Brief Comparative Analysis on Coupon Acceptance and Rejection

1 Problem Description

Various coupon types are distributed to drivers for meal services and operations who either accept or refuse the assigned coupon.

There are five categories of meal establishments:

- coffee houses,
- bars,
- carry away
- two types of restaurants distinguished upon pricing (costs less than twenty dollars or from twenty to fifty dollars).

Each coupon has a precise expiration duration taking two distinct values, two hours or one day, after which the coupon becomes invalid.

Additional personal information on drivers is available regarding gender, age, marital status, number of children, education, occupation, annual revenues as well the related frequency of visiting each type of establishment.

Furthermore, other environmental data (temperature, weather, time and distance to the establishment), driver final destination and potential co-passengers are also available.

Client response, accepting or refusing the coupon is also given.

Based on the available information, characterization of the population regarding acceptance and rejection of the delivered coupons is aimed.

Considering a specific coupon type the related driver characteristics are going to be discussed based only on visualisations. A similar analysis will be able to be followed for any other type of coupon.

The study starts with a brief data examination contributing to a better understanding of the related context and utility of each feature.

Furthermore, this part includes a first data treatment aiming at the employment of correct, complete and coherent information.

The remaining of this analysis is comprised of three distinct parts each once concerning a different set of the considered driver population.

2 Exploring Available Information

A data exploration shows that two types of variables exist:

- *numerical data* consisted of eight variables:
  - temperature, describing the temperature at the time the coupon was sent
  - has_children, responding to whether or not the considered driver has children
  - toCoupon_GEQ5min, distance between driver's location and the proposed meal service location, (measured in time, here it is five minutes)
  - toCoupon_GEQ15min, distance between driver's location and the proposed meal service location, (measured in time, here it is fifteen minutes)
  - toCoupon_GEQ25min , distance between driver's location and the proposed meal service location, (measured in time, here it is twenty five minutes)
  - direction_same, defining whether the proposed coupon is within the same destination as driver's itinerary or not
  - direction_opp, determining whether the proposed coupon is in the opposite destination from driver's destination or not
  - Y, target value defining whether the proposed coupon was accepted or rejected by the driver.
- *object type data* comprised of eighteen variables:
  - destination, showing the purpose of driver's trip
  - passenger, determining whether a co-passenger accompanies the driver and his/her relationship to him
  - weather, defining the meteorological context (sunny etc.)
  - time, presenting at which time the coupon was distributed
  - coupon, explaining coupon type
  - expiration, showing coupon validity duration
  - gender, defining driver's gender
  - age, defining driver's age
  - maritalStatus, defining driver's marital status
  - education, defining driver's education
  - occupation, defining driver's type of employment
  - income, defining driver's gender
  - car, vehicle type
  - Bar, type of meal service, (coupon type)
  - CoffeeHouse, type of meal service, (coupon type)
  - CarryAway, type of meal service, (coupon type)

- RestaurantLessThan20, type of meal service, (coupon type)
- Restaurant20To50, type of meal service, (coupon type).

Examination of *missing values* indicates that variable “car" is associated with a high percentage (99%) of unavailable information and consequently this feature is not going to be taken into consideration in this analysis.

No investigation of *outliers* is provided. The present analysis is based only in visualisations in which case outliers do not compromise the performance of any algorithm. Moreover, examination of outliers (whether they form the majority or minority) can reveal important information and thus all data will be observed.

3 Representation of Numerical Variables

In this section numerical features are going to be explored. Data distribution and pairwise relationships involving a potential linear correlation will be examined.

Figure 1 provides multiple information on the numerical variables.

The plots along the diagonal depict the probability density function of the corresponding variable (obtained by means of kernel density estimation).

One observes a frequently occurring bimodal distribution (two peaks) which is an expected outcome as most numerical variables (with the exception of variables “temperature” and “toCoupon_GEQ5min”) take only two values, zero and one (representing rejection and acceptance respectively).

As variable “temperature” takes three distinct values (30, 55 and 80) one sees that the corresponding probability distribution presents three peaks (element $(1, 1)$ in the matrix plot).

Finally, variable “toCoupon_GEQ5min” takes a single value equal to one and there is no curve (single point, see Remark 1).

The scatter plots, non-diagonal elements in Figure 1 illustrate relationships between any two distinct numerical variables. As all variables but ‘temperature’ and “toCoupon_GEQ5min” take two possible values (0 or 1) à priori there are at most four potential points which can be expected $(0, 0)$, $(0, 1)$, $(1, 0)$, $(1, 1)$.

Points $(0, 0)$, $(1, 1)$ imply that the involved variables perfectly coincide while points $(0, 1)$, $(1, 0)$ induce that the binary variables present an inverse behavior.

Regarding “temperature”, as it may receive three possible values while all other variables may value 0 or 1, (with the exception of variable “toCoupon_GEQ5min’ which will be examined separately) the set of possible points regarding pairwise relationships is comprised of 6 points $\{(30, 0),\ (30, 1),\ (55, 0),\ (55, 1),\ (80, 0),\ (80, 1)\}$, (see scatter plots located in the eighth row and first column in Figure 1).

Finally, as “toCoupon_GEQ5min” is a single valued variable (always equal to one), in the pairwise plots with all variables but “temperature”, the set of possible points is comprised only of two elements $\{(1, 0),\ (1, 1)\}$ (see all plots located in the third column in Figure 1). When variable “toCoupon_GEQ5min” is considered in relation to ‘temperature’ then in the pairwise relationship (“toCoupon_GEQ5min”, temperature’) the set of possible values is $\{(30, 1),\ (55, 1),\ (80, 1)\}$ (see plot located in the third row and first column in Figure 1).

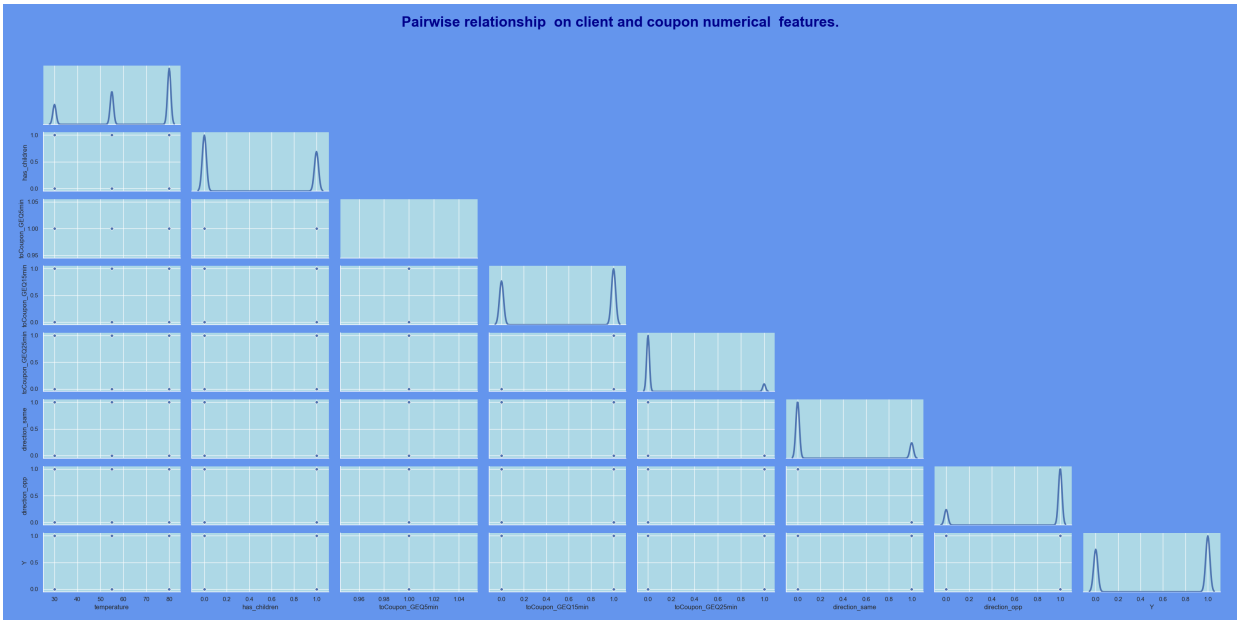

Figure 1: Pairwise relationship and probability distribution.

Remark 1 *Equation 1 provides the formula of Pearson's correlation coefficient where* μ_X, μ_Y *are the mean values of variables* X, Y *and* σ_X ,σ_Y *are the standard deviation of variables X and Y respectively.*

$$\rho_{X,Y} = \frac{\mathbb{E}[(X - \mu_X)(Y - \mu_Y)]}{\sigma_X \sigma_Y} \tag{1}$$

From the above discussion one should expect a weak linear relationship (positive or negative) among any two distinct numerical features.

Figure 2 depicts the coefficient correlation matrix between numerical variables. Clearly there is a weak positive or negative correlation for most pairs of variables. However, there is a perfect negative correlation (value equals -1) for the pair of variables (direction_opp, direction_same). This is an expected result as these two variables are complementary. Each variable represents whether a location is positioned either within the same or the opposite direction of a moving object. Thus, when variable direction_opp values 0 (respectively 1), variable direction_same equals 1 (respectively 0). As previously explained, variable "toCoupon_GEQ5min" equals only to one, no correlation coefficient can be determined.

4 Exploring Coupon Types

With the purpose of selecting a type of coupon to analyze a brief analysis on coupons is going to be presented.

It could be useful to quantify the coupon distribution regarding their type based on the given data set.

