



MRA PROJECT MILESTONE - 2

Pooja Kabadi

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Market Basket Analysis



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Problem Statement:

A Grocery Store shared the transactional data with you. Your job is to identify the most popular combos that can be suggested to the Grocery Store chain after a thorough analysis of the most commonly occurring sets of menu items in the customer orders. The Store doesn't have any combo meals. Can you suggest the best combo and offers?

Exploratory Analysis

- Exploratory Analysis of data & an executive summary (in PPT) of your top findings, supported by graphs.
- Are there trends across months/years/quarters/days etc. that you are able to notice?

Use of Market Basket Analysis (Association Rules)

- Write Something about the association rules and their relevance in this case
- Add KNIME workflow Image
- Write about threshold values of Support and Confidence

Associations Identified

- Put the associations in a tabular manner
- Explain about support, confidence, & lift values that are calculated

A suggestion of Possible Combos with Lucrative Offers

- Write recommendations
- Make discount offers or combos (or buy two get one free) based on the associations and your experience

Tools to be used:

- KNIME Analytics Platform or
- Tableau or
- Python or

1



The project entails completing a detailed study of data in order to provide ideas for how a grocery store may enhance revenue through popular combination offers and customer discounts.

2



Objective:

We have a dataset of a Grocery store. We are expected to do Market Basket analysis and provide

- Recommendations for combos to increase revenue
- Provide the list of associations of items that are sold together
- Recommendations on offers for the possible combos.

3



Approach:

Market Basket analysis has been done & recommendations are provided on possible combos and offers that can be bundled with the combos.

4



Tools Used:

Python : EDA
Tableau : EDA Data visualization
KNIME : Market Basket Analysis



About Data:

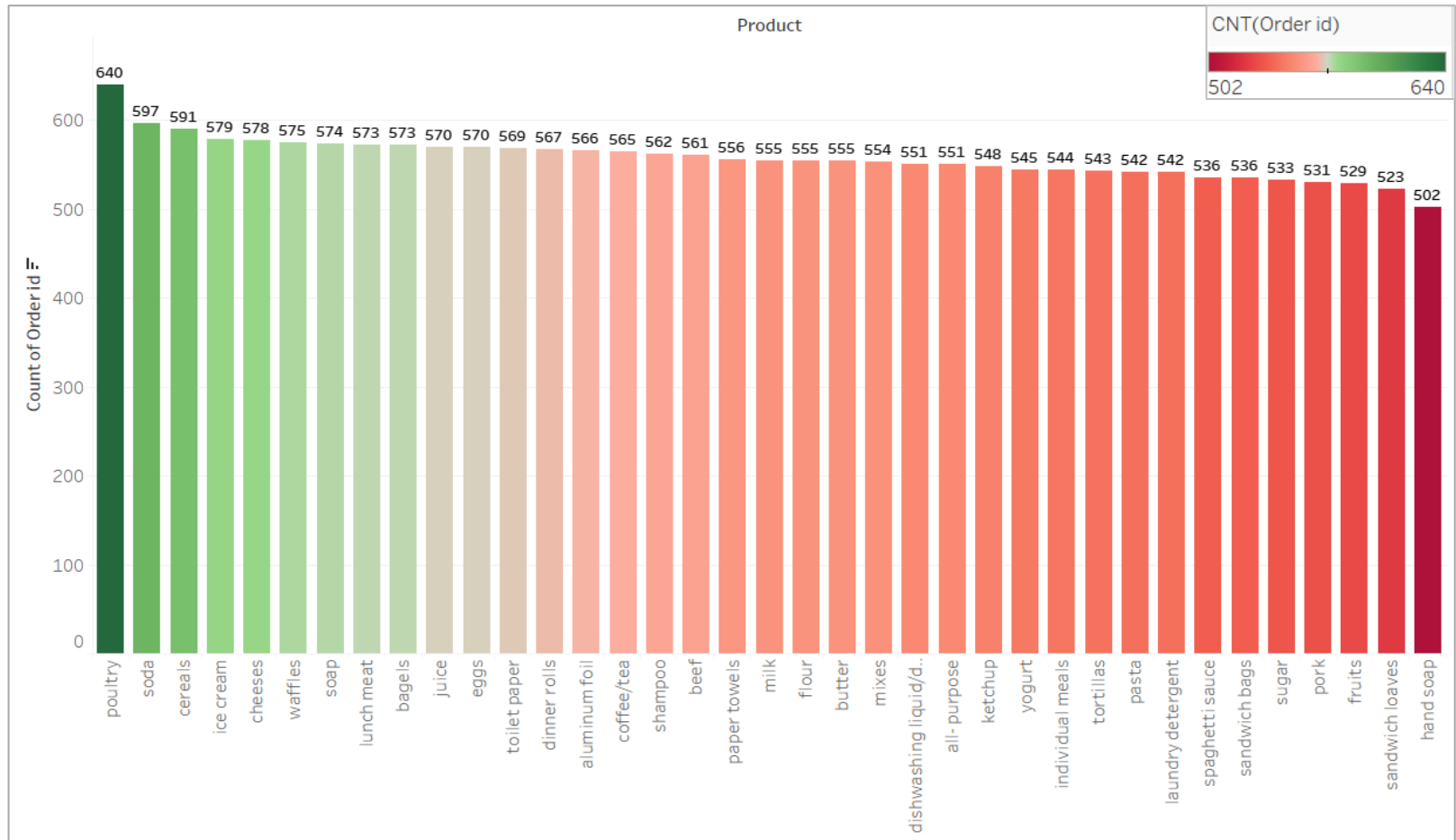
- The data is about an Grocery store. They have provided the data collected of transactions for 2 years and 2 months.
- Dataset is having 3 variables (Date, Order id ,Product Name) out of which 1 is Categorical , one numerical & one date field & total number of observations are 20641.
- The dataset does not have missing values.
- The data contains 603 unique values under Date column, 1139 under Order id and 37 under products.
- This means that 1139 orders were placed in total and the customers bought 37 unique items
- .Poultry is the most sold product with count of 640.

