



# **Product Recommendation for Online Groceries**

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- **Conclusion & Next Steps**

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# Current Solutions



# Online Groceries

- Data provides insights on consumption behavior and patterns
- Customers lose opportunity to 'chance' upon products compared to traditional retail store
- Depends largely on specific searches
- How to best utilise screen real estate for quality recommendations?

< redmart

Home

Q


Search in RedMart


## Past Purchases

[See All >](#)

🔔 You might be running low on 1 product


5% Off



**\$12.25**  
~~\$12.99~~  
Tropical Maria Raspberry Fruits - Frozen  
500 g  
  
🔔 Bought 1 month ago  

Add To Cart

Buy 3 For \$6 >




**\$2.35**  
Red Dragonfruit 300g  
300 g  

5D

Add To Cart

Buy 2 for \$7.5 >



**\$3.95**  
RedMart Navel Orange  
850 g  

8D

Add To Cart

< redmart


Home

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Search in RedMart

## Recommended For You, David Ng

Any 2 Save 28% >




**\$24.60**  
Derma E Hydrating Gentle Cleanser  
175 ml  

★★★★★ (5)

Add To Cart

Save 25¢




**\$7.95**  
~~\$8.20~~  
Pearlie White Fluorinze Anti-Bacterial Fluoride Mouth Rinse  
750ml  
Helps Fight Cavities & Plaque  
N SINGAPORE  

★★★★★ (515)

Add To Cart

Save \$2.90



**\$14.50**  
~~\$17.40~~  
Gillette Venus Spa Breeze With White Tea Razor...  
1 per pack  

★★★★★ (114)


Add To Cart

Overview

Reviews

Recommendations

/// You may also like ///



Red Dragonfruit 450g  
450g  


3D

  
**\$2.80**  

Buy 2 For \$5....

ADD TO CART




Zespri Golden Kiwi 5s  
5per pack  

3D

  
**\$7.85**  

ADD TO CART



RedMart Australian Broccoli  
300g  


6D

  
**\$3.20**  

Buy 2 for \$5....

ADD TO CART




GIVVO Local Tomatoes  
500g  

6D

Yay! You get free delivery.

Delivery Options >




Prime Cavendish Bananas  
1kg  

4D

ADD TO CART



GIVVO Small Thai Watermelon  
1.8kg  

8D




# Problems

- No data on demographics on customers
- Without demographics, clustering becomes difficult
- Category managers unable to target specific groups within customer base
- Recommendations take on a very generic form
- Most recommendations come from the same category

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# Problem Statement



Without the flexibility of browsing physical store, e-grocers face difficulty in recommending **relevant** products to their customers, losing potential for **increased sales** and **customer retention**.

The objective is to develop a recommender system that leverages on consumption behavior to **group customers**. Based on their groups, relevant products based on **item association** will be recommended to the consumer.

Success will be measured by the increase in **average order value**, and the **average number of new products** a customer checks out per order.