As Figure 3 illustrates the 32% of all the distributed coupons were concerning Coffee Houses, the 16% was for Bars, the 19% was for Take away services, the 22%

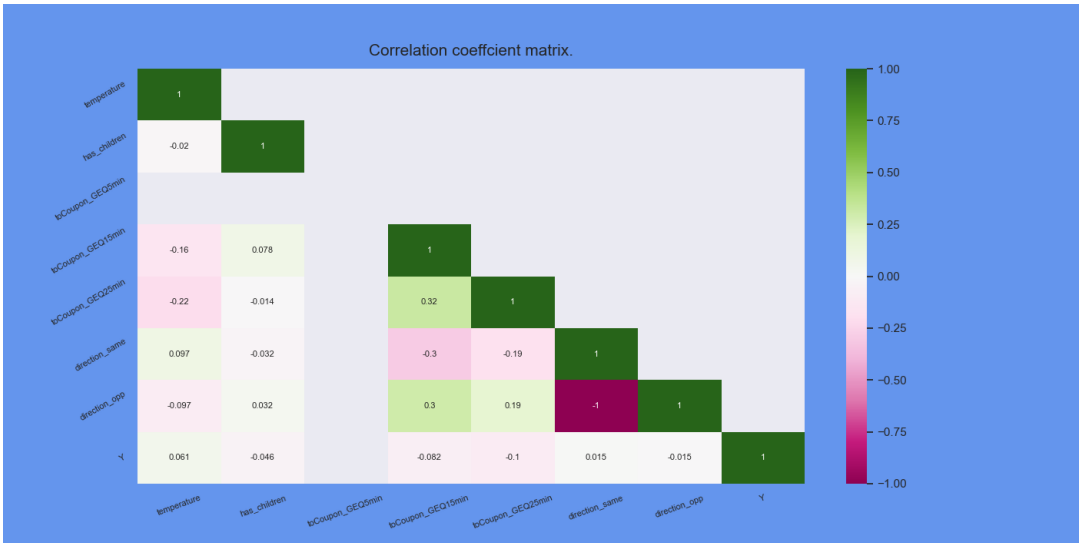

Figure 2: Coefficient correlation.

was concerning cheaper restaurants (Restaurants under 20$) and finally the last 12% was for more expensive restaurants (from 20 to 50$).

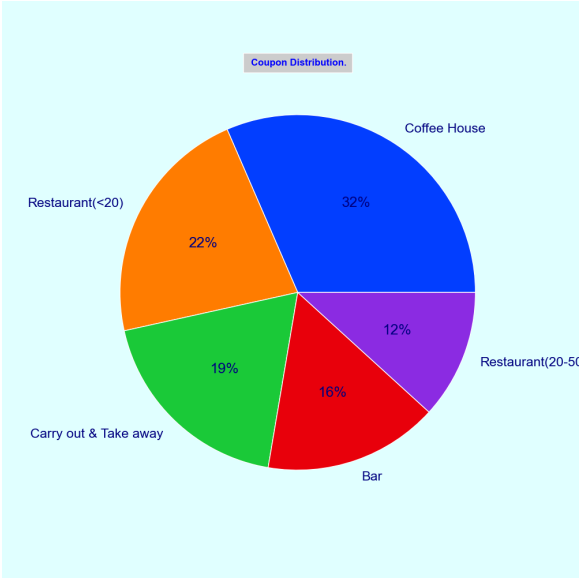

Figure 3: Distribution of Coupon Types.

Additionally, knowledge of the coupon acceptance and rejection rate (regarding the total number of distributed coupons) could be useful. From Figure 4 one reads that among all the distributed coupons ($12,684$, one coupon per driver) the 57% was accepted by drivers while the 43% was refused.

Let us now examine the acceptance and refusal frequency per coupon type when only the accepted or rejected coupons are considered. Figure 5 depicts that the 28% of all the accepted coupons was concerning Coffee Houses, the 24% was for Carry away

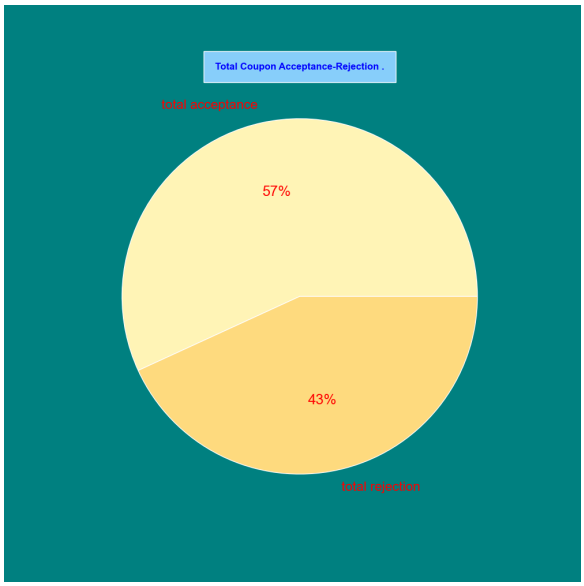

Figure 4: Coupon Acceptance and Refusal.

services, the 11% was for Bars, the 27% was related to Restaurants under $20\$$ where the remaining 9% was concerning the expensive restaurants.

Similarly, Figure 6 represents the rejection percentage per coupon type among all the refused coupons. Thus, the 37% of the total rejections was related to Coffee Houses, (that is the max rejection percentage), the 22% was for Bars, the 12% was for Carry away services where Restaurants cheaper or expensive had a rejection rate equal to 15% each.

Comparison of Figure 5 and Figure 6 shows that although Coffee Houses are associated with the higher percentage of acceptations (28%) they are also involving the higher percentage of rejections (37%). Bars are in the penultimate position regarding coupon acceptance and reach the second position regarding refusals (considering a descending coupon classification order). As the expensive restaurants (pricing between $20 - 50\$$) have the smallest acceptance rate one could think that they would also be associated with the higher rejection rate, however this is not true. Both expensive and cheaper restaurants occupy the second from the last position regarding coupon rejections. Carry out services are in the third position regarding acceptance and in the last position regarding refusals (they are associated with the smallest rejection percentage).

The previous observations imply multiple questions related to the examination of the following outcomes.

- While Coffee Houses, Carry out services and Restaurants under $20\$$ attract the majority of drivers, bars and more expensive Restaurants concern the minority of potential customers. Which elements appear frequently when such a phenomenon occur ?
- What types of clients prefer Bars or expensive restaurants to the other food service alternatives ?
- Does the meal cost plays the crucial role to the customer's preferences or other

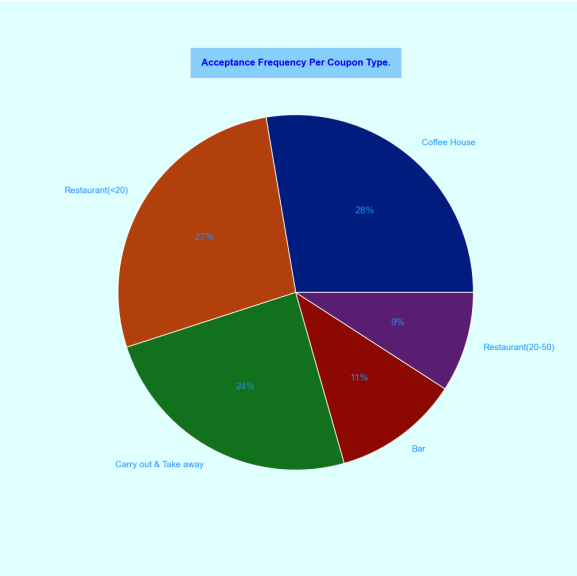

Figure 5: Acceptance Frequency Per Coupon Type.

interfering parameters are forcing drivers to use a particular category of food establishment ?

- Is a driver's choice occasional or not ?
- Is it possible to decrease coupon rejections while increasing the involved acceptance rate ?

  If yes for which coupon categories this can be achieved and at which cost ?
- etc.

Expensive restaurants are associated with the smallest distribution and acceptance rate but not with the greatest refusal rate. It would be of interest to examine this coupon category and the related client characteristics. A potential approximation of the client category which respond rather positively/negatively could be useful to examine whether and how more clients can be attracted.

In the following, the client preferences and characteristics will be examined separately for each variable category (numerical, object type ones) and per possible client response: accepting or rejecting the related coupon.

5 Expensive Restaurants Analysis

Aiming at quantifying the interference of each feature regarding the expensive restaurant coupons (prices vary between 20$ and 50$) a specific kind of bar plot will be considered. The height of each bar will represent the frequency of the associated value instead of the total number of occurrences associated with the variable (equivalently this can be considered as an empirical probability).

We recall that the object type variable "car" is associated with a high percentage of missing values and consequently this variable will be ignored in the analysis.

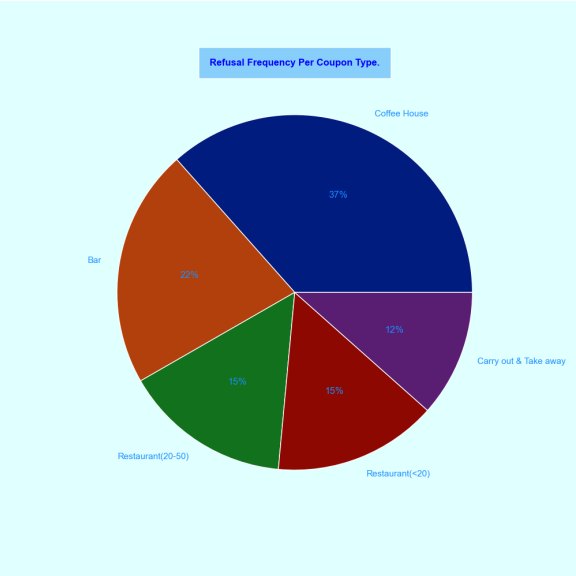

Figure 6: Rejection Frequency Per Coupon Type.

5.1 Case study: All population

Population who received coupons for expensive restaurants (type Restaurant(20-50)) is only considered (including both acceptances and rejections).

Numerical Variables

Each subplot in Figure 7 concerns a numerical variable receiving two potential values either zero or one with the exception of variable to Coupon_GEQ5min valuing always one.

Observation of variable *Y* (subplot located in the last row and second column in Figure 7) shows that the 55.9% of the total distributed coupons regarding expensive restaurants were refused by drivers (blue bar) where the 44.1% was accepted (orange bar).

Let's un now examine variable *direction_opp* (subplot located in the fourth row and first column in Figure 7).

One sees that the 82.8% of the expensive restaurant coupons were concerning restaurants located in the opposite direction to the driver's itinerary (orange bar) while only the 17.2% (blue bar) was not in the opposite direction to the driver.

This result is in accord with the subplot of variable *direction_same*.

In this case, the 17.2% of the distributed coupons for the expensive restaurants were in the same direction as the driver (orange bar valuing one) where the 82.8% were for restaurants in a different direction than the driver's one (blue bar valuing zero).

