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Evaluating Production and Marketing Opportunities Using Market Window and Expected Value Analyses

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Abstract

Increasing demand for traditional and specialty fruit and vegetable crops has encouraged many financially stressed U.S. farmers to diversify their farm operations to include some form of alternative enterprise. Decisions on whether or not to enter into the production of a new crop are frequently distorted by impractical expectations of returns generally associated with unrealistic estimates of market prices and crop yields. As a result, many of these new enterprises have failed or are only marginally successful.

Two relatively simple methods of analysis are presented, which, when combined with the other market evaluation techniques, can provide some insight into the decision of whether or not an enterprise should be undertaken as well as reduce some of the risk of implementing a potentially unprofitable venture.

Keywords: Market window analysis, expected value, market opportunities, vegetables, fruit

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June 1991

Evaluating Production and Marketing Opportunities Using Market Window and Expected Value Analyses

by

Richard G. Mook and Andrew A. Jermolowicz*

Introduction

In recent years fruit and vegetable production has developed into a profitable alternative enterprise for some U.S. farmers suffering from adverse economic conditions. An increasing number of producers facing similar economic problems have had fresh fruit and vegetable production promoted to them as the economic salvation for their area. Oftentimes the process of deciding whether or not a group of producers should enter into the production of a given crop is distorted by impractical expectations of returns generally associated with unrealistic estimates of prices and yields.

Detailed evaluation of potential enterprises is critical to minimize the risk of failure. Given that a large initial investment may be required to enter a new production activity, it is essential to determine the production capability as well as the marketing potential prior to implementation. Furthermore, the risk associated with producing these commodities is often very high due to the price-sensitive and perishable nature of most horticultural crops. Thus, there is no substitute for a thorough enterprise analysis and a sound operating plan.

The purpose of this paper is to present two methodologies, market window and expected value analysis, for identifying and evaluating the potential production, marketing, and distribution opportunities for fruit and vegetable enterprises. Application of these methods by producers, intermediaries, and wholesalers can help, in many cases, to evaluate and reduce a portion of the risks traditionally associated with the fruit and vegetable industry. Specifically, by compiling and interpreting historical market data, these analyses can provide interested parties with an estimate of "likely" returns and the sensitivity of these returns to yield and price variability.

The market window and expected value techniques should be of value to those presently involved with commercial vegetable production and marketing as well as those who are planning new production and marketing organizations. Cooperative extension agents, produce cooperative management, and others interested in investigating market opportunities from a production standpoint will find these techniques applicable to a variety of individual situations.

The specific objectives of this report are as follows:

- 1) To present the conceptual framework and methodologies of the market window and expected value techniques used for the analysis of fruit and vegetable market opportunities.
- 2) To introduce some of the sources of production, price, and volume data available for market window and expected value analysis.
- 3) To present applications of these techniques by use of examples of actual past market situations.
- 4) To briefly discuss some of the problems and limitations associated with these applications.

In order to fulfill these objectives, the report has been divided into two sections. Section I provides an overview of the market window analysis method along with a sample application. Section II contains the appropriate background information and working example of the expected value concept. A discussion of data requirements and sources is presented in each section.

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I. Market Window Analysis

The term market window analysis has historically been used to describe a group of techniques that have been applied toward the assessment of market potential for fruit and vegetable crop production. Although this term has escaped specific definition, its meaning (as implied by past research) centers around the economic viability of production relative to the yields, the total cost incurred and the price received for the commodity produced. For the purpose of this report, a market window is specifically defined as an estimated time during a given marketing period in which the wholesale market price of a commodity exceeds the variable and fixed costs associated with its production, packaging, marketing, and delivery to an identified market.

Conceptual Framework

Past research using market window analysis as an indicator of possible market opportunities has utilized techniques ranging from simple visual analysis of price data to more sophisticated empirical programming models. The foundation of much of this research evolved from a study originating at the University of Florida by Collette and Wall, which evaluated alternative vegetable crops as a means of increasing small farm income. Other work in this area has been conducted by Mizelle, O'Rourke, and others (see references).

The preliminary steps in market window analysis are determining the specific commodity or commodities, defining the corresponding feasible or practical marketing period for each crop, and developing realistic production and packaging costs. The feasible marketing period is defined as the interval of time that quality crops in "usable" commercial volumes can be produced and delivered for commercial sale from a specific location. Marketing periods are influenced by

variables such as climatic conditions, biological factors, and other production and marketing constraints.

After the initial conditions have been established, target markets must be identified and examined for their ability to support new entrants or expansion. Potential markets may be either terminal markets such as Cincinnati, Ohio, Atlanta, Georgia, and Jessup, Maryland, or smaller, secondary markets such as Richmond, Virginia, and Knoxville, Tennessee. Generally speaking, data are more readily available for the large terminal markets than for the secondary wholesale markets.

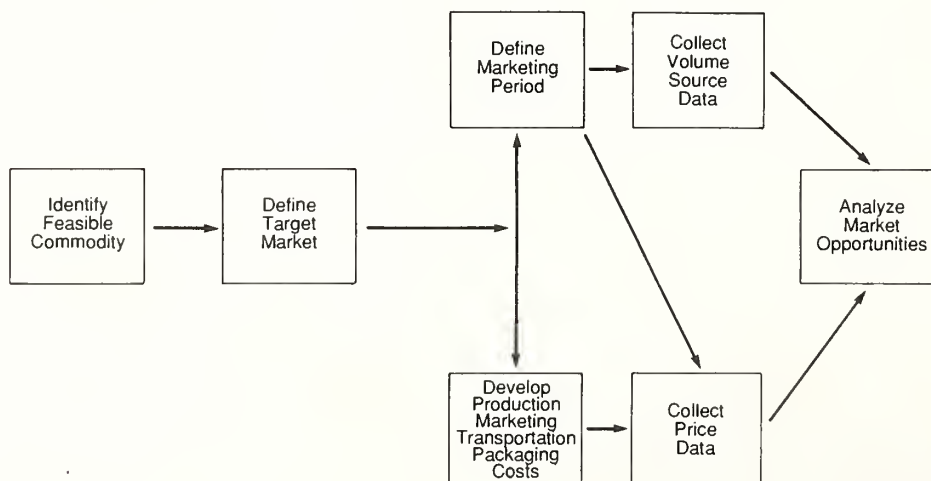
The remaining steps of the analysis entail collecting specific information on the marketing characteristics that must be taken into consideration for entry into these markets. Collecting price and volume data as well as defining packing, transportation, and marketing costs are essential steps for the analysis.

Data Requirements and Sources

Successful identification of marketing opportunities greatly depends upon the availability and quality of market data. Thus, it is essential to obtain data from the most reliable sources possible. Sources for marketing data include, but are not limited to, government institutions, universities, and private industry. Information regarding production possibilities, cultural practices, budgets, etc., can be obtained from sources such as State Cooperative Extension Services, production and marketing specialists, seed companies, and trade organizations including the Produce Marketing Association (PMA) and the United Fresh Fruit and Vegetable Association.