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# Data Highlights



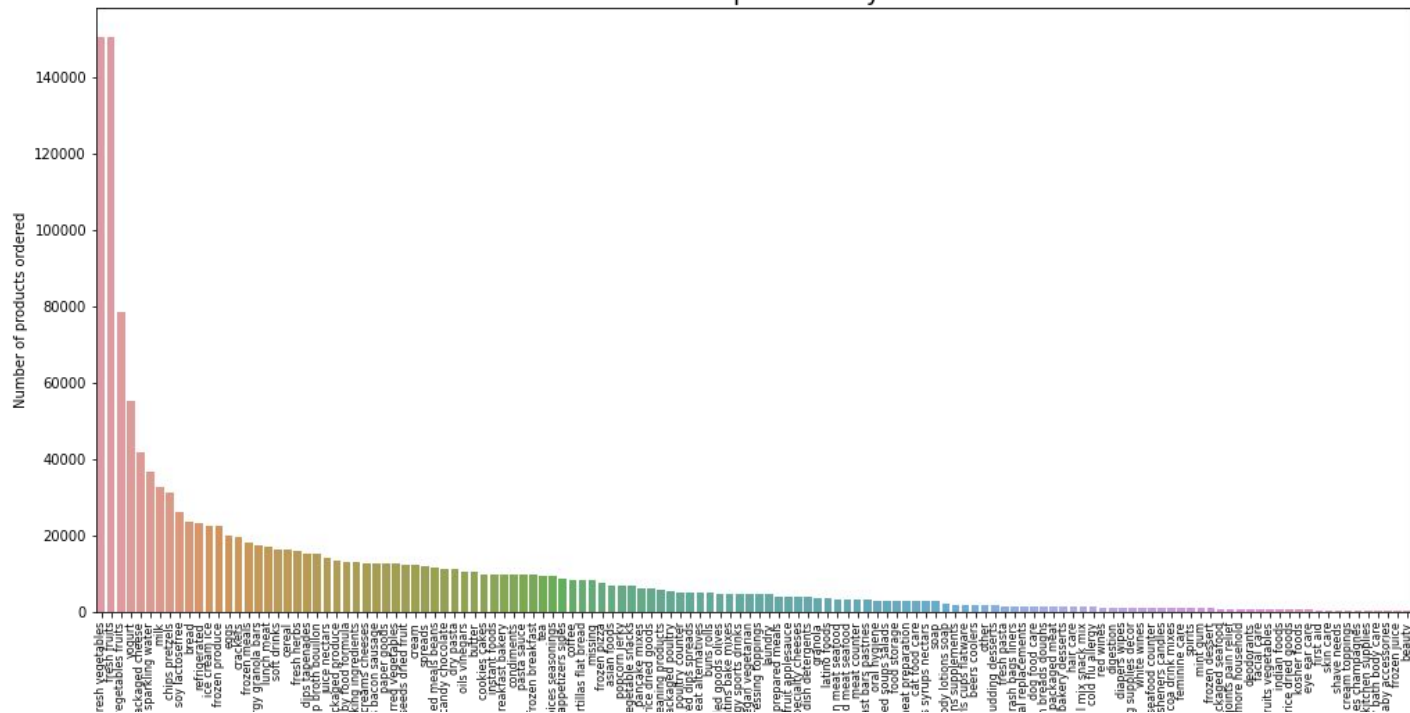
# Number of Orders



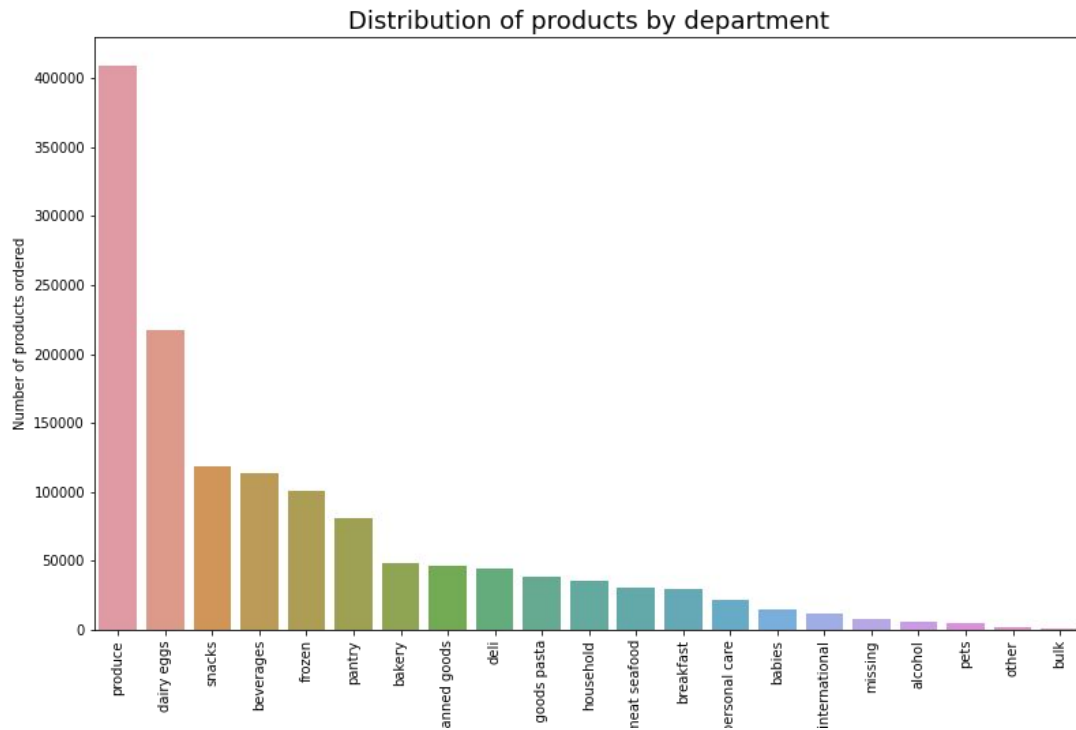
# Items per Order



### Distribution of products by aisles



# Department