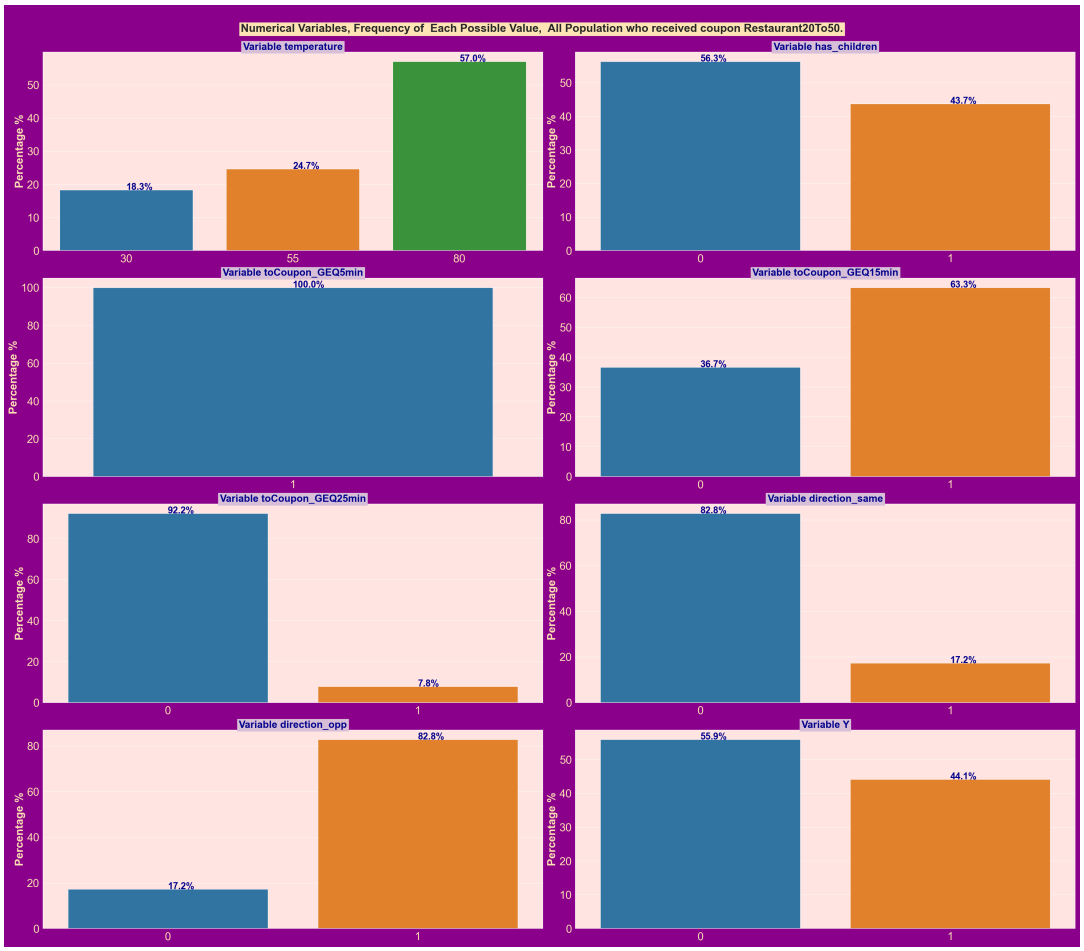

Figure 7: Numerical Variables, All Population received coupons for Restaurant(20-50).

Object Type Variables

Figures 8,9,10,11 illustrate the frequency of each possible value regarding the object type variables.

Examination of variable *destination* (see Fig. 8, subplot depicted in the first row and column notated as (1,1)) shows that the 43.8% of drivers who received expensive restaurant coupons are headed towards "home" (light blue bar) while the remaining population is divided into two destinations "work" (28.8%, dark blue bar) and "no urgent place" (27.5%, green bar).

Among others, one may notice that the majority of these coupons was distributed at 7 AM, 6PM and 10 PM where the minority was sent at 2 PM and 10 AM (see variable *time*, subplot (2,2) in Fig. 8).

Fig. 9 illustrates variables characterizing driver personal profile such as gender, age and marital status.

Fig. 10 presents variables regarding driver professional profile such as educational level as well employment information.

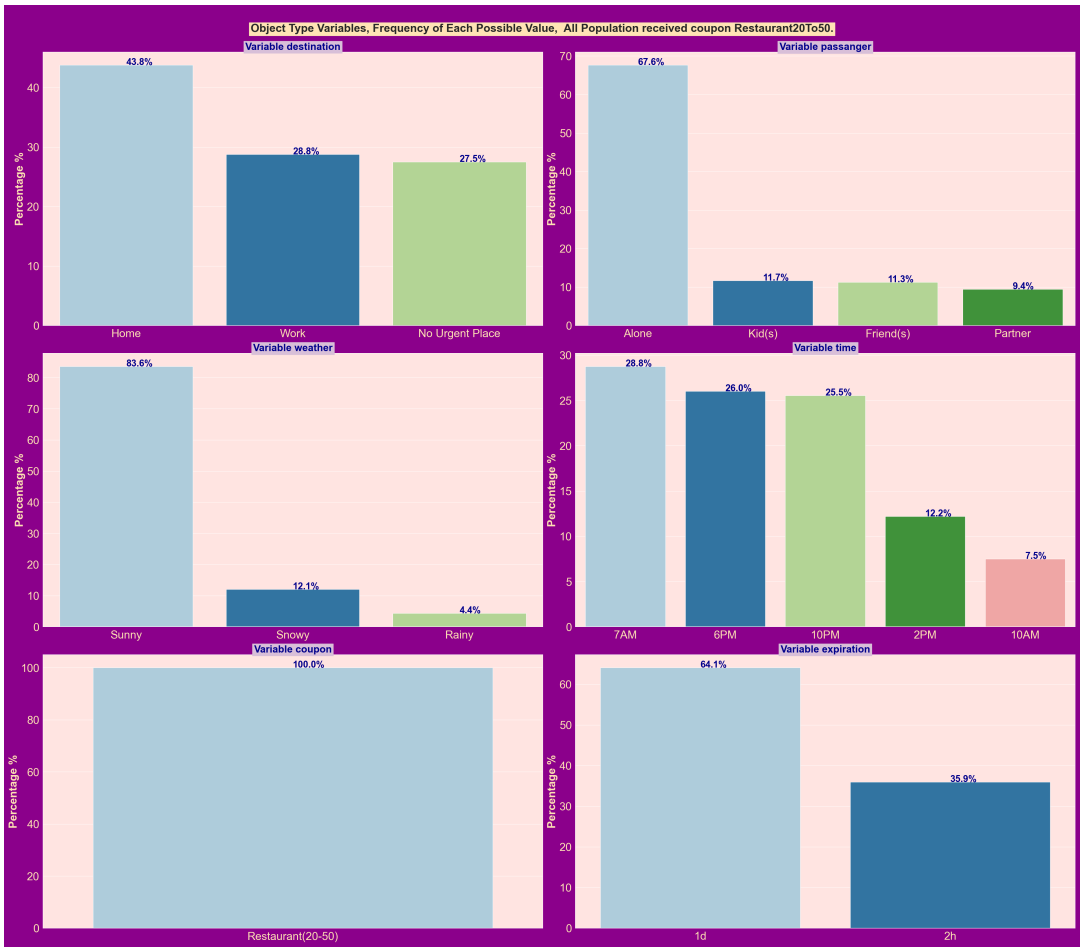

Figure 8: Object Type Variables, All Population with coupons for Restaurant(20-50).

Finally, Fig. 11 provides interesting information on driver preferences regarding all considered meal services (monthly).

Thus, subplot (1,1) in Fig. 11 illustrates at which frequency the drivers who received expensive restaurant coupon types go to Bars.

Observe how the 42.2% never visits Bars while those who go more than eight times per month form only the (2.8%) of the population.

Examination of variable *Restaurant(20-50)* (see Fig. 11, subplot (3,1)) presents the frequency at which drivers who received coupons for expensive restaurants visit expansive restaurants.

One observes the 49.9% of the considered population goes to expensive restaurants at a frequency smaller than once a month (light blue bar) while those who go from one to three times form the 26.1% (dark blue bar).

Notice that the light green bar having frequency equal to 15.7% corresponds to the population who received coupons for expensive restaurants but never go.

Lastly, only the 6.2% and 2.2% of those who received coupons for expensive restaurants go to expensive restaurants between four and eight times (dark green bar) and more than eight times (pink bar) respectively.

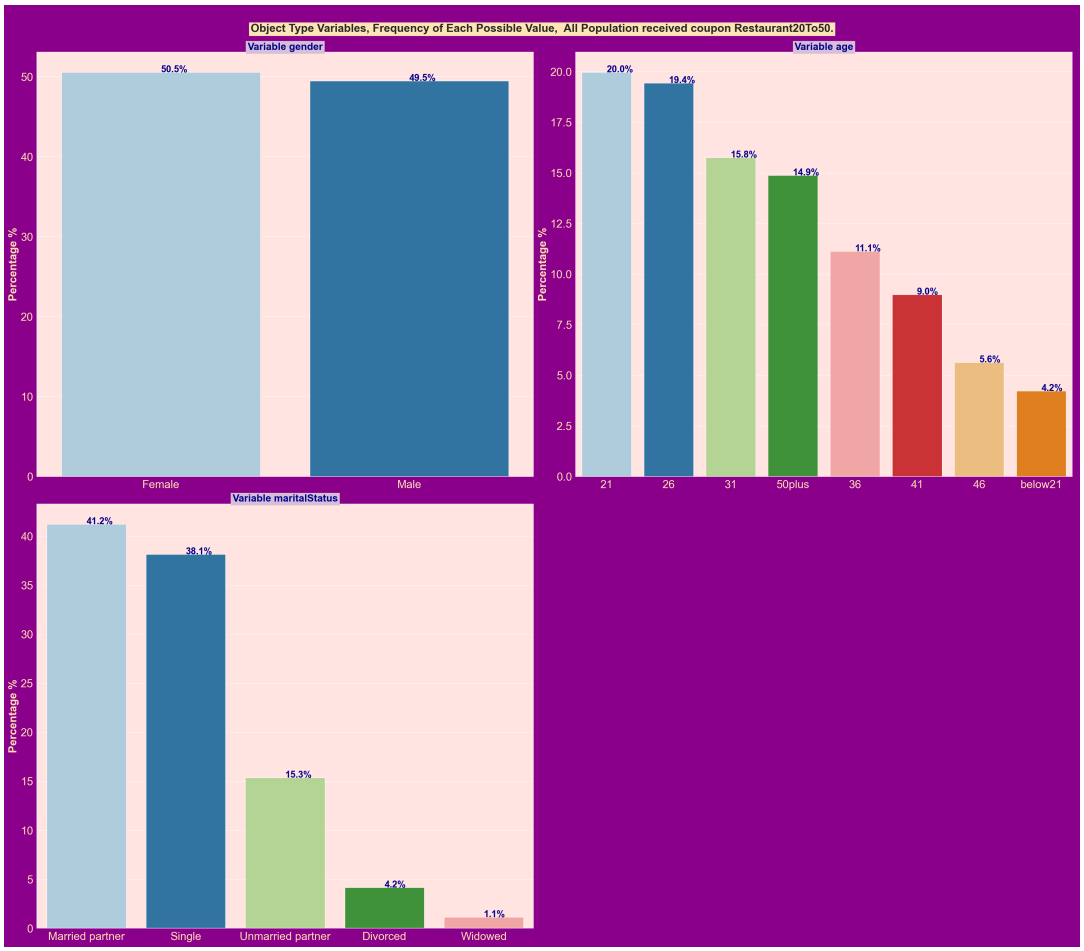

Figure 9: Object Type Variables, All Population with coupons for Restaurant(20-50).

