**In-vehicle Coupon Recommendation Analysis**

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**Project Milestone**: Project Check Point #3

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6. **Project Objective**

In today’s world, it is very important for companies to tailor their marketing and advertisement to individual customers to effectively utilize their resources and reach/attract more customers.

The goal of this project is to build a machine learning model to predict whether a driver accepts the coupon provided or not. Utilizing this model, based on the demographics of a driver, companies can perform the personalized marketing and provide the coupon that is the most likely to be accepted by the driver.

1. **Dataset Overview**

The dataset used for the project is called “in-vehicle coupon recommendation Data Set” and can be found at UCI Machine Learning Repository at:

<https://archive.ics.uci.edu/ml/datasets/in-vehicle+coupon+recommendation>.

Tong Wang (University of Iowa) and Cynthia Rudin (Duke University) collected this dataset via a survey on Amazon Mechanical Turk and used it for their published paper “A bayesian framework for learning rule sets for interpretable classification”. The survey describes driving scenarios with different conditions such as destination, passengers, weather, temperature, etc.. and asks the people surveyed if he/she would accept a provided coupon if he/she was a driver.

1. **Data Dictionary**

|  |  |  |
| --- | --- | --- |
| *Attribute* | *Data Type* | *Possible Values / Description* |
| destination | String | No Urgent Place, Home, Work |
| passanger | String | Alone, Friend(s), Kid(s), Partner (feature meaning: who are the passengers in the car) |
| weather | String | Sunny, Rainy, Snowy |
| temperature | Integer | 55, 80, 30 |
| time | String | 2PM, 10AM, 6PM, 7AM, 10PM |
| coupon | String | Restaurant(<$20), Coffee House, Carry out & Take away, Bar, Restaurant($20-$50) |
| expiration | String | 1d, 2h (the coupon expires in 1 day or in 2 hours) |
| gender | String | Female, Male |
| age | String | 21, 46, 26, 31, 41, 50plus, 36, below21 |
| maritalStatus | String | Unmarried partner, Single, Married partner, Divorced, Widowed |
| has\_Children | Integer | 1, 0 |
| education | String | Some college - no degree, Bachelors degree, Associates degree, High School Graduate, Graduate degree (Masters or Doctorate), Some High School |
| occupation | String | Unemployed, Architecture & Engineering, Student,   |  | | --- | | Education&Training&Library, Healthcare Support, | | Healthcare Practitioners & Technical, Sales & Related, Management, | | Arts Design Entertainment Sports & Media, Computer & Mathematical, | | Life Physical Social Science, Personal Care & Service, | | Community & Social Services, Office & Administrative Support, | | Construction & Extraction, Legal, Retired, | | Installation Maintenance & Repair, Transportation & Material Moving, | | Business & Financial, Protective Service, | | Food Preparation & Serving Related, Production Occupations, | | Building & Grounds Cleaning & Maintenance, Farming Fishing & Forestry | |
| income | String | $37500 - $49999, $62500 - $74999, $12500 - $24999, $75000 - $87499, $50000 - $62499, $25000 - $37499, $100000 or More, $87500 - $99999, Less than $12500 |
| car | String | Scooter and motorcycle, Mazda5, do not drive, crossover, Car that is too old to install Onstar :D (feature meaning: type of car) |
| Bar | String | never, less1, 1~3, gt8, nan4~8 (feature meaning: how many times do you go to a bar every month?) |
| CoffeeHouse | String | never, less1, 4~8, 1~3, gt8, nan (feature meaning: how many times do you go to a coffeehouse every month?) |
| CarryAway | String | 1~3, 4~8, gt8, less1, never (feature meaning: how many times do you get take-away food every month?) |
| RestaurantLessThan20 | String | 4~8, 1~3, less1, gt8, never (feature meaning: how many times do you go to a restaurant with an average expense per person of less than $20 every month?) |
| Restaurant20To50 | String | 1~3, less1, never, gt8, 4~8, nan (feature meaning: how many times do you go to a restaurant with average expense per person of $20 - $50 every month?) |
| toCoupon\_GEQ5min | Integer | 0,1 (feature meaning: driving distance to the restaurant/bar for using the coupon is greater than 5 minutes) |
| toCoupon\_GEQ15min | Integer | 0,1 (feature meaning: driving distance to the restaurant/bar for using the coupon is greater than 15 minutes) |
| toCoupon\_GEQ25min | Integer | 0, 1 (feature meaning: driving distance to the restaurant/bar for using the coupon is greater than 25 minutes) |
| direction\_same | Integer | 0, 1 (feature meaning: whether the restaurant/bar is in the same direction as your current destination) |
| direction\_opp | Integer | 1, 0 (feature meaning: whether the restaurant/bar is in the same direction as your current destination) |
| Y | Integer | 1, 0 (whether the coupon is accepted) |

1. **Exploratory Data Analysis**

In this dataset, there are 12,684 instances with 26 attributes as shown in the table above. Among these attributes, the target feature is ***‘Y’***, which indicates whether the coupon provided is accepted or not by a driver.

