Giannini Foundation
of Agricultural Economics

Economics of Orchard Replacement

Giannini Foundation Information Series No. 86-1

Division of
Agriculture and Natural Resources
UNIVERSITY OF CALIFORNIA
PRINTED MARCH 1986

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The Giannini Foundation Information Series publishes items of timely interest for specific readerships. The Series was initiated in 1963. Reports are numbered serially within years. In 1978, the Information Series was incorporated into the University of California, Division of Agricultural Sciences Bulletin Series and that practice continued through 1983. The Information Series is once again issued solely by the Giannini Foundation. Reports are no longer Bulletins though they continue to be identified with the University's Division of Agriculture and Natural Resources. Single copies of this report may be requested from Agriculture and Natural Resources Publications, 6701 San Pablo Avenue, Oakland, CA 94608.

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ECONOMICS OF ORCHARD REPLACEMENT

INTRODUCTION

Deciding when to replace an orchard is a difficult but important decision. The answer depends on the age and condition of the trees, the presence of disease problems, economic and market outlook for the future, the availability of new varieties and new pollinizing arrangements, and many other factors.

Sometimes it is obvious when to replace an orchard. Disease may have caused enough damage to warrant replacement. Yields may have decreased so much that gross income does not pay operating expenses. Changes in consumer tastes and preferences and/or changes in export demand may have caused expected receipts to drop below the future cost of production.

But at other times replacement is not such an obvious decision. Still it may be the right choice. Consider a 30-year old orchard: Since it was planted, better orchard management techniques, improved pollinizing arrangements, and more efficient irrigation systems have been developed resulting in the potential for an orchard with a higher and more stable mature yield. Should the present orchard be replaced?

There are several reasons why this replacement question is difficult to answer. The present orchard is making a positive income. Perhaps management changes could improve its yield without replacement. Replacement would entail several years of costs with no income from a new orchard. And interest rates are higher now than when the existing orchard was planted.

How can a new orchard's potential be compared to the reality of the present orchard? Because the replacement decision affects income for many years, the time value of money needs to be taken into account. That is, because money can earn interest over time, revenues and costs in different years are not of equal value. One hundred dollars in income now is worth more than $100 received in five years. That is, the time value of money must be incorporated into the decision.

Any decision method not accounting for the time value of money should be avoided. One such method to be avoided is to estimate the average annual income over the life of the new orchard and compare it to the income from the present orchard. This approach ignores the facts that (1) average income is comprised of that from many years in the future which is not the same as income received this year and (2) the average income figure disguises the early years of large development costs when there is little or no income. Thus, the average income approach will not provide an adequate answer.

Another method to be avoided is to estimate the total income produced during the remaining life of the present orchard and compare it with that from the entire life of the new orchard. This approach also ignores the differences in value of income in different years. It neither adjusts for the difference in life span nor adequately allows for the impact of development costs.

Both of these approaches are too simplistic. Both fail to recognize that today's income has a greater value than income next year, income five years from now, or income received far in the future. Thus, the critical part of the replacement decision is to convert future income into a value for equitable comparison with the present orchard's income.

There are two appropriate methods to analyze the replacement decision. Both of them account for the time value of money. The more complicated approach uses dynamic programming--a multiperiod optimization of the decision to replace or not to replace. The other method converts the future income of a new orchard into an equivalent annuity which can be directly compared to the income from the present orchard. This paper explains the second method, building on work by Faris (1960a, 1961) and Winder and Trant (1961) on optimum replacement patterns and on Faris (1960b) and Faris and Reed (1962) who applied the replacement principles to cling peach orchards.

ECONOMIC CONSIDERATIONS

Besides the loss of physical yield or of market demand, there are several other economic factors that affect the replacement decision. While the basic decision rule is critical, it is influenced by the choice of price and yield expectations, the discount rate used, inflation anticipations, and uncertainty. First the basic decision rule will be developed; then, the impacts of these other factors will be discussed.

The Basic Replacement Decision Rule

Stated very simply, *the optimal time to replace an orchard is when the net returns from a new orchard are expected to be greater than those from the present orchard.* This simple rule needs to be expanded by accounting for income received over time, the development period for the new orchard, the uncertainty of future yields and prices, and the difference in their respective life spans. To account for these factors, the annual expected net returns from the new orchard are converted into an equivalent annuity. An annuity is an amount of money received each year for a specified number of years. For the new orchard, the annuity is the annual value equivalent to receiving the expected net returns from the time of planting to when the orchard is a specified age. By calculating this equivalent annuity for every possible age of the new orchard, its economic life span can be found. The age at which the equivalent annuity reaches its maximum is noted. It is this maximum annuity which should be compared to the annual income from the present orchard in making the replacement decision.

Since most replacement decisions are made in the fall, it is also necessary to calculate the present value of next year's expected net income from the present orchard. This will account for the time value of that income and put it on an equal basis with the maximum

equivalent annuity of the new orchard.

The potential salvage value of any investment is usually also taken into account. But for orchards the salvage value is firewood which is usually the payment for removal, so it does not affect the replacement decision.

For orchards, the replacement rule becomes: *The optimum time to replace is when the present value of next year's expected net return from the present orchard is equal to or less than the equivalent annuity of the after-tax net return from the new orchard.* That is, next year's net return from the present orchard is compared to the future net return from the new orchard after adjusting for the time value of money. If the equivalent annuity is greater than the present value of next year's income from the present orchard, the analysis supports the decision to replace the orchard.

Calculating Net Returns

In a replacement decision, the net return should be gross income adjusted for operating costs, development costs, other variable costs, and income tax considerations. Several resources, such as land, equipment, and other such investments, may not change when an orchard is replaced; thus, they are not relevant to the analysis for either the new orchard or the present orchard. But when additional investment is needed for the new orchard, not incurred with the present orchard, e.g., a new irrigation system, it must be included. In replacement decisions, the goal is to maximize the return to the fixed resources: land, management, and capital.

The annual net return is adjusted by tax considerations--the allowed depreciation for orchard development and the investment tax credit. Assuming the grower is making enough income to pay taxes, the increased depreciation and tax credit will decrease after-tax costs. The decrease in the grower's taxes is the annual, allowed depreciation multiplied by the relevant marginal tax rate plus the investment tax credit, if any.

The net return, adjusted for each year, is given by the following formula:

$$NR_t = (P_t \cdot Y_t) - NHC_t - (HC_t \cdot Y_t) + (X_t \cdot D_t) + ITC_t$$

where NR_t = the net return in the year t,

P_t = expected price per pound (or ton),

Y_t = expected yield in year t,

NHC_t = nonharvest costs in year t,

HC = harvest costs per pound (or ton),

X = marginal tax rate (in decimal form),

D_t = depreciation allowed for orchard development costs in year t,
and
ITC_t = investment tax credit, if any, in year t.

The equivalent annuity can be expressed in mathematical form:

$$A_T = \frac{\sum_{t=o}^{T} \left[\frac{NR_t}{(1+i)^t} \right]}{1 - \left[\frac{1}{(1+i)^T} \right] \Big/ i}$$

where A_T = the equivalent annuity in year T,
NR_t = the net after-tax return in year t,
i = the discount rate, and
T = the expected life of the new orchard for this specific equivalent annuity.

Formulating Price and Yield Expectations

Accurately forecasting next year's net return from the present orchard is a difficult task. Rather than formulate expectations for a single year, it is better to use prices and yields expected over a three- to five-year period. This would help avoid the potential problem of a single bad year's prediction signaling the need for replacement when the outlook may improve in the second or third year.

Forecasting prices for the next 30 to 50 years involves even greater uncertainty. Rather than try to predict different prices for each year, it is better to set a price based on past prices, current bearing and nonbearing acreage, and price and production trends in the United States and the world. A pessimistic price forecast can be used to estimate the impact of a poor market.

Future yields are also uncertain but they are easier to predict than prices. The maximum yield and the length of time needed to achieve that yield will vary with soils, climate, and management.