At this point, it would be of interest to have the related subplots for all other drivers regarding the coupon category they received (those who received coupons for bars only, for carry out services only, for coffee bars only and for less expansive restaurants only). Hence, one could have a first understanding of how coupons are distributed and measure the efficiency of this distribution (regarding both drivers and meal services profits, potentially if extra features could be considered).

5.2 Case study: Accepted versus Refused Restaurant(20-50) Coupons

Population who received *Restaurant(20-50)* coupons can be distinguished conditionally to their response: acceptance or refusal.

Thus, these two subpopulations, one only consisted of drivers who responded positively while the other is comprised of those who responded negatively to these coupons, will be analyzed separately.

A similar analysis as the one presented above regarding the entire driver population receiving coupons *Restaurant(20-50)* will be discussed.

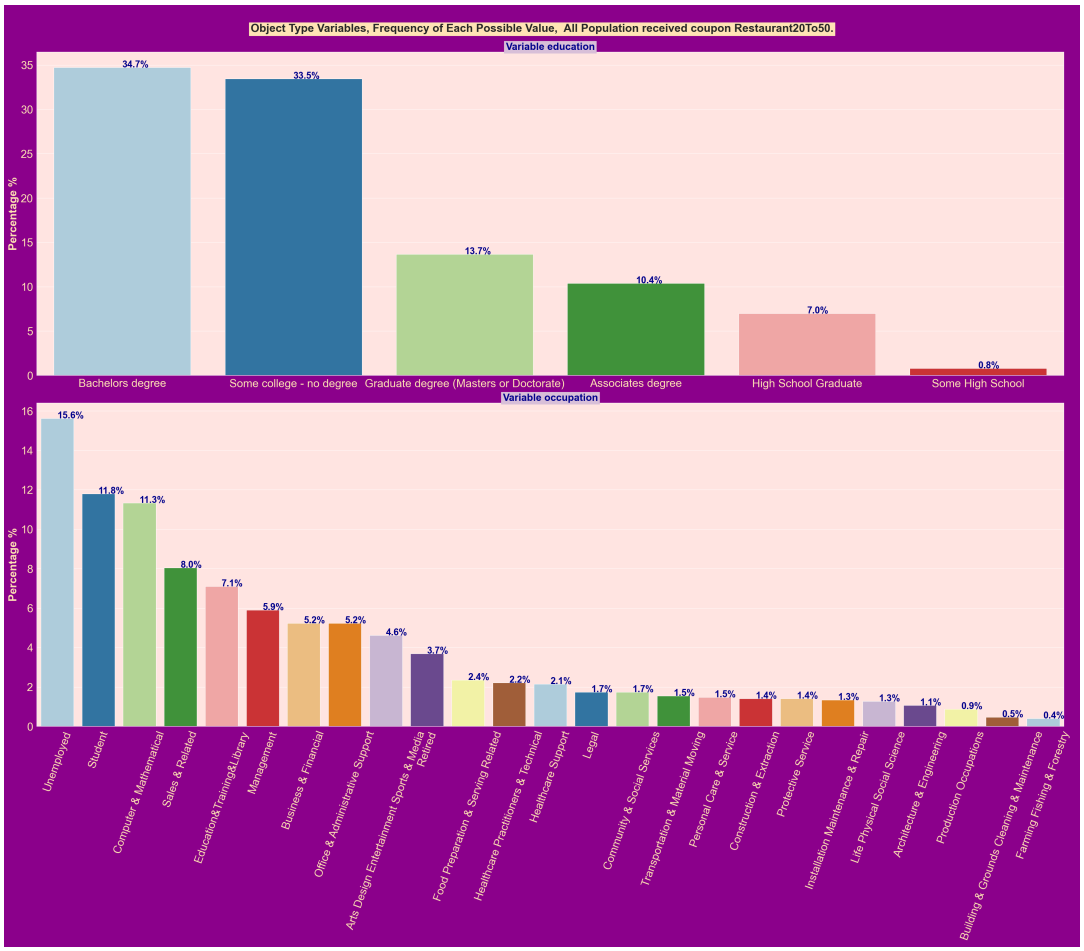

Figure 10: Object Type Variables, All Population with coupons for Restaurant(20-50).

Numerical Variables

Figures 12 and 13 represent the frequency of each possible value of Numerical variables for the two possible cases, *Restaurant(20-50)* coupons accepted and refused respectively.

Observation of each figure separately implies that there is a small variation regarding the corresponding values among the two subpopulations.

Thus, considering variable *has_children*, the 40.4% and 59.6% of those who accepted the coupon has children or not (see subplot (1,2) in Fig. 12) where the related frequency for those who preferred to ignore the coupon is 46.3% and 53.7% respectively (subplot (1,2) in Fig. 13).

There is an even slighter variation of the value frequencies between the two subpopulations for the remaining numerical variables.

Thus, observe the frequency of values regarding variable *direction_same* (subplot (3,2) in Figures 12 and 13).

The 18.1% of the coupons was located within the driver's direction (value 1) for those who accepted the coupon while the associated value is 16.6% for those who

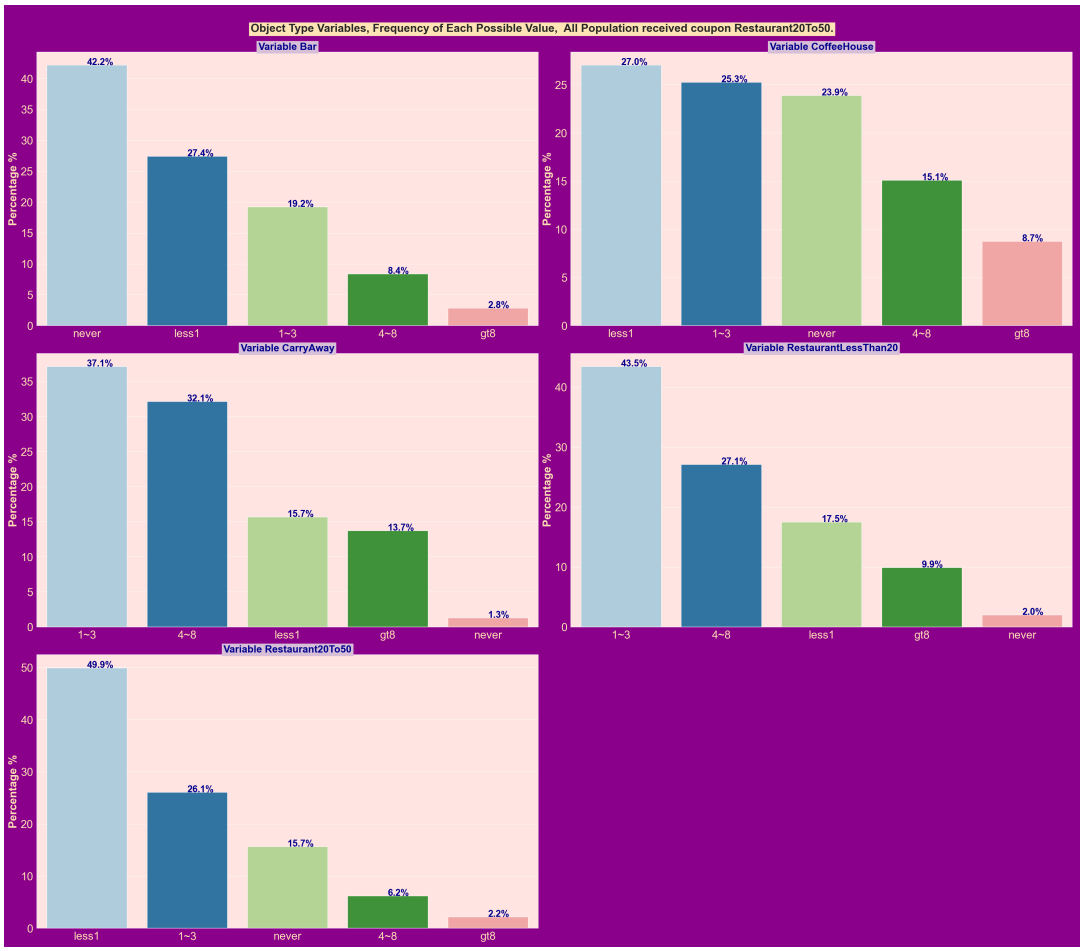

Figure 11: Object Type Variables, All Population with coupons for Restaurant(20-50).

rejected it.

Object Type Variables

Let's now proceed to a visual examination of the object type variables and observe the behavior of each subpopulation.

Figures 14,16,18,20 refer to the population who accepted the expensive restaurant coupons while Figures 15,17, 19, 21 concern those who rejected them.

Variables presenting the most significant differences are going to be discussed.

