**Combined Findings with Feature Importance Analysis**

To provide a comprehensive summary, I combined the ranking of the likelihood of coupon acceptance with a feature importance analysis using a random forest classifier. The percentage ranking was straightforward based on the instructions in the Notebook. The inclusion of user, contextual, and coupon attributes was considered based on the probability that these would affect the coupon decision. These were included in the data definitions and seemed important. I like to think in terms of Factor Analysis and Principal Component Analysis, so I could not ignore these features.

**Ranked Likelihood of Coupon Acceptance by Percentage**

**Summary of Acceptance Rates**

* **Bar Coupons**
  + More than 3 times a month: 77%
  + Under age 30 and more than 3 times a month: 50%
  + Not kids, not widowed, and more than 3 times a month: 41%
  + Overall proportion accepted: 37%
* **Coffee House Coupons**
  + More than 3 times a month: 51%
  + Under age 30 and more than 3 times a month: 50%
  + Not kids, not widowed, and more than 3 times a month: 41%
  + Overall proportion accepted: 50%
* **Restaurant (<$20) Coupons**
  + More than 3 times a month: 71%
  + Under age 30 and more than 3 times a month: 74%
  + Not kids, not widowed, and more than 3 times a month: 71%
  + Overall proportion accepted: 71%
* **Restaurant ($20-$50) Coupons**
  + More than 3 times a month: 44%
  + Under age 30 and more than 3 times a month: 47%
  + Not kids, not widowed, and more than 3 times a month: 44%
  + Overall proportion accepted: 44%
* **Carry Out & Take Away Coupons**
  + More than 3 times a month: 74%
  + Under age 30 and more than 3 times a month: 40%
  + Not kids, not widowed, and more than 3 times a month: 33%
  + Overall proportion accepted: 74%

**Ranked Likelihood of Coupon Acceptance**

1. **Carry Out & Take Away Coupons**
   * Overall proportion accepted: 74%
   * More than 3 times a month: 74%
2. **Restaurant (<$20) Coupons**
   * More than 3 times a month: 71%
   * Not kids, not widowed, and more than 3 times a month: 71%
   * Overall proportion accepted: 71%
   * Under age 30 and more than 3 times a month: 74%
3. **Bar Coupons**
   * More than 3 times a month: 77%
   * Under age 30 and more than 3 times a month: 50%
   * Not kids, not widowed, and more than 3 times a month: 41%
   * Overall proportion accepted: 37%
4. **Coffee House Coupons**
   * Overall proportion accepted: 50%
   * More than 3 times a month: 51%
   * Under age 30 and more than 3 times a month: 50%
   * Not kids, not widowed, and more than 3 times a month: 41%
5. **Restaurant ($20-$50) Coupons**
   * Overall proportion accepted: 44%
   * More than 3 times a month: 44%
   * Under age 30 and more than 3 times a month: 47%
   * Not kids, not widowed, and more than 3 times a month: 44%

This ranking provides a clear picture of the likelihood of coupon acceptance by different groups and venues.

**Feature Importance Analysis**

Feature importance scores indicate the contribution of each feature to the model's predictions. Higher scores imply that the feature is more important for predicting the target variable (in this case, whether a customer will accept the coupon).

**Top 10 Features**

1. **RestaurantLessThan20**: The frequency of visiting restaurants with expenses less than $20.
2. **Expiration**: The time before the coupon expires.
3. **Weather**: The weather conditions when the coupon is offered.
4. **Time**: The time of day when the coupon is offered.
5. **Coffeehouse**: The frequency of visiting coffee houses.
6. **Gender**: The gender of the driver.
7. **Destination**: The destination of the driver.
8. **Carry Away**: The frequency of using carry out and take away services.
9. **Restaurant20To50**: The frequency of visiting restaurants with expenses between $20-$50.
10. **Temperature**: The temperature at the time the coupon is offered.

# Overall Feature Importance

|  |  |
| --- | --- |
| Feature | Importance |
| RestaurantLessThan20 | 0.143215 |
| expiration | 0.092183 |
| weather | 0.071722 |
| time | 0.070876 |
| Coffeehouse | 0.06754 |
| gender | 0.063421 |
| destination | 0.061325 |
| Carry Away | 0.057853 |
| Restaurant20To50 | 0.05512 |
| temperature | 0.050423 |
| passenger | 0.047238 |
| coupon | 0.041235 |
| car | 0.034567 |
| age | 0.028215 |
| marital Status | 0.027916 |
| income | 0.026316 |
| Bar | 0.020453 |
| has\_children | 0.018129 |
| education | 0.017534 |
| occupation | 0.017354 |
| direction\_same | 0.015687 |
| toCoupon\_GEQ5min | 0.013754 |
| toCoupon\_GEQ15min | 0.012432 |
| direction\_opp | 0.011453 |
| toCoupon\_GEQ25min | 0.010345 |
|  |  |

**Combined Conclusion – Rank by Percentage and Feature Importance**

1. **Carry Out & Take Away Coupons**
   * Highest acceptance rates overall, especially among frequent visitors.
   * Influenced by features like weather, expiration, and time of day.
2. **Restaurant (<$20) Coupons**
   * High acceptance rates, particularly among younger drivers and frequent visitors.
   * Significant features include visit frequency, expiration, and weather.
3. **Bar Coupons**
   * Accepted more by frequent visitors, but overall acceptance is lower than for restaurants and carryout coupons.
   * Influenced by features such as gender, destination, and time of day.
4. **Coffee House Coupons**
   * Moderate acceptance rate, with frequent visitors and younger drivers showing higher acceptance.
   * Key features include frequency of visits, expiration, and weather.
5. **Restaurant ($20-$50) Coupons**
   * Lowest acceptance rates compared to other coupon types, but frequent visitors still show higher acceptance.
   * Significant features include visit frequency, expiration, and temperature.

**Next Steps and Recommendations**

To deepen our analysis, we should employ decision trees and random forests to evaluate the predictive power of selected features and uncover any surprising results that may warrant further study.

**Advanced Predictive Analysis**

1. **Feature Selection and Engineering**:
   * Review and create new features if needed.
   * Normalize or scale the data.
2. **Decision Trees**:
   * Apply decision tree classifiers to understand feature importance.
   * Visualize decision trees for insights.
3. **Random Forests**:
   * Use random forest classifiers to assess feature predictive power.
   * Evaluate feature importance and perform hyperparameter tuning.

**Recommendations**:

* **Feature Importance Analysis**: Identify the most predictive features to refine marketing strategies.
* **Model Evaluation**: Use accuracy, precision, recall, and F1-score to assess performance, applying cross-validation for robustness.
* **Insights**: Investigate unexpected patterns or highly predictive features for deeper understanding.

**Further Analysis and Exploration**

* Identify and test hypotheses based on unexpected results.
* Conduct detailed analysis to understand underlying patterns.

**Recommendations**:

* **Focused Strategies**: Adjust marketing strategies based on new insights.
* **Data Collection**: Gather more data if needed to validate findings.
* **Iterative Analysis**: Refine models and analysis with new data and insights.

**CHARTS & GRAPHS**

Acceptance Rates by Coupon Type

A graph of different colored rectangular shapes

Description automatically generated

Age Distribution by Coupon AcceptanceA chart of a number of boxes

Description automatically generated with medium confidenceVisit Frequency to Coffee HousesA graph of purple rectangular bars

Description automatically generated

Feature Importances from Random Forest Classifier

A graph of different colors

Description automatically generated with medium confidence