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THE DEMAND FOR PACKAGED MUMS

Farrell E. Jensen
Assistant Professor
Department of Agricultural Economics & Marketing
Rutgers University

Patrick J. Kirschling 1/
Research Associate
Department of Agricultural Economics & Marketing
Rutgers University

Introduction

The principal sales outlet for floral products has traditionally been the retail florist shop. Florist shops have performed many market functions including arranging, delivery, information, and credit. The sale of flowers through mass outlets started on a limited scale prior to World War II. Recently, however, supermarkets have demonstrated a greater interest in the floricultural business. Consequently, many chains have included florist shops in their stores or in adjacent areas. Others have become involved, on a smaller scale, by stocking a limited number of plants in the produce departments of the individual stores on a regular or seasonal basis.

The small-scale operations have led to a number of problems. First, flowers require periodic maintenance and produce personnel are generally not trained or inclined to perform this function. Improper care results in a lower quality product for the consumer and greater losses for the supermarkets. The second problem is physical damage to the plant from shipping and in-store handling. It is not uncommon to see blooms, buds, leaves and stems broken during distribution, or by overzealous customers. Most of these damaged plants are a loss to the store.

Recent work with chrysanthemum cultivars indicates that these problems can be solved (for mums) by enclosing the plant in a 4-mil polyethylene bag. The bag is heat sealed and injected with air which cushions the plant and protects it from damage. The film allows the passage of gases but retains water vapor, which eliminates the need to water the plant during

1/ We are indebted to Malcolm R. Harrison, Extension Specialist in Floriculture, Department of Horticulture and Forestry, for his contribution to the study. Mr. Harrison developed the packaging concept tested in this study. We also acknowledge the contribution of Dr. Bruno C. Moser and Dr. John Scalisi of the same department.
distribution and merchandising. In laboratory tests conducted at Rutgers University, chrysanthemum plants that were in the package up to 17 days still had a life of 16 or more days after being unpacked. [3] The package also serves as a merchandising aid, as it provides a product that doesn't require additional packaging at the store. An attached handle provides convenience of handling by customers.

The purpose of this study was to conduct a market test to determine if this new packaging approach to flower merchandising was economically feasible and would meet with consumer acceptance. A number of studies have examined the feasibility of mass merchandising but this study is unique because of the packaging concept. [1,2,4,5,6]

Eastern markets have a competitive advantage in potted plants due to the transportation cost which offsets the economic advantages of other areas. The concept tested in this study has potential for expanding markets for potted plants produced for the local metropolitan markets.

Objectives

The objectives of this study were to:

1. Obtain an estimate of the demand for potted chrysanthemum plants at a series of controlled prices in supermarkets.

2. Determine the price a supermarket would charge to maximize profits from the sale of these plants.

Procedure

Six supermarkets located in New Jersey suburbs served as cooperating stores. Display units were located in the individual produce departments but the location varied between stores according to the available space. The stores were selected on the basis of volume and geographic location. They were not selected at random so the results cannot be generalized to the industry.

Flowers were delivered to the stores starting Tuesday, January 16, 1973, with deliveries continuing for a 12-week period ending April 9, 1973. The flowers were delivered to the stores and the display units were serviced by Rutgers personnel. Inventories were counted every Tuesday morning to determine plant sales for the week. Flowers were left in the packages for a maximum period of 12 days after which they were removed from the display units.

Neptune, Yellow Mandalay and Illini Trophy varieties -- white, yellow and pink respectively -- were sold. A constant ratio of two Yellow Mandalays to one of each of the other varieties was maintained throughout the
test. This ratio was selected on the basis of the results of a preliminary market test where yellow mums was the most popular color. [5]

Point-of-purchase signs were used to advertise the product. No other promotion activities were attempted. The product was sold under the brand name, "Dew Fresh."

