

MRA Project – Milestone 2

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Project Description

- ▶ The project involves conducting a thorough analysis of Point of Sale (POS) Data for providing recommendations through which a grocery store can increase its revenue by popular combo offers & discounts for customers.

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 items in the customer orders. The Store doesn't have any combo offers. Can you suggest the best combos & offers?

Exploratory Data Analysis(EDA)

- ▶ Let's first look at the head and tail of the dataset:

Head

	Date	Order_id	Product
0	2018-01-01	1	yogurt
1	2018-01-01	1	pork
2	2018-01-01	1	sandwich bags
3	2018-01-01	1	lunch meat
4	2018-01-01	1	all- purpose

Tail

	Date	Order_id	Product
20636	2020-02-25	1138	soda
20637	2020-02-25	1138	paper towels
20638	2020-02-26	1139	soda
20639	2020-02-26	1139	laundry detergent
20640	2020-02-26	1139	shampoo

Basic information about the dataset

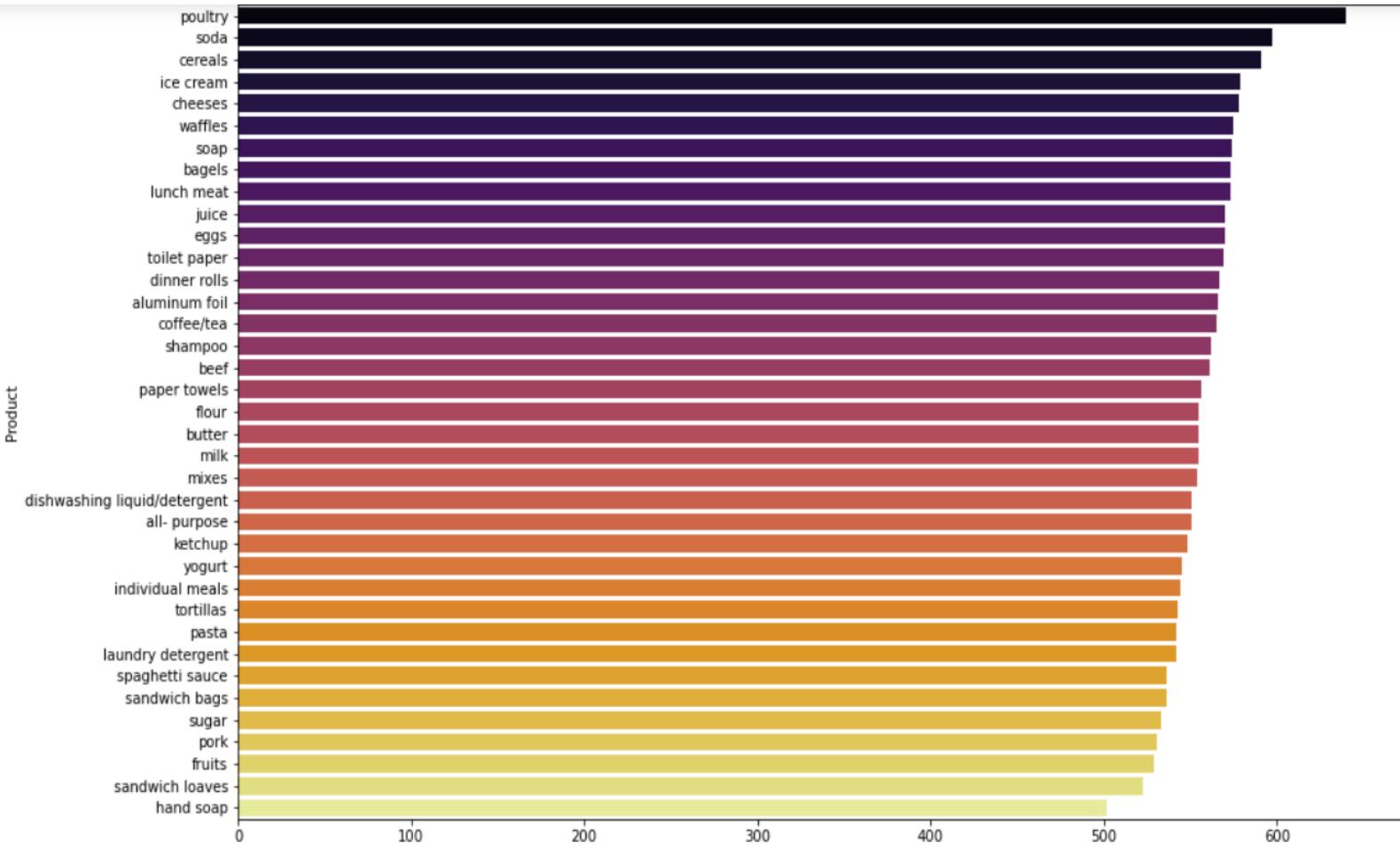
- ▶ Shape of the dataset: (20641, 3)
- ▶ Number of Rows: 20641
- ▶ Number of Columns: 3
- ▶ Distinct Columns: Date, Order_id, Product
- ▶ Data Types: Date(object), Order_id(int64), Product(object)
- ▶ Five point Summary/Describe:

```
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)
```

