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# Three Jays Corporation

Between the first and second years of his MBA program, Brodie Arens accepted an internship at Three Jays Corporation (3Js), which produced and distributed organic jams and jellies. On his first day at work, Brodie met with Jana Fremont, president of 3Js, who had received her MBA from the school Brodie was attending. In this meeting, Jana discussed a major issue that concerned her.

"Brodie, I'm really glad you're here. I think you can help us with an important problem. I think our finished-goods inventory is much higher than it needs to be. I could probably dig into it and figure it out myself, but right now I am too busy with other issues that demand my attention.

"I'd like you to familiarize yourself with our production process. We've grown significantly since we first started, more than three years ago, as there is a growing demand for organic foods. However, we can't take advantage of this opportunity without a major marketing campaign that will allow us to grow at the same rate we have been. We estimate that the investment in this campaign will return us 20%. It appears that one of the quickest and easiest ways to obtain these funds is to reduce our current inventory levels of finished goods.

"After you understand the production process and the various costs associated with it, I'd like you to evaluate the current inventory situation. Ideally, I would like you to make some recommendations that will reduce our current inventory levels and increase our efficiency.

"To start, look into how we schedule production runs for the different jams and jellies and jar sizes that we produce. The present method, which we introduced in 2010, uses the Economic Order Quantity (EOQ) model to determine how large a batch we should produce of a product or stock-keeping unit (SKU), which is defined by the kind of jam or jelly, the size of the jar, and the label. The requirement to produce a given amount of a SKU is generated each time the stock level for that SKU falls below its Reorder Point (ROP), which equals three weeks of inventory for each SKU based on the average weekly demand as determined by the sales for our first full year of operations. Because of our growth, I think that many of the EOQ and ROP quantities now need to be recalculated using data that are based on our most recent annual demand. I want you to begin by updating the EOQ and ROP figures. While you're doing this, I also want you to think about how we can reduce our current levels of inventories."

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HBS Emeritus Professor Paul Marshall and Professor Mark Davis, Bentley University, prepared this case solely as a basis for class discussion and not as an endorsement, a source of primary data, or an illustration of effective or ineffective management. Although based on real events and despite occasional references to actual companies, this case is fictitious and any resemblance to actual persons or entities is coincidental.

After this conversation, Brodie realized that he had a lot of work to do. He knew from his operations management class that he needed to make sure he was using the right data to analyze the problem. He kept hearing in his head his professor's voice: "Garbage in means garbage out." He therefore wanted to get a good understanding of the production process and the various costs involved.

## Company Background

Three Jays Corporation was started by Jana Fremont. It was a wholly owned subsidiary of Fremont Jams and Jellies (FJ&J). Whereas FJ&J was primarily a contract manufacturer (also known as a "co-packer" in the food industry) that processed fruits into jams and jellies under private labels for large supermarket chains in the United States, 3Js focused on producing organic jams and jellies under its own label and for specialty stores and small food chains that sell primarily organic food products.

Located in rural Michigan, FJ&J was founded by Jana's grandfather Alex Fremont in 1954, shortly after he returned home from serving in the U.S. Army during the Korean War. Having grown up in Michigan, Alex saw the potential of starting a business that processed locally grown fruits, such as blueberries, strawberries, peaches, and cherries into high-quality jams and jellies. Initially, he produced jams and jellies only under the firm's own label, Fremont Preserves. In 1971, however, a major supermarket chain in the Midwest approached him about producing jams and jellies under its own private label. Given that FJ&J had surplus capacity at that time, he entered into a contract with the supermarket chain. Over time, FJ&J became known for high-quality products. It was subsequently approached by other supermarket chains to produce jams and jellies under their own private labels.

Andrew Fremont, Alex's son, joined the company in 1980 after he graduated from business school, where he had majored in operations management. In applying his education, Andrew focused on increasing the overall efficiency of FJ&J's manufacturing processes. He then became president of FJ&J, in 1992, as Alex began to take a less active role in FJ&J's daily operations. With Andrew at the helm, FJ&J focused more on private-label products. By 2000, FJ&J was producing only private-label products.

Jana Fremont, Alex's daughter, joined FJ&J in 2005 following her graduation from college and two years in the Peace Corps. Jana saw a growing market for organic food products, and convinced her father to let her start a new business that would make only organic jams and jellies. In order to comply with the accepted practices and regulations required for products to be labeled organic, Andrew and Jana agreed that the new manufacturing facility should be totally separate from FJ&J's main production operations. As there was some unused floor space at one end of the production area and surplus equipment available, Jana set up as a totally independent operation with its own storage areas for raw materials and finished goods, as well as its own production equipment.

