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Project Report No. 49, Loblolly Pine Plantations in East Texas Two Harvest Schedules No Thinning, Final Harvest at 30 Years Thin at 20 Years, Final Harvest at 30 Years Sawlog/Veneer Wood Flow Comparison, A Simulation

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...Loblolly Pine Plantations in East Texas...
...Two Harvest Schedules...
...No Thinning & Final Harvest at 30 years...
...Thin at 20 years & Final Harvest at 30 years...
...Sawlog/Veneer Wood Flow Comparison...
...A Simulation...

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REPORT 49

From
the
East Texas Pine Plantation Research Project
College of Forestry
SFASU
Nacogdoches, TX 75962

November ... 1996

A SIMULATION MODEL WAS CONSTRUCTED TO REPRESENT THE SITUATION AND INVESTIGATE THE RESEARCH QUESTIONS

Model Components are:

Plantation Parameters

01. Species - loblolly pine.
02. Establish, grow and harvest one rotation.
03. Two possible plantation management schedules are considered.
 - a. Final harvest at 30years ... no thinning.
 - b. Final harvest at 30 years ... thinning @ 20 years.
04. Items defined and set by user.
 - a. Site index (base age 25 years).
 - b. Surviving number of trees per acre @ 5 years.
 - c. Percentage of trees with fusiform rust stem infection @ 5 years.
 - d. Merchantability/Utilization standards.
 - 01) Minimum dbh value for pulpwood utilization.
 - 02) Minimum upper stem dob value for pulpwood utilization.
 - 03) Minimum dbh value for sawlog/veneer utilization.
 - 04) Minimum upper stem dob for sawlog/veneer utilization.
 - 05) Percentage of unthinned yield expected to be suitable for sawlog/veneer harvest.
 - 06) Percentage of residual yield expected to be suitable for sawlog/veneer harvest.
05. Unit of measure = tons per acre green weight of wood only.

Thinning Specifications

06. Timing of thinning is at plantation age = 20 years.
07. Percent of wood removed at 15 years of age. Four settings included in simulation model.
 - a. 25%. c. 50%.
 - b. 33%. d. 67%.
08. Increase in growth of residual trees between thinning and final harvest relative to unthinned growth during same period of time. Five settings included in simulation model.
 - a. 0%. c. 20%. e. 40%.
 - b. 10%. d. 30%.

SIMULATION MODEL CONTINUED

Economic Values

09. Interest percent for alternative investments - compounded annually. For discounting future cash flows to 0 years hence.
10. Inflation percent - compounded annually. For compounding stumpage prices into the future.
11. Pulpwood stumpage price per ton at beginning of rotation (0 years hence).
12. Sawlog/veneer stumpage price per ton at beginning of rotation (0 years hence).
13. Establishment cost per acre (0 years hence).
14. Annual administration and operations cash flows each year for 30 years.

Mensurational Concepts

15. Future number of fusiform rust infected & uninfected trees per acre are estimated using the Adams et al. (1996) survival models.
16. For management schedule 3a above (no thinning), total yield (Q) at age 30 years (final harvest) is estimated using Lenhart (1996) prediction models.
17. For a management schedule with thinning at age 20 years, a thinning simulation was designed as:
 - a. Using Lenhart (1996), total yield (R) is predicted at age 20 years.
 - b. Using R & Q wood flow values as present value & future value, respectively, plus the number of years between thinning and final harvest as 20, a compound growth percentage (interest rate) can be calculated.
 - c. In turn, this growth percentage is increased by the values listed in 8a - 8e above to represent hypothetical increases in growth of residual trees following a thinning.
 - d. Thinning wood flow is determined by multiplying values listed in 7a - 7d above by the expected yield in year of thinning.
 - e. By subtraction, a residual yield is calculated after each thinning.
 - f. Using the modified growth %s from 17c above, residual yield is compounded year-by-year for a wood flow at final harvest 15 years later.
 - g. All yields are computed after consideration of merchantability standards listed in 4d above.
 - h. The percentage of unthinned yield expected to be available for sawlog/veneer utilization at 30 years can vary, see 4d above.
 - i. The percentage of residual trees expected to be available for sawlog/veneer utilization at 30 years can vary, see 4d above.

THE SIMULATION MODEL WAS TRANSLATED INTO A SPREADSHEET MODEL

A two-page spreadsheet was designed to represent the simulation model.

In the spreadsheet, the user can easily conduct simulation runs.

Runs that ascertain the effect of different combinations of biological and economical factors.

Sensitivity of wood flow and net present value to plantation management attributes.

A forester can use the spreadsheet to investigate specific combinations of factors.

This spreadsheet is a versatile analytical tool for comparing management scenarios.

THE SIMULATION RUNS FOR THIS STUDY

As an illustration of one possible combination of plantation management settings, the following representative values were designated

- Plantation parameters were:
 - Site index was defined as 50', 70' & 90'.
 - Trees per acre were defined as 300, 500 & 700.
 - Percent of fusiform rust infected stems = 10%.
- For each of the 9 sets of plantation parameters:
 - Economic factors were:
 - Alternative investment interest percent = 6% per year compounded annually.
 - Inflation interest percent = 2% per year compounded annually.
 - Stumpage price for pulpwood = \$10 per ton at beginning of rotation.
 - Stumpage price for sawlog/venner = \$50 per ton at beginning of rotation.
 - No other cash flows were included in this study.
 - Pulpwood merchantability standards were set at: minimum dbh = 4" and minimum upper stem dob = 4".
 - Sawlog/venner merchantability standards were set at: minimum dbh = 8" and minimum upper stem dob = 6".
 - Expected percentage of unthinned yield at 30 years that may be available for possible utilization as sawlog/venner products = 90%.
 - Expected percentages of residual yield at 30 years that may be available for possible utilization as sawlog/venner products were specified as 50%, 70% and 90%.
 - Residual yield situations were specified as:
 - Percent of wood removed values were set at: 25%, 33%, 50% & 67%.
 - Hypothetical increases in growth rates were set as: 0%, 10%, 20%, 30% & 40%.

Results are summarized in 9 charts.

CHARTS 1 - 9

- Results of the simulation runs are presented in 9 charts on the last 18 pages of this report.
- One chart for each plantation parameter combination.
- In turn, each chart consists of specified management parameters:
 - Three percentages of residual yield at final harvest expected to be sawlog/veneer merchantable.
 - Four percentages of possible yield removed at thinning.
 - Five percentages of possible increases in residual tree growth rate after thinning.
- Management information is presented in 60 pairs of ellipses.
- First ellipse in a pair is the difference of:
(sawlog/veneer wood flow/acre with a thinning) -
(sawlog/veneer wood flow/acre with no thinning).
- Second ellipse in a pair is the difference of:
(npv/acre for all products with a thinning) -
(npv/acre for all products with no thinning).
- Shaded ellipses depict management situations where a thinning at 20 years may be advantageous.



Rotation age = 30 years
Thin at 20 years?

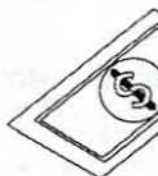
Advantageous?



We recommend caution and care in interpreting and applying the results of the comparisons in Charts 1-9 because:



Advantages in sawlog/vener wood flow are sensitive to age, site index, trees per acre and fusiform rust and merchantability standards.



Advantages in net present value are also sensitive to items mentioned above. In addition, varying interest rates, inflation rates, stumpage prices, establishment costs and annual cash flows probably influence NPV, but this was not investigated in this report.

The 9 charts in this Report 49 provide general indications of possible trends in comparing no thin regimes to thinning regimes

Due to high sensitivity, it may be necessary to fine-tune plantation parameter and management factor combinations to specific values to meet particular situations.

However, we do want to alert readers that in some cases there may be management circumstances that override the results in the charts 1-9.

Several caveats about the comparisons...

- A wide-ranging comprehensive sensitivity analysis was not conducted.
- Data on actual response of East Texas loblolly pine plantations to these types of thinnings are not available.
- Genetic considerations are not included.
- Herbicide applications are not included.
- Pruning treatments are not included.

A LOBLOLLY PINE PLANTATION IN EAST TEXAS

WITH

- SITE INDEX BASE AGE 25 YRS = 50'
- TREES PER ACRE @ 5 YRS = 300
- PERCENT OF TREES WITH FUSIFORM RUST ON STEM = 10%
- INTEREST PERCENT = 6%
- INFLATION PERCENT = 2%
- CURRENT STUMPAGE PRICE PER TON FOR PULPWOOD = \$10
- CURRENT STUMPAGE PRICE PER TON FOR SAWLOG/VENEER = \$50

...One Possible Plantation Management Plan...

...Establish...

...Grow...

...Final harvest of pulpwood and sawlog/veneer at 30 yrs ...

...This Plan with no thinning is expected to produce...

...14 tons/acre of sawlog/veneer timber...

...Net present value of all products is \$719/acre...

...Another Possible Plantation Management Plan...

...Establish...

...Grow...

...Pulpwood thin at 20 yrs ...