Observation of variable *destination* (subplot (1,1) in Figures 14 and 15) shows the following observations:

- **drivers who accepted coupons**
  - 42.7% were going home (dark purple bar in Figure 14)
  - 31.3% were destined towards a no urgent place (red bar in Figure 14)
  - 26% were going to work (orange bar in Figure 14)

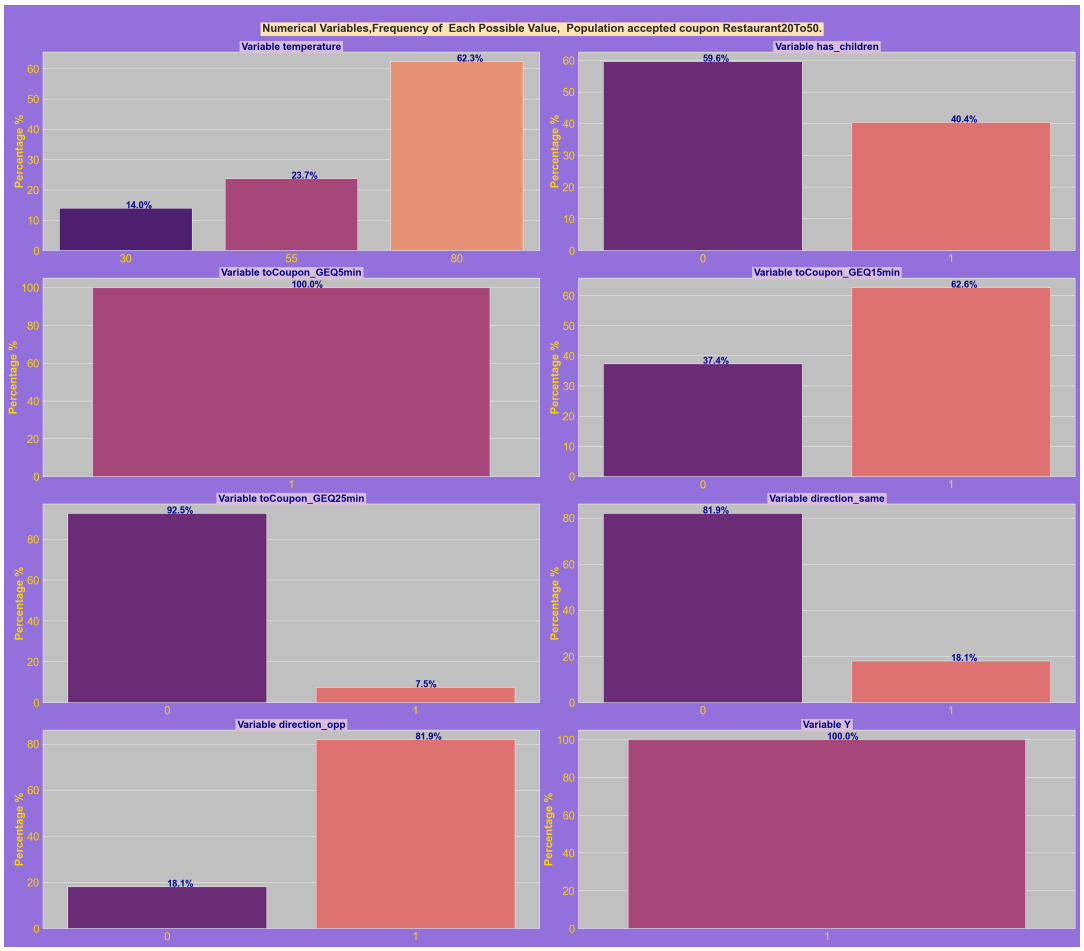

Figure 12: Numerical Variables - case Restaurant(20-50) coupons accepted.

- **drivers who rejected coupons**
  - 44.6% were going home(dark purple bar in Figure 15)
  - 24.5% were destined towards a no urgent place (orange bar in Figure 15)
  - 30.9% were going to work (red bar in Figure 15).

Regarding variable *passanger* (subplot (1,2) in Figures 14 and 15) one sees:

- **drivers who accepted coupons**
  - 64.7% were alone (dark purple bar in Figure 14)
  - 15.5% had a partner with them (red bar in Figure 14)
  - 11.8% were with friend(s) (dark orange bar in Figure 14)
  - 9.9% had kid(s) with them (bright orange bar in Figure 14)

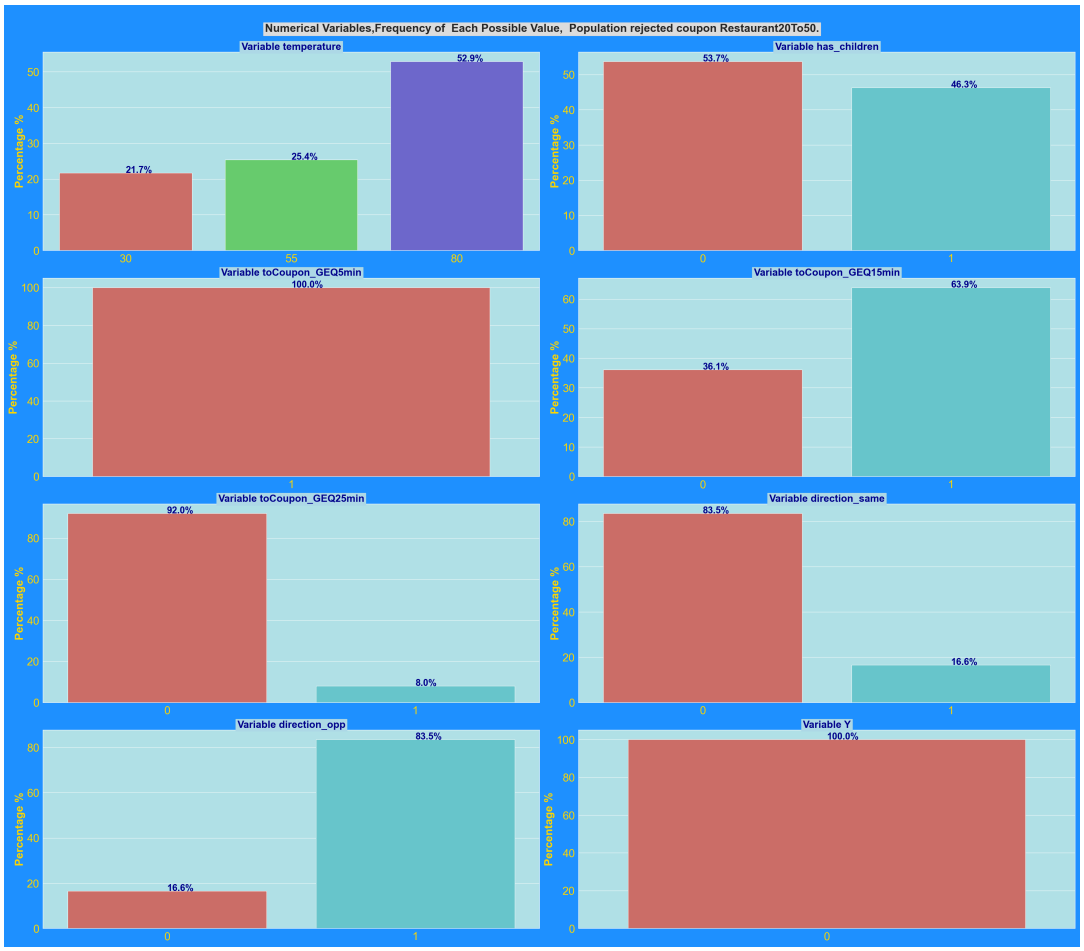

Figure 13: Numerical Variables - case Restaurant(20-50) coupons rejected.

- **drivers who rejected coupons**
  - 69.9% were alone (dark purple bar in Figure 15)
  - 6.2% had a partner with them (light orange bar in Figure 15)
  - 10.8% were with friend(s) (dark orange bar in Figure 15)
  - 13.1% had kid(s) with them (red bar in Figure 15).

Thus, variable *passanger* presents slightly more significant differences in most values bur "friends" among the two subpopulations regarding the previously examined variables.

Observation of variable *weather* (subplot (2,1) in Figures 14 and 15), values "Sunny", "Snowy" and "Rainy" present frequencies equal to 88%, 8.2%, 3.8% when drivers accept coupons versus 80.1%, 15.1%, 4.8% for those who refused them.

One sees how values "Sunny", "Snowy" are relatively significant characteristics regarding the two driver categories.

Variable *Time* also presents relatively significant differences (subplot (2, 2) in Figures 14 and 15).

The frequency of possible values is:

- 6PM: 29.6% for drivers who accepted coupons versus 23.1% for those who refused them
- 7AM: 26% for drivers who accepted coupons versus 30.9% for those who refused them
- 10PM: 19% for drivers who accepted coupons versus 30.7% for those who refused them
- 2PM: 14.9% for drivers who accepted coupons versus 10.1% for those who refused them
- 10AM: 10.5% for drivers who accepted coupons versus 5.2% for those who refused them.

Let's now examine variable *expiration* which also presents rather significant differences and could play an important role in driver characterization regarding coupon acceptance or refusal (subplot (3, 2) in Figures 14 and 15). The involved frequencies are:

- 1d: 75.7% for drivers who accepted coupons versus 54.9% for those who refused them
- 2h: 24.3% for drivers who accepted coupons versus 45.1% for those who refused them.

