Customer Behavior & Wine Purchasing Analysis

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Agenda

1. Business Understanding
2. Data Understanding
3. Supervised Model
4. Unsupervised Model
5. Prescriptive Analysis Model

Business Understanding

Overall Goal of the Analysis

- Helping a business to better understand its customers
- Targeting the right group of customers who are likely to buy wines
- Providing foundation information a firm can use to modify its marketing strategies based on customers' specific characteristics
    - Allowing the firm to spend the marketing budget most effectively and target specific customers most accurately

Data Understanding

Dataset

- From a third-parties online database: Kaggle
- Containing customers' background information and information about where the customers purchased the products, transactions' information, and related promotions
- There are 2240 observations, with 30 variables/predictors associated with each customers

Data Quality & Preparation

- Key variables includes year of birth, income, numbers of children at home, amount spent on wines, number of store purchases, amount spent on meat, whether or not a customer accept the offer promotion, and number of purchases made with a discount
- We also added an additional variable of age by subtracting the current year (2021) with year of birth

- There are 24 missing values for income
  - We substituted N/A with average income
- Outliers are found in the amount spent on wines and income
  - We dropped the extreme observations that exceeded 95th percentile for amount spent on wines
  - Outliers for income are reasonable
- Incorrect values are found in income (rows containing 666,666)
  - We dropped the incorrect values

- Main variables that will be used are normally distributed

```
    Income
 Min.   :  1730
 1st Qu.: 35303
 Median : 51382
 Mean   : 52247
 3rd Qu.: 68522
 Max.   :666666
 NA's   :24
```

```
    Income
 Min.   :  1730
 1st Qu.: 33494
 Median : 47723
 Mean   : 48985
 3rd Qu.: 64168
 Max.   :162397
```

Data Description

Variable	Type	Description
Income	Numerical	Customer's yearly household income
Age	Numerical	Customer's age
Kidhome	Numerical	Number of children in household
MntWines	Numerical	Amount spent on wine in last 2 years
MntMeatProducts	Numerical	Amount spent on meat in last 2 years
NumDealsPurchases	Numerical	Number of purchases made with a discount
Response	Categorical	1 if customer accepted the offer in the last campaign; 0 otherwise

Supervised Model: Linear Regression 1

Goal of the regression: predicting the amount spent on wines, based on continuous predictors of customers' age and income

- We believed that both predictors have an impact on the amount spent on wines
  - The higher the age and income, the higher amount spent on wines

```
Call:
lm(formula = MntWines ~ AGE + Income, data = marketing_campaign)

Residuals:
     Min       1Q   Median       3Q      Max 
-1227.94  -116.92   -30.21    86.96   676.09 

Coefficients:
              Estimate   Std. Error t value            Pr(>|t|)    
(Intercept) -234.1901798  20.5920457 -11.373 <0.0000000000000002 ***
AGE            0.6859714   0.3710798   1.849              0.0647 .  
Income         0.0090154   0.0002099  42.944 <0.0000000000000002 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 199.9 on 2125 degrees of freedom
Multiple R-squared:  0.4792,	Adjusted R-squared:  0.4787 
F-statistic: 977.7 on 2 and 2125 DF,  p-value: < 0.00000000000000022
```

The analysis showed that:

- Age is not significant; the coefficient of age indicates that additional 1 year increase in age is correlated with an increase of $0.69 of wines spending in the last 2 years
- Income is significant; the coefficient of income indicates that additional $1 increase in income is correlated with an increase of $0.009 amount of wines spending in the last 2 years

RMSE for the validation data = 202.7

RMSE for training data = 197.7

Supervised Model: Linear Regression 2

In order to have a better prediction, we improved the linear model by adding more variables to the model: number of children in household and number of purchases made with a discount

- We believed that both predictors have an impact on the amount spent on wines
  - Discount leads to higher spending and having kids might decrease the amount spent on

```
Call:
lm(formula = MntWines ~ AGE + Income + Kidhome + NumDealsPurchases,
    data = train_set)

Residuals:
     Min       1Q   Median       3Q      Max
-1380.09  -104.01   -24.42    65.39   654.27

Coefficients:
                    Estimate  Std. Error t value            Pr(>|t|)
(Intercept)      -103.5479702  32.3510491  -3.201             0.00141 **
AGE                 0.0402653   0.5235081   0.077             0.93870
Income              0.0071901   0.0002963  24.266 < 0.0000000000000002 ***
Kidhome          -143.5667821  11.8756541 -12.089 < 0.0000000000000002 ***
NumDealsPurchases  25.3919760   2.9273340   8.674 < 0.0000000000000002 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 188.8 on 1215 degrees of freedom
Multiple R-squared:  0.5328,    Adjusted R-squared:  0.5313
F-statistic: 346.4 on 4 and 1215 DF,  p-value: < 0.00000000000000022
```

The analysis showed that:

- KidHome is significant; the coefficient of KidHome indicates that an additional 1 child increase in household is correlated with a decrease of $143.57 amount of wines spending in the last 2 years
- NumDealsPurchases is significant; the coefficient of NumDealsPurchases indicates that every 1 purchases with a discount is correlated with an increase of $25.39 amount of wines spending in the last 2 years

RMSE for the validation data = 178.84

RMSE for training data = 188.45

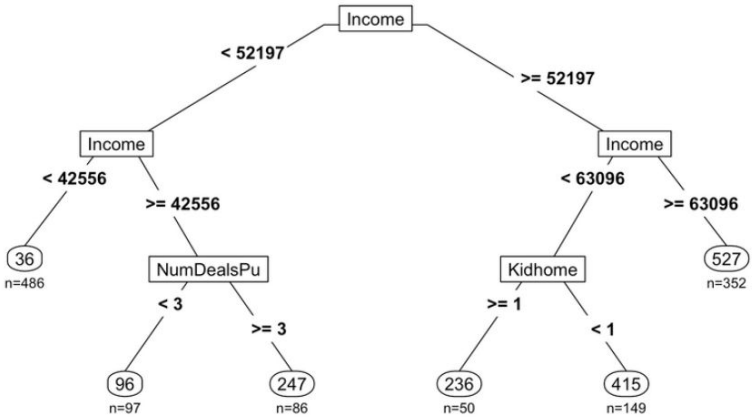
Supervised Model: Regression Tree

Goal of the regression: predicting and visualizing the value of the amount each customer spent on wine, based on the same set of numerical predictors used in linear prediction model

Target Variable: Amount spent on wine in the last 2 years

Predictors: Income, age, number of kids at home, number of purchases made with a discount

```
> rpart.rules(reg_tree_3)
 MntWines
       36 when Income <  42556
       96 when Income is 42556 to 52197                & NumDealsPurchases <  3
      236 when Income is 52197 to 63096 & Kidhome >= 1
      247 when Income is 42556 to 52197                & NumDealsPurchases >= 3
      415 when Income is 52197 to 63096 & Kidhome <  1
      527 when Income >=          63096
```

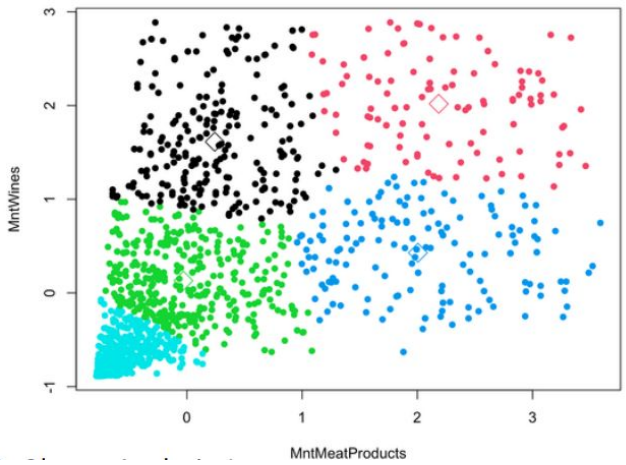


RMSE for the validation data = 173.43
RMSE for training data = 188.46

Unsupervised Model: Cluster Analysis 1

Goal of clustering: forming groups of similar customers, based on their transactions and number of purchases where customers make in one store