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 20641 entries, 0 to 20640
Data columns (total 3 columns):
#   Column      Non-Null Count  Dtype
---  -
0   Date        20641 non-null  object
1   Order_id    20641 non-null  int64
2   Product     20641 non-null  object
dtypes: int64(1), object(2)
memory usage: 483.9+ KB
```

	Date	Product
count	20641	20641
unique	603	37
top	08-02-2019	poultry
freq	183	640

	Order_id
count	20641.000000
mean	575.986289
std	328.557078
min	1.000000
25%	292.000000
50%	581.000000
75%	862.000000
max	1139.000000

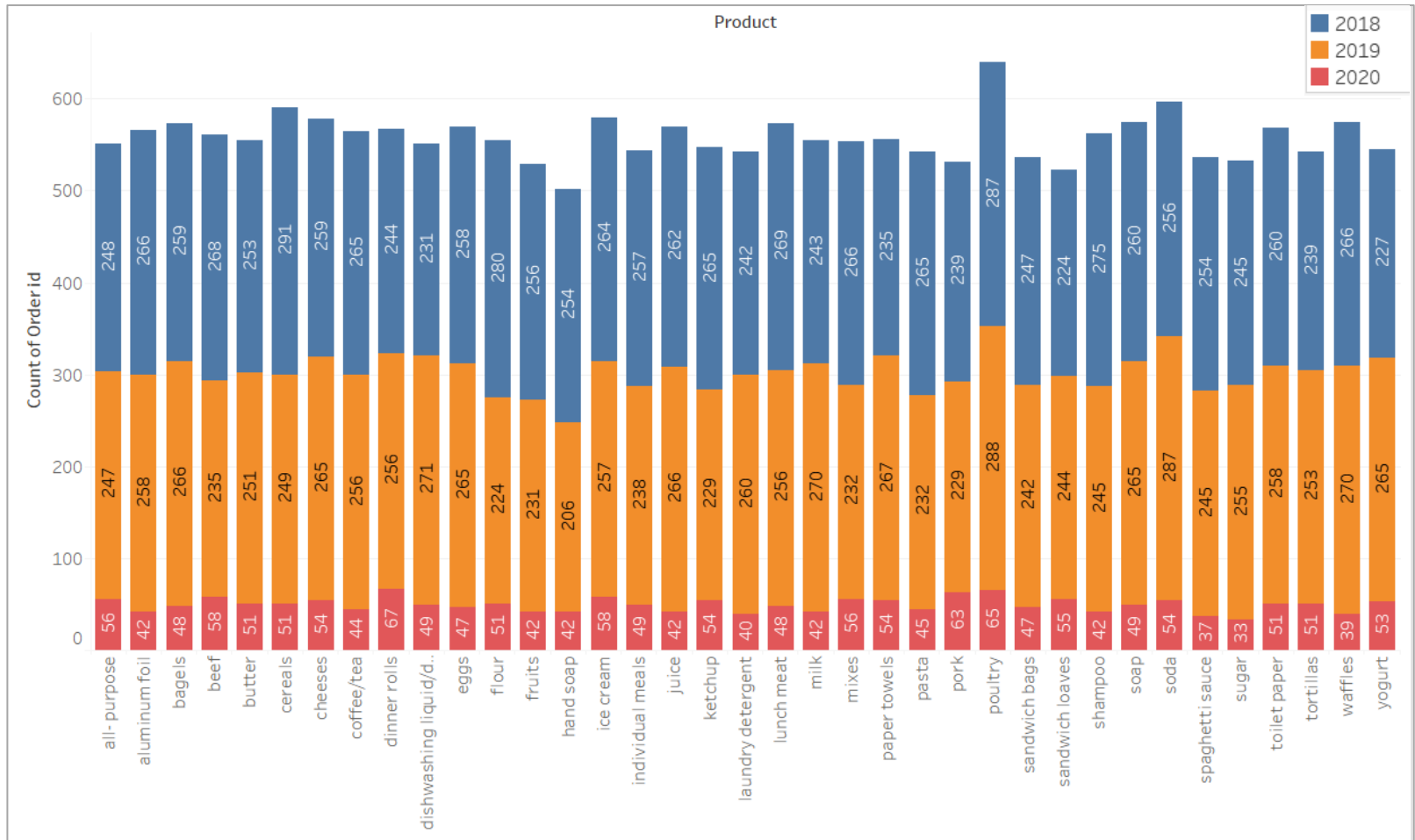
EDA : Count of Orders of Products



Inferences:

- Poultry products have highest number of orders of 640 out of 1139, followed by soda and cereals.
- Hand soap has the least number of orders of 502, followed by sandwich loaves and fruits.

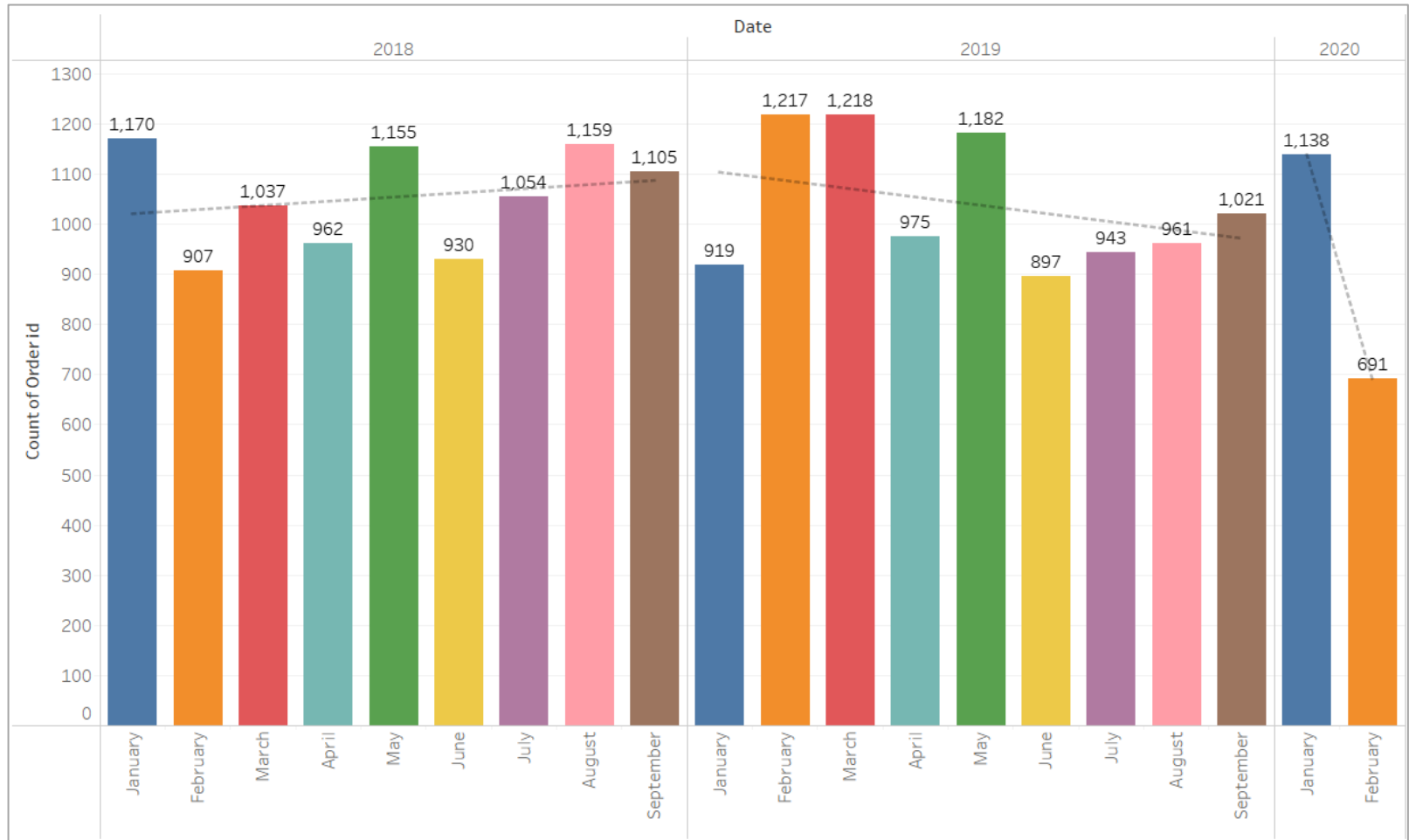
EDA : Products purchased on Yearly bases



Inferences:

- Maximum number of orders of products are in the year of 2019, while 2020 as the least orders, may be due to the pandemic.

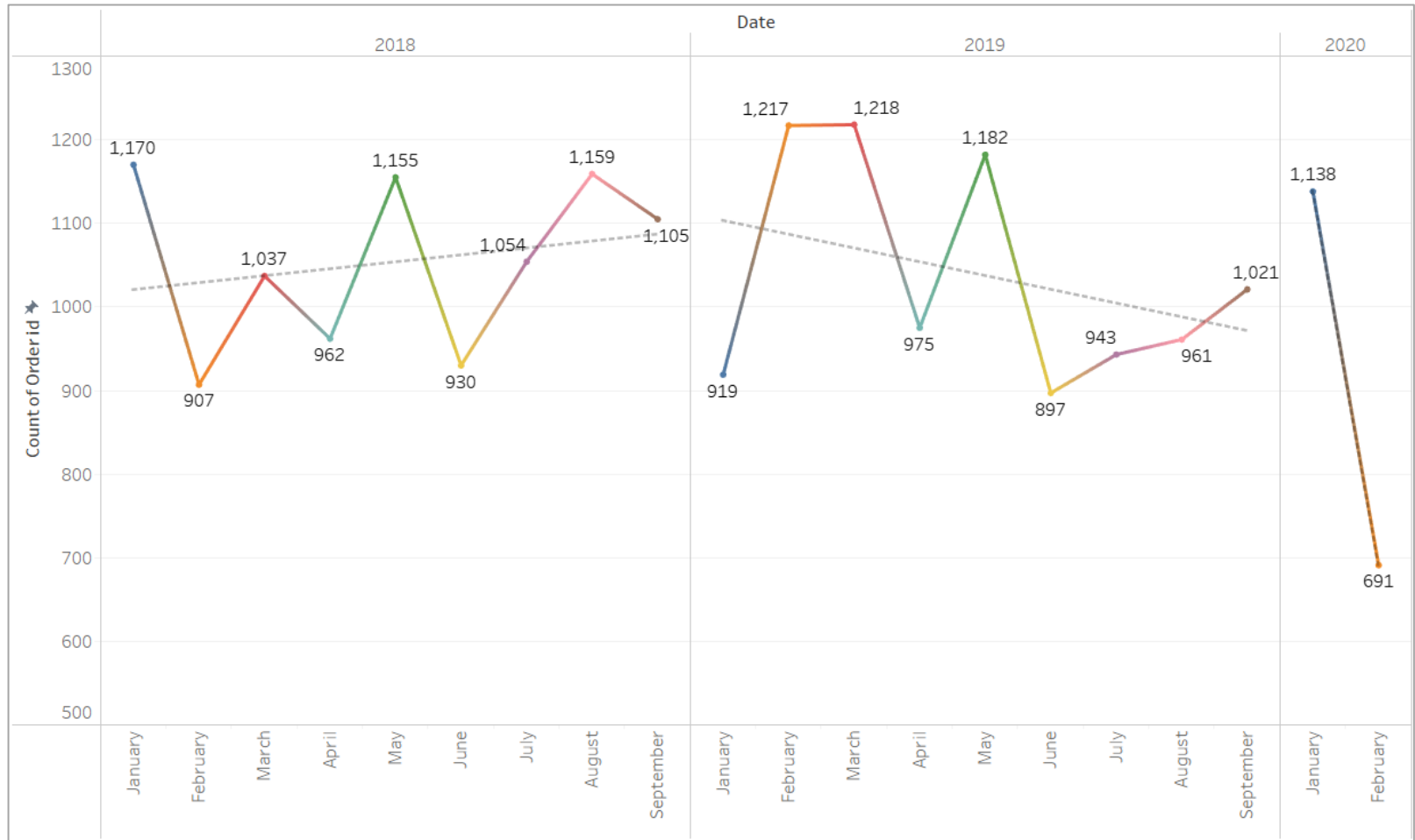
EDA : Monthly trend across different years



Inferences:

- We can see that in the year of 2018 there is increasing trend line, while in 2019 there is gradual decrease in number of sales.
- In the year 2020, there is steep decrease in number of orders from Jan to Feb.

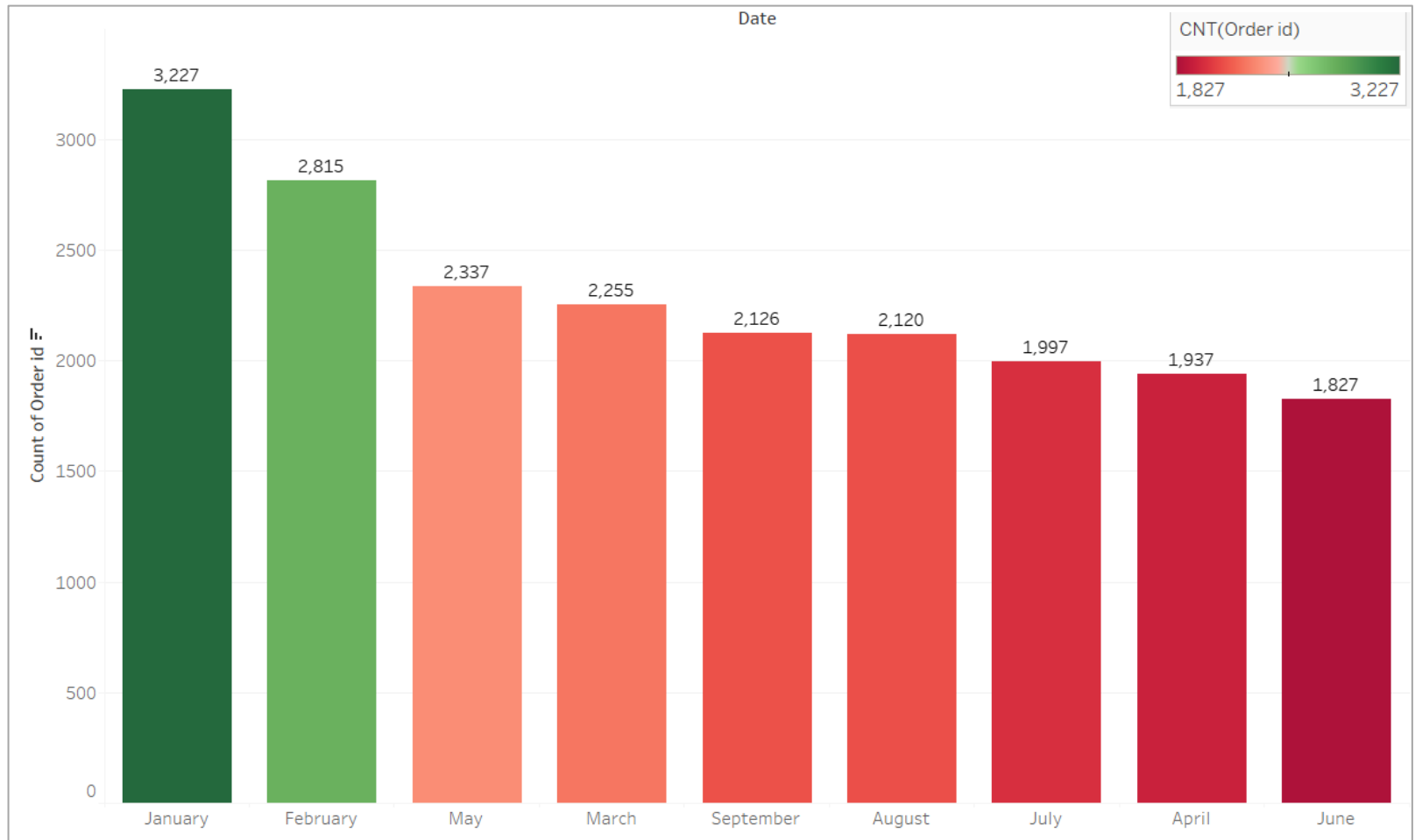
EDA : Monthly trend across different years



Inferences:

- There is no pattern of seasonality within the year of the count of orders.

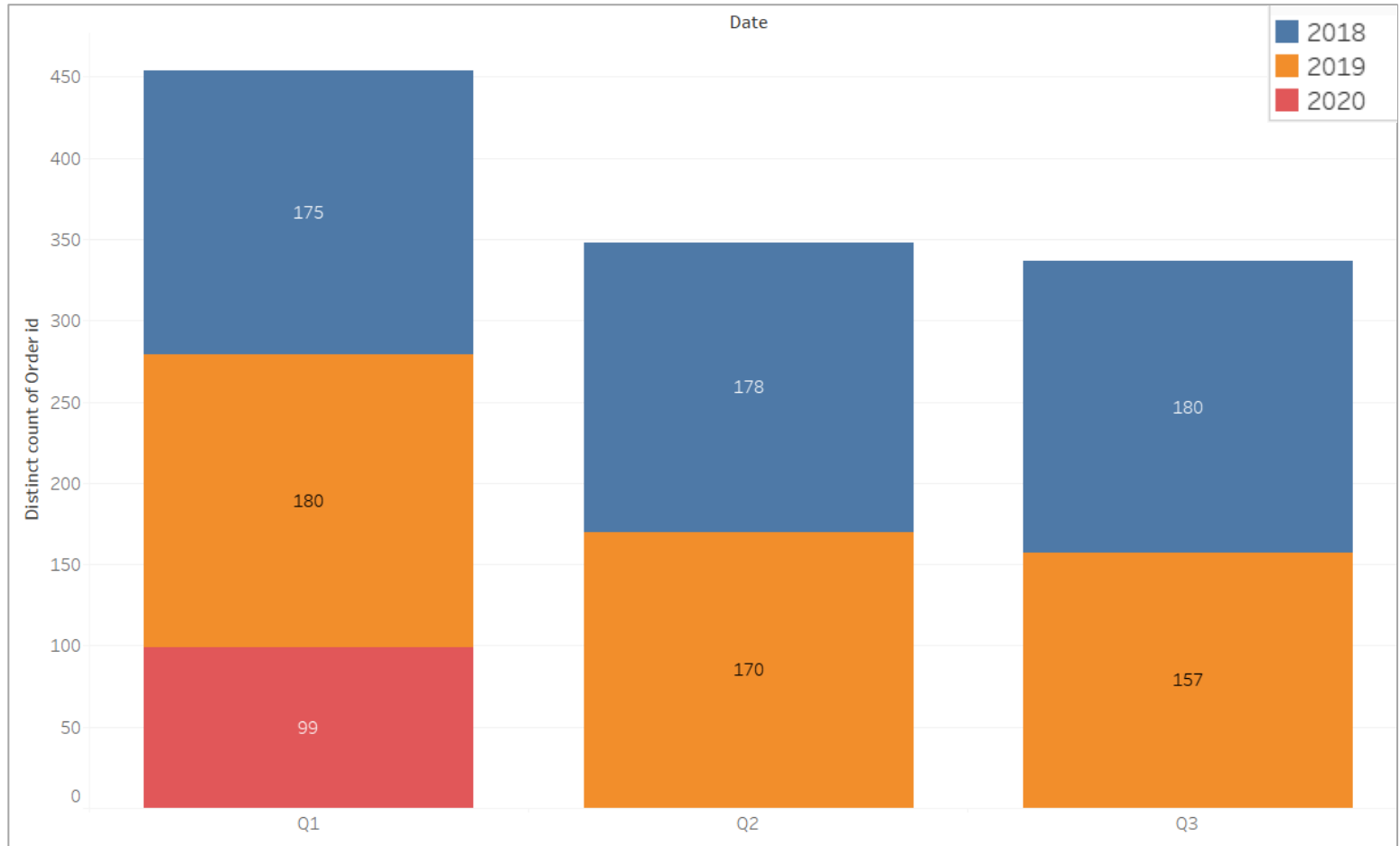
EDA : Monthly trend of orders



Inferences:

- We can see that, January has the hight number of orders followed by February and may. Looks like the 1st Quarter of year has maximum order count.
- The least number of orders are in June.

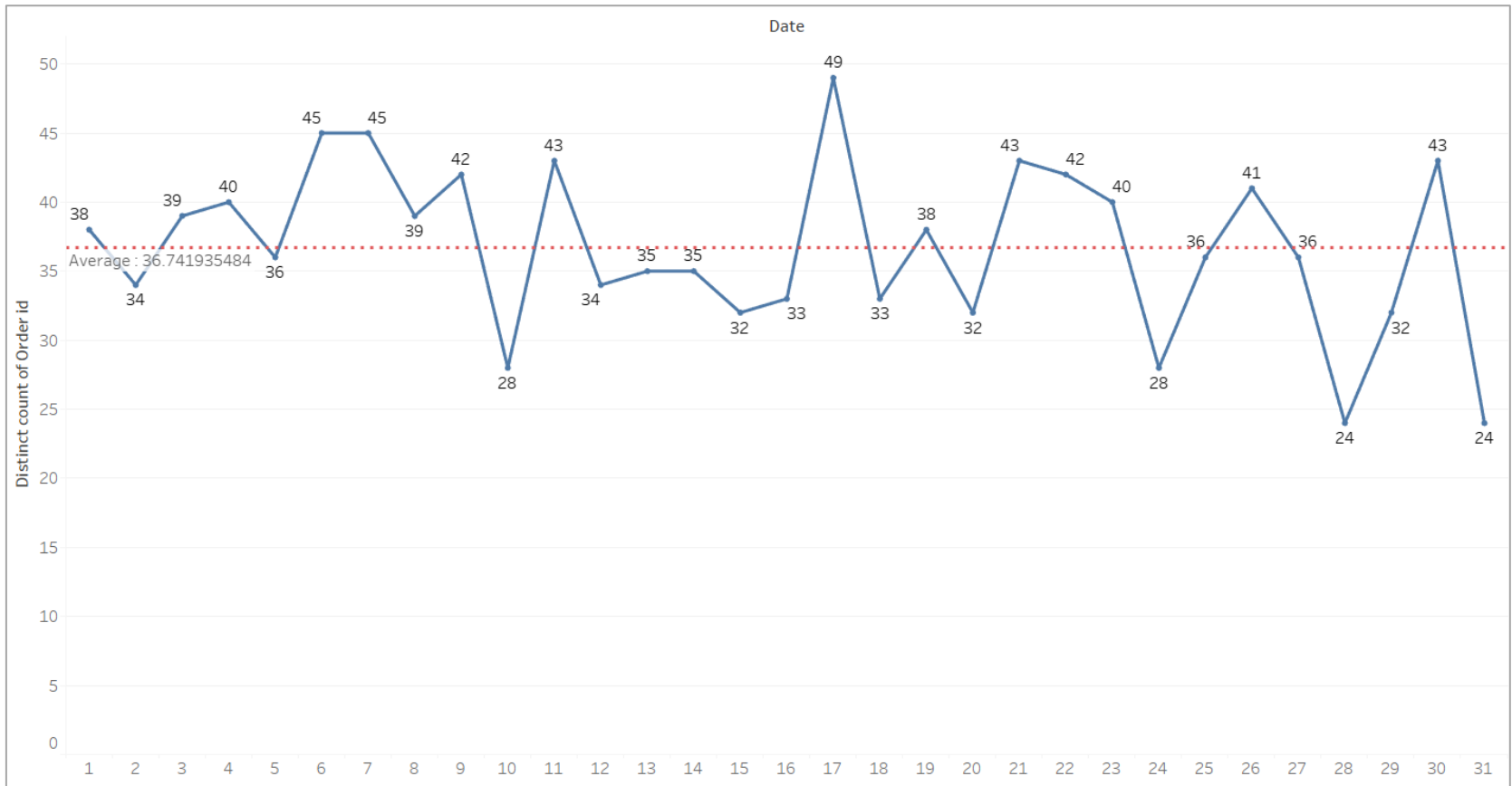
EDA : Quarterly trend of orders



Inferences:

- As discussed earlier, we can see that Quarter 1 has the maximum number of orders , followed by Quarter 2 and 3.
- We can see that the year 2018 has maximum orders in all the quarters.

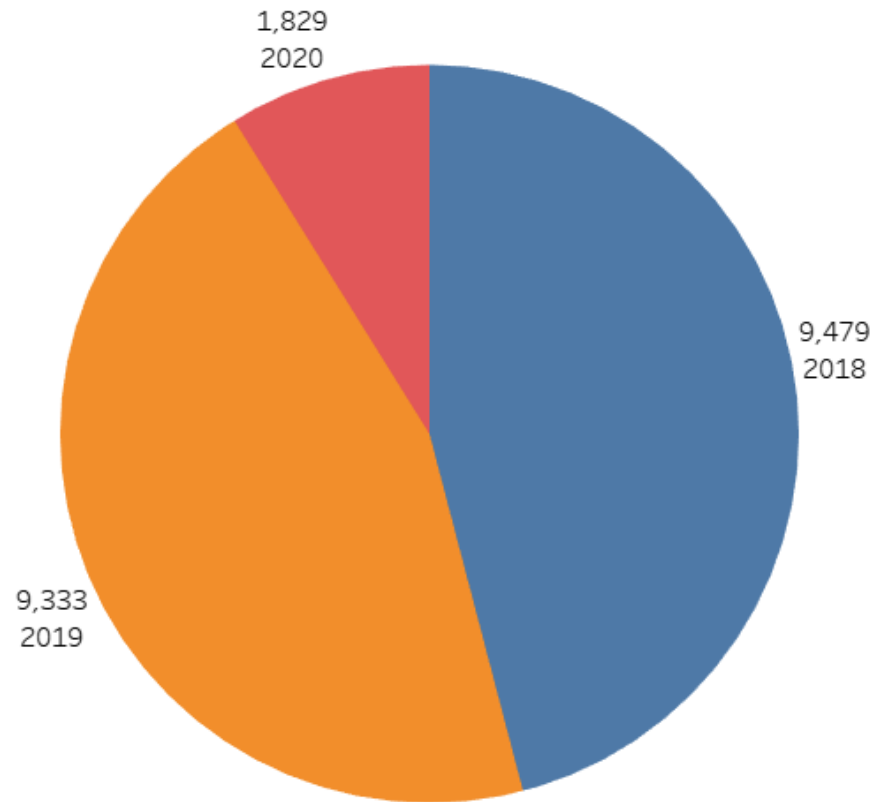
EDA : Daily trend of orders



Inferences:

- There is no visible pattern or trend on the number of orders on daily bases.
- The average number of orders per day is approximately of 36 in count, as seen in the above graph

EDA : Yearly trend of orders



Inferences:

- The year 2018 has the highest no of orders followed by 2019, Since the data in the year 2020 has only 2 months so very low count in orders.

Market Basket Analysis

- Market Basket Analysis is one of the key techniques used by large retailers to uncover associations between items. It works by looking for combinations of items that occur together frequently in transactions. To put it another way, it allows retailers to identify relationships between the items that people buy.
- Association Rules are widely used to analyze retail basket or transaction data, and are intended to identify strong rules discovered in transaction data using measures of interestingness, based on the concept of strong rules.
- Market Basket Analysis is a technique for determining the strength of link between two goods purchased together and identifying co-occurrence patterns. A co-occurrence occurs when two or more events occur at the same time. If-Then scenario rules are created by Market Basket Analysis, for example, if item A is purchased, item B is likely to be purchased. The rules are probabilistic in nature, meaning they are generated from the co-occurrence frequencies in the observations. The fraction of baskets containing the items of interest is known as frequency. Pricing methods, product placement, and different forms of cross-selling techniques can all benefit from the guidelines. Consider Market Basket Analysis in terms of shopping at a super mart to make it easier to comprehend.