## Producing Jams and Jellies at 3Js

### *Product line*

During his first week, Brodie learned that 3Js' product line comprised six types of jams and jellies that were packaged in four different size jars—2, 4, 8, and 12 ounces—under its own label. 3Js also sold its products to several small chains and independent supermarkets under their own private labels. In all, 3Js had 141 SKUs, broken down as follows:

24 SKUs—12-oz. size (6 types x 4 labels)

24 SKUs—8-oz. size (6 types x 4 labels)

48 SKUs—4-oz. size (6 types x 8 labels)

45 SKUs—2-oz. size (5 types x 9 labels)

*Current situation*

While all the raw ingredients used in the production of its jams and jellies were purchased and stored separately, a buyer in FJ&J's purchasing department generated an order. It took the buyer about 15 minutes to place it, which included completing all of the necessary paperwork. The buyers were paid approximately $42,000 per year (all salaries and wages include employee fringe benefits).

Major raw-material inventories for 3Js comprised packaging material (jars, labels, and cartons) and ingredients that were common to most of the product recipes (e.g., sugar and pectin). The cartons and jars were identical to those that FJ&J used. Whenever cartons and jars were withdrawn from FJ&J's inventory, an invoice was automatically generated and sent electronically to 3Js, where it was paid immediately. The fruits used to make the products were purchased from a nearby organic food distributor only when a batch was scheduled to be prepared. The product was then typically delivered within a week.

Jake Evans and Josh Francis, who performed the setups on the organic production line between production runs, worked full time for FJ&J. Josh and Jake each earned $23.50 an hour.

The manufacturing of jams and jellies was straightforward (see **Exhibit 1**). The raw-ingredient stockroom, which included both ambient- and cold-storage areas (for perishable ingredients) was located on a mezzanine overlooking the main production line. Also located on the mezzanine was the preparation room, where the ingredients for each recipe were weighed, measured, and placed on a cart. The cart was then wheeled into the kitchen, where the ingredients were combined in one of two 50-gallon kettles. The mixture was cooked for 20 to 25 minutes, depending on which product was being made, and then immediately transferred to a vacuum cooking kettle, where it cooked for ten more minutes to remove any air bubbles that had formed during the cooking process.

The two workers in the kitchen and prep area were employed on a full-time basis by 3Js. Emma Sawyer, the kitchen manager and cook, oversaw the cooking process. Her assistant, Julia Logan, assembled the ingredients for each batch in the prep room. Each batch took about an hour to complete. Emma's and Julia's annual salaries were $32,500 and $28,000, respectively. When Emma and Julia were not producing jams and jellies, they performed a variety of other tasks, such as managing the raw-materials inventories; placing purchase orders with FJ&J for raw ingredients used in products that were scheduled to be made; cleaning the kitchen and prep areas; and experimenting with new recipes.

After cooking, the contents of the kettle were transferred through a stainless steel gravity feed pipe to an 80-gallon holding tank that was located adjacent to the filling station on the ground floor. The filling process began with the jars being placed on a conveyor where they were first cleaned. The jars were then automatically filled with the hot jam or jelly. The filling operation had four heads that filled four jars simultaneously at an average rate of 50 jars a minute for the larger sizes and 75 jars a minute for the smaller jars. Immediately after they were filled, the jars were capped and sealed. They then

proceeded to the pasteurizing stage, where their contents were sterilized. This process took about 40 minutes. Labels were applied and the jars were dated. The final step in the process was packaging, where the jars were placed in cartons (12 jars to a carton) and stacked on a pallet. When an order was completed, the pallet was moved to a temporary stock room and later transferred to a nearby warehouse that FJ&J owned. FJ&J did not charge 3Js storage costs because it had excess warehouse capacity. When the production line was running, three part-time workers supported the operation, each of whom was paid $12.50 an hour by 3Js.

## Calculating EOQ and ROP Quantities

Before correcting the EOQ and ROP figures for the 141 SKUs that 3Js produced, Brodie reviewed documents that showed how the formal scheduling system was developed (see **Exhibit 2** for these records, which describe how the EOQ and ROP quantities for each SKU were determined). As he reviewed these documents, Brodie noted the following costs were used to calculate the EOQ quantities.

