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A METHOD FOR ESTIMATING NET TOTAL LOSS FROM LOSING AN ORANGE TREE[1]

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Abstract. **Each year production of citrus is lost due to damage to citrus trees. If the damaged tree cannot be saved, the income lost includes both that lost in the current crop and the expected future income from the lost tree. Assuming the tree is replaced with a reset, the loss in future income can be partitioned into 2 parts: the additional care given a reset after planting, and the difference in yield between the lost tree and the newly replanted tree. Since both of these occur in the future, discounting is used to calculate the present value of the loss. To provide an illustration, the calculation is made to estimate the discounted loss from a mature 'Valencia' orange tree.**

The estimated net present value of total loss from losing a tree can assist in estimating casualty losses and grower compensation from eminent domain (condemnation) action. The methodology can be used for differing age trees and other citrus varieties.

Method

After visually inspecting a damaged tree and determining that it should be removed, it was assumed that a tree would be replaced by the end of the first year after tree loss (8). Earlier work by Abbitt (1), and Muraro, et al. (7) provide guidelines for determining when trees should be replaced and the profit advantages of such.

Three pieces of information are required to perform the necessary calculations. First, the estimated care costs of a reset are needed. It was assumed that additional care[2] costs are incurred for the first 4 years of a reset's life and that an average 1-2 trees per acre are lost. Estimated annual additional care costs for one reset after planting (when annually losing 1-2 trees/acre) through 4 years of age was \$45.35[3] (5). As more trees are lost per acre, the costs of additional care per tree after planting normally decrease (7). Second, a yield profile for the lost and newly replanted tree are required. Nearby trees with similar characteristics can help determine future yields. Statewide average yields were used in the examples (4). Third, an appropriate discount rate must be determined (2).

To develop the concept of discounting, consider its more familiar counterpart, compounding. Suppose an investor possesses a sum of money, say X dollars, which he can invest at an annual interest rate of r, compounded annually for n years. At the end of n years, his investment has grown to a value R where

$$R = \underbrace{X(1+r)\ldots.(1+r)}_{n\text{—terms}}$$

$$= X(1+r)^n.$$

Equivalently, a sum R received n years from today has a present value X given by

$$X = \frac{R}{(1+r)^n}.$$

This expression is known as the present value formula.

The appropriate value to use for r, the interest rate or discount factor, is difficult to determine. Several methods to derive a discount rate are available that yield different rates (9). The summation method is one. An example of the summation method is:

Safe or non-risk rate (prime rate, passbook saving rate, C. D.'s, bonds, etc.)	5.0%
Risk of ownership (uncertain weather, disease, unstable prices)	2.5%
Lack of liquidity (slowness of converting land into money)	2.0%
Management (cost of managing money)	1.0%
Discount rate	10.5%

Present value factors from the above formula, given a range of discount rates, are shown in Table 3. For example \$1.00 (R) received one year (n) from today discounted at 5% (r) has a \$ .95 present value (X). In the following analysis, a 10.5% discount rate, as derived above, and corresponding present value factors were used for illustrative purposes.

The annual expected gross income and grove care costs of the lost tree are multiplied by the present value factors yielding discounted income and costs. The difference between these 2 values gives the annual discounted net return of the lost tree. The same procedure is used to discount income and costs for the replanted tree. Then these annual discounted returns are summed to derive the discounted net

[1]Florida Agricultural Experiment Stations Journal Series No. 1451.
[2]Includes watering, fertilizing, banking and unbanking, sprouting, and herbiciding.
[3]Includes normally expected annual tree care cost (\$5.00) and costs for additional care outlined in footnote 2.

return of the lost tree[4] and the discounted net cost[5] of the replanted tree.

The number of years over which the summation is performed is the number of years required for the replanted tree to reach maturity. Tree age at maturity varies among citrus varieties. Yields normally level off at approximately 25 years of age. For purposes of analysis, 25-year-old trees were classified as mature. At maturity, the lost tree and replanted yield equally, and thus no income is "lost."