Because of the uncertainty involved, the replacement decision should be analyzed under several different price and yield scenarios. By using different prices and yields, we can observe how the decision may be affected by differing assumptions about future yields and prices.

Discount Rate Selection

The selection of the discount rate is critical because it affects the equivalent annuity for the new orchard and the present value of next year's net return from the present orchard. The simplest selection process involves choosing the desired after-tax, risk-free opportunity rate of return and the risk premium associated with risky investments.

The after-tax, risk-free opportunity rate of return is determined by an individual's tax bracket and a relatively safe rate of return, say, on U.S. Treasury bills. If long-term T-bills have an interest rate of 6.5 percent and the investor is in the 25 percent tax bracket, the after-tax, risk-free opportunity rate of return is 4.875 percent: (6.5)•(1-.25). The rate on T-bills already has an inflation factor incorporated into its price and rate, reflecting Wall Street's view of the future.

The risk premium is the additional rate of return required because of the risky nature of a potential investment. A subjective method of determining one's risk premium is to decide what additional rate of return is needed to replace an orchard rather than putting the same money in a certificate of deposit. For example, suppose that after considering all options, an additional 3 percent return is needed to compensate for the risk involved in almond production. There are more complicated procedures for determining the risk premium, but this simple method will usually suffice.

After the after-tax, risk-free opportunity rate of return and the risk premium are selected, the discount rate is found by addition. In the example, the discount rate is 7.875 percent: 4.875 + 3--or about 8 percent.

Inflation

Inflation, a general increase in an economy's prices, is also a general erosion in purchasing power. There are two ways to incorporate inflation into the replacement decision (or any investment decision): One is complex and confusing; the other, simple and straightforward.

In the first method, all future prices and costs are increased by an inflation-free (i.e., real) growth rate and then discounted by an inflation-free discount rate. But this method requires an accurate prediction of future growth and inflation rates--forecasts which are questionable at best. Real (i.e., inflation-free) rates are low, relative to nominal interest rates that banks charge, so the solutions from this method may be confusing.

The simpler, and recommended, method is to (1) assume that most prices and costs will be increasing at the same rate, (2) adjust those prices and costs which probably will change at a different rate, and (3) select a discount rate which already incorporates an inflation factor (Gittinger, 1972). Thus we use today's costs and prices for the future, assuming their relative

positions will not change. Then if it can be reasonably argued that some prices or costs will increase (or decrease) at a rate different from the general inflation rate, they should be changed accordingly. For example, if the future inflation rate is expected to be 5 percent, but fuel costs are anticipated to rise by 7 percent, we should increase the fuel costs by 2 percent. This method is realistic in that it recognizes that we can't predict the future perfectly, but we do know that some prices and costs will change at rates different from the general inflation rate. Or if we are unsure about how individual prices and costs will behave in the future, we can analyze the replacement decision under various assumptions about growth rates. For example, does the replacement decision differ if fuel costs are assumed to increase 0, 2, or 5 percent more than the general inflation rate?

Other Considerations

The actual decision to replace or not to replace an orchard depends on other factors also. The cash flow situation is an important consideration. If the cash or credit necessary for the investment is not available, profitable trees should not be pulled no matter what the equivalent annuity analysis shows. Insufficient capital may mean scheduling replacements over several years rather than replacing a large block in a single year. Anticipation of improved technology may also delay replacement. Anticipation of several years of low prices and then a return to higher average prices may speed up replacement because the expected income potential of the present orchard would be lower. The age and goals of the owner may also affect the decision. Higher expected profitability of alternative crops may lead to pulling the orchard and planting a different kind of orchard, a vineyard, or an annual crop.

Since prices and yields are uncertain, it is very important to analyze several sets of prices and yields in making the replacement decision. Also, different inflation rates and discount rates should be used in the analysis. By doing so, the sensitivity of the replacement decision to changes in prices, yields, and interest rates can be evaluated and incorporated into the final decision.

THE ANALYTIC PROCEDURE

While the equivalent annuity method is superior to those using simple averages or totals, the analysis is more complicated. However, the value of improved information usually outweighs the "costs" of more complicated work. Steps involved in the analysis are the following:

Step 1. Determine Projected Returns and Costs of the New Orchard. First, estimate the expected net return from the new orchard for each year of its life. To do this, estimates must be made of the expected life, costs, and gross incomes of the new orchard. Any costs that remain the same whether the orchard

is replaced or not (such as interest payments for land) should be excluded from the analysis.

As an example, the projected net returns for the first 50 years of a new almond orchard are presented in Table 1. While many factors affect the production pattern over time, these yields are considered typical. (A second example in Table 3 uses a more productive orchard assumption.) The cost in year zero is that of tree removal and land preparation minus the value of the firewood. The establishment and production costs are adapted from budgets by Asai (1981a and 1981b). Development costs are depreciated starting when income begins; the accelerated cost recovery system (ACRS) method for 15 years is used assuming the orchard is in service for 12 months in the first year of depreciation. The tax rate used is 32 percent. The after-tax expected net return is calculated using an expected price of $1.00 per pound and a harvest cost of $0.10 per pound of almond meat. The net return is expected to be positive in years four through 35.

Step 2. Calculate the Present Value of Future Returns from the New Orchard. Next, the present value of the expected returns is needed in order to compare net returns in different years. Discounting is done by multiplying the estimated net return by the appropriate present value factor as determined by the discount rate chosen and the year specified. The present value factors for different years and rates are listed in Appendix Table A.

A discount rate of 12 percent is used to estimate the present value of the net returns in the example as presented in Table 2. The net return in year 10 is $951.79; the present value of that net return is $306.45. That is, multiply the net return by the present value factor for 10 years at 12 percent: 0.3220.

Step 3. Calculate Accumulated Discounted Net Returns for the New Orchard Over its Productive Life. Third, accumulate the discounted net returns over time. The sum of the present values of the expected net returns for years zero through 10 ($1,069.39) is the accumulated present value in year 10 (Table 2). The accumulated, discounted net income indicates the profitability in discounted dollars of the new orchard through a specific year. At the selected discount rate, a grower is economically indifferent between receiving the accumulated discounted net returns now as a lump sum payment and having the expected net returns from the new orchard from year zero through the specified year. However, this indifference is only in monetary terms with no allowance for psychic value differences, the decision maker's risk preferences, or other factors.

Step 4. Determine the Equivalent Annuity of the Accumulated Discounted Net Returns for the New Orchard. Fourth, the accumulated, discounted net returns, when positive, need to be adjusted to allow for comparison on an annual basis. Thus, we calculate the ordinary annuity that is equivalent to the accumulated, discounted net returns for a specific year. A grower

should be indifferent between this annuity and the expected net income from the new orchard. (Remember, this indifference does not account for other, nonmonetary factors.) The equivalent annuity makes it easy to compare the profitability of keeping the orchard to various ages. In year 10, the accumulated present value of $1,069.39 is converted to an annuity by dividing by the appropriate annuity factor. For 10 years and a 12 percent discount rate, the annuity factor is 5.6502; thus, the equivalent annuity is $189.26. The annuity factors are listed in Appendix Table B.

Step 5. Compare the Maximum Equivalent Annuity of the New Orchard with the Expected Return from the Old Orchard. Finally, the maximum of the equivalent annuities calculated in the previous step is compared to the present value of next year's expected net return from the present orchard. If the present value of next year's net return from the present orchard is less than the maximum equivalent annuity of the new orchard, it is time to replace; if it is greater, the present orchard is profitable to keep for at least one more year.

THE EXAMPLE ELABORATED

As an example of analyzing the replacement decision, consider a 30-year old almond orchard. The orchard has always been well managed. Although net income is still positive, the grower has noticed the yield starting to decrease.

Since this is a long-term decision, prices and costs for future years are needed. While next year's estimate of the cost of nursery trees is appropriate, a longer-term estimate of the almond meat price is needed because this year's or even next year's prices are probably not good indicators of the price in 10, 20, or 30 years.

