

Lecture 8: Valuation and appraisal

FOR 4684 Natural Resource
Economics and Management



School of Forest Resources



Valuation vs. appraisal

- Valuation establishes..
 - value for some good or service
 - value is specific to some use, organization
 - typically used for investment purposes
 - an investor's value
- Appraisal establishes...
 - most likely market price for a good or service at a specific point in time
 - seller's value
 - Market value



About valuation of a good...

- Valuation can be based upon:
 - Value in use
 - Market value
 - Social value
 - Existence value
 - Potential value for future gains (or losses)
- Issues:
 - Quantitative values difficult for some goods to obtain
 - As much “art” as “science”



Appraisal concepts

- Remember, appraisal is the valuation for a specific good at a specific time and putting a most likely market value on that object.
- Purposes of appraisal
 - Buying and selling
 - Planning
 - Damage claims / theft
 - Taxation
 - Loans, financial transactions



Overview of appraisal methods

- Market transactions or comparable sales
- Net present worth
- Derived value (conversion returns)
- Market quantification
- Replacement cost
- Subjective judgment



Key differences between valuation and appraisal

- Valuation is usually a net present worth or value calculation using one investor's specific financial inputs (\neq market value)
- Valuation can apply to bare land, trees, stand, or a collection of stands
- Appraisal is the process of determining the MOST LIKELY market value: an object's most likely current price for sale given a willing buyer(s) and seller(s).

Valuation of logs and trees – conversion returns

- Stumpage value – what buyers pay for standing timber ready for sale
- Value of a standing tree:
 - Lumber value – milling costs = Log value
 - Log value – logging costs = tree value
- Concept simple, practical application requires a LOT of data.
 - Specific to location of tree
 - Logging equipment
 - Milling equipment
 - Species and size of tree
 - Experience/ability of all operators, from logging site to sawmill

Example of conversion returns

- Red oak lumber, average grade (1 Common) sells for \$725 / MBF
- At one particular mill, the following holds true:
 - Sawmill costs to mill 1000 bf of red oak lumber from average sized logs delivered to the mill is \$125.
 - Labor costs
 - Mill depreciation costs
 - Operating expenses
 - Insurance and administration expenses
 - On average sized logs, the mill has a 3% overrun, that is, for every 1000 bf of logs, the mill produces 1030 bf of lumber.
 - For every 1000 bf of logs, the mill incurs a cost of \$10 for unloading and storage.
 - The mill wants a 20% profit margin on raw material purchased
- The price the mill is willing to pay for delivered red oak logs is:
 - $((\$725 - \$125)1.03 - \$10)0.8 = \$486.40 / \text{MBF}$

Now the logger...

- The logger is receiving, from this particular mill, \$486.40 per 1000 bf for red oak logs
 - For this particular logger:
 - Costs to fell and buck trees is \$25 / MBF
 - Costs to skid trees to landing is \$18 /MBF
 - Cost to load trees is \$4.50 / MBF
 - Hauling costs to the mill are \$12.50 / MBF
 - Logger wants a 30% profit margin
 - This logger on this site is willing to pay the landowner
 - $(\$486.40 - \$25 - \$18 - \$4.50 - \$12.50)0.7 = \298.48
 - So, while lumber is worth \$725 per thousand, the standing tree is worth about \$300 per thousand

Why so complicated?

- Overrun/underrun varies at mill by:
 - Species
 - Diameter
 - Length
 - Log quality
 - Equipment used for sawing, trimming and edging
- Grade recovery varies by tree grade:
 - FAS/1F
 - 1 Common
 - 2A Common
 - 3A Common

Why so complicated?

- At the logging site, production will vary by:
 - Distance to mill
 - Access and terrain
 - Harvesting equipment combinations
 - Operator experience
 - Season – wet weather logging

Prices for lumber vary by species and grade – examples for October 2004

- From Hardwood Market Lumber Report (9 October 2004)
- Southern hardwoods
- 4/4 – four quarter (1 inch), random widths and grades per shipment


Price \$/MBF delivered lumber

Species	FAS	1C	2A
Red oak	\$960	\$825	\$615
Ash	\$840	\$630	\$415
Black gum	\$365	\$335	\$270
White oak	\$880	\$710	\$540
Cherry	\$1775	\$1325	\$640



Practice for you!