The sum of the annual discounted net returns of the lost tree and the annual discounted net costs of the replanted tree at maturity gives the net present value of total loss to the grower.[6]

Examples

Assume lightning killed a mature, 25-year-old 'Valencia' orange tree. A method to estimate the net present value of the owner's total loss is shown in Table 1. The methodology can best be understood by separating Table 1 into 2 sections, columns 1-6 (net foregone income) and columns 7-11 (net additional cost). In columns 1 through 6 are the computed production, income and costs expected, and the resulting present value if the tree had lived. The expected annual income (column2) and grove care costs (column 4) are discounted to present values (columns 3 and 5, respectively). These annual present values over the 25-year future are then summed. The total present value of expected costs, $43.68 (column 5) is subtracted from the total present value of expected income $76.34 (column 3) to derive a $32.66 discounted net return of the tree lost (column 6).

In columns 7 through 11 are the computed production, income and costs expected, and the resulting present values when a reset is planted. These are expected in the future, are discounted annually, and then summed to derive an estimated $41.61 discounted net cost (column 11) of the reset tree (sum of column 8 minus sum of column 10).

The sum of the annual discounted net costs for 25 years for the reset ($41.61, column 11), is added to the sum of the annual discounted net returns if the tree had lived for 25 years ($32.66, column 6) to derive the estimated net present value of total loss from losing a 25-year-old tree, $32.66 + $41.61 = $74.27, column 12.

The same analysis is applied if a 10-year-old 'Valencia' orange tree is lost. To determine the net present value of

[4]Defined as expected income if the tree had lived minus expected tree care cost if the tree had lived.

[5]Defined as expected tree care cost of maturing reset tree minus expected income from the maturing reset.

[6]This approach implicitly assumes citrus trees have infinite lives. Citrus trees do, in fact, have potential life spans of 100 years or more, and, thus this is a reasonable assumption.

Table 1. Estimated net present value of total loss from losing a 25-year-old 'Valencia' orange tree.

	Column											
	1	2	3	4	5	6	7	8	9	10	11	12
Year	Present value factor @ 10.5% discount rate[z]	Expected income if tree had lived: average boxes/tree[y] @ $2.08/box[x]	Present value of expected income (1 x 2)	Grove care cost if tree had lived[w]	Present value of grove care cost (1 x 4)	Discounted net return of tree lost (3 − 5)	Expected grove care cost of reset tree[v]	Present value of grove care cost (1 x 7)	Expected income from reset tree[u]	Present value of expected income (1 x 9)	Discounted net cost of reset tree (8 − 10)	Net present value of total loss from tree lost (6 + 11)
1	.91	$8.74	$7.91	$5.00	$4.53		$21.25	$19.23	$0.00	$0.00		
2	.82	8.74	7.17	5.00	4.10		9.90	8.12	0.00	0.00		
3	.74	8.74	6.47	5.00	3.70		7.40	5.48	0.00	0.00		
4	.67	8.74	5.86	5.00	3.35		6.80	4.56	1.41	.94		
5	.61	8.74	5.33	5.00	3.05		5.00	3.05	1.77	1.08		
6	.55	8.74	4.81	5.00	2.75		5.00	2.75	2.12	1.17		
7	.50	8.74	4.37	5.00	2.50		5.00	2.50	2.45	1.23		
8	.45	8.74	3.93	5.00	2.25		5.00	2.25	2.79	1.26		
9	.41	8.74	3.58	5.00	2.05		5.00	2.05	3.12	1.28		
10	.37	8.74	3.23	5.00	1.85		5.00	1.85	3.45	1.28		
11	.33	8.74	2.88	5.00	1.65		5.00	1.65	3.79	1.25		
12	.30	8.74	2.62	5.00	1.50		5.00	1.50	4.16	1.25		
13	.27	8.74	2.36	5.00	1.35		5.00	1.35	4.51	1.22		
14	.25	8.74	2.19	5.00	1.25		5.00	1.25	4.91	1.23		
15	.22	8.74	1.92	5.00	1.10		5.00	1.10	5.30	1.17		
16	.20	8.74	1.75	5.00	1.00		5.00	1.00	5.70	1.14		
17	.18	8.74	1.57	5.00	.90		5.00	.90	6.09	1.10		
18	.17	8.74	1.49	5.00	.85		5.00	.85	6.49	1.10		
19	.15	8.74	1.31	5.00	.75		5.00	.75	6.88	1.03		
20	.14	8.74	1.22	5.00	.70		5.00	.70	7.22	1.01		
21	.12	8.74	1.05	5.00	.60		5.00	.60	7.53	.90		
22	.11	8.74	.96	5.00	.55		5.00	.55	7.84	.86		
23	.10	8.74	.87	5.00	.50		5.00	.50	8.15	.82		
24	.09	8.74	.79	5.00	.45		5.00	.45	8.47	.76		
25	.08	8.74	.70	5.00	.40		5.00	.40	8.74	.70		
Total			$76.34		$43.68	$32.66		$65.39		$23.78	$41.61	$74.27

