As per the assigned settings we have done the market basket analysis for the given dataset where we have got the sequence of buying behaviors of customers based on the sequence analysis. After doing the analysis we got 200 sequence which are shown as below, and they are sorted descending as per their lift values:

Lift:

Lift suggests how strong our rule is. The lift value for association rule A -> B states that the likelihood of purchase of B when customer has already bought A with the likelihood of item B being purchased alone.

Value of lift:

Lift = 1 -> This means that there is no relation between the items A and B and they only bought together by chance.

Lift > 1 -> This means that items A and B are bought together more than random.

Lift < 1 -> This means that items A and B are bought together less than random means placing them together results in less sale than the customer buy it randomly. So, placing them together has contradictory results of having less sales of both the products.

Significance of lift:

When we are searching for the associations between products, we check two values associated with the given rules. Support and Confidence.

Support tells the probability of having both the items bought by the customers among all the customers. For example, when rule A -> B has support values of 3%. Then we say that out 100 customers 3 customers buy both the products.

While confidence states the probability of buying B when the customer has already bought A. For example, when rule A -> B has confidence value of 50% we say that out of 2 customers who has bought A 1 customer buy the product B.

But we can not rely only on the support and confidence value as it can be biased. For example, in one analysis a supermarket found that toothbrush and milk have a confidence of 0.7. Although we do know deeply that these two products do not have any associations related to each other. After calculating the lift, they came to know that the lift value here is only 0.87 which states that placing both the products together does not increases the chance of buying milk when customer has toothbrush bought.

Association Report

Relations	Expected Confidence (%)	Confidence (%)	Support (%)	Lift	Transaction Count	Rule	Left Hand of Rule
4	10.70	20.51	2.28	1.92	89.00	yogurt & rolls/buns ==> whole milk & sausage	yogurt & rolls/buns
4	11.13	21.34	2.28	1.92	89.00	whole milk & sausage ==> yogurt & rolls/buns	whole milk & sausage
4	8.23	15.16	2.28	1.84	89.00	yogurt & whole milk ==> sausage & rolls/buns	yogurt & whole milk
4	15.06	27.73	2.28	1.84	89.00	sausage & rolls/buns ==> yogurt & whole milk	sausage & rolls/buns
4	10.70	19.19	2.31	1.79	90.00	yogurt & other vegetables ==> whole milk & sausage	yogurt & other vegetables
4	12.03	21.58	2.31	1.79	90.00	whole milk & sausage ==> yogurt & other vegetables	whole milk & sausage
4	17.86	30.27	2.28	1.70	89.00	yogurt & sausage ==> whole milk & rolls/buns	yogurt & sausage
4	7.54	12.79	2.28	1.70	89.00	whole milk & rolls/buns ==> yogurt & sausage	whole milk & rolls/buns
4	20.60	34.63	2.28	1.68	89.00	yogurt & whole milk & rolls/buns ==> sausage	yogurt & whole milk & rolls/buns
4	6.59	11.08	2.28	1.68	89.00	sausage ==> yogurt & whole milk & rolls/buns	sausage
4	14.67	24.46	2.62	1.67	102.00	whole milk & sausage ==> rolls/buns & other vegetables	whole milk & sausage
4	10.70	17.83	2.62	1.67	102.00	rolls/buns & other vegetables ==> whole milk & sausage	rolls/buns & other vegetables
4	8.23	13.67	2.62	1.66	102.00	whole milk & other vegetables ==> sausage & rolls/buns	whole milk & other vegetables
4	19.14	31.78	2.62	1.66	102.00	sausage & rolls/buns ==> whole milk & other vegetables	sausage & rolls/buns
4	28.30	46.84	2.28	1.66	89.00	whole milk & sausage & rolls/buns ==> yogurt	whole milk & sausage & rolls/buns
4	9.29	15.33	2.31	1.65	90.00	yogurt & whole milk ==> sausage & other vegetables	yogurt & whole milk
4	15.06	24.86	2.31	1.65	90.00	sausage & other vegetables ==> yogurt & whole milk	sausage & other vegetables
4	28.30	45.92	2.31	1.62	90.00	whole milk & sausage & other vegetables ==> yogurt	whole milk & sausage & other vegetables
4	11.13	17.96	3.44	1.61	134.00	whole milk & other vegetables ==> yogurt & rolls/buns	whole milk & other vegetables
4	19.14	30.88	3.44	1.61	134.00	yogurt & rolls/buns ==> whole milk & other vegetables	yogurt & rolls/buns
4	17.86	28.57	3.44	1.60	134.00	yogurt & other vegetables ==> whole milk & rolls/buns	yogurt & other vegetables
4	12.03	19.25	3.44	1.60	134.00	whole milk & rolls/buns ==> yogurt & other vegetables	whole milk & rolls/buns
4	7.54	12.06	2.31	1.60	90.00	whole milk & other vegetables ==> yogurt & sausage	whole milk & other vegetables
4	19.14	30.61	2.31	1.60	90.00	yogurt & sausage ==> whole milk & other vegetables	yogurt & sausage
3	17.75	28.32	2.46	1.60	96.00	whole milk & pip fruit ==> pastry	whole milk & pip fruit

Figure 11

Analysis of highest lift value for the resulted rules

After performing Apriori algorithm to the given dataset with having item set as a target variable we arrived at the result shown in figure - 4. The rules are sorted according to their lift values. So, as we can see the largest lift value, we got is a 1.92. There are two rules which showed the highest lift values.