- Market Basket Analysis uses transaction-level data, which identifies all of the things purchased by a customer in a single transaction. The method detects which items were purchased in conjunction with which other products (s). These connections are then utilized to create profiles with If-Then rules for the things bought. If A Then B might be stated as a rule. The antecedent of the rule (the A above) is known as the antecedent, and the consequent (the B above) is known as the consequent.
- The condition is the antecedent, and the consequence is the result. Support, Confidence, and Lift are three measurements that reflect the degree of confidence in the association rule.

Market Basket Analysis

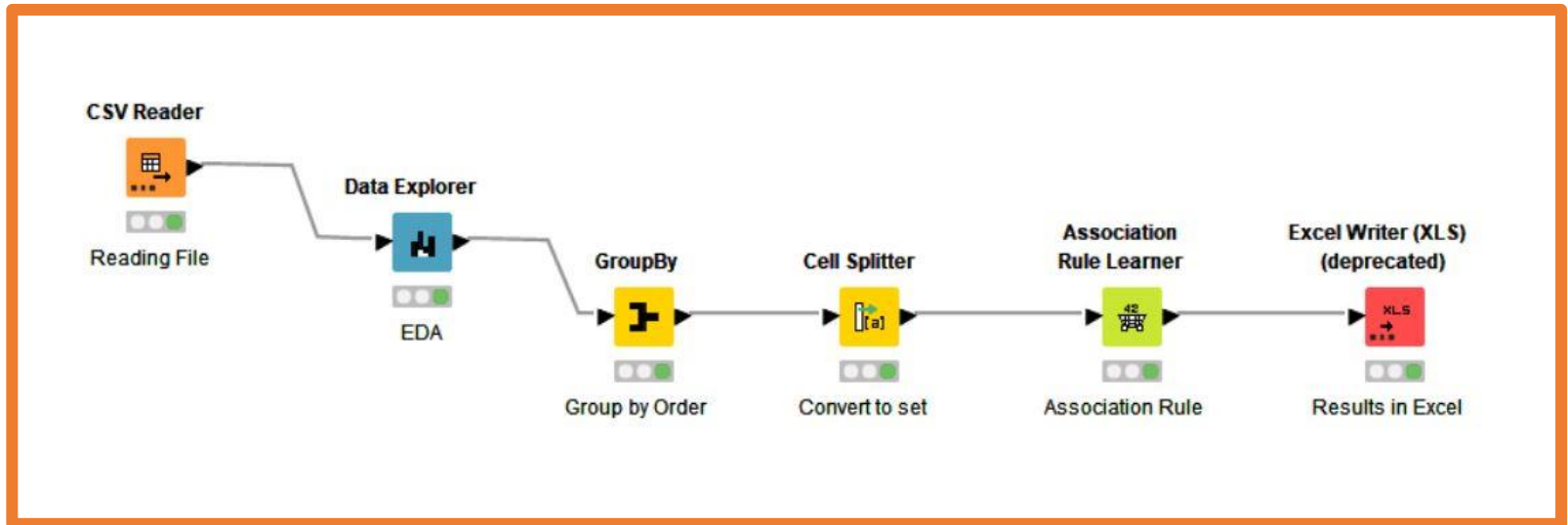
- **Support:** Its the default popularity of an item. In mathematical terms, the support of item A is nothing but the ratio of transactions involving A to the total number of transactions.
- **Confidence:** Likelihood that customer who bought both A and B. Its divides the number of transactions involving both A and B by the number of transactions involving B.
- **Lift :** Increase in the sale of A when you sell B.

$$\begin{array}{l} \text{Rule: } X \Rightarrow Y \begin{cases} \nearrow \text{Support} = \frac{frq(X,Y)}{N} \\ \rightarrow \text{Confidence} = \frac{frq(X,Y)}{frq(X)} \\ \searrow \text{Lift} = \frac{\text{Support}}{Supp(X) \times Supp(Y)} \end{cases} \end{array}$$

An example of Association Rules

- Assume there are 100 customers
- 10 of them bought milk, 8 bought butter and 6 bought both of them.
- bought milk => bought butter
- support = P(Milk & Butter) = 6/100 = 0.06
- confidence = support/P(Butter) = 0.06/0.08 = 0.75
- lift = confidence/P(Milk) = 0.75/0.10 = 7.5

Market Basket Analysis : Workflow



Sl.No	Node Name	Description
1.	Read CSV	Reading the CSV file
2.	Data Explorer	Explore and EDA of data parameters
3.	Group By	Grouping the data by Order ID and concatenating the products
4.	Cell Splitter	Converting the products into set for unique product values
5.	Association Rule Learner	Market Basket Analysis to generate the frequent/ Item list
6.	Excel Extract	Extracting the results to Excel file.

Market Basket Analysis : Data read output

Table "default" - Rows: 20641 Spec - Columns: 3 Properties			
Row ID	\$ Date	I Order_id	\$ Product
Row0	01-01-2018	1	yogurt
Row1	01-01-2018	1	pork
Row2	01-01-2018	1	sandwich bags
Row3	01-01-2018	1	lunch meat
Row4	01-01-2018	1	all- purpose
Row5	01-01-2018	1	flour
Row6	01-01-2018	1	soda
Row7	01-01-2018	1	butter
Row8	01-01-2018	1	beef
Row9	01-01-2018	1	aluminum foil
Row10	01-01-2018	1	all- purpose
Row11	01-01-2018	1	dinner rolls
Row12	01-01-2018	1	shampoo
Row13	01-01-2018	1	all- purpose
Row14	01-01-2018	1	mixes
Row15	01-01-2018	1	soap
Row16	01-01-2018	1	laundry det...
Row17	01-01-2018	1	ice cream
Row18	01-01-2018	1	dinner rolls
Row19	01-01-2018	2	toilet paper
Row20	01-01-2018	2	shampoo

- The data of Grocery store is read using csv reader.
- We can see that, the data is read correctly with 20641 observations and 3 columns.
- The data type of Date is changed in to data type for further analysis.

Market Basket Analysis : Group By output

Table "default" - Rows: 1139 Spec - Columns: 3 Properties Flow Variables			
Row ID	Order_id	First(D...	Concatenate(Product)
Row0	1	01-01-2018	yogurt, pork, sandwich bags, lunch meat, all-purpose, flour, soda, butter, beef, aluminum foil, all-purpose, dinner rolls, shampoo, all-purpose, mixes, soap, laundry detergent, ice cream, dinner rolls
