SC1015 Mini Project

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The Story of Mall X

Practical
MOTIVATION

Sample
COLLECTION

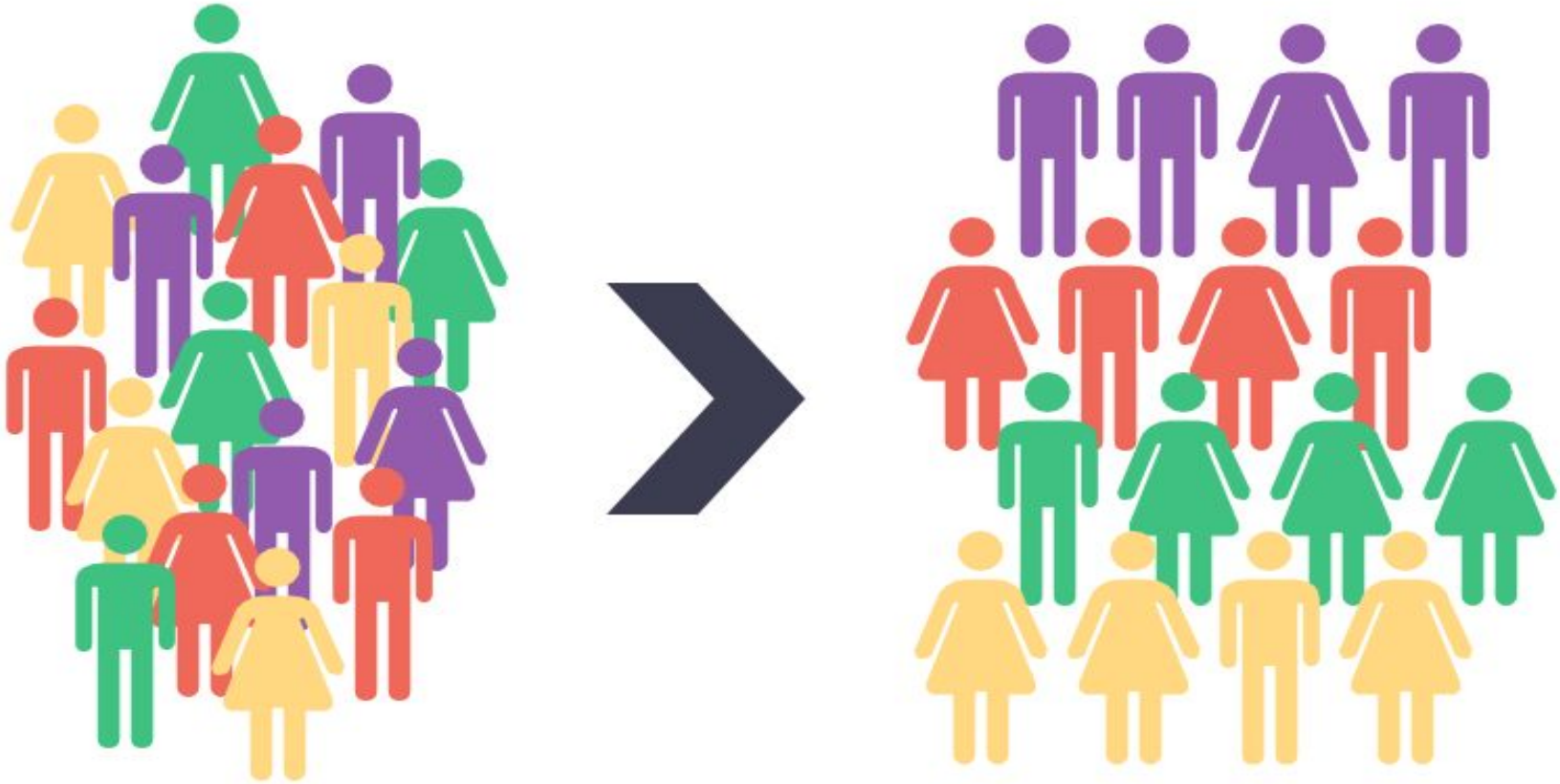
Practical
MOTIVATION

Sample
COLLECTION

Practical
MOTIVATION

Sample
COLLECTION

Customer Segmentation



Key Questions to Consider

1. What products should be advertised?

2. Which purchasing platform (e.g. physical stores, website) to advertise the chosen products?

3. Should there be any promotions as part of the advertisement?

Our Dataset

Practical MOTIVATION

Sample COLLECTION

Our Dataset

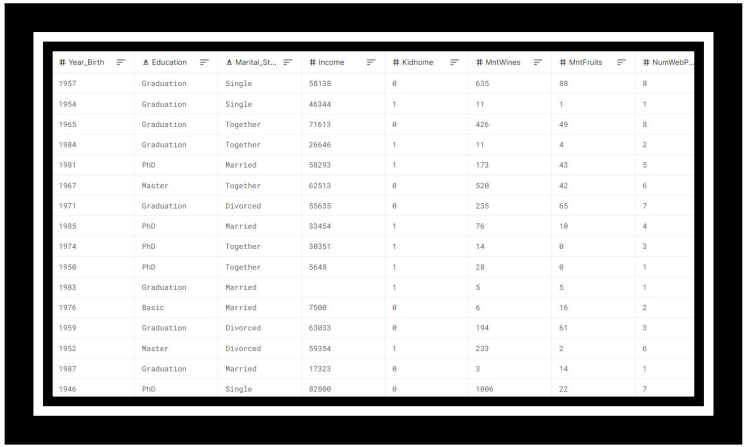
RODOLFO SALDANHA · UPDATED 2 YEARS AGO

Marketing Campaign

Boost the profit of a marketing campaign

kaggle

Size of dataset: 2240



Year_Birth	Education	Marital_St...	Income	Kidhome	MntWines	MntFruits	NumWebP...
1957	Graduation	Single	58138	0	635	88	8
1954	Graduation	Single	46344	1	11	1	1
1965	Graduation	Together	71613	0	426	49	8
1984	Graduation	Together	26646	1	11	4	2
1981	PhD	Married	58293	1	173	43	5
1967	Master	Together	62513	0	520	42	6
1971	Graduation	Divorced	55635	0	235	65	7
1985	PhD	Married	33454	1	76	10	4
1974	PhD	Together	30351	1	14	0	3
1950	PhD	Together	5648	1	28	0	1
1983	Graduation	Married		1	5	5	1
1976	Basic	Married	7500	0	6	16	2
1959	Graduation	Divorced	63033	0	194	61	3
1952	Master	Divorced	59354	1	233	2	6
1987	Graduation	Married	17323	0	3	14	1
1946	PhD	Single	82800	0	1006	22	7

Practical MOTIVATION

Sample COLLECTION

Our Variables

People

- ID: Customer's unique identifier
- Year_Birth: Customer's birth year
- Education: Customer's education level
- Marital_Status: Customer's marital status
- Income: Customer's yearly household income
- Kidhome: Number of children in customer's household
- Teenhome: Number of teenagers in customer's household
- Dt_Customer: Date of customer's enrollment with the company
- Recency: Number of days since customer's last purchase
- Complain: 1 if the customer complained in the last 2 years, 0 otherwise
- Products

Products

- MntWines: Amount spent on wine in last 2 years
- MntFruits: Amount spent on fruits in last 2 years
- MntMeatProducts: Amount spent on meat in last 2 years
- MntFishProducts: Amount spent on fish in last 2 years
- MntSweetProducts: Amount spent on sweets in last 2 years
- MntGoldProds: Amount spent on gold in last 2 years

Promotion

- NumDealsPurchases: Number of purchases made with a discount
- AcceptedCmp1: 1 if customer accepted the offer in the 1st campaign, 0 otherwise
- AcceptedCmp2: 1 if customer accepted the offer in the 2nd campaign, 0 otherwise
- AcceptedCmp3: 1 if customer accepted the offer in the 3rd campaign, 0 otherwise
- AcceptedCmp4: 1 if customer accepted the offer in the 4th campaign, 0 otherwise
- AcceptedCmp5: 1 if customer accepted the offer in the 5th campaign, 0 otherwise
- Response: 1 if customer accepted the offer in the last campaign, 0 otherwise

Place

- NumWebPurchases: Number of purchases made through the company’s website
- NumCatalogPurchases: Number of purchases made using a catalogue
- NumStorePurchases: Number of purchases made directly in stores
- NumWebVisitsMonth: Number of visits to company’s website in the last month

Data Preparation & Exploratory Analysis

Problem FORMULATION

Data PREPARATION

Dropping Useless columns

Drop unneeded columns

First, we decided to drop the following columns as they were not relevant.

- ID
- NumDealsPurchases (we dropped this as this includes discounted items not from promotional campaigns)
- Complain
- Z_CostContact
- Z_Revenue
- Dt_customer
- Recency

Problem FORMULATION

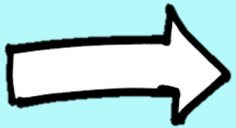
Data PREPARATION

Dropping Rows with Null Values

```
# Shows that all rows with null values
new_df4[new_df4.isnull().any(axis=1
```

	Age	Education	Marital_Status	Income	Kidhome	Teenhome	MntWines	MntFruits	MntMeatProducts	MntFishProducts	MntSweetProducts	MntGold
10	31	Graduation	Married	NaN	1	0	5	5	6	0	2	
27	28	Graduation	Single	NaN	1	0	5	1	3	3	263	
43	55	PhD	Single	NaN	0	0	81	11	50	3	2	
48	63	Graduation	Single	NaN	2	1	48	5	48	6	10	
58	32	Graduation	Single	NaN	1	0	11	3	22	2	2	
71	41	2n Cycle	Married	NaN	1	0	25	3	43	17	4	
90	57	PhD	Married	NaN	2	1	230	42	192	49	37	
91	57	Graduation	Single	NaN	1	1	7	0	8	2	0	
92	41	Master	Together	NaN	0	0	445	37	359	98	28	
128	53	PhD	Married	NaN	0	1	352	0	27	10	0	
133	51	Graduation	Married	NaN	0	1	231	65	196	38	71	
312	25	Graduation	Married	NaN	0	0	861	138	461	60	30	
319	44	Graduation	Single	NaN	1	2	738	20	172	52	50	
1379	44	Master	Together	NaN	0	1	187	5	65	26	20	
1382	56	Graduation	Together	NaN	1	1	19	4	12	2	2	
1383	50	2n Cycle	Single	NaN	1	1	5	1	9	2	0	
1386	42	PhD	Together	NaN	1	0	25	1	13	0	0	
2059	45	Master	Together	NaN	1	1	375	42	48	94	66	
2061	33	PhD	Single	NaN	1	0	23	0	15	0	2	
2078	43	Graduation	Married	NaN	1	1	71	1	16	0	0	
2079	60	Master	Together	NaN	0	1	161	0	22	0	0	
2081	59	Graduation	Single	NaN	0	1	264	0	21	12	6	
2084	71	Master	Widow	NaN	0	0	532	126	490	164	126	
2228	36	2n Cycle	Together	NaN	0	0	32	2	1607	12	4	

Modifying existing rows

Year_Birth  Age

AcceptedCmp1-5
&
Response

Receptiveness

Statistical DESCRIPTION

Exploratory ANALYSIS

Identifying our Features and Responses

Feature variables

- Age
- Income
- Kidhome
- Teenhome
- Education
- Marital_Status

Response variables

- MntWines
- MntFruits
- MntMeatProducts
- MntFishProducts
- MntSweetProducts
- MntGoldProds
- NumWebPurchases
- NumCatalogPurchases
- NumStorePurchases
- NumWebVisitsMonth
- Receptiveness

Statistical DESCRIPTION

Exploratory ANALYSIS

Identifying the different variable types

Continuous Numerical Variables

- Age
- Income
- MntWines
- MntFruits
- MntMeatProducts
- MntFishProducts
- MntSweetProducts
- MntGoldProds

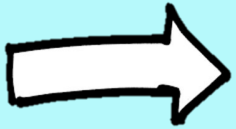
Discrete Numerical Variables

- Kidhome
- Teenhome
- NumWebPurchases
- NumCatalogPurchases
- NumStorePurchases
- NumWebVisitsMonth