- Assume the following costs
 - Sawmill
 - Milling costs \$/MBF lumber is \$175
 - On average, 5% overrun
 - Unloading and storage costs on mill yard are \$15 / MBF logs
 - Mill wants a profit margin of 15% on a log basis.
 - Logging site
 - Hauling costs from forest to mill are \$15/MBF
 - Felling, bucking and skidding logs is \$22.50/MBF
 - Loading costs \$3.50/MBF
 - Logger wants a 20% profit margin
- Given these values, what are the delivered log prices and stumpage prices in \$/MBF for cherry and blackgum given the prices for 1C lumber on the previous slide?



Now, a look at market-based techniques for valuation and appraisal of timberland



Young timber stands

- Let's say you have an 8-year old loblolly pine stand
 - Planted to 550 trees/acre
 - Currently 542 trees/acre, QMD = 3.8"
- What is the best way to determine the value of this stand?
 - Current market value of trees?
 - Replacement cost?
 - Net present value?



Young timber stands

- Current market value
 - Non-merchantable (young growth) may have NO market value!
 - Ignores time value of investment
- Replacement costs
 - Let's say the stand was planted at a cost of \$135 per acre 8 years ago.
 - If the owner has a cost of capital of, say, 8%, then the replacement cost would be \$250 per acre.
 - $\$135(1.08)^8 = \250
 - Ignores value of growth rate in young forests

Young timber stands

- Net present value
 - Must assume some “likely” rotation scheme and future yields and stumpage values
 - In 7 years, at age fifteen, thin 7 cords/acre
 - In 12 years, at age 20, thin 16 cords/acre
 - In 22 years, at age 30, final harvest yields 11.3 MBF (Scribner) and 9 cords per acre
- Stumpage prices of \$16/cord and \$300/MBF
- Interest rate of 8%

Years in future	Cash Flow	PV @ 8%
7	\$112	\$65
12	\$256	\$102
22	\$3500	\$644
Net present value		\$811

The present value of this 8-year old stand is \$811/acre

Another look at valuing young stands

- 350 acre forest
 - 5 stands, each of 70 acres
 - Stand 1 is 0 years old (just planted)
 - Stand 2 is 7 years old
 - Stand 3 is 14 year old
 - Stand 4 is 21 years old
 - Stand 5 is 28 years old.
- Every seven years, you harvest 70 acres of 35-year old pine and receive \$255,000.
- Annual management costs are \$1400 for the forest
- Every seven years you spend \$15,000 on reforestation of the harvested areas
- Assuming you can manage this property in perpetuity, you could afford to pay (with a 7% cost of capital):

$$NPV = \frac{\$255,000 - \$15,000}{1.07^7 - 1} - \frac{\$1400}{0.07} = \$376,182 \quad (\$1075/\text{acre})$$

Valuation of bare land

- Land is valued separately from stumpage or growing stock
- Value of land directly tied to the maximum value of the products it can produce
- Let's go back to our 350 acre pine forest:
 - If a 35-year rotation produces a net value of \$255,000 (\$3640/acre), the bare land value is:

$$SEV = \$3640 \frac{1}{1.07^{35} - 1} - \frac{\$4}{0.07} = \$319$$

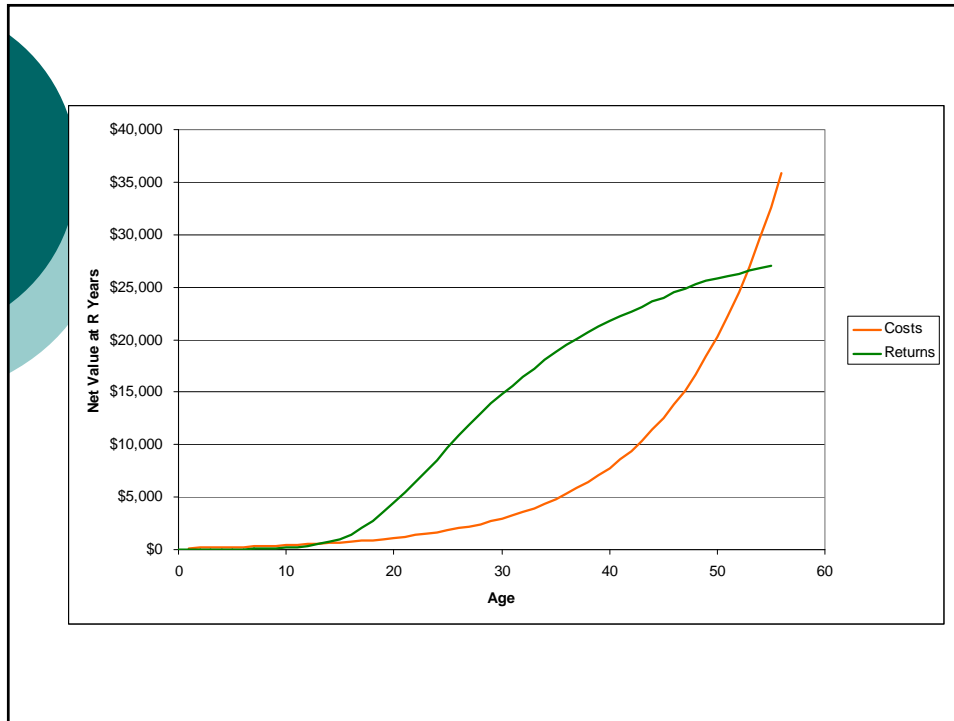
- The value of the LAND alone is $\$319 \times 350 = \$111,650$ (assumes this is the best rotation and is sustainable)
- Using the data, the value of the existing timber is $\$376,182 - \$111,650 = \$264,532$
 - This would NOT be equal to the current stumpage value of the timber.
 - Stands at age 0, 7, and 14 would likely have large amounts of premerchantable timber.

Another way to look at valuation using NPV

- Let's we have pine sawtimber valued today at \$40/ton, and pulpwood at \$6/ton, and we expect that sawtimber stumpage prices will increase by 2% per year and pulpwood prices by 1% per year
- Furthermore, we have establishment costs of \$150 and annual management costs of \$4/year.