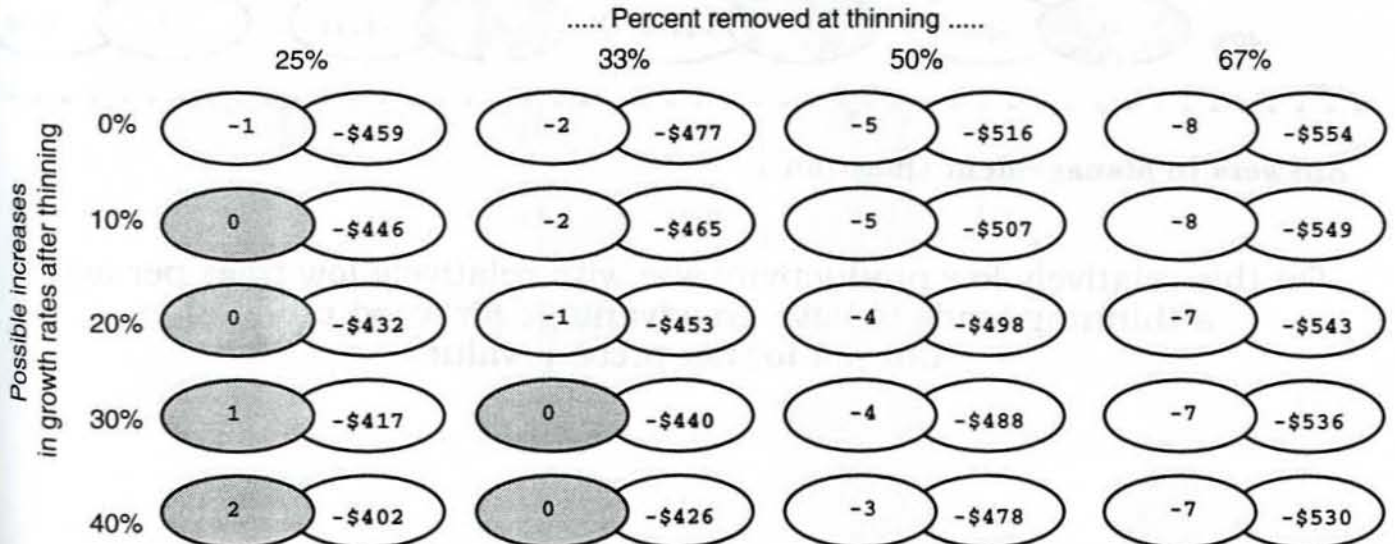
...Grow residual...

...Final harvest of residual pulpwood and sawlog/veneer at 30 yrs...

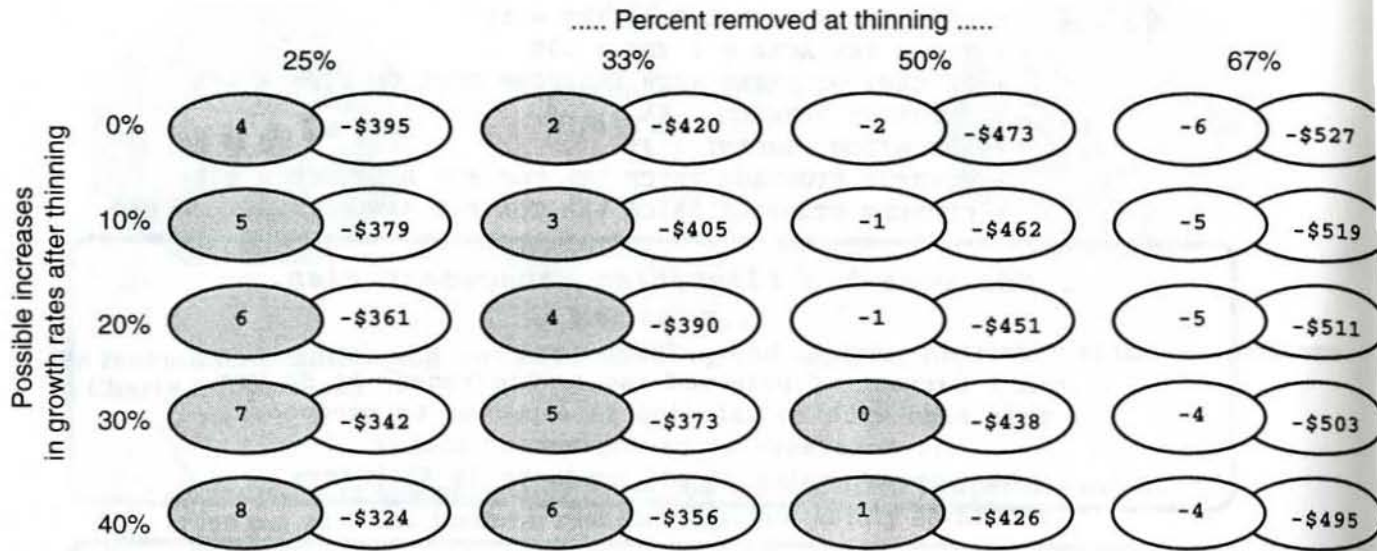
Management question ... Is a thinning @ 20 years advantageous?

For each of the three following merchantability percentage values- 50%, 70% & 90%, there is a set of ellipse pairs. Each set has 20 combinations of percent of yield removed and possible increases in residual growth rates. The first ellipse of a pair = { tons/acre with a thinning } - {14 tons/acre with no thinning } for sawlog/veneer only. The second ellipse of a pair = { npv/acre with a thinning } - { \$719 npv/acre with no thinning } for all products. Shaded ellipses indicate situations where thinning may be advantageous. Unshaded ellipses indicate situations where thinning may not be advantageous.

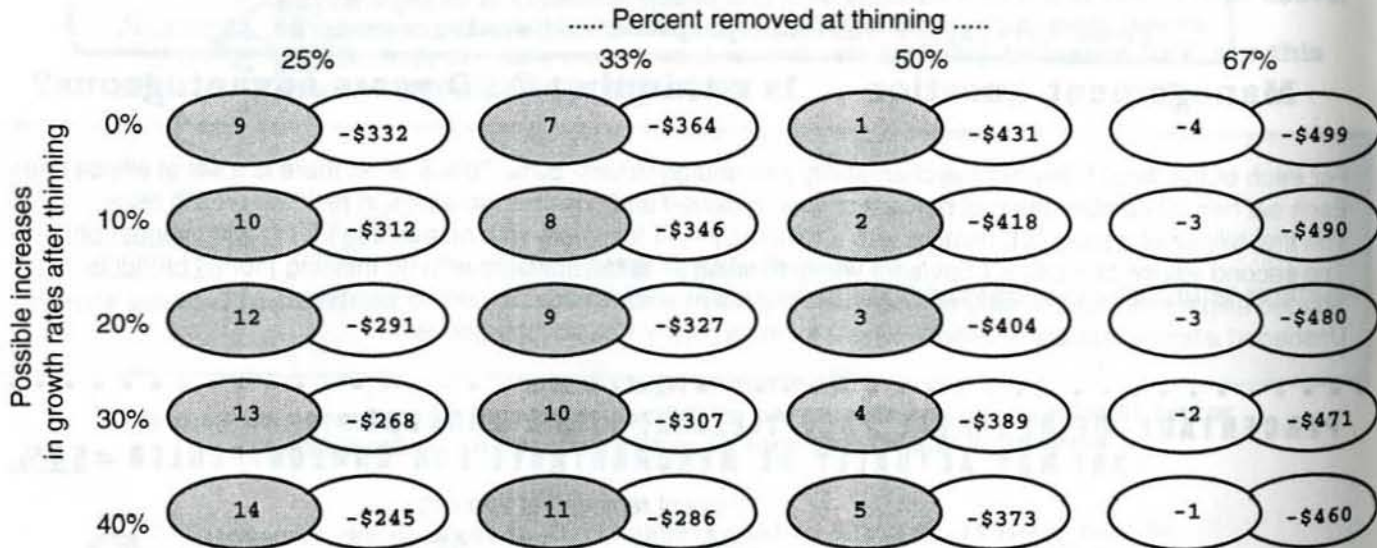
PERCENTAGE OF RESIDUAL TREE YIELD AT FINAL HARVEST THAT MAY ACTUALLY BE MERCHANTABLE FOR SAWLOG/VENEER = 50%



**PERCENTAGE OF RESIDUAL TREE YIELD AT FINAL HARVEST
THAT MAY ACTUALLY BE MERCHANTABLE FOR SAWLOG/VENEER = 70%**



**PERCENTAGE OF RESIDUAL TREE YIELD AT FINAL HARVEST
THAT MAY ACTUALLY BE MERCHANTABLE FOR SAWLOG/VENEER = 90%**



Answers to Management Question...

On this relatively low productivity site with relatively low trees per acre,
a thinning tends to have an advantage for wood production
but not for net present value.