Figure 1

Identifying Market Windows



As previously stated, a commodity's marketing period depends upon a variety of factors. These variables require close consideration when choosing the commodities that are to be analyzed. For instance, tomato prices may be at their peak in January, but unless an area has the ability to produce January tomatoes, this fact will be of little or no concern.

The extension horticultural departments at many of the land-grant universities regularly publish crop reports which contain information on crop potential, production costs, expected yields, and other data useful for management decisions. These reports, as well as correspondence with extension specialists, are invaluable in the selection of alternative fruit and vegetable crops. Before any crop selection is actually made, these sources should be consulted.

After determining which crops are feasible from a production standpoint, the next step involves investigating whether or not the identified crops can be produced, packaged, transported, and marketed to an available market at a price which covers all the associated costs as well as provides an adequate return to the producer. For this step of the analysis, target markets, having adequate price and volume data available, are identified so that questions regarding the profitability of an enterprise begin to be answered. Presently, the Market News Service of USDA's Agricultural Marketing Service can provide (for a fee) a variety of reports useful in market window analysis. These include terminal market price reports as well as shipping point and marketing trend reports. Appendix I provides a list of the markets where data are collected, along with a list of the commodity classifications.

For the purpose of this presentation, the data used are from the terminal market reports provided by the Market News Service. A terminal market is defined as a wholesale market located in a major consuming area and made up of a variety of food handling facilities, brokers, and others associated with the food industry. The relatively large number of wholesale intermediaries and buyers operating through a terminal market provide price data that reflects a more competitive market than what may be present in the smaller farm assembly markets. A more competitive market situation may be the result of better and more frequent communications between buyers and sellers.

Two general types of data, price and arrival (supplies), are available for many market areas in the United States. The Market News Service regularly publishes both weekly and annual summaries of these data.

The reported prices represent the general price range or "mostly" price received by the wholesalers at the terminal market for sales of less than carload or truckload quantities. It can be assumed that the most consistent areas of supply

and the most popular containers, varieties, grades, and sizes of generally good (marketable) quality are reported. Any deviation from these assumptions is noted in the report. In addition, each terminal market report also provides a description of the data collection and reporting procedures used as well as any deviation unique to a specific market.

Quantity data for many of the large market areas are also available from the Market News Service. Market arrival data are collected and presented in much the same manner as the price data and are broken down into two categories, annual and monthly. Total fruit and vegetable arrival data are available by origin and month for a yearly period. This breakdown gives a general indication of the quantities of produce on a monthly basis moving through the market which can be useful when comparing the activity of one market to that of another. In addition, arrival comparisons by commodity, origin, and mode of transportation are reported on a yearly as well as monthly basis. The latter is perhaps the most useful for assessing market windows for specific commodities in that it provides information which offers some insight into the existing competitive structure of the market.

Methodology

Manipulation of the collected data into a usable format to uncover a market opportunity can be accomplished through a variety of methods. The method chosen will depend upon the resources available to the researcher. Past analyses have been completed with methods ranging from nothing more than a hand-held calculator, graph paper, and a straightedge to more sophisticated empirical methods using computer forecasting and graphic capabilities. (For a simple method of data manipulation see Mizelle 1/.)

As previously noted, the reported terminal market price data represent prices received by wholesalers for marketing less than carload or truckload quantities. Since producer groups are mainly interested in estimating prices that will be received on the buying side of the wholesale markets, the reported price should be discounted by the percentage of the sales cost that the distributor receives for dividing a shipment into smaller lots. The discounted prices represent the prices that a producer might expect to receive for produce delivered to the wholesale market. For the examples presented in this paper, it is assumed that this margin approximates 15 percent. However, this margin may vary from business to business or between geographic areas. It is generally dependent upon such factors as the number of competitors operating in a market, the size of the wholesale customers, and the mix of services offered to both the buyers and sellers. Therefore, investigations into the marketing environment and practices of those involved with servicing the target market should be conducted prior to assigning this value. Any price adjustment, as expressed in the marketing margin, results in a downward shift of the USDA reported price ranges.

An Application

Fresh market bell pepper production in Kentucky serves as a good example to illustrate the market window analysis techniques. In this example, the Kentucky marketing period for fresh bell peppers is defined as July 25 through November 15. In other words, there are approximately 19 weeks during which Kentucky producers can market fresh bell peppers commercially. The market window approach focuses on determining the "best" time and place during this period to market a commodity based upon the analysis of prices and competition.

Price data were collected for the 19-week Kentucky marketing season from the Cincinnati terminal market reports. Weekly averages of the adjusted high and low prices for the previous 5-year period (1983-87) were calculated and are shown in table 1. Figure 2 presents these price ranges as vertical lines. The solid and broken horizontal lines represent the average high and low wholesale prices paid in 1987 for the 19-week Kentucky bell pepper marketing period. The price graph provides an indication of what range of prices may be expected based on a recent marketing period, although 1987 is not necessarily assumed to be a normal or typical year.

The graphical illustration of the price data suggests that the 1987 Cincinnati bell pepper average discounted wholesale price during the 19-week marketing period was generally within the 5-year average price range. It should also be noted that, historically, the highest prices have been paid during the first and last 4 or 5 weeks of the marketing period. Prices tend to decline during August and September (weeks 32-40) because other major producing areas are entering the market at this time.

In order to determine whether a market window exists, it is important to estimate the returns of an enterprise relative to the costs associated with the production, packaging, transportation, and marketing. Production, packaging, and marketing costs can be determined either by quantity or the value of the product.

Information provided by the Kentucky Cooperative Extension Service concerning the crop budgets for various horticultural crops was applied to the bell pepper example. The total cost of production was calculated to be \$2,258 per acre. The budget assumed that the crop is irrigated and provides a yield of 350 1 1/9 bu-boxes per acre. This results in a per unit (box) production cost of \$6.45. Transportation costs from Kentucky to the Cincinnati terminal market adds an additional expense of \$0.75 per box for a total cost of \$7.20 per box.

Figure 3 summarizes the Cincinnati wholesale prices and the Kentucky cost information for fresh bell peppers. Based upon this data, the first and last 4 to 5 weeks of the Kentucky marketing period appear to be the best time during

which Kentucky producers should enter the Cincinnati wholesale market. The 5-year adjusted, weekly average price ranges for the fresh bell pepper market appear to be depressed from approximately August 15 through October 3 (weeks 33-40). However, these weeks should not be eliminated completely from consideration because of this information alone.

Up to this point, only price data have been considered for market opportunity recognition. In order to gain insight as to why bell pepper prices behave in the manner in which they do, arrival data should also be considered. Table 2 presents the annual arrivals of bell peppers into Cincinnati for the 5-year period 1983 to 1987. The figures in table 2 indicate that all of the bell peppers delivered to Cincinnati during this time period were transported by truck. Further, the annual volume of bell peppers handled through Cincinnati appears to be increasing. This increase could be the result of increasing demand by final consumers, more produce wholesalers operating in the market, or generally more transactions being reported by the Market News Service (i.e., better reporting methods that capture the volume bought direct by chain grocery stores). Before any of these hypotheses can be verified, further examination is needed.

