



# Lecture 20. Marginal analysis

FOR 2022. Financial Analysis for Natural Resources.



School of Forest Resources



## What is the “margin?”

- Based on theory of diminishing returns
- In any system, adding additional units of a single resource will increase production at a decreasing rate
- The margin is the change in production from a system with the change of one unit of input



## Example of marginal returns

Hours of study	Score on exam	Marginal returns
0	40	---
1	60	20
2	75	15
3	85	10
4	90	5
5	93	3
6	95	2
7	96	1
8	96	0



## Rules of economic efficiency

- Total project benefits must be greater than total project costs
- Benefits for any separable component must be greater or equal to costs for that component
- There should be no lower cost technology or method for achieving project goals.



## With and without analysis

- We can identify “separable” components and marginal costs and benefits using with and without analysis
- Requires data or techniques for measuring or predicting results with and without a project component




## Example of with and without analysis

Year(s)	Activity	Plantation A	Plantation B
0	Site prep / planting	(\$200)	(\$200)
1	Release	(\$80)	(\$80)
8	Precommercial thinning		(\$100)
20	Pulpwood thinning	\$500	\$600
25	CNS / Pulpwood thinning	\$1000	\$1250
30	Regeneration felling	\$3000	\$3500


What is the marginal or “separable component”?

What are the marginal costs and benefits?



## Marginal components

Year(s)	Activity	Plantation A	Plantation B	Marginal Returns
0	Site prep / planting	(\$200)	(\$200)	0
1	Release	(\$80)	(\$80)	0
8	Precommercial thinning		(\$100)	(\$100)
20	Pulpwood thinning	\$500	\$600	\$100
25	CNS / Pulpwood thinning	\$1000	\$1250	\$250
30	Regeneration felling	\$3000	\$3500	\$500



## Analysis of marginal benefits

- Assume a cost of capital of 6%

Years	Activity	Cash Flow A	Cash Flow B	Marginal Cash Flow	NPV A 6%	NPV B 6%	PV PCT 6%
0	Site prep / planting	(200)	(200)	0	(200)	(200)	0
1	Release	(80)	(80)	0	(75)	(75)	0
8	Precommercial thinning	0	(100)	(100)	0	(63)	(63)
20	Pulpwood thinning	500	600	100	156	187	31
25	CNS / Pulpwood thinning	1,000	1,250	250	233	291	58
30	Regeneration felling	3,000	3,500	500	522	609	87
					636	750	114

At 6%, both plantations have total benefits greater than total costs.

The separable component, precommercial thinning (PCT) has marginal benefits that are greater than marginal costs.

We would have to conduct this type of “with and without” analysis for each component (release, all thinnings) to test for efficiency.



## Analysis of marginal benefits

- Assume a cost of capital of 12%

Years	Activity	Cash Flow	Cash Flow	Marginal Cash Flow	NPV A	NPV B	PV PCT
		A	B		12%	12%	12%
0	Site prep / planting	(200)	(200)	0	(200)	(200)	0
1	Release	(80)	(80)	0	(71)	(71)	0
8	Precommercial thinning	0	(100)	(100)	0	(40)	(40)
20	Pulpwood thinning	500	600	100	52	62	10
25	CNS / Pulpwood thinning	1,000	1,250	250	59	74	15
30	Regeneration felling	3,000	3,500	500	100	117	17
					(61)	(59)	1

At 12%, both plantations have total benefits less than total costs.

The separable component, precommercial thinning (PCT) has marginal benefits that are greater than marginal costs.

The projects are economically inefficient, even though PCT is efficient!



## Analysis of marginal benefits

- Now let's examine marginal benefits of release treatment
- Assume a cost of capital of 6%

Years	Activity	Cash Flow	Cash Flow	Marginal Cash Flow	NPV A	NPV B	PV PCT
		A	B		6%	6%	6%
0	Site prep / planting	(200)	(200)	0	(200)	(200)	0
1	Release	0	(80)	(80)	0	(75)	(75)
8	Precommercial thinning	(100)	(100)	0	(63)	(63)	0
20	Pulpwood thinning	550	600	50	171	187	16
25	CNS / Pulpwood thinning	1,100	1,250	150	256	291	35
30	Regeneration felling	3,400	3,500	100	592	609	17
					757	750	(8)

At 6%, both plantations have total benefits greater than total costs.

The separable component, chemical release has marginal benefits that are less than marginal costs.

Only plantation A is economically efficient because plantation B has a component that is inefficient!



## Test your knowledge

Year	Cash Flow by Project		Marginal cash flow
	Project A	Project B	
0	(\$1500)	(\$2000)	
1-20	(\$50)	(\$40)	
10	\$1500	\$1600	
15	\$5000	\$6000	
20	\$15,000	\$15,000	



## Next lecture...

Inflation, real dollars,  
nominal dollars