Row1	2	01-01-2018	toilet paper, shampoo, hand soap, waffles, cheeses, mixes, milk, sandwich bags, laundry detergent, dishwashing liquid/detergent, waffles, individual meals, hand soap, individual meals, yogurt, cer...
Row2	3	02-01-2018	soda, pork, soap, ice cream, toilet paper, dinner rolls, hand soap, spaghetti sauce, milk, ketchup, sandwich loaves, poultry, toilet paper, ice cream, ketchup, laundry detergent, spaghetti sauce, ba...
Row3	4	02-01-2018	cereals, juice, lunch meat, soda, toilet paper, all-purpose
Row4	5	02-01-2018	sandwich loaves, pasta, tortillas, mixes, hand soap, toilet paper, paper towels, flour, pork, poultry, eggs, pork, spaghetti sauce, milk, waffles, individual meals, dinner rolls, all-purpose, soda, yogurt
Row5	6	02-01-2018	laundry detergent, toilet paper, eggs, toilet paper, bagels, dishwashing liquid/detergent, cereals, paper towels, laundry detergent, butter, cereals, bagels, paper towels, shampoo, toilet paper, soa...
Row6	7	03-01-2018	individual meals, paper towels, tortillas, milk, ice cream, juice, dishwashing liquid/detergent, soap, sandwich bags, pasta, ketchup, all-purpose, yogurt, mixes, mixes, toilet paper, beef, sandwich ba...
Row7	8	04-01-2018	ice cream, juice, paper towels, waffles, soda, cheeses, poultry, toilet paper
Row8	9	04-01-2018	juice, poultry, coffee/tea, coffee/tea, dishwashing liquid/detergent
Row9	10	05-01-2018	ketchup, coffee/tea, toilet paper, pork, flour, milk, soda, dishwashing liquid/detergent, eggs, tortillas, tortillas, fruits, sugar, soap, dishwashing liquid/detergent, juice, sandwich loaves, poultry, egg...
Row10	11	05-01-2018	sandwich loaves, ice cream, soda, bagels, dishwashing liquid/detergent, eggs, sugar, waffles, individual meals, toilet paper, pasta, sandwich loaves, cheeses, hand soap, ketchup, poultry, dinner r...
Row11	12	06-01-2018	pork, tortillas, pork, shampoo, lunch meat, pasta, juice, bagels, bagels, laundry detergent, yogurt, sugar, waffles, hand soap, hand soap, butter, juice, spaghetti sauce, flour
Row12	13	07-01-2018	sugar, fruits, all-purpose, aluminum foil, laundry detergent, individual meals, flour, pork, shampoo, sugar, aluminum foil, shampoo, soap, bagels, toilet paper, juice, ice cream, ice cream, sandwich l...
Row13	14	07-01-2018	fruits, dinner rolls, individual meals, shampoo, ketchup, cereals, sandwich bags, laundry detergent, sandwich loaves, cheeses
Row14	15	07-01-2018	individual meals, ice cream, cereals, paper towels, bagels, mixes, lunch meat, juice, toilet paper, cheeses, paper towels, paper towels, juice, aluminum foil, fruits, butter, sandwich loaves, tortillas, s...
Row15	16	08-01-2018	sugar, sandwich bags, flour, juice, milk, paper towels, cereals, sandwich bags, pasta, soda, dishwashing liquid/detergent, ice cream, soap, cheeses, beef, flour, dinner rolls
Row16	17	08-01-2018	milk, hand soap, pasta, individual meals, spaghetti sauce, cereals, sandwich loaves, hand soap, individual meals
Row17	18	08-01-2018	sandwich bags, toilet paper, bagels, shampoo, coffee/tea
Row18	19	09-01-2018	individual meals, laundry detergent, coffee/tea, eggs, aluminum foil, beef, juice, flour, sugar, individual meals, waffles, bagels, coffee/tea, spaghetti sauce, butter, beef
Row19	20	10-01-2018	shampoo, dishwashing liquid/detergent, yogurt, juice, sugar, soap, sandwich loaves, butter, sandwich loaves, coffee/tea, ketchup, aluminum foil, dishwashing liquid/detergent, mixes, laundry deter...
Row20	21	11-01-2018	waffles, fruits, all-purpose, pork, juice, bagels, mixes
Row21	22	11-01-2018	cheeses, cereals, sugar, bagels, soda