Frequencies of variable *age* are hereafter presented, (subplot (1, 2) in Figures 16 and 17). Hence:

- 26: 21.9% for drivers who accepted coupons versus 17.5% for those who refused them
- 21: 19.9% for drivers who accepted coupons versus 20% for those who refused them
- 31: 14.9% for drivers who accepted coupons versus 16.4% for those who refused them
- 50plus: 12% for drivers who accepted coupons versus 17.1% for those who refused them
- 36: 11.8% for drivers who accepted coupons versus 10.6% for those who refused them
- 41: 9.3% for drivers who accepted coupons versus 8.8% for those who refused them
- 46: 6.2% for drivers who accepted coupons versus 5.2% for those who refused them

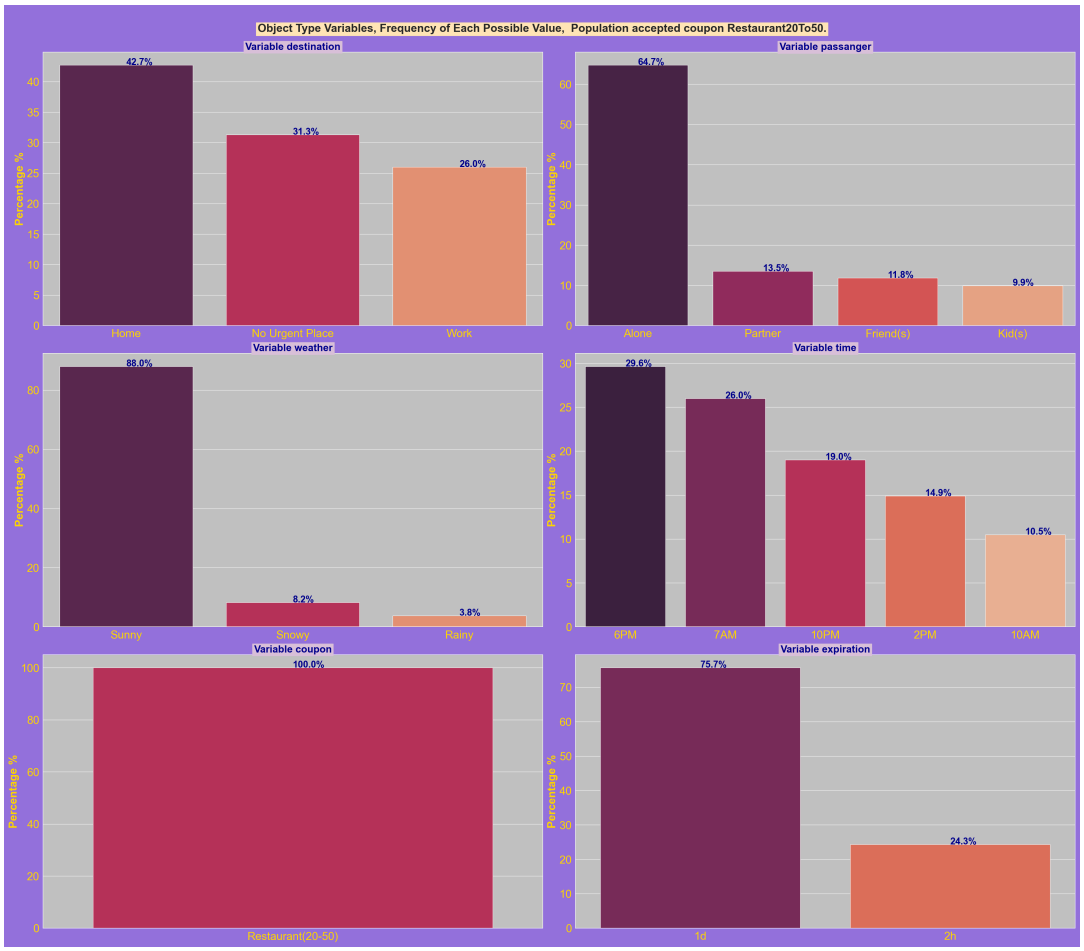

Figure 14: Object Type Variables - case Restaurant(20-50) coupons accepted.

- below21: 4% for drivers who accepted coupons versus 4.4% for those who refused them

One sees that regarding *age*, values 26 and 31 present the most significant differences between the two populations.

A similar observation holds true for variable *maritalstatus* (subplot (2, 1) in Figures 16 and 17) where

- Single: 40% for drivers who accepted coupons versus 36.7% for those who refused them
- Married partner: 39.1% for drivers who accepted coupons versus 42.9% for those who refused them
- Unmarried partner: 17% for drivers who accepted coupons versus 14% for those who refused them
- Divorced: 3.3% for drivers who accepted coupons versus 4.8% for those who refused them

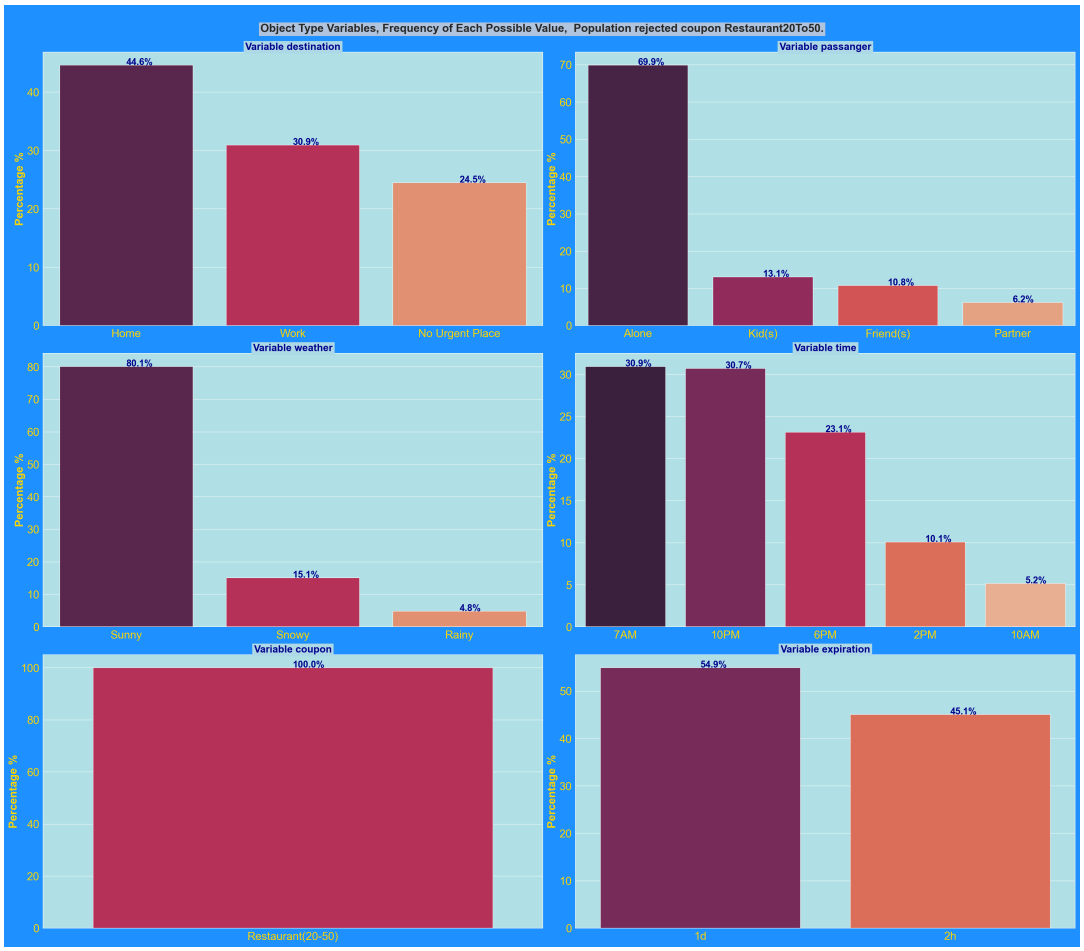

Figure 15: Object Type Variables - case Restaurant(20-50) coupons rejected.

- Widowed: 0.6% for drivers who accepted coupons versus 1.6% for those who refused them

Examination of variable *education* presents the following outcomes (subplot (1,1) in Fig. 18 and Fig. 19)

- Some college - no degree: 35.9% for drivers who accepted coupons versus 31.5% for those who refused them
- Bachelors degree: 32.8% for drivers who accepted coupons versus 36.2% for those who refused them
- Graduate degree: 11.8% for drivers who accepted coupons versus 15.1% for those who refused them
- Associates degree: 10.2% for drivers who accepted coupons versus 10.6% for those who refused them
- High School Graduate: 8.2% for drivers who accepted coupons versus 6% for those who refused them

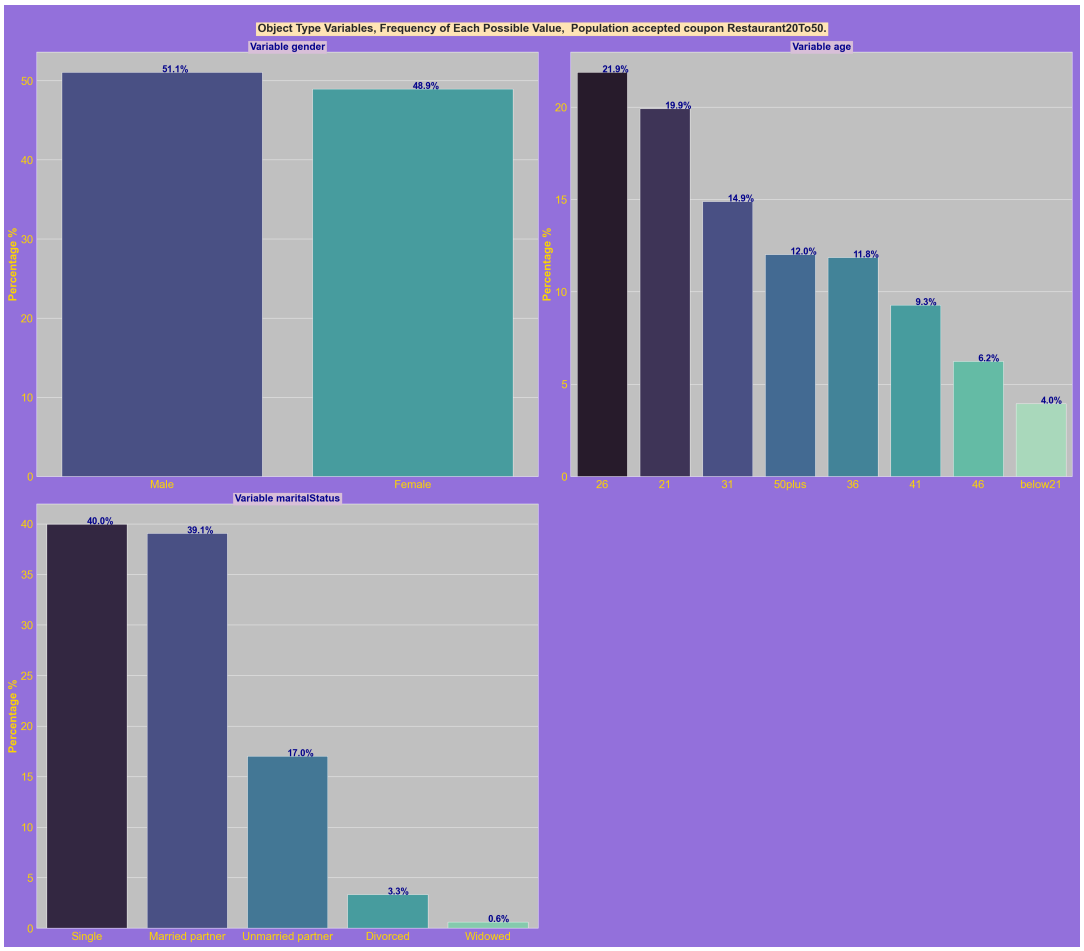

Figure 16: Object Type Variables - case Restaurant(20-50) coupons accepted.