### *Setup Costs (S)*

The setup costs consisted of several components. First was the cost of placing an order for the raw ingredients used in the production run. Next were the costs of assembling all of the ingredients, preparing the kitchen, and cooking. This took Emma and Julia about an hour. Third were the cleaning costs, which included the time it took to clean the steam-jacketed kettles, hold tank, pipes that transferred the product to the filling station, and four filling heads. It took Emma and Julia about 20 minutes to clean the kettles and the other equipment on the mezzanine; this time was included in the prep time. At the same time, Jake and Josh needed 30 minutes to clean the transfer pipes, holding tank, and filling machine. Jake and Josh also needed 30 minutes every time there was a change in jar size in order to reset all the rails that guided the jars on the conveyor belts as they moved between the different steps in the production process. This effort included the time to adjust the filling machine so that it dispensed the proper amount of product into the different jar size, as well as the time to change the labels that were placed on the jars whenever there was a new batch or product being made (which took about five minutes). The total setup time between production runs was therefore about an hour.

### *Unit cost (C)*

Three Jays used a standard form, Product Cost and Price Data, which it adopted from FJ&J, to determine the wholesale price per case of each product it produced (see **Exhibit 3**). The cost of each case was calculated using the full unit cost, per case. This amount included all direct expenses incurred in producing and selling the item, plus an allocation of the company's total fixed expenses.

### *Carrying cost percentage (i)*

The only significant component of the inventory carrying cost was the cost of capital. Equity was not considered as a source of funds because Andrew and Jana held all the common stock in 3Js. As a result, the cost of capital was assumed to be 6%, the prevailing interest rate for debt available to 3Js. As FJ&J provided the finished-goods space at no cost, the other components of the carrying cost percentage and the cost of capital amounted to only 3%. This figure included estimated costs of discarding products with expired dates, shrinkage, insurance, and year-end inventory tax (see **Exhibit 2**).

## Scheduling System

Brodie decided to make his first corrections to the EOQ and ROP figures for the products that were going to be scheduled next. He learned from Jake and Josh that they were going to produce the following items (12-ounce size) during the last week of June:

| Label | Type | Number on Hand 5/31/2013 | Number of Cases to Be Produced |
|---|---|---|---|
| 3Js | strawberry jam | 134 | 750 |
| Marran Markets | raspberry jelly | 76 | 670 |
| Kerry's Marts | peach jam | 98 | 75 |
| Dom's Food Stores | blueberry jam | 55 | 110 |
| AAA Grocers | apple/mint jelly | 39 | 100 |

Within a week, Brodie had finished calculating the EOQ and ROP quantities for five SKUs (see **Exhibit 2** for the information he found in the original documents, and **Exhibit 4** for the results of his calculations). He then decided to find out how Jake and Josh had determined the schedule for the upcoming production run. He found them in the production area and questioned them.

**Brodie:** How did you decide to produce these items next week, Jake?

**Jake:** Well, every week we receive a printout that is generated by the inventory control system. It shows us each item that has dropped below its three-week ROP level. As of yesterday, we had several 12-ounce and 8-ounce products that dropped below their ROP levels.

**Brodie:** Why don't you produce both the 12-ounce and the 8-ounce jars together next week?

**Jake:** Because it takes Josh and me about half an hour to adjust the production line every time we make a size change. In addition to adjusting the heads on the filling machine, we have to adjust the rails on the conveyors, and they have to be just right: if they are off by even a small amount, the jars will hang up and shut the line down. Consequently, we limit each production run to a single size. Because the 12-ounce jar is our most popular size, we have scheduled to run only that size next week. We will schedule the 8-ounce size jars for the week after that. We hope the lead time will keep us from being stocked out of any of the 8-ounce items.

**Brodie:** How did the peach jam, blueberry jam, and apple/mint jelly get added to the schedule?

**Josh:** After we decided to run the 12-ounce jars, based on the low strawberry-jam and raspberry-jelly inventories, we checked the stock levels for the 22 other 12-ounce products. We typically try to make a run of 12-ounce products every four weeks. Likewise, we run the 8-ounce jars every four weeks, and the 2- and 4-ounce jars in the same week, again every four weeks. Right

now, we have plenty of capacity, so we use the fourth week in the cycle as a backup, in case we have to make some items that unexpectedly have run out. That doesn't happen too often. Given that we produce each size every four weeks, we build in an additional two weeks of safety stock to make sure we don't run out. Any 12-ounce items that we don't run next week will typically have to wait an additional four weeks before we can produce it when we run that size again. The stocking levels of the peach jam, blueberry jam, and apple/mint jelly were all below the six-week level when we checked yesterday, so we added them to the run. We usually have four to six different SKUs in the same 12-ounce production run.