Categorical Variables

- Education
- Marital_Status
- Receptiveness

Decoding Kidhome & Teenhome

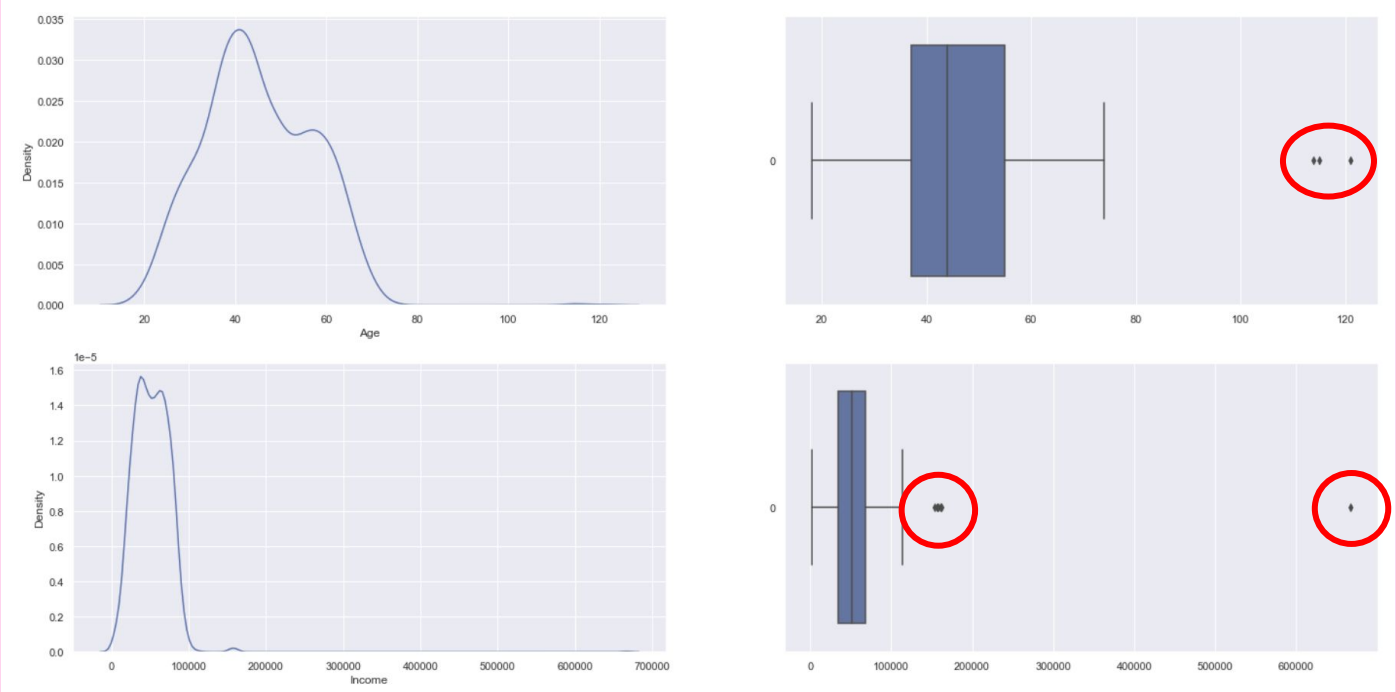
0		zero
1		one
2		two

Uni-variate analysis

Statistical
DESCRIPTION

Exploratory
ANALYSIS

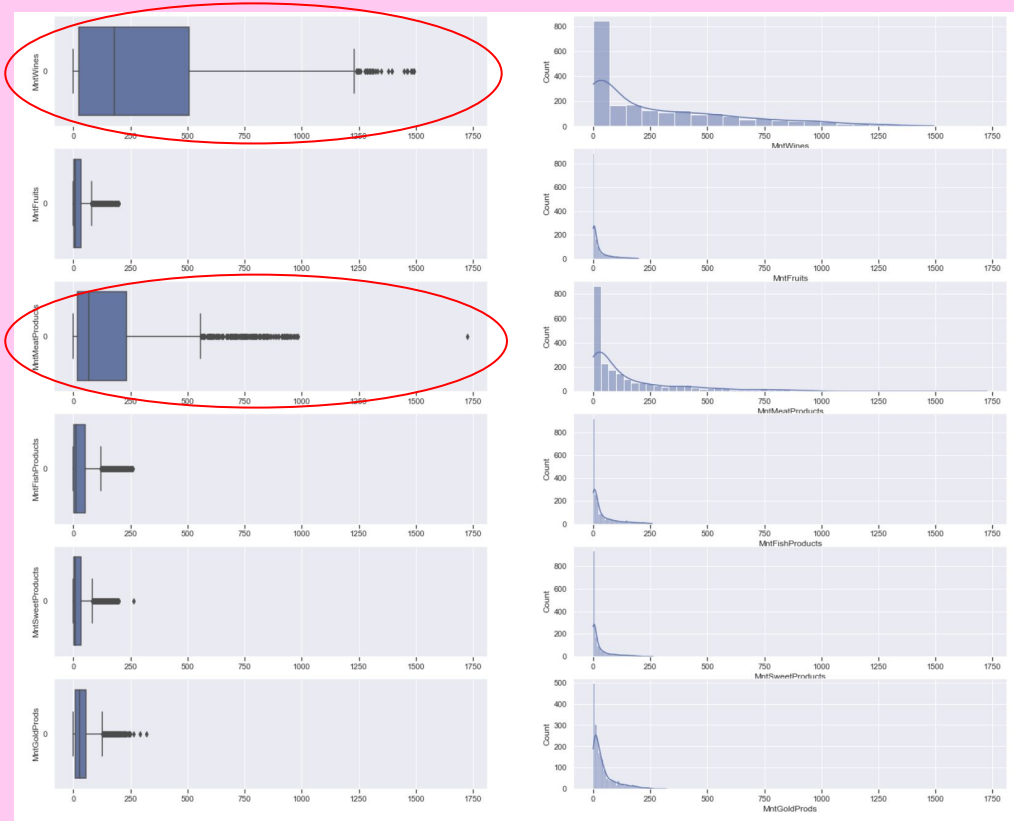
Income & Age



Statistical
DESCRIPTION

Exploratory
ANALYSIS

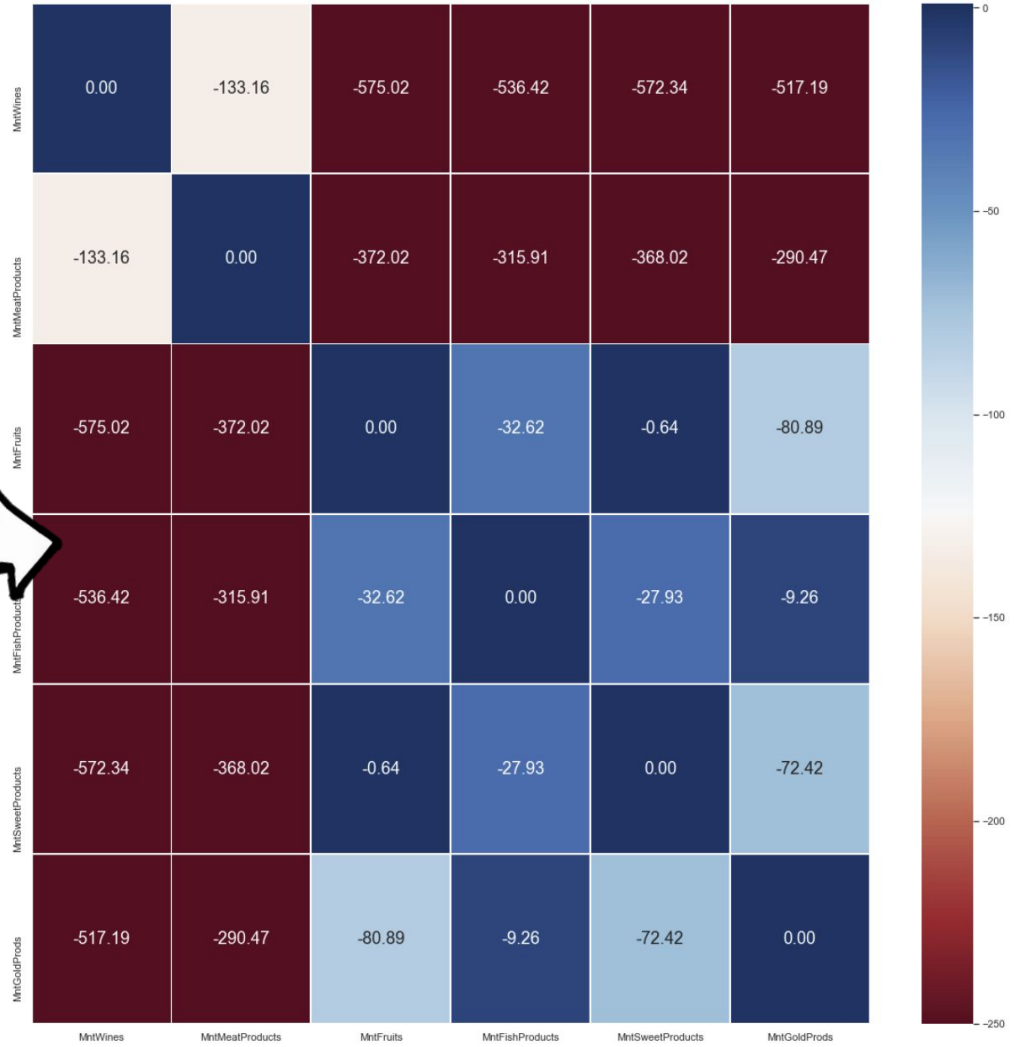
Amount Spent on various goods



Statistical
DESCRIPTION

Exploratory
ANALYSIS

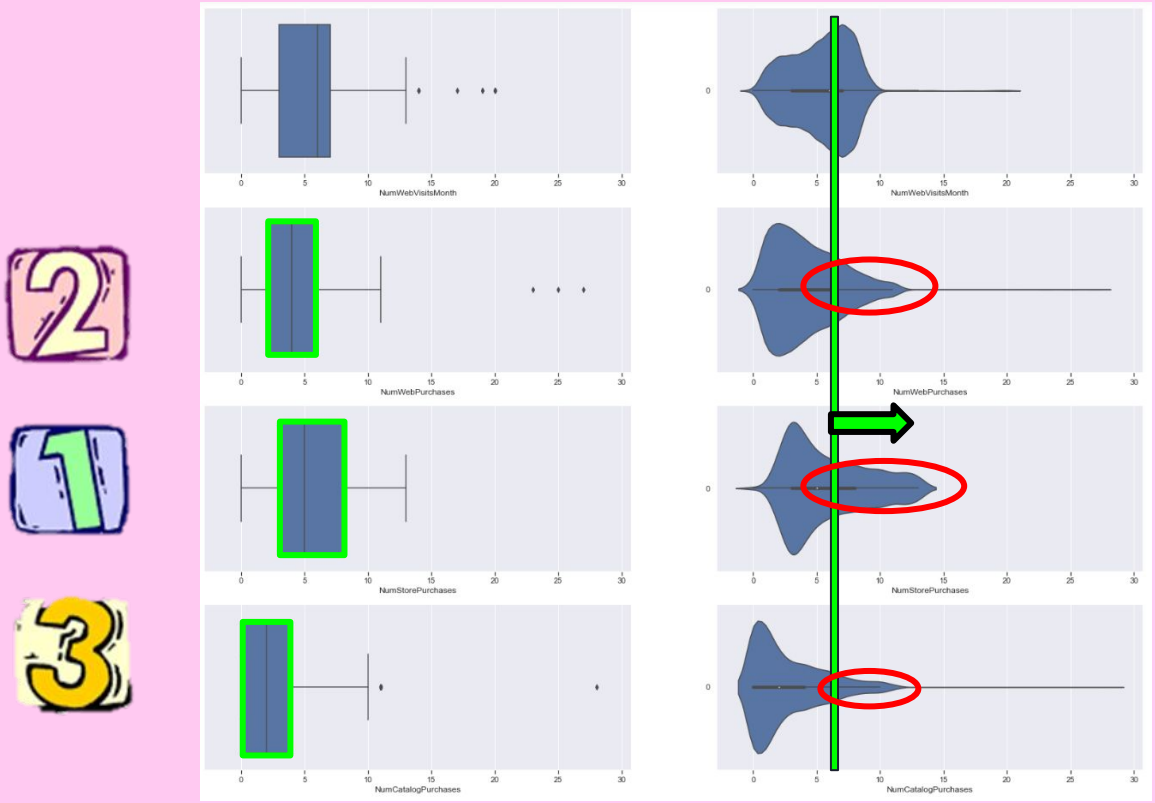
Dark Red indicates greater difference in distribution!



Statistical DESCRIPTION

Exploratory ANALYSIS

Number of Purchases on different platforms & Number of Web visits



Uni-variate analysis of **Categorical** Variables

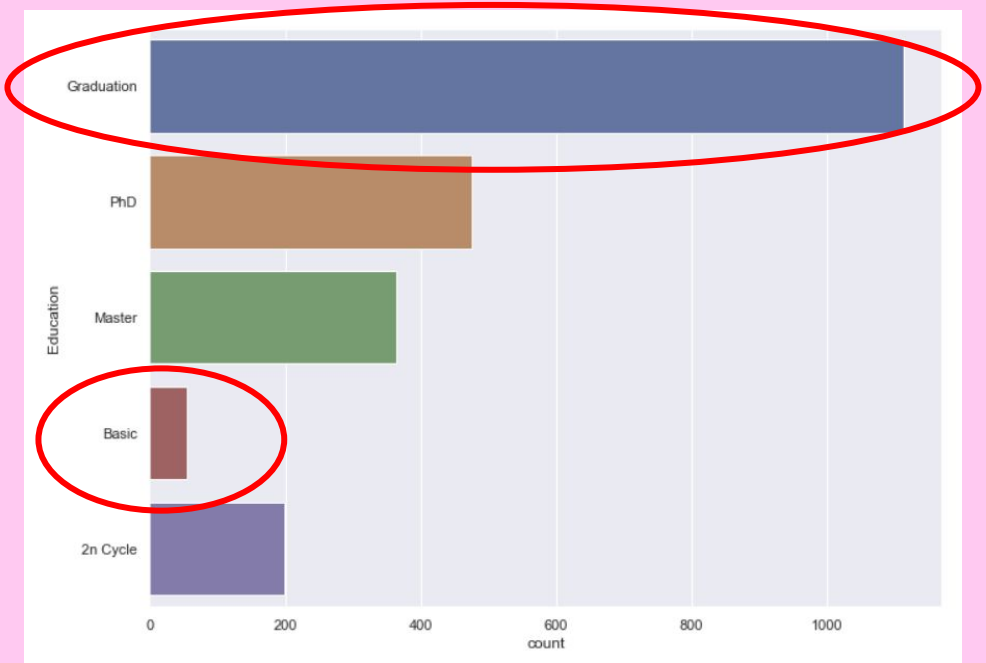
Imbalances

Statistical DESCRIPTION

Exploratory ANALYSIS

Education
(Categorical Cluster Feature)

```
Education:
Graduation     1113
PhD             476
Master          364
2n Cycle        198
Basic            54
Name: Education, dtype: int64
```

