|  |  |
| --- | --- |
| University of Leicester logo | **MA1254 – Business challenge**  *Yu Li, Junbiao Li*  *Haoxiang Zhao Siyu Pu*  *Yunkuo Zhang*  *Group 3* |

**Consulting for Belvoir Dairy Limited**

## Problem description:

Belvoir Dairies Limited (BDL) is a producer of three kinds of cheeses. Each cheese has different costs, storage time, and quantity demand. BDL operates two dairies, having different types of cheese and costs. The CEO has requested us to analyse the data and give recommendations to get higher profits.

Analysis**:**

To better illustrate how BDL operates, we analyse it in order of cost, profit, and sales approach.

## Cost Estimation

To evaluate the current cost allocation, we should analyse the cost of different cheeses.

### Upper Basset

Blue Belvoir and White Belvoir can be produced in the Upper Basset, and the quantities of both cheeses manufactured are currently known. By analysing, it can be concluded that there are costs associated with Blue Belvoir, such as Penicillium roqueforti and costs such as rennet for both cheese costs. Assuming that the production of blue cheese is “a” and the production of white cheese is “b.” The corresponding factor cost of the enzyme (the coefficient of b) is k1 blue mould, and other factors corresponding to the cost (the coefficient of a+b) are k2. Based on what we have known, the cost of the Upper Basset is a high probability of linear correlation with the above two factors.

To test this hypothesis, we found that the correlation between the total output of the Upper Basset and the cost of the Upper Basset is 0.89721. That is to say, the total output of the Upper Basset and the cost of the Upper Basset is linearly dependent. Similarly, the correlation between Blue Belvoir and the total cost of the Upper Basset is 0.900662. We can consider the above hypothesis to be consistent with the factor by these values.

Meanwhile, We are also trying to exclude some factors with low impact to locate the factor with a more critical impact on cost in volume data, which can be more conducive to the subsequent fitting process. We learned from the data that the butterfat impacts the output, which can further affect the cost of cheese. Here, we have carried on the data analysis to the butterfat. The result is shown below.

We brought in the total average fat content and the determined fat content with the highly well-fitted function obtained from the table above. The determined fat content is the average fat content of the data points used in our fitted function. The yield difference was found to be very small, meaning that we did not subsequently need to correct the resulting fitted function, so we chose not to consider the effect of oil content in our analytical model. We use Y to represent fixed costs, such as labour and equipment maintenance costs, as they usually accumulate over time but do not fluctuate significantly.

Based on the above assumptions and analysis, we may wish to list the formula for the total cost of Upper Basset:

With the help of this formula, we substituted the previous production data for fitting.

|  |  |
| --- | --- |
|  |  |

By verifying the above figure, the equation we obtained has a reasonably good fitting effect.

### Lower Basset

Blue Belvoir, White Belvoir, and Red Belvoir can be produced in the Upper Basset because the data volume is relatively too dense and fluctuates wildly. As a result, it is difficult for us to carry out accurate fitting. Considering that the influence factors of the same cheese do not change much, we decided to use the coefficient of white and Blue Belvoir and set up an independent linear influence factor for red cheese to carry out formula fitting. Due to the relatively small amount of red Belvoir data in the estimator and the significant difference, which was not stable, we first considered using MSE to measure the estimation standard in the fitting process. In the fitting process, we tried to minimize the value of MSE to ensure the accuracy and stability of the equation and get a better fitting effect. In this way, we establish the fitting formula of the Lower Basset and substitute the known data for verification.

|  |  |
| --- | --- |
|  |  |

Above is a comparison of our proper function, and we can see that the fitting effect is good。

## Sales Forecast

Based on the general market conditions above, the demand for Red Belvoir and White Belvoir has reached saturation, and we can only change the sales volume by changing the price of Blue Belvoir. To find the relationship between the selling price and demand of Blue Belvoir, we fitted the data of selling price and sales volume.

Considering that there is a certain amount of milk that the two dairies can handle a limited amount of milk each year, we used Solver to solve the planning solution for the profit. By varying the selling price of blue cheese, we calculate the maximum profit for the year while ensuring that cheese production is within acceptable limits, and thus, we obtain the appropriate allocation ratio.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Blue | White | Red |
| Upper | 63% | 37% | - |
| Lower | 29% | 9% | 62% |

Similarly, based on the results of the planning scenario, we have the following suggestions.

|  |  |  |
| --- | --- | --- |
|  | Annual sales (tonnes) | Average selling price (£ per kg) |
| Blue | 470 | 9.81 |
| White | 265 | 7.00 |
| Red | 398 | 7.00 |

## Consider the Unique Nature of the Christmas Period

According to internet data, cheese sales during the last three weeks of December, Christmas, can reach 40% of the year, which means that we cannot use the usual supply and demand to map profits. For this reason, we have created a Sunburst spread over six weeks specifically for Christmas.

General industry data tells us that the general level of impact for the last three weeks of December is 40% of cheese sales for the year. We have used this to establish the market demand for Christmas. Because red cheese is the most expensive to produce and can be stored for a long time, the impact of Christmas is low, and because of capacity constraints, we do not consider the impact of Christmas on demand for red cheese. Based on the production process for blue and white cheeses, we find that there are six weeks of production throughout the year that affect the sales of these particular three weeks, limiting the maximum production capacity and solving for the production ratios of the respective cheeses via Slover, we solve for the following legend.

|  |  |  |
| --- | --- | --- |
|  | Christmas sales (tonnes) | Average selling price (£ per kg) |
| Blue | 61 | 12.00 |
| White | 52 | 7.00 |
| Red | 52 | 7.00 |

Based on the unique situation during Christmas, “solver” was used for finding the best price and the demand relative to it.

## Recommendation:

Summing up the above analysis results, we obtain the following allocation.

1. White Belvoir generally accounts for 37% of the Upper Basset cost, and Blue Belvoir for 63%. For the Lower Basset, red accounts for 62%, blue for 29%, and white for 9%. At the same time, our different types of cheese can be sold at the following prices. We suggest selling Blue Basset for 12 £ per kg, White Basset and Red Basset for 7 £ per kg to get a higher profit.
2. At Christmas time, we can sell in the following way. White Belvoir accounts for 48.99% of the Upper Basset cost, and Blue Belvoir for 51.01%. For the Lower Basset, red accounts for 22.03%, blue 29.18%, and white 48.79%. This section suggests selling Blue Basset for 9.82£ per kg, White Basset, and Red Basset for 7 £ per kg.

## Technical Formulas:

The fitting equations of cost are as follows.

The total cost of Upper Basset:

Blue Belvoir of Upper Basset:

White Belvoir of Upper Basset:

The total cost of Lower Basset

Blue Belvoir of Lower Basset:

White Belvoir of Lower Basset:

Red Belvoir of Lower Basset:

MSE:

## Reference:

1. Durham, Catherine & Bouma, Andrea & Meunier-Goddik, Lisbeth. (2015***). A decision-making tool to determine economic feasibility and break-even prices for artisan cheese operations***. Journal of dairy science. 98. 10.3168/jds.2014-9252.
2. Specification Sheets [Internet]. ***NEALS YARD DAIRY***. [cited 2022 May 19]. Available from:[***https://cdn.shopify.com/s/files/1/0037/6022/6419/files/Sparkenhoe\_Blue\_Specification.pdf?v=1647858998***](https://cdn.shopify.com/s/files/1/0037/6022/6419/files/Sparkenhoe_Blue_Specification.pdf?v=1647858998)