- Some High School: 1.1% for drivers who accepted coupons versus 0.6% for those who refused them

Let's see how variable *occupation* behaves for each driver subpopulation (subplot (2,1) in Fig. 18 and Fig. 19).

- Architecture & Engineering : 1.2% for drivers who accepted coupons versus 1% for those who refused them
- Arts Design Entertainment Sports & Media: 4% for drivers who accepted coupons versus 5.2% for those who refused them
- Building & Grounds Cleaning & Maintenance : 0.5% for drivers who accepted coupons versus 0.5% for those who refused them
- Business & Financial: 4.3% for drivers who accepted coupons versus 6% for those who refused them
- Community & Social Services: 1.5% for drivers who accepted coupons versus 1.9% for those who refused them

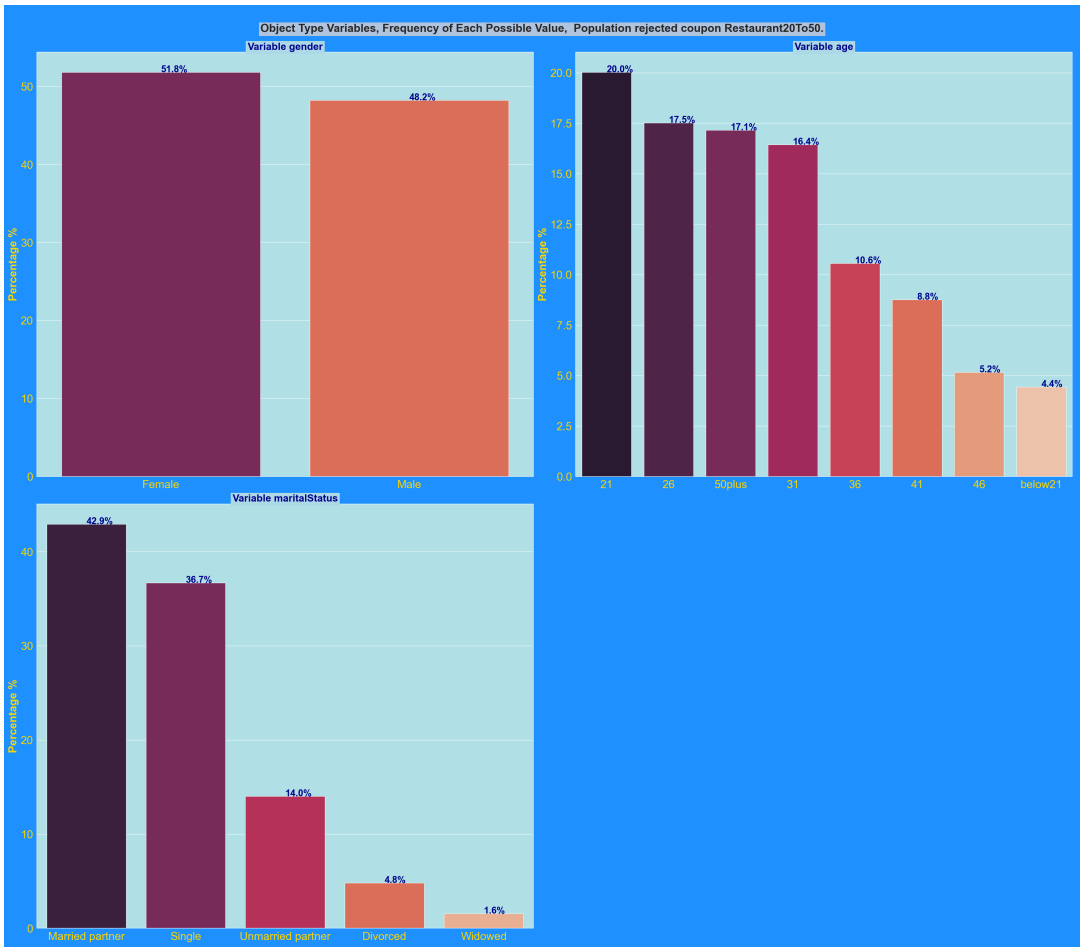

Figure 17: Object Type Variables - case Restaurant(20-50) coupons rejected.

- Computer & Mathematical: 13.4% for drivers who accepted coupons versus 9.7% for those who refused them
- Construction &Extraction: 2% for drivers who accepted coupons versus 1% for those who refused them
- Education&Training&Library: 6.5% for drivers who accepted coupons versus 7.5% for those who refused them
- Farming Fishing & Forestry: 0.1% for drivers who accepted coupons versus 0.6% for those who refused them
- Food Preparation & Serving Related: 2% for drivers who accepted coupons versus 2.6% for those who refused them
- Healthcare Practitioners & Technical: 2.6% for drivers who accepted coupons versus 1.9% for those who refused them
- Healthcare Support: 3.2% for drivers who accepted coupons versus 1.3% for those who refused them

- Installation Maintenance & Repair: 0.6% for drivers who accepted coupons versus 1.9% for those who refused them
- Legal : 2.1% for drivers who accepted coupons versus 1.4% for those who refused them
- Life Physical Social Science : 1.4% for drivers who accepted coupons versus 1.2% for those who refused them
- Management : 6.1% for drivers who accepted coupons versus 5.8% for those who refused them
- Office & Administrative Support : 7.3% for drivers who accepted coupons versus 3.6% for those who refused them
- Personal Care & Service : 1.5% for drivers who accepted coupons versus 1.4% for those who refused them
- Production Occupations: 1.2% for drivers who accepted coupons versus 0.6% for those who refused them
- Protective Service: 1.5% for drivers who accepted coupons versus 1.2% for those who refused them
- Retired : 2.1% for drivers who accepted coupons versus 4.9% for those who refused them
- Sales & Related: 9.1% for drivers who accepted coupons versus 7.2% for those who refused them
- Student : 11.7% for drivers who accepted coupons versus 11.9% for those who refused them
- Transportation & Material Moving : 1.4% for drivers who accepted coupons versus 1.7% for those who refused them
- Unemployed : 12.8% for drivers who accepted coupons versus 17.9% for those who refused them

One observes that (sub)variables "Computer & Mathematical", "Unemployed" are associated with the most significant differences regarding all all other (sub)variables of variable *occupation*.

Let's now examine some information on the coupon types.
Observation of variable *CoffeeHouse*, (subplot (1, 2) in Fig. 20 and Fig. 21) shows:

- frequency between 1-3 times (month) : 31.3% for drivers who accepted coupons versus 20.4% for those who refused them
- frequency less1 (month): 24.1% for drivers who accepted coupons versus 29.4% for those who refused them

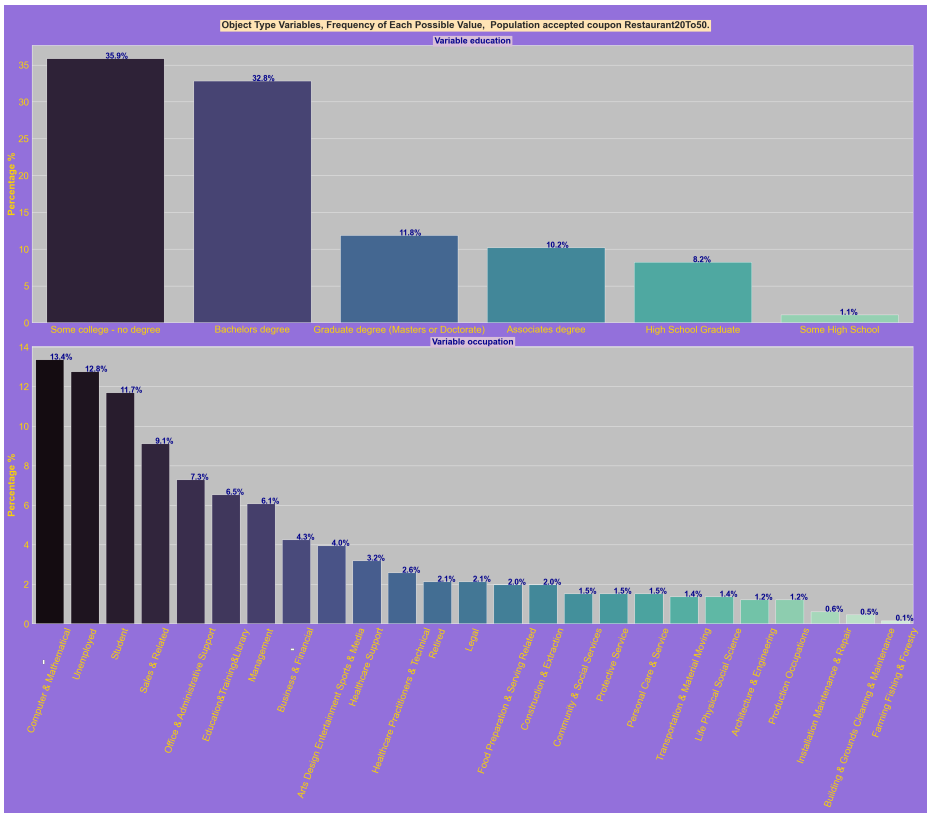

Figure 18: Object Type Variables - case Restaurant(20-50) coupons accepted.

- never: 22.2% for drivers who accepted coupons versus 25.2% for those who refused them
- frequency between 4-8 (month): 13.8% for drivers who accepted coupons versus 16.1% for those who refused them
- frequency greater then 8, gt8 (month): 8.6% for drivers who accepted coupons versus 8.9% for those who refused them

Coffee Houses frequencies of values "between one and three times", "less1" and "between four and eight times" per month seems to present (relatively) significant differences.

Regarding *CarryAway* variable the most significant difference concerns value "less1" where the associated value is 13.8% regarding drivers who accepted coupons and 17.1% for those who rejected them (subplot (2,1) in Fig. 20 and Fig. 21).