Monthly arrivals of bell peppers for 1986 and 1987 are shown in table 3. These data provide information on the competitive nature of the Cincinnati market during the Kentucky marketing period. California, Texas, and North Carolina are the largest suppliers of bell peppers during the Kentucky marketing period. From this data, it can be seen that some marginal suppliers such as Kentucky, Michigan, New Jersey, and Ohio have been able to deliver product to Cincinnati during the Kentucky marketing period. This suggests that buyers operating in this market may be receptive to suppliers that can only provide product during a limited time period.

Also, given that transportation costs to Cincinnati are greater from California and Texas than they are from Kentucky and Ohio, Kentucky producers may have a competitive advantage during this marketing season based on the transportation differential alone. The larger transportation costs paid by California and Texas may provide an opportunity for Kentucky producers to receive a higher price during this segment of their marketing period. Another potential advantage may be Kentucky's ability to deliver a higher quality product. A shorter delivery time resulting from the proximity of production to the market may enable Kentucky producers to provide a fresher and higher quality product.

Further Applications

The previous sections of this report presented the basic methodology for one type of market analysis. This section is included to provide additional examples of techniques helpful in evaluating marketing opportunities. These ex-

amples are included to provide methods to help answer the following questions:

- What monetary returns can be expected?
- Which market or markets should be targeted?
- When should the chosen market or markets be targeted?

While a variety of alternative crops and markets may exist, only those that are compatible with the available resources can be deemed feasible. Not-for-profit cooperatives or profit-oriented producers should consider those alternatives or combinations of alternatives in which returns or profits are maximized. Further, application of the production budgets along with the collected price data enables cost-volume-return relationships to be calculated. Calculation of these relationships, in turn, provides a method of forecasting the economic viability of a particular commercial enterprise as well as a framework to compare various commercial alternatives.

The dependence of economic returns on prices, marketable quantities, and production costs can be generalized by the following relationships:

$$P_w \times Q_{ty} = R_g \text{ and } R_g - TC = R_n$$

where: P_w = wholesale price

Q_{ty} = marketable quantity

R_g = gross returns

TC = total costs (production, packaging, marketing, and transportation)

R_n = net returns

With these relationships, the expected wholesale price, an estimate of the marketable quantities, and the range of possible outcomes for a production activity can be derived. These relationships and the calculations for use in an example will be covered in the second section of this report.

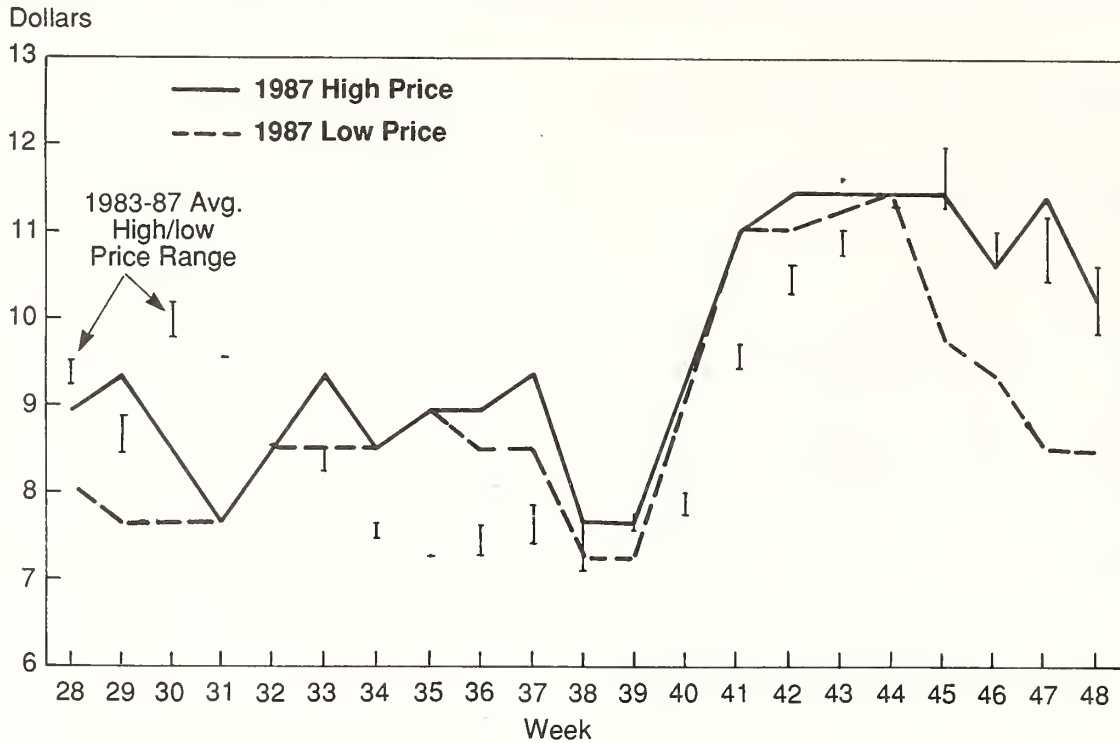
Choosing which market to target is an important consideration when addressing the issues of defining a market position or establishing a market penetration strategy. Markets located in relative proximity to production areas may provide the best opportunities for newly established enterprises. Competitive advantages including lower transportation costs, quality differentials such as a fresher product resulting from a shortened delivery time, local product identity, and generally more control over the products from production to final consumption all contribute to reducing marketing risk. As a result of this reduced risk, locally grown produce may be more desirable in some markets than a product transported from other production areas. In any case, it is extremely important to establish and maintain a

Table 1.—Cincinnati adjusted, average terminal market prices (1983-87) bell peppers-CA wonders/large & extra large 1 1/9-bu crates and cartons

Week	Date	5-year average high price	5-year average low price
1	03-Jan	\$10.12	\$ 9.95
2	10-Jan	10.97	10.54
3	17-Jan	11.99	11.56
4	24-Jan	11.56	11.48
5	31-Jan	11.99	11.31
6	07-Feb	16.92	16.49
7	14-Feb	14.88	13.77
8	21-Feb	15.22	14.71
9	28-Feb	20.06	20.06
10	07-Mar	20.40	19.64
11	14-Mar	13.49	13.28
12	21-Mar	18.02	17.85
13	28-Mar	15.90	15.64
14	04-Apr	15.73	15.05
15	11-Apr	17.00	16.07
16	18-Apr	14.79	13.43
17	25-Apr	14.28	13.60
18	02-May	11.82	10.63
19	09-May	15.22	14.03
20	16-May	13.01	12.45
21	23-May	13.01	12.24
22	30-May	13.35	13.09
23	06-Jun	13.60	13.60
24	13-Jun	12.50	12.33
25	20-Jun	10.71	10.46
26	27-Jun	9.52	9.52
27	04-Jul	10.20	10.20
28	11-Jul	9.52	9.26
29	18-Jul	8.88	8.46
30	25-Jul	10.20	9.78
31	01-Aug	9.56	9.56
32	08-Aug	8.55	8.55
33	15-Aug	8.50	8.25
34	22-Aug	7.65	7.48
35	29-Aug	7.27	7.23
36	05-Sep	7.61	7.27
37	12-Sep	7.86	7.40
38	19-Sep	7.65	7.10
39	26-Sep	7.74	7.57
40	03-Oct	7.99	7.74
41	10-Oct	9.69	9.43
42	17-Oct	10.63	10.29
43	24-Oct	11.05	10.75
44	31-Oct	11.48	11.31
45	07-Nov	11.99	11.31
46	14-Nov	11.05	10.63
47	21-Nov	11.22	10.46
48	28-Nov	10.67	9.86
49	05-Dec	9.01	8.50
50	12-Dec	9.43	9.01
51	19-Dec	9.35	8.88
52	26-Dec	10.03	9.61