**Brodie:** How do you minimize the time that the line is idle when you shift between products?

**Josh:** First, we try to schedule similar products together that require only a label change, which takes about fifteen minutes. Unfortunately, that doesn't happen too often. We usually have to clean the holding tank and gravity feed pipe along with the filling machine, including the four filling heads. That usually takes about 30 minutes, during which the part-time workers are idle. Also, we start with the lighter-colored jams and jellies and then move to the darker-colored ones.

**Brodie:** Once you have decided on the SKUs you will produce, and the order in which you are going to make them, how do you determine how many cases of each item to produce? Do you use the EOQ formula that was developed when the scheduling system was implemented?

**Jake:** Not exactly. Since we typically produce each size every four weeks, we try to predict what the demand for each SKU will be between runs. We also take into account the inventory on hand and schedule enough cases to be produced to last until the next scheduled production run of that size jar, which is usually four weeks.

**Brodie:** How did you go about predicting what the demand for each item will be?

**Jake:** We used the data from the monthly sales summary [see **Exhibit 5**] to see what the demand was the previous month. Then we adjusted this figure by adding a safety factor based on last year's monthly sales to offset any difference between sales in May and July.

**Brodie:** Then the planned production amount for each item to be run next week represents your predicted demand for July, with an adjustment made for the current inventory on hand?

**Jake:** Yes, that is basically what we try to do.

That night, Brodie sorted through what he had learned about the production process and the costs involved, especially during setups. He kept scratching his head while trying to figure out what was really important. Some things just did not seem right. For example, since FJ&J paid both for the cost of placing an order and Jake's and Josh's salaries, should these costs still be included in the setup costs?

The day after Brodie's discussion with Jake and Josh, Jana Fremont asked Brodie to report on what he had accomplished in his first assignment and to recommend some actions 3Js should take, based on his findings. Brodie realized that the scheduling system that Jake and Josh used bore little resemblance to the original EOQ-ROP system. As he prepared to meet Jana, Brodie decided to evaluate and compare the advantages and disadvantages of both the original scheduling system and the system developed by Jake and Josh. Based on his analysis, he thought that he could determine if 3Js could make improvements that would justify its adoption of one system on a permanent basis.