A LOBLOLLY PINE PLANTATION IN EAST TEXAS

WITH

- SITE INDEX BASE AGE 25 YRS = 50'
- TREES PER ACRE @ 5 YRS = 500
- PERCENT OF TREES WITH FUSIFORM RUST ON STEM = 10%
- INTEREST PERCENT = 6%
- INFLATION PERCENT = 2%
- CURRENT STUMPAGE PRICE PER TON FOR PULPWOOD = \$10
- CURRENT STUMPAGE PRICE PER TON FOR SAWLOG/VENEER = \$50

...One Possible Plantation Management Plan...

...Establish...

...Grow...

...Final harvest of pulpwood and sawlog/veneer at 30 yrs ...

...This Plan with no thinning is expected to produce...

...9 tons/acre of sawlog/veneer timber...

...Net present value of all products is \$640/acre...

...Another Possible Plantation Management Plan...

...Establish...

...Grow...

...Pulpwood thin at 20 yrs ...

...Grow residual...

...Final harvest of residual pulpwood and sawlog/veneer at 30 yrs...

Management question ... Is a thinning @ 20 years advantageous?

For each of the three following merchantability percentage values- 50%, 70% & 90%, there is a set of ellipse pairs. Each set has 20 combinations of percent of yield removed and possible increases in residual growth rates.

The first ellipse of a pair = { tons/acre with a thinning } - { 9 tons/acre with no thinning } for sawlog/veneer only.

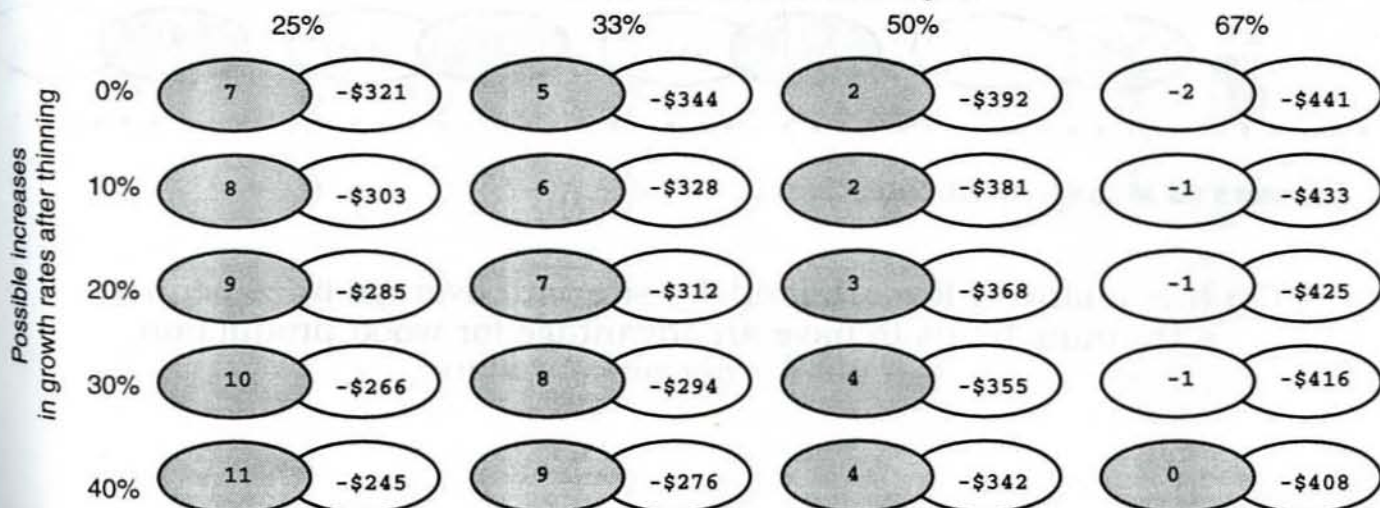
The second ellipse of a pair = { npv/acre with a thinning } - { \$640 npv/acre with no thinning } for all products.

Shaded ellipses indicate situations where thinning may be advantageous.

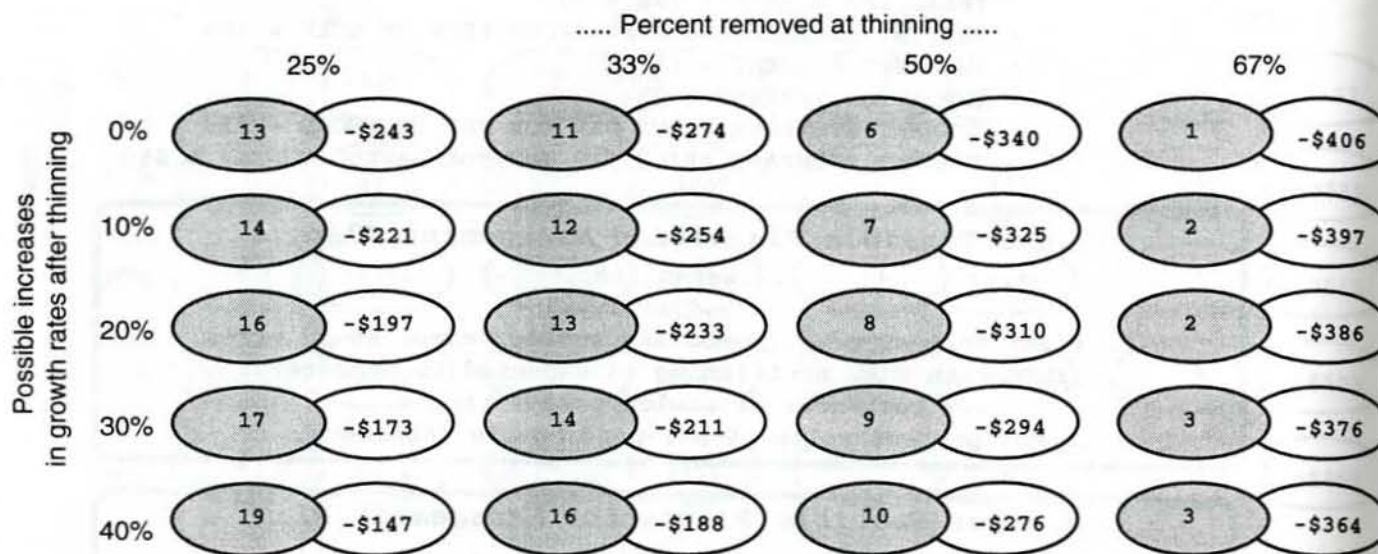
Unshaded ellipses indicate situations where thinning may not be advantageous.

PERCENTAGE OF RESIDUAL TREE YIELD AT FINAL HARVEST THAT MAY ACTUALLY BE MERCHANTABLE FOR SAWLOG/VENEER = 50%

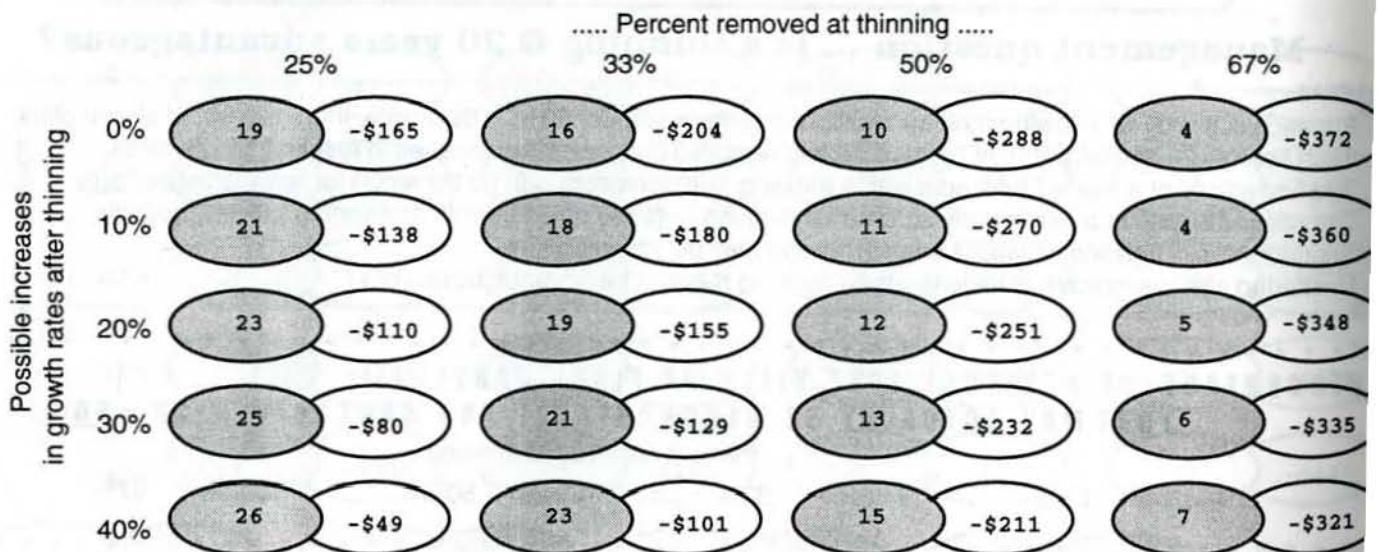
..... Percent removed at thinning



**PERCENTAGE OF RESIDUAL TREE YIELD AT FINAL HARVEST
THAT MAY ACTUALLY BE MERCHANTABLE FOR SAWLOG/VENEER = 70%**



**PERCENTAGE OF RESIDUAL TREE YIELD AT FINAL HARVEST
THAT MAY ACTUALLY BE MERCHANTABLE FOR SAWLOG/VENEER = 90%**



Answers to Management Question...