Figure 2

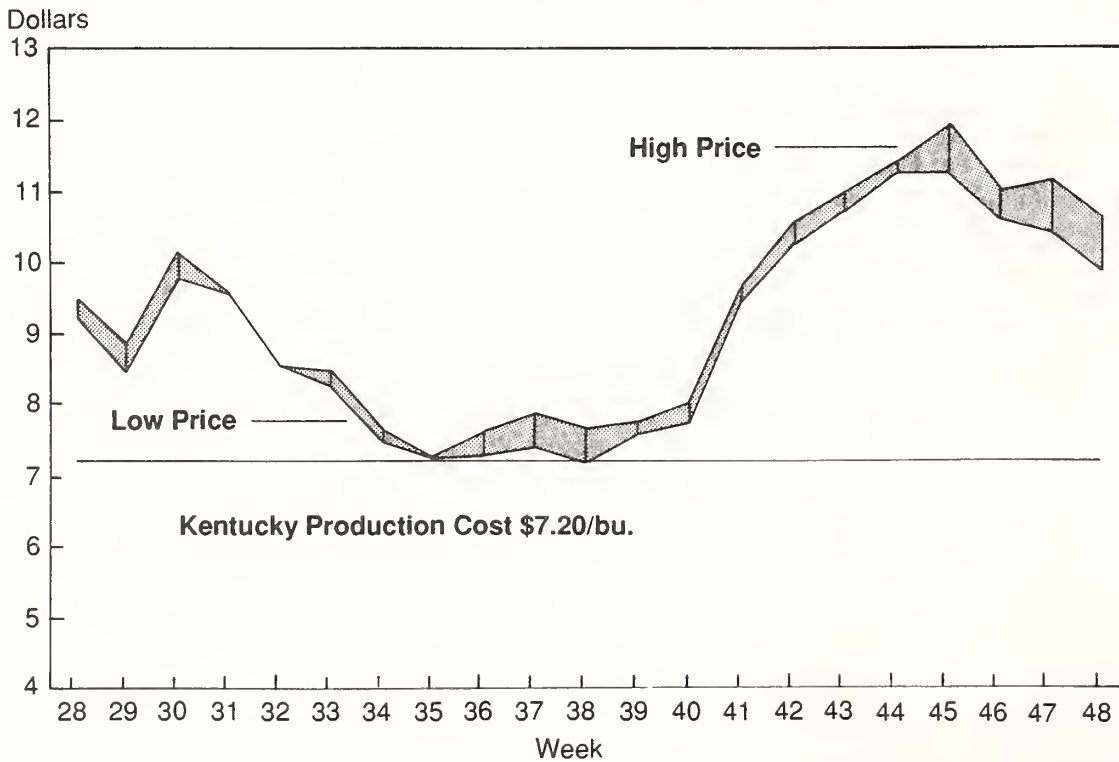
Average Weekly Price Range 1983-87: Cincinnati, High/Low Bell Peppers - 11/9 bu.



Marketing period: July 11-November 28

Figure 3

1983-87 High/Low Price Range Cincinnati: Bell Peppers - 11/9 bu.



Marketing period: July 11-November 28

Table 2—Cincinnati annual unloads - bell peppers (1983-87)

Origin	Mode	1987	1986	1985	1984	1983
-----1,000 cwt-----						
California	T ¹	17	14	7	5	11
Florida	T	32	31	33	38	40
Georgia	T	4	2	1	3	3
Kentucky	T	1	1	1	2	0
Louisiana	T	1	0	0	1	1
Michigan	T	4	2	4	2	4
North Carolina	T	4	5	5	7	2
New Jersey	T	0	1	0	0	0
Ohio	T	1	2	2	1	0
Puerto Rico	T	1	2	0	0	0
Texas	T	16	11	11	16	18
Canada	T	0	0	0	0	1
Jamaica	T	0	3	1	0	0
Mexico	T	23	23	23	22	14
Total		104	97	88	97	94

¹ T = Truck.

reputation for providing a high-quality product. In summary, local outlets may provide the best market opportunities, at least initially.

Once a reputation has been established and volume is adequate, expansion into other markets may be advantageous. Comparisons of price and volume data between markets provides a means to address the question of the specific markets to target and when to target them. For the purpose of this illustration, the bell pepper example is expanded to include data from the Atlanta terminal market. The Atlanta price and arrival data are presented in the same format as the Cincinnati data and are included in appendix II.

Figures 4 and 5 illustrate a comparison of the 5-year average high and low prices for Cincinnati and Atlanta. These graphs allow for a visual inspection of the weekly averages for one market relative to another market.

From these two figures it can be seen that the Atlanta terminal market prices were historically more variable than those paid in Cincinnati. During the first weeks of the Kentucky marketing period higher wholesale prices were realized in Atlanta. The opposite holds true during the final weeks of the marketing period. Cincinnati prices were substantially less variable than those paid in Atlanta.

Comparisons of arrival data are also useful in the analysis of targeted terminal markets. Table 4 illustrates one method of data presentation which separates the arrivals into the total amounts marketed during 1986 and 1987 and the percentages of the annual amounts marketed during the specific marketing periods.

This information can be used along with the price comparisons in deciding issues such as when during a marketing season to shift from one geographic market area to another or what combination of geographic markets to target.

The market window techniques are not without their limitations. Some of these limitations center around issues that affect the supply and demand characteristics of a commodity which are ultimately reflected in the price volatility in the fresh produce markets. This volatility, in turn, can be induced by a variety of factors such as the weather, other production areas entering the markets, or other unforeseen events which complicate the age-old problem of predicting future prices and quantities using historical data.

Other limitations are related to the validity of the conclusions made by the analysis. The problems associated with concluding that a market window exists, when in fact the converse is true, can be minimized by substantiating those conclusions with further analysis. One form of additional analysis that is critical to a successful marketing plan is continual contact with potential buyers to uncover preferences, problems, and opportunities. Potential buyers are interested in discussing these issues and concerns with prospective suppliers.

Another possible problem is that potential marketing opportunities can go unrecognized. This can result from false assumptions and conclusions related to expected prices and returns by only considering reported varieties and markets. Cantaloupe production was evaluated for a group of producers in the South using these methods. From this analysis it was concluded that few opportunities existed for commercial

cantaloupe production by this group. Other terminal markets were examined and similar conclusions were made. However, some of these producers have successfully found a marketing period during which they are currently able to

produce commercial cantaloupe with adequate returns. They have done this by growing varieties in which product differentiation has become a major asset in their ability to penetrate a commercial market.