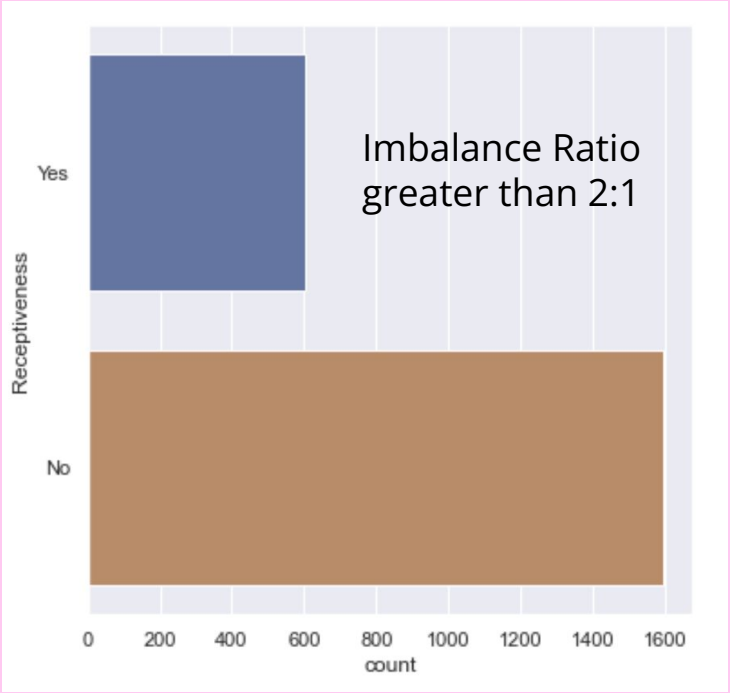


Statistical DESCRIPTION

Exploratory ANALYSIS

Receptiveness

```
Receptiveness:
No      1597
Yes      601
Name: Receptiveness, dtype: int64
```

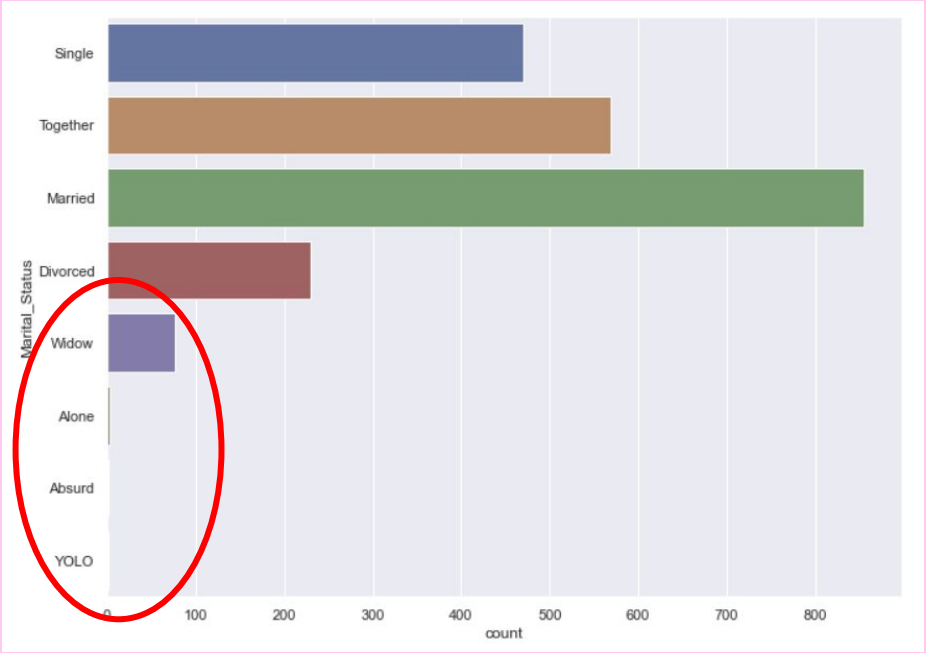


Statistical DESCRIPTION

Exploratory ANALYSIS

Marital Status
(Categorical Cluster Feature)

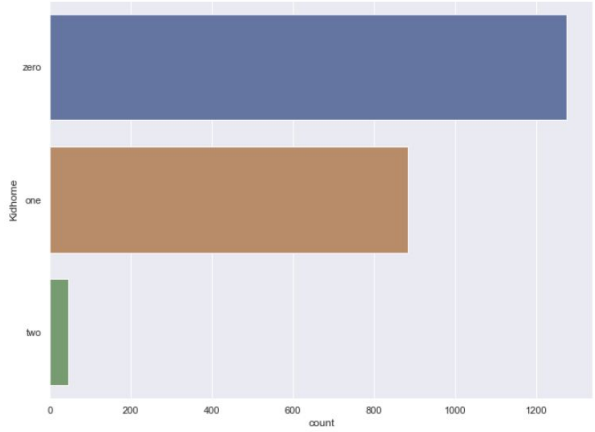
```
Marital_Status:
Married     854
Together    568
Single      470
Divorced    230
Widow        76
Alone         3
Absurd        2
YOLO          2
Name: Marital_Status, dtype: int64
```

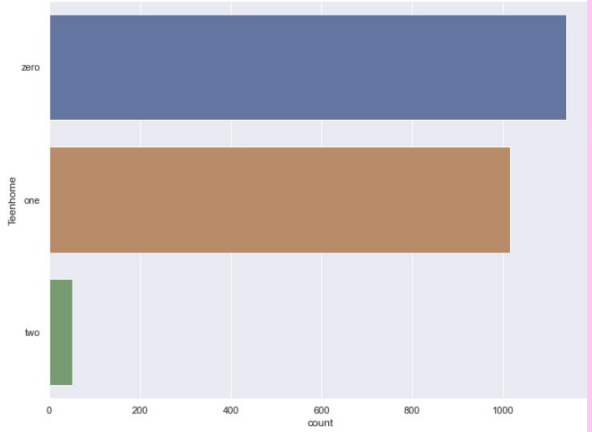


Kidhome & Teenhome
(Categorical Cluster Features)

```
Kidhome:
zero    1276
one      883
two       46
Name: Kidhome, dtype: int64
```

```
Teenhome:
zero    1139
one     1015
two       51
Name: Teenhome, dtype: int64
```





Combining 'one' and 'two' for Kidhome and Teenhome into a **single level**

```
No Kids      1276
Have Kids     929
Name: Kidhome, dtype: int64
```

```
No Teens     1139
Have Teens   1066
Name: Teenhome, dtype: int64
```

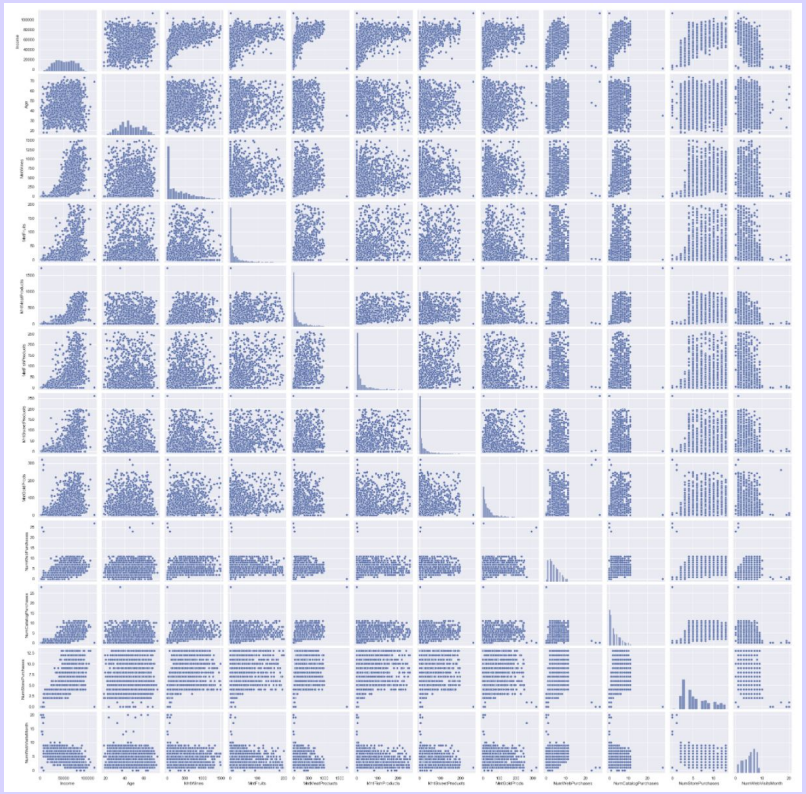
Analytic Visualisation & In-Depth Analysis

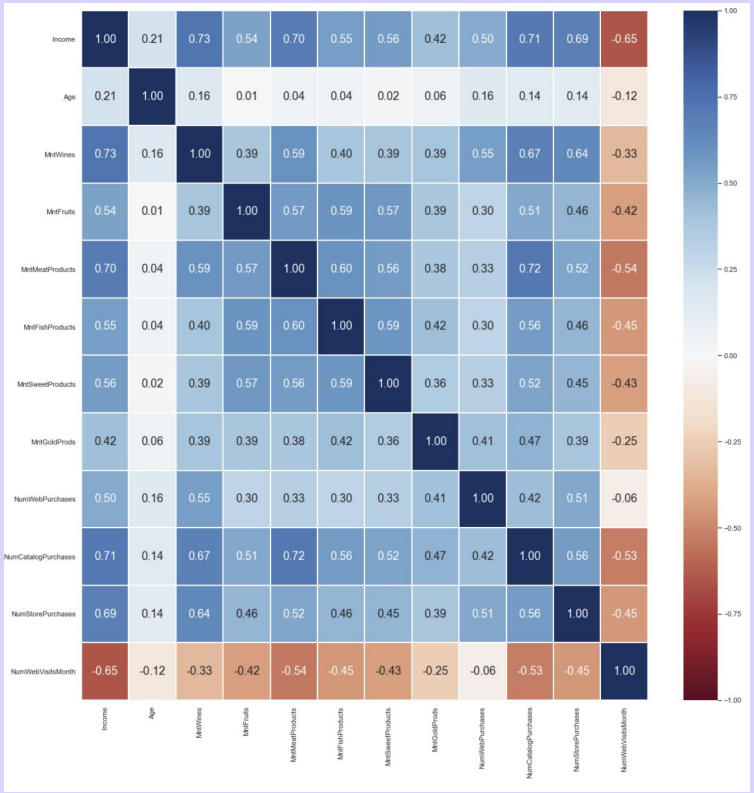
Bi-variate analysis of **Numerical** Variables

Pattern RECOGNITION

Analytic VISUALIZATION

Income & Age against ALL Numerical Response variables



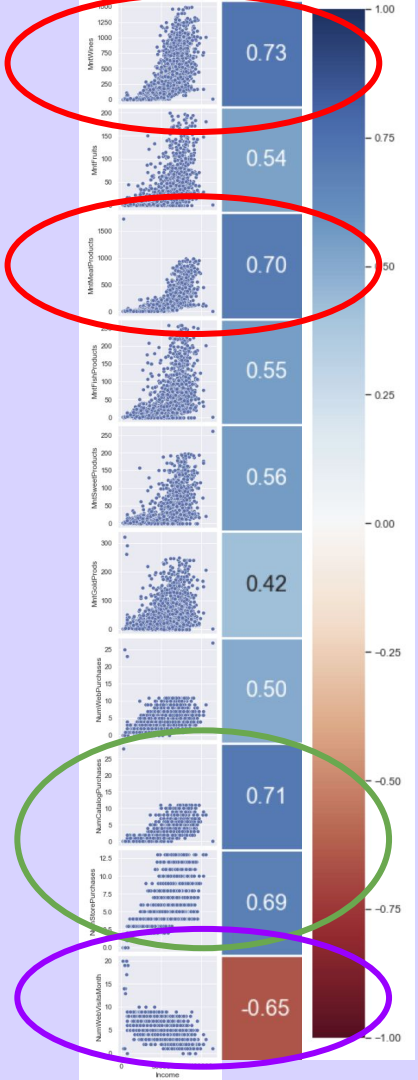


Pattern RECOGNITION

Analytic VISUALIZATION

Income

- High positive correlation with amount spent on Wine and Meat products
- High positive correlation with number of store and catalogue purchases
- Moderate **negative** correlation with number of website visits per month

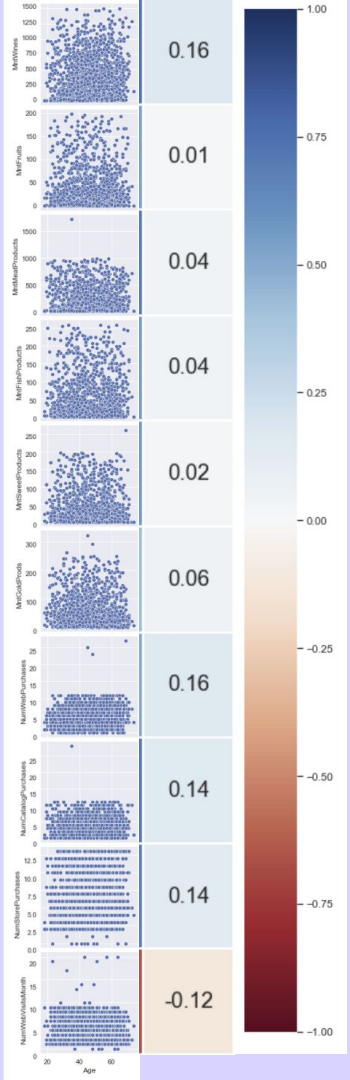


Pattern RECOGNITION

Analytic VISUALIZATION

Age

- Weak to almost negligible correlation with any of the numerical response variables
- This might mean that it isn't a good clustering feature
- **However**, since effective adverts are designed to appeal to the age-group of the target audience, we decided to still keep it as a clustering feature