On this relatively low productivity site with average trees per acre, a thinning tends to have an advantage for wood production but not for net present value.

A LOBLOLLY PINE PLANTATION IN EAST TEXAS

WITH

- SITE INDEX BASE AGE 25 YRS = 50'
- TREES PER ACRE @ 5 YRS = 700
- PERCENT OF TREES WITH FUSIFORM RUST ON STEM = 10%
- INTEREST PERCENT = 6%
- INFLATION PERCENT = 2%
- CURRENT STUMPAGE PRICE PER TON FOR PULPWOOD = \$10
- CURRENT STUMPAGE PRICE PER TON FOR SAWLOG/VENEER = \$50

...One Possible Plantation Management Plan...

...Establish...

...Grow...

...Final harvest of pulpwood and sawlog/veneer at 30 yrs ...

...This Plan with no thinning is expected to produce...

...5 tons/acre of sawlog/veneer timber...

...Net present value of all products is \$577/acre...

...Another Possible Plantation Management Plan...

...Establish...

...Grow...

...Pulpwood thin at 20 yrs ...

...Grow residual...

...Final harvest of residual pulpwood and sawlog/veneer at 30 yrs...

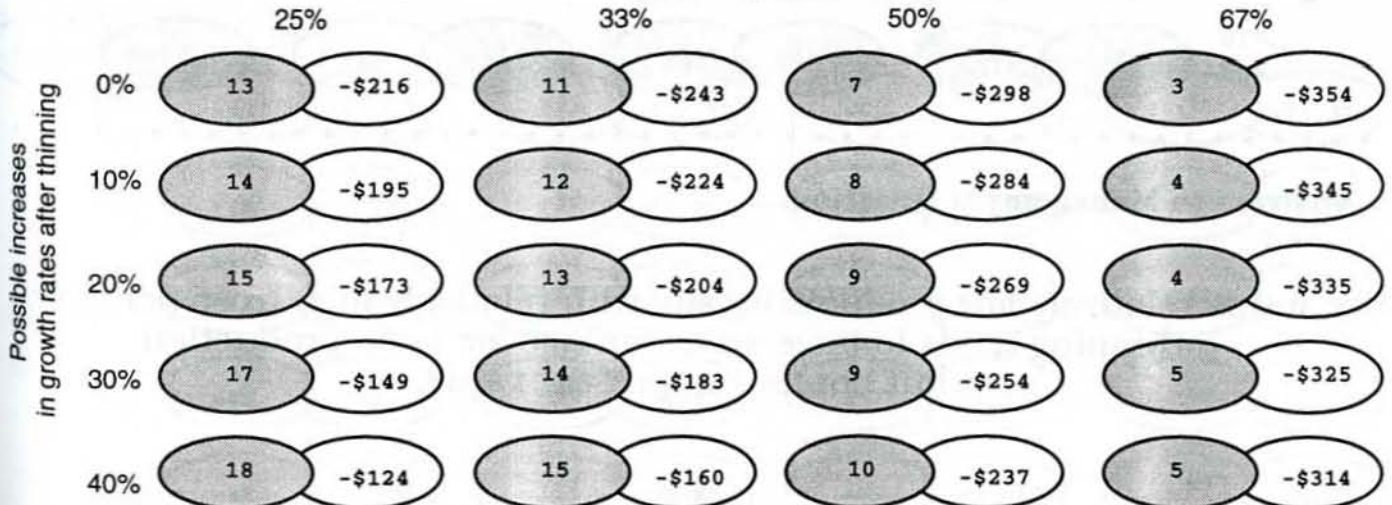
Management question ... Is a thinning @ 20 years advantageous?

For each of the three following merchantability percentage values- 50%, 70% & 90%, there is a set of ellipse pairs. Each sat has 20 combinations of percent of yield removed and possible increases in residual growth rates. The first ellipse of a pair = { tons/acre with a thinning } - { 5 tons/acre with no thinning } for sawlog/veneer only. The second ellipse of a pair = { npv/acre with a thinning } - { \$577 npv/acre with no thinning } for all products. Shaded ellipses indicate situations where thinning may be advantageous. Unshaded ellipses indicate situations where thinning may not be advantageous.

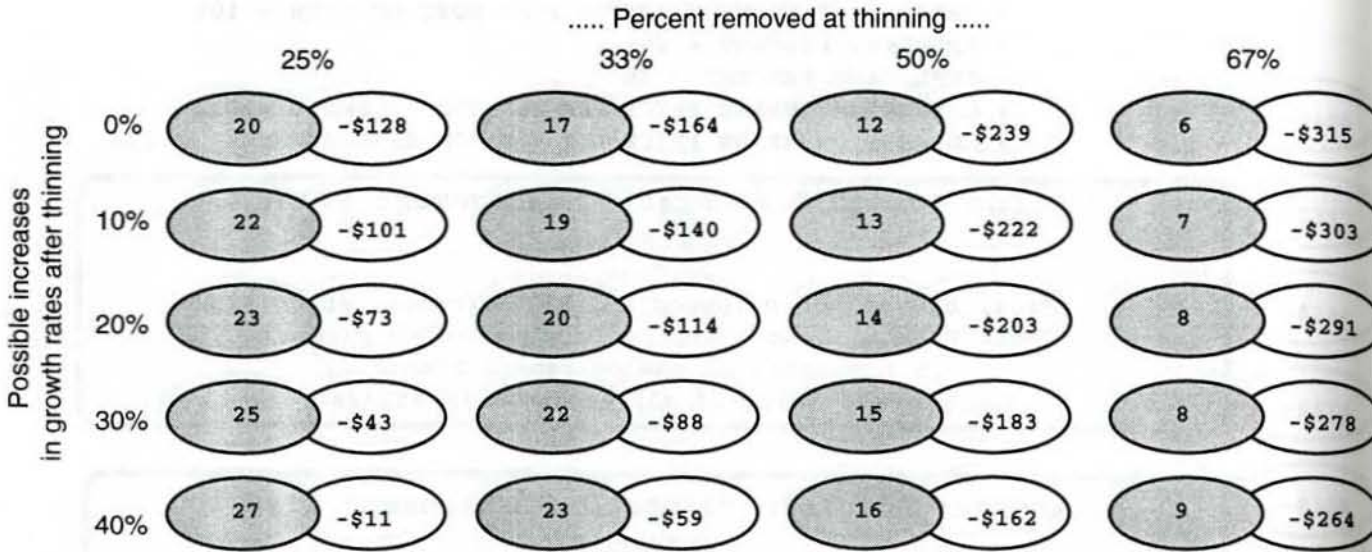
PERCENTAGE OF RESIDUAL TREE YIELD AT FINAL HARVEST

THAT MAY ACTUALLY BE MERCHANTABLE FOR SAWLOG/VENEER = 50%

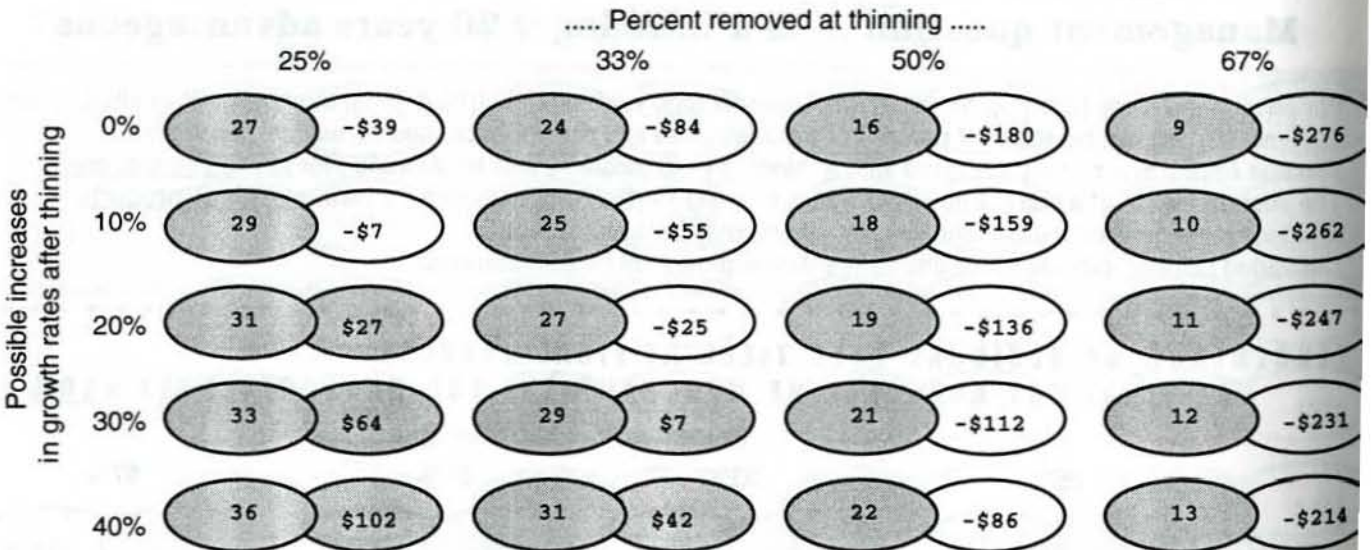
..... Percent removed at thinning



**PERCENTAGE OF RESIDUAL TREE YIELD AT FINAL HARVEST
THAT MAY ACTUALLY BE MERCHANTABLE FOR SAWLOG/VENEER = 70%**



**PERCENTAGE OF RESIDUAL TREE YIELD AT FINAL HARVEST
THAT MAY ACTUALLY BE MERCHANTABLE FOR SAWLOG/VENEER = 90%**



Answers to Management Question...