In this example, two new orchards are evaluated. The first is a typical orchard which increases to a maximum mature yield of 1,800 pounds of meat per acre (Tables 1 and 2). The second is a more productive orchard which increases rapidly to a maximum mature yield of 2,200 pounds of meat per acre (Tables 3 and 4). The annual yields and net returns costs are shown in Tables 1 and 3. The firewood value is considered as equal to the cost of orchard removal, so doesn't enter the decision.

To evaluate the sensitivity of the replacement decision to different variables, the equivalent annuities and optimal replacement ages are estimated for various combinations of four nut prices, three discount rates, and two tax rates (Table 5).

From this sensitivity analysis, we note that: (1) the optimal replacement age does not vary greatly, (2) the equivalent annuities are very sensitive to the price and interest rate, (3) the annuities are not very sensitive to the tax rate, and (4) the equivalent annuities are higher for the more productive orchard than for the typical orchard (Tables 2 and 4). A higher nut price has the expected effect of increasing both the equivalent annuity and the optimal age. A higher interest rate decreases the equivalent

annuity but increases the optimal replacement age. The change in the tax rate has little effect on the equivalent annuity or the optimal age.

To complete the replacement decision, the annuities must be compared to the expected return from the present orchard. Suppose the grower expects a yield of 1,400 pounds of almond meat. Even though the estimate is only of next year's return, we should use a longer-term estimate of the almond meat price, say, $.80 per pound. With expected total costs of $830 per acre and a discount rate of 12 percent, the present value of next year's returns from the present orchard is $259 per acre. If the long-term meat price is expected to be above $.80 per pound, this analysis shows that the owner should seriously consider replacing the present orchard--especially if the high-yielding scenario can be expected.

As stated earlier, other factors may also affect the replacement decision. Cash flow may dictate that replacement not be done at all or done on a scheduled basis rather than all at once. Long-term trends in supply and demand may cause optimistic or pessimistic views of future profitability. If the nut market is expected to be soft for a few years and then regain its strength, a grower may decide to replace now because the potential income from the present orchard is lower relative to the new orchard. If the grower can expect the more productive orchard (instead of the typical), the argument to replace now is stronger.

The replacement decision needs to be evaluated under different assumptions about prices, interest rates, costs, yields, and other variables. The example analysis shows that expected price, expected yields, and desired rate of return are more important than the tax rate. However, the year in which the equivalent annuity is maximized is fairly stable even with variation in price and interest rate.

SUMMARY

This type of replacement decision analysis should be done for those orchards which have decreasing or below-normal yields. In the long-term view, it may be profitable to replace an orchard even when it still produces positive income. Then, of course, there are several other considerations which enter the final decision besides the equivalent annuity analysis.

REFERENCES

Asai, W. K. *Estimated Costs to Establish an Almond Orchard--1981.* Stanislaus County, California, Cooperative Extension, 1981(a).

Asai, W. K. *Estimated Costs to Produce Almonds in a Mature Orchard.* Stanislaus County, California, Cooperative Extension, 1981(b).

Faris, J. E. "Analytical Techniques Used in Determining the Optimum Replacement Pattern." *Journal of Farm Economics,* Vol. 42, No. 4, November 1960(a), pp. 755-766.

Faris, J. E. *Economics of Replacing Cling Peach Trees.* California Agricultural Experiment Station, Giannini Foundation of Agricultural Economics, Mimeographed Report No. 232, 1960(b).

Faris, J. E. "On Determining the Optimum Replacement Pattern: A Reply." *Journal of Farm Economics,* Vol. 43, No. 4, Part 1, November 1961, pp. 952-955.

Faris, J. E. and A. D. Reed. *When to Replace Cling Peach Trees.* California Agricultural Experiment Station and Extension Service, Circular 512, 1962.

Gittinger, J. P. *Economic Analysis of Agricultural Projects.* Baltimore: The Johns Hopkins University Press, 1972, pp. 37-38.

Winder, J. W. L. and G. I. Trant. "Comments on 'Determining the Optimum Replacement Pattern'." *Journal of Farm Economics,* Vol. 43, No. 4, Part 1, November 1961, pp. 939-951.

Table 1. Yields, Costs, and Net Returns for a New Almond Orchard with Typical Yields. (Assumptions: $1/Pound Price for Almond Nut Meat, 12 Percent Discount Rate, 32 Percent Marginal Tax Rate, and $.10/Pound for Harvest Costs)

Year	Yield	Gross Income	Costs			Expected Net Returns
			Nonharvest	Harvest	Depreciation	
	(pounds)	dollars per acre				
0	0	.00	150.00	.00	.00	-150.00
1	0	.00	520.00	.00	.00	-520.00
2	0	.00	205.00	.00	.00	-205.00
3	0	.00	260.00	.00	.00	-260.00
4	400	400.00	310.00	40.00	136.20	207.08
5	800	800.00	400.00	80.00	113.50	356.32
6	1,200	1,200.00	500.00	120.00	102.15	612.69
7	1,500	1,500.00	600.00	150.00	90.80	779.06
8	1,800	1,800.00	690.00	180.00	79.45	955.42
9	1,800	1,800.00	690.00	180.00	68.10	951.79
10	1,800	1,800.00	690.00	180.00	68.10	951.79
11	1,800	1,800.00	690.00	180.00	68.10	951.79
12	1,800	1,800.00	690.00	180.00	68.10	951.79
13	1,800	1,800.00	690.00	180.00	56.75	948.16
14	1,800	1,800.00	690.00	180.00	56.75	948.16
15	1,800	1,800.00	690.00	180.00	56.75	948.16
16	1,800	1,800.00	690.00	180.00	56.75	948.16
17	1,800	1,800.00	690.00	180.00	56.75	948.16
18	1,800	1,800.00	690.00	180.00	56.75	948.16
19	1,800	1,800.00	690.00	180.00	.00	930.00
20	1,800	1,800.00	690.00	180.00	.00	930.00
21	1,800	1,800.00	690.00	180.00	.00	930.00
22	1,800	1,800.00	690.00	180.00	.00	930.00
23	1,800	1,800.00	690.00	180.00	.00	930.00
24	1,800	1,800.00	690.00	180.00	.00	930.00
25	1,800	1,800.00	690.00	180.00	.00	930.00
26	1,750	1,750.00	690.00	175.00	.00	885.00
27	1,700	1,700.00	690.00	170.00	.00	840.00
28	1,650	1,650.00	690.00	165.00	.00	795.00
29	1,600	1,600.00	690.00	160.00	.00	750.00
30	1,500	1,500.00	690.00	150.00	.00	660.00
31	1,400	1,400.00	690.00	140.00	.00	570.00
32	1,300	1,300.00	690.00	130.00	.00	480.00
33	1,200	1,200.00	690.00	120.00	.00	390.00
34	1,100	1,100.00	690.00	110.00	.00	300.00
35	1,000	1,000.00	750.00	100.00	.00	150.00
36	950	950.00	750.00	95.00	.00	105.00
37	900	900.00	750.00	90.00	.00	60.00
38	850	850.00	750.00	85.00	.00	15.00
39	800	800.00	750.00	80.00	.00	-30.00
40	750	750.00	800.00	75.00	.00	-125.00
41	700	700.00	800.00	70.00	.00	-170.00
42	650	650.00	800.00	65.00	.00	-215.00
43	600	600.00	800.00	60.00	.00	-260.00
44	550	550.00	800.00	55.00	.00	-305.00
45	500	500.00	700.00	50.00	.00	-250.00
46	450	450.00	700.00	45.00	.00	-295.00
47	400	400.00	600.00	40.00	.00	-240.00
48	350	350.00	600.00	35.00	.00	-285.00
49	300	300.00	500.00	30.00	.00	-230.00
50	250	250.00	400.00	25.00	.00	-175.00

Table 2. Expected Net Returns and the Equivalent Annuity Calculations for a Typical Yielding Almond Orchard