Pricing Model

Six prices which represented the likely price range for quality 4-inch pot mums sold in mass outlets were selected. The prices ranged from $0.99 to $1.99 in 20-cent increments. A randomized block design was used to assign prices to the stores each week. The model was:

$$Y_{ijk} = u + S_i + P_j + T_k + (SP)_{ij} + (ST)_{ik} + (PT)_{jk} + E_{ijk}$$ (1)

where:

- $Y_{ijk}$ = sales per thousand customers for store $i$ at price $j$ in week $k$
- $u$ = the grand average for all $Y_{ijk}$
- $S_i$ = the effect of store $i$
- $P_j$ = the effect of price $j$
- $T_k$ = the effect of week $k$
- $(SP)_{ij}$ = interaction of store $i$ and price $j$
- $(ST)_{ik}$ = interaction of store $i$ and time period $k$
- $(PT)_{jk}$ = interaction of price $j$ with time period $k$
- $E_{ijk}$ = NID (0, $\sigma^2$) variates

Two time blocks were used to reduce variation due to seasonal and holiday effects. The six prices were assigned at random within the six weeks of each block for each store. Under this system, all stores had each of the prices on two separate weeks, once within each block.

Demand Model

Demand theory states that quantity demanded is a function of price, when demand-shifting factors are constant. The reason for using the six prices was to estimate a number of points on the demand curve for packaged mums. This type of experimental approach is not optimal because of changing factors in the market which affect substitutability, incomes and other
factors. However, it can provide some points on the demand curve. The model tested was:

\[ \hat{Q} = f(P_s, S_1, S_2, S_3, S_4, S_5, S_6) \]  

(2)

where:

\[ \hat{Q} = \text{quantity sold per thousand customers} \]
\[ P_s = \text{the six test prices} \]
\[ S_1, \ldots, S_6 = \text{these are 0 or 1 dummy variables used to account for the difference in the level of sales at each of the stores.} \]
\[ S_3 \text{ was set equal to 1.} \]

The use of dummy variables is based on the assumption that the slope of the demand curve is constant for all stores. As such, the estimate of the coefficient for \( P_s \) is a common estimate for all stores. The dummy variables allow for differences in the level of sales among stores.

**Profit-Maximizing Model**

The firm's objective for handling flowers should be to maximize the net returns after procurement costs, in-store handling expenses, and shrinkage losses. Traditionally, supermarkets have used a stipulated percentage gross margin to determine the selling price for products. This gross margin may or may not reflect the profit-maximizing price for the store.

After an estimate of the demand curve is obtained, it is possible to determine the profit-maximizing price. Consider a case where:

1. Operating costs at the supermarket level are constant per unit over a relevant range of output.
2. Procurement costs are independent of the level of output.
3. All stores in a given company charge the same price for the flowers.

Let:

\[ T_i = \text{total revenue per thousand customers for store } i \]
\[ Q_i = \text{quantity purchased per thousand customers for store } i \]
\[ P_s = \text{price for an individual flower which is constant for all stores} \]

Therefore:

\[ T_i = P_s Q_i \]  

(3)
Net profit is defined as total revenue minus total costs. Assume that flowers are purchased in a perfectly competitive market so that a given company is unable to influence the purchase price. Under these conditions, which likely approximate actual market structure, procurement costs will be constant. Let:

\[ P_i = \text{total procurement cost per 1,000 customers for store } i \]
\[ p_p = \text{procurement price per plant} \]

Therefore:

\[ P_i = q_i p_p \] (4)

The most important in-store cost factor is shrinkage loss from damaged plants, dead plants, unsaleable plants, etc. Let:

\[ L_i = \text{shrinkage losses per thousand customers for store } i \]
\[ L_s = \text{percent shrinkage loss which is constant for all stores.} \]

Since the amount of losses will be a function of the purchase price and quantity handled, we can define:

\[ L_i = L_s p_p q_i \] (5)

All other costs incidental to in-store merchandising are assumed to be constant over the relevant range of sales. Let:

\[ C_i = \text{all other costs per thousand customers} \]

Now that the cost factors are delineated, we can define net revenue \((N_i)\) at store \(i\) as:

\[ N_i = f(q_i, p_s, p_p, L_s, C_i) \] (6)

The exact form is as follows:

\[ N_i = T_i - P_i - L_i - C_i \]

This equation can be written in terms of the demand function as:

\[ N_i = p_s q_i - q_i p - L_s p q_i - C_i \]

But \(q_i\) can be expressed as \(q_i = f_i(p_s)\) when all other factors are constant. Upon substitution of this functional relationship for \(q_i\) we obtain:
The objective will be to differentiate this function with respect to \( P_s \) to determine the price that will maximize net revenue for all stores. Let:

\[
N = \text{average net revenue per thousand customers for all stores in a company. It can be written as:}
\]

\[
N = \frac{1}{n} \sum_{i=1}^{n} N_i
\]

where:

\( n = \text{the number of stores} \)

All other variables can be expressed in the aggregate as:

\[
Q = \frac{1}{n} \sum_{i=1}^{n} Q_i \quad \text{and} \quad C = \frac{1}{n} \sum_{i=1}^{n} C_i
\]

\( Q = \text{average number of plants sold per thousand customers} \)

\( C = \text{average amount of all other costs for all stores} \)

\( Q \) can be expressed in terms of the demand function as:

\[
Q = \frac{1}{n} \sum_{i=1}^{n} f_i(P_s)
\]

From the form of the equation (8), net profit per thousand customers can now be expressed as:

\[
N = \frac{1}{n} \sum_{i=1}^{n} f_i(P_s) [P_s - P - L_s P] - \frac{1}{n} \sum_{i=1}^{n} C_i
\]

The objective of the firm will be to maximize \( N \).
Number of Plants Sold per Thousand Customers per Week

In order to standardize the data for comparison between stores, the data were expressed as the number of plants sold per thousand customers per store for each week. The high, low, and average volume of sales for all stores at the six prices are shown in Table 1. The high week was 11.1 plants sold per thousand customers when the price was $0.99, and the low was .8 plants when the price was $1.99. Average number of plants sold per thousand customers was lowest at the $1.79 price.

Table 1
Number of Dew Fresh Mums Sold per Week per Thousand Customers at Various Prices, Six Supermarkets, New Jersey, 1973 a/

<table>
<thead>
<tr>
<th>Price</th>
<th>High</th>
<th>Low</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>$.99</td>
<td>11.1</td>
<td>2.9</td>
<td>7.2</td>
</tr>
<tr>
<td>1.19</td>
<td>10.2</td>
<td>2.2</td>
<td>5.0</td>
</tr>
<tr>
<td>1.39</td>
<td>8.6</td>
<td>2.0</td>
<td>4.0</td>
</tr>
<tr>
<td>1.59</td>
<td>8.7</td>
<td>1.5</td>
<td>3.8</td>
</tr>
<tr>
<td>1.79</td>
<td>4.6</td>
<td>.9</td>
<td>2.5</td>
</tr>
<tr>
<td>1.99</td>
<td>5.6</td>
<td>.8</td>
<td>2.8</td>
</tr>
</tbody>
</table>

a/ Based on 12-week market test.

Total Revenue per Thousand Customers

The high, low, and average total revenue per thousand customers at various price levels are shown in Table 2. These figures represent the amount spent per thousand customers per week. The largest total revenue of $13.80 was at the $1.59 price and the low of $1.53, at the $1.99 price. The highest average of $7.15 per store was at the $0.99 price. The figures for sales per linear foot of display space are also included.

Analysis of variance was performed to test if the time, price, and store means were significantly different (Table 3). There were significant differences in total revenue per thousand customers between stores. No significant difference existed for the sales between the two time blocks but there were significant differences in total revenue means at each of the six prices at the 6% level. Thus, total revenue and number of plants sold varied among stores and prices.
Table 2
Weekly Total Revenue per Thousand Customers and Weekly Total Revenue per Thousand Customers per Linear Foot of Display Space at Various Prices for Dew Fresh Mums, Six Supermarkets, New Jersey, 1973 a/.

<table>
<thead>
<tr>
<th>Price per Plant</th>
<th>Weekly Total Revenue per Store per Thousand Customers</th>
<th>Weekly Total Revenue per Store per Thousand Customers per Linear Foot of Display Space b/</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>$.99</td>
<td>$10.97</td>
<td>$2.88</td>
</tr>
<tr>
<td>1.19</td>
<td>12.17</td>
<td>2.59</td>
</tr>
<tr>
<td>1.39</td>
<td>11.91</td>
<td>2.74</td>
</tr>
<tr>
<td>1.59</td>
<td>13.80</td>
<td>2.43</td>
</tr>
<tr>
<td>1.79</td>
<td>8.15</td>
<td>1.63</td>
</tr>
<tr>
<td>1.99</td>
<td>11.20</td>
<td>1.53</td>
</tr>
</tbody>
</table>

a/ Based on 12-week market test.
b/ Display unit equaled 4 linear feet.

Table 3
Analysis of Variance on Weekly Total Revenue per Thousand Customers, Six Supermarkets, New Jersey, 1973 a/.