Age	Establishment Cost	Annual Costs	Pulpwood		1% Sawtimber		2% Sawtimber		Value Pulpwood	Value Sawtimber	Value @ R	Profit	SEV
			Cords	BF	Tons Pulpwood	Tons Sawtimber	ARR = 10%	ARR = 10%					
0	\$150	\$0	0	0	0	0	0	0	\$0	\$0	\$0	-\$150	
1	\$165	\$4	0	0	0	0	0	\$0	\$0	\$0	-\$169	-\$1,690	
2	\$182	\$8	0	0	0	0	0	\$0	\$0	\$0	-\$190	-\$904	
3	\$200	\$13	0	0	0	0	0	\$0	\$0	\$0	-\$213	-\$643	
4	\$220	\$19	0	0	0	0	0	\$0	\$0	\$0	-\$238	-\$513	
5	\$242	\$24	1	0	3	0	\$17	\$0	\$17	\$17	-\$249	-\$408	
6	\$266	\$31	3	0	8	0	\$51	\$0	\$51	\$51	-\$245	-\$318	
7	\$292	\$38	5	0	13	0	\$86	\$0	\$86	\$86	-\$244	-\$257	
8	\$322	\$46	7	0	19	0	\$122	\$0	\$122	\$122	-\$245	-\$215	
9	\$354	\$54	9	0	24	0	\$158	\$0	\$158	\$158	-\$250	-\$184	
10	\$389	\$64	12	0	32	0	\$213	\$0	\$213	\$213	-\$240	-\$150	
11	\$428	\$74	14	0	38	0	\$251	\$0	\$251	\$251	-\$251	-\$135	
12	\$471	\$86	18	0	48	0	\$326	\$0	\$326	\$326	-\$230	-\$108	
13	\$518	\$98	22	300	59	2	\$403	\$116	\$519	\$519	-\$97	-\$40	
14	\$570	\$112	25	800	67	6	\$462	\$317	\$779	\$779	\$97	\$35	
15	\$627	\$127	28	1200	75	9	\$523	\$485	\$1,007	\$1,007	\$254	\$80	
16	\$689	\$144	31	2000	83	15	\$585	\$824	\$1,408	\$1,408	\$575	\$160	
17	\$758	\$162	34	3300	91	25	\$647	\$1,386	\$2,034	\$2,034	\$1,113	\$275	
18	\$834	\$182	37	4800	99	36	\$712	\$2,057	\$2,768	\$2,768	\$1,752	\$384	
19	\$917	\$205	39	6400	105	48	\$758	\$2,797	\$3,555	\$3,555	\$2,433	\$476	
20	\$1,009	\$229	41	8100	110	61	\$804	\$3,611	\$4,415	\$4,415	\$3,177	\$555	
21	\$1,110	\$256	43	10000	115	75	\$852	\$4,547	\$5,399	\$5,399	\$4,033	\$630	
22	\$1,221	\$286	44	12000	118	90	\$881	\$5,566	\$6,446	\$6,446	\$4,940	\$692	
23	\$1,343	\$318	45	14000	121	105	\$910	\$6,623	\$7,533	\$7,533	\$5,871	\$738	
24	\$1,477	\$354	44	15800	118	119	\$898	\$7,624	\$8,522	\$8,522	\$6,691	\$756	
25	\$1,625	\$393	42	18000	113	135	\$866	\$8,859	\$9,725	\$9,725	\$7,707	\$784	
26	\$1,788	\$437	40	20000	107	150	\$833	\$10,041	\$10,874	\$10,874	\$8,649	\$792	
27	\$1,966	\$484	35	21800	94	164	\$736	\$11,163	\$11,899	\$11,899	\$9,448	\$780	
28	\$2,163	\$537	32	23500	86	176	\$680	\$12,274	\$12,954	\$12,954	\$10,254	\$764	
29	\$2,379	\$595	30	25000	80	188	\$644	\$13,319	\$13,963	\$13,963	\$10,989	\$739	
30	\$2,617	\$658	28	26200	75	197	\$607	\$14,237	\$14,844	\$14,844	\$11,569	\$703	
31	\$2,879	\$728	25	27200	67	204	\$547	\$15,076	\$15,624	\$15,624	\$12,017	\$660	
32	\$3,167	\$805	22	28200	59	212	\$486	\$15,943	\$16,430	\$16,430	\$12,458	\$619	
33	\$3,484	\$889	20	29000	54	218	\$447	\$16,723	\$17,170	\$17,170	\$12,797	\$576	
34	\$3,832	\$982	20	29900	54	224	\$451	\$17,587	\$18,038	\$18,038	\$13,224	\$539	
35	\$4,215	\$1,084	20	30600	54	230	\$456	\$18,359	\$18,815	\$18,815	\$13,515	\$499	
36	\$4,637	\$1,197	19	31100	51	233	\$437	\$19,032	\$19,469	\$19,469	\$13,636	\$456	
37	\$5,101	\$1,320	19	31500	51	236	\$441	\$19,662	\$20,104	\$20,104	\$13,683	\$415	