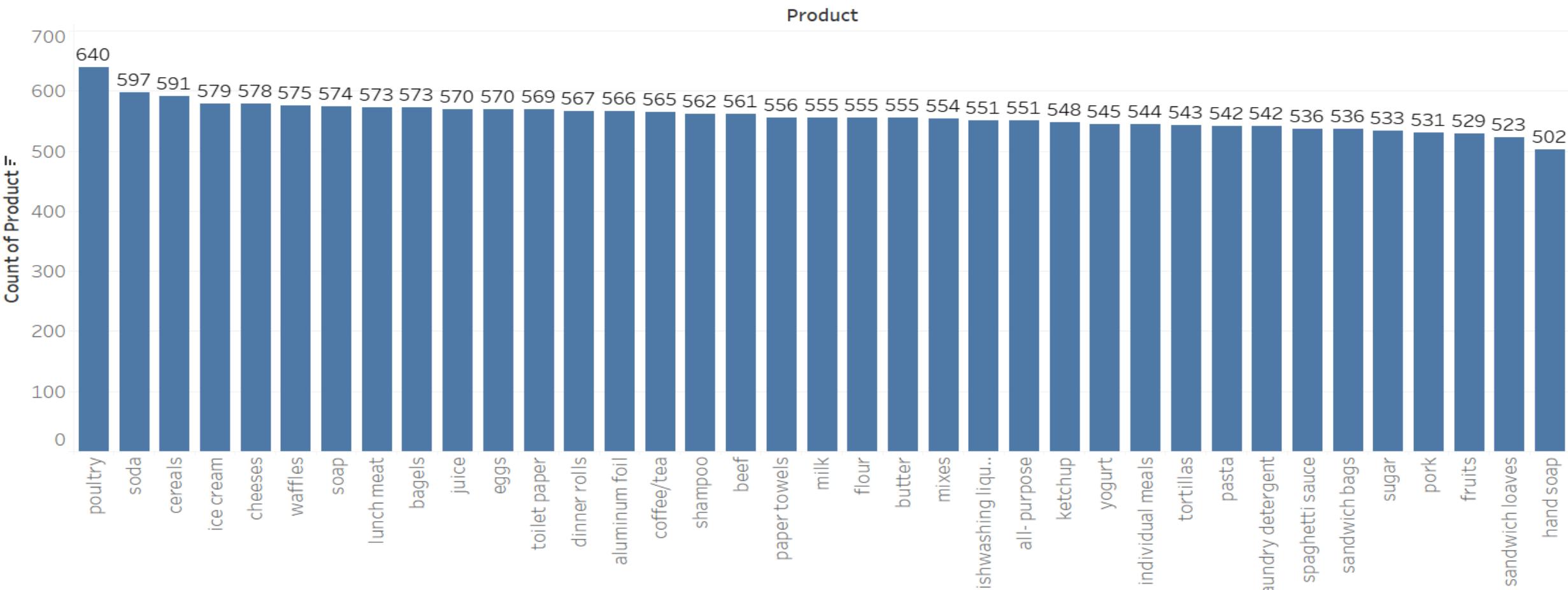
	count	mean	std	min	25%	50%	75%	max
Order_id	20641.0	575.986289	328.557078	1.0	292.0	581.0	862.0	1139.0

Count of different Products

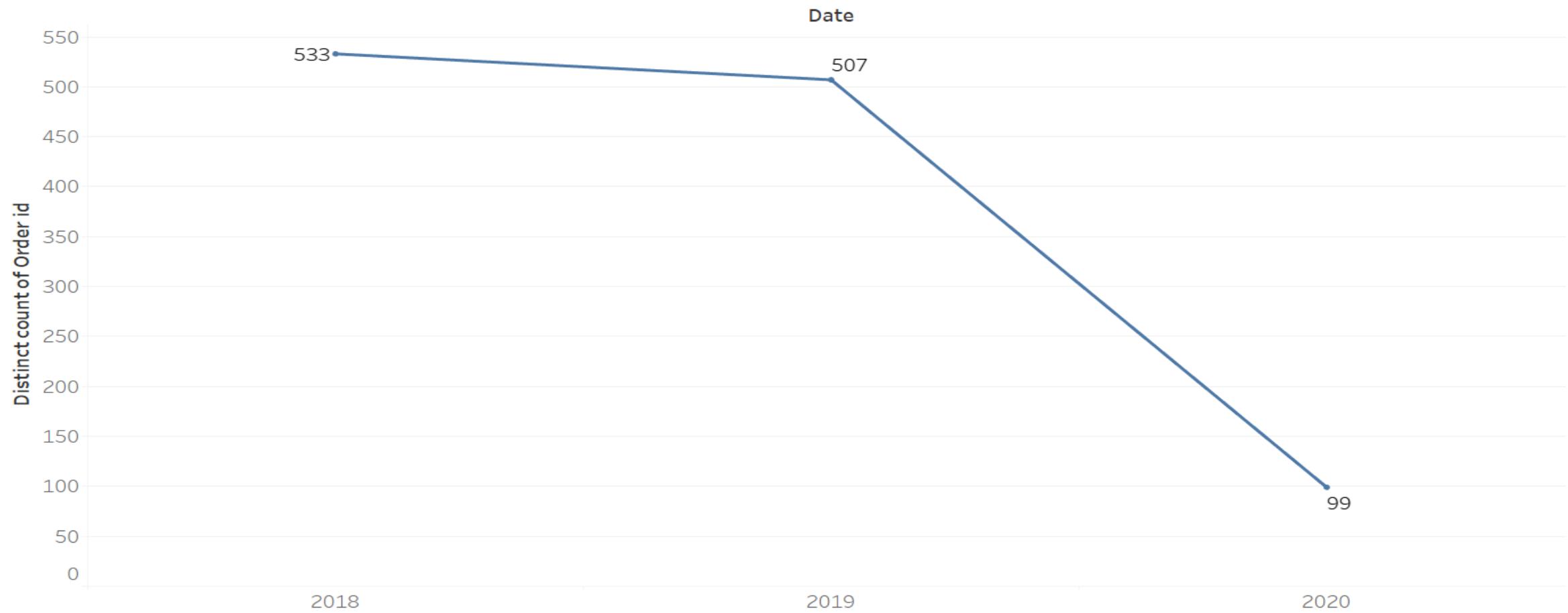
poultry	640
soda	597
cereals	591
ice cream	579
cheeses	578
waffles	575
soap	574
bagels	573
lunch meat	573
juice	570
eggs	570
toilet paper	569
dinner rolls	567
aluminum foil	566
coffee/tea	565
shampoo	562
beef	561
paper towels	556
flour	555
butter	555
milk	555
mixes	554
dishwashing liquid/detergent	551
all- purpose	551
ketchup	548
yogurt	545
individual meals	544
tortillas	543
pasta	542
laundry detergent	542
spaghetti sauce	536
sandwich bags	536
sugar	533
pork	531
fruits	529
sandwich loaves	523
hand soap	502