[z]Refer to Table 3.
[y]Average yield for tree lost (4).
[x]Average price for most recent 25 year time span (3).
[w]Based on budgeted information (6).
[v]Includes removing dead tree and planting reset tree; watering, fertilizing, banking and unbanking, sprouting and herbicide of reset the first 4 years.
[u]Average price for most recent 25 year time span multiplied by the average yield for a maturing tree.

total loss, the cost of caring for the tree if it had lived, the additional cost of the reset, and the income foregone as the reset matures to the age of the tree that was lost must be estimated over 25 years (Table 2). The expected annual income and cost through 25 years if the tree had lived are discounted to a present value, $53.99 (column 3) and $43.68 (column 5) respectively, and then subtracted for an estimated $10.31 discounted net return (column 6) from the lost tree.

When the reset is planted, the procedure in columns 1-6 is followed in columns 7-11 (Table 2). The $41.61 discounted net cost of the reset tree (column 11) is derived by subtracting the $23.78 present value of expected income, column 10, from the $65.39 present value of grove care cost, column 8.

In column 12, the $41.61 discounted net cost of the reset tree (column 11) is added to the $10.31 discounted net return of the lost tree over 25 years (column 6) to derive the $51.92 ($10.31 + $41.61) net present value of total loss from losing a 10-year-old 'Valencia' orange tree and replacing it.

Applications

A casualty as defined by the IRS is the complete or partial destruction or loss of property resulting from an identifiable event that is damaging to property and is sudden, unexpected, or unusual in nature (10). Therefore, the loss of a citrus tree is a partial loss in a citrus operation. The allowable casualty loss deduction for a citrus tree would be the lower of the remaining book *value* (cost – depreciation taken) or the decrease in the fair market value of the tree lost. IRS defines the decrease in fair market value as the difference between the fair market value before the loss and the fair market value after the loss (10). The discounted net cost of the reset tree (Table 1, column 11) can indicate the decrease in the fair market value. Therefore, appraisers can utilize the discounted net cost of the reset as a check for comparison to their appraised estimation of the decrease in fair market value.

For example, assume a mature (25-year-old) 'Valencia' grove (80 trees) was purchased for $3,000 in 1973. For income tax purposes, one-third ($1,000) of the purchase price was allocated to the land and two-thirds ($2,000) was allocated to the 25-year-old trees. The original book value per tree was $25.00 ($2,000/80). The depreciation schedule per tree was set at 4% annually, or $1/year (4% x $25.00). In 1978, assume a tree is killed by lightning and the owner wishes to expense the remaining book value as a casualty loss. The remaining book value per tree is $20.00 [$25.00 (original book value) – $5.00 (depreciation for 5 years)]. The $20.00 remaining book value must be equal to or less

Table 2. Estimated net present value of total loss from losing a 10-year-old 'Valencia' orange tree.