On this relatively low productivity site with relatively high trees per acre,
a thinning tends to have an advantage for wood production
but not for net present value.

A LOBLOLLY PINE PLANTATION IN EAST TEXAS

WITH

- SITE INDEX BASE AGE 25 YRS = 70'
- TREES PER ACRE @ 5 YRS = 300
- PERCENT OF TREES WITH FUSIFORM RUST ON STEM = 10%
- INTEREST PERCENT = 6%
- INFLATION PERCENT = 2%
- CURRENT STUMPAGE PRICE PER TON FOR PULPWOOD = \$10
- CURRENT STUMPAGE PRICE PER TON FOR SAWLOG/VENEER = \$50

...One Possible Plantation Management Plan...

...Establish...

...Grow...

...Final harvest of pulpwood and sawlog/veneer at 30 yrs ...

...This Plan with no thinning is expected to produce...

...89 tons/acre of sawlog/veneer timber...

...Net present value of all products is \$1,911/acre...

...Another Possible Plantation Management Plan...

...Establish...

...Grow...

...Pulpwood thin at 20 yrs ...

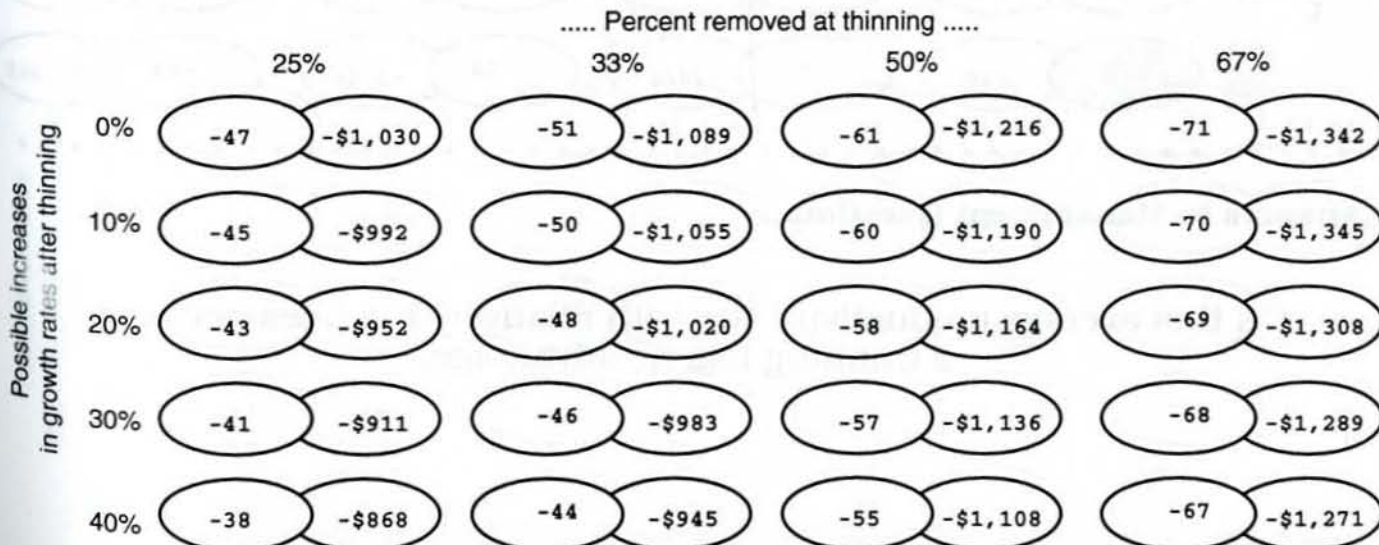
...Grow residual...

...Final harvest of residual pulpwood and sawlog/veneer at 30 yrs...

Management question ... Is a thinning @ 20 years advantageous?

For each of the three following merchantability percentage values- 50%, 70% & 90%, there is a set of ellipse pairs. Each set has 20 combinations of percent of yield removed and possible increases in residual growth rates. The first ellipse of a pair = { tons/acre with a thinning } - {89 tons/acre with no thinning } for sawlog/veneer only. The second ellipse of a pair = { npv/acre with a thinning } - { \$1,911 npv/acre with no thinning } for all products. Shaded ellipses indicate situations where thinning may be advantageous. Unshaded ellipses indicate situations where thinning may not be advantageous.

PERCENTAGE OF RESIDUAL TREE YIELD AT FINAL HARVEST THAT MAY ACTUALLY BE MERCHANTABLE FOR SAWLOG/VENEER = 50%



**PERCENTAGE OF RESIDUAL TREE YIELD AT FINAL HARVEST
THAT MAY ACTUALLY BE MERCHANTABLE FOR SAWLOG/VENEER = 70%**

..... Percent removed at thinning

		25%	33%	50%	67%
Possible increases in growth rates after thinning	0%	-30 -\$817	-36 -\$899	-50 -\$1,073	-63 -\$1,248
	10%	-27 -\$769	-34 -\$856	-48 -\$1,041	-62 -\$1,227
	20%	-24 -\$718	-31 -\$811	-46 -\$1,008	-61 -\$1,205
	30%	-21 -\$666	-28 -\$764	-44 -\$973	-59 -\$1,182
	40%	-18 -\$611	-26 -\$715	-42 -\$937	-58 -\$1,158

**PERCENTAGE OF RESIDUAL TREE YIELD AT FINAL HARVEST
THAT MAY ACTUALLY BE MERCHANTABLE FOR SAWLOG/VENEER = 90%**

..... Percent removed at thinning

		25%	33%	50%	67%
Possible increases in growth rates after thinning	0%	-13 -\$603	-21 -\$708	-38 -\$931	-56 -\$1,154
	10%	-9 -\$545	-18 -\$656	-36 -\$892	-54 -\$1,128
	20%	-6 -\$484	-15 -\$602	-34 -\$852	-52 -\$1,102
	30%	-2 -\$421	-11 -\$545	-31 -\$810	-51 -\$1,074
	40%	2 -\$355	-7 -\$486	-28 -\$766	-49 -\$1,045

Answers to Management Question...

On this average productivity site with relatively low trees per acre,
a thinning has no advantage.

A LOBLOLLY PINE PLANTATION IN EAST TEXAS WITH

- SITE INDEX BASE AGE 25 YRS = 70'
- TREES PER ACRE @ 5 YRS = 500
- PERCENT OF TREES WITH FUSIFORM RUST ON STEM = 10%
- INTEREST PERCENT = 6%
- INFLATION PERCENT = 2%
- CURRENT STUMPAGE PRICE PER TON FOR PULPWOOD = \$10
- CURRENT STUMPAGE PRICE PER TON FOR SAWLOG/VENEER = \$50

...One Possible Plantation Management Plan...

...Establish...

...Grow...

...Final harvest of pulpwood and sawlog/veneer at 30 yrs ...

...This Plan with no thinning is expected to produce...

...105 tons/acre of sawlog/veneer timber...

...Net present value of all products is \$2,164/acre...

...Another Possible Plantation Management Plan...

...Establish...

...Grow...

...Pulpwood thin at 20 yrs ...

...Grow residual...

...Final harvest of residual pulpwood and sawlog/veneer at 30 yrs...

Management question ... Is a thinning @ 20 years advantageous?

For each of the three following merchantability percentage values- 50%, 70% & 90%, there is a set of ellipse pairs. Each set has 20 combinations of percent of yield removed and possible increases in residual growth rates. The first ellipse of a pair = { tons/acre with a thinning } - {105 tons/acre with no thinning } for sawlog/veneer only. The second ellipse of a pair = { npv/acre with a thinning } - { \$2,164 npv/acre with no thinning } for all products. Shaded ellipses indicate situations where thinning may be advantageous. Unshaded ellipses indicate situations where thinning may not be advantageous.