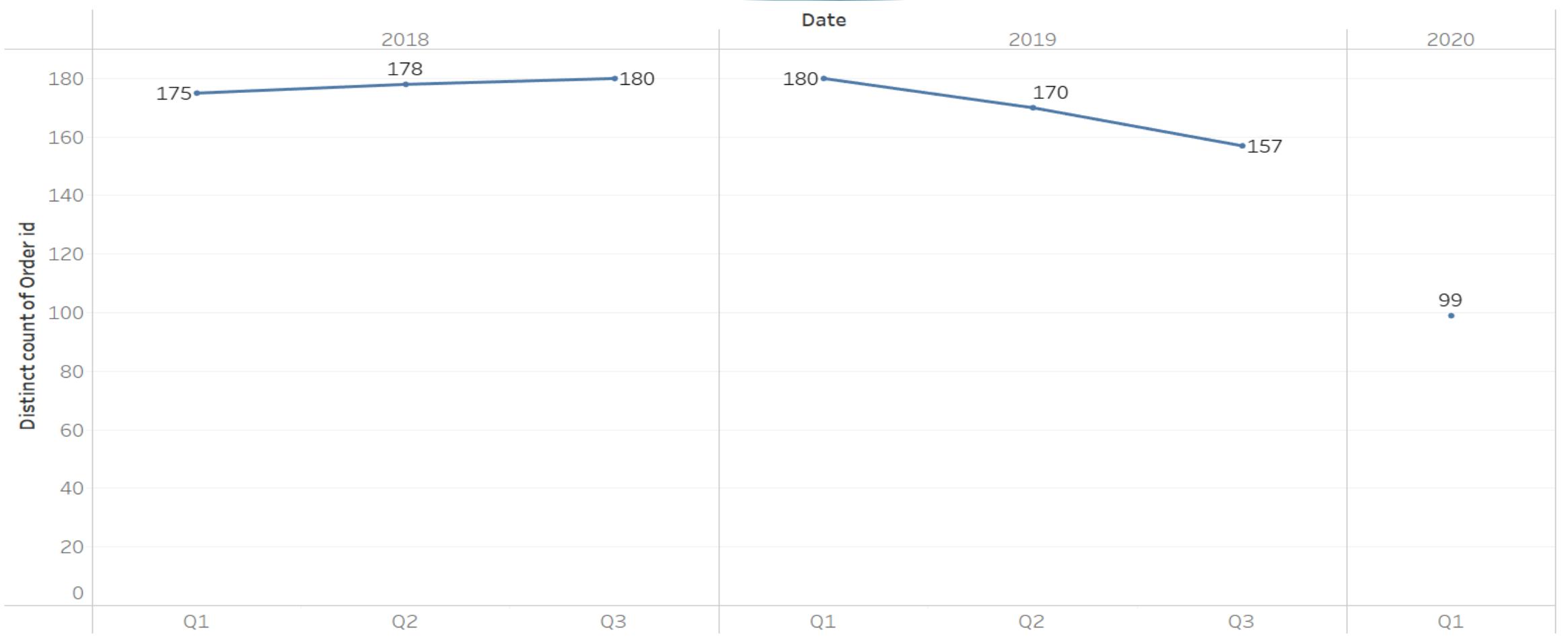
Visualizing the count:



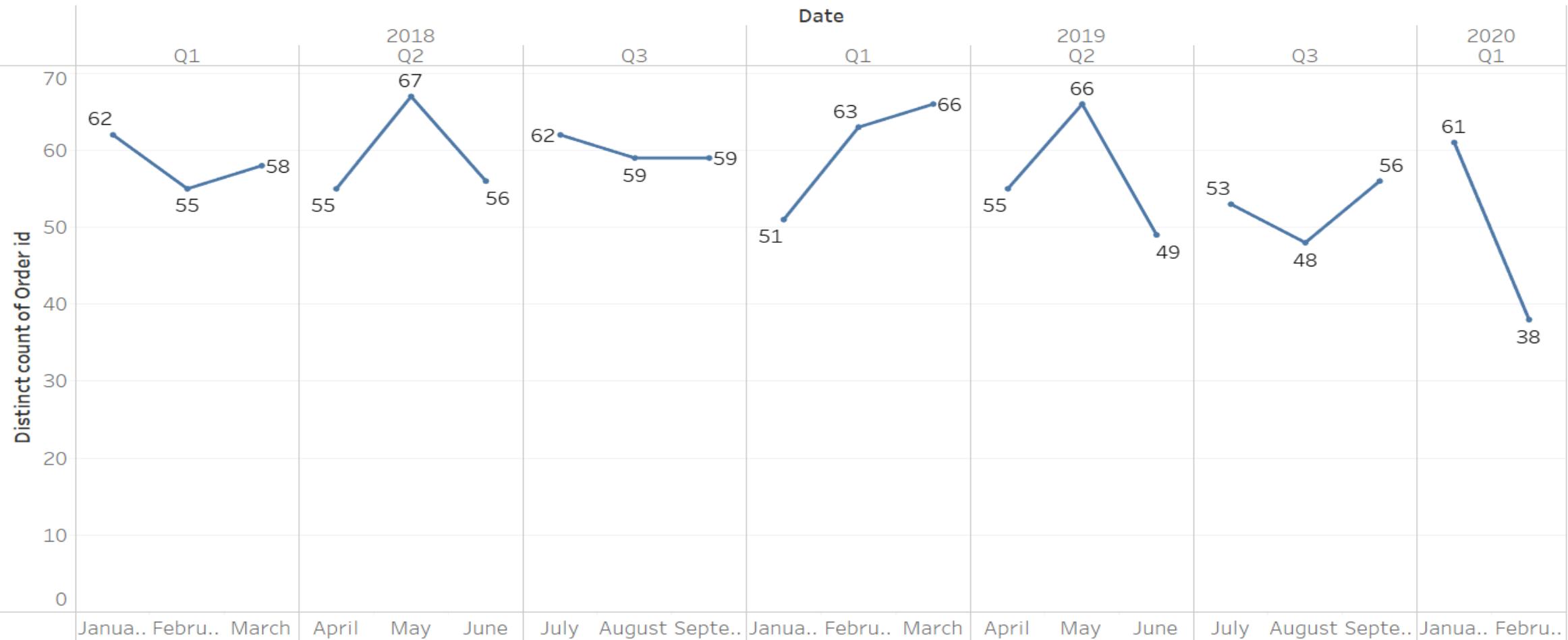
Yearly Trends based on Number of Orders



Quarterly Trends based on Number of Orders

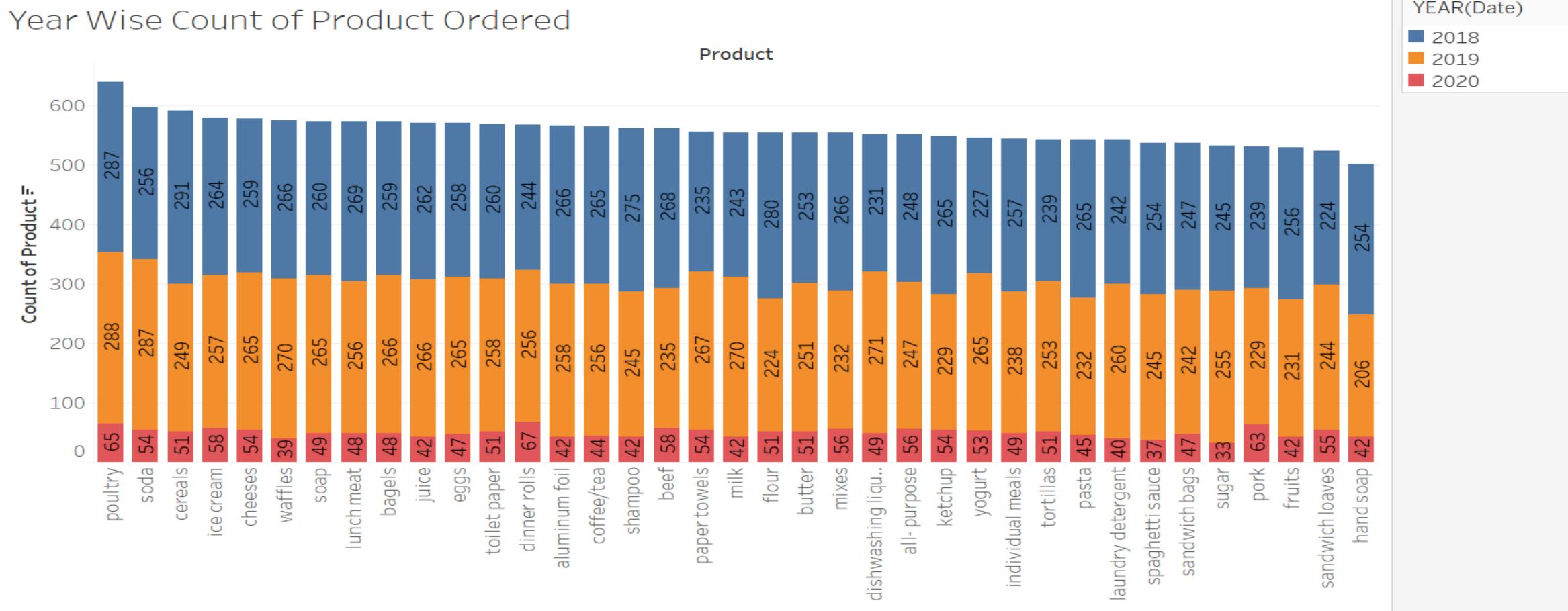


Monthly Trends based on Number of Orders



Visualizing Year Wise Count of Ordered Product

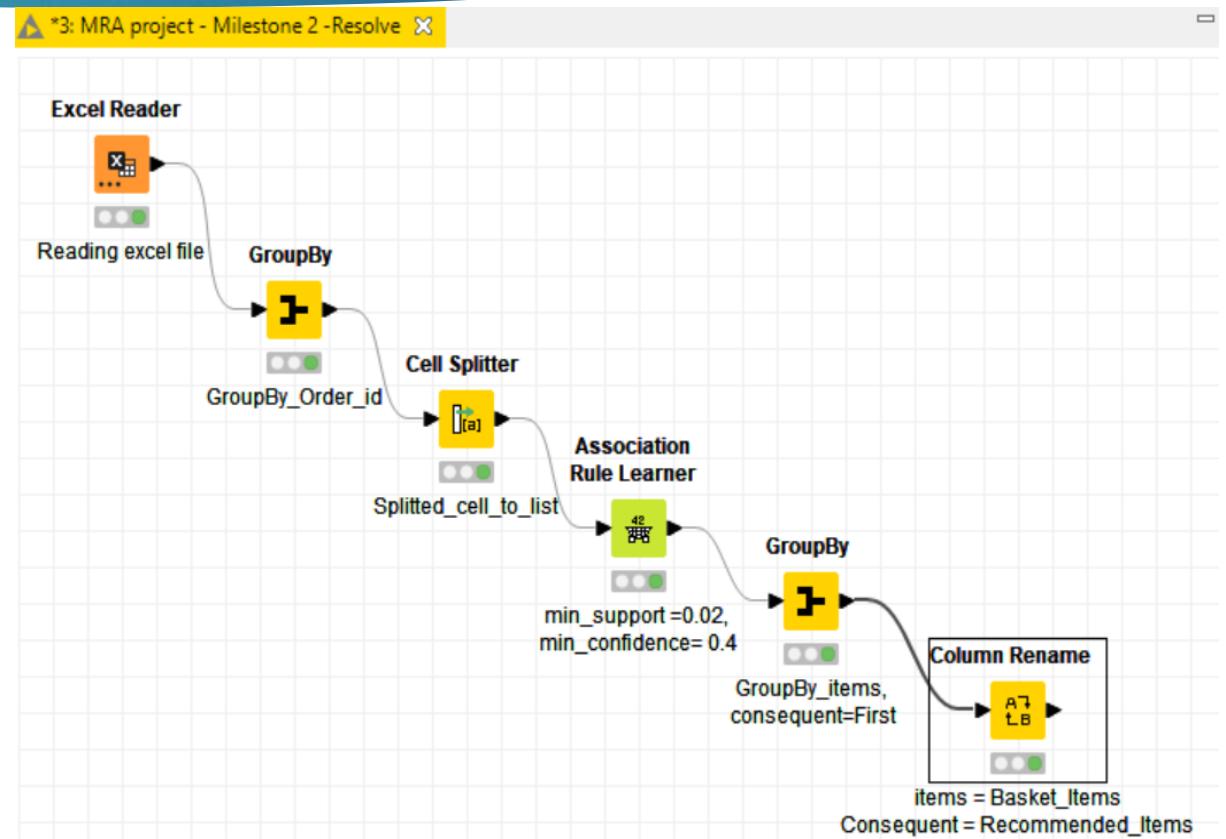
Year Wise Count of Product Ordered



KNIME Workflow Image:

Steps:

- 1) Reading the dataset using *Excel Reader*.
- 2) Applying *Group by* on 'Order_id'.
- 3) Splitting the cell to list using *Cell Splitter* node.
- 4) Applying the Association Rules using *Association Rule Learner*.
- 5) Again applying the *Group by* on Products(Items).
- 6) Renaming the item column to *Basket_Items*, and Consequent to *Recommended_items*.



Sample Image of Original dataset (after reading excel in KNIME)

- ▶ Displaying the sample image after reading the original dataset from the excel using Excel Reader.
- ▶ Here we have columns : Date, Order_id, and Product.
- ▶ Total Rows: 20641
- ▶ Total Columns: 3
- ▶ In the next step, we will apply group by on 'Order_id' and will do the concatenation on 'Product'.