	Column											
	1	2	3	4	5	6	7	8	9	10	11	12
Year	Present value factor @ 10.5% discount rate[z]	Expected income if tree had lived: average boxes/tree[y] @ $2.08/ box[x]	Present value of expected income (1 x 2)	Grove care cost if tree had lived[w]	Present value of grove care cost (1 x 4)	Discounted net return of tree lost (3 – 5)	Expected grove care cost of reset tree[v]	Present value of grove care cost (1 x 7)	Expected income from reset tree[u]	Present value of expected income (1 x 9)	Discounted net cost of reset tree (8 – 10)	Net present value of total loss from tree lost (6 + 11)
1	.91	$3.79	$ 3.43	$5.00	$ 4.53		$21.25	$19.23	$0.00	$0.00		
2	.82	4.16	3.41	5.00	4.10		9.90	8.12	0.00	0.00		
3	.74	4.51	3.34	5.00	3.70		7.40	5.48	0.00	0.00		
4	.67	4.78	3.20	5.00	3.35		6.80	4.56	1.41	.94		
5	.61	5.30	3.23	5.00	3.05		5.00	3.05	1.77	1.08		
6	.55	5.70	3.14	5.00	2.75		5.00	2.75	2.12	1.17		
7	.50	6.09	3.05	5.00	2.50		5.00	2.50	2.45	1.23		
8	.45	6.49	2.92	5.00	2.25		5.00	2.25	2.79	1.26		
9	.41	6.88	2.82	5.00	2.05		5.00	2.05	3.12	1.28		
10	.37	7.22	2.67	5.00	1.85		5.00	1.85	3.45	1.28		
11	.33	7.53	2.48	5.00	1.65		5.00	1.65	3.79	1.25		
12	.30	7.84	2.35	5.00	1.50		5.00	1.50	4.16	1.25		
13	.27	8.15	2.30	5.00	1.35		5.00	1.35	4.51	1.22		
14	.25	8.47	2.12	5.00	1.25		5.00	1.25	4.91	1.23		
15	.22	8.74	1.92	5.00	1.10		5.00	1.10	5.30	1.17		
16	.20	8.74	1.75	5.00	1.00		5.00	1.00	5.70	1.14		
17	.18	8.74	1.57	5.00	.90		5.00	.90	6.09	1.10		
18	.17	8.74	1.49	5.00	.85		5.00	.85	6.49	1.10		
19	.15	8.74	1.31	5.00	.75		5.00	.75	6.88	1.03		
20	.14	8.74	1.22	5.00	.70		5.00	.70	7.22	1.01		
21	.12	8.74	1.05	5.00	.60		5.00	.60	7.53	.90		
22	.11	8.74	.96	5.00	.55		5.00	.55	7.84	.86		
23	.10	8.74	.87	5.00	.50		5.00	.50	8.15	.82		
24	.09		.79	5.00	.45		5.00	.45	8.47	.76		
25	.08		.70	5.00	.40		5.00	.40	8.74	.70		
Total			$53.99		$43.68	$10.31		$65.39		$23.78	$41.61	$51.92

[z]Refer to Table 3.
[y]Average yield for tree lost (4).
[x]Average price for most recent 25 year time span (3).
[w]Based on budgeted information (6).
[v]Includes removing dead tree and planting reset tree; watering, fertilizing, banking and unbanking, sprouting and herbicide of reset the first 4 years.
[u]Average price for most recent 25 year time span multiplied by the average yield for a maturing tree.

than the estimated discounted net cost of the reset tree to represent the casualty loss. Since the $20.00 remaining book value is less than the $41.61 estimated discounted net cost of the reset tree (Table 1, column 11), the entire $20.00 can represent the casualty loss.

If the remaining book value is more than the discounted net cost of the reset tree, only the discounted net cost of the reset tree can represent the casualty loss. For example, suppose in 1977 a 10-year-old, 70-tree 'Valencia' grove was purchased for $5,000 with $4,200 allocated to the trees. The original book value per tree was $60 with a 4% annual depreciation rate. The $57.60 remaining book value from losing a tree in 1978 ($60.00 – $2.40) is $15.99 more than the $41.61 discounted net cost of the reset tree (Table 2, column 11). Thus only $41.61 can represent the casualty loss.

The powers of eminent domain (condemnation) allow government to take private property for the general public good or interest. The private owner must be justly compensated (usually in money) for his loss. Just compensation represents the property's current estimated value (via an appraisal) to the owner. The net present value of total loss can be used as an estimate of compensation for owners whose trees are taken by eminent domain proceedings. Assume a county plans to extend a paved road that will necessitate taking 2 rows (20 trees) of privately owned, 10-year-old 'Valencia' orange trees. Further assume the grower will plant 20 young trees in another planting to replace the trees that are taken. The owner must be justly compensated for the trees lost. The discounted net return of the tree taken (Table 2, column 6) and the discounted net cost of the reset tree (Table 2, column 11) can be used as an estimate of the owner's loss. For taking the 2 rows of trees, the government could pay the owner an estimated $1,038.40 ($51.92/tree, Table 2, column 12); the net present value of total loss from losing a tree.