The table below shows the missing (null) values in the dataset. Among all the listed attributes, the attribute ‘car’ has the highest number of missing values, which accounts for 99% of the entire dataset. I will remove this entire ‘car’ attribute as well as perform some imputation for other attributes with missing values during the data preprocessing stage.

|  |  |
| --- | --- |
| ***Attribute*** | ***# of Null (% of entire dataset)*** |
| car | 12,576 (99%) |
| Bar | 107 (0.8%) |
| CoffeeHouse | 217 (1.7%) |
| CarryAway | 151 (1.2%) |
| RestaurantLessThan20 | 130 (1%) |
| Restaurant20To50 | 189 (1/5%) |

There is one non-binary integer attribute, ‘temperature’. Although the data type of this attribute is integer, the values of this attribute in the provided dataset are either 30, 55, or 80, and it does not contain any other value.

**‘temperature’ Attribute - Unique Value Counts:**

|  |  |
| --- | --- |
| ***Class/Label*** | ***Count*** |
| 30 | 2316 |
| 55 | 3840 |
| 80 | 6528 |

Chart, bar chart

Description automatically generatedRegarding the target feature, which shows whether a driver accepted a coupon or not (‘Y’ attribute), and the provided coupon types (‘coupon’ attribute), the counts of each class/label in these attributes are shown below:

**‘Y’ Attribute – Unique Value Counts:**

|  |  |
| --- | --- |
| ***Class/Label*** | ***Count*** |
| 1 | 7210 |
| 0 | 5474 |

**‘coupon’ Attribute - Unique Value Counts:**

|  |  |
| --- | --- |
| ***Class/Label*** | ***Count*** |
| Coffee House | 3996 |
| Restaurant(<20) | 2786 |
| Carry out & Take away | 2393 |
| Bar | 2017 |
| Restaurant(20-50) | 1492 |

When looking at the distributions within each attribute, the attributes such as ‘weather’, ‘martialStatus’, ‘Bar’, ‘toCoupon\_GEQ25min’, ‘direction\_same’, and ‘direction\_opp’ are highly imbalanced (\*Distributions of all attributes are listed in the Appendix – A. Distributions of each attribute):

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The cardinalities of each attribute are shown below. The ‘occupation’ attribute has the highest cardinality among all attributes and has 25 unique values. If algorithms chosen for this project require predictors to be continuous such as logistic regression, I need to perform some encoding to convert categorical predictors to numerical. However, if I choose One Hot Encoding, the attribute with high cardinality like ‘occupation’ will generate 25 new attributes, and this can cause performance issues as well as the curse of dimensionality. In case such issues result in poor performance of the model, I will try the Target Encoding or dropping this attribute and see how it will improve the performance.

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Data Preprocessing

* Drop ‘car’ due to its missing values

1. **Appendix**
2. Distributions of each attribute

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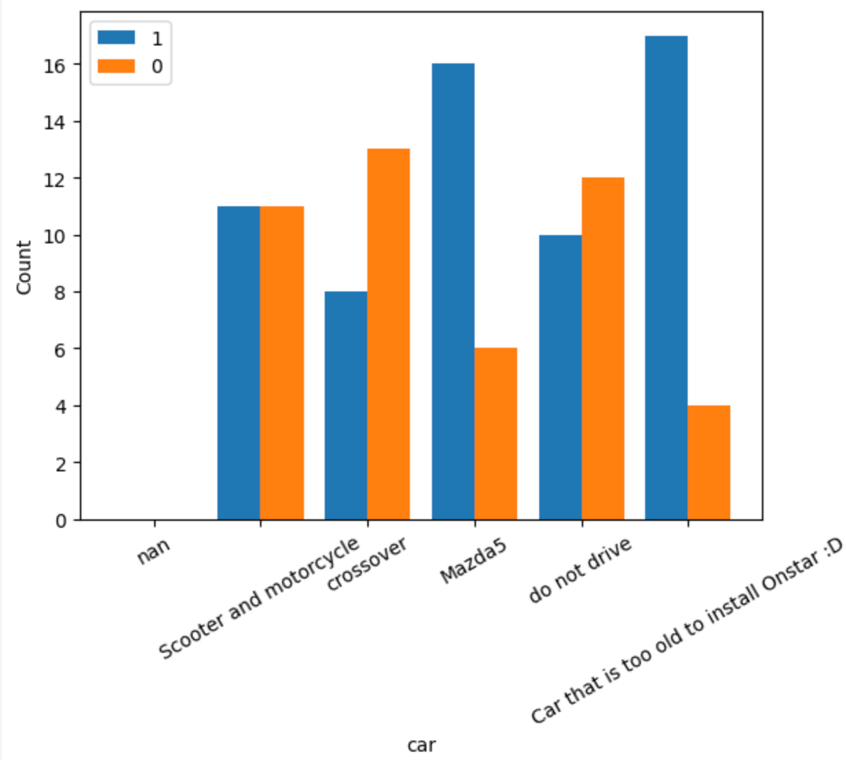
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