



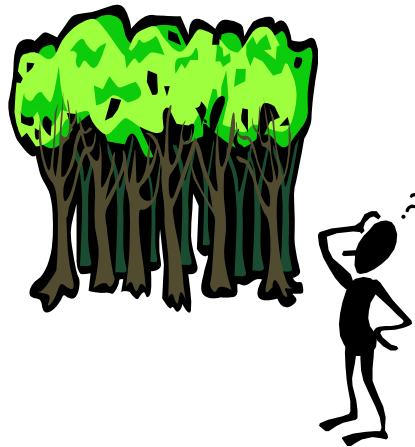
Lecture 15. Determining an optimal level of reserve growing stock

FOR 4684 Natural Resource Economics and Management



Whole stand: uneven-aged

- Two questions:
 - When to cut
 - Individual or groups of trees
 - Whole stand – determine cutting cycle
 - How much to cut
 - What is optimal reserve growing stock?





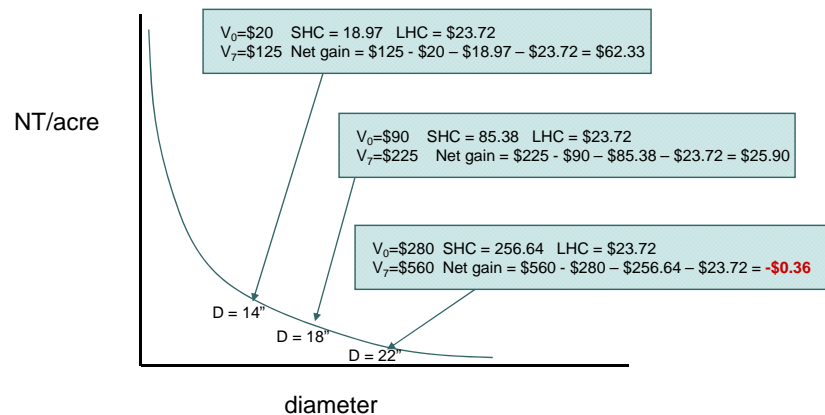
How much or when to cut

- From last lecture, we learned about when to cut.
- We could use same approach to help us determine maximum diameter in a stand's diameter distribution curve...



Determining d_{\max} in a stand

SEV of land for one tree is \$25. Assume ARR = 10% and cutting cycle of 7 years.

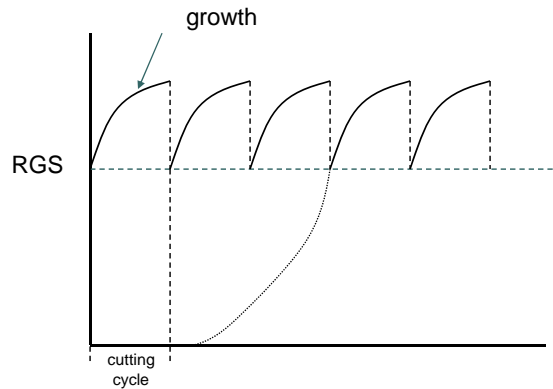


Which is best diameter for d_{\max} ?



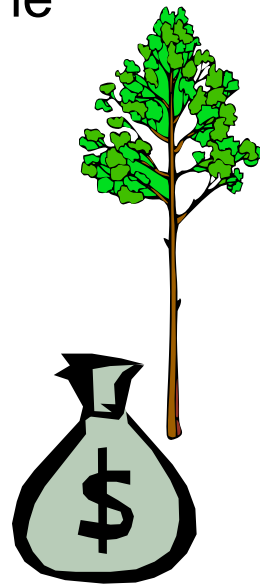
Reserve growing stock

Another important determination is how much total volume should remain in reserve growing stock for an uneven-aged stand.



Two ways to determine optimal RGS

- Find level that maximizes quantity:
 - Value growth – interest charges on growing stock
- Find level of growing stock that equates marginal value growth to guiding rate of return.





Determining optimal RGS

- Our hypothetical example:
 - 7-year growing cycle
 - Price for growing stock and growth at \$0.398 per board foot
 - Hurdle or guiding rate of 6%
- Interest charges on growing stock calculated by:

$$SHC = V_{RGS} (1 + ARR)^{CC} - V_{RGS}$$



Maximize value growth – interest charges...

Initial data...

ARR =	6%					
Cutting cycle	7					
			Value of		Interest	
Initial		7-year	Initial		Charges on	
Growing	Price	Growth	Growing	Value of	Growing	Net
Stock	(\$/bf)	(bd ft.)	Stock	Growth	Stock	Revenue
(1)	(2)	(3)	(4)=(1) * (2)	(5)=(3)*(2)	(6)	(7) = (5) - (6)
3000	0.398	2500				
4000	0.398	3100				
5000	0.398	3800				
6000	0.398	4400				
7000	0.398	4900				
8000	0.398	5200				
9000	0.398	5400				
10000	0.398	5600				

● ● ● | Maximize value growth – interest charges...

Determine value of initial growing stock

ARR =	6%					
Cutting cycle	7					
			Value of		Interest	
Initial		7-year	Initial		Charges on	
Growing	Price	Growth	Growing	Value of	Growing	Net
Stock	(\$/bf)	(bd ft.)	Stock	Growth	Stock	Revenue
(1)	(2)	(3)	(4)=(1) *(2)	(5)=(3)*(2)	(6)	(7) = (5) - (6)
3000	0.398	2500	\$1,194.00			
4000	0.398	3100	\$1,592.00			
5000	0.398	3800	\$1,990.00			
6000	0.398	4400	\$2,388.00			
7000	0.398	4900	\$2,786.00			
8000	0.398	5200	\$3,184.00			
9000	0.398	5400	\$3,582.00			
10000	0.398	5600	\$3,980.00			

● ● ● | Maximize value growth – interest charges...