PERCENTAGE OF RESIDUAL TREE YIELD AT FINAL HARVEST THAT MAY ACTUALLY BE MERCHANTABLE FOR SAWLOG/VENEER = 50%

..... Percent removed at thinning

25%

33%

50%

67%

Possible increases in growth rates after thinning

Percent removed at thinning	25%	33%	50%	67%
0%	(-51, -\$1,040)	(-57, -\$1,116)	(-69, -\$1,278)	(-81, -\$1,440)
10%	(-49, -\$990)	(-55, -\$1,071)	(-67, -\$1,245)	(-80, -\$1,418)
20%	(-46, -\$938)	(-52, -\$1,025)	(-66, -\$1,210)	(-79, -\$1,395)
30%	(-43, -\$884)	(-50, -\$977)	(-64, -\$1,174)	(-78, -\$1,371)
40%	(-40, -\$828)	(-47, -\$926)	(-62, -\$1,136)	(-77, -\$1,346)

**PERCENTAGE OF RESIDUAL TREE YIELD AT FINAL HARVEST
THAT MAY ACTUALLY BE MERCHANTABLE FOR SAWLOG/VENEER = 70%**

	 Percent removed at thinning							
		25%		33%		50%		67%	
Possible increases in growth rates after thinning	0%	-30	-\$767	-38	-\$872	-55	-\$1,096	-72	-\$1,320
	10%	-26	-\$704	-34	-\$816	-52	-\$1,054	-70	-\$1,292
	20%	-22	-\$639	-31	-\$758	-50	-\$1,010	-69	-\$1,263
	30%	-18	-\$570	-27	-\$696	-47	-\$965	-67	-\$1,233
	40%	-14	-\$499	-24	-\$632	-44	-\$917	-65	-\$1,202

**PERCENTAGE OF RESIDUAL TREE YIELD AT FINAL HARVEST
THAT MAY ACTUALLY BE MERCHANTABLE FOR SAWLOG/VENEER = 90%**

	 Percent removed at thinning							
		25%		33%		50%		67%	
Possible increases in growth rates after thinning	0%	-8	-\$495	-18	-\$629	-40	-\$915	-62	-\$1,200
	10%	-3	-\$419	-14	-\$561	-37	-\$864	-60	-\$1,166
	20%	2	-\$339	-10	-\$490	-34	-\$811	-58	-\$1,131
	30%	7	-\$256	-5	-\$416	-31	-\$755	-56	-\$1,095
	40%	12	-\$169	0	-\$339	-27	-\$698	-54	-\$1,057

Answers to Management Question...

On this average productivity site with average trees per acre,
a thinning has no advantage.

A LOBLOLLY PINE PLANTATION IN EAST TEXAS WITH

- SITE INDEX BASE AGE 25 YRS = 70'
- TREES PER ACRE @ 5 YRS = 700
- PERCENT OF TREES WITH FUSIFORM RUST ON STEM = 10%
- INTEREST PERCENT = 6%
- INFLATION PERCENT = 2%
- CURRENT STUMPAGE PRICE PER TON FOR PULPWOOD = \$10
- CURRENT STUMPAGE PRICE PER TON FOR SAWLOG/VENEER = \$50

...One Possible Plantation Management Plan...

...Establish...

...Grow...

...Final harvest of pulpwood and sawlog/veneer at 30 yrs ...

...This Plan with no thinning is expected to produce...

...113 tons/acre of sawlog/veneer timber...

...Net present value of all products is \$2,292/acre...

...Another Possible Plantation Management Plan...

...Establish...

...Grow...

...Pulpwood thin at 20 yrs ...

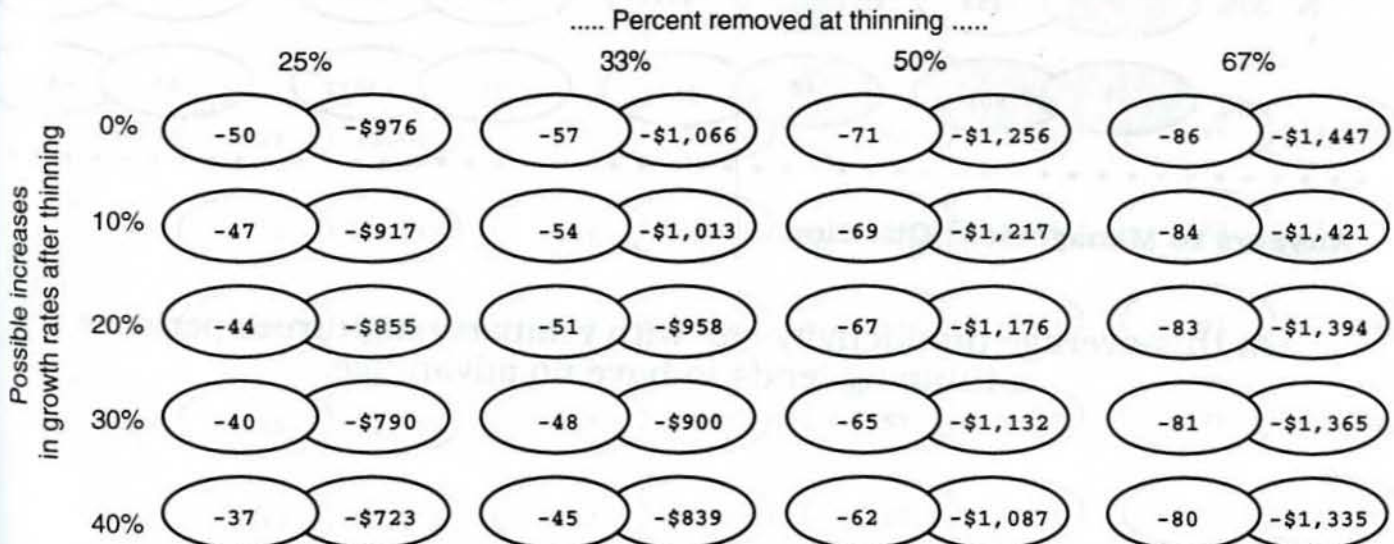
...Grow residual...

...Final harvest of residual pulpwood and sawlog/veneer at 30 yrs...

Management question ... Is a thinning @ 20 years advantageous?

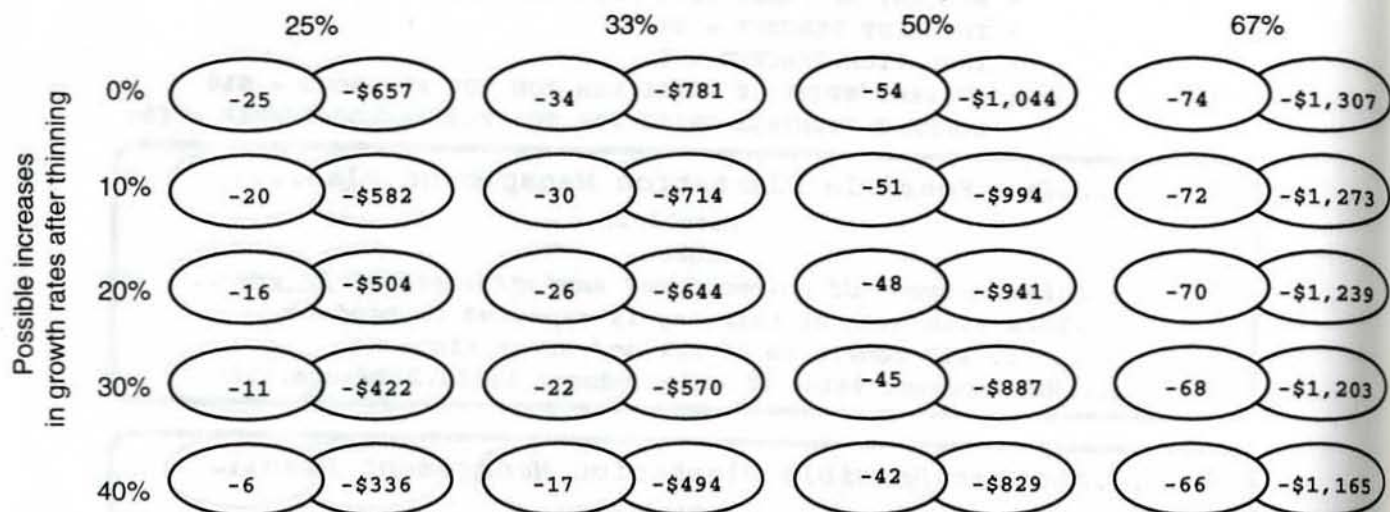
For each of the three following merchantability percentage values- 50%, 70% & 90%, there is a set of ellipse pairs. Each set has 20 combinations of percent of yield removed and possible increases in residual growth rates. The first ellipse of a pair = { tons/acre with a thinning } - {113 tons/acre with no thinning } for sawlog/veneer only. The second ellipse of a pair = { npv/acre with a thinning } - { \$2,292 npv/acre with no thinning } for all products. Shaded ellipses indicate situations where thinning may be advantageous. Unshaded ellipses indicate situations where thinning may not be advantageous.