Table "default" - Rows: 20641				Spec - Columns: 3	Properties	Flow Variables
Row ID	Date	Order_id	Product			
Row0	2018-01-01	1	yogurt			
Row1	2018-01-01	1	pork			
Row2	2018-01-01	1	sandwich bags			
Row3	2018-01-01	1	lunch meat			
Row4	2018-01-01	1	all- purpose			
Row5	2018-01-01	1	flour			
Row6	2018-01-01	1	soda			
Row7	2018-01-01	1	butter			
Row8	2018-01-01	1	beef			
Row9	2018-01-01	1	aluminum foil			
Row10	2018-01-01	1	all- purpose			
Row11	2018-01-01	1	dinner rolls			
Row12	2018-01-01	1	shampoo			
Row13	2018-01-01	1	all- purpose			
Row14	2018-01-01	1	mixes			
Row15	2018-01-01	1	soap			
Row16	2018-01-01	1	laundry det...			
Row17	2018-01-01	1	ice cream			
Row18	2018-01-01	1	dinner rolls			
Row19	2018-01-01	2	toilet paper			
Row20	2018-01-01	2	shampoo			
Row21	2018-01-01	2	hand soap			
Row22	2018-01-01	2	waffles			
Row23	2018-01-01	2	cheeses			
Row24	2018-01-01	2	mixes			
Row25	2018-01-01	2	milk			
Row26	2018-01-01	2	sandwich bags			
Row27	2018-01-01	2	laundry det...			
Row28	2018-01-01	2	dishwashing...			
Row29	2018-01-01	2	waffles			
Row30	2018-01-01	2	individual m...			
Row31	2018-01-01	2	hand soap			
Row32	2018-01-01	2	individual m...			
Row33	2018-01-01	2	yogurt			
Row34	2018-01-01	2	cereals			
Row35	2018-01-01	2	shampoo			
Row36	2018-01-01	2	aluminum foil			

Sample image after applying the Group_by on 'Order_id' (KNIME)

Table "default" - Rows: 1139		
	I Order_id	S Product
Row0	1	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	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	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	cereals, juice, lunch meat, soda, toilet paper, all-purpose
Row4	5	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	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	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	ice cream, juice, paper towels, waffles, soda, cheeses, poultry, toilet paper
Row8	9	juice, poultry, coffee/tea, coffee/tea, dishwashing liquid/detergent
Row9	10	ketchup, coffee/tea, toilet paper, pork, flour, milk, soda, dishwashing liquid/detergent, eggs, tortillas, fruits, sugar, soap, dishwashing liquid/detergent, juice, sandwich loaves, poultry, egg...
Row10	11	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	pork, tortillas, pork, shampoo, lunch meat, pasta, juice, bagels, laundry detergent, yogurt, sugar, waffles, hand soap, hand soap, butter, juice, spaghetti sauce, flour
Row12	13	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	fruits, dinner rolls, individual meals, shampoo, ketchup, cereals, sandwich bags, laundry detergent, sandwich loaves, cheeses
Row14	15	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	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	milk, hand soap, pasta, individual meals, spaghetti sauce, cereals, sandwich loaves, hand soap, individual meals
Row17	18	sandwich bags, toilet paper, bagels, shampoo, coffee/tea
Row18	19	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	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	waffles, fruits, all-purpose, pork, juice, bagels, mixes
Row21	22	cheeses, cereals, sugar, bagels, soda
Row22	23	aluminum foil, bagels, shampoo, dishwashing liquid/detergent, cereals, cheeses, flour, lunch meat, pasta, soda, toilet paper, poultry, coffee/tea, flour, all-purpose, waffles, coffee/tea, ...
Row23	24	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	bagels, sugar, pork, sandwich loaves, tortillas, ice cream, all-purpose, yogurt, fruits, pasta, lunch meat, dishwashing liquid/detergent, juice
Row25	26	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	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	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	pasta, butter, sandwich loaves, spaghetti sauce, juice, dinner rolls, all-purpose, pork, yogurt, spaghetti sauce
Row29	30	flour, bagels, cheeses, sandwich loaves, toilet paper
Row30	31	aluminum foil, eggs, ice cream, pasta, juice, waffles, shampoo, dinner rolls, soda, laundry detergent, hand soap, waffles, cereals, toilet paper, individual meals, yogurt, spaghetti sauce, ice cream, ...
Row31	32	soap, paper towels, individual meals, dinner rolls, lunch meat, sugar, soap, eggs, beef, yogurt, soda, sandwich loaves, aluminum foil, dinner rolls, soap, cheeses, sandwich loaves, ice cream, ketchup
Row32	33	sandwich loaves, pork, sandwich bags, ketchup, coffee/tea, soda, poultry, pasta, all-purpose, coffee/tea, paper towels, individual meals, poultry, flour, aluminum foil, soap, yogurt, mixes, soda
Row33	34	lunch meat, mixes, soap, hand soap, tortillas, coffee/tea, cheeses, tortillas, cheeses, ice cream, tortillas, beef, yogurt, spaghetti sauce, soda, eggs
Row34	35	aluminum foil, cheeses, cereals, mixes, laundry detergent, juice, pork, bagels, sandwich loaves, yogurt, milk, sandwich loaves, spaghetti sauce, cereals, individual meals, eggs
Row35	36	soap, lunch meat, flour, juice, yogurt, shampoo, spaghetti sauce, ketchup, laundry detergent, dinner rolls, ketchup, shampoo, sugar, flour, sandwich bags, paper towels, pork, butter, dinner rolls, ...