Year	Expected Net Returns	Present Value of Expected Net Returns	Accumulated Present Value	Equivalent Annuity
	dollars per acre			
0	-150.00	-150.00	-150.00	.00
1	-520.00	-464.29	-614.29	.00
2	-205.00	-163.42	-777.71	.00
3	-260.00	-185.06	-962.77	.00
4	207.08	131.61	-831.17	.00
5	356.32	202.19	-628.98	.00
6	612.69	310.41	-318.58	.00
7	779.06	352.41	33.83	7.41
8	955.42	385.88	419.71	84.49
9	951.79	343.23	762.94	143.19
10	951.79	306.45	1,069.39	189.26
11	951.79	273.62	1,343.00	226.18
12	951.79	244.30	1,587.31	256.25
13	948.16	217.29	1,804.60	280.94
14	948.16	194.01	1,998.61	301.53
15	948.16	173.23	2,171.84	318.88
16	948.16	154.67	2,326.50	333.60
17	948.16	138.09	2,464.60	346.17
18	948.16	123.30	2,587.90	356.97
19	930.00	107.98	2,695.87	366.00
20	930.00	96.41	2,792.28	373.83
21	930.00	86.08	2,878.36	380.64
22	930.00	76.86	2,955.22	386.57
23	930.00	68.62	3,023.85	391.77
24	930.00	61.27	3,085.12	396.32
25	930.00	54.71	3,139.82	400.33
26	885.00	46.48	3,186.30	403.55
27	840.00	39.39	3,225.69	406.13
28	795.00	33.29	3,258.98	408.17
29	750.00	28.04	3,287.02	409.76
30	660.00	22.03	3,309.05	410.80
31	570.00	16.99	3,326.03	411.38
32	480.00	12.77	3,338.80	411.61
33	390.00	9.27	3,348.07	411.55
34	300.00	6.36	3,354.43	411.26
35	150.00	2.84	3,357.28	410.65
36	105.00	1.78	3,359.05	410.02
37	60.00	.91	3,359.96	409.38
38	15.00	.20	3,360.16	408.73
39	-30.00	-.36	3,359.80	408.09
40	-125.00	-1.34	3,358.45	407.39
41	-170.00	-1.63	3,356.82	406.72
42	-215.00	-1.84	3,354.98	406.08
43	-260.00	-1.99	3,352.99	405.46
44	-305.00	-2.08	3,350.91	404.87
45	-250.00	-1.52	3,349.38	404.39
46	-295.00	-1.61	3,347.78	403.93
47	-240.00	-1.17	3,346.61	403.56
48	-285.00	-1.24	3,345.37	403.20
49	-230.00	-.89	3,344.48	402.90
50	-175.00	-.61	3,343.88	402.66

Table 3. Yields, Costs, and Net Returns for a New Almond Orchard with High Yields. (Assumptions: $1/Pound Price for Almond Nut Meat, 12 Percent Discount Rate, 32 Percent Marginal Tax Rate, and $.10/Pound for Harvest Costs)

Year	Yield	Gross Income	Costs			Expected Net Returns
			Nonharvest	Harvest	Depreciation	
	(pounds)	dollars per acre				
0	0	.00	150.00	.00	.00	-150.00
1	0	.00	520.00	.00	.00	-520.00
2	0	.00	205.00	.00	.00	-205.00
3	500	500.00	260.00	50.00	105.00	311.10
4	900	900.00	350.00	90.00	87.50	488.00
5	1,500	1,500.00	500.00	150.00	78.75	875.20
6	2,000	2,000.00	650.00	200.00	70.00	1,172.40
7	21,00	2,100.00	750.00	210.00	61.25	1,159.60
8	2,200	2,200.00	750.00	220.00	52.50	1,246.80
9	2,200	2,200.00	750.00	220.00	52.50	1,246.80
10	2,200	2,200.00	750.00	220.00	52.50	1,246.80
11	2,200	2,200.00	750.00	220.00	52.50	1,246.80
12	2,200	2,200.00	750.00	220.00	43.75	1,244.00
13	2,200	2,200.00	750.00	220.00	43.75	1,244.00
14	2,200	2,200.00	750.00	220.00	43.75	1,244.00
15	2,200	2,200.00	750.00	220.00	43.75	1,244.00
16	2,200	2,200.00	750.00	220.00	43.75	1,244.00
17	2,200	2,200.00	750.00	220.00	43.75	1,244.00
18	2,200	2,200.00	750.00	220.00	.00	1,230.00
19	2,200	2,200.00	750.00	220.00	.00	1,230.00
20	2,200	2,200.00	750.00	220.00	.00	1,230.00
21	2,100	2,100.00	750.00	210.00	.00	1,140.00
22	2,100	2,100.00	750.00	210.00	.00	1,140.00
23	2,100	2,100.00	750.00	210.00	.00	1,140.00
24	2,100	2,100.00	750.00	210.00	.00	1,140.00
25	2,100	2,100.00	750.00	210.00	.00	1,140.00
26	2,100	2,100.00	750.00	210.00	.00	1,140.00
27	2,100	2,100.00	750.00	210.00	.00	1,140.00
28	2,000	2,000.00	750.00	200.00	.00	1,050.00
29	2,000	2,000.00	750.00	200.00	.00	1,050.00
30	2,000	2,000.00	750.00	200.00	.00	1,050.00
31	1,950	1,950.00	750.00	195.00	.00	1,005.00
32	1,900	1,900.00	750.00	190.00	.00	960.00
33	1,850	1,850.00	750.00	185.00	.00	915.00
34	1,800	1,800.00	750.00	180.00	.00	870.00
35	1,700	1,700.00	800.00	170.00	.00	730.00
36	1,600	1,600.00	800.00	160.00	.00	640.00
37	1,500	1,500.00	800.00	150.00	.00	550.00
38	1,400	1,400.00	800.00	140.00	.00	460.00
39	1,300	1,300.00	800.00	130.00	.00	370.00
40	1,200	1,200.00	850.00	120.00	.00	230.00
41	1,100	1,100.00	850.00	110.00	.00	140.00
42	1,000	1,000.00	850.00	100.00	.00	50.00
43	950	950.00	850.00	95.00	.00	5.00
44	900	900.00	850.00	90.00	.00	-40.00
45	850	850.00	700.00	85.00	.00	65.00
46	800	800.00	700.00	80.00	.00	20.00
47	750	750.00	600.00	75.00	.00	75.00
48	700	700.00	600.00	70.00	.00	30.00
49	650	650.00	500.00	65.00	.00	85.00
50	600	600.00	400.00	60.00	.00	140.00

Table 4. Expected Net Returns and the Equivalent Annuity Calculations for a High Yielding Almond Orchard