Row22	23	11-01-2018	aluminum foil, bagels, shampoo, shampoo, dishwashing liquid/detergent, cereals, cheeses, flour, lunch meat, pasta, soda, toilet paper, poultry, coffee/tea, flour, all-purpose, waffles, coffee/tea, ...
Row23	24	11-01-2018	fruits, all-purpose, pasta, cheeses, juice, sandwich bags, sandwich loaves, coffee/tea, juice, lunch meat, spaghetti sauce, paper towels, hand soap, soap, ice cream, individual meals, ketchup, but...
Row24	25	11-01-2018	bagels, sugar, pork, sandwich loaves, tortillas, ice cream, all-purpose, yogurt, fruits, pasta, lunch meat, dishwashing liquid/detergent, juice
Row25	26	12-01-2018	fruits, sandwich loaves, coffee/tea, aluminum foil, shampoo, cereals, dinner rolls, coffee/tea, poultry, butter, juice, paper towels, beef, mixes, lunch meat, bagels, tortillas, aluminum foil, individual ...
Row26	27	13-01-2018	laundry detergent, pork, pasta, cheeses, fruits, sugar, lunch meat, laundry detergent, paper towels, butter, sandwich loaves, ice cream, waffles, all-purpose, sandwich bags, lunch meat, sandwic...
Row27	28	13-01-2018	pork, bagels, poultry, pasta, butter, all-purpose, pasta, shampoo, sugar, ketchup, eggs, soda, tortillas, soap, individual meals, ketchup, butter, mixes, juice, lunch meat, cereals, waffles, shampoo...
Row28	29	13-01-2018	pasta, butter, sandwich loaves, spaghetti sauce, juice, dinner rolls, all-purpose, pork, yogurt, spaghetti sauce
Row29	30	14-01-2018	flour, bagels, cheeses, sandwich loaves, toilet paper

- Above are the output table after group by of first 30 observations.
- The data is group by the unique order ID and concatenating all the products.
- After grouping the data, the number of observations are 1139, which implies there are 1139 unique order ID's.

Market Basket Analysis : Cell Splitter output

Table "default" - Rows: 1139 Spec - Columns: 4 Properties Flow Variables				
Row ID	Order_id	First(Date)	Concatenate(Product)	Concatenate(Product)_SplitResultList
Row0	1	01-01-2018	yogurt, pork, sandwich bags, lunch meat, all- purpose, flour, soda, butter, beef, aluminu...	[yogurt,pork,sandwich bags,...]
Row1	2	01-01-2018	toilet paper, shampoo, hand soap, waffles, cheeses, mixes, milk, sandwich bags, laundry...	[toilet paper,shampoo,hand soap,...]
Row2	3	02-01-2018	soda, pork, soap, ice cream, toilet paper, dinner rolls, hand soap, spaghetti sauce, milk, ...	[soda,pork,soap,...]
Row3	4	02-01-2018	cereals, juice, lunch meat, soda, toilet paper, all- purpose	[cereals,juice,lunch meat,...]
Row4	5	02-01-2018	sandwich loaves, pasta, tortillas, mixes, hand soap, toilet paper, paper towels, flour, por...	[sandwich loaves,pasta,tortillas,...]
Row5	6	02-01-2018	laundry detergent, toilet paper, eggs, toilet paper, bagels, dishwashing liquid/detergent,...	[laundry detergent,toilet paper,eggs,...]
Row6	7	03-01-2018	individual meals, paper towels, tortillas, milk, ice cream, juice, dishwashing liquid/deterge...	[individual meals,paper towels,tortillas,...]
Row7	8	04-01-2018	ice cream, juice, paper towels, waffles, soda, cheeses, poultry, toilet paper	[ice cream,juice,paper towels,...]
Row8	9	04-01-2018	juice, poultry, coffee/tea, coffee/tea, dishwashing liquid/detergent	[juice,poultry,coffee/tea,...]
Row9	10	05-01-2018	ketchup, coffee/tea, toilet paper, pork, flour, milk, soda, dishwashing liquid/detergent, e...	[ketchup,coffee/tea,toilet paper,...]
Row10	11	05-01-2018	sandwich loaves, ice cream, soda, bagels, dishwashing liquid/detergent, eggs, sugar, wa...	[sandwich loaves,ice cream,soda,...]
Row11	12	06-01-2018	pork, tortillas, pork, shampoo, lunch meat, pasta, juice, bagels, bagels, laundry deterge...	[pork,tortillas,pork,...]
Row12	13	07-01-2018	sugar, fruits, all- purpose, aluminum foil, laundry detergent, individual meals, flour, pork,...	[sugar,fruits,all- purpose,...]