K-mean Analysis: group of amount spent on meat products and wines

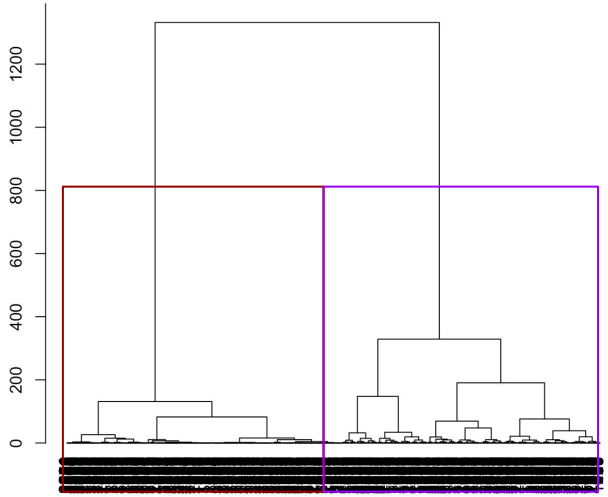


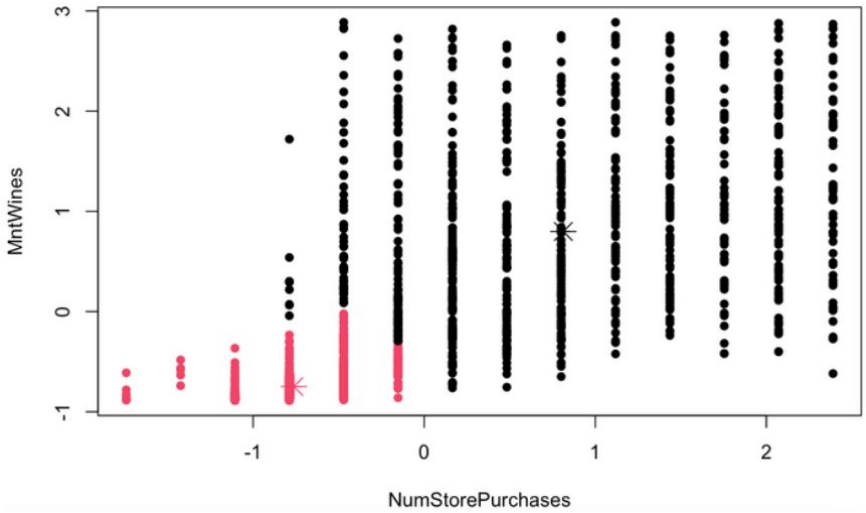
- customers who did not spend much on both meat and wines (1008 observations)
- customers who spent money on meat but not much on wine (165 observations)
- customers who spent a relative amount on meat and wines (96 observations)
- customers who spent much on wine, but not meat (241 observations)
- customers who spent on a lot of both meat and wine (121 observations)

Unsupervised Model: Cluster Analysis 2

Goal of the clustering: forming groups of similar customers, based on their transactions and number of purchases where customers directly make in a store

Ward Method: group of the amount spent on wine and in-store purchases

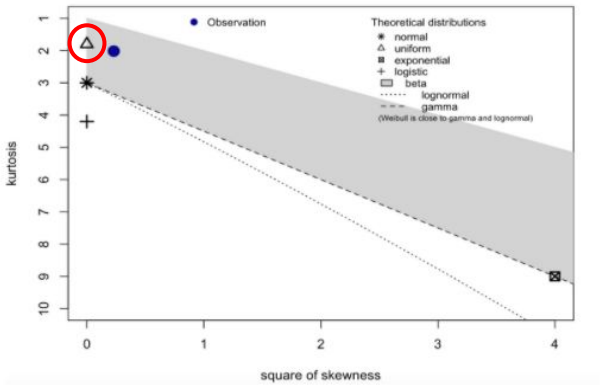




Prescriptive Analysis: Monte Carlo Simulation

Goal of the simulation: to better understand the uncertainty in total spending on wines by a group of new customers who accept the discount promotion

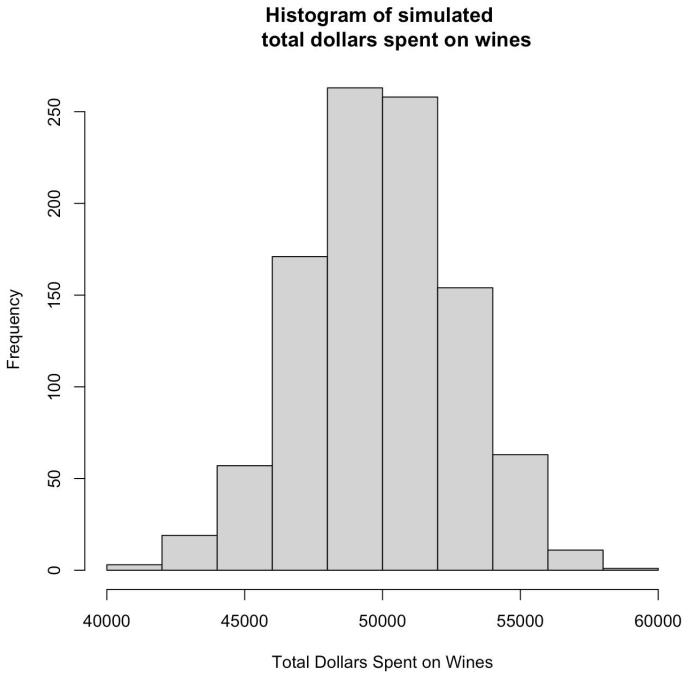
Assumptions: Suppose that the store attracted 100 new customers in a recent campaign. We assumed that the spending on wines from these customers for the next 2 years followed the same distribution pattern as the previous customers who accepted the promotion for the last 2 years



Parameters of the distribution:
Min = 1
Max = 997

Fittest distribution to the average amount of spending each time of the observations is most close to the uniform line

Prescriptive Analysis: Monte Carlo Simulation




```
WineSpent_vec <- c()
nsim <- 1000

for (i in 1:nsim) {
  sim_W <- runif(n = 100, min = 1, max = 997)
  WineSpent_vec[i]<- sum(sim_W)
}
```

Findings:

- The average total spending on wines by this group of new 100 customers would be around $49,911
- The 95% confidence intervals for the expected amount of spending fall into a range of $49,735 to $50,087
- The probability of receiving more than $50,000 in total spending from these 100 new customers is around 48.1%

Q & A