Year	Expected Net Returns	Present Value of Expected Net Returns	Accumulated Present Value	Equivalent Annuity
	dollars per acre			
0	-150.00	-150.00	-150.00	.00
1	-520.00	-464.29	-614.29	.00
2	-205.00	-163.42	-777.71	.00
3	311.10	221.43	-556.28	.00
4	488.00	310.13	-246.14	.00
5	875.20	496.61	250.47	.00
6	1,172.40	593.97	844.44	.00
7	1,159.60	524.54	1,368.99	299.97
8	1,246.80	503.56	1,872.55	376.95
9	1,246.80	449.61	2,322.16	435.82
10	1,246.80	401.44	2,723.59	482.03
11	1,246.80	358.43	3,082.02	519.06
12	1,244.00	319.30	3,401.32	549.10
13	1,244.00	285.09	3,686.42	573.89
14	1,244.00	254.55	3,940.96	594.58
15	1,244.00	227.27	4,168.24	612.00
16	1,244.00	202.92	4,371.16	626.78
17	1,244.00	181.18	4,552.34	639.41
18	1,230.00	159.95	4,712.29	650.00
19	1,230.00	142.81	4,855.10	659.14
20	1,230.00	127.51	4,982.61	667.07
21	1,140.00	105.52	5,088.13	672.85
22	1,140.00	94.21	5,182.34	677.90
23	1,140.00	84.12	5,266.46	682.32
24	1,140.00	75.11	5,341.57	686.20
25	1,140.00	67.06	5,408.62	689.60
26	1,140.00	59.87	5,468.50	692.60
27	1,140.00	53.46	5,521.96	695.24
28	1,050.00	43.96	5,565.92	697.10
29	1,050.00	39.25	5,605.17	698.74
30	1,050.00	35.05	5,640.22	700.20
31	1,005.00	29.95	5,670.17	701.32
32	960.00	25.54	5,695.71	702.17
33	915.00	21.74	5,717.45	702.79
34	870.00	18.45	5,735.91	703.23
35	730.00	13.83	5,749.73	703.29
36	640.00	10.82	5,760.56	703.16
37	550.00	8.30	5,768.86	702.88
38	460.00	6.20	5,775.06	702.48
39	370.00	4.45	5,779.51	701.99
40	230.00	2.47	5,781.99	701.38
41	140.00	1.34	5,783.33	700.72
42	50.00	.43	5,783.76	700.05
43	5.00	.04	5,783.80	699.41
44	-40.00	-.27	5,783.52	698.80
45	65.00	.40	5,783.92	698.33
46	20.00	.11	5,784.03	697.88
47	75.00	.36	5,784.39	697.52
48	30.00	.13	5,784.52	697.17
49	85.00	.33	5,784.85	696.88
50	140.00	.48	5,785.34	696.65

Table 5. Estimated Maximum Equivalent Annuities and the Corresponding Age of the Almond Orchard for Both Yield Levels and for Variations in Expected Prices, Interest Rates, and Tax Rates

Expected Almond Meat Price	32 Percent Marginal Tax Rate						50 Percent Marginal Tax Rate					
	Discount Rate						Discount Rate					
	8 Percent		12 Percent		15 Percent		8 Percent		12 Percent		15 Percent	
	EA[a]	Age	EA	Age	EA	Age	EA	Age	EA	Age	EA	Age
($/pound)	$	yrs	$	yrs	$	yrs	$	yrs	$	yrs	$	yrs
Typical-Yielding Orchard (Table 1):												
.60	49	30	1	31	--[b]	--[b]	58	30	11	30	--[b]	--[b]
.80	284	31	206	32	151	32	293	30	216	32	160	32
1.00	521	31	412	32	334	33	530	31	421	32	344	33
1.20	757	31	617	33	518	34	766	31	626	33	528	33
High-Yielding Orchard (Table 3):												
.60	185	32	137	34	101	34	192	32	145	34	109	34
.80	501	34	420	34	361	35	508	34	428	34	369	35
1.00	817	34	703	35	621	36	824	34	711	35	629	36
1.20	1,133	34	986	35	880	36	1,140	34	994	35	889	36

[a]EA = equivalent annuity.

[b]When the accumulated present value was not positive, an equivalent annuity was not calculated.

Appendix Table A. The Present Value of $1 at Various Discount Rates and Years. Present Value Factors, PVF = $/(1 + i)^n$

Year (n)	Discount Rate Per Year (i)											
	1	2	3	4	5	6	7	8	9	10	11	12
1	.9901	.9804	.9709	.9615	.9524	.9434	.9346	.9259	.9174	.9091	.9009	.8929
2	.9803	.9612	.9426	.9246	.9070	.8900	.8734	.8573	.8417	.8264	.8116	.7972
3	.9706	.9423	.9151	.8890	.8638	.8396	.8163	.7938	.7722	.7513	.7312	.7118
4	.9610	.9238	.8885	.8548	.8227	.7921	.7629	.7350	.7084	.6830	.6587	.6355
5	.9515	.9057	.8626	.8219	.7835	.7473	.7130	.6806	.6499	.6209	.5935	.5674
6	.9420	.8880	.8375	.7903	.7462	.7050	.6663	.6302	.5963	.5645	.5346	.5066
7	.9327	.8706	.8131	.7599	.7107	.6651	.6227	.5835	.5470	.5132	.4817	.4523
8	.9235	.8535	.7894	.7307	.6768	.6274	.5820	.5403	.5019	.4665	.4339	.4039
9	.9143	.8368	.7664	.7026	.6446	.5919	.5439	.5002	.4604	.4241	.3909	.3606
10	.9053	.8203	.7441	.6756	.6139	.5584	.5083	.4632	.4224	.3855	.3522	.3220
11	.8963	.8043	.7224	.6496	.5847	.5268	.4751	.4289	.3875	.3505	.3173	.2875
12	.8874	.7885	.7014	.6246	.5568	.4970	.4440	.3971	.3555	.3186	.2858	.2567
13	.8787	.7730	.6810	.6006	.5303	.4688	.4150	.3677	.3262	.2897	.2575	.2292
14	.8700	.7579	.6611	.5775	.5051	.4423	.3878	.3405	.2992	.2633	.2320	.2046
15	.8613	.7430	.6419	.5553	.4810	.4173	.3624	.3152	.2745	.2394	.2090	.1827
16	.8528	.7284	.6232	.5339	.4581	.3936	.3387	.2919	.2519	.2176	.1883	.1631
17	.8444	.7142	.6050	.5134	.4363	.3714	.3166	.2703	.2311	.1978	.1696	.1456
18	.8360	.7002	.5874	.4936	.4155	.3503	.2959	.2502	.2120	.1799	.1528	.1300
19	.8277	.6864	.5703	.4746	.3957	.3305	.2765	.2317	.1945	.1635	.1377	.1161
20	.8195	.6730	.5537	.4564	.3769	.3118	.2584	.2145	.1784	.1486	.1240	.1037
21	.8114	.6598	.5375	.4388	.3589	.2942	.2415	.1987	.1637	.1351	.1117	.0926
22	.8034	.6468	.5219	.4220	.3418	.2775	.2257	.1839	.1502	.1228	.1007	.0826
23	.7954	.6342	.5067	.4057	.3256	.2618	.2109	.1703	.1378	.1117	.0907	.0738
24	.7876	.6217	.4919	.3901	.3101	.2470	.1971	.1577	.1264	.1015	.0817	.0659
25	.7798	.6095	.4776	.3751	.2953	.2330	.1842	.1460	.1160	.0923	.0736	.0588
26	.7720	.5976	.4637	.3607	.2812	.2198	.1722	.1352	.1064	.0839	.0663	.0525
27	.7644	.5859	.4502	.3468	.2678	.2074	.1609	.1252	.0976	.0763	.0597	.0469
28	.7568	.5744	.4371	.3335	.2551	.1956	.1504	.1159	.0895	.0693	.0538	.0419
29	.7493	.5631	.4243	.3207	.2429	.1846	.1406	.1073	.0822	.0630	.0485	.0374
30	.7419	.5521	.4120	.3083	.2314	.1741	.1314	.0994	.0754	.0573	.0437	.0334
31	.7346	.5412	.4000	.2965	.2204	.1643	.1228	.0920	.0691	.0521	.0394	.0298
32	.7273	.5306	.3883	.2851	.2099	.1550	.1147	.0852	.0634	.0474	.0355	.0266
33	.7201	.5202	.3770	.2741	.1999	.1462	.1072	.0789	.0582	.0431	.0319	.0238
34	.7130	.5100	.3660	.2636	.1904	.1379	.1002	.0730	.0534	.0391	.0288	.0212
35	.7059	.5000	.3554	.2534	.1813	.1301	.0937	.0676	.0490	.0356	.0259	.0189
36	.6989	.4902	.3450	.2437	.1727	.1227	.0875	.0626	.0449	.0323	.0234	.0169
37	.6920	.4806	.3350	.2343	.1644	.1158	.0818	.0580	.0412	.0294	.0210	.0151
38	.6852	.4712	.3252	.2253	.1566	.1092	.0765	.0537	.0378	.0267	.0190	.0135
39	.6784	.4619	.3158	.2166	.1491	.1031	.0715	.0497	.0347	.0243	.0171	.0120
40	.6717	.4529	.3066	.2083	.1420	.0972	.0668	.0460	.0318	.0221	.0154	.0107
41	.6650	.4440	.2976	.2003	.1353	.0917	.0624	.0426	.0292	.0201	.0139	.0096
42	.6584	.4353	.2890	.1926	.1288	.0865	.0583	.0395	.0268	.0183	.0125	.0086
43	.6519	.4268	.2805	.1852	.1227	.0816	.0545	.0365	.0246	.0166	.0112	.0076
44	.6454	.4184	.2724	.1780	.1169	.0770	.0509	.0338	.0226	.0151	.0101	.0068
45	.6391	.4102	.2644	.1712	.1113	.0727	.0476	.0313	.0207	.0137	.0091	.0061
46	.6327	.4022	.2567	.1646	.1060	.0685	.0445	.0290	.0190	.0125	.0082	.0054
47	.6265	.3943	.2493	.1583	.1009	.0647	.0416	.0269	.0174	.0113	.0074	.0049
48	.6203	.3865	.2420	.1522	.0961	.0610	.0389	.0249	.0160	.0103	.0067	.0043
49	.6141	.3790	.2350	.1463	.0916	.0575	.0363	.0230	.0147	.0094	.0060	.0039
50	.6080	.3715	.2281	.1407	.0872	.0543	.0339	.0213	.0134	.0085	.0054	.0035