1.) Yogurt & rolls/buns ==> whole milk & sausage
2.) Whole milk & sausage ==> Yogurt & rolls/buns

As seen in the above both the rules have the highest lift values of 1.92. The value of lift states the likelihood of the given rule. So, for first rule lift value of 1.92 states that likelihood of customer buying whole milk and sausage after buying yogurt and rolls/buns is 1.92 times better then customer buys whole milk & sausage randomly. And for the second rule lift value of 1.92 states that likelihood of customer buying yogurt & rolls/buns after buying whole milk & sausage is 1.92 times better than customer buys these two products randomly. These two rules are vice versa of each other. But the first rule has the confidence value 20.51% and second rule has confidence value of 21.34% and both of them has support same which is obvious thing. So, we set second rule as best here.

3 Product bundles and promotions to increase the sales

As it can be seen in the figure-4 out of 167 items only few items like yogurt, whole milk, sausage and rolls/buns are the key items which customers are buying more. Based on the support, confidence and lift value we suggest below three bundles.

1.) Yogurt, rolls/buns, whole milk and sausage:

This product bundle has been selected based on the lift value it has. The lift value of 1.92 has been achieved for the rule which consist these four items in it. This rule has lift value more than one so placing them together increases the chances of more item buying. Also, supermarket chain can give discount if customers buy them together. Which tends customers to buy bundle instead of specific products. One thing to note here is the sequence in where these products will be placed is whole milk and sausage first which is followed by the yogurt and roll/buns. Based on the second rule which has more confidence than the first one.

2.) Whole milk, other vegetables, yogurt and sausage

Based on the confidence value of 45.92% we have derived the given product bundle. The rule has support value of 2.31 and lift value of 1.61 which is good as compared to all the other rules lift and support values. So, based on the rule customers have tendency to buy yogurt after they bought whole milk, other vegetables and sausage. So, placing them according to rule and giving discount on only yogurt can lead to more sell of yogurt.

3.) Whole milk, yogurt, other vegetables and rolls/buns

This product bundle has been selected based on the high support value of 3.44. Because of the more support it tells that customers are buying more this type of bundles. So, instead of giving promotional discounts on the bundle we can place them at the entrance of the market will leave customers to less travelling for the products they desire more. The placement of internal product will be done as the confidence value of 30.88 for the rule yogurt & rolls/buns ==> other vegetables & sausage.

Outcomes of the analysis and further recommendations:

Problem:

For a supermarket chain having a greater number of sales of products rather than having more profit margin on individual products is better because it will lead to increase in revenue. About 60% of customers go into the general store without a rundown, believing that they will recollect what they need when they enter the shop. The supermarket chain can exploit this by putting related items close to one another, which leaves them in danger of imprudent purchasing. For the most part, clients don't just follow their buy plans, they additionally will in general purchase things that are not present in their buying plans. Consequently, this leads to building the income for the general store with consumer loyalty, which is a win-win situation for the supermarket. (Schindly, 2017).

Solution:

For increasing the revenue by selling more products we want to know two things. First, what people are buying more and what is their buying pattern. After market basket

analysis we came to know patterns and frequently buying products. Based on the results discussed in the above part we have derived two types of recommendations.

1.) Product Placement
2.) Product promotion and pricing

1.) Product Placement:

There are two types of product placements can be done one is placing two products which tends to decrease their individual buying chance separately. And placing two products together which have been seen to increase the chance of buying them. As per the analysis we derived that not a single rule has lift value less than one. So, there is no contradictory products available in the given dataset. Now, as per the solutions given in the task – 3. We derive below placement.

- At the entrance other vegetables and sausage
- Followed by whole milk
- Then yogurt and at last rolls/buns

2.) Product promotion and pricing:

From the above task we got the associated products in terms of bundles and sequence. Based on their support, confidence and lift values we derive below conclusions.

- Promotional discount can be given on yogurt because of It has biggest confidence after customers buying the whole milk, sausage and other vegetables.
- One more promotional offer can be given to the customers who will buy the entire products bundle of whole milk, sausage, yogurt and rolls/buns.
- Can make an email driven target marketing campaign where we'll send the product offers or recommendations to customers who bought specific items. The campaign will work as Amazon's recommendation system.

Outcomes:

Due to product placements we will improve the customer shopping experience which helps in increasing loyal customers for the supermarket chain. And due to promotions on individual products and bundles the chain will increase its revenue which resulted in increasing the profit generation.

Analysis results:

After combining the results of the lift, support and confidence we have derived the strongness and sequence of the products as discussed earlier. Based on this Combining results of support and confidence we can tell that if a customer does not buy more frequently then we can rule out this rule as the frequency of buying together is less. But in the suggested bundle we do not have any bundle which needs this kind of attention. Also, no single rule has expected confidence more than the confidence. So, all the rules here are strong.