Row13	14	07-01-2018	fruits, dinner rolls, individual meals, shampoo, ketchup, cereals, sandwich bags, laundry ...	[fruits,dinner rolls,individual meals,...]
Row14	15	07-01-2018	individual meals, ice cream, cereals, paper towels, bagels, mixes, lunch meat, juice, toilet...	[individual meals,ice cream,cereals,...]
Row15	16	08-01-2018	sugar, sandwich bags, flour, juice, milk, paper towels, cereals, sandwich bags, pasta, so...	[sugar,sandwich bags,flour,...]
Row16	17	08-01-2018	milk, hand soap, pasta, individual meals, spaghetti sauce, cereals, sandwich loaves, han...	[milk,hand soap,pasta,...]
Row17	18	08-01-2018	sandwich bags, toilet paper, bagels, shampoo, coffee/tea	[sandwich bags,toilet paper,bagels,...]
Row18	19	09-01-2018	individual meals, laundry detergent, coffee/tea, eggs, aluminum foil, beef, juice, flour, s...	[individual meals,laundry detergent,coffee/tea,...]
Row19	20	10-01-2018	shampoo, dishwashing liquid/detergent, yogurt, juice, sugar, soap, sandwich loaves, but...	[shampoo,dishwashing liquid/detergent,yogurt,...]
Row20	21	11-01-2018	waffles, fruits, all- purpose, pork, juice, bagels, mixes	[waffles,fruits,all- purpose,...]
Row21	22	11-01-2018	cheeses, cereals, sugar, bagels, soda	[cheeses,cereals,sugar,...]
Row22	23	11-01-2018	aluminum foil, bagels, shampoo, shampoo, dishwashing liquid/detergent, cereals, cheese...	[aluminum foil,bagels,shampoo,...]
Row23	24	11-01-2018	fruits, all- purpose, pasta, cheeses, juice, sandwich bags, sandwich loaves, coffee/tea, j...	[fruits,all- purpose,pasta,...]
Row24	25	11-01-2018	bagels, sugar, pork, sandwich loaves, tortillas, ice cream, all- purpose, yogurt, fruits, pa...	[bagels,sugar,pork,...]
Row25	26	12-01-2018	fruits, sandwich loaves, coffee/tea, aluminum foil, shampoo, cereals, dinner rolls, coffee/...	[fruits,sandwich loaves,coffee/tea,...]
Row26	27	13-01-2018	laundry detergent, pork, pasta, cheeses, fruits, sugar, lunch meat, laundry detergent, p...	[laundry detergent,pork,pasta,...]
Row27	28	13-01-2018	pork, bagels, poultry, pasta, butter, all- purpose, pasta, shampoo, sugar, ketchup, eggs...	[pork,bagels,poultry,...]
Row28	29	13-01-2018	pasta, butter, sandwich loaves, spaghetti sauce, juice, dinner rolls, all- purpose, pork, y...	[pasta,butter,sandwich loaves,...]
Row29	30	14-01-2018	flour, bagels, cheeses, sandwich loaves, toilet paper	[flour,bagels,cheeses,...]
Row30	31	15-01-2018	aluminum foil, eggs, ice cream, pasta, juice, waffles, shampoo, dinner rolls, soda, laundr...	[aluminum foil,eggs,ice cream,...]

- Cell splitter is used to get the unique set products of each of order ID.
- Basically removes the duplicate products in each row of order ID.

Market Basket Analysis : Association Rule

Association rules are actionable in that they can be used to target customers for marketing, or for product placing, or more generally to inform decision making. Examples of areas in which association rules have been used include: Supermarket purchases: common combinations of products can be used to inform product placement on supermarket shelves.

The screenshot shows a software window titled "File" with three tabs: "Options", "Flow Variables", and "Memory Policy". The "Options" tab is active and contains three sections:

- Itemset Mining**:
 - Column containing transactions: A dropdown menu showing "Concatenate(Product)_SplitResultList".
 - Minimum support (0-1): A numeric input field set to "0.03".
 - Underlying data structure: A dropdown menu set to "ARRAY".
- Output**:
 - Itemset type: A dropdown menu set to "CLOSED".
 - Maximal itemset length: A numeric input field set to "10".
- Association Rules**:
 - ☒ Output association rules
 - Minimum confidence: A numeric input field set to "0.5".