Variable *RestaurantLess20*, also presents relatively significant differences is most possible values, (subplot (2, 2) in Fig. 20 and Fig. 21). Thus:

- frequency between 1-3 times (month) : 41.3% for drivers who accepted coupons versus 45.1% for those who refused them
- frequency between 4-8 (month): 29% for drivers who accepted coupons versus 25.6% for those who refused them

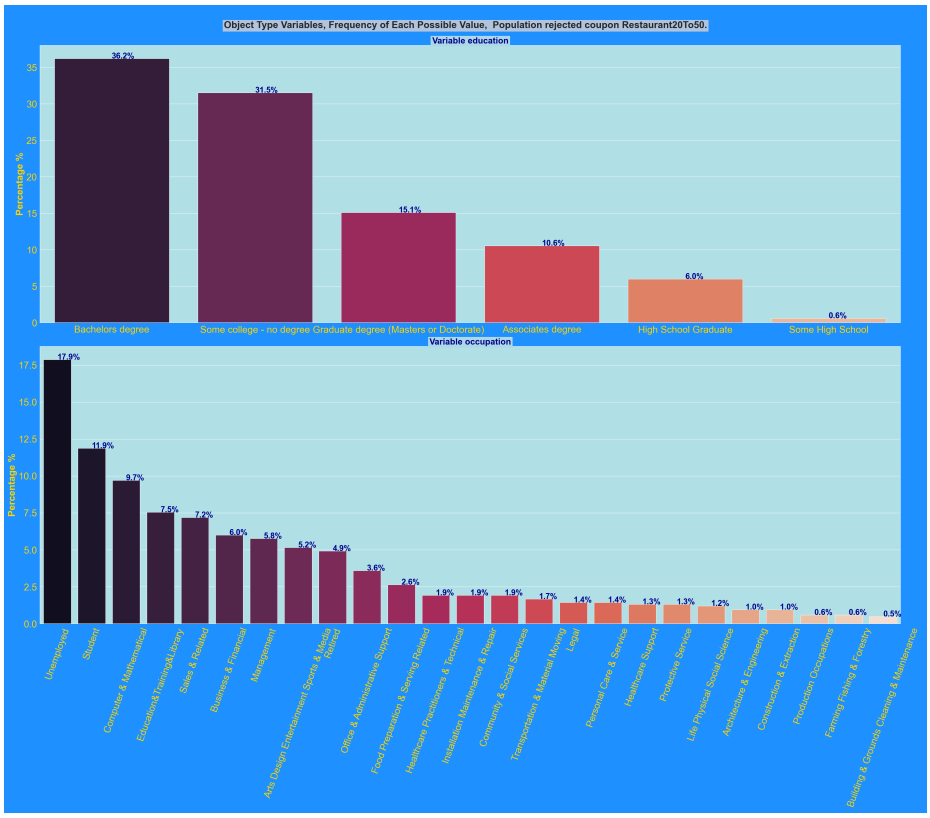

Figure 19: Object Type Variables - case Restaurant(20-50) coupons rejected.

- frequency less1 (month): 16.5% for drivers who accepted coupons versus 18.3% for those who refused them
- frequency greater then 8, gt8 (month): 11.7% for drivers who accepted coupons versus 8.5% for those who refused them
- frequency never (month): 1.5% for drivers who accepted coupons versus 2.4% for those who refused them.

As in many other variables the possible values of variable *RestaurantLess20* follow the same order for both driver categories (that is, the descending order of values "1-3", "4-8", "less1", "g8" and "never" hold true for drivers who accepted or rejected the expensive restaurant coupons).

Finally, the last object type variable *Restaurant20To50* will be observed. As shows subplot (3, 1) in Fig. 20 and Fig. 21)

- frequency less1 times (month) : 46.4% for drivers who accepted coupons versus 52.8% for those who refused them
- frequency between 1-3 (month): 31% for drivers who accepted coupons versus 22.1% for those who refused them
- frequency never (month): 10.4% for drivers who accepted coupons versus 19.8% for those who refused them

- frequency between 4-8 (month): 8.8% for drivers who accepted coupons versus 4.2% for those who refused them
- frequency greater than 8, gt8 (month): 3.4% for drivers who accepted coupons versus 1.2% for those who refused them.

Observe how values " less1" and "never", implying a minimal preference for expensive restaurants, are associated with the greatest frequencies for those who rejected this type of coupons (*Restaurant20To50*)) regarding those who accepted them.

At the same time all other values are associated with greater frequencies when considering the population who accepted the coupons regarding rejections.

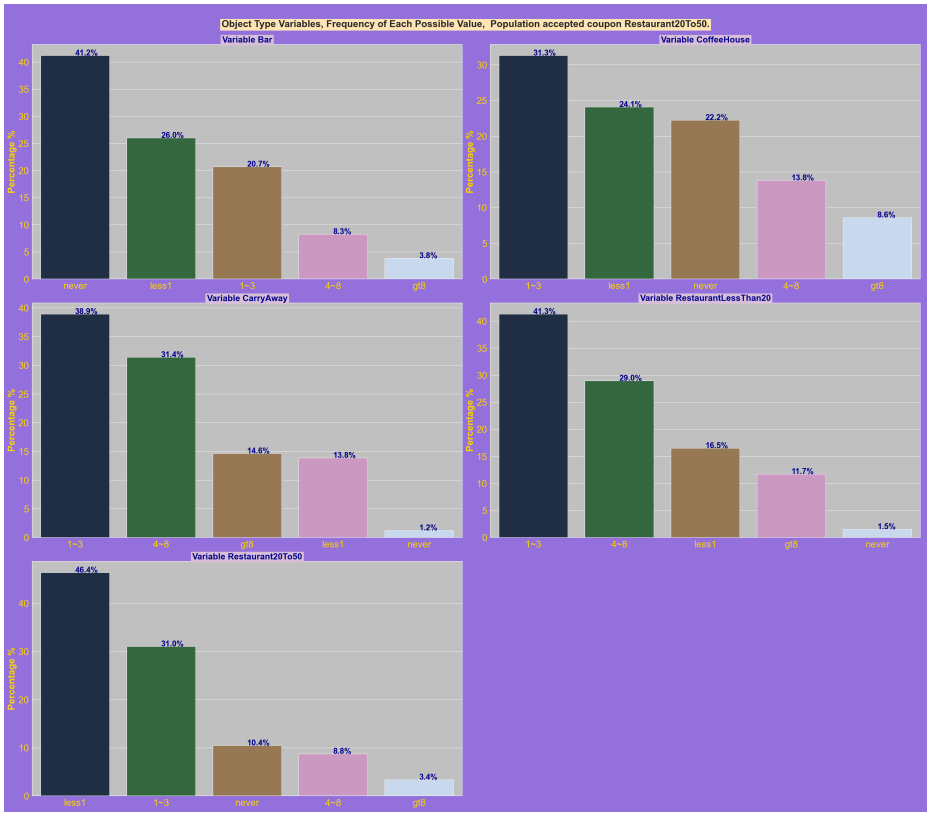

Figure 20: Object Type Variables - case Restaurant(20-50) coupons accepted.

6 Conclusion-Future Work

In this work the values of each characteristic are observed either independently or conditionally regarding to the driver decision to make use or ignore the coupon.

Hence, potential linear correlation regarding numerical variables was examined where the empirical probabilities were also presented. Nevertheless, neither of these is enough for proceeding to definite conclusions or wrong outcomes may result.

Furthermore, it is not examined whether the provided data sample is of an appropriate size for proceeding to quantitative analysis.

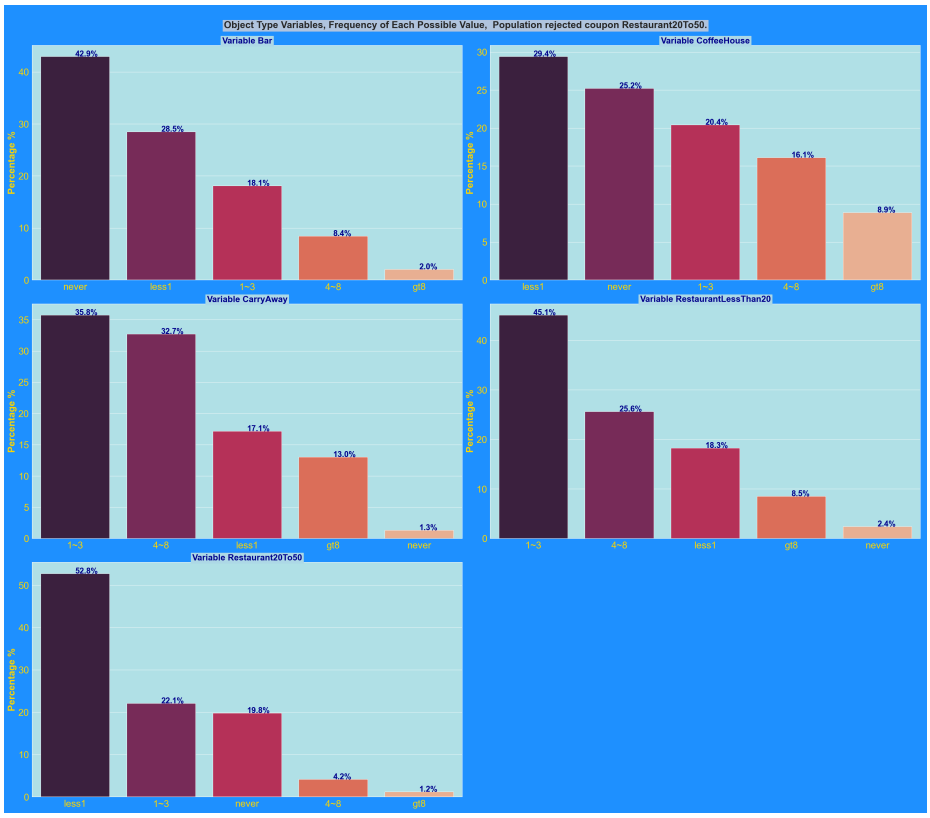

Figure 21: Object Type Variables - case Restaurant(20-50) coupons rejected.

However, it would be informative to compute various conditional probabilities per coupon type and for both driver populations (having accepted or refused the coupon) aiming at a better understanding of the acceptance and rejection context.

Distinguishing potential elements influencing the acceptance or rejection of a particular coupon type would be of interest.