PERCENTAGE OF RESIDUAL TREE YIELD AT FINAL HARVEST THAT MAY ACTUALLY BE MERCHANTABLE FOR SAWLOG/VENEER = 50%



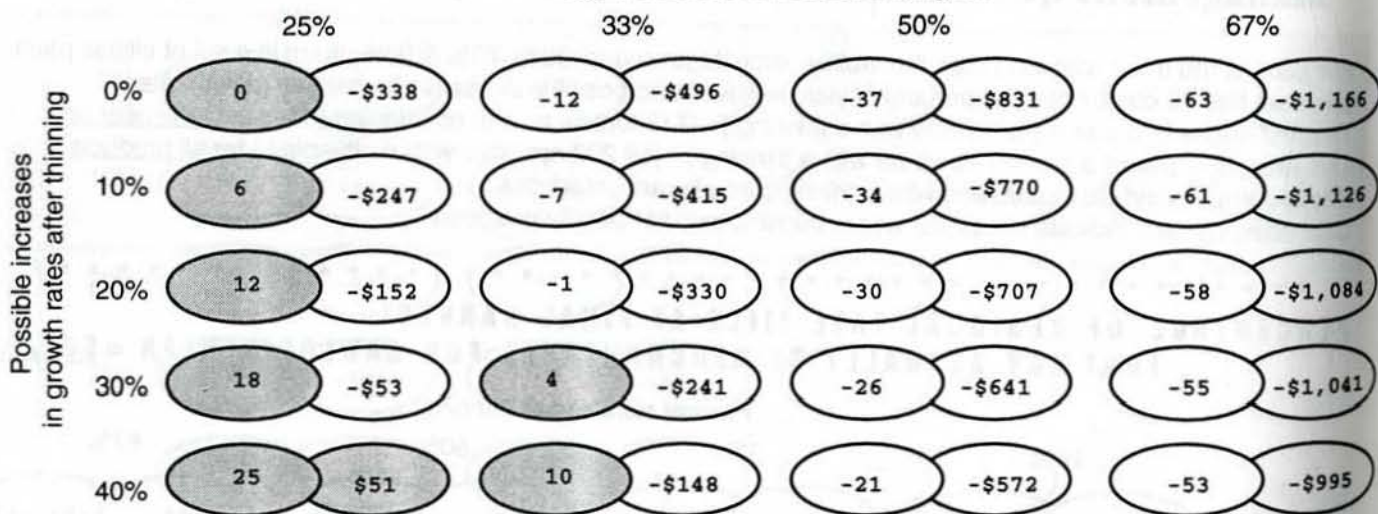
**PERCENTAGE OF RESIDUAL TREE YIELD AT FINAL HARVEST
THAT MAY ACTUALLY BE MERCHANTABLE FOR SAWLOG/VENEER = 70%**

..... Percent removed at thinning



**PERCENTAGE OF RESIDUAL TREE YIELD AT FINAL HARVEST
THAT MAY ACTUALLY BE MERCHANTABLE FOR SAWLOG/VENEER = 90%**

..... Percent removed at thinning



Answers to Management Question...

On this average productivity site with relatively high trees per acre,
a thinning tends to have no advantage.

A LOBLOLLY PINE PLANTATION IN EAST TEXAS

WITH

- SITE INDEX BASE AGE 25 YRS = 90'
- TREES PER ACRE @ 5 YRS = 300
- PERCENT OF TREES WITH FUSIFORM RUST ON STEM = 10%
- INTEREST PERCENT = 6%
- INFLATION PERCENT = 2%
- CURRENT STUMPAGE PRICE PER TON FOR PULPWOOD = \$10
- CURRENT STUMPAGE PRICE PER TON FOR SAWLOG/VENEER = \$50

...One Possible Plantation Management Plan...

...Establish...

...Grow...

...Final harvest of pulpwood and sawlog/veneer at 30 yrs ...

...This Plan with no thinning is expected to produce...

...229 tons/acre of sawlog/veneer timber...

...Net present value of all products is \$4,109/acre...

...Another Possible Plantation Management Plan...

...Establish...

...Grow...

...Pulpwood thin at 20 yrs ...

...Grow residual...

...Final harvest of residual pulpwood and sawlog/veneer at 30 yrs...

Management question ... Is a thinning @ 20 years advantageous?

For each of the three following merchantability percentage values- 50%, 70% & 90%, there is a set of ellipse pairs. Each set has 20 combinations of percent of yield removed and possible increases in residual growth rates. The first ellipse of a pair = { tons/acre with a thinning } - {229 tons/acre with no thinning } for sawlog/veneer only. The second ellipse of a pair = { npv/acre with a thinning } - { \$4,109 npv/acre with no thinning } for all products. Unshaded ellipses indicate situations where thinning may be advantageous. Shaded ellipses indicate situations where thinning may not be advantageous.

PERCENTAGE OF RESIDUAL TREE YIELD AT FINAL HARVEST THAT MAY ACTUALLY BE MERCHANTABLE FOR SAWLOG/VENEER = 50%

..... Percent removed at thinning

	25%	33%	50%	67%
0%	(-129, -\$2,031)	(-140, -\$2,168)	(-162, -\$2,461)	(-185, -\$2,754)
10%	(-125, -\$1,947)	(-136, -\$2,094)	(-159, -\$2,405)	(-183, -\$2,717)
20%	(-120, -\$1,860)	(-132, -\$2,016)	(-156, -\$2,348)	(-181, -\$2,679)
30%	(-115, -\$1,770)	(-127, -\$1,936)	(-153, -\$2,287)	(-179, -\$2,639)
40%	(-110, -\$1,676)	(-123, -\$1,852)	(-150, -\$2,225)	(-177, -\$2,598)

in growth rates after thinning

**PERCENTAGE OF RESIDUAL TREE YIELD AT FINAL HARVEST
THAT MAY ACTUALLY BE MERCHANTABLE FOR SAWLOG/VENEER = 70%**

..... Percent removed at thinning

Possible increases in growth rates after thinning	25%		33%		50%		67%	
	0%	-89	-\$1,529	-104	-\$1,720	-136	-\$2,127	-167
10%	-83	-\$1,423	-99	-\$1,626	-132	-\$2,056	-165	-\$2,486
20%	-77	-\$1,313	-93	-\$1,527	-127	-\$1,983	-162	-\$2,438
30%	-70	-\$1,199	-87	-\$1,425	-123	-\$1,906	-159	-\$2,388
40%	-63	-\$1,080	-81	-\$1,319	-118	-\$1,827	-156	-\$2,335

**PERCENTAGE OF RESIDUAL TREE YIELD AT FINAL HARVEST
THAT MAY ACTUALLY BE MERCHANTABLE FOR SAWLOG/VENEER = 90%**

..... Percent removed at thinning

Possible increases in growth rates after thinning	25%		33%		50%		67%	
	0%	-50	-\$1,027	-69	-\$1,272	-109	-\$1,792	-150
10%	-42	-\$899	-62	-\$1,158	-104	-\$1,707	-146	-\$2,256
20%	-33	-\$766	-54	-\$1,039	-98	-\$1,618	-143	-\$2,197
30%	-25	-\$627	-47	-\$915	-93	-\$1,526	-139	-\$2,136
40%	-16	-\$484	-39	-\$786	-87	-\$1,430	-135	-\$2,073

Answers to Management Question...

On this relatively high productivity site with relatively low trees per acre,
a thinning has no advantage.

A LOBLOLLY PINE PLANTATION IN EAST TEXAS

WITH

- SITE INDEX BASE AGE 25 YRS = 90'
- TREES PER ACRE @ 5 YRS = 500
- PERCENT OF TREES WITH FUSIFORM RUST ON STEM = 10%
- INTEREST PERCENT = 6%
- INFLATION PERCENT = 2%
- CURRENT STUMPAGE PRICE PER TON FOR PULPWOOD = \$10
- CURRENT STUMPAGE PRICE PER TON FOR SAWLOG/VENEER = \$50

...One Possible Plantation Management Plan...

...Establish...

...Grow...

...Final harvest of pulpwood and sawlog/veneer at 30 yrs ...

...This Plan with no thinning is expected to produce...

...288 tons/acre of sawlog/veneer timber...

...Net present value of all products is \$5,053/acre...

...Another Possible Plantation Management Plan...

...Establish...

...Grow...

