# A TARGET MOTAD ANALYSIS OF SWEET POTATO MARKETING

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### Abstract

Decisions regarding when to harvest and when to sell sweet potatoes are more complex than for other crops because yields continue to increase after the crop is initially ready for harvest, and sweet potatoes can either be sold at harvest or cured and stored for later sale. The optimum marketing decision, based on expected net revenue, is dependent on yield and prices and their variability, and on costs of storage. A marketing strategy is developed using Target MOTAD and data covering 21 years.


*Key words*: target MOTAD, marketing strategy, sweet potatoes

Sweet potatoes differ from other crops in that yield depends on time of harvest—the crop continues to grow after initially being ready for harvest. Sweet potatoes can be sold immediately or cured and stored for later sale. Economic theory assumes producers maximize profit or net revenue, but marketing decisions depend on many factors. In the case of sweet potatoes, net revenue depends on yield, which is in turn influenced by time of harvest, price and its seasonal variation, and storage costs. In this analysis, the development of the marketing decision was based on these factors and on the assumption that, *ceteris paribus*, producers also attempt to reduce "down side risk," i.e., keeping income above a level necessary to meet minimum financial needs. It was also assumed that the facilities necessary to properly cure and store sweet potatoes were available and that all production was sold for fresh market rather than contracted for processing.

## OBJECTIVE

The objective of this study was to analyze the marketing decisions for an individual sweet potato producer. These decisions included when to harvest, whether to sell at harvest or cure and store, and, if stored, when to sell.

## PROCEDURE

In recent years, MOTAD (minimization of total absolute deviations) has been used to approximate mean-variance analysis and to incorporate risk into decisions. The method was developed by Hazell and minimizes deviations, both positive and negative, around a decision variable. Target MOTAD, presented by Tauer, is a modification that minimizes only negative deviations from a specified target income. Both were discussed and illustrated in Watts et al. Target MOTAD was applied to the present problem.

The Target MOTAD model was used to develop a marketing strategy that minimized negative deviations from the target income over the period 1965-1985. The basic assumption of this application was that the decision that would have minimized negative deviations over the previous period will minimize future negative deviations, i.e., future distributions of price and yield will be identical to historical distributions.

## DATA AND TARGET MOTAD MODEL

Monthly data were used in this study. Sweet potatoes can be harvested in August, September, and October and can be sold green at harvest, or cured for sale from November through May.

Average annual yields for North Carolina were obtained from USDA *Crop Production*. These yields were assumed to be representative of September harvests. Based on discussions with producers, August yields were assumed to be one-third less than September yields, and October yields one-third more. Cost of production data came from North Carolina State University budgets (Estes and Wilson).

Monthly prices for 1965-1985 were obtained from the North Carolina Agricultural Statistics Service. These data were not available after 1985. To remove the effect of changes in the general price level, prices were deflated with the Consumer Price Index (United States Department of Commerce). The deflated monthly average prices, and the averages plus and minus one monthly standard deviation are plotted in Figure 1. The average price declined during the August-to-October harvest period but increased throughout the November-to-May marketing sea-

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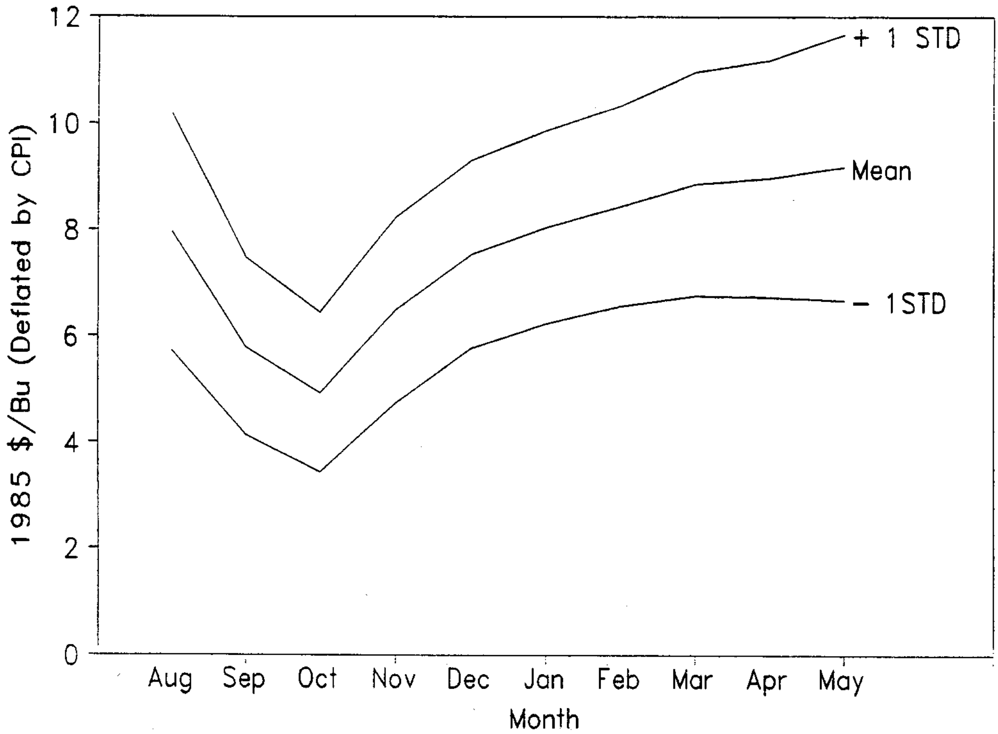


Figure 1. Average Sweet Potato Prices, Plus and Minus One Standard Deviation, North Carolina, 1965-1985

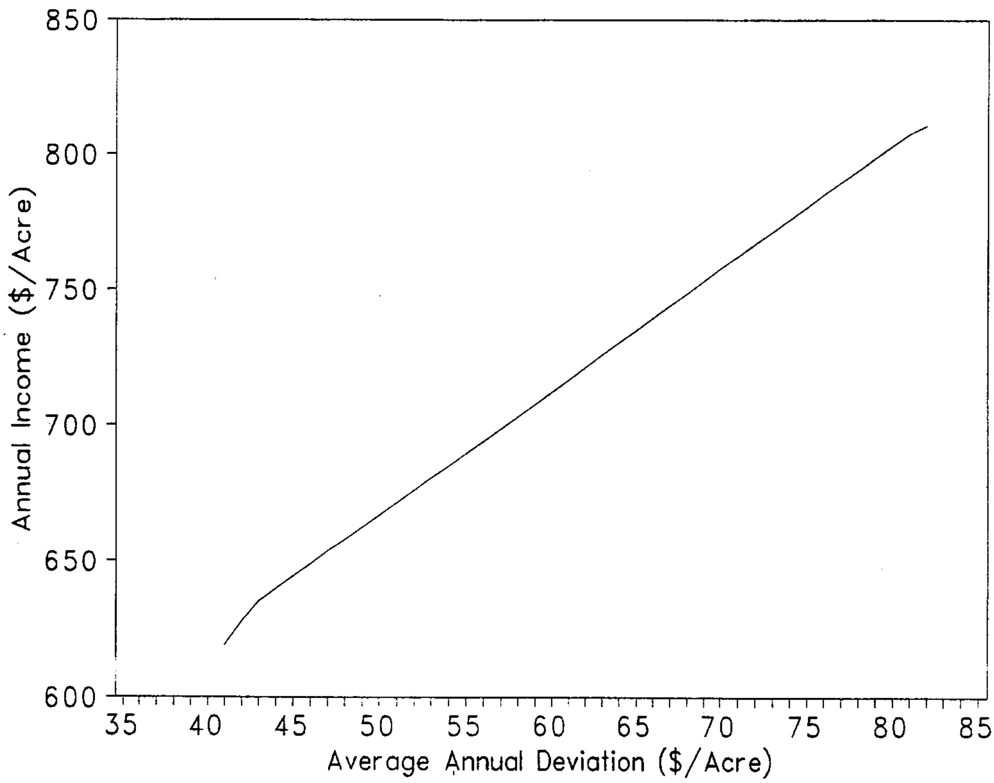


Figure 2. E-A Frontier, $250 Per Acre Target Income, 1965-1985.

Table 1. Tableau for Target MOTAD

| | | HAR8 | HAR9 | HAR10 | SLGR8 | SLGR9 | SLGR10 | SL8-11 | SL8-12 | SL8-1 | SL8-2 | SL8-3 | SL8-4 | SL8-5 | SL9-11 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| OBJ FCN | | | | | 503.1 | 482.7 | 544.3 | -188.5 | -57.3 | -17.8 | 19.3 | 69.6 | 82.5 | 106.2 | 79.4 |
| ACRE | E | 1 | 1 | 1 | | | | | | | | | | | |
| SP-8 | E | -1 | | | 1 | | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | |
| SP-9 | E | | -1 | | | 1 | | | | | | | | | 1 |
| SP-10 | E | | | -1 | | | 1 | | | | | | | | |
| D1965 | G | | | | 777.9 | 1244.7 | 1493.7 | 64.3 | 32.5 | 5.6 | 4.1 | -67.4 | -15.2 | -27.2 | 474.8 |
| D1966 | G | | | | 394.0 | 868.6 | 1215.3 | -4.8 | -30.9 | -126.3 | -70.5 | -54.6 | -56.0 | -24.7 | 362.4 |
| D1967 | G | | | | 703.7 | 705.9 | 80.9 | -418.3 | -296.0 | -263.2 | -155.6 | 31.3 | 45.9 | 183.8 | -282.2 |
| D1968 | G | | | | 262.1 | 356.1 | 534.8 | -47.4 | 126.0 | 225.9 | 146.0 | 255.4 | 160.2 | 189.1 | 297.4 |
| D1969 | G | | | | 704.5 | 274.5 | 74.8 | -517.1 | -82.0 | -12.6 | 5.5 | 60.8 | 73.2 | 107.2 | -432.2 |
| D1970 | G | | | | 1101.6 | -14.0 | 43.1 | -371.1 | 76.2 | 121.9 | 272.8 | 243.9 | 194.3 | 185.8 | -201.9 |
| D1971 | G | | | | 1368.5 | 268.3 | 313.6 | -313.2 | -90.9 | 12.7 | 27.1 | 119.5 | 134.2 | 73.5 | -113.6 |
| D1972 | G | | | | 684.2 | 599.4 | 356.9 | -290.6 | 12.9 | 200.1 | 308.5 | 311.8 | 377.2 | 461.1 | -76.2 |
| D1973 | G | | | | 917.0 | 1300.1 | 919.4 | -40.4 | -130.2 | 220.9 | 263.4 | 327.2 | 235.5 | 218.5 | 312.6 |
| D1974 | G | | | | 871.7 | 1329.7 | 1458.7 | 165.4 | 210.5 | 99.3 | 98.8 | 148.7 | 100.2 | 53.7 | 632.8 |
| D1975 | G | | | | 201.4 | 258.1 | 356.6 | -124.9 | 84.3 | 134.0 | 130.7 | 112.5 | 175.4 | 104.9 | 180.7 |
| D1976 | G | | | | -86.1 | 67.5 | 57.8 | -610.8 | -541.0 | -442.8 | -322.8 | -206.8 | -130.7 | 13.9 | -580.8 |
| D1977 | G | | | | 784.7 | 704.7 | 982.7 | -65.5 | 113.6 | 100.1 | 95.7 | 166.4 | 210.3 | 307.3 | 272.0 |
| D1978 | G | | | | 866.3 | 651.6 | 372.7 | -78.6 | 120.8 | 121.0 | 76.3 | 84.6 | 110.0 | 94.7 | 250.8 |
| D1979 | G | | | | 135.3 | 266.1 | 369.1 | -349.1 | -357.5 | -342.8 | -401.3 | -390.9 | -386.9 | -327.7 | -173.4 |
| D1980 | G | | | | 725.3 | 224.7 | 629.0 | 105.8 | 180.9 | 164.2 | 209.4 | 359.9 | 541.4 | 673.5 | 536.8 |
| D1981 | G | | | | 239.7 | 358.5 | 826.8 | -36.1 | 63.5 | 163.1 | 131.2 | 336.8 | 321.4 | 159.3 | 315.8 |
| D1982 | G | | | | -115.7 | -88.6 | -5.4 | -549.5 | -509.2 | -546.4 | -496.5 | -544.6 | -558.6 | -607.1 | -484.3 |
| D1983 | G | | | | 65.2 | 474.1 | 716.3 | 10.6 | 49.3 | 110.5 | 264.2 | 385.1 | 443.4 | 638.4 | 388.7 |
| D1984 | G | | | | 203.7 | 355.3 | 731.1 | 105.3 | 288.2 | 213.0 | 343.9 | 245.6 | 210.9 | 197.6 | 538.9 |
| D1985 | G | | | | -239.8 | -68.6 | -96.9 | -593.3 | -524.2 | -531.8 | -526.1 | -462.7 | -453.5 | -444.4 | -550.5 |
| MAXN | L | | | | | | | | | | | | | | |
| TARGET | E | | | | | | | | | | | | | | |

Table 1. Tableau for Target MOTAD (continued)

| | | SL9-12 | SL9-1 | SL9-2 | SL9-3 | SL9-4 | SL9-5 | SL10-11 | SL10-12 | SL10-1 | SL10-2 | SL10-3 | SL10-4 | SL10-5 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| OBJ FCN | | 281.1 | 339.8 | 363.0 | 408.8 | 425.5 | 458.5 | 381.4 | 659.2 | 738.1 | 768.3 | 785.7 | 768.5 | 810.7 |
| ACRE | E | | | | | | | | | | | | | |
| SP-8 | E | | | | | | | | | | | | | |
| SP-9 | E | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | |
| SP-10 | E | | | | | | | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| D1965 | G | 421.7 | 376.6 | 339.9 | 203.2 | 278.9 | 258.2 | 930.8 | 854.9 | 789.6 | 736.5 | 506.4 | 573.1 | 543.7 |
| D1966 | G | 318.3 | 166.2 | 224.0 | 222.5 | 217.8 | 262.0 | 768.9 | 705.5 | 491.6 | 569.8 | 530.0 | 491.5 | 548.8 |
| D1967 | G | -94.4 | -46.3 | 94.4 | 351.4 | 370.5 | 574.7 | -124.4 | 134.2 | 198.5 | 391.8 | 706.0 | 695.2 | 965.7 |
| D1968 | G | 564.9 | 718.0 | 555.6 | 687.4 | 542.0 | 582.7 | 680.5 | 1049.9 | 1259.9 | 1032.3 | 1162.7 | 923.8 | 976.3 |
| D1969 | G | 244.2 | 349.6 | 342.7 | 395.6 | 411.5 | 459.9 | -326.9 | 610.3 | 754.0 | 742.4 | 768.7 | 749.9 | 812.6 |
| D1970 | G | 493.5 | 562.0 | 752.3 | 670.1 | 593.2 | 577.8 | -4.2 | 959.4 | 1051.8 | 1314.1 | 1143.1 | 992.1 | 969.8 |
| D1971 | G | 230.4 | 389.1 | 375.8 | 483.6 | 503.0 | 409.4 | 115.5 | 591.0 | 808.9 | 788.3 | 888.4 | 871.8 | 745.3 |
| D1972 | G | 394.7 | 684.2 | 806.9 | 772.0 | 867.6 | 990.8 | 170.5 | 822.2 | 1221.5 | 1390.0 | 1281.6 | 1357.9 | 1520.5 |
| D1973 | G | 169.0 | 714.5 | 737.0 | 795.2 | 655.0 | 626.9 | 707.6 | 505.8 | 1260.8 | 1290.0 | 1311.8 | 1074.5 | 1035.3 |
| D1974 | G | 699.8 | 523.0 | 484.7 | 527.3 | 452.0 | 379.6 | 1150.3 | 1241.1 | 992.9 | 937.6 | 946.9 | 803.8 | 705.5 |
| D1975 | G | 504.0 | 578.6 | 534.1 | 473.1 | 564.8 | 456.5 | 524.3 | 971.1 | 1072.1 | 1008.1 | 874.0 | 954.2 | 808.0 |
| D1976 | G | -475.0 | -324.8 | -160.3 | -5.9 | 105.7 | 320.0 | -536.3 | -391.6 | -185.5 | 40.9 | 221.8 | 342.1 | 626.0 |
| D1977 | G | 548.3 | 524.2 | 479.9 | 554.0 | 617.1 | 760.1 | 649.2 | 1030.8 | 994.6 | 931.0 | 983.1 | 1024.0 | 1212.8 |
| D1978 | G | 558.9 | 556.2 | 450.0 | 431.2 | 466.8 | 441.2 | 618.8 | 1044.5 | 1038.0 | 888.5 | 815.8 | 823.5 | 787.7 |
| D1979 | G | -189.9 | -170.0 | -280.8 | -282.0 | -278.6 | -192.4 | 27.6 | 2.5 | 27.7 | -128.4 | -154.2 | -170.3 | -57.1 |
| D1980 | G | 650.7 | 621.5 | 652.4 | 844.2 | 1113.9 | 1309.3 | 1013.0 | 1169.0 | 1125.9 | 1166.8 | 1375.8 | 1686.3 | 1945.1 |
| D1981 | G | 467.9 | 620.6 | 533.2 | 809.6 | 783.8 | 538.0 | 707.1 | 916.1 | 1125.5 | 1002.2 | 1329.2 | 1246.2 | 916.7 |
| D1982 | G | -424.6 | -485.9 | -425.4 | -512.6 | -536.1 | -611.6 | -401.2 | -320.6 | -408.2 | -326.4 | -466.3 | -513.7 | -616.1 |
| D1983 | G | 445.7 | 538.4 | 736.5 | 882.0 | 966.8 | 1256.7 | 808.3 | 885.3 | 1011.4 | 1284.6 | 1427.6 | 1490.2 | 1875.0 |
| D1984 | G | 821.2 | 700.7 | 859.5 | 672.7 | 618.1 | 595.5 | 1019.8 | 1409.7 | 1239.6 | 1458.2 | 1144.4 | 1025.3 | 993.4 |
| D1985 | G | -446.0 | -460.9 | -469.6 | -389.7 | -378.5 | -367.5 | -490.2 | -347.4 | -370.7 | -385.0 | -298.0 | -303.6 | -290.6 |
| MAXN | L | | | | | | | | | | | | | |
| TARGET | E | | | | | | | | | | | | | |

son. Note that price variability increased as the storage time increased.

A target income of $250 per acre was used. It was assumed that this was the minimum income necessary to cover debt retirement and the opportunity cost of investment, and to provide for family living expenses.

The linear programming tableau for the Target MOTAD model is presented in Table 1. The objective was to maximize income subject to minimizing negative deviations from the target income. The rows were the following:

OBJ FCN = objective function

ACRE = land restriction

Table 1. Tableau for Target MOTAD (continued)

| | | Y1965 | Y1966 | Y1967 | Y1968 | Y1969 | Y1970 | Y1971 | Y1972 | Y1973 | Y1974 | Y1975 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| OBJ FCN | | | | | | | | | | | | |
| ACRE | E | | | | | | | | | | | |
| SP-8 | E | | | | | | | | | | | |
| SP-9 | E | | | | | | | | | | | |
| SP-10 | E | | | | | | | | | | | |
| D1965 | G | 1 | | | | | | | | | | |
| D1966 | G | | 1 | | | | | | | | | |
| D1967 | G | | | 1 | | | | | | | | |
| D1968 | G | | | | 1 | | | | | | | |
| D1969 | G | | | | | 1 | | | | | | |
| D1970 | G | | | | | | 1 | | | | | |
| D1971 | G | | | | | | | 1 | | | | |
| D1972 | G | | | | | | | | 1 | | | |
| D1973 | G | | | | | | | | | 1 | | |
| D1974 | G | | | | | | | | | | 1 | |
| D1975 | G | | | | | | | | | | | 1 |
| D1976 | G | | | | | | | | | | | |
| D1977 | G | | | | | | | | | | | |
| D1978 | G | | | | | | | | | | | |
| D1979 | G | | | | | | | | | | | |
| D1980 | G | | | | | | | | | | | |
| D1981 | G | | | | | | | | | | | |
| D1982 | G | | | | | | | | | | | |
| D1983 | G | | | | | | | | | | | |
| D1984 | G | | | | | | | | | | | |
| D1985 | G | | | | | | | | | | | |
| MAXN | L | 0.048 | 0.048 | 0.048 | 0.048 | 0.048 | 0.048 | 0.048 | 0.048 | 0.048 | 0.048 | 0.048 |
| TARGET | E | | | | | | | | | | | |

Table 1. Tableau for Target MOTAD (continued)

| | | Y1976 | Y1977 | Y1978 | Y1979 | Y1980 | Y1981 | Y1982 | Y1983 | Y1984 | Y1985 | TRAN | RHS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| OBJ FCN | | | | | | | | | | | | | |
| ACRE | E | | | | | | | | | | | | 1 |
| SP-8 | E | | | | | | | | | | | | |
| SP-9 | E | | | | | | | | | | | | |
| SP-10 | E | | | | | | | | | | | | |
| D1965 | G | | | | | | | | | | | -1 | |
| D1966 | G | | | | | | | | | | | -1 | |
| D1967 | G | | | | | | | | | | | -1 | |
| D1968 | G | | | | | | | | | | | -1 | |
| D1969 | G | | | | | | | | | | | -1 | |
| D1970 | G | | | | | | | | | | | -1 | |
| D1971 | G | | | | | | | | | | | -1 | |
| D1972 | G | | | | | | | | | | | -1 | |
| D1973 | G | | | | | | | | | | | -1 | |
| D1974 | G | | | | | | | | | | | -1 | |
| D1975 | G | | | | | | | | | | | -1 | |
| D1976 | G | 1 | | | | | | | | | | -1 | |
| D1977 | G | | 1 | | | | | | | | | -1 | |
| D1978 | G | | | 1 | | | | | | | | -1 | |
| D1979 | G | | | | 1 | | | | | | | -1 | |
| D1980 | G | | | | | 1 | | | | | | -1 | |
| D1981 | G | | | | | | 1 | | | | | -1 | |
| D1982 | G | | | | | | | 1 | | | | -1 | |
| D1983 | G | | | | | | | | 1 | | | -1 | |
| D1984 | G | | | | | | | | | 1 | | -1 | |
| D1985 | G | | | | | | | | | | 1 | -1 | |
| MAXN | L | 0.048 | 0.048 | 0.048 | 0.048 | 0.048 | 0.048 | 0.048 | 0.048 | 0.048 | 0.048 | | $\lambda$ |
| TARGET | E | | | | | | | | | | | 1 | 250 |

SPi = transfer production in month i to sales activities
Dk = estimated net revenue for year k for each sales activity
MAXN = negative deviations restriction
TARGET = target income.

The nature of restrictions were the following:
E = equal
L = less than or equal
G = greater than or equal.

The columns were the following:
HARi = harvest in month i
SLGRi = sale of green sweet potatoes in month i
SLi-j = potatoes harvested in month i sold in month j
Yk = transfer negative deviations for year k

Table 2. Target MOTAD Results, $250 Target Income

| | Results | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Income ($/A) | 811 | 781 | 758 | 735 | 712 | 690 | 667 | 644 | 618 |
| Avg. Dev. ($ / A / Yr) | 82 | 75 | 70 | 65 | 60 | 55 | 50 | 45 | 41 |
| SlGr-10 (A) | 0 | .11 | .20 | .28 | .37 | .45 | .54 | .62 | .72 |
| Sl 10-5 (A) | 1 | .89 | .80 | .72 | .63 | .55 | .46 | .38 | .28 |

TRAN = transfer income to target constraint
RHS = right hand side.

The ACRE equation restricted land to one acre. Therefore, results were in proportions of an acre.

HAR8, HAR9, and HAR10 were harvest activities for August, September, and October, respectively. These activities transferred production from each harvest month to the months of possible sale. The entry in the objective function was zero because average net revenues were reflected in the objective function for each of the sales activities.

The SLGR8, SLGR9, and SLGR10 activities allowed the sale of green sweet potatoes at harvest in August, September, and October. The objective function coefficients for these activities were average net returns per acre over the period covered by the data.

The SLi-j activities allowed product harvested and cured in month i to be sold in month j. Objective function values were average net revenues.

Coefficients in the D1965 through D1985 rows were the respective annual net returns per acre for each of the sales activities. Annual gross returns were calculated using yield and price data for each year. Pre-harvest costs of $647 per acre and harvest costs of $1.45 per bushel (Estes and Wilson) were deducted, as were curing and storing costs of $0.35 per bushel (Clemson University). Based on discussions with horticulturists, a shrinkage rate of 4 percent per month of storage was assumed with maximum shrinkage of 20 percent. An opportunity cost of not harvesting and selling in August, the earliest possibility, was based on an annual interest rate of 10.5 percent and the number of months after August.

Annual incomes from the D1978-D1985 rows were transferred by the TRAN column into the TARGET row. The average negative deviation, i.e., the negative deviation divided by the number of years (1/21=0.048), was transferred into the MAXN row where an upper limit was imposed. Parametric programming on the MAXN right-hand-side coefficient ($\lambda$) allowed an income-deviations curve to be estimated.

## TARGET MOTAD RESULTS

Results are presented in Table 2. The estimated income-absolute negative deviations, or E-A frontier, is plotted in Figure 2. The frontier is essentially a straight line with slight curvature on both ends. Over the major portion, there is a constant trade-off of $4.55 income per dollar of average annual deviation. The maximum income (linear programming) solution was to harvest in October and store for sale in May when the price was highest. In the minimum deviation solution, harvest was in October with 72 percent of the crop sold green at harvest, and 28 percent cured and stored for sale in May.