**Exhibit 1** Production Process for Making Jams and Jellies at 3Js

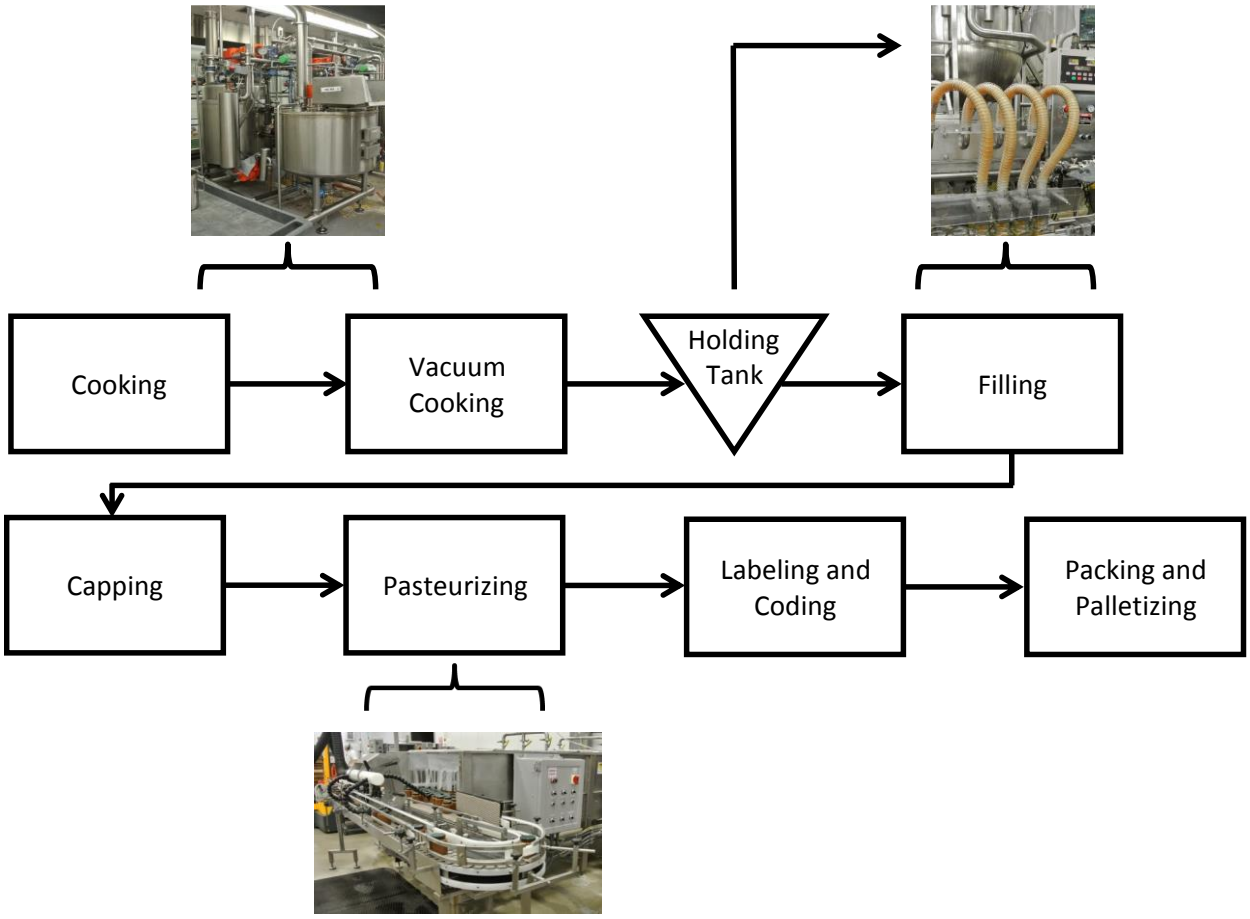

**Exhibit 2** EOQ and ROP Quantity Calculations (see **Exhibit 4** for a summary of these costs)

$$EOQ = \sqrt{\frac{2SD}{iC}} \qquad ROP = \frac{3}{52} \times D$$

**Where:**

**D = Annual demand**

Demand for an item for year ending December 31, 2010, in cases of product.

**S = Setup cost**

Setup cost per batch of product produced. This amount included order processing cost, product prep and cooking cost + size changeover cost + label changeover cost, where:

- Order processing cost = average cost of administrative labor to process an order for a batch of product, which was a constant $5.25[1] per batch ($21.00/hr x .25 hr).
- Product prep, cooking, and cleaning cost = cost of the two individuals preparing, weighing, and measuring the ingredients, cooking the product, and cleaning the kitchen, which was a constant $30.25 per batch ($16.25/hr + $14.00/hr).
- Size changeover cost = cost of labor required to adjust the guide rails to accommodate the different size jar and adjust the filling heads, which was a constant $23.50 per batch ($23.50 per hour x two workers x 30 minutes). With an average of five different SKUs produced in a single run, this amount equaled $23.50/5 = $4.70.
- Production-line cleaning cost = cost to clean the holding tank, pipes, and filling machine, which was a constant $23.50 per batch ($23.50 x two workers x 30 minutes). The label changeover cost was assumed to be zero because it was done at the same time.

**C = Unit cost**

Total (full) cost per case of an item after it was produced and packaged, which included materials cost + production labor + variable overhead allocation + fixed overhead allocation, where:

- Materials cost = Cost of ingredients used in the product, plus the cost of jars, caps, labels, and packaging.
- Production labor cost = Cost of part-time workers who were hired for the production runs, which was estimated at a constant $1.29 per case for all 141 SKUs.
- Fixed overhead allocation = Total company fixed overhead for the year divided by the number of cases sold per year. It was estimated at a constant $2.55 per case for all 141 SKUs.

[1] For annual salaries, cost calculations assume an employee works 2,000 hours per year.

- Variable overhead = Total direct expense (other than material and direct labor costs) resulting from production of one case of an item. It was estimated at a constant $1.45 per case for all 141 SKUs.

**i = Carrying cost (percentage)**

Percent of average inventory value, which represents annual cost of carrying inventory of an SKU.

**i =** Cost of capital + storage costs + other carrying costs = 6% + 0% + 3% = 9%

Cost of capital = 6% for all SKUs.

Other carrying costs, including estimated costs of products with expired dates (the shelf life for these types of products is more than a year), shrinkage, insurance, and year-end inventory tax = 3% for all SKUs.