At the bottom of the window are four buttons: "OK", "Apply", "Cancel", and a help icon (a question mark inside a circle).

- This is the most important node for our Market Basket Analysis.
- There are three metrics for Association rule which are Support, Confidence and Lift.
- The Support value is from 0-1, where 0 is 0% and 1 is 100%
- After many trial and error, the support value is considered to be 0.03.
- The confidence interval is the percentage at which the recommended project is most likely to get picked.
- In our case the confidence of association of product is of 50%.
- The Lift is the value at which the product gets purchased. Higher the lift more likely the product gets purchased.
- As seen in the configuration table the threshold values are set according which gives mostly good combos and recommended products are kind off related.

Association rule output from KNIME

Table "default" - Rows: 50743 Spec - Columns: 6 Properties Flow Variables						
Row ID	D Support	D Confide...	D ▼ Lift	S Conseq...	S implies	[...] Items
rule2790	0.031	0.795	2.194	paper towels	<---	[eggs,ice cream,pasta,...]
rule6038	0.032	0.783	2.158	paper towels	<---	[eggs,ice cream,pasta,...]
rule2791	0.031	0.729	2.066	flour	<---	[dishwashing liquid/detergent,cheeses,waffles,...]
rule9828	0.032	0.74	2.041	paper towels	<---	[eggs,dinner rolls,ice cream,...]
rule6043	0.032	0.72	1.986	paper towels	<---	[eggs,poultry,ice cream,...]
rule2787	0.031	0.778	1.951	ice cream	<---	[paper towels,eggs,pasta,...]
rule2792	0.031	0.761	1.947	soda	<---	[dishwashing liquid/detergent,cheeses,flour,...]
rule14095	0.033	0.717	1.931	pasta	<---	[paper towels,dishwashing liquid/detergent,egg...
rule42417	0.04	0.697	1.922	paper towels	<---	[all- purpose,individual meals,toilet paper]
rule2803	0.031	0.714	1.914	spaghetti sa...	<---	[dinner rolls,poultry,laundry detergent,...]
rule14094	0.033	0.745	1.911	eggs	<---	[paper towels,dishwashing liquid/detergent,ice ...]
rule14096	0.033	0.691	1.905	paper towels	<---	[dishwashing liquid/detergent,eggs,ice cream,...]
rule6042	0.032	0.706	1.901	pasta	<---	[paper towels,eggs,poultry,...]
rule6041	0.032	0.72	1.847	eggs	<---	[paper towels,poultry,ice cream,...]
rule9827	0.032	0.685	1.845	pasta	<---	[paper towels,eggs,dinner rolls,...]
rule24706	0.036	0.641	1.833	sandwich lo...	<---	[all- purpose,flour,individual meals]
rule9826	0.032	0.712	1.825	eggs	<---	[paper towels,dinner rolls,ice cream,...]
rule42521	0.04	0.676	1.822	pasta	<---	[hand soap,soda,aluminum foil]
rule42709	0.04	0.676	1.822	ketchup	<---	[butter,aluminum foil,soap]
rule33318	0.038	0.632	1.81	sandwich lo...	<---	[paper towels,flour,individual meals]

- The output of first 20 observations which are sorted based on descending order of lift, whose minimum support value is 0.03 and minimum confidence threshold is 0.5.
- From the first observation, we can say that at 0.03% support and confidence of 79.5% people purchasing paper towels are most likely to buy eggs, ice cream and pasta along which comes under recommended products list.

Insights and Recommendations

- From above association table we see that Consequent column contains recommended products and we have sorted the lift values from higher to lower for the better recommendations/combos.
- In general the products with higher lift is recommended as it as high probability of purchase.
- In our case the following are the best 5 combs of products through the threshold set on our Market Basket Analysis:

1. Paper towels	←	[eggs, dinner rolls, ice cream, pasta, lunch meat]
2. Flour	←	[dishwashing liquid/detergent, cheeses, waffles, soda]
3. Ice Cream	←	[paper towels, eggs, pasta, lunch meat]
