



Lecture 24. Sensitivity analysis

FOR 2022. Financial Analysis for Natural Resources.



School of Forest Resources



What is sensitivity analysis?

- We often know that the values of our inputs may not be exact
 - Prediction of costs, volumes, or prices in the future
 - Interest rates change
- Sensitivity analysis is a process of changing values of inputs to see when the result would end up in changing a decision.
 - Evaluate how “robust” a project is to changing values
- Excellent application for spreadsheets!



An example project's cash flow...

Year(s)	Activity	Cash Flow (per acre)
0	Site preparation, planting	(\$200)
1-35	Annual hunting lease	\$3.50
1-35	Annual taxes, management costs	\$2.25
1	Chemical release	(\$80)
10	Precommercial thinning	(\$100)
18	Pulpwood thinning	\$300
25	Pulpwood / small sawtimber thinning	\$1000
26	Fertilization	(\$75)
35	Regeneration felling	\$3000



Sensitivity questions

- The decision maker's time preference for resources is currently 8%, what happens if his cost of capital rises to 14%?
- At a cost of capital of 8%, what if...
 - ...planting and site prep costs increase \$100 per acre?
 - ...timber yields are 25% less than expected?
 - ...annual taxes increase to \$6 per acre per year?
 - ...if timber yields are 25% more than expected?



Baseline analysis at 8%...

Year(s)	Activity	Cash Flow	
		per acre	8%
0	Site preparation, planting	(200.00)	(200.00)
1-35	Annual hunting lease	3.50	40.79
1-35	Annual taxes, mgmt. costs	(2.25)	(26.22)
1	Release	(80.00)	(74.07)
10	Precommercial thinning	(100.00)	(46.32)
18	Pulpwood thinning	300.00	75.07
25	CNS / Pulpwood thinning	1,000.00	146.02
26	Fertilization	(75.00)	(10.14)
35	Regeneration felling	3,000.00	202.90
		NPV =	108.03



Interest rate increases to 10%...

Year(s)	Activity	Cash Flow per acre	IRR		
			8%	10%	9.21%
0	Site preparation, planting	(200.00)	(200.00)	(200.00)	(200.00)
1-35	Annual hunting lease	3.50	40.79	33.75	36.26
1-35	Annual taxes, mgmt. costs	(2.25)	(26.22)	(21.70)	(23.31)
1	Release	(80.00)	(74.07)	(72.73)	(73.25)
10	Precommercial thinning	(100.00)	(46.32)	(38.55)	(41.44)
18	Pulpwood thinning	300.00	75.07	53.96	61.43
25	CNS / Pulpwood thinning	1,000.00	146.02	92.30	110.52
26	Fertilization	(75.00)	(10.14)	(6.29)	(7.59)
35	Regeneration felling	3,000.00	202.90	106.75	137.38
		NPV =	108.03	(52.51)	0.01

Establishment costs increase by \$100 per acre...

Year(s)	Activity	Cash Flow			IRR
		per acre	8%	10%	8.08%
0	Site preparation, planting	(300.00)	(300.00)	(300.00)	(300.00)
1-35	Annual hunting lease	3.50	40.79	33.75	40.46
1-35	Annual taxes, mgmt. costs	(2.25)	(26.22)	(21.70)	(26.01)
1	Release	(80.00)	(74.07)	(72.73)	(74.02)
10	Precommercial thinning	(100.00)	(46.32)	(38.55)	(45.98)
18	Pulpwood thinning	300.00	75.07	53.96	74.08
25	CNS / Pulpwood thinning	1,000.00	146.02	92.30	143.34
26	Fertilization	(75.00)	(10.14)	(6.29)	(9.95)
35	Regeneration felling	3,000.00	202.90	106.75	197.71
		NPV =	8.03	(152.51)	(0.36)

Timber yields decrease by 25%...

Year(s)	Activity	Cash Flow			IRR
		per acre	8%	10%	8.02%
0	Site preparation, planting	(200.00)	(200.00)	(200.00)	(200.00)
1-35	Annual hunting lease	3.50	40.79	33.75	40.71
1-35	Annual taxes, mgmt. costs	(2.25)	(26.22)	(21.70)	(26.17)
1	Release	(80.00)	(74.07)	(72.73)	(74.06)
10	Precommercial thinning	(100.00)	(46.32)	(38.55)	(46.23)
18	Pulpwood thinning	225.00	56.31	40.47	56.12
25	CNS / Pulpwood thinning	750.00	109.51	69.22	109.01
26	Fertilization	(75.00)	(10.14)	(6.29)	(10.09)
35	Regeneration felling	2,250.00	152.18	80.06	151.19
		NPV =	2.03	(115.76)	0.47

Taxes and management costs increase to \$6/ac/yr...

Year(s)	Activity	Cash Flow			IRR
		per acre	8%	10%	8.70%
0	Site preparation, planting	(200.00)	(200.00)	(200.00)	(200.00)
1-35	Annual hunting lease	3.50	40.79	33.75	38.06
1-35	Annual taxes, mgmt. costs	(6.00)	(69.93)	(57.86)	(65.25)
1	Release	(80.00)	(74.07)	(72.73)	(73.60)
10	Precommercial thinning	(100.00)	(46.32)	(38.55)	(43.42)
18	Pulpwood thinning	300.00	75.07	53.96	66.83
25	CNS / Pulpwood thinning	1,000.00	146.02	92.30	124.24
26	Fertilization	(75.00)	(10.14)	(6.29)	(8.57)
35	Regeneration felling	3,000.00	202.90	106.75	161.84
	NPV =		64.33	(88.68)	0.14

Timber yields increase by 25%...

Year(s)	Activity	Cash Flow			IRR
		per acre	8%	10%	10.15%
0	Site preparation, planting	(200.00)	(200.00)	(200.00)	(200.00)
1-35	Annual hunting lease	3.50	40.79	33.75	33.31
1-35	Annual taxes, mgmt. costs	(2.25)	(26.22)	(21.70)	(21.42)
1	Release	(80.00)	(74.07)	(72.73)	(72.63)
10	Precommercial thinning	(100.00)	(46.32)	(38.55)	(38.03)
18	Pulpwood thinning	375.00	93.84	67.45	65.81
25	CNS / Pulpwood thinning	1,250.00	182.52	115.37	111.51
26	Fertilization	(75.00)	(10.14)	(6.29)	(6.07)
35	Regeneration felling	3,750.00	253.63	133.44	127.23
	NPV =		214.03	10.74	(0.29)



Another way to ask sensitivity questions...

- How much could regeneration harvest revenue fall and still earn at least 8% on this project?
- How much could planting/site prep costs increase and still earn at least 8% on the project?
- How much could precommercial thinning costs increase and still earn 8% on the project?



Minimum regeneration harvest returns to earn 8%..

We know that at 8%, NPV of original project is \$108.03

So, what is the future value of \$108.03?


$$V_{35} = 108.03(1.08)^{35} = \$1597.26$$

So, regeneration revenue could drop by \$1597.26, to \$1,402.74, and the project would still earn 8%



Test your knowledge...

How much could precommercial thinning costs increase and still maintain an 8% IRR for the project?



Test your knowledge...

NTLS

How much could site/prep and planting costs increase and still maintain an 8% IRR for the project?

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Risk and expected net
present value