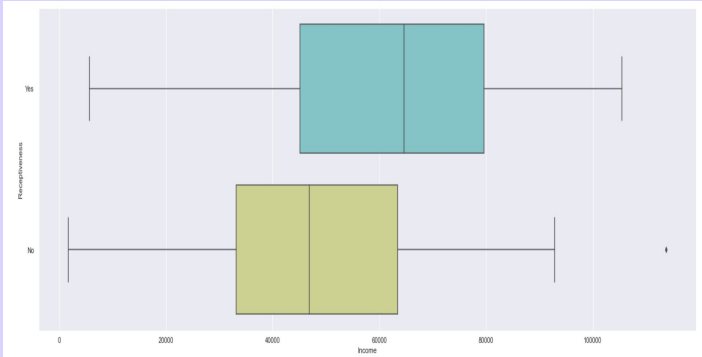
Pattern RECOGNITION

Analytic VISUALIZATION

Income & Age against Receptiveness

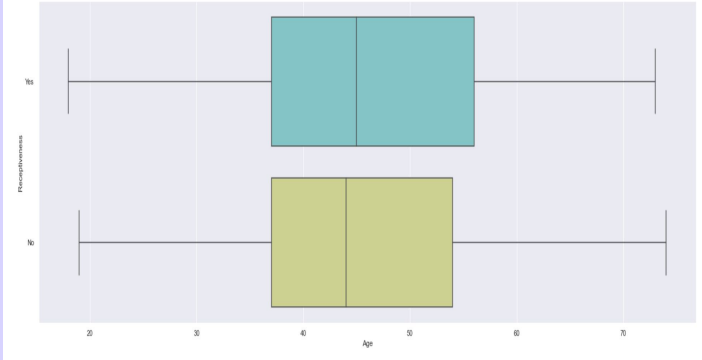
Income:

The higher one's income, the more receptive one is to promotions



Age:

Weak to negligible relationship between one's age and his receptiveness to promotions



Bi-variate analysis of **Categorical** Variables

Pattern RECOGNITION

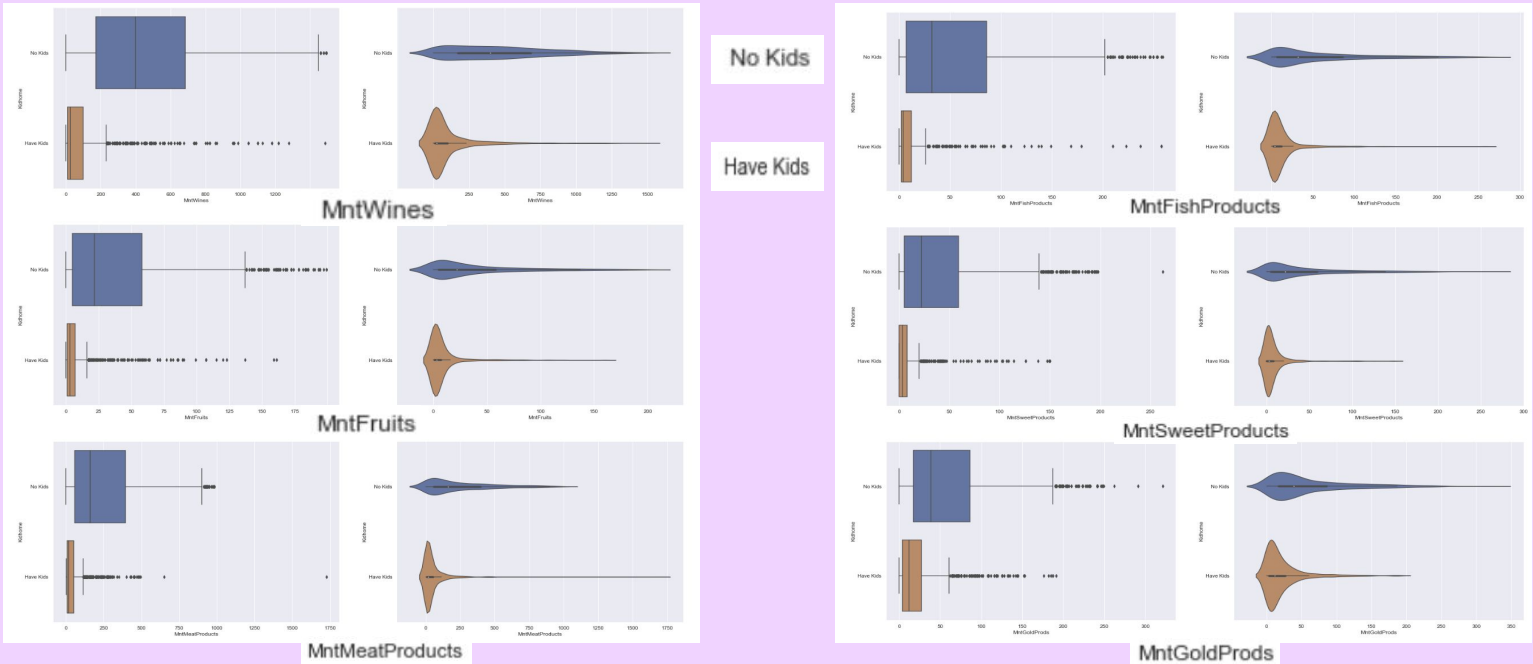
Analytic VISUALIZATION

1. Kidhome

Kidhome against Amount Spent on products

(Numerical Response Variables)

- Amount purchased tends to be higher for all products among people without kids.

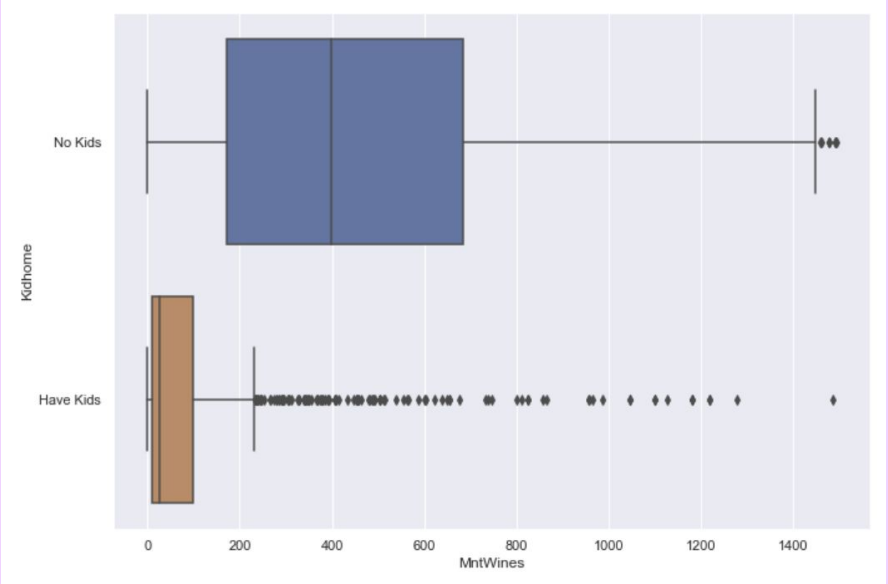


Pattern RECOGNITION

Analytic VISUALIZATION

Amount Spent on Wine (MntWines)

- Most notably, people without kids tend to spend a lot more on wine
- This can be seen from the greatest separation between the Interquartile ranges of both boxplots



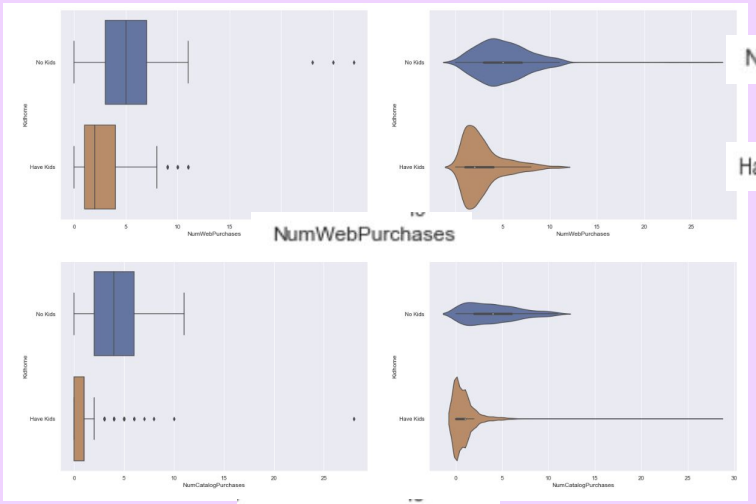
Pattern RECOGNITION

Analytic VISUALIZATION

Kidhome against Number of Purchases on different platforms & Website visits

(Numerical Response Variables)

- Number of purchases on all platforms higher among people without kids
- People with kids tend to visit the online store more frequently

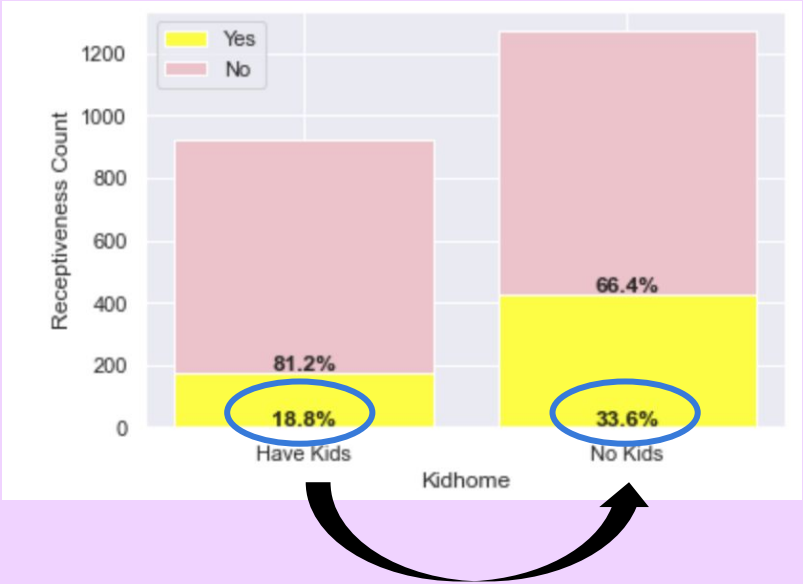


Pattern RECOGNITION

Analytic VISUALIZATION

Kidhome against Responsiveness
(Categorical Response Variable)

- People without kids tend to be more receptive to promotions
- This can be seen from the increase in proportion of people receptive to promotions



2. Teenhome

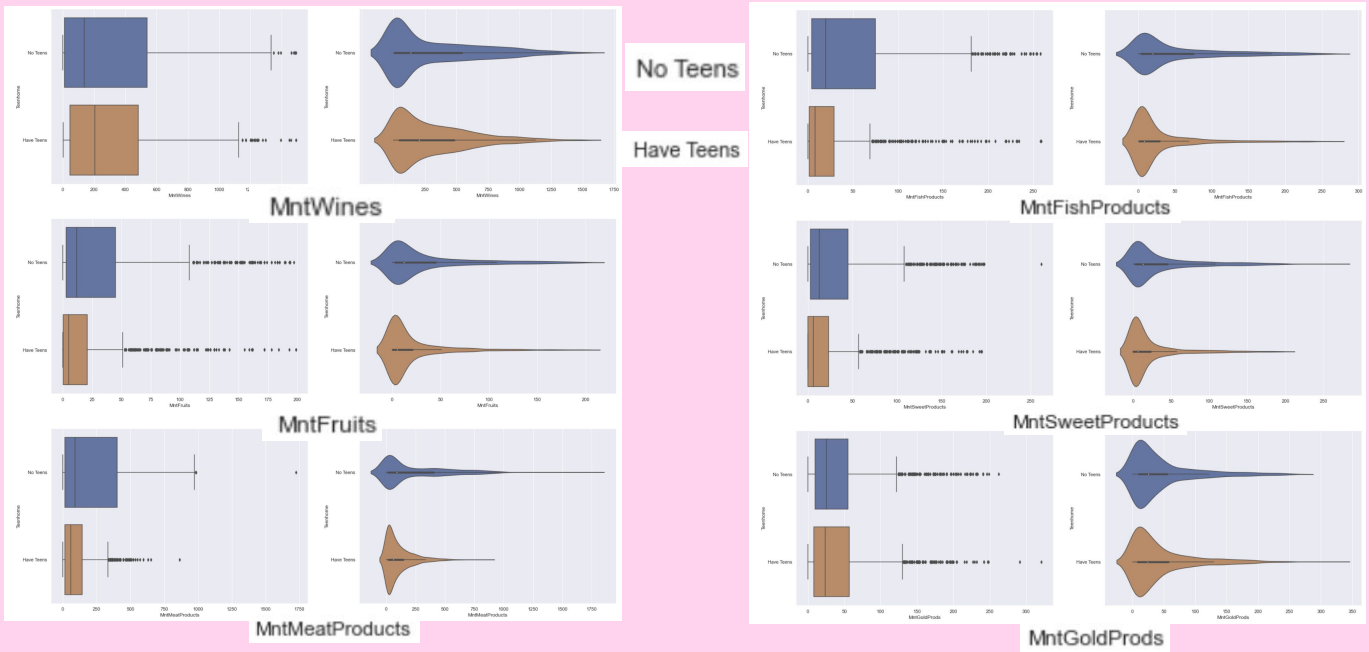
Pattern RECOGNITION

Analytic VISUALIZATION

Teenhome against Amount Spent on products

(Numerical Response Variables)

