GOOD BURGER

GROUP Q
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In this project, it was questioned whether we should produce a hamburger that met certain qualities, at what price and to what type of customer we could sell this hamburger. We got help from coding to choose the desired burgers and the most expensive one among them. While determining the price range, we evaluated 2 different segments where hamburgers can be used and decided on the appropriate one. While choosing our suitable customer type, we made assumptions based on the nutritional value of the hamburger and its multi-ingredients. In this whole process, we not only learned to evaluate the given objective data, but also made decisions about the preferences of the customers with appropriate assumptions.

Our Approach to The Problem:

To find the product consisting of maximum number of items that fits the definition in the question, we decided to create a program that generates all possible hamburgers and checks them according to the rules in the question.

Representation of Products in Our Program:

A hamburger consists of 8 different items in this problem. However, number of pickles and tomatoes are defined to be equal in the problem. Also, the number of ketchup and lettuce are the same too. So, in order to represent a product, we used 6x1 matrices. Every row in those matrices represent the number of items.

$$\begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \\ x_5 \\ x_6 \end{bmatrix}$$

Matrix representation of a product

Variable	Item
x_1	Number of Beef Patty's
x_2	Number of Buns
x_3	Number of Cheeses
x_4	Number of Onions
x_5	Number of Pickles Number of Tomatoes
x_6	Number of Ketchups Number of Lettuces

Generating Every Possible Product:

In the definition of the problem, its clearly mentioned that a hamburger consists of the given items and it has to include at least one and at most five of those items. Since the number of free variables is six as mentioned in the previous topic, and each of those variables has to get one of five values, the number of all the possible hamburgers is 5^6, 15625. To Generate those hamburgers, we calculated the cartesian product of a set containing all the possible number of items as below. Then, we stored those values in the product matrix format described above.

$$A = \{1,2,3,4,5,6\}$$

$$A \times A \times A \times A \times A \times A = \{(1,1,1,1,1,1), (1,1,1,1,1,2), (1,1,1,1,1,3) \ldots\}$$

$$\underbrace{\begin{bmatrix}1\\1\\1\\1\\1\\1\end{bmatrix}\begin{bmatrix}1\\1\\1\\1\\1\\2\end{bmatrix}\begin{bmatrix}1\\1\\1\\1\\1\\3\end{bmatrix}\cdots\cdots\begin{bmatrix}5\\5\\5\\5\\5\\4\end{bmatrix}\begin{bmatrix}5\\5\\5\\5\\5\\5\end{bmatrix}}_{\text{15625 different matrices}}$$

Calculating the Nutritional Values:

To calculate the nutritional value of each matrix in order to check if that product complies with the demands or not, we created three 1x6 matrices that contain the nutritional value of each ingredient/ingredients. For example, the first cell of the sodium matrix represents the amount of sodium in one unit of the first ingredient, which is sodium. So it contains 50 in that cell.

$$Sodium = [50 \quad 330 \quad 310 \quad 1 \quad 263 \quad 163]$$

$$Fat = [17 \quad 9 \quad 6 \quad 2 \quad 0 \quad 0]$$

The last two cells in each nutrient's matrix contains the sum of those nutrients for both ingredients they represent. For Example, the last cell of sodium matrix is 163, which is the sum of the amount of sodium in a lettuce and a ketchup.

$$Calory = [220 \quad 260 \quad 70 \quad 10 \quad 14 \quad 24]$$

After creating those matrices, to calculate the nutritional values of a product, all we need to do is calculate the dot product of product and given nutrient. For example, to calculate the total amount of sodium contained in the first product, we calculate the dot product of first product and sodium as below:

$$\begin{bmatrix} 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \end{bmatrix} . [50 \quad 330 \quad 310 \quad 1 \quad 263 \quad 163] = 1117$$

Checking if the Product Meets the Nutrient Limitations:

To check if the product meets the limitations, we simply run the procedure above for each single product and check if it meets the limitations. If it does, we store it in a python list. We found out that there are 5194 possible products that meet the limitations. After that, all we needed to do is calculate the number of ingredients in those products and select the one that contains the maximum number of ingredients.