Appendix Table A. Continued

Year (n)	Discount Rate Per Year (i)											
	13	14	15	16	17	18	19	20	21	22	23	24
1	.8850	.8772	.8696	.8621	.8547	.8475	.8403	.8333	.8264	.8197	.8130	.8065
2	.7831	.7695	.7561	.7432	.7305	.7182	.7062	.6944	.6830	.6719	.6610	.6504
3	.6931	.6750	.6575	.6407	.6244	.6086	.5934	.5787	.5645	.5507	.5374	.5245
4	.6133	.5921	.5718	.5523	.5337	.5158	.4987	.4823	.4665	.4514	.4369	.4230
5	.5428	.5194	.4972	.4761	.4561	.4371	.4190	.4019	.3855	.3700	.3552	.3411
6	.4803	.4556	.4323	.4104	.3898	.3704	.3521	.3349	.3186	.3033	.2888	.2751
7	.4251	.3996	.3759	.3538	.3332	.3139	.2959	.2791	.2633	.2486	.2348	.2218
8	.3762	.3506	.3269	.3050	.2848	.2660	.2487	.2326	.2176	.2038	.1909	.1789
9	.3329	.3075	.2843	.2630	.2434	.2255	.2090	.1938	.1799	.1670	.1552	.1443
10	.2946	.2697	.2472	.2267	.2080	.1911	.1756	.1615	.1486	.1369	.1262	.1164
11	.2607	.2366	.2149	.1954	.1778	.1619	.1476	.1346	.1228	.1122	.1026	.0938
12	.2307	.2076	.1869	.1685	.1520	.1372	.1240	.1122	.1015	.0920	.0834	.0757
13	.2042	.1821	.1625	.1452	.1299	.1163	.1042	.0935	.0839	.0754	.0678	.0610
14	.1807	.1597	.1413	.1252	.1110	.0985	.0876	.0779	.0693	.0618	.0551	.0492
15	.1599	.1401	.1229	.1079	.0949	.0835	.0736	.0649	.0573	.0507	.0448	.0397
16	.1415	.1229	.1069	.0930	.0811	.0708	.0618	.0541	.0474	.0415	.0364	.0320
17	.1252	.1078	.0929	.0802	.0693	.0600	.0520	.0451	.0391	.0340	.0296	.0258
18	.1108	.0946	.0808	.0691	.0592	.0508	.0437	.0376	.0323	.0279	.0241	.0208
19	.0981	.0829	.0703	.0596	.0506	.0431	.0367	.0313	.0267	.0229	.0196	.0168
20	.0868	.0728	.0611	.0514	.0433	.0365	.0308	.0261	.0221	.0187	.0159	.0135
21	.0768	.0638	.0531	.0443	.0370	.0309	.0259	.0217	.0183	.0154	.0129	.0109
22	.0680	.0560	.0462	.0382	.0316	.0262	.0218	.0181	.0151	.0126	.0105	.0088
23	.0601	.0491	.0402	.0329	.0270	.0222	.0183	.0151	.0125	.0103	.0086	.0071
24	.0532	.0431	.0349	.0284	.0231	.0188	.0154	.0126	.0103	.0085	.0070	.0057
25	.0471	.0378	.0304	.0245	.0197	.0160	.0129	.0105	.0085	.0069	.0057	.0046
26	.0417	.0331	.0264	.0211	.0169	.0135	.0109	.0087	.0070	.0057	.0046	.0037
27	.0369	.0291	.0230	.0182	.0144	.0115	.0091	.0073	.0058	.0047	.0037	.0030
28	.0326	.0255	.0200	.0157	.0123	.0097	.0077	.0061	.0048	.0038	.0030	.0024
29	.0289	.0224	.0174	.0135	.0105	.0082	.0064	.0051	.0040	.0031	.0025	.0020
30	.0256	.0196	.0151	.0116	.0090	.0070	.0054	.0042	.0033	.0026	.0020	.0016
31	.0226	.0172	.0131	.0100	.0077	.0059	.0046	.0035	.0027	.0021	.0016	.0013
32	.0200	.0151	.0114	.0087	.0066	.0050	.0038	.0029	.0022	.0017	.0013	.0010
33	.0177	.0132	.0099	.0075	.0056	.0042	.0032	.0024	.0019	.0014	.0011	.0008
34	.0157	.0116	.0086	.0064	.0048	.0036	.0027	.0020	.0015	.0012	.0009	.0007
35	.0139	.0102	.0075	.0055	.0041	.0030	.0023	.0017	.0013	.0009	.0007	.0005
36	.0123	.0089	.0065	.0048	.0035	.0026	.0019	.0014	.0010	.0008	.0006	.0004
37	.0109	.0078	.0057	.0041	.0030	.0022	.0016	.0012	.0009	.0006	.0005	.0003
38	.0096	.0069	.0049	.0036	.0026	.0019	.0013	.0010	.0007	.0005	.0004	.0003
39	.0085	.0060	.0043	.0031	.0022	.0016	.0011	.0008	.0006	.0004	.0003	.0002
40	.0075	.0053	.0037	.0026	.0019	.0013	.0010	.0007	.0005	.0004	.0003	.0002
41	.0067	.0046	.0032	.0023	.0016	.0011	.0008	.0006	.0004	.0003	.0002	.0001
42	.0059	.0041	.0028	.0020	.0014	.0010	.0007	.0005	.0003	.0002	.0002	.0001
43	.0052	.0036	.0025	.0017	.0012	.0008	.0006	.0004	.0003	.0002	.0001	.0001
44	.0046	.0031	.0021	.0015	.0010	.0007	.0005	.0003	.0002	.0002	.0001	.0001
45	.0041	.0027	.0019	.0013	.0009	.0006	.0004	.0003	.0002	.0001	.0001	.0001
46	.0036	.0024	.0016	.0011	.0007	.0005	.0003	.0002	.0002	.0001	.0001	.0001
47	.0032	.0021	.0014	.0009	.0006	.0004	.0003	.0002	.0001	.0001	.0001	.0000
48	.0028	.0019	.0012	.0008	.0005	.0004	.0002	.0002	.0001	.0001	.0000	.0000
49	.0025	.0016	.0011	.0007	.0005	.0003	.0002	.0001	.0001	.0001	.0000	.0000
50	.0022	.0014	.0009	.0006	.0004	.0003	.0002	.0001	.0001	.0000	.0000	.0000

Appendix Table B. The Present Value of an Annuity of $1 at Various Discount Rates and Years. Annuity Factors, ANF = $1 - (1/(1 + i)^n)/i$