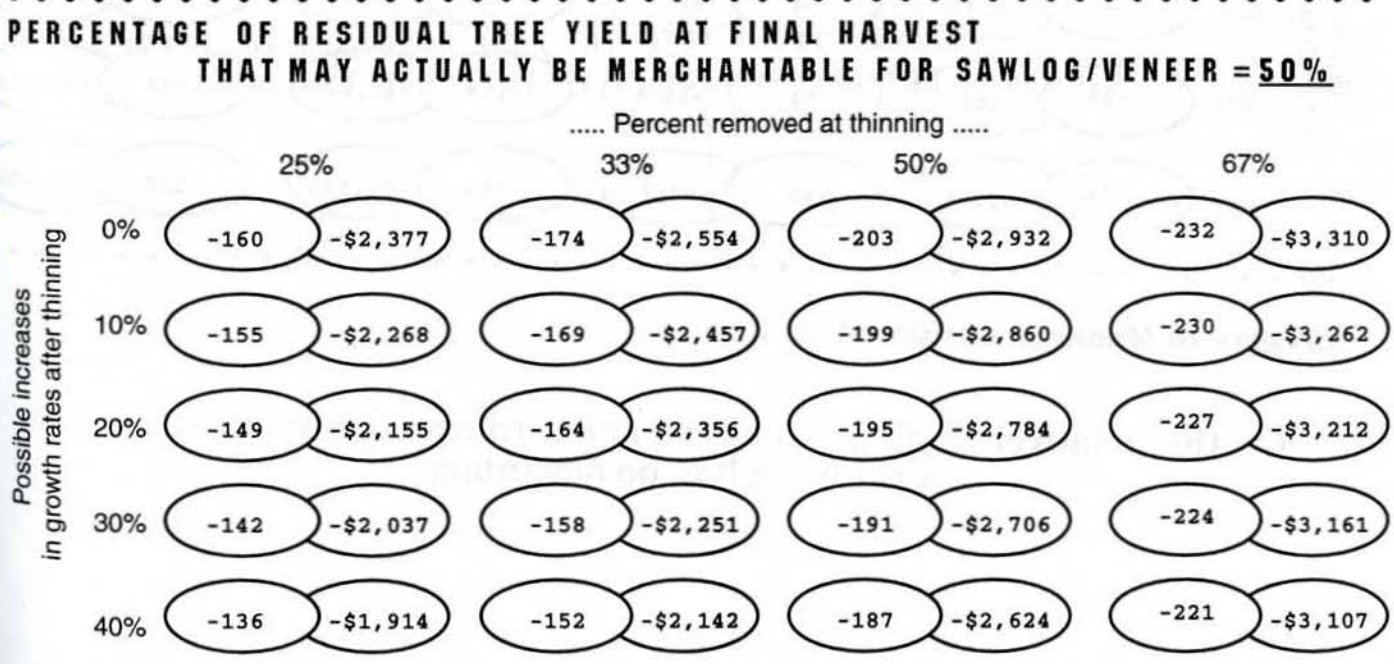
...Pulpwood thin at 20 yrs ...

...Grow residual...

...Final harvest of residual pulpwood and sawlog/veneer at 30 yrs...

Management question ... Is a thinning @ 20 years advantageous?

For each of the three following merchantability percentage values- 50%, 70% & 90%, there is a set of ellipse pairs. Each set has 20 combinations of percent of yield removed and possible increases in residual growth rates. The first ellipse of a pair = { tons/acre with a thinning } - {288 tons/acre with no thinning } for sawlog/veneer only. The second ellipse of a pair = { npv/acre with a thinning } - { \$5,053 npv/acre with no thinning } for all products. Shaded ellipses indicate situations where thinning may be advantageous. Unshaded ellipses indicate situations where thinning may not be advantageous.



**PERCENTAGE OF RESIDUAL TREE YIELD AT FINAL HARVEST
THAT MAY ACTUALLY BE MERCHANTABLE FOR SAWLOG/VENEER = 70%**

..... Percent removed at thinning

Possible increases in growth rates after thinning	25%		33%		50%		67%	
	0%	-109	-\$1,730	-128	-\$1,977	-169	-\$2,501	-210
10%	-101	-\$1,592	-121	-\$1,854	-164	-\$2,409	-206	-\$2,965
20%	-93	-\$1,449	-114	-\$1,726	-158	-\$2,314	-202	-\$2,902
30%	-84	-\$1,300	-106	-\$1,593	-153	-\$2,214	-198	-\$2,836
40%	-75	-\$1,145	-98	-\$1,454	-146	-\$2,111	-194	-\$2,768

**PERCENTAGE OF RESIDUAL TREE YIELD AT FINAL HARVEST
THAT MAY ACTUALLY BE MERCHANTABLE FOR SAWLOG/VENEER = 90%**

..... Percent removed at thinning

Possible increases in growth rates after thinning	25%		33%		50%		67%	
	0%	-58	-\$1,084	-82	-\$1,399	-135	-\$2,070	-187
10%	-47	-\$917	-73	-\$1,250	-128	-\$1,959	-182	-\$2,668
20%	-37	-\$743	-64	-\$1,095	-121	-\$1,843	-178	-\$2,592
30%	-26	-\$563	-54	-\$934	-113	-\$1,723	-173	-\$2,512
40%	-14	-\$375	-43	-\$767	-105	-\$1,598	-168	-\$2,430

Answers to Management Question...

On this relatively high productivity site with average trees per acre,
a thinning has no advantage.

A LOBLOLLY PINE PLANTATION IN EAST TEXAS

WITH

- SITE INDEX BASE AGE 25 YRS = 90'
- TREES PER ACRE @ 5 YRS = 700
- PERCENT OF TREES WITH FUSIFORM RUST ON STEM = 10%
- INTEREST PERCENT = 6%
- INFLATION PERCENT = 2%
- CURRENT STUMPAGE PRICE PER TON FOR PULPWOOD = \$10
- CURRENT STUMPAGE PRICE PER TON FOR SAWLOG/VENEER = \$50

...One Possible Plantation Management Plan...

...Establish...

...Grow...

...Final harvest of pulpwood and sawlog/veneer at 30 yrs ...

...This Plan with no thinning is expected to produce...

...334 tons/acre of sawlog/veneer timber...

...Net present value of all products is \$5,765/acre...

...Another Possible Plantation Management Plan...

...Establish...

...Grow...

...Pulpwood thin at 20 yrs ...

...Grow residual...

...Final harvest of residual pulpwood and sawlog/veneer at 30 yrs...

Management question ... Is a thinning @ 20 years advantageous?

For each of the three following merchantability percentage values- 50%, 70% & 90%, there is a set of ellipse pairs. Each set has 20 combinations of percent of yield removed and possible increases in residual growth rates. The first ellipse of a pair = { tons/acre with a thinning } - {334 tons/acre with no thinning } for sawlog/veneer only. The second ellipse of a pair = { npv/acre with a thinning } - { \$5,765 npv/acre with no thinning } for all products. Shaded ellipses indicate situations where thinning may be advantageous. Unshaded ellipses indicate situations where thinning may not be advantageous.

PERCENTAGE OF RESIDUAL TREE YIELD AT FINAL HARVEST THAT MAY ACTUALLY BE MERCHANTABLE FOR SAWLOG/VENEER = 50%

..... Percent removed at thinning

	25%	33%	50%	67%
0%	(-182, -2,608)	(-199, -\$2,818)	(-233, -\$3,265)	(-267, -\$3,711)
10%	(-176, -\$2,478)	(-192, -\$2,702)	(-228, -\$3,178)	(-264, -\$3,654)
20%	(-168, -\$2,343)	(-186, -\$2,582)	(-223, -\$3,088)	(-261, -\$3,595)
30%	(-161, -\$2,203)	(-179, -\$2,456)	(-219, -\$2,995)	(-258, -\$3,533)
40%	(-153, -\$2,057)	(-173, -\$2,326)	(-213, -\$2,898)	(-254, -\$3,469)

Possible increases in growth rates after thinning

**PERCENTAGE OF RESIDUAL TREE YIELD AT FINAL HARVEST
THAT MAY ACTUALLY BE MERCHANTABLE FOR SAWLOG/VENEER = 70%**

	 Percent removed at thinning							
		25%		33%		50%		67%	
Possible increases in growth rates after thinning	0%	-122	-\$1,845	-145	-\$2,136	-192	-\$2,756	-240	-\$3,376
	10%	-112	-\$1,681	-136	-\$1,990	-186	-\$2,647	-236	-\$3,303
	20%	-102	-\$1,510	-127	-\$1,837	-179	-\$2,533	-232	-\$3,228
	30%	-92	-\$1,332	-118	-\$1,678	-173	-\$2,414	-227	-\$3,150
	40%	-81	-\$1,147	-108	-\$1,513	-165	-\$2,291	-223	-\$3,069

**PERCENTAGE OF RESIDUAL TREE YIELD AT FINAL HARVEST
THAT MAY ACTUALLY BE MERCHANTABLE FOR SAWLOG/VENEER = 90%**

	 Percent removed at thinning							
		25%		33%		50%		67%	
Possible increases in growth rates after thinning	0%	-61	-\$1,082	-90	-\$1,455	-152	-\$2,247	-214	-\$3,040
	10%	-49	-\$883	-79	-\$1,277	-144	-\$2,115	-208	-\$2,953
	20%	-36	-\$676	-68	-\$1,093	-135	-\$1,977	-203	-\$2,862
	30%	-23	-\$461	-56	-\$901	-127	-\$1,834	-197	-\$2,767
	40%	-9	-\$238	-44	-\$701	-117	-\$1,685	-191	-\$2,669

Answers to Management Question...

On this relatively high productivity site with relatively high trees per acre, a thinning has no advantage.