Distribution

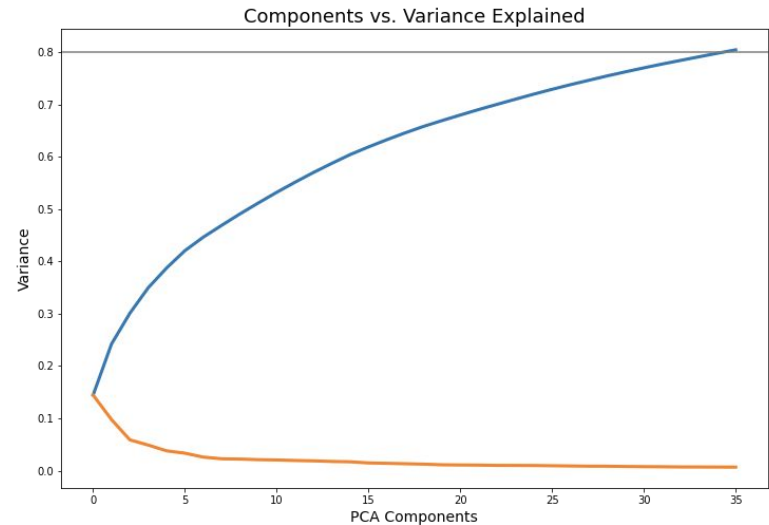


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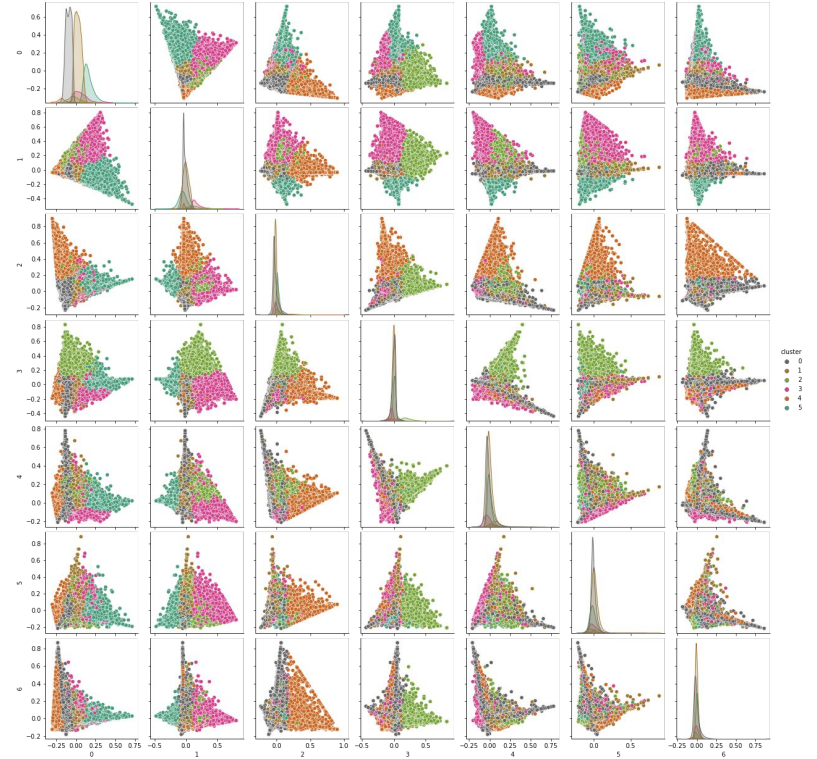
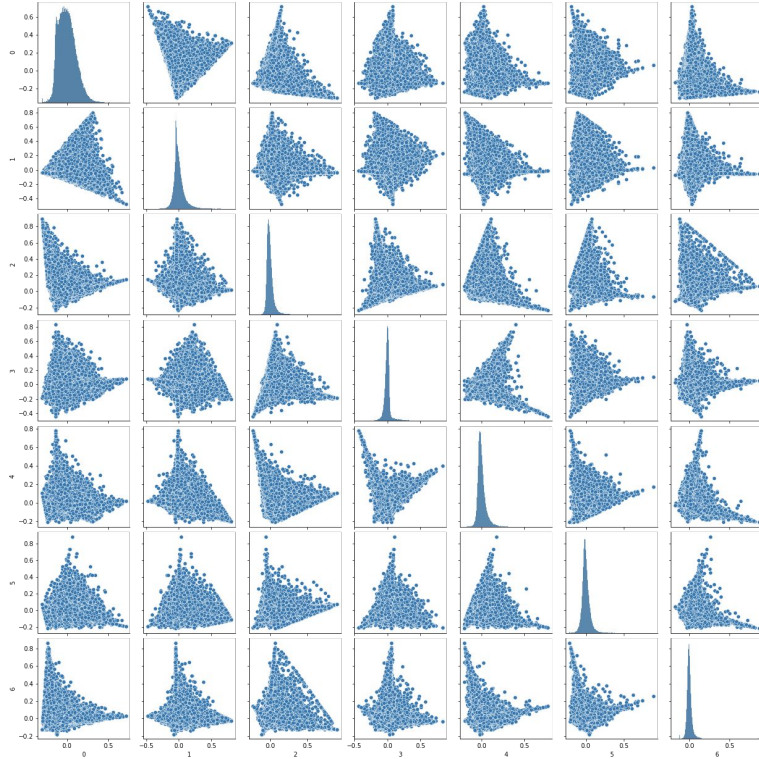
# Clustering

# Principal Component Analysis (PCA)

- Data has total of 134 different aisles
- For each customer, the aisle weightage is computed
- Due to the high number of aisles, PCA was employed to help reduce the number of features
- PCA reduced features from 134 to 36, with ~80% of the variance explained



