Frictionless Payments
Using Machine Learning to Predict Customer Payments

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Abstract
As the amount of data we can collect and store increases, there is an increased need to utilize that data to produce creative useful solutions. A common method of analyzing this data is machine learning; utilizing these techniques allows applications to reach smarter solutions faster.

This project develops models that can be used to predict the payment actions of Capital One’s customers. By analyzing these customers’ history and clustering them into similar groups/types, we can generate predictions about their payment behavior. These predictions can be used to streamline the payment process for the customers, in addition to catching any suspicious or unusual payment actions made by the customer. This project provides the basis for myriad applications that can benefit both Capital One and its customers.

Results and Metrics
Using machine learning techniques, this project analyzed customer data and payment data provided by CapitalOne, and produced several working models detailing predictions about customers’ future payments.

- Formatter normalized data and contextualize payment data with customer data
  - created new attributes from raw data, based on the customer’s previous behavior
- Create customer profiles based on contextualized data and new attributes from formatter
- Model used the customer profiles and payment data as input to make predictions:
  - whether customer payment behavior will deviate from norm
  - when the payment will be made
- Best results with Gaussian Naive Bayes algorithm

<table>
<thead>
<tr>
<th>Model Attempts and Their Accuracies</th>
<th>Raw Normalized Data</th>
<th>Contactualized Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Payment Deviation (Binary)</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Week of Month (Categorial)</td>
<td>83%</td>
<td>98%</td>
</tr>
<tr>
<td>Day of Month (Categorial)</td>
<td>20%</td>
<td>0.1%</td>
</tr>
<tr>
<td>Any 3 Days of Month (Categorial)</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Neural Net</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Decision Tree Forest</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>SVM</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Gaussian Naive Bayes</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Architecture
This project was developed in python, using the scikit-learn machine learning toolkit.

Input:
- Unformatted customer, loan, and payment data

Formatter:
- Customer data with inferred attributes added for classification

Classification sub-model:
- Model trained on payment data

Output:
- Models predicting customer payment features

Impact
Our project’s impact is centered around providing a tool to analyze customer payment data. This tool can positively impact Capital One by providing the basis for further applications.

Streamlined Payment Process
Payment predictions will allow for a more streamlined payment process, that can be adaptive to the customer type. For instance, payment predictions can be used to alert a customer who tends to miss their payment date, saving them from making a late payment.

Customer Safety
In addition, this tool can be used from a security perspective, identifying unusual payment behavior made by a customer.

Summary
During this class, our project team worked with a group of developers from Capital One to create machine learning models that could be used to analyze customer payment information and predict details about a customer’s future payments. This project was developed using R and Python tools, with heavy utilization of Python’s scikit-learn machine learning toolset. While our project encountered many difficulties in the development of the predictive models, we succeeded in creating several useful predictive models of customer behavior.

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