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Degree of Freedom</th>
<th>Sums of Squares</th>
<th>Mean Squares</th>
<th>F-Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stores</td>
<td>5</td>
<td>352.26</td>
<td>70.45</td>
<td>20.93***</td>
</tr>
<tr>
<td>Time a/</td>
<td>1</td>
<td>1.23</td>
<td>1.23</td>
<td>.37</td>
</tr>
<tr>
<td>Price</td>
<td>5</td>
<td>42.27</td>
<td>8.45</td>
<td>2.51*</td>
</tr>
<tr>
<td>Store X Time</td>
<td>5</td>
<td>9.89</td>
<td>1.98</td>
<td>.59</td>
</tr>
<tr>
<td>Store X Price</td>
<td>25</td>
<td>87.96</td>
<td>3.52</td>
<td>1.05</td>
</tr>
<tr>
<td>Time X Price</td>
<td>5</td>
<td>19.52</td>
<td>3.90</td>
<td>1.16</td>
</tr>
<tr>
<td>Residual</td>
<td>25</td>
<td>84.15</td>
<td>3.37</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>71</td>
<td>597.28</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a/ The 12 test weeks were divided into two blocks of six weeks.

* Significant at 6% level.

** Significant at 1% level.
Demand Curve Estimate

A number of different specifications of the model were used to obtain an estimate of the demand curve. Variables tested included lagged prices, first differences in price, a time trend, income, customer count, availability of other mums, availability of other fresh plant material and flowers, holidays, advertising, and a lagged dependent variable. Although economic theory would indicate that these variables can affect the quantity sold, the effects could not be isolated from the data. The final model used was:

\[
\hat{Q} = 8.63 - 4.15P_s + 4.57S_1 + 1.84S_2 + 1.63S_4 - .21S_5 + 2.90S_6
\]

\[
( .53 ) ( .63 ) ( .63 ) ( .63 ) ( .63 ) ( .63 ) \]

\[
R^2 = .69 \quad \quad F = 23.6
\]

Standard errors of the coefficients are indicated in the parentheses. The price coefficient is significant at the 1% level indicating that the quantity of plants sold was a function of price. The negative sign on the price coefficient was as hypothesized.

The coefficients on the dummy variables are significant at the 5-percent level for all stores except Store 5, which indicates that the level of sales for these four stores was significantly different from Store 3. Given this situation of a different level of sales at individual stores, the question arises as to how a company can maximize profits when all stores charge a uniform price for the product. The maximizing net revenue section is concerned with this question.

Maximizing Net Revenue

The estimated regression obtained previously can be separated into separate store demand curves by individually setting each dummy variable equal to one while all others are zero. The individual store estimates are:

- Store 1: \( \hat{Q}_1 = 13.20 - 4.15P_s \)
- Store 2: \( \hat{Q}_2 = 10.47 - 4.15P_s \)
- Store 3: \( \hat{Q}_3 = 8.63 - 4.15P_s \)
- Store 4: \( \hat{Q}_4 = 10.26 - 4.15P_s \)
- Store 5: \( \hat{Q}_5 = 8.42 - 4.15P_s \)
- Store 6: \( \hat{Q}_6 = 11.53 - 4.15P_s \)
The average values for estimates of all $\hat{Q}_i$ can be substituted into the form of equation (10).

$$N = [10.42 - 4.15P_s] [P_s - P - L_s P_s] - C$$  \hspace{1cm} (12)

The objective of the company is to maximize $N$, given that all stores charge the same price $P_s$. The value for $\frac{\partial N}{\partial P_s}$ is:

$$\frac{\partial N}{\partial P_s} = 10.42 - 8.30P_s + 4.15P + 4.15L_s P_s$$  \hspace{1cm} (13)

At a maximum, the first derivative is equal to zero so the selling price which maximizes $N$ is:

$$\bar{P}_s = $1.26 + .50P + .50L_s P_s$$  \hspace{1cm} (14)

For a maximum to exist $\frac{\partial^2 N}{\partial P_s^2} < 0$ and this is the case as the value is $-8.30$.

$\bar{P}_s$ is the price that the test stores should charge to maximize net revenue. Larger amounts of total revenue could be obtained by selling at a lower price but the net profit would be lower. The interpretation of equation (14) above is straightforward. The constant term of 1.26 indicates the minimum price to charge if there were no procurement costs or shrinkage losses. The positive signs for $P$, $L_s$, and $P_s$ indicate that the selling price must increase as these factors increase. Either higher wholesale costs for the product or greater in-store losses necessitate a higher selling price for the product.