4. Soda	←	[dishwashing liquid/detergent, cheeses, flour, waffles]
5. Pasta	←	[paper towels, dishwashing liquid/detergent, eggs, ice cream]

Retailers can use the insights gained from MBA in a number of ways, including:

1. **Cross Sell:** Group products that customers purchase frequently together in the store's product placement
2. **Webstores:** Recommend associated products that are frequently bought together. "Customers who purchased this product also viewed this product..."
3. **Marketing Promotions:** Target marketing campaigns to customers and entice them to purchase related products for items they purchased recently

Combos and Offers

Why should you offer Combo Offers?

Combo offers is one of the most alluring modes of offering benefits to your customers and make them feel more wanted on the platform.

1. Makes the Customer Loyal

There is indeed no denying that a customer who feels special and is given the impression that he is important for the platform, will be able to connect more efficiently and fondly with the platform. Combo offers are the additional form of discount that can be offered to customers and make them more loyal to your Website.

2. Gives More Visibility to Customers

Combo offers are the best way to keep the website offerings moving and visible to the customers. The net result of a combo offer being proposed to the customer is that products which did not have as much visibility earlier will now be brought to the notice of the customer.

3. Move Dead Stock

It is obvious that some of the products on the website, do not gain as much visibility as others. This could be due to lack of utility or ignorance of the brand of the product. However, since it is your Website, you must keep the stocks running. Too much piling stocks can lead to disruption of normal business operations. The best way to ensure this is to offer combo offers tempting prices to the customers.

4. Boost Sales

The tempting prices that you offer on a combo offer will give the result of increased sales of multiple products at once. Tapping a customer for infrequent products can be tough but can be easily achieved with combo offers.

Combos and Offers

Recommendations for types of combos offers:

1. **Buy X Get Y products Free:** It means the customer will get Y number of products free on buying X number products but in cart, there should be X+Y products. Customer will get only Y lowest price products as free.
2. **Buy X number of products & Get a freebie :** It means a customer will get a freebie product that will get automatically added to the cart on buying X number of products.
3. **Buy Product worth Rs X & Get a freebie :** It means a customer will get a freebie product if their order total becomes equal or greater than Rs. X.

These offers at a different level as per your requirement:

- **Store Level**

At this level, the combo offer will apply all over the store.

- **Category Level**

At this level combo offer will apply only to the selected categories, an offer will not apply to un-selected categories.

- **Product Level**

At this level offer will apply only to products that will be added by merchant itself. The rule's priority can be decided by the owner for the offers accordingly, offers will apply as per the rule priority.

Reference Links:

1- EDA Data visualisation:

https://public.tableau.com/app/profile/pooja.kabadi8245/viz/Milestone_2_16533851397940/CountofOrdersofProducts?publish=yes

2 - Reference link for combos and offers: <https://360.shiprocket.in/blog/complete-guide-on-benefits-of-combo-offers/>

3 - Python file: Attached along with presentation pdf

4 - KNIME : Attached along with presentation pdf

Thank you