Sample Image after applying Cell Splitter

Row ID	I Order_id	S Product	[...] Product_SplitResultList
Row0	1	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, dishwashing liquid/detergent, waffles, individual meals, hand soap, individual...	[yogurt,pork,sandwich bags,...]
Row1	2	toilet paper, shampoo, hand soap, waffles, cheeses, mixes, milk, sandwich bags, laundry detergent, dishwashing liquid/detergent, waffles, individual meals, hand soap, individual...	[toilet paper,shampoo,hand s...
Row2	3	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, dishwashing liquid/detergent,...	[soda,pork,soap,...]
Row3	4	cereals, juice, lunch meat, soda, toilet paper , all- purpose	[cereals,juice,lunch meat,...]
Row4	5	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-...	[sandwich loaves,pasta,tortill...
Row5	6	laundry detergent, toilet paper, eggs, toilet paper, bagels, dishwashing liquid/detergent, cereals, paper towels, laundry detergent, butter, cereals, bagels, paper towels, sha...	[laundry detergent,toilet pap...
Row6	7	individual meals, paper towels, tortillas, milk, ice cream, juice, dishwashing liquid/detergent, soap, sandwich bags, pasta, ketchup, all- purpose, yogurt, mixes, mixes, toilet pap...	[individual meals,paper towel...
Row7	8	ice cream, juice, paper towels, waffles, soda, cheeses, poultry, toilet paper	[ice cream,juice,paper towels...
Row8	9	juice, poultry, coffee/tea, coffee/tea, dishwashing liquid/detergent	[juice,poultry,coffee/tea,...]
Row9	10	ketchup, coffee/tea, toilet paper, pork, flour, milk, soda, dishwashing liquid/detergent, eggs, tortillas, tortillas, fruits, sugar, soap, dishwashing liquid/detergent, juice, sandwich...	[ketchup,coffee/tea,toilet pa...
Row10	11	sandwich loaves, ice cream, soda, bagels, dishwashing liquid/detergent, eggs, sugar, waffles, individual meals, toilet paper, pasta, sandwich loaves, cheeses, hand soap, ketc...	[sandwich loaves,ice cream,s...
Row11	12	pork, tortillas, pork, shampoo, lunch meat, pasta, juice, bagels, laundry detergent, yogurt, sugar, waffles, hand soap, hand soap, butter, juice, spaghetti sauce, flour	[pork,tortillas,pork,...]
Row12	13	sugar, fruits, all- purpose, aluminum foil, laundry detergent, individual meals, flour, pork, shampoo, sugar, aluminum foil, shampoo, soap, bagels, toilet paper, juice, ice cream, ...	[sugar,fruits,all- purpose,...]
Row13	14	fruits, dinner rolls, individual meals, shampoo, ketchup, cereals, sandwich bags, laundry detergent, sandwich loaves, cheeses	[fruits,dinner rolls,individual ...]
Row14	15	individual meals, ice cream, cereals, paper towels, bagels, mixes, lunch meat, juice, toilet paper, cheeses, paper towels, paper towels, juice, aluminum foil, fruits, butter, sand...	[individual meals,ice cream,ce...
Row15	16	sugar, sandwich bags, flour, juice, milk, paper towels, cereals, sandwich bags, pasta, soda, dishwashing liquid/detergent, ice cream, soap, cheeses, beef, flour, dinner rolls	[sugar,sandwich bags,flour,...]
Row16	17	milk, hand soap, pasta, individual meals, spaghetti sauce, cereals, sandwich loaves, hand soap, individual meals	[milk,hand soap,pasta,...]
Row17	18	sandwich bags, toilet paper, bagels, shampoo, coffee/tea	[sandwich bags,toilet paper,...]
Row18	19	individual meals, laundry detergent, coffee/tea, eggs, aluminum foil, beef, juice, flour, sugar, individual meals, waffles, bagels, coffee/tea, spaghetti sauce, butter, beef	[individual meals,laundry det...
Row19	20	shampoo, dishwashing liquid/detergent, yogurt, juice, sugar, soap, sandwich loaves, butter, sandwich loaves, coffee/tea, ketchup, aluminum foil, dishwashing liquid/detergent...	[shampoo,dishwashing liquid/...
Row20	21	waffles, fruits, all- purpose, pork, juice, bagels, mixes	[waffles,fruits,all- purpose,...]
Row21	22	cheeses, cereals, sugar, bagels, soda	[cheeses,cereals,sugar,...]
Row22	23	aluminum foil, bagels, shampoo, dishwashing liquid/detergent, cereals, cheeses, flour, lunch meat, pasta, soda, toilet paper, poultry, coffee/tea, flour, all- purpose, ...	[aluminum foil,bagels,shampo...
Row23	24	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...	[fruits,all- purpose,pasta,...]
Row24	25	bagels, sugar, pork, sandwich loaves, tortillas, ice cream, all- purpose, yogurt, fruits, pasta, lunch meat, dishwashing liquid/detergent, juice	[bagels,sugar,pork,...]
Row25	26	fruits, sandwich loaves, coffee/tea, aluminum foil, shampoo, cereals, dinner rolls, coffee/tea, poultry, butter, juice, paper towels, beef, mixes, lunch meat, bagels, tortillas, al...	[fruits,sandwich loaves,coffe...
Row26	27	laundry detergent, pork, pasta, cheeses, fruits, sugar, lunch meat, laundry detergent, paper towels, butter, sandwich loaves, ice cream, waffles, all- purpose, sandwich bags,...	[laundry detergent,pork,past...
Row27	28	pork, bagels, poultry, pasta, butter, all- purpose, pasta, shampoo, sugar, ketchup, eggs, soda, tortillas, soap, individual meals, ketchup, butter, mixes, juice, lunch meat, cere...	[pork,bagels,poultry,...]
Row28	29	pasta, butter, sandwich loaves, spaghetti sauce, juice, dinner rolls, all- purpose, pork, yogurt, spaghetti sauce	[pasta,butter,sandwich loave...
Row29	30	flour, bagels, cheeses, sandwich loaves, toilet paper	[flour,bagels,cheeses,...]
Row30	31	aluminum foil, eggs, ice cream, pasta, juice, waffles, shampoo, dinner rolls, soda, laundry detergent, hand soap, waffles, cereals, toilet paper, individual meals, yogurt, spaghetti...	[aluminum foil,eggs,ice cream...
Row31	32	soap, paper towels, individual meals, dinner rolls, lunch meat, sugar, soap, eggs, beef, yogurt, soda, sandwich loaves, aluminum foil, dinner rolls, soap, cheeses, sandwich lo...	[soap,paper towels,individual...
Row32	33	sandwich loaves, pork, sandwich bags, ketchup, coffee/tea, soda, poultry, pasta, all- purpose, coffee/tea, paper towels, individual meals, poultry, flour, aluminum foil, soap, y...	[sandwich loaves,pork,sandw...
Row33	34	lunch meat, mixes, soap, hand soap, tortillas, coffee/tea, cheeses, tortillas, cheeses, ice cream, tortillas, beef, yogurt, spaghetti sauce, soda, eggs	[lunch meat,mixes,soap,...]
Row34	35	aluminum foil, cheeses, cereals, mixes, laundry detergent, juice, pork, bagels, sandwich loaves, yogurt, milk, sandwich loaves, spaghetti sauce, cereals, individual meals, eggs	[aluminum foil,cheeses,cereal...
Row35	36	soap, lunch meat, flour, juice, yogurt, shampoo, spaghetti sauce, ketchup, laundry detergent, dinner rolls, ketchup, shampoo, sugar, flour, sandwich bags, paper towels, pork...	[soap,lunch meat,flour,...]
Row36	37	fruits, lunch meat, dinner rolls, shampoo, hand soap, mixes, pasta, sugar	[fruits,lunch meat,dinner rolls...]