- Generally, the amount spent on all products are higher among people without teens

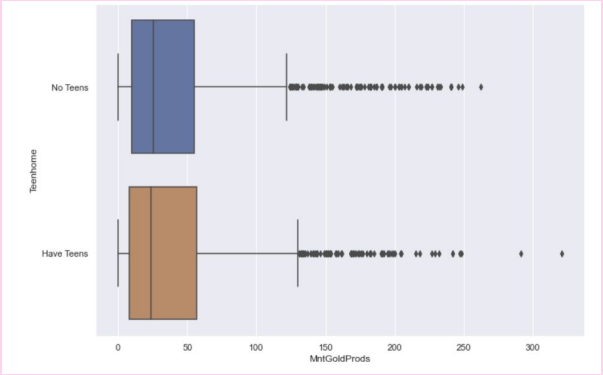


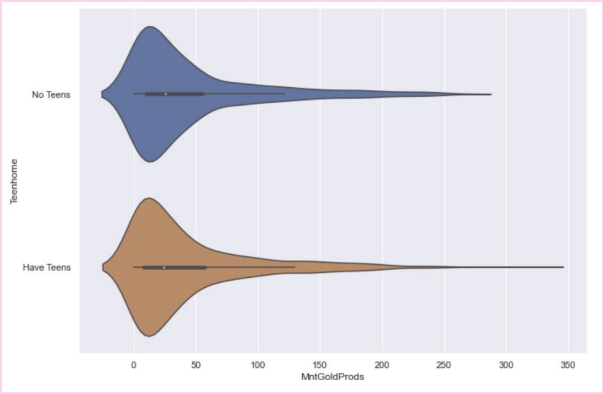
Pattern RECOGNITION

Analytic VISUALIZATION

Amount Spent on Gold (MntGoldProds)

- The amount spent on Gold (MntGold) are similar for both levels
- This can be seen from almost identical distributions and box plots for both levels



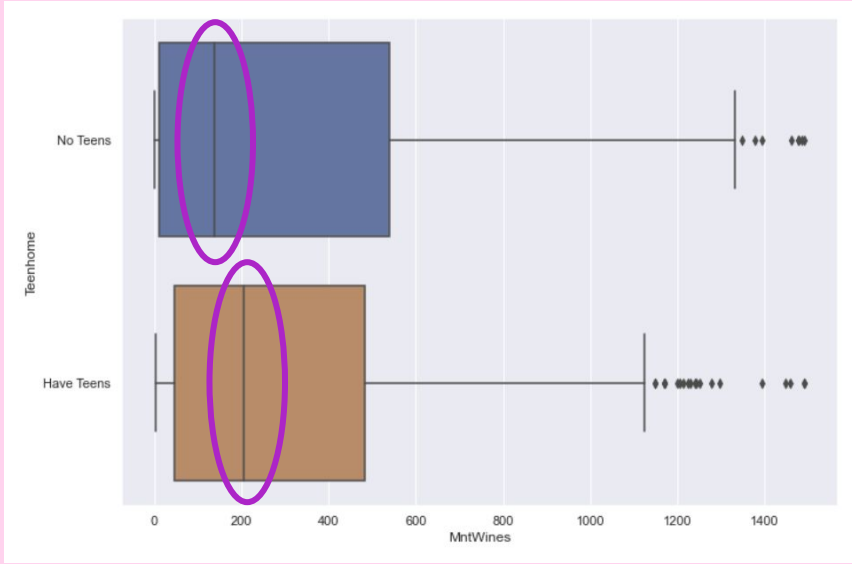


Pattern RECOGNITION

Analytic VISUALIZATION

Amount Spent on Wine (MntWines)

- People with teens tend to purchase slightly more wine (MntWines) than people without
- This is seen from the slightly higher median in the box plot for 'Have Teens' compared to that of 'No Teens'



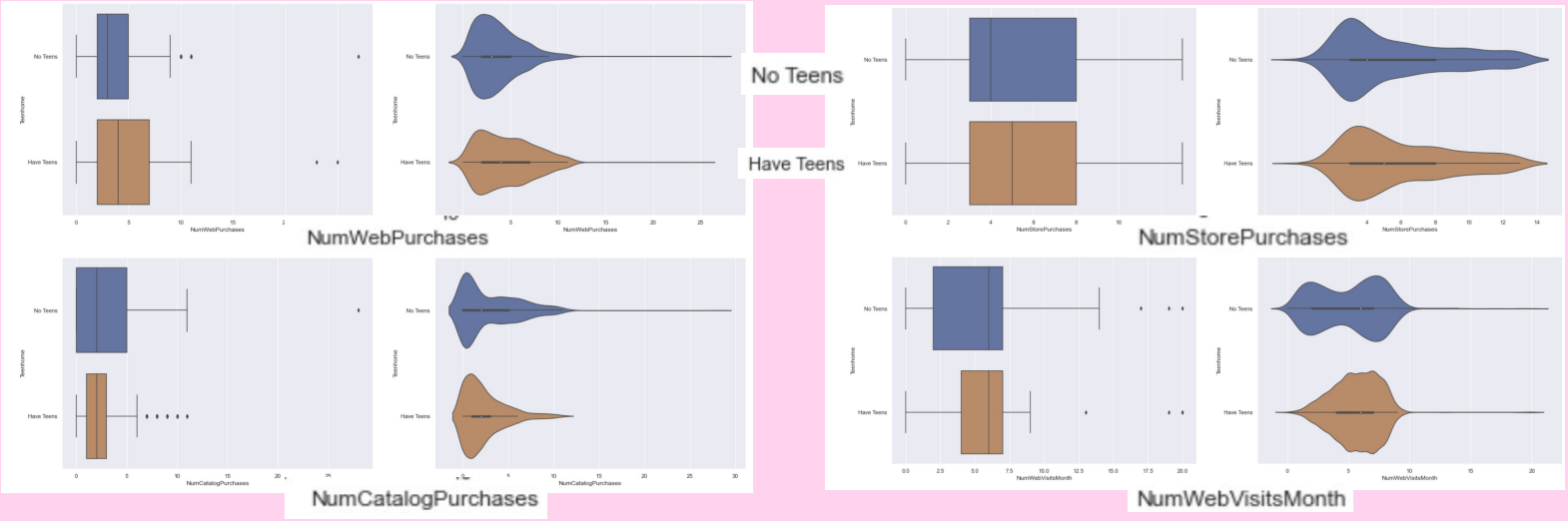
Pattern RECOGNITION

Analytic VISUALIZATION

Teenhome against Number of Purchases on different platforms & Website visits

(Numerical Response Variables)

- Generally, the number of purchases between both levels are largely the same with the exception of Number of Website Visits per month (NumWebVisits)

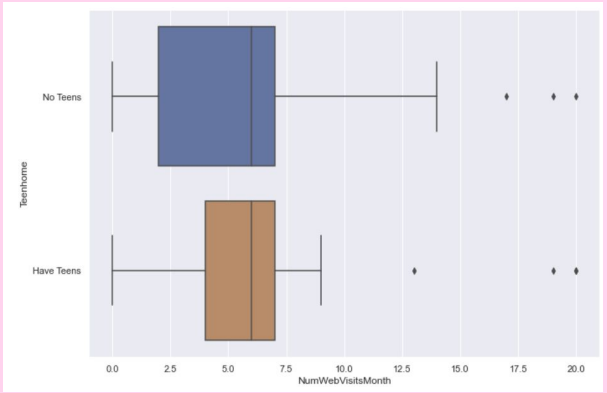


Pattern RECOGNITION

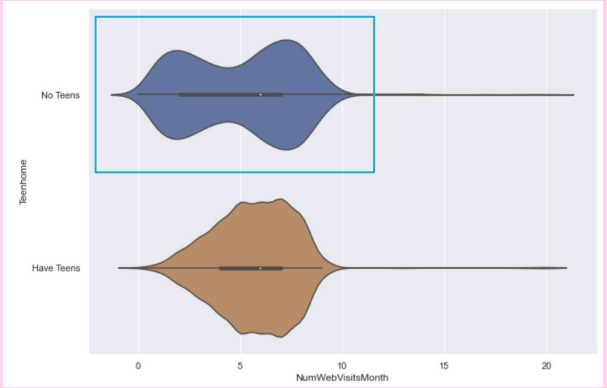
Analytic VISUALIZATION

Number of Website Visits per month (NumWebVisitsMonth)

- Bimodal distribution for 'No Teens' as evinced from violin plot



- A possible indication of two separate groups of people without teens – one group tends to visit the mall's website more often



Pattern RECOGNITION

Analytic VISUALIZATION

Teenhome against Responsiveness
(Categorical Response Variable)

- People without teens also tend to be more receptive to promotions
- This can be seen from the increase in proportion of people receptive to promotions

Pattern RECOGNITION

Analytic VISUALIZATION

3. Education

Pattern RECOGNITION

Analytic VISUALIZATION

Education against Amount Spent on products

(Numerical Response Variables)

- People with 'Basic' Education spend and purchase the least compared to other levels

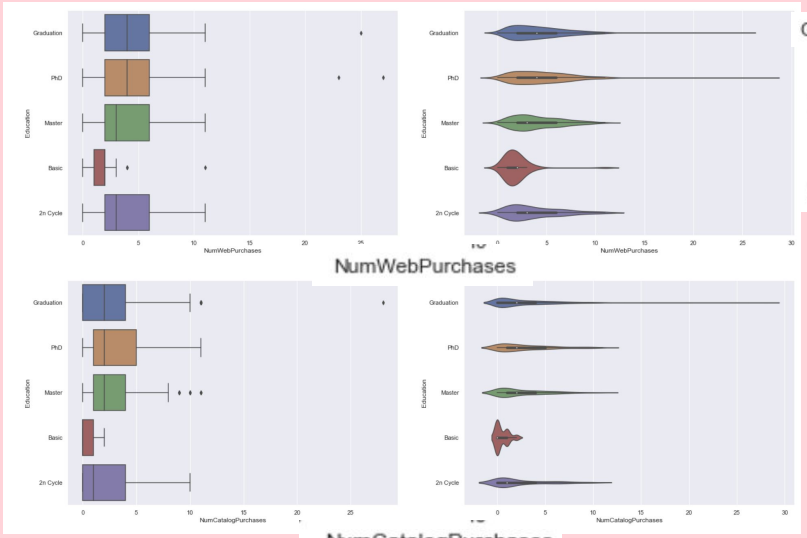
Pattern RECOGNITION

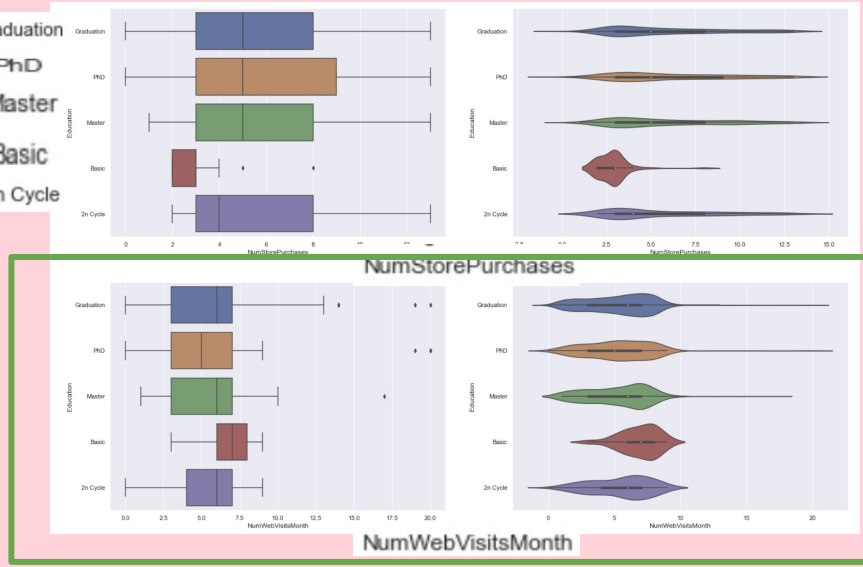
Analytic VISUALIZATION

Education against Number of Purchases on different platforms & Website visits

(Numerical Response Variables)

- Although spending the least on all platforms, people with 'Basic' education visit the online website most often





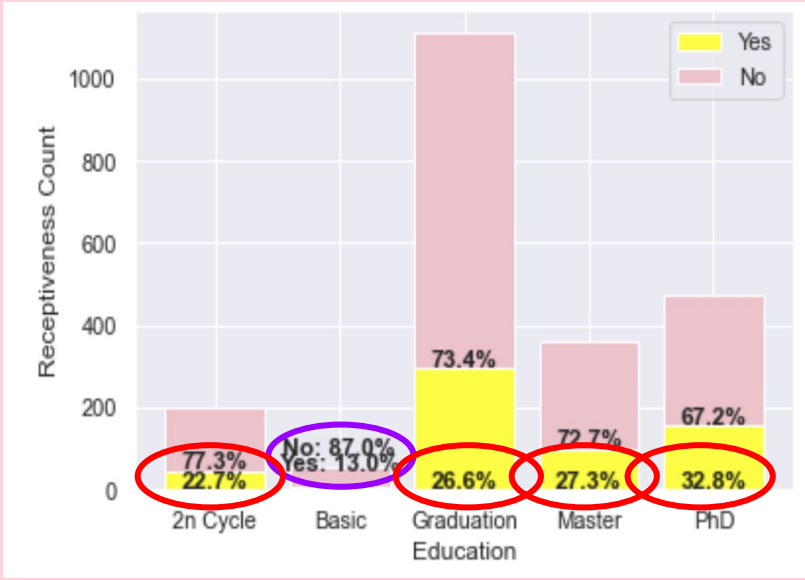
Pattern RECOGNITION

Analytic VISUALIZATION

Teenhome against Responsiveness
(Categorical Response Variable)

- People with 'Basic' Education tend to be less receptive to promotions compared to other education levels

- This can be seen from how only 13% of data points with 'Basic' are receptive compared to between 22.7% to 32.8% in the other Education levels



Pattern RECOGNITION

Analytic VISUALIZATION

HOWEVER...