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32	\$3,167	\$805	22	28200	59	212	\$486	\$15,943	\$16,430	\$16,430	\$12,458	\$619	
33	\$3,484	\$889	20	29000	54	218	\$447	\$16,723	\$17,170	\$17,170	\$12,797	\$576	
34	\$3,832	\$982	20	29900	54	224	\$451	\$17,587	\$18,038	\$18,038	\$13,224	\$539	
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36	\$4,637	\$1,197	19	31100	51	233	\$437	\$19,032	\$19,469	\$19,469	\$13,636	\$456	
37	\$5,101	\$1,320	19	31500	51	236	\$441	\$19,662	\$20,104	\$20,104	\$13,683	\$415	
38	\$5,611	\$1,456	18	31800	48	239	\$422	\$20,247	\$20,669	\$20,669	\$13,602	\$374	
39	\$6,172	\$1,606	18	32000	48	240	\$427	\$20,782	\$21,208	\$21,208	\$13,431	\$335	
40	\$6,789	\$1,770	18	32200	48	242	\$431	\$21,330	\$21,761	\$21,761	\$13,201	\$298	
41	\$7,468	\$1,951	17	32300	46	242	\$411	\$21,824	\$22,235	\$22,235	\$12,816	\$263	
42	\$8,215	\$2,151	16	32400	43	243	\$391	\$22,329	\$22,720	\$22,720	\$12,355	\$230	
43	\$9,036	\$2,370	15	32400	40	243	\$370	\$22,776	\$23,146	\$23,146	\$11,740	\$198	
44	\$9,940	\$2,611	14	32500	38	244	\$349	\$23,303	\$23,652	\$23,652	\$11,102	\$170	
45	\$10,934	\$2,876	13	32400	35	243	\$327	\$23,696	\$24,023	\$24,023	\$10,214	\$142	
46	\$12,027	\$3,167	12	32400	32	243	\$305	\$24,170	\$24,475	\$24,475	\$9,281	\$117	
47	\$13,230	\$3,488	12	32300	32	242	\$308	\$24,577	\$24,885	\$24,885	\$8,168	\$94	
48	\$14,553	\$3,841	11	32150	29	241	\$285	\$24,952	\$25,237	\$25,237	\$6,844	\$71	
49	\$16,008	\$4,229	11	32000	29	240	\$288	\$25,333	\$25,621	\$25,621	\$5,384	\$51	
50	\$17,609	\$4,656	10	31600	27	237	\$264	\$25,516	\$25,781	\$25,781	\$3,516	\$30	
51	\$19,369	\$5,125	10	31300	27	235	\$267	\$25,779	\$26,047	\$26,047	\$1,552	\$12	
52	\$21,306	\$5,642	9	31000	24	233	\$243	\$26,043	\$26,286	\$26,286	-\$662	-\$5	
53	\$23,437	\$6,210	9	30700	24	230	\$245	\$26,307	\$26,552	\$26,552	-\$3,095	-\$20	
54	\$25,781	\$6,835	8	30400	21	228	\$220	\$26,571	\$26,791	\$26,791	-\$5,825	-\$34	



Impact of loans on property valuation

- Let's say you wanted to buy that 350 acres of land for \$350,000.
- You borrow \$100,000 and pay the balance (\$250,000) in cash.
 - Bank charges you 8.74% interest rate
 - 3% pure time preference
 - 2% risk premium
 - 3.5% annual inflation rate
 - Wants repayment in 20 years

$$A = \$100,000 \frac{0.0874}{1 - (1.0874)^{-20}} = \$10,752$$

- What is the NPV of the loan?
 - Borrower has no risk concerning payments, delete interest rate from ARR determination
 - ARR for NPV of loan should be 6.61%

$$A = \$100,000 + (10,752) \frac{1 - (1.0661)^{-20}}{0.0661} = (17,443)$$



Appraisal of timberland

Appraisal is a method to determine or estimate the most likely market value.



Appraisal by comparable sales

For bare land, sales must be similar in terms of...

- Size of tracts
- Site quality
- Location
 - Access
 - Proximity to markets
- Topography
- Time

For timber, sales must be similar in terms of...

- Quality and quantity of timber by product class
 - Age
 - Stocking
 - Diameter distribution
 - Product classes
- Total size and volume of sale
- Harvest type
- Terms of sale
 - Lump sum vs. pay-as-cut
 - Length of time to complete sale
 - Log rule / weight
- Need for BMPs
- Location
- Topography



Comparable sales

- May need to “adjust” sales which have significantly different variables
 - Econometric techniques

Bid Price = $f(V, A, D, \text{Age}, \text{Slope}, \text{Dist}, \text{Plumber})$



Appraisal by capitalized income

- Uses similar approach to NPV approach for valuation
 - Valuation determines *investment value* for a specific use or individual
 - Here, NPV will be used with the *most likely* inputs and methods.
- Also known as income appraisal or income approach
- Not a good approach if the property also provides significant non-income benefits.