Table 3—Cincinnati monthly unloads - bell peppers (1986-87)

Origin Year		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Tot
		1,000 cwt												
CA	87	-	-	-	-	-	1	3	4	4	4	1	-	17
	86	-	-	-	-	-	-	3	2	3	5	1	-	14
FL	87	2	1	3	7	7	3	-	-	-	-	3	6	32
	86	1	1	2	4	8	6	-	-	-	-	2	7	31
GA	87	-	-	-	-	-	3	1	-	-	-	-	-	4
	86	-	-	-	-	-	2	-	-	-	-	-	-	2
KY	87	-	-	-	-	-	-	1	-	-	-	-	-	1
	86	-	-	-	-	-	-	1	-	-	-	-	-	1
MI	87	-	-	-	-	-	-	-	2	2	-	-	-	4
	86	-	-	-	-	-	-	-	1	1	-	-	-	2
NC	87	-	-	-	-	-	1	3	-	-	-	-	-	4
	86	-	-	-	-	-	-	5	-	-	-	-	-	5
NJ	87	-	-	-	-	-	-	-	-	-	-	-	-	0
	86	-	-	-	-	-	-	-	1	-	-	-	-	1
OH	87	-	-	-	-	-	-	-	1	-	-	-	-	1
	86	-	-	-	-	-	-	-	1	1	-	-	-	2
PR	87	-	-	1	-	-	-	-	-	-	-	-	-	1
	86	-	-	2	-	-	-	-	-	-	-	-	-	2
TX	87	1	-	-	-	-	2	-	-	2	4	6	1	16
	86	-	-	-	-	1	1	-	-	1	3	5	-	11
Jamaica	87	-	-	-	-	-	-	-	-	-	-	-	-	0
	86	-	1	1	1	-	-	-	-	-	-	-	-	3
Mexico	87	8	7	6	1	-	-	-	-	-	-	-	1	23
	86	9	8	5	-	-	-	-	-	-	-	-	1	23
Total	87	11	8	10	8	7	11	8	7	8	8	10	8	104
	86	10	10	10	5	9	9	9	5	6	8	8	8	97

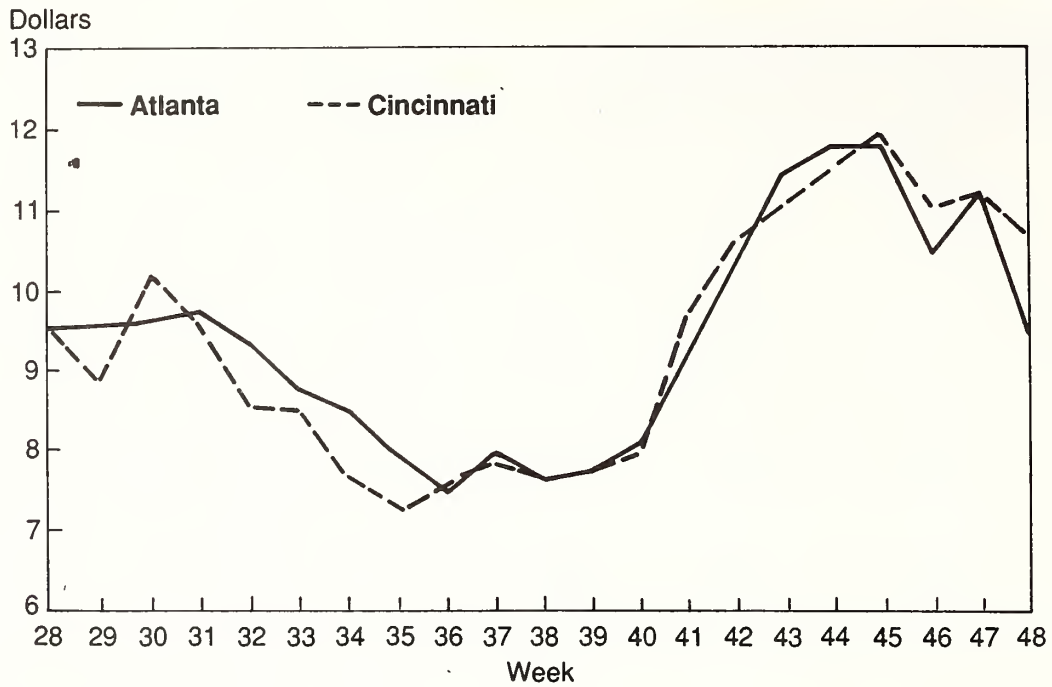
"-" Indicates that unload volume was not reported for that particular month.

Table 4—Bell pepper arrival comparisons (1986-87)

Terminal market and	Annual amounts marketed	Kentucky marketing period					
		Total	July	Aug	Sep	Oct	Nov
	1,000 cwt	1,000 cwt/percent marketed during period					
Cincinnati:							
1987	104	41/39	8/20	7/17	8/20	8/20	10/24
1986	97	36/37	8/25	5/14	6/17	8/22	8/22
Atlanta:							
1987	102	50/49	12/24	8/16	10/20	11/22	9/18
1986	92	40/43	5/13	7/18	9/23	10/25	9/23
Total:							
1987	206	91/44	20/22	15/16	18/20	19/21	19/21
1986	189	76/40	14/18	12/16	15/20	18/24	17/22

Figure 4

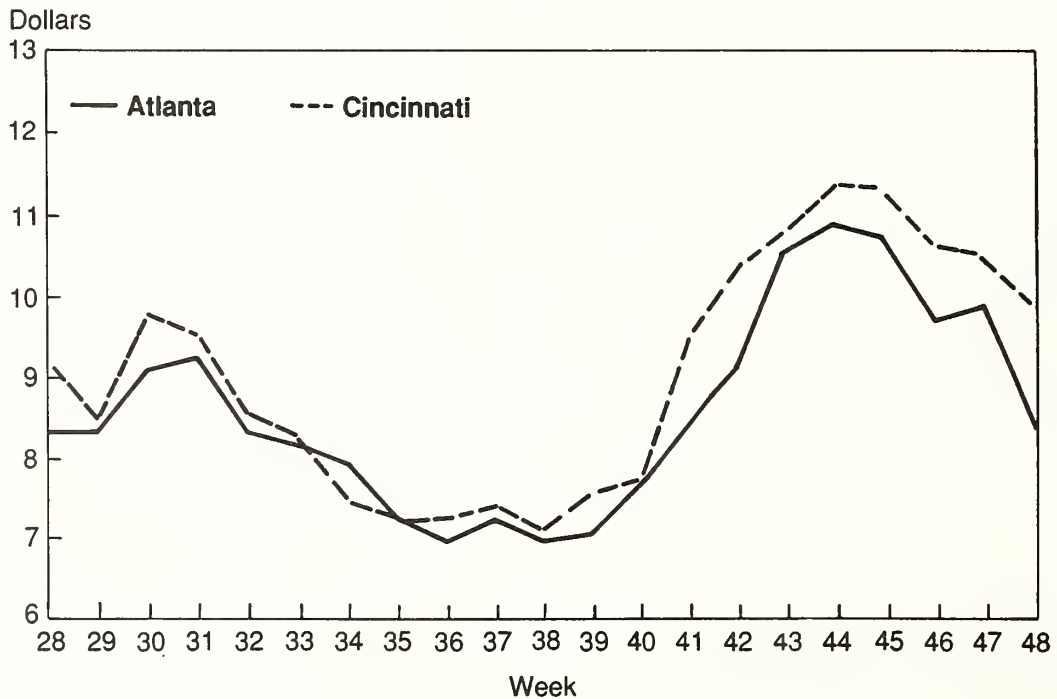
Average High Price Comparisons 1983-87: Atlanta vs Cincinnati (Bell Peppers - 11/9 bu.)