Year (n)	Discount Rate Per Year (i)								
	1	2	3	4	5	6	7	8	9
1	.9901	.9804	.9709	.9615	.9524	.9434	.9346	.9259	.9174
2	1.9704	1.9416	1.9135	1.8861	1.8594	1.8334	1.8080	1.7833	1.7591
3	2.9410	2.8839	2.8286	2.7751	2.7232	2.6730	2.6243	2.5771	2.5313
4	3.9020	3.8077	3.7171	3.6299	3.5460	3.4651	3.3872	3.3121	3.2397
5	4.8534	4.7135	4.5797	4.4518	4.3295	4.2124	4.1002	3.9927	3.8897
6	5.7955	5.6014	5.4172	5.2421	5.0757	4.9173	4.7665	4.6229	4.4859
7	6.7282	6.4720	6.2303	6.0021	5.7864	5.5824	5.3893	5.2064	5.0330
8	7.6517	7.3255	7.0197	6.7327	6.4632	6.2098	5.9713	5.7466	5.5348
9	8.5660	8.1622	7.7861	7.4353	7.1078	6.8017	6.5152	6.2469	5.9952
10	9.4713	8.9826	8.5302	8.1109	7.7217	7.3601	7.0236	6.7101	6.4177
11	10.3676	9.7868	9.2526	8.7605	8.3064	7.8869	7.4987	7.1390	6.8052
12	11.2551	10.5753	9.9540	9.3851	8.8633	8.3838	7.9427	7.5361	7.1607
13	12.1337	11.3484	10.6350	9.9856	9.3936	8.8527	8.3577	7.9038	7.4869
14	13.0037	12.1062	11.2961	10.5631	9.8986	9.2950	8.7455	8.2442	7.7862
15	13.8651	12.8493	11.9379	11.1184	10.3797	9.7122	9.1079	8.5595	8.0607
16	14.7179	13.5777	12.5611	11.6523	10.8378	10.1059	9.4466	8.8514	8.3126
17	15.5623	14.2919	13.1661	12.1657	11.2741	10.4773	9.7632	9.1216	8.5436
18	16.3983	14.9920	13.7535	12.6593	11.6896	10.8276	10.0591	9.3719	8.7556
19	17.2260	15.6785	14.3238	13.1339	12.0853	11.1581	10.3356	9.6036	8.9501
20	18.0456	16.3514	14.8775	13.5903	12.4622	11.4699	10.5940	9.8181	9.1285
21	18.8570	17.0112	15.4150	14.0292	12.8212	11.7641	10.8355	10.0168	9.2922
22	19.6604	17.6580	15.9369	14.4511	13.1630	12.0416	11.0612	10.2007	9.4424
23	20.4558	18.2922	16.4436	14.8568	13.4886	12.3034	11.2722	10.3711	9.5802
24	21.2434	18.9139	16.9355	15.2470	13.7986	12.5504	11.4693	10.5288	9.7066
25	22.0232	19.5235	17.4131	15.6221	14.0939	12.7834	11.6536	10.6748	9.8226
26	22.7952	20.1210	17.8768	15.9828	14.3752	13.0032	11.8258	10.8100	9.9290
27	23.5596	20.7069	18.3270	16.3296	14.6430	13.2105	11.9867	10.9352	10.0266
28	24.3164	21.2813	18.7641	16.6631	14.8981	13.4062	12.1371	11.0511	10.1161
29	25.0658	21.8444	19.1885	16.9837	15.1411	13.5907	12.2777	11.1584	10.1983
30	25.8077	22.3965	19.6004	17.2920	15.3725	13.7648	12.4090	11.2578	10.2737
31	26.5423	22.9377	20.0004	17.5885	15.5928	13.9291	12.5318	11.3498	10.3428
32	27.2696	23.4683	20.3888	17.8736	15.8027	14.0840	12.6466	11.4350	10.4062
33	27.9897	23.9886	20.7658	18.1476	16.0025	14.2302	12.7538	11.5139	10.4644
34	28.7027	24.4986	21.1318	18.4112	16.1929	14.3681	12.8540	11.5869	10.5178
35	29.4086	24.9986	21.4872	18.6646	16.3742	14.4982	12.9477	11.6546	10.5668
36	30.1075	25.4888	21.8323	18.9083	16.5469	14.6210	13.0352	11.7172	10.6118
37	30.7995	25.9695	22.1672	19.1426	16.7113	14.7368	13.1170	11.7752	10.6530
38	31.4847	26.4406	22.4925	19.3679	16.8679	14.8460	13.1935	11.8289	10.6908
39	32.1630	26.9026	22.8082	19.5845	17.0170	14.9491	13.2649	11.8786	10.7255
40	32.8347	27.3555	23.1148	19.7928	17.1591	15.0463	13.3317	11.9246	10.7574
41	33.4997	27.7995	23.4124	19.9931	17.2944	15.1380	13.3941	11.9672	10.7866
42	34.1581	28.2348	23.7014	20.1856	17.4232	15.2245	13.4524	12.0067	10.8134
43	34.8100	28.6616	23.9819	20.3708	17.5459	15.3062	13.5070	12.0432	10.8380
44	35.4555	29.0800	24.2543	20.5488	17.6628	15.3832	13.5579	12.0771	10.8605
45	36.0945	29.4902	24.5187	20.7200	17.7741	15.4558	13.6055	12.1084	10.8812
46	36.7272	29.8923	24.7754	20.8847	17.8801	15.5244	13.6500	12.1374	10.9002
47	37.3537	30.2866	25.0247	21.0429	17.9810	15.5890	13.6916	12.1643	10.9176
48	37.9740	30.6731	25.2667	21.1951	18.0772	15.6500	13.7305	12.1891	10.9336
49	38.5881	31.0521	25.5017	21.3415	18.1687	15.7076	13.7668	12.2122	10.9482
50	39.1961	31.4236	25.7298	21.4822	18.2559	15.7619	13.8007	12.2335	10.9617