Appraisal by capitalized income

- Most likely inputs
 - Growth and yield models
 - Simulate average expected losses
 - Harvest times, management methods should be *typical* for a region.
 - Discount rate should be based on:
 - Risk-free long-term government bond rate + 2% or 3% for risk
 - Corporate bond with risk rate: Baa
- Capitalization rate
 - IRR for a series of similar properties
 - Average IRR for this class is it's capitalization rate or "cap rate"
 - Need a lot of data

Example of "cap rate" calculations

Let's say you have the following similar forest properties in an area with the expected cash flows for under the most likely management scenarios...

Property	A	B	C	D	E	F	G
Year	Cash Flow	Cash Flow	Cash Flow	Cash Flow	Cash Flow	Cash Flow	Cash Flow
0	(\$135)	(\$145)	(\$125)	(\$135)	(\$185)	(\$110)	(\$135)
1	(\$80)	(\$86)	(\$75)	\$0	(\$95)	(\$88)	(\$80)
8	(\$145)	(\$160)	(\$125)	\$0	(\$175)	\$0	(\$130)
15	\$100	\$0	\$120	\$0	\$225	\$125	\$150
20	\$150	\$210	\$350	\$0	\$800	\$0	\$0
25	\$350	\$0	\$450	\$0	\$3,000	\$350	\$500
26	\$0	(\$18)	(\$18)	\$0	\$0	(\$40)	\$0
30	\$600	\$700	\$1,200	\$1,200	\$0	\$700	\$1,100
31	\$0	(\$18)	(\$18)	\$0	\$0	(\$40)	(\$40)
35	\$4,200	\$3,700	\$5,200	\$0	\$0	\$2,800	\$2,900

Cap rate example, continued...

For each property, we determine the IRR (capitalization rate) for that cash flow. We then can determine the "cap rate" by averaging the individual properties cash flow...

Property	A	B	C	D	E	F	G
IRR	9.81%	8.54%	11.62%	7.55%	11.32%	10.13%	9.65%
0	-\$135	-\$145	-\$125	-\$135	-\$185	-\$110	-\$135
1	-\$73	-\$79	-\$67	\$0	-\$85	-\$80	-\$73
8	-\$69	-\$83	-\$52	\$0	-\$74	\$0	-\$62
15	\$25	\$0	\$23	\$0	\$45	\$29	\$38
20	\$23	\$41	\$39	\$0	\$94	\$0	\$0
25	\$34	\$0	\$29	\$0	\$205	\$31	\$50
26	\$0	-\$2	-\$1	\$0	\$0	-\$3	\$0
30	\$36	\$60	\$44	\$135	\$0	\$39	\$69
31	\$0	-\$1	-\$1	\$0	\$0	-\$2	-\$2
35	\$159	\$210	\$111	\$0	\$0	\$96	\$115
NPV	\$0	\$0	\$0	\$0	\$0	\$0	\$0

Cap Rate = 9.8% (95% CI \pm 1.3%)

Replacement cost

- Essentially, what it would cost to replace the asset
 - For physical assets, the replacement costs has the depreciation deducted from the replacement cost (replacement in same condition)
- Emphasis on replacement in similar condition
- Must include expected mortality in forestry
- Best used on very young stands (< 5 years for pine)

Replacement costs in forestry

- As you get further into a stand's rotation, the value of timber has less to do with what you paid for it and more with what can be made of it in the future.
- Concept of "sunk costs"
 - You might have invested \$500 per acre in establishing timber...
 - As a seller, you want a return on that full \$500, but,
 - These costs are "sunk," you cannot recover them, buyers are not interested in previous investments into an asset.

Example of replacement cost

- Rate of return is 6%
- Planting cost of \$130
- Release costs of \$55 in year 1
- Annual management costs of \$2/year
- Annual hunting lease revenue of \$3/year
- Any income is treated as a negative, as it is value already received
- Stand replacement cost (\$/acre) at age 5:

$$R = \$130(1.06)^5 + 55(1.06)^4 + (\$1)\frac{(1.06)^5 - 1}{0.06} = \$236.64$$



Next lecture...

Valuing non-market forest
outputs...