The profit-maximizing prices for a range of hypothesized procurement costs and in-store losses are shown in Table 4. These profit-maximizing prices vary from $1.54$ to $1.76$. Using conventional supermarket pricing techniques, i.e., prices ending in 7 or 9, the prices would range from $1.49$ to $1.79$, based on the estimated demand curve.

At each procurement price, the profit-maximizing gross margin percentages are larger than the traditional 33 to 50 percent gross margins charged by supermarkets. Based on procurement costs and in-store losses as hypothesized in this study, the percentages range from 67.5 percent to 52.9 percent. For these stores to have maximized profits under these conditions, gross margins should have been increased by approximately 18 to 20 percent over conventional practices.
Table 4
Net Revenue Maximizing Selling Price and Gross Margin Percentage for 4-lnch Pot Mums for Various Hypothesized Procurement Costs and In-Store Losses, Six Supermarkets, New Jersey, 1973

<table>
<thead>
<tr>
<th>Percent In-Store Losses a</th>
<th>Procurement Prices</th>
<th>Selling Price</th>
<th>Gross Margin Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$0.50</td>
<td>$0.60</td>
<td>$0.70</td>
</tr>
<tr>
<td>10%</td>
<td>$1.54</td>
<td>$1.59</td>
<td>$1.65</td>
</tr>
<tr>
<td>15%</td>
<td>1.55</td>
<td>1.61</td>
<td>1.66</td>
</tr>
<tr>
<td>20%</td>
<td>1.56</td>
<td>1.62</td>
<td>1.68</td>
</tr>
<tr>
<td>25%</td>
<td>1.57</td>
<td>1.64</td>
<td>1.70</td>
</tr>
</tbody>
</table>

Gross Margin Percentages

- 10%                     | 67.5%              | 62.3%         | 57.6%                    | 52.9%                    |
- 15%                     | 67.7%              | 62.7%         | 57.8%                    | 53.5%                    |
- 20%                     | 68.0%              | 63.0%         | 58.3%                    | 54.0%                    |
- 25%                     | 68.2%              | 63.4%         | 58.8%                    | 54.6%                    |

Summary and Conclusions

The allocation of shelf space among alternative products is an economic problem for the mass merchandiser. Any decision to add or expand a product line must be considered in light of available space and its contribution to the profits of the store. New products must contribute an amount to profits which is greater than existing products to justify their inclusion in the product mix. These principles apply to the consideration of packaged pot mums by the mass merchandiser. To warrant the introduction of this product, the sales per linear foot and profits generated must be equal to, or greater than, items that presently exist on the shelves.

The sales response indicates that consumers will purchase prepackaged mums in supermarkets. The sales per linear foot of display space which ranged from $8.95 to $13.95 compare favorably with minor vegetable items like beans, broccoli, corn, cucumbers, spinach, squash and yams, but not with the largest volume vegetables like iceberg lettuce, dry onions, tomatoes and potatoes. The test flowers did not have the same level of sales as these high-volume items, but sales movement can be expected to be equal to or greater than sales of many of the medium and low volume items.
Sales varied inversely with the selling price as expected. Sales per thousand customers decreased by 4.15 plants as price increased by $1.00 in the range from $0.99 to $1.99. The elasticity of demand was greater than 1 over most of the estimated demand curve.

The number of plants sold per thousand customers varied significantly among different stores. Store differences were probably attributable to income levels, age of consumers, geographic location, and other factors that could not be isolated from the data.

Based on the estimated demand curve, the selling price which would maximize the profits of the six stores ranged from $1.54 to $1.76. This is based on estimated procurement costs ranging from $0.50 to $0.80 per plant, and in-store shrinkage losses estimated to range from 10 percent to 25 percent. For the test stores, the gross margin percentages that maximized profits ranged from 55 percent to 68 percent, which is 18 to 22 percent higher than the customary 33 to 50 percent industry gross-margin targets.

Limitations

The stores used in the study were not selected from a random sample, so the results cannot be extended to the industry in general. However, the results will provide an indication of possible reaction.

The 12-week duration of the test was not long enough to determine if sales could be sustained over a long period of time. Seasonal effects were not determined, as the test was conducted during the winter months. Sales will be likely to vary during different seasons of the year.

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