- 'Basic' is skewed with only 54 counts
- Statistically unreliable as current distribution may not reflect actual distribution
- Other levels of education are all considered highly educated enough to make similar spending decisions

Decided **not** to use it as a clustering feature

Statistical DESCRIPTION

Exploratory ANALYSIS

4. Marital Status

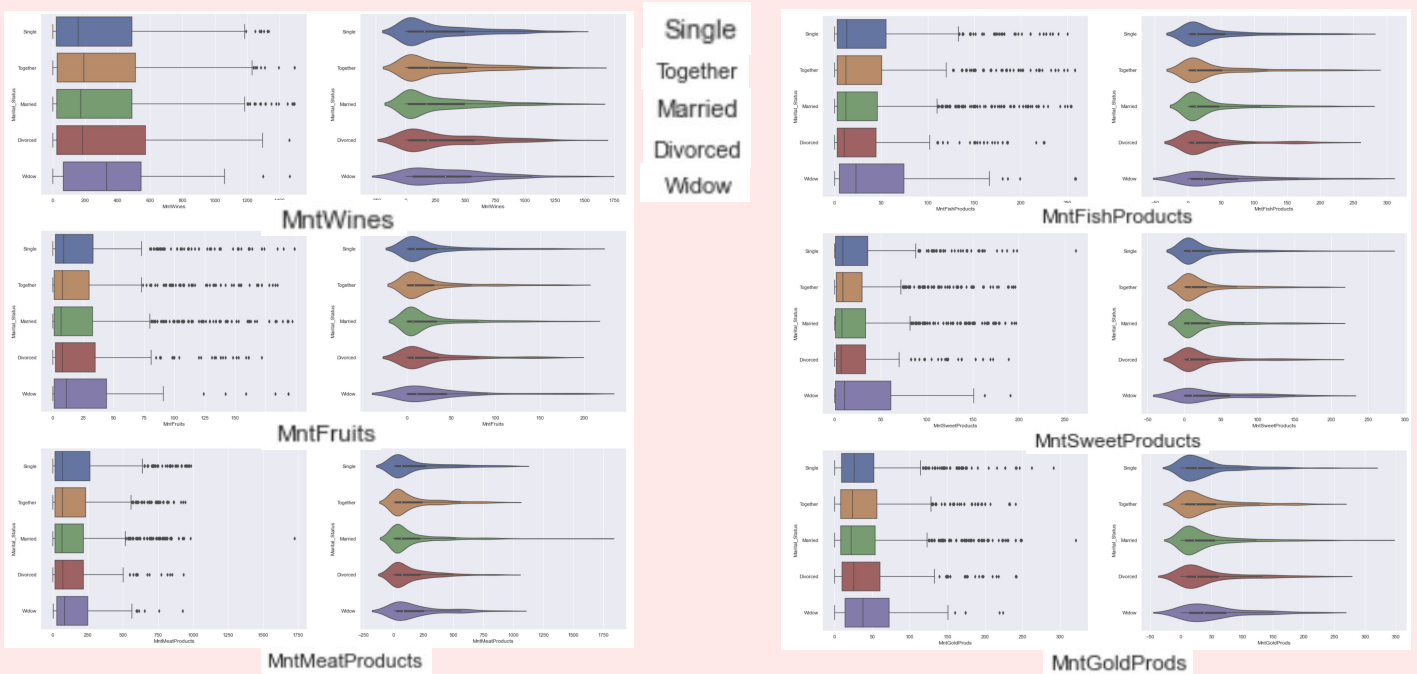
Pattern RECOGNITION

Analytic VISUALIZATION

Marital Status against Amount Spent on products

(Numerical Response Variables)

- Except for 'Widow', Marital Status **does not seem to affect the amount spent** on different products much
- This can be seen from the **largely similar distributions and box plots** for all levels except for 'Widow' which is only **slightly different**



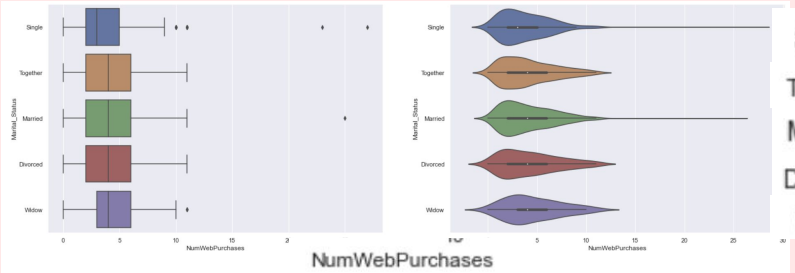
Pattern RECOGNITION

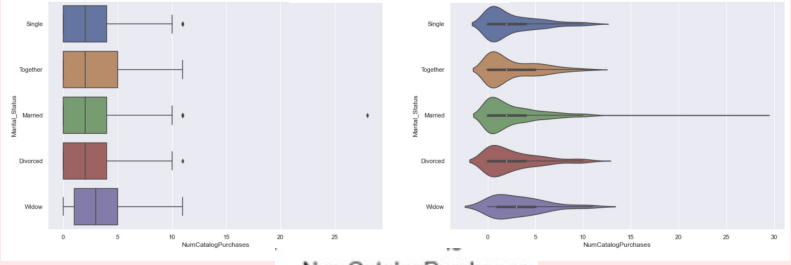
Analytic VISUALIZATION

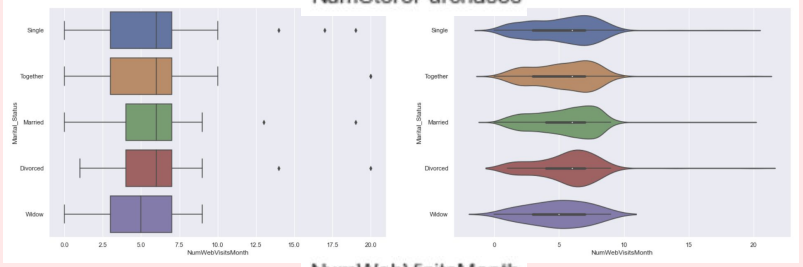
Education against Number of Purchases on different platforms & Website visits

(Numerical Response Variables)

- Likewise, Marital Status do not seem to be related to these response variables as seen from the largely similar distributions and box plots, with the exception of 'Widow' which is also slightly different

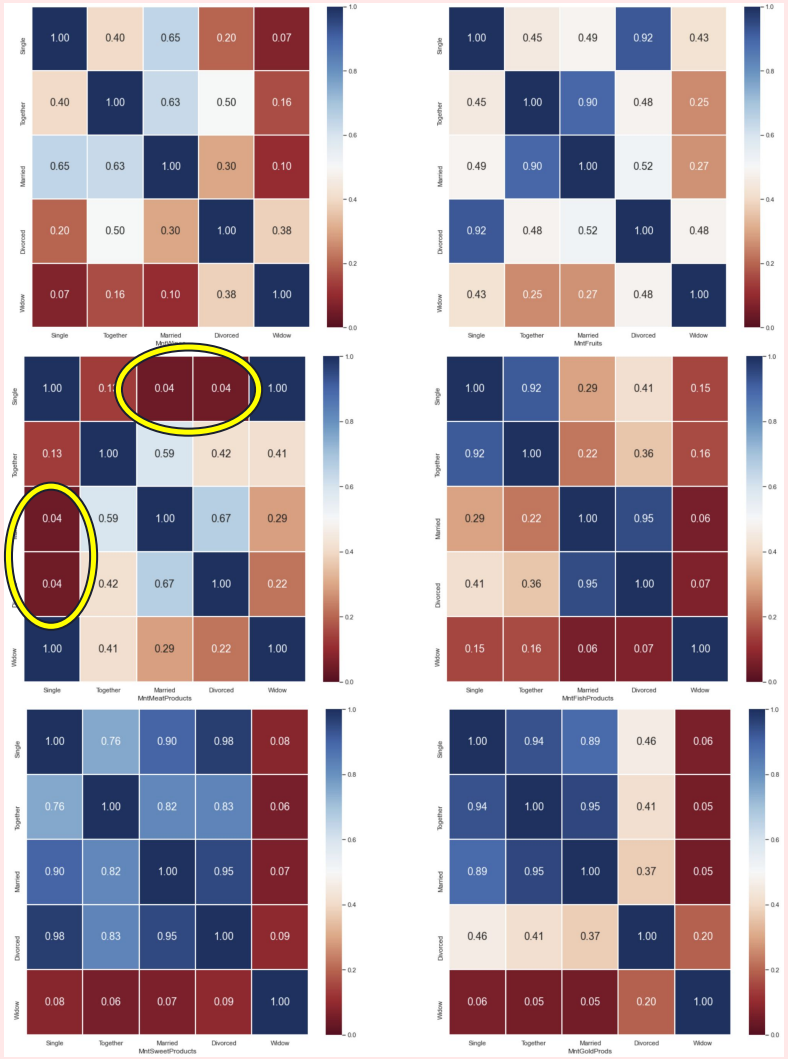


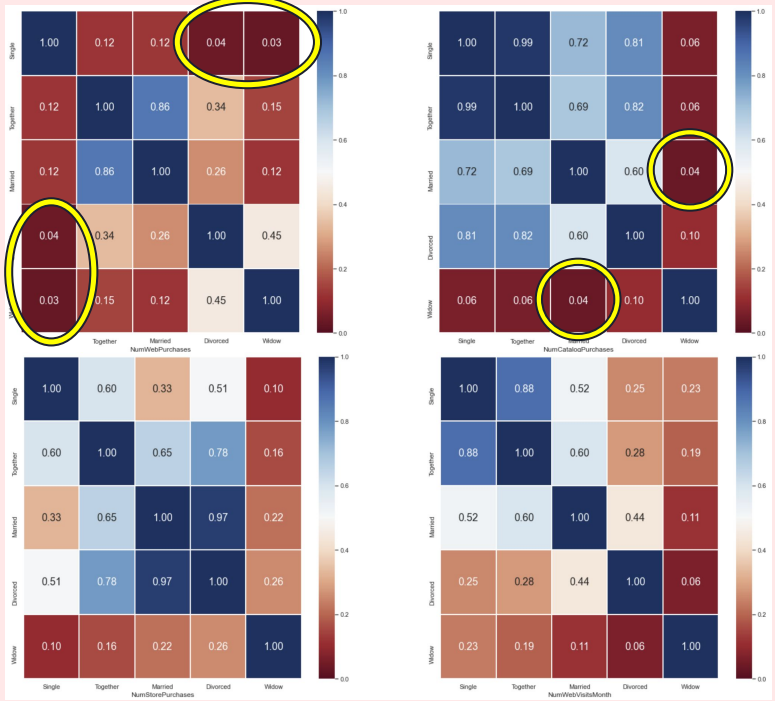




Statistical
DESCRIPTION

Exploratory
ANALYSIS





p-value of below 0.05
indicates that the two
distributions are different

A closer look

- The lowest p-value (0.03) is seen between 'Widow' and 'Single' for "NumWebPurchases"

- Low p-values of 0.04 also seen between levels other than 'Widow" but it isn't far from 0.05

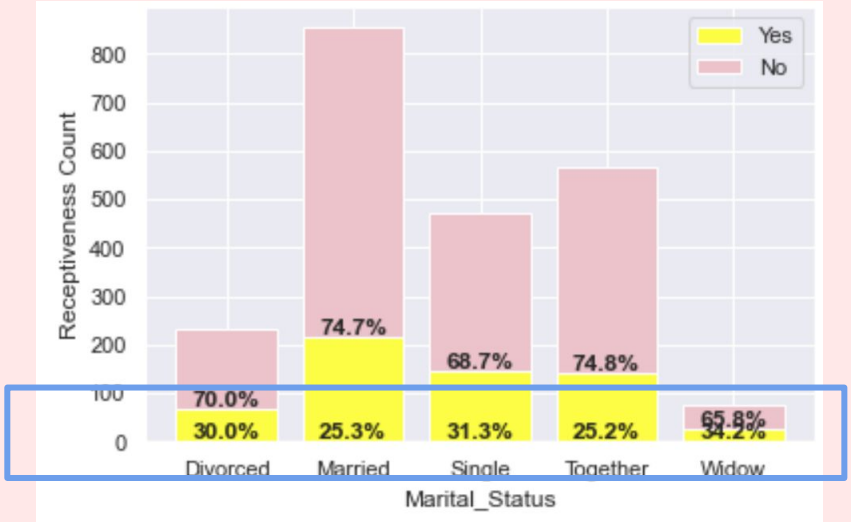
Pattern RECOGNITION

Analytic VISUALIZATION

Marital Status against Responsiveness
(Categorical Response Variable)

- No clear relationship between one's marital status and receptiveness towards promotions

- This can be seen from a largely similar proportion of data that are receptive to promotions in each level



BAD CLUSTERING FEATURE!