Determine value of growth...

ARR =	6%					
Cutting cycle	7					
			Value of		Interest	
Initial		7-year	Initial		Charges on	
Growing	Price	Growth	Growing	Value of	Growing	Net
Stock	(\$/bf)	(bd ft.)	Stock	Growth	Stock	Revenue
(1)	(2)	(3)	(4)=(1) *(2)	(5)=(3)*(2)	(6)	(7) = (5) - (6)
3000	0.398	2500	\$1,194.00	\$995.00		
4000	0.398	3100	\$1,592.00	\$1,233.80		
5000	0.398	3800	\$1,990.00	\$1,512.40		
6000	0.398	4400	\$2,388.00	\$1,751.20		
7000	0.398	4900	\$2,786.00	\$1,950.20		
8000	0.398	5200	\$3,184.00	\$2,069.60		
9000	0.398	5400	\$3,582.00	\$2,149.20		
10000	0.398	5600	\$3,980.00	\$2,228.80		

● ● ● | Maximize value growth – interest charges...

Determine interest charges on RGS..

$$SHC = V_{RGS} (1 + ARR)^{CC} - V_{RGS}$$

ARR =	6%					
Cutting cycle	7					
			Value of		Interest	
Initial		7-year	Initial		Charges on	
Growing	Price	Growth	Growing	Value of	Growing	Net
Stock	(\$/bf)	(bd ft.)	Stock	Growth	Stock	Revenue
(1)	(2)	(3)	(4)=(1)*(2)	(5)=(3)*(2)	(6)	(7) = (5) - (6)
3000	0.398	2500	\$1,194.00	\$995.00	\$601.33	
4000	0.398	3100	\$1,592.00	\$1,233.80	\$801.78	
5000	0.398	3800	\$1,990.00	\$1,512.40	\$1,002.22	
6000	0.398	4400	\$2,388.00	\$1,751.20	\$1,202.67	
7000	0.398	4900	\$2,786.00	\$1,950.20	\$1,403.11	
8000	0.398	5200	\$3,184.00	\$2,069.60	\$1,603.56	
9000	0.398	5400	\$3,582.00	\$2,149.20	\$1,804.00	
10000	0.398	5600	\$3,980.00	\$2,228.80	\$2,004.45	

● ● ● | Maximize value growth – interest charges...

Calculate net revenue and pick initial RGS level that maximizes net revenue.

ARR =	6%					
Marginal	7					
Value of			Value of		Interest	
Growth		7-year	Initial		Charges on	
Growing	Price	Growth	Growing	Value of	Growing	Net
Stock	(\$/bf)	(bd ft.)	Stock	Growth	Stock	Revenue
(1)	(2)	(3)	(4)=(1)*(2)	(5)=(3)*(2)	(6)	(7) = (5) - (6)
3000	0.398	2500	\$1,194.00	\$995.00	\$601.33	\$393.67
4000	0.398	3100	\$1,592.00	\$1,233.80	\$801.78	\$432.02
5000	0.398	3800	\$1,990.00	\$1,512.40	\$1,002.22	\$510.18
6000	0.398	4400	\$2,388.00	\$1,751.20	\$1,202.67	\$548.53
7000	0.398	4900	\$2,786.00	\$1,950.20	\$1,403.11	\$547.09
8000	0.398	5200	\$3,184.00	\$2,069.60	\$1,603.56	\$466.04
9000	0.398	5400	\$3,582.00	\$2,149.20	\$1,804.00	\$345.20
10000	0.398	5600	\$3,980.00	\$2,228.80	\$2,004.45	\$224.35



Now, base decision on marginal value growth

- Remember, we are equating marginal value growth percent with hurdle or guiding rate
- Marginal value growth percent is:

$$MVG\% = \left[\sqrt[cc]{\frac{MV_{RGS} + MV_G}{MV_{RGS}}} - 1 \right] 100$$

where: MV_{RGS} = marginal value of growing stock

MV_G = marginal value of growth

CC = cutting cycle in years



Equating MVG% to guiding rate...

Initial Growing Stock (1)	Price (\$/bf) (2)	7-year Growth (bd ft.) (3)	Value of Initial Growing Stock (4)=(1)*(2)	Marginal Value of Growing Stock (5)	Value of Growth (6)=(3)*(2)	Marginal Value of Growth (7)	Marginal Value of Growth Percent (8)
3000	0.398	2500	\$1,194.00		995		
				\$398.00		\$238.80	6.94%
4000	0.398	3100	\$1,592.00		1233.8		
				\$398.00		\$278.60	7.88%
5000	0.398	3800	\$1,990.00		1512.4		
				\$398.00		\$238.80	6.94%
6000	0.398	4400	\$2,388.00		1751.2		
				\$398.00		\$199.00	5.96%
7000	0.398	4900	\$2,786.00		1950.2		
				\$398.00		\$119.40	3.82%
8000	0.398	5200	\$3,184.00		2069.6		
				\$398.00		\$79.60	2.64%
9000	0.398	5400	\$3,582.00		2149.2		
				\$398.00		\$79.60	2.64%
10000	0.398	5600	\$3,980.00		2228.8		

Decision is to add RGS up to 6000 bf



Next lecture....

Even-aged rotation determination