Marketing period: July 11-November 28

Figure 5

Average Low Price Comparisons 1983-87: Atlanta vs Cincinnati (Bell Peppers - 11/9 bu.)



Marketing period: July 11-November 28

II. Expected Value Analysis

The previous section of this report outlined a method for identifying potential, profitable crops and markets for producers seeking to expand or diversify their agricultural operations. This section is intended to extend the results obtained from the market window analysis to include some consideration of the more volatile and dynamic characteristics of fresh fruit and vegetable markets by incorporating the concept of expected value. The addition of this particular analysis allows the prospective producer to analyze the probable outcome of an activity given various production and market conditions. The expected value analysis uses historical market data to calculate an array of profitability estimates for a specific enterprise. The producer can use the results of the expected value analysis to assess the potential risk of an activity prior to committing to its implementation.

Expected Value

Given the inherent uncertainty in most agricultural enterprises, particularly horticultural crop production, it is beneficial to have a method of evaluating the potential profit and the sensitivity of profit to variations in yields and prices. As in most economic price analyses, past prices are the best indicator of future prices. Thus, by considering past market experience, the expected value method attempts to incorporate past data to indicate future outcomes.

There is likely to be a large amount of uncertainty in many alternative enterprises and, in general, uncertainty translates into risk. Therefore, a relatively simple method of evaluating the potential risk of an activity, prior to its implementation, will be very useful to the producer. This analysis concentrates solely on the risk associated with two of the basic components of an activity, namely, production and marketing. However, risk is not limited exclusively to possible production problems such as crop failure resulting from drought, freezes, or other acts of nature. Risk is also present in the financial and managerial aspects of an enterprise and, although not covered in detail in this report, should be examined by the producer.

Frequently, many alternative enterprises are also "new" production activities or face limited markets. These two factors compound the need for a method of risk evaluation. Due to a lack of experience, a new production activity will generally be accompanied by a greater degree of uncertainty and, in turn, increased risk. The expected value analysis requires the producer to formulate estimates of prices, production costs, and yields which, in turn, can stimulate a more thorough understanding of the specific activity in addition to offering a more realistic picture of the commodity's operating environment. The ability of the expected value analysis to provide an assessment of potential risk makes it a valuable tool in analyzing a potential enterprise.

By definition, the simple expected profit function of an enterprise can be expressed as:

$$\text{Expected Profit} = \text{Expected Revenues} - \text{Expected Costs}$$

Thus, in order to have a positive expected profit, revenues must exceed costs.

In the case of horticultural crop production, it is necessary to first invest capital into production inputs (i.e., plants, seed, fertilizer, etc.). These costs are fixed and the expected profitability (return on investment) is dependent upon the outcome of the activity undertaken. Consequently, variations in the two basic components of revenue, yields and prices, will have the greatest effect on profitability. For example, adverse weather conditions during the growing season can severely damage a crop resulting in virtually no yield. In addition, an overabundant crop put on the market has the potential to exert downward pressure on price. Although both examples presented here are extreme, they are possible outcomes that must be considered by the producer.

In this context, the concept of expected value refers to the average return the producer might expect to receive from a crop over a long period of production seasons. Past price and yield data are compiled in order to derive an average expected outcome. However, instead of being given equal weight in the averaging process, potential outcomes (yields and prices) are weighted according to their probability or "chance" of occurring. That is, events that are deemed to have a greater likelihood of taking place are given higher weights than those with a lower chance of occurring. The expected value of an activity is then calculated by taking the summation of the weighted outcomes of all the identified production scenarios (yield and price combinations). The expected value analysis allows for the profitability of a crop to be evaluated taking into account the potential variability in yields and prices.

Procedures

Assuming a crop and marketing period have been identified, the first step in deriving an expected value requires information on crop yields and production costs. This information should include the average crop yield, average production costs, and an estimate of yields under ideal and poor growing conditions. If available, crop budgets are frequently the best source for this data.

The second step of the analysis is to establish an average price of the commodity during the given marketing period. Section I outlined sources of price data, and these figures are readily amendable to the expected value analysis. An average price for a given marketing period can be easily computed by using a series of market price data. It is recommended that the data series report prices on a weekly basis and that it at least cover the marketing periods during the most recent 5 years.

Next, probability values or weights must be assigned to the price and yield estimates. This is likely to be the most difficult

or potentially confusing step of the expected value analysis. Again, examination of the data series for prices and yields should provide a basis for estimating the probability values. Analysis of the frequency and distribution of observations in the data set can be used to determine probability estimates. For instance, if the average price of a crop was \$8/box during 4 of the previous 10 marketing periods, it would not be unrealistic to assign this price a probability of .40 (4/10). Since the assignment of probabilities will likely be subjective, it is suggested that the investigator be conservative in deriving these estimates.

When assigning probabilities, it is important to incorporate the economic conditions that are likely to prevail in the market. In order to approximate the environment the producer will operate in, it is necessary to account for the interrelationship between yields and prices. For instance, during a heavy crop year, yields (supply) are likely to be higher than the average. Consequently, this surplus will be reflected in a lower-than-average market price. The reverse would be true during crop years when low yields prevail.

These market conditions can be incorporated into the analysis through the probability values. High prices would receive a low probability value when they correspond to high yields, but would receive a higher probability value when they correspond to low yields. This idea is demonstrated in the example that will follow.

The final step in the analysis entails compiling the collected data into a decision tree in order to derive the expected value of the activity. The expected value will represent the weighted return the grower can expect during a given year based on a variety of possible production scenarios. Again, the example to follow will provide a working application of the procedures outlined here.

Data Requirements

The basic data requirements for the expected value analysis are similar to those in the market window analysis. Reliable price, yield, and production cost data will be needed for the crop being examined. As previously noted in the market window analysis section, production cost and yield estimates should be based on the biological and climatic conditions indigenous to the specific region being studied. Again, it is imperative that the collected data be current and precise, since the accuracy of the generated results and their subsequent interpretation will be contingent upon the quality of the data used.