Sample Image after applying Association Rules : Support=0.02, Min confidence=0.4

Row ID	Support	Confidence	Lift	Consequent	implies	Items
rule0	0.02	0.426	1.108	yogurt	<---	[pasta,pork,soap]
rule1	0.02	0.404	1.135	pork	<---	[yogurt,dishwashing liquid/detergent,hand soap]
rule2	0.02	0.404	1.076	all- purpose	<---	[yogurt,ice cream,hand soap]
rule3	0.02	0.426	1.108	yogurt	<---	[butter,hand soap,beef]
rule4	0.02	0.418	1.115	beef	<---	[yogurt,butter,hand soap]
rule5	0.02	0.418	1.07	cheeses	<---	[yogurt,butter,hand soap]
rule6	0.02	0.418	0.992	poultry	<---	[yogurt,butter,hand soap]
rule7	0.02	0.418	1.103	coffee/tea	<---	[yogurt,butter,hand soap]
rule8	0.02	0.404	1.064	coffee/tea	<---	[yogurt,ice cream,hand soap]
rule9	0.02	0.404	1.019	cereals	<---	[yogurt,dishwashing liquid/detergent,hand soap]
rule10	0.02	0.411	1.155	pork	<---	[sandwich loaves,toilet paper,sandwich bags]
rule11	0.02	0.411	1.116	sandwich bags	<---	[eggs,fruits,pork]
rule12	0.02	0.404	1.035	eggs	<---	[pasta,lunch meat,pork]
rule13	0.02	0.434	1.158	all- purpose	<---	[sandwich loaves,laundry detergent,pork]
rule14	0.02	0.426	1.198	pork	<---	[all- purpose,hand soap,individual meals]
rule15	0.02	0.404	1.135	pork	<---	[all- purpose,hand soap,bagels]
rule16	0.02	0.434	1.23	flour	<---	[sandwich loaves,laundry detergent,pork]
rule17	0.02	0.404	1.143	flour	<---	[fruits,milk,pork]
rule18	0.02	0.411	1.068	aluminum foil	<---	[butter,fruits,pork]
rule19	0.02	0.426	1.158	butter	<---	[shampoo,fruits,pork]
rule20	0.02	0.411	1.114	shampoo	<---	[butter,fruits,pork]
rule21	0.02	0.411	1.042	waffles	<---	[butter,fruits,pork]
rule22	0.02	0.404	1.097	butter	<---	[fruits,milk,pork]
rule23	0.02	0.411	1.08	milk	<---	[butter,fruits,pork]
rule24	0.02	0.411	0.975	poultry	<---	[butter,fruits,pork]
rule25	0.02	0.411	1.138	sugar	<---	[butter,fruits,pork]
rule26	0.02	0.426	1.136	beef	<---	[pasta,pork,soap]
rule27	0.02	0.434	1.129	aluminum foil	<---	[sandwich loaves,laundry detergent,pork]
rule28	0.02	0.404	1.049	aluminum foil	<---	[hand soap,cereals,pork]
rule29	0.02	0.404	1.037	dinner rolls	<---	[sandwich loaves,pork,sugar]
rule30	0.02	0.426	1.076	cereals	<---	[shampoo,fruits,pork]
rule31	0.02	0.404	1.074	mixes	<---	[hand soap,cereals,pork]
rule32	0.02	0.404	1.064	soap	<---	[fruits,hand soap,pork]
rule33	0.02	0.426	1.133	individual meals	<---	[pasta,pork,soap]
rule34	0.02	0.426	1.141	spaghetti sauce	<---	[pasta,pork,soap]
rule35	0.02	0.426	1.123	coffee/tea	<---	[pasta,pork,soap]
rule36	0.02	0.404	1.066	laundry detergent	<---	[fruits,toilet paper,pork]

Reason behind Association Rules

- ▶ Since we need to get the best and enough association rules for our list of given products and recommended products on the basis of each individual orders, we should start with the minimum support and min confidence levels.
- ▶ As it is an iterative process, I tried selecting minimum support at different levels like 0.05, 0.04, 0.03, 0.02 but got the best results and enough rules by using support at 0.02, so I chose 0.02 as the minimum support.
- ▶ And same goes for minimum confidence, I chose 0.4 as the minimum confidence level.
- ▶ The lift value is a measure of importance of a rule. The lift value of an association rule is the ratio of the confidence of the rule and the expected confidence of the rule.
- ▶ There are different lift values for different combination of products in the basket.
- ▶ A lift ratio larger than **1.0** implies that the relationship between the antecedent and the consequent is more significant than would be expected if the two sets were independent. The larger the lift ratio, the more significant the association.

Sample image after applying Group_by on items, consequent = First

Row ID	Items	Support	Confide...	Lift	Consequ...	implies
Row0	[all-purpose, aluminum foil, ketchup]	0.033	0.476	1.259	sandwich bags	<---
Row1	[all-purpose, aluminum foil, soap, ...]	0.022	0.55	1.469	butter	<---
Row2	[all-purpose, aluminum foil, soap]	0.035	0.474	1.256	sandwich bags	<---
Row3	[all-purpose, aluminum foil, sugar]	0.026	0.465	1.221	flour	<---
Row4	[all-purpose, aluminum foil]	0.07	0.448	1.177	cheeses	<---
Row5	[all-purpose, bagels, aluminum foil]	0.031	0.444	1.178	soap	<---
Row6	[all-purpose, bagels, beef, ...]	0.021	0.667	1.799	fruits	<---
Row7	[all-purpose, bagels, beef]	0.026	0.477	1.269	butter	<---
Row8	[all-purpose, bagels, cereals, ...]	0.022	0.735	1.861	lunch meat	<---
Row9	[all-purpose, bagels, cereals]	0.029	0.47	1.248	sandwich bags	<---
Row10	[all-purpose, bagels, coffee/tea]	0.029	0.459	1.214	ice cream	<---
Row11	[all-purpose, bagels, individual meals]	0.028	0.476	1.257	beef	<---
Row12	[all-purpose, bagels, juice, ...]	0.02	0.605	1.574	yogurt	<---
Row13	[all-purpose, bagels, juice]	0.032	0.473	1.252	dinner rolls	<---
Row14	[all-purpose, bagels, ketchup]	0.028	0.452	1.191	yogurt	<---
Row15	[all-purpose, bagels, laundry detergent]	0.028	0.446	1.169	sandwich bags	<---
Row16	[all-purpose, bagels, lunch meat, ...]	0.022	0.622	1.627	juice	<---
Row17	[all-purpose, bagels, lunch meat, ...]	0.022	0.615	1.636	pork	<---
Row18	[all-purpose, bagels, lunch meat, ...]	0.021	0.585	1.567	butter	<---
Row19	[all-purpose, bagels, lunch meat]	0.032	0.462	1.227	dinner rolls	<---
Row20	[all-purpose, bagels, milk]	0.03	0.461	1.215	butter	<---
Row21	[all-purpose, bagels, mixes]	0.029	0.45	1.19	dinner rolls	<---
Row22	[all-purpose, bagels, pasta, ...]	0.02	0.697	1.788	eggs	<---
Row23	[all-purpose, bagels, pasta, ...]	0.021	0.706	1.811	eggs	<---
Row24	[all-purpose, bagels, pasta]	0.029	0.454	1.196	yogurt	<---
Row25	[all-purpose, bagels, pork, ...]	0.02	0.605	1.617	toilet paper	<---
Row26	[all-purpose, bagels, pork, ...]	0.021	0.573	1.492	toilet paper	<---
Row27	[all-purpose, bagels, pork]	0.03	0.456	1.205	beef	<---
Row28	[all-purpose, bagels, sandwich bags]	0.026	0.464	1.225	flour	<---
Row29	[all-purpose, bagels, soap]	0.028	0.472	1.25	flour	<---
Row30	[all-purpose, bagels, soda]	0.026	0.467	1.237	yogurt	<---
Row31	[all-purpose, bagels, sugar]	0.029	0.467	1.227	waffles	<---
Row32	[all-purpose, bagels, toilet paper, ...]	0.02	0.605	1.672	pork	<---
Row33	[all-purpose, bagels, toilet paper, ...]	0.021	0.649	1.664	eggs	<---
Row34	[all-purpose, bagels, toilet paper, ...]	0.02	0.575	1.617	pork	<---
Row35	[all-purpose, bagels, toilet paper, ...]	0.022	0.628	1.668	paper towels	<---
Row36	[all-purpose, bagels, toilet paper, ...]	0.021	0.632	1.776	pork	<---