Appendix Table B. Continued

Year (n)	Discount Rate Per Year (i)									
	10	11	12	13	14	15	16	17	18	19
1	.9091	.9009	.8929	.8850	.8772	.8696	.8621	.8547	.8475	.8403
2	1.7355	1.7125	1.6901	1.6681	1.6467	1.6257	1.6052	1.5852	1.5656	1.5465
3	2.4869	2.4437	2.4018	2.3612	2.3216	2.2832	2.2459	2.2096	2.1743	2.1399
4	3.1699	3.1024	3.0373	2.9745	2.9137	2.8550	2.7982	2.7432	2.6901	2.6386
5	3.7908	3.6959	3.6048	3.5172	3.4331	3.3522	3.2743	3.1993	3.1272	3.0576
6	4.3553	4.2305	4.1114	3.9975	3.8887	3.7845	3.6847	3.5892	3.4976	3.4098
7	4.8684	4.7122	4.5638	4.4226	4.2883	4.1604	4.0386	3.9224	3.8115	3.7057
8	5.3349	5.1461	4.9676	4.7988	4.6389	4.4873	4.3436	4.2072	4.0776	3.9544
9	5.7590	5.5370	5.3282	5.1317	4.9464	4.7716	4.6065	4.4506	4.3030	4.1633
10	6.1446	5.8892	5.6502	5.4262	5.2161	5.0188	4.8332	4.6586	4.4941	4.3389
11	6.4951	6.2065	5.9377	5.6869	5.4527	5.2337	5.0286	4.8364	4.6560	4.4865
12	6.8137	6.4924	6.1944	5.9176	5.6603	5.4206	5.1971	4.9884	4.7932	4.6105
13	7.1034	6.7499	6.4235	6.1218	5.8424	5.5831	5.3423	5.1183	4.9095	4.7147
14	7.3667	6.9819	6.6282	6.3025	6.0021	5.7245	5.4675	5.2293	5.0081	4.8023
15	7.6061	7.1909	6.8109	6.4624	6.1422	5.8474	5.5755	5.3242	5.0916	4.8759
16	7.8237	7.3792	6.9740	6.6039	6.2651	5.9542	5.6685	5.4053	5.1624	4.9377
17	8.0216	7.5488	7.1196	6.7291	6.3729	6.0472	5.7487	5.4746	5.2223	4.9897
18	8.2014	7.7016	7.2497	6.8399	6.4674	6.1280	5.8178	5.5339	5.2732	5.0333
19	8.3649	7.8393	7.3658	6.9380	6.5504	6.1982	5.8775	5.5845	5.3162	5.0700
20	8.5136	7.9633	7.4694	7.0248	6.6231	6.2593	5.9288	5.6278	5.3527	5.1009
21	8.6487	8.0751	7.5620	7.1016	6.6870	6.3125	5.9731	5.6648	5.3837	5.1268
22	8.7715	8.1757	7.6446	7.1695	6.7429	6.3587	6.0113	5.6964	5.4099	5.1486
23	8.8832	8.2664	7.7184	7.2297	6.7921	6.3988	6.0442	5.7234	5.4321	5.1668
24	8.9847	8.3481	7.7843	7.2829	6.8351	6.4338	6.0726	5.7465	5.4509	5.1822
25	9.0770	8.4217	7.8431	7.3300	6.8729	6.4641	6.0971	5.7662	5.4669	5.1951
26	9.1609	8.4881	7.8957	7.3717	6.9061	6.4906	6.1182	5.7831	5.4804	5.2060
27	9.2372	8.5478	7.9426	7.4086	6.9352	6.5135	6.1364	5.7975	5.4919	5.2151
28	9.3066	8.6016	7.9844	7.4412	6.9607	6.5335	6.1520	5.8099	5.5016	5.2228
29	9.3696	8.6501	8.0218	7.4701	6.9830	6.5509	6.1656	5.8204	5.5098	5.2292
30	9.4269	8.6938	8.0552	7.4957	7.0027	6.5660	6.1772	5.8294	5.5168	5.2347
31	9.4790	8.7331	8.0850	7.5183	7.0199	6.5791	6.1872	5.8371	5.5227	5.2392
32	9.5264	8.7686	8.1116	7.5383	7.0350	6.5905	6.1959	5.8437	5.5277	5.2430
33	9.5694	8.8005	8.1354	7.5560	7.0482	6.6005	6.2034	5.8493	5.5320	5.2462
34	9.6086	8.8293	8.1566	7.5717	7.0599	6.6091	6.2098	5.8541	5.5356	5.2489
35	9.6442	8.8552	8.1755	7.5856	7.0700	6.6166	6.2153	5.8582	5.5386	5.2512
36	9.6765	8.8786	8.1924	7.5979	7.0790	6.6231	6.2201	5.8617	5.5412	5.2531
37	9.7059	8.8996	8.2075	7.6087	7.0868	6.6288	6.2242	5.8647	5.5434	5.2547
38	9.7327	8.9186	8.2210	7.6183	7.0937	6.6338	6.2278	5.8673	5.5452	5.2561
39	9.7570	8.9357	8.2330	7.6268	7.0997	6.6380	6.2309	5.8695	5.5468	5.2572
40	9.7791	8.9511	8.2438	7.6344	7.1050	6.6418	6.2335	5.8713	5.5482	5.2582
41	9.7991	8.9649	8.2534	7.6410	7.1097	6.6450	6.2358	5.8729	5.5493	5.2590
42	9.8174	8.9774	8.2619	7.6469	7.1138	6.6478	6.2377	5.8743	5.5502	5.2596
43	9.8340	8.9886	8.2696	7.6522	7.1173	6.6503	6.2394	5.8755	5.5510	5.2602
44	9.8491	8.9988	8.2764	7.6568	7.1205	6.6524	6.2409	5.8765	5.5517	5.2607
45	9.8628	9.0079	8.2825	7.6609	7.1232	6.6543	6.2421	5.8773	5.5523	5.2611
46	9.8753	9.0161	8.2880	7.6645	7.1256	6.6559	6.2432	5.8781	5.5528	5.2614
47	9.8866	9.0235	8.2928	7.6677	7.1277	6.6573	6.2442	5.8787	5.5532	5.2617
48	9.8959	9.0302	8.2972	7.6705	7.1296	6.6585	6.2450	5.8792	5.5536	5.2619
49	9.9063	9.0362	8.3010	7.6730	7.1312	6.6596	6.2457	5.8797	5.5539	5.2621
50	9.9148	9.0417	8.3045	7.6752	7.1327	6.6605	6.2463	5.8801	5.5541	5.2623

Appendix Table B. Continued

Year (n)	Discount Rate Per Year (i)				
	20	21	22	23	24
1	.8333	.8264	.8197	.8130	.8065
2	1.5278	1.5095	1.4915	1.4740	1.4568
3	2.1065	2.0739	2.0422	2.0114	1.9813
4	2.5887	2.5404	2.4936	2.4483	2.4043
5	2.9906	2.9260	2.8636	2.8035	2.7454
6	3.3255	3.2446	3.1669	3.0923	3.0205
7	3.6046	3.5079	3.4155	3.3270	3.2423
8	3.8372	3.7256	3.6193	3.5179	3.4212
9	4.0310	3.9054	3.7863	3.6731	3.5655
10	4.1925	4.0541	3.9232	3.7993	3.6819
11	4.3271	4.1769	4.0354	3.9018	3.7757
12	4.4392	4.2784	4.1274	3.9852	3.8514
13	4.5327	4.3624	4.2028	4.0530	3.9124
14	4.6106	4.4317	4.2646	4.1082	3.9616
15	4.6755	4.4890	4.3152	4.1530	4.0013
16	4.7296	4.5364	4.3567	4.1894	4.0333
17	4.7746	4.5755	4.3908	4.2190	4.0591
18	4.8122	4.6079	4.4187	4.2431	4.0799
19	4.8435	4.6346	4.4415	4.2627	4.0967
20	4.8696	4.6567	4.4603	4.2786	4.1103
21	4.8913	4.6750	4.4756	4.2916	4.1212
22	4.9094	4.6900	4.4882	4.3021	4.1300
23	4.9245	4.7025	4.4985	4.3106	4.1371
24	4.9371	4.7128	4.5070	4.3176	4.1428
25	4.9476	4.7213	4.5139	4.3232	4.1474
26	4.9563	4.7284	4.5196	4.3278	4.1511
27	4.9636	4.7342	4.5243	4.3316	4.1542
28	4.9697	4.7390	4.5281	4.3346	4.1566
29	4.9747	4.7430	4.5312	4.3371	4.1585
30	4.9789	4.7463	4.5338	4.3391	4.1601
31	4.9824	4.7490	4.5359	4.3407	4.1614
32	4.9854	4.7512	4.5376	4.3421	4.1624
33	4.9878	4.7531	4.5390	4.3431	4.1632
34	4.9898	4.7546	4.5402	4.3440	4.1639
35	4.9915	4.7559	4.5411	4.3447	4.1644
36	4.9929	4.7569	4.5419	4.3453	4.1649
37	4.9941	4.7578	4.5426	4.3458	4.1652
38	4.9951	4.7585	4.5431	4.3462	4.1655
39	4.9959	4.7591	4.5435	4.3465	4.1657
40	4.9966	4.7596	4.5439	4.3467	4.1659
41	4.9972	4.7600	4.5441	4.3469	4.1661
42	4.9976	4.7603	4.5444	4.3471	4.1662
43	4.9980	4.7606	4.5446	4.3472	4.1663
44	4.9984	4.7608	4.5447	4.3473	4.1663
45	4.9986	4.7610	4.5449	4.3474	4.1664
46	4.9989	4.7612	4.5450	4.3475	4.1665
47	4.9991	4.7613	4.5451	4.3476	4.1665
48	4.9992	4.7614	4.5451	4.3476	4.1665
49	4.9993	4.7615	4.5452	4.3477	4.1666
50	4.9995	4.7616	4.5452	4.3477	4.1666