If the owner was not intending to plant new trees, the discounted net return of the trees lost (Table 2, column 6) would not represent just compensation because income and costs are discounted for only 25 years. For the discounted net return of the trees lost to represent compensation, income and costs must be discounted for the entire expected life of the tree; not just to its maturity of 25 years of age as shown in column 6.

Compensation for the appraised value of the land without the trees and compensation for improvements to the land (usually the present cost of reproducing the improvement) would also be paid the owner. Improvements to citrus land include equipment barns, irrigation systems, permanent chemical storage tanks, etc.

Conclusion

State average prices, yields, costs, and a discount rate with resulting present value factors selected by the authors were utilized in the examples. To determine the net present value of total loss from losing a tree, the authors suggest the methodology be utilized with prices, yields, costs, and a discount rate for the specific case being analyzed. Discount rates vary among growers. Present value factors, given a range of discount rates are shown in Table 3. If trees are assumed to reach maturity past 25 years of age in specific cases, the analysis in Table 1 and 2 should be continued to the maturity age.

The examples for estimating casualty losses and just compensation for eminent domain proceedings were hypothesized. The authors' intent was to demonstrate how the methodology can be used. Other uses for the methodology and the derived net present value of total loss from losing a tree may be found after exposure to industry scrutiny.

Table 3. Present value factors, given selected discount rates.

	Discount rate												
Year	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10.0	10.5	11.0
1	.95[z]	.95	.94	.94	.93	.93	.93	.92	.92	.91	.91	.91	.90
2	.91	.90	.89	.88	.87	.87	.86	.85	.84	.83	.83	.82	.81
3	.86	.85	.84	.83	.82	.81	.79	.78	.77	.76	.75	.74	.73
4	.82	.81	.79	.78	.76	.75	.74	.72	.71	.70	.68	.67	.66
5	.78	.77	.75	.73	.71	.70	.68	.67	.65	.64	.62	.61	.59
6	.75	.73	.70	.69	.67	.65	.63	.61	.60	.58	.56	.55	.53
7	.71	.69	.67	.64	.62	.60	.58	.56	.55	.53	.51	.50	.48
8	.68	.65	.63	.60	.58	.56	.54	.52	.50	.48	.47	.45	.43
9	.64	.62	.60	.57	.54	.51	.50	.48	.46	.44	.42	.41	.39
10	.61	.59	.56	.53	.51	.49	.46	.44	.42	.40	.39	.37	.35
11	.59	.55	.53	.50	.48	.45	.43	.41	.39	.37	.35	.33	.32
12	.56	.53	.50	.47	.44	.42	.40	.38	.35	.34	.32	.30	.29
13	.53	.50	.47	.44	.41	.39	.37	.35	.33	.31	.29	.27	.26
14	.51	.47	.44	.41	.39	.36	.34	.32	.30	.28	.26	.25	.23
15	.48	.45	.42	.39	.36	.34	.32	.29	.27	.27	.24	.22	.21
16	.46	.42	.39	.37	.34	.31	.29	.27	.25	.23	.22	.20	.19
17	.44	.40	.37	.34	.32	.29	.27	.25	.23	.21	.20	.18	.17
18	.42	.38	.35	.32	.30	.27	.25	.23	.21	.20	.18	.17	.15
19	.40	.36	.33	.30	.28	.25	.23	.21	.19	.18	.16	.15	.14
20	.38	.34	.31	.28	.26	.24	.21	.20	.18	.16	.15	.14	.12
21	.36	.32	.29	.27	.24	.22	.20	.18	.16	.15	.14	.12	.11
22	.34	.31	.28	.25	.23	.20	.18	.17	.15	.14	.12	.11	.10
23	.33	.29	.26	.23	.21	.19	.17	.15	.14	.12	.11	.10	.09
24	.31	.28	.25	.22	.20	.18	.16	.14	.13	.11	.10	.09	.08
25	.30	.26	.23	.21	.18	.16	.15	.13	.12	.10	.09	.08	.07

[z]Example in text, under "Methods".

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