Calculating the Number of Ingredients in a Product:

To calculate the number of ingredients in a product, we created a procedure which is similar to the procedure we apply to calculate the nutritional values. We created a matrix that represent the number of ingredients, 1 for rows that consist of only one ingredient and 2 for rows that contain two ingredients like the last two rows.

$$Ingredients = \begin{bmatrix} 1 & 1 & 1 & 1 & 2 & 2 \end{bmatrix}$$

Later, when we calculate the dot product of this matrix and the product, we get the number of ingredients in that product. For Example, the operation below calculates the number of ingredients in the first product.

$$\begin{bmatrix} 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \end{bmatrix} . \begin{bmatrix} 1 & 1 & 1 & 1 & 2 & 2 \end{bmatrix} = 8$$

Calculating the Cost of a Product:

To calculate the cost of a single product, we again created a similar procedure. We created a 1x6 cost matrix that contains the price of each row. Again, the dot product of two matrices will result in the price of a given product. For example, below operation calculates the total cost of the first product.

$$Costs = \begin{bmatrix} 0.25 & 0.15 & 0.10 & 0.09 & 0.07 & 0.06 \end{bmatrix}$$

$$\begin{bmatrix}1\\1\\1\\1\\1\\1\end{bmatrix}.\begin{bmatrix}0.25 & 0.15 & 0.10 & 0.09 & 0.07 & 0.06\end{bmatrix} = 0.72$$

Results:

After the procedures we described, our program found out that the product that both contains the highest number of ingredients and meets the limitations contains 31 ingredients. The product is represented below:

$$\begin{bmatrix}4\\1\\1\\5\\5\\5\end{bmatrix}$$

Value	Item
4	Number of Beef Patty's
1	Number of Buns
1	Number of Cheeses
5	Number of Onions
5	Number of Pickles Number of Tomatoes
5	Number of Ketchups Number of Lettuces

So, the best product contains 4 Beef Patty's, a bun, a cheese, 5 onions, 5 pickles, 5 ketchups, 5 lettuces, 5 tomatoes. Since there is no other product found by our program that both meet the limitations and has the same or higher number of ingredients, this product is our answer to the question.

Total Nutritional Values and Cost of the Product:

Nutritional Values:

Total Sodium Amount:

$$\begin{bmatrix} 4 \\ 1 \\ 1 \\ 5 \\ 5 \\ 5 \end{bmatrix} . \begin{bmatrix} 50 & 330 & 310 & 1 & 263 & 163 \end{bmatrix} = 2975$$

Total Fat Amount:

$$\begin{bmatrix} 4 \\ 1 \\ 1 \\ 5 \\ 5 \\ 5 \end{bmatrix} . \begin{bmatrix} 17 & 9 & 6 & 2 & 0 & 0 \end{bmatrix} = 93$$

Total Calory Amount:

$$\begin{bmatrix} 4 \\ 1 \\ 1 \\ 5 \\ 5 \\ 5 \end{bmatrix} . \begin{bmatrix} 220 & 260 & 70 & 10 & 14 & 24 \end{bmatrix} = 1450$$

Cost:

Total Cost:

$$\begin{bmatrix} 4 \\ 1 \\ 1 \\ 5 \\ 5 \\ 5 \end{bmatrix} . \begin{bmatrix} 0.25 & 0.15 & 0.10 & 0.09 & 0.07 & 0.06 \end{bmatrix} = 2.35$$

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We have chosen two price bands to sell our burgers, medium and high price bands. because it was not profitable for us to sell such a calorie-dense food source, which could be sufficient even as a single meal, at a low-price band. If we were to sell our burger in the high price band, we would set a price of $20 or more and make it a more experiential burger. that is, we would present and market it in a concept that individuals would not consume on a daily basis but would taste several times as an experience. In this situation, the only group in which we could achieve continuity in our customer base would be the wealthy segment with excessive caloric needs. The remaining customer profile would be content creators and customers who like to spend money on experiential food. but since our burger does not promise anything extraordinary in terms of taste and luxury, we decided that the high price band would not be a very correct sales strategy. If we sell in the middle price band, that is, if we set the price of the burger as 10 dollars, we realized that more people would prefer us to be satiated and meet most of their daily calorie needs. We thought that people might turn to our brand because it would be more nutritious and more satisfying than the average burger. We decided that we would attract a lot of customers who would come not only to be full but also to experience the 4 burger patties because of their interestingness.

As a result, the fact that our sales in the middle price band will attract many customers in the long run and that the customer base it will appeal to will be high numbers pushed us to set a price in the mid-range.

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Since the hamburger we make is rich in material, high calories, and satiating, it will be suitable for athletes who are fed according to their calorie needs and who need a lot of calories. Also, for people who want to meet their daily calorie needs in one go, this high-calorie hamburger without an extreme price will be a good choice too. Since we don't use a very different product as an ingredient and only make a bigger hamburger with classic hamburger ingredients, our typical customers will not be a group of people who want to try different things. However, some of the people who try to produce content on social media applications such as YouTube and Instagram can think that such a big hamburger will create good content, and they may eat the hamburger to shoot a video. Some brand and sponsorship agreements with them will also create a good advertisement for us. As a result, our typical customers can be listed as athletes who are fed according to their calorie needs, people who want to eat their food in a minimum of meals a day, and some content producers.

References:

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Note: Source code can be found here https://github.com/1942Spectre/Burgers