# K-Means Clustering



- | Food Item                     | Cluster |
|-------------------------------|---------|
| air fresheners candles        | 1       |
| asian food                    | 1       |
| baby accessories              | 1       |
| baby bath body care           | 1       |
| baby food formula             | 1       |
| bakery desserts               | 1       |
| bakery pastries               | 1       |
| baking supplies decor         | 1       |
| beauty                        | 1       |
| beers coolers                 | 1       |
| body skins soap               | 1       |
| breakfast bakery              | 1       |
| breakfast bars snacks         | 1       |
| bulk dried fruits vegetables  | 1       |
| bulk grains rice dried goods  | 1       |
| butcher                       | 1       |
| candy chocolate               | 1       |
| canned fruit appearance       | 1       |
| canned jarred vegetables      | 1       |
| canned meat fish              | 1       |
| canned meat seafood           | 1       |
| canned or food care           | 1       |
| cereal                        | 1       |
| chips pretzels                | 1       |
| cleaning products             | 1       |
| coarse drink mixes            | 1       |
| cold flu allergy              | 1       |
| condiments                    | 1       |
| cookies cakes                 | 1       |
| crackers                      | 1       |
| deodorants                    | 1       |
| diapers wipes                 | 1       |
| detergent                     | 1       |
| dish detergents               | 1       |
| doughs gelatin bake mixes     | 1       |
| dry pasta                     | 1       |
| eggs                          | 1       |
| energy granola bars           | 1       |
| energy                        | 1       |
| eye ear care                  | 1       |
| facial care                   | 1       |
| feminine care                 | 1       |
| first aid                     | 1       |
| fresh dips tapenades          | 2       |
| fresh fruit                   | 2       |
| fresh herbs                   | 2       |
| fresh pasta                   | 2       |
| fresh veg                     | 2       |
| frozen appetizers sides       | 2       |
| frozen breads buns            | 2       |
| frozen breakfast              | 2       |
| frozen dessert                | 2       |
| frozen juice                  | 2       |
| frozen meat seafood           | 2       |
| frozen produce                | 2       |
| frozen pizza                  | 2       |
| frozen vegan vegetarian       | 2       |
| fruit vegetable snacks        | 2       |
| grains rice dried goods       | 2       |
| hair care                     | 2       |
| honey syrup nectars           | 2       |
| hot cereal granola mixes      | 2       |
| hot dogs frozen sausage       | 2       |
| ice cream toppings            | 2       |
| indian foods                  | 2       |
| instant foods                 | 2       |
| kitchen supplies              | 2       |
| laser nectars                 | 2       |
| laptop food                   | 2       |
| latin foods                   | 2       |
| marinades meat preparation    | 2       |
| meal preparation              | 2       |
| meat chicken                  | 2       |
| meat gum                      | 2       |
| meat jerky                    | 2       |
| more house food               | 2       |
| muscles joints food           | 2       |
| nuts seeds dried fruit        | 2       |
| oil vinegars                  | 2       |
| oral hygiene                  | 2       |
| other creams                  | 2       |
| other                         | 2       |
| packaged cheese               | 2       |
| packaged meat                 | 2       |
| packaged poultry              | 2       |
| packaged produce              | 2       |
| packaged seafood              | 2       |
| packaged vegetables fruits    | 2       |
| paper goods                   | 2       |
| pasta sauce                   | 2       |
| pickled goods olives          | 2       |
| plates bowls cup linens       | 2       |
| protein jerky                 | 2       |
| pudding                       | 2       |
| prepared meals                | 2       |
| prepared meat salads          | 2       |
| prepared dips snacks          | 2       |
| protein meal replacements     | 2       |
| red wine                      | 2       |
| refrigerated pudding desserts | 2       |
| salad dressing vinaigrettes   | 2       |
| seasonal                      | 2       |
| seasoning                     | 2       |
| skin care                     | 2       |
| soap                          | 2       |
| salt drinks                   | 2       |
| soup broth bouillon           | 2       |
| specialty cheeses             | 2       |
| specialty wines champagnes    | 2       |
| spices seasonings             | 2       |
| spices                        | 2       |
| tea                           | 2       |
| tofu meat alternatives        | 2       |
| tomato flat bread             | 2       |
| top me snack mix              | 2       |
| topping                       | 2       |
| vitamins supplements          | 2       |
| water water sparkling water   | 2       |
| white wine                    | 2       |
| wine                          | 2       |



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# Recommender Basis



# Association Rule Mining (ARM)

- Dealing with implicit data (past purchases)
- ARM is more session based and caters for differing tastes in different periods
- Apriori algorithm
  - Support: Probability of an item pair appearing
  - Confidence: Probability of a given item pair A & B given item A
  - Lift: Ratio of Confidence to Support

Recommendations are based on Lift. Lift values  $> 1$  indicate positive correlation whereas  $< 1$  indicates items being substitutes for each other.



# Association Rule Mining

	item_A	item_B	product_name_A	product_name_B	freqAB	supportAB	freqA	supportA	freqB	supportB	confidenceAtoB	confidenceBtoA	lift
0	4985	36278	Homestyle Some Pulp Orange Juice	Chocolate Breakfast Biscuits Chocolate	27	0.000121	30	0.000134	32	0.000143	0.900000	0.843750	6281.437500
1	4985	48927	Homestyle Some Pulp Orange Juice	Fat Free Plain Yoghurt	24	0.000107	30	0.000134	62	0.000278	0.800000	0.387097	2881.806452
2	36278	48927	Chocolate Breakfast Biscuits Chocolate	Fat Free Plain Yoghurt	25	0.000112	32	0.000143	62	0.000278	0.781250	0.403226	2814.264113
3	24852	48927	Banana	Fat Free Plain Yoghurt	32	0.000143	50557	0.226368	62	0.000278	0.000633	0.516129	2.280045
4	38259	38576	Blueberry Greek Yogurt + Chia	The Epic Seed Greek Yogurt Strawberry & Chia	23	0.000103	33	0.000148	25	0.000112	0.696970	0.920000	6226.448485