An Application of Expected Value

The following example demonstrates the concept of expected value in evaluating the profitability of producing fresh market bell peppers in Kentucky. Based upon industry data and area horticultural studies, the average expected yield of a bell pepper crop in Kentucky is 350 boxes/acre (assuming irrigation). For this analysis, a better-than-average crop is

assumed to produce a 20-percent greater yield or 420 boxes/acre. Further, a below average crop is assumed to produce a yield 30 percent less than the average, or 245 boxes/acre. The greater percentage adjustment for a below average crop is made since most new production activities will typically be more susceptible to adverse impacts. By taking into account variations in the average yield, three potential output levels have been established for analysis.

Probabilities are assigned to each of the three potential yields. Given that the production of 350 boxes is considered to be the average, it is assumed to have the highest probability of occurring. Therefore, in order to capture the greater likelihood of this outcome it is given the probability value of .50. Theoretically, the .50 probability value implies that during an infinite series of growing seasons, the producer would expect to achieve the 350-box yield during 50 percent of the seasons the crop is produced. Probability values of .20 and .30 are assigned to the 420 and 245-box yields, respectively. The slightly higher probability associated with the 245 box output is intended to account for a greater chance of a poor crop-year. (Note: In accordance with probability theory, the summation of each of the individual yield probabilities equals 1.0.)

Examination of wholesale market price data from the Cincinnati terminal market indicates that the 5-year (1983-87) adjusted average price during the Kentucky marketing period (weeks 28-46) is approximately \$9.20/box. The adjusted average price during the peak weeks (weeks 31-40) of the marketing period was calculated to be \$8/box. Since the majority of producers will likely market their crop during this time period, the \$8 figure is used as the average price. The \$9.20/box figure is retained to represent above average prices. Additionally, the \$9.20/box adjusted average price is reduced by 33 percent (\$3.05) to \$6.15/box to account for below average market prices.

As previously noted, in order to provide realistic profitability estimates, it is necessary to approximate market conditions as best as possible. Therefore, the established adjusted average price (\$8) is assigned the highest probability while both the above and below average prices are assigned probability values in relation to the specific yield estimate. Specifically, the high price in the high-yield scenario is given a low (.10) probability of occurring while the low price in the same case is given a slightly higher (.30) probability value. The reverse is done for the case of a low yield. (Note that, again, the sum of the individual price probabilities in each case equals 1.0.)

Net income is calculated by multiplying the yield by price and then subtracting the cost of production. In this example, data on area production costs were calculated to be approximately \$2,520/acre (350 boxes/acre x \$7.20/box = \$2,520.00/acre). Net income probabilities are obtained by multiplying the yield probability by the price probability

(These figures are presented as percentages in table 5.). Net income probabilities imply the percentage of times the producer would expect to receive the associated net income amount for his crop.

The *expected value* of the activity is calculated by taking the sum of each net income result multiplied by its corresponding income probability.

Based on the data used in this example, the yield/price combinations of 420/\$9.20, 420/\$8, 420/\$6.15, 350/\$9.20, and 350/\$8, result in outcomes that produce a positive net income. Summing the net income probabilities of the profitable combinations, it can be inferred that positive returns can be expected during 60 percent of the years it is implemented. Given the data in this example, the expected value of producing fresh market bell peppers in Kentucky is \$63.17/acre. This implies that, on average, a producer facing the production and marketing conditions outlined in the example would expect to achieve an average return of approximately \$63/acre.

Positive net income values ranged from \$1,344/acre to \$63/acre, with the most attractive returns occurring in the cases of high yields and prices (above average). The probability or chance of achieving returns in the \$1,344/acre to \$700/acre range was determined to be 24 percent. Further, the

probability of positive returns below \$700/acre was calculated to be 36 percent. Instances of negative net income are observed in the low yield and price scenarios (350/\$6.15, 245/\$9.20, 245/\$8, and 245/\$6.15). These probabilities can be summarized as follows:

Returns per Acre	Probability
\$700 - \$1,344	.24
0 - \$699	.36
Less than zero	.40

This example indicates that, under the outlined conditions, bell pepper production in Kentucky has limited potential as a profitable activity. There is a relatively low probability (.24) of positive net income in excess of \$700/acre. Further, low or negative net income occurs in all instances of below average yields and prices. It should be noted that the most attractive net income figures are attained in the above average yield scenario. This implies that growers who concentrate on maintaining high-yielding, quality crops will be in the best position to capitalize on favorable market conditions in addition to surviving during years when the market is not as attractive.

Table 5—Expected analysis for bell pepper production in Kentucky

Yield (boxes/acre)	Yield probability (percent)	Price (\$/box)	Price probability	Net Income (\$/acre)	Income probability
420	0.20	\$9.20	0.10	\$1,344.00	2
		8.00	0.60	840.00	12
		6.15	0.30	63.00	6
350	0.50	\$9.20	0.20	\$ 700.00	10
		8.00	0.60	280.00	30
		6.15	0.20	-367.50	10
245	0.30	\$9.20	0.30	\$ -266.00	9
		8.00	0.60	-560.00	18
		6.15	0.10	-1,013.25	3

Expected Value = \$ 63.17

SUMMARY

Concerns over losses in farm income have prompted many agricultural producers to look for viable alternative crops to supplement farm income. Fruits, vegetables, and other specialty crops have attracted considerable attention since the potential returns on many of these crops are substantially greater than traditional row crop and livestock enterprises.

The growth and expansion of the fruit, vegetable, and specialty crop sectors will create many new opportunities for progressive entrepreneurs. Producers seeking to diversify their farm operations by incorporating alternative crops must first critically evaluate their production and marketing potential. The ability to produce should not be confused with the ability to market a crop.

The substantial risk and high probability of failure that often accompany these new ventures will require potential producers to be cognizant of all factors influencing their operations. Thorough analyses of prospective crops and markets, in

addition to obtaining knowledge of the dynamic nature of produce markets and the overall industry, will help producers minimize the chance of implementing an unprofitable activity.

The market window and expected value techniques are relatively simple and effective methods of evaluating market potential. The procedures should be used as tools for screening potential new crops or markets and not as the sole decision factors for implementing a new activity.

There is no single formula for success. Each individual producer will face unique production costs, output levels, and marketing opportunities. Success of any enterprise will depend on how well the producer can compete. Efforts to analyze, develop, implement, and promote a crop will go far in identifying and maintaining a market niche.

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APPENDIX I

Fresh Fruit and Vegetable Market Data

The Agricultural Marketing Service (AMS) of USDA regularly publishes wholesale price and arrival data for the following metropolitan terminal markets and shipping point markets.

