Basal Area	Forest Value (per acre)		
	5-year Cycle	10-year Cycle	15-year Cycle
50	\$1,063.80	\$1,342.10	\$1,078.40
60	\$1,238.80	**\$1,344.10**	\$1,057.50
70	\$1,320.90	\$1,273.50	\$1,082.10

Individual Tree Selection

- General rule of thumb: "Keep the trees with the most potential to increase in value";
- The Financial Maturity Principle (W. Duerr): The rate of value increase in a tree must exceed the alternative rate of return;
- d_{max}: the diameter at which the increase in value becomes less than the opportunity cost of not cutting the tree.

The financial maturity of a single tree

Applying the financial maturity principle to an individual tree:

1. Determine the ARR;
2. Calculate the current stumpage value of the tree;
3. Estimate the stumpage value of the tree at the next point in time when the tree could be cut;
4. Compare the projected rate of value increase with the ARR. If that rate is less than the ARR then cut the tree now, otherwise keep it.

Example 1: An individual tree decision

Consider a tree with a current stumpage value of \$221.7. The projected stumpage value of this tree after 8 years is \$323.1. If ARR=4%, is the tree financially mature?

Answer: We know that: SV_0 = \$221.7, SV_8 = \$323.1. Calculate the annual rate of value increase:

$$r_{sv} = \sqrt[8]{\frac{SV_8}{SV_0}} - 1 = \sqrt[8]{\frac{323.1}{221.7}} - 1 = 0.0482 = \underline{\underline{4.82\% > 4\%}}$$

Answer: **Keep the tree.**

The (growing) stock holding cost

- Stock holding cost = the opportunity cost of not reinvesting the value of the tree (analogue to the inventory cost in even-aged stands):

$$SHC = SV_0(1+r)^n - SV_0 = SV_0[(1+r)^n - 1]$$

$$Tree\ \ Value\ \ Growth = SV_n - SV_0$$

- The Financial Maturity Rule reinstated: If the Tree Value Growth > the Stock Holding Cost, then keep the tree, otherwise cut it.

<u>Example</u>: An individual tree decision

Consider a tree with a current stumpage value of $221.7. The projected stumpage value of this tree after 8 years is $323.1. If ARR=4%, is the tree financially mature?

$$SHC = \$221.7[(1.04)^8 - 1] = \underline{\$81.71}$$

$$Tree\ \ Value\ \ Growth = \$323.1 - \$221.7 = \underline{\$101.4}$$

Since the Tree Value Growth is greater than the Stock Holding Cost The answer is to **<u>keep the tree</u>.**

The land holding cost

- Land holding cost = the opportunity cost of allowing a tree to continue to use the growing space that it occupies;
- A new tree could be started earlier if the mature tree is cut;
- Calculate the LEV for the space occupied by the tree:

$$Land\ \ Holding\ \ Cost = LEV(1+r)^n - LEV = LEV[(1+r)^n - 1]$$

$$Land\ \ Holding\ \ Cost = LEV[(1+r)^n - 1] = \frac{\overbrace{(r \cdot LEV)}^{annual\ \ rent}[(1+r)^n - 1]}{r}$$

- The Financial Maturity Rule Redefined: If the Tree Value Growth > the Stock + Land Holding Cost, then keep the tree, otherwise cut it.

Example: An individual tree decision

Consider a tree with a current stumpage value of \$221.7. The projected stumpage value of this tree after 8 years is \$323.1. If ARR=4%, is the tree financially mature? Once the current tree is cut, a new crop tree will start to grow and will reach an expected value of \$451.3 at age 30, \$785.9 at age 40 and \$1,128.5 at age 50. There are no management costs. Should the tree be kept?

$$LEV_{30} = \frac{\$451.3}{(1.04)^{30} - 1} = \$201.17$$

$$LEV_{40} = \frac{\$785.9}{(1.04)^{40} - 1} = \underline{\$206.76}$$

$$LEV_{50} = \frac{\$1{,}128.5}{(1.04)^{50} - 1} = \$184.80$$

<u>Example</u> (cont.)

$$Land\ \ Holding\ \ Cost = LEV[(1+r)^n - 1] =$$

$$= \$206.76\{[(1.04)^8 - 1] = \underline{\$76.21}$$

Since we know that the Tree Value Growth is $101.4 and the Stock Holding Cost is $81.71, the net gain from keeping the tree is:

$$Net\ \ Holding\ \ Gain = \$101.4 - \$81.71 - \$76.21 = \underline{\underline{-\$56.52}}$$

Since the Net Holding Gain is negative, the optimal decision is to **<u>cut the tree now</u>.**