Sample Image after renaming column names

Row ID	[...] Basket_Items	D Support	D Confide...	D Lift	S Recommended_Items
Row0	[all-purpose,aluminum foil,ketchup]	0.033	0.476	1.259	sandwich bags
Row1	[all-purpose,aluminum foil,soap,...]	0.022	0.55	1.469	butter
Row2	[all-purpose,aluminum foil,soap]	0.035	0.474	1.256	sandwich bags
Row3	[all-purpose,aluminum foil,sugar]	0.026	0.465	1.221	flour
Row4	[all-purpose,aluminum foil]	0.07	0.448	1.177	cheeses
Row5	[all-purpose,bagels,aluminum foil]	0.031	0.444	1.178	soap
Row6	[all-purpose,bagels,beef,...]	0.021	0.667	1.799	fruits
Row7	[all-purpose,bagels,beef]	0.026	0.477	1.269	butter
Row8	[all-purpose,bagels,cereals,...]	0.022	0.735	1.861	lunch meat
Row9	[all-purpose,bagels,cereals]	0.029	0.47	1.248	sandwich bags
Row10	[all-purpose,bagels,coffee/tea]	0.029	0.459	1.214	ice cream
Row11	[all-purpose,bagels,individual meals]	0.028	0.476	1.257	beef
Row12	[all-purpose,bagels,juice,...]	0.02	0.605	1.574	yogurt
Row13	[all-purpose,bagels,juice]	0.032	0.473	1.252	dinner rolls
Row14	[all-purpose,bagels,ketchup]	0.028	0.452	1.191	yogurt
Row15	[all-purpose,bagels,laundry detergent]	0.028	0.446	1.169	sandwich bags
Row16	[all-purpose,bagels,lunch meat,...]	0.022	0.622	1.627	juice
Row17	[all-purpose,bagels,lunch meat,...]	0.022	0.615	1.636	pork
Row18	[all-purpose,bagels,lunch meat,...]	0.021	0.585	1.567	butter
Row19	[all-purpose,bagels,lunch meat]	0.032	0.462	1.227	dinner rolls
Row20	[all-purpose,bagels,milk]	0.03	0.461	1.215	butter
Row21	[all-purpose,bagels,mixes]	0.029	0.45	1.19	dinner rolls
Row22	[all-purpose,bagels,pasta,...]	0.02	0.697	1.788	eggs
Row23	[all-purpose,bagels,pasta,...]	0.021	0.706	1.811	eggs
Row24	[all-purpose,bagels,pasta]	0.029	0.454	1.196	yogurt
Row25	[all-purpose,bagels,pork,...]	0.02	0.605	1.617	toilet paper
Row26	[all-purpose,bagels,pork,...]	0.021	0.573	1.492	toilet paper
Row27	[all-purpose,bagels,pork]	0.03	0.456	1.205	beef
Row28	[all-purpose,bagels,sandwich bags]	0.026	0.464	1.225	flour
Row29	[all-purpose,bagels,soap]	0.028	0.472	1.25	flour
Row30	[all-purpose,bagels,soda]	0.026	0.467	1.237	yogurt
Row31	[all-purpose,bagels,sugar]	0.029	0.467	1.227	waffles
Row32	[all-purpose,bagels,toilet paper,...]	0.02	0.605	1.672	pork
Row33	[all-purpose,bagels,toilet paper,...]	0.021	0.649	1.664	eggs
Row34	[all-purpose,bagels,toilet paper,...]	0.02	0.575	1.617	pork
Row35	[all-purpose,bagels,toilet paper,...]	0.022	0.628	1.668	paper towels
Row36	[all-purpose,bagels,toilet paper,...]	0.021	0.632	1.776	pork

Suggestion of Possible Combos with Lucrative Offers

- ▶ After applying the association rules, we can see in the final table that the customers who bought dinner rolls, cheese, fruits, also bought yogurt, aluminum foil, eggs, ice cream. So, in this category, we can make a food combo with some percent discount to get the customers all at once at some discounted price.
- ▶ In the category of hand soap, shampoo, toilet paper, we could see people also added paper towels in their basket, so we can give a offer on a bundle of toilet paper and paper towels. We can also provide free hand soap with the big bottle of shampoo.
- ▶ Customers who bought pork and eggs also bought beef, so in this food category we can give a discount based on some minimum quantity(in kilograms and grams).
- ▶ With 0.021 support and at 0.649 confidence, we see that the people who bought ice cream, lunch meat, sugar together also added flour, beef and pasta in their basket. So we can make a '*lunch items combo deal*' of these items all together and we can offer cheese or butter on some total minimum transaction amount.
- ▶ We can also do a deal with online payment partners to provide cashback offers to our customers on particular payment method. In this way all will get some benefits.