- Marital Status does not seem to have any relationship with the response variables as seen earlier
- Marital Status is also very imbalanced ('Widow' and 'Divorced' are the minority classes)
- Conclusions drawn for 'Widow' and 'Divorced' may be unreliable

Decided not to use it as a clustering feature

Pattern RECOGNITION

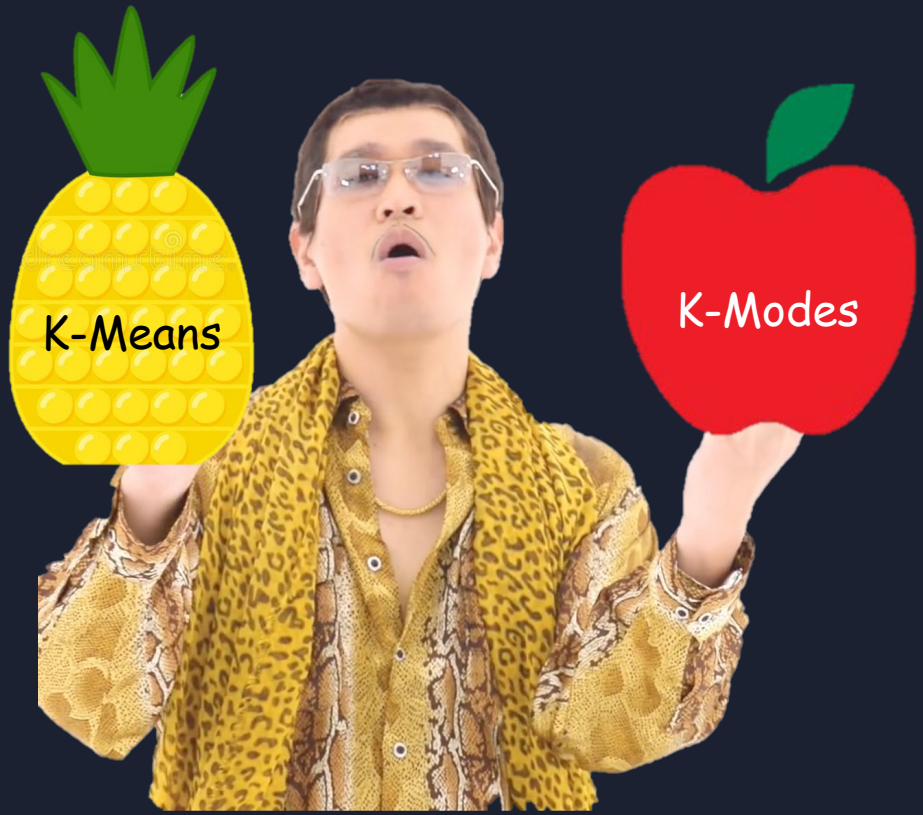
Analytic VISUALIZATION

Machine Learning (Clustering)

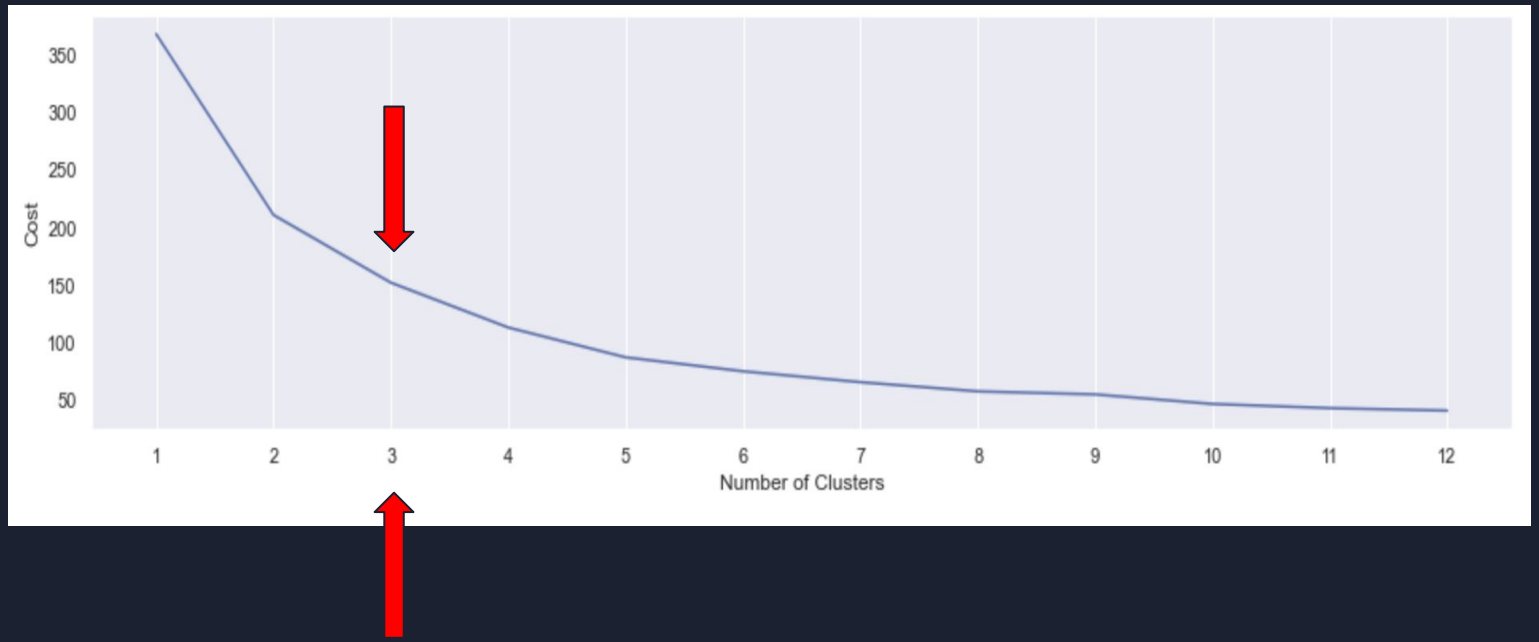
Machine LEARNING

Algorithmic OPTIMIZATION

K-Prototypes



The Best k-value



Machine LEARNING

Algorithmic OPTIMIZATION

Core-Analysis

Statistical INFERENCE

Information PRESENTATION

Customer Profiles of each Cluster

Statistical INFERENCE

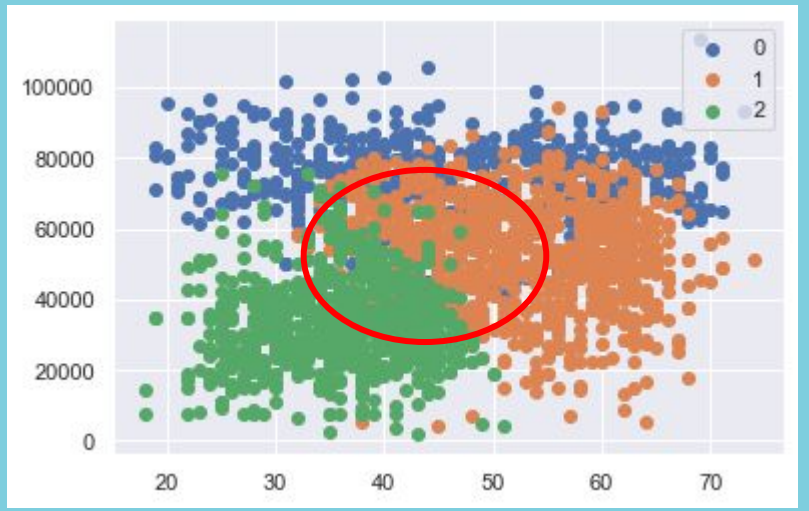
Information PRESENTATION

Analysis of clusters

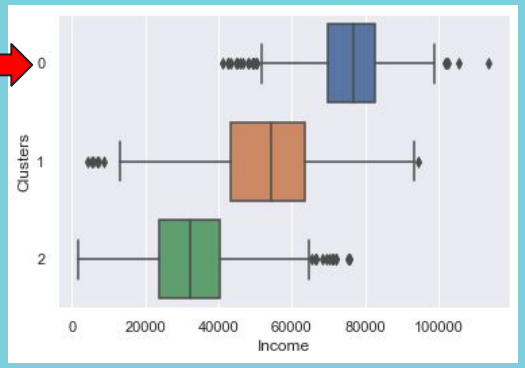
Plotting our clusters on a 2-D graph shows some degree of separation among the clusters

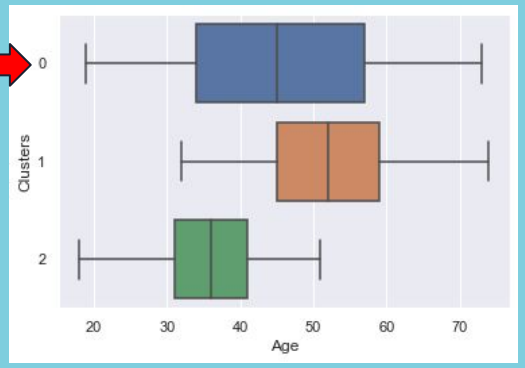
However, since we used 4 features for clustering, using a 2-D graph does not seem to exhibit the actual 'Distance' between the clusters

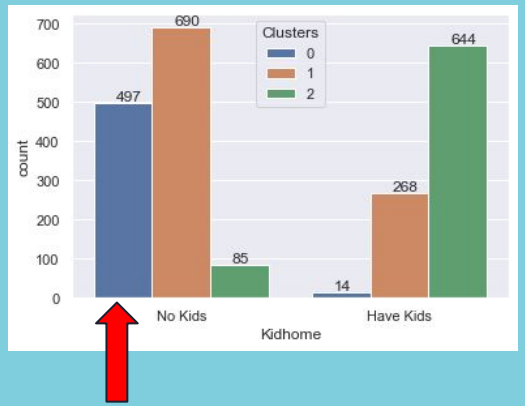
We will analyse the clusters against each cluster variable individually to have a better understanding of the different clusters

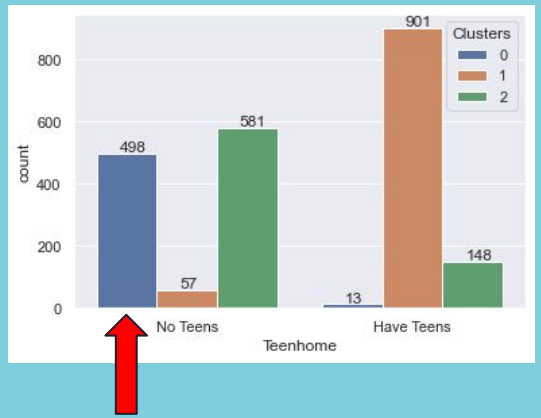


Analysis of clusters









Statistical INFERENCE

Information PRESENTATION

Statistical INFERENCE

Information PRESENTATION

Customer Profiles of each Cluster

Cluster 0:
- No Children (Kids or Teens)
- Rich

Cluster 1:
- Only have Teens
- Middle-Income
- 30 Years old and above

Cluster 2:
- Only have Kids
- Low-Income
- 50 Years old and below

Statistical INFERENCE

Information PRESENTATION

Purchasing behaviour for each cluster

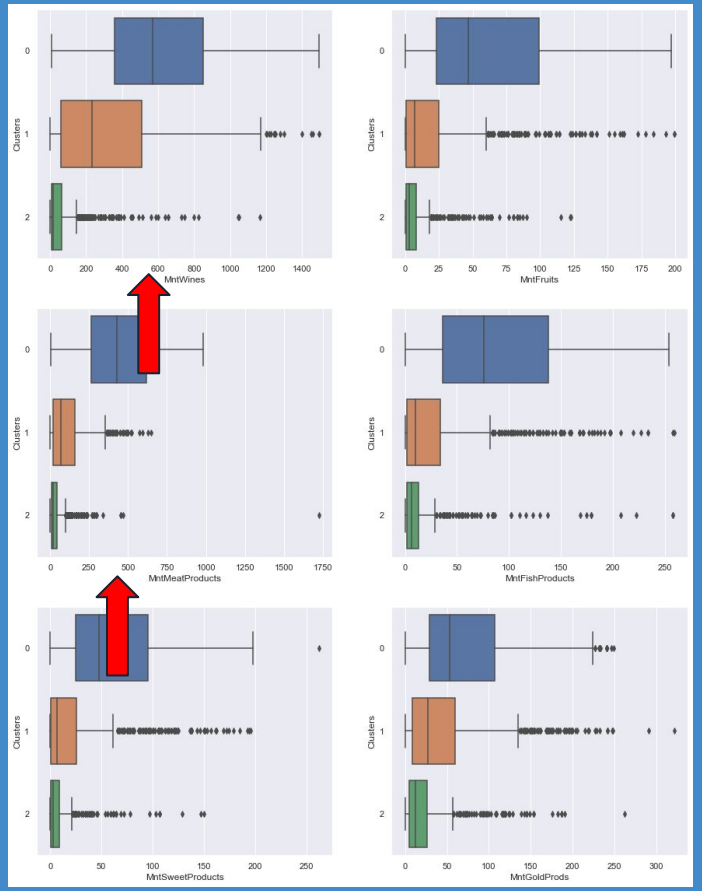
Statistical INFERENCE

Information PRESENTATION

Cluster 0 (Rich & No Children)

Purchase the most products in all categories

Disproportionately higher amount for Wine and Meat products (Absolute terms)