**Exhibit 3** Product Cost and Price Data Summary: 12-Ounce Jars (dollars per case)

| Products | Strawberry Jam | Raspberry Jelly | Peach Jam | Blueberry Jam | Apple/Mint Jelly |
|---|---|---|---|---|---|
| Wholesale/Case (12) | 32.45 | 35.40 | 31.26 | 32.76 | 29.75 |
| Materials - Food Cost | 15.92 | 18.10 | 14.44 | 16.59 | 13.90 |
| Materials - Packaging (Jars) | 6.60 | 6.60 | 6.60 | 6.60 | 6.60 |
| Materials - Packaging (Carton) | 0.53 | 0.53 | 0.53 | 0.53 | 0.53 |
| Labor Cost | 1.29 | 1.29 | 1.29 | 1.29 | 1.29 |
| Variable Overhead | 1.45 | 1.45 | 1.45 | 1.45 | 1.45 |
| Total Variable Costs | 25.79 | 27.97 | 24.31 | 26.46 | 23.77 |
| Contribution to Overhead & Profit | 6.66 | 7.43 | 6.95 | 6.30 | 5.98 |
| Fixed Overhead Costs | 2.55 | 2.55 | 2.55 | 2.55 | 2.55 |
| **Full Costs** | 28.34 | 30.52 | 26.86 | 29.01 | 26.32 |
| **Profit** | 4.11 | 4.88 | 4.40 | 3.75 | 3.43 |

**Exhibit 4** EOQ and ROP Calculations Using Existing Method (see **Exhibit 2**) and 2010 Sales Data

| 12-ounce Jar | Total Set Up Cost (S)* | Annual Demand (D)** | % Carrying Cost (i)*** | Unit Cost ( C )**** | EOQ (Cases) | ROP (Cases) |
|---|---|---|---|---|---|---|
| Strawberry Jam | 63.70 | 2,993 | 9% | 28.34 | 387 | 173 |
| Raspberry Jelly | 63.70 | 2,335 | 9% | 30.52 | 329 | 135 |
| Peach Jam | 63.70 | 1,492 | 9% | 26.86 | 280 | 86 |
| Blueberry Jam | 63.70 | 886 | 9% | 29.01 | 208 | 51 |
| Apple/Mint Jelly | 63.70 | 625 | 9% | 26.32 | 183 | 36 |

* = 5.25 + 30.25 + 4.70 + 23.50 (from **Exhibit 3**)

** 2010 Annual Demand

*** = 6% cost of borrowing + 3% other carrying costs

**** Full cost from **Exhibit 4**

**Exhibit 5** Monthly Sales Data—Cases of 12-Ounce Jars per Month

| Label | Type | Jan | Feb | Mar | Apr | May | June | July | Aug | Sept | Oct | Nov | Dec | Year Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3Js | Strawberry Jam | | | | | | | | | | | | | |
| 2012 | | 345 | 301 | 325 | 299 | 344 | 296 | 329 | 334 | 349 | 325 | 289 | 333 | 3,869 |
| 2013 | | 566 | 671 | 384 | 631 | 616 | | | | | | | | 2,868 |
| Marran Markets | Raspberry Jelly | | | | | | | | | | | | | |
| 2012 | | 229 | 270 | 236 | 279 | 273 | 255 | 236 | 232 | 235 | 276 | 244 | 241 | 3,006 |
| 2013 | | 744 | 737 | 425 | 379 | 571 | | | | | | | | 2,856 |
| Kerry's Marts | Peach Jam | | | | | | | | | | | | | |
| 2012 | | 156 | 176 | 174 | 144 | 160 | 178 | 155 | 159 | 178 | 166 | 176 | 148 | 1,970 |
| 2013 | | 167 | 146 | 78 | 84 | 117 | | | | | | | | 592 |
| Dom's Food Stores | Blueberry Jam | | | | | | | | | | | | | |
| 2012 | | 92 | 109 | 98 | 99 | 102 | 111 | 103 | 99 | 94 | 104 | 107 | 93 | 1,211 |
| 2013 | | 100 | 99 | 80 | 139 | 108 | | | | | | | | 526 |
| AAA Grocers | Apple/Mint Jelly | | | | | | | | | | | | | |
| 2012 | | 66 | 77 | 79 | 69 | 65 | 66 | 68 | 67 | 62 | 74 | 71 | 68 | 832 |
| 2013 | | 73 | 63 | 110 | 146 | 88 | | | | | | | | 480 |