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# Recommender Results

Product added to cart: 9098 - Carrot Bunch.  
Customer is grouped in cluster: 0.

product_id		product_name
0	14168	Penne Pasta
1	49176	Cinnamon Roll Dough With Icing
2	29553	Super Soft Taco Flour Tortillas
3	48144	Tater Tots
4	46041	Beef Franks

Product added to cart: 23087 - Organic Sweet Pea Sprouts.  
Customer is grouped in cluster: 0.

product_id		product_name
0	32734	Spaghetti
1	49176	Cinnamon Roll Dough With Icing
2	19508	Corn Tortillas
3	2452	Naturals Chicken Nuggets
4	46041	Beef Franks

Product added to cart: 38548 - Gala Apple.  
Customer is grouped in cluster: 5.

product_id		product_name
0	5240	Spaghetti No 12
1	30391	Organic Cucumber
2	33787	Total 2% Lowfat Greek Strained Yogurt with Peach
3	39275	Organic Blueberries
4	36011	Organic Fat Free Milk

Product added to cart: 9874 - Organic Greek Yogurt Honey.  
Customer is grouped in cluster: 5.

product_id		product_name
0	12872	Penne Rigate
1	27966	Organic Raspberries
2	13042	with Crispy Almonds Cereal
3	7649	Whole Wheat Tandoori Naan
4	31766	Cheese Pizza Snacks

# Cluster Differentiation

Product added to cart: 3235 - Sriracha Flavor Tortilla Chips.  
Customer is grouped in cluster: 1.

	product_id	product_name
0	2855	Organic Good Seed Bread
1	37710	Trail Mix
2	20448	Organic Raisins
3	32689	Romaine Hearts
4	20019	Lowfat Kefir Smoothie Blueberry

Product added to cart: 3235 - Sriracha Flavor Tortilla Chips.  
Customer is grouped in cluster: 3.

	product_id	product_name
0	42701	Organic Sour Cream
1	19508	Corn Tortillas
2	33198	Sparkling Natural Mineral Water
3	12872	Penne Rigate
4	21267	Sourdough Bread

Product added to cart: 3235 - Sriracha Flavor Tortilla Chips.  
Customer is grouped in cluster: 2.

	product_id	product_name
0	28199	Clementines, Bag
1	31651	Extra Fancy Unsalted Mixed Nuts
2	43889	Dark Chocolate Covered Banana
3	2855	Organic Good Seed Bread
4	19767	Old Fashioned Oatmeal

Product added to cart: 3235 - Sriracha Flavor Tortilla Chips.  
Customer is grouped in cluster: 5.

	product_id	product_name
0	21883	Irish Whiskey
1	19660	Spring Water
2	24489	Organic Whole Strawberries
3	21903	Organic Baby Spinach
4	46676	Total 0% Nonfat Greek Yogurt

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# Conclusion & Next Steps



## Conclusion

- Clustering seems to be effective in segregating customers according to their tastes, which is defined by the market share in the different aisles
- Recommender pushes products based on lift of item pairs, and goes further up to aisle lift if insufficient item lift pairs are available
- These products do not necessarily belong to the same category, allowing for pushing of cross category products and increasing exposure of products
- Clusters seem to be effective as customers from different aisles get recommended different products based on their cluster





## Next Steps

- A/B testing required to evaluate effectiveness of recommender
- Metrics to be monitored:
  - Average Order Value
  - Average New Products Added
  - Product Recommendations Click Through Rate
  - Customer Churn



## Further Opportunities & Limitations

- Currently, if insufficient items pairs with lift criteria are met, recommender resorts to pushing products from associated aisles
- These products can be prioritised by category managers (on the basis of product margin/promotions) in order to better influence click through rate of recommendations
- Additional information from customers such as order frequency and average order value can also be useful features in clustering
- Further breakdown dense aisles and combine loose aisles