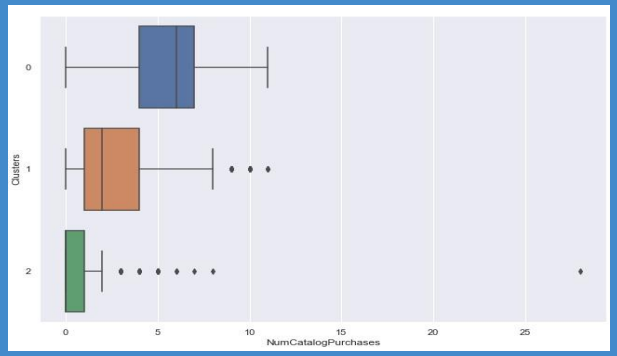


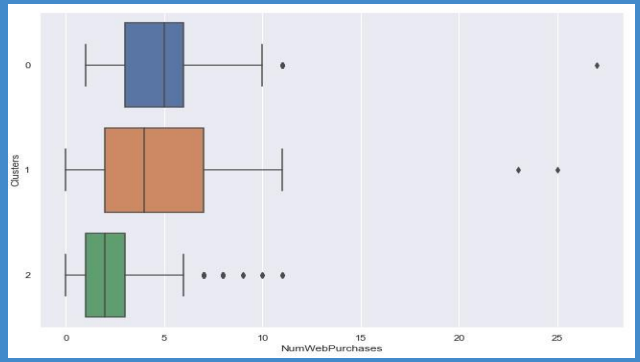
Statistical INFERENCE

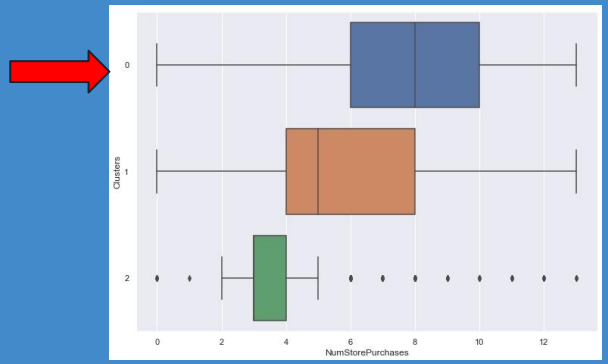
Information PRESENTATION

Cluster 0 (Rich & No Children)

Purchase from physical stores most out of the 3 platforms







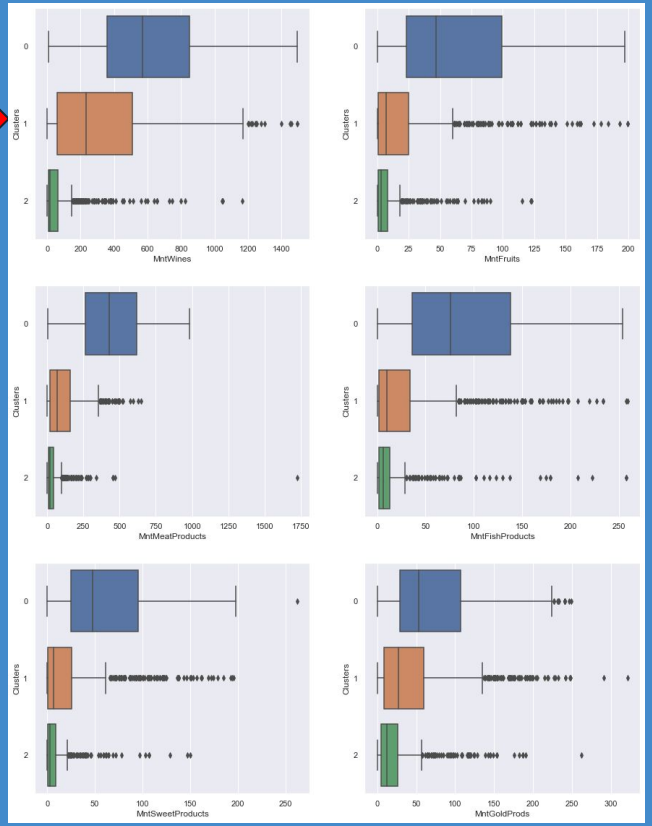
Statistical INFERENCE

Information PRESENTATION

Cluster 1 (Has Teen, >30 Y/O, Middle-income)

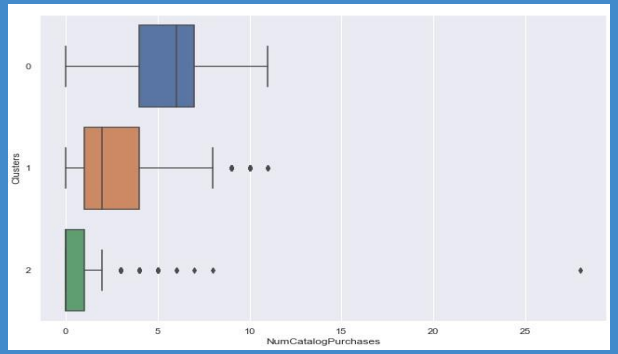
Purchase less than those in cluster 0 but more than those in cluster 2

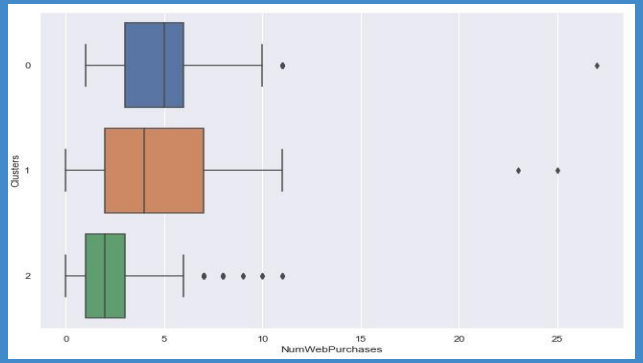
Buys a lot more wine products out of all the products

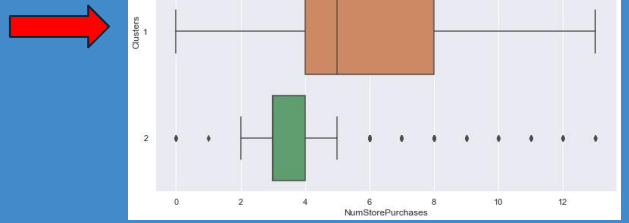


Cluster 1 (Has Teen, >30 Y/O, Middle-income)

Similar to cluster 0, cluster 1 purchase from physical stores most out of the 3 platforms







Statistical INFERENCE

Information PRESENTATION

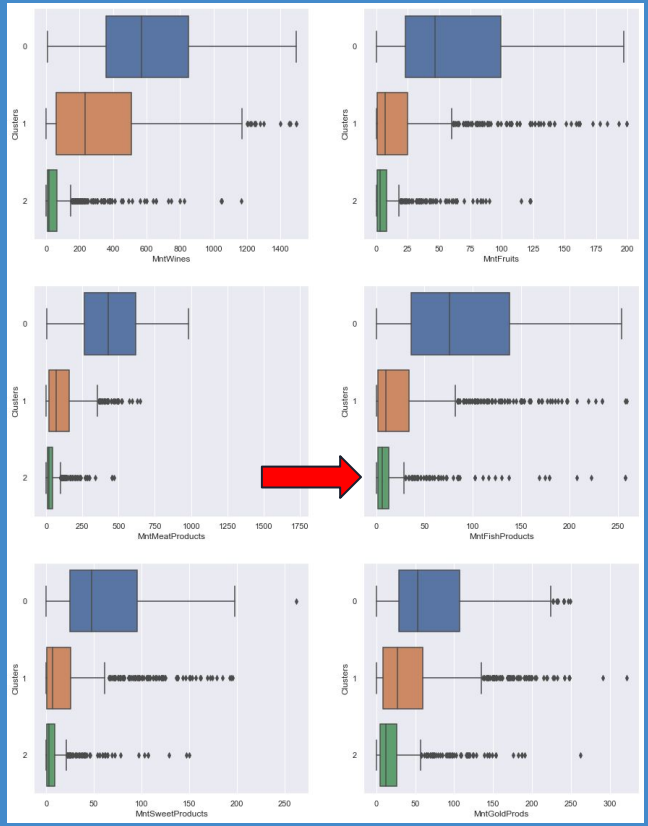
Statistical INFERENCE

Information PRESENTATION

Cluster 2 (Has Kid, <50 Y/O, Low-income)

Purchase the least amount of products in all categories

Out of the necessities, buys the most amount of fish products (although not by much)

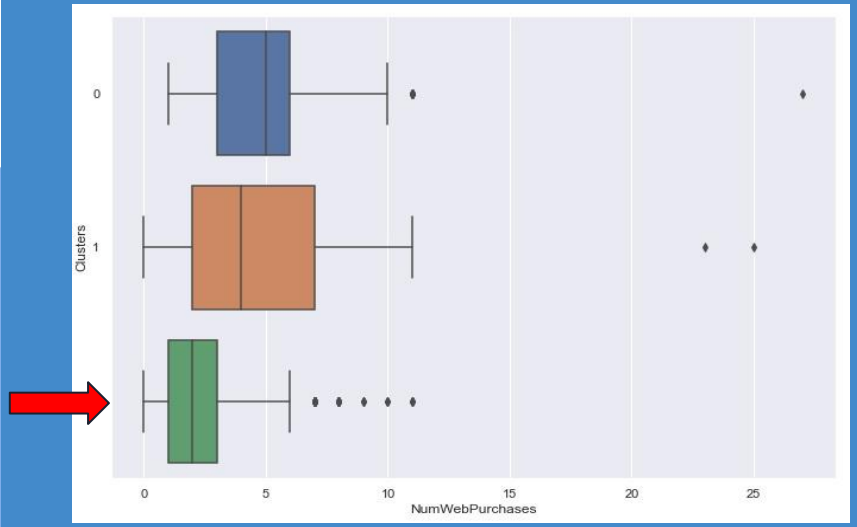


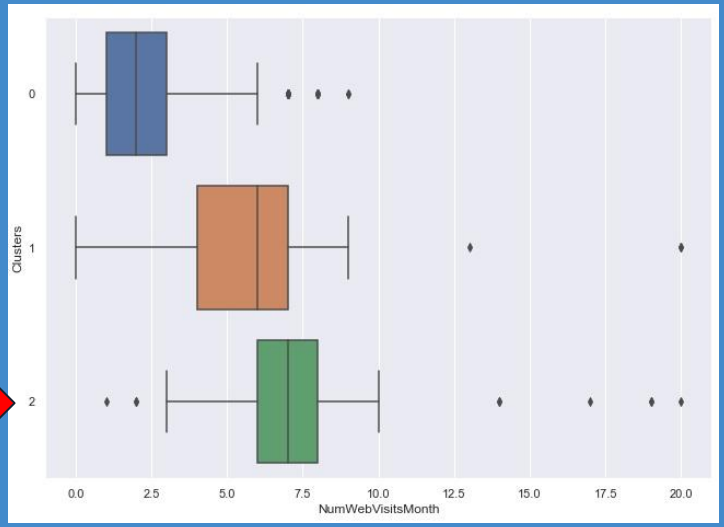
Statistical INFERENCE

Information PRESENTATION

Cluster 2 (Has kid, <50 Y/O, Low-income)

Visits the online shop most often but purchase the least from the online shop (tendency to window-shop)



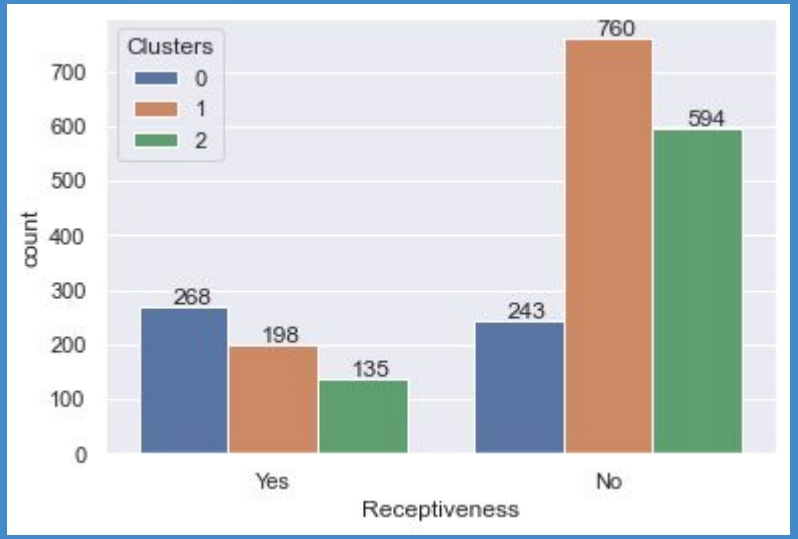


Statistical INFERENCE

Information PRESENTATION

Receptiveness based on clusters

People with higher income are more receptive to promotions
(in line with our previous conclusion)



Cluster 0 - 52% , Cluster 1 - 21% , Cluster 2 - 18%

Conclusion

Intelligent DECISION

Ethical CONSIDERATION

Possible advertising strategies

1. Carry out advertisements for meat and wine products in physical stores to target clusters 0 and 1
   (Make these advertisements cater to people of all age range)

2. Carry out advertisements for fish products in online stores to target cluster 2
   (Make these advertisements cater to the younger population)

Main problems answered:

1. What products to advertise
2. Which platform to advertise on
3. Whether promotions should be used

Limitations

Intelligent DECISION

Ethical CONSIDERATION

1. Ethical considerations:
While it is in line with business' interest to attract customers to maximise profits, advertisements of sensitive/addictive products should be done in a tasteful manner and with accordance with the law. (eg. our advertisements should not promote unhealthy consumption of wine)

2. Our conclusion is limited to the types of products given in the dataset which might not be reflective of all the all the products sold. We could be missing out on a large opportunity to advertise other products which are not reflected in the dataset


ZARA
ZARA
Chloé

WE GOT PROMOTED!!!


Thank you