As discussed earlier, the basic assumption of this analysis was that the decision that would have minimized negative deviations over the previous period would minimize future negative deviations. Annual net incomes for each of the 21 years covered by the data were calculated using the linear programming profit maximization solution and the minimum negative deviation solution (Table 3). The average annual income per acre for the minimum deviation solution was $192 less than for the profit maximization solution. In either case, there were three years with income less than the target. However, the range was $1,137 less and the minimum income was $440 greater with the minimum deviation solution. In 1979-1980, the maximum profit solution would have resulted in a net revenue of -$57, while with the minimum deviation solution the net revenue would have been $250. It is reasonable to conclude that if the producer is averse to down-side risk, the minimum deviation decision would be preferable.

Because the price data used were not available after 1985, monthly prices for the marketing years 1986-1987 through 1989-1990 were obtained from the Marketing Division of the North Carolina Department of Agriculture. These data were used to calculate estimated net revenues given the maximum revenue and minimum negative deviation solutions. As with the original data, the average income with the minimum deviation solution was lower, by $74, but the down-side risk was much less (Table 4). The lowest income was $434 for the minimum deviation solution, compared to -$45 for the maximum income solution. The range and stand-

Table 3. Annual Net Revenues for Linear Programming Maximum Income and Minimum Negative Deviation Solutions, 1965-1985 Crop Years

| Year | Minimum Negative Deviation Solution | Maximum Income Solution |
|---|---|---|
| | ($/ A) | ($/ A) |
| 1965-66 | 1,228 | 544 |
| 1966-67 | 1,029 | 549 |
| 1967-68 | 329 | 966 |
| 1968-69 | 658 | 976 |
| 1969-70 | 281 | 813 |
| 1970-71 | 303 | 970 |
| 1971-72 | 434 | 745 |
| 1972-73 | 683 | 1,520 |
| 1973-74 | 952 | 1,035 |
| 1974-75 | 1,248 | 706 |
| 1975-76 | 483 | 808 |
| 1976-77 | 217[a] | 626 |
| 1977-78 | 1,047 | 1,213 |
| 1978-79 | 489 | 788 |
| 1979-80 | 250 | -57[a] |
| 1980-81 | 998 | 1,945 |
| 1981-82 | 852 | 917 |
| 1982-83 | -176[a] | -616[a] |
| 1983-84 | 1,041 | 1,875 |
| 1984-85 | 805 | 991 |
| 1985-86 | -151[a] | -291[a] |
| Average | 619 | 811 |
| Maximum | 1,248 | 1,945 |
| Minimum | -176 | -616 |
| Range | 1,424 | 2,561 |
| Standard Deviation | 410 | 596 |

[a] Net revenue is less than $250/acre target.

Table 4. Estimated Annual Net Revenues for Linear Programming Maximum and Minimum Deviation Solutions, 1986-1989 Crop Years

| Year | Minimum Negative Deviation Solution | Maximum Income Solution |
|---|---|---|
| | ($ / A) | ($ / A) |
| 1986-87 | 549 | 695 |
| 1987-88 | 612 | 1,118 |
| 1988-89 | 434 | 553 |
| 1989-90 | 435 | -45[a] |
| Average | 507 | 581 |
| Maximum | 612 | 1,118 |
| Minimum | 434 | -45 |
| Range | 178 | 1,163 |
| Standard Deviation | 76 | 417 |

[a] Net revenue is less than $250/acre target

ard deviation for the minimum deviation solution were also substantially smaller.

## CONCLUSIONS

Given the price patterns that existed for North Carolina sweet potatoes from 1965 to 1985, a marketing plan based on the minimum negative deviation Target MOTAD solution would have reduced income variability. With the profit maximization solution, all the produce was harvested in October and sold in May when the price was highest but most variable. With the minimum negative deviation solution, harvest was in the same month, but more than half was sold at harvest when prices were lower and less variable. The minimum negative deviation solution reduced down-side risk, even though average income was reduced and the highest annual incomes were sacrificed. The risk an individual is willing to bear, plus annual income requirements, would influence how the results would be applied to a particular situation.

This model could be used as an aid for extension workers in teaching marketing techniques. Individual sweet potato producers with personal computers could also use the model adapted to their particular situations. An advantage of the linear programming framework is the availability of shadow prices and sensitivity analysis to evaluate alternative marketing decisions. Given the management skills of the producers for whom this study is applicable, it is not unreasonable to expect that many could make direct use of such a model.

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