Terminal Market Reports

Atlanta, GA
 Boston, MA
 Buffalo, NY
 Chicago, IL
 Cincinnati, OH
 Columbia, SC
 Dallas, TX
 Denver, CO
 Detroit, MI
 Honolulu, HI
 Jessup, MD
 Los Angeles, CA
 Miami, FL
 New York, NY
 New Orleans, LA
 Philadelphia, PA
 Pittsburgh, PA
 St. Louis, MO
 San Francisco, CA
 Seattle, WA

Shipping Point Market Reports

Asheville, NC
 Baton Rouge, LA
 Benton Harbor, MI
 Bridgeton, NJ
 Columbia, SC
 Denver, CO
 El Centro, CA
 Faison, NC
 Fresno, CA
 Idaho Falls, ID
 Inwood, WV
 Los Angeles, CA
 Madison, WI
 McAllen, TX
 Miami, FL
 New York, NY
 Nogales, AZ
 Olney, MD
 Phoenix, AZ
 Presque Island, ME
 Raleigh, NC
 Riverhead, LI, NY
 Rochester, NY
 Sacramento, CA
 Salinas, CA
 San Francisco, CA
 Stockton, CA
 Thomasville, GA
 Walden, NY
 Winter Park, FL
 Yakima, WA

Commodity Classification

CITRUS FRUITS

Grapefruit
 Lemons
 Mixed Citrus
 Oranges
 Tangelos
 Tangerines
 Temples

NONCITRUS FRUITS

Apples
 Apricots
 Avocados
 Bananas
 Blueberries
 Cherries
 Cranberries
 Grapes, table
 Grapes, black juice
 Grapes, white juice
 Grapes, mixed juice
 Mixed deciduous
 Nectarines
 Peaches
 Pears
 Plums, prunes
 Strawberries

MELONS

Cantaloupes
 Honeydews
 Mixed & misc. melons
 Watermelons

VEGETABLES

Asparagus
 Beans
 Beets
 Broccoli
 Cabbage
 Carrots
 Cauliflower
 Celery
 Corn, sweet
 Cucumbers
 Eggplant
 Escarole-Endive
 Greens
 Lettuce, iceberg
 Lettuce, romaine
 Lettuce, other
 Mixed Vegetables
 Onions, dry
 Onions, green
 Peas, green
 Peppers, bell
 Peppers, other
 Potatoes
 Radishes
 Spinach
 Squash
 Sweetpotatoes
 Tomatoes
 Tomatoes, cherry
 Turnips-Rutabagas

MISCELLANEOUS FRUITS & BERRIES

Fruits, other
 Limes
 Mangoes
 Misc. Berries
 Misc. citrus
 Papaya
 Persimmons
 Pineapples
 Plantains
 Pomegranates

MISCELLANEOUS VEGETABLES

Artichokes
 Brussels sprouts
 Chinese cabbage
 Garlic
 Misc. herbs
 Misc. tropical fruits
 and vegetables
 Misc. oriental vegetables
 Mushrooms
 Okra
 Parsley
 Peas, other than green
 Pumpkins
 Rhubarb
 Vegetables, other

APPENDIX II

Appendix Table 1.—Atlanta adjusted, average terminal market prices (1983-87), bell peppers-CA wonders/large/1 1/9-bu crates and cartons

Week	Date	5-year average high price	5-year average low price
1	03-Jan	\$11.22	\$ 9.95
2	10-Jan	11.22	10.37
3	17-Jan	11.56	10.37
4	24-Jan	12.41	11.22
5	31-Jan	13.26	12.07
6	07-Feb	17.43	16.07
7	14-Feb	16.24	14.54
8	21-Feb	16.49	14.96
9	28-Feb	20.32	18.45
10	07-Mar	19.64	18.53
11	14-Mar	15.90	14.37
12	21-Mar	17.68	16.41
13	28-Mar	15.56	14.11
14	04-Apr	18.79	17.43
15	11-Apr	18.28	17.09
16	18-Apr	13.18	12.41
17	25-Apr	12.84	11.99
18	02-May	13.77	12.92
19	09-May	13.94	12.92
20	16-May	13.52	12.58
21	23-May	12.50	11.56
22	30-May	12.41	11.90
23	06-Jun	12.58	11.82
24	13-Jun	11.56	10.54
25	20-Jun	9.18	8.08
26	27-Jun	8.50	7.57
27	04-Jul	9.01	8.08
28	11-Jul	9.52	8.33
29	18-Jul	9.56	8.33
30	25-Jul	9.60	9.10
31	01-Aug	9.73	9.26
32	08-Aug	9.35	8.33
33	15-Aug	8.76	8.16
34	22-Aug	8.50	7.91
35	29-Aug	7.91	7.23
36	05-Sep	7.48	6.97
37	12-Sep	7.99	7.23
38	19-Sep	7.65	6.97
39	26-Sep	7.74	7.06
40	03-Oct	8.08	7.65
41	10-Oct	9.18	8.42
42	17-Oct	10.29	9.10
43	24-Oct	11.48	10.54
44	31-Oct	11.82	10.88
45	07-Nov	11.82	10.71
46	14-Nov	10.46	9.69
47	21-Nov	11.22	9.86
48	28-Nov	9.35	8.42
49	05-Dec	8.50	7.48
50	12-Dec	9.27	8.42
51	19-Dec	10.20	9.35
52	26-Dec	10.12	9.18

Appendix Table 2—Atlanta annual unloads - bell peppers (1983-87)

Origin	Mode	1987	1986	1985	1984	1983
1,000 cwt						
California	T ¹	9	11	5	4	6
Florida	T	49	47	34	30	26
Georgia	T	12	14	12	6	10
Illinois	T	2	0	0	0	0
Michigan	T	4	3	3	2	2
New Jersey	T	0	1	0	0	0
North Carolina	T	5	3	6	6	5
Texas	T	16	8	7	9	8
Mexico	T	5	5	8	7	0
Total		102	92	75	64	57

¹ T = Truck.

Appendix Table 3—Atlanta monthly unloads - bell peppers (1986-87)

Origin	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Tot
		1,000 cwt												
CA	87	-	-	-	-	-	-	1	2	4	2	-	-	9
	86	-	-	-	-	-	1	-	2	3	4	1	-	11
FL	87	5	5	8	6	7	6	2	-	-	-	4	6	49
	86	5	3	6	8	8	5	-	-	-	1	6	5	47
GA	87	-	-	-	-	-	3	5	2	1	1	-	-	12
	86	-	-	-	-	-	5	3	2	2	2	-	-	14
IL	87	-	-	-	-	-	-	-	1	1	-	-	-	2
	86	-	-	-	-	-	-	-	-	-	-	-	-	0
MI	87	-	-	-	-	-	-	-	1	2	1	-	-	4
	86	-	-	-	-	-	-	-	1	2	-	-	-	3
NC	87	-	-	-	-	-	-	3	1	1	-	-	-	5
	86	-	-	-	-	-	-	2	1	-	-	-	-	3
NJ	87	-	-	-	-	-	-	-	-	-	-	-	-	0
	86	-	-	-	-	-	-	-	1	-	-	-	-	1
TX	87	-	-	-	-	-	-	-	-	2	8	5	1	16
	86	-	-	-	-	-	-	-	-	2	3	2	1	8
Mexico	87	2	1	1	-	-	-	-	-	-	-	-	1	5
	86	1	3	1	-	-	-	-	-	-	-	-	-	5
Total	87	7	6	9	6	7	9	12	8	10	11	9	8	102
	86	6	6	7	8	8	11	5	7	9	10	9	6	92

"-